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FIBER-MIXING AND FABRICATING APPARATUS

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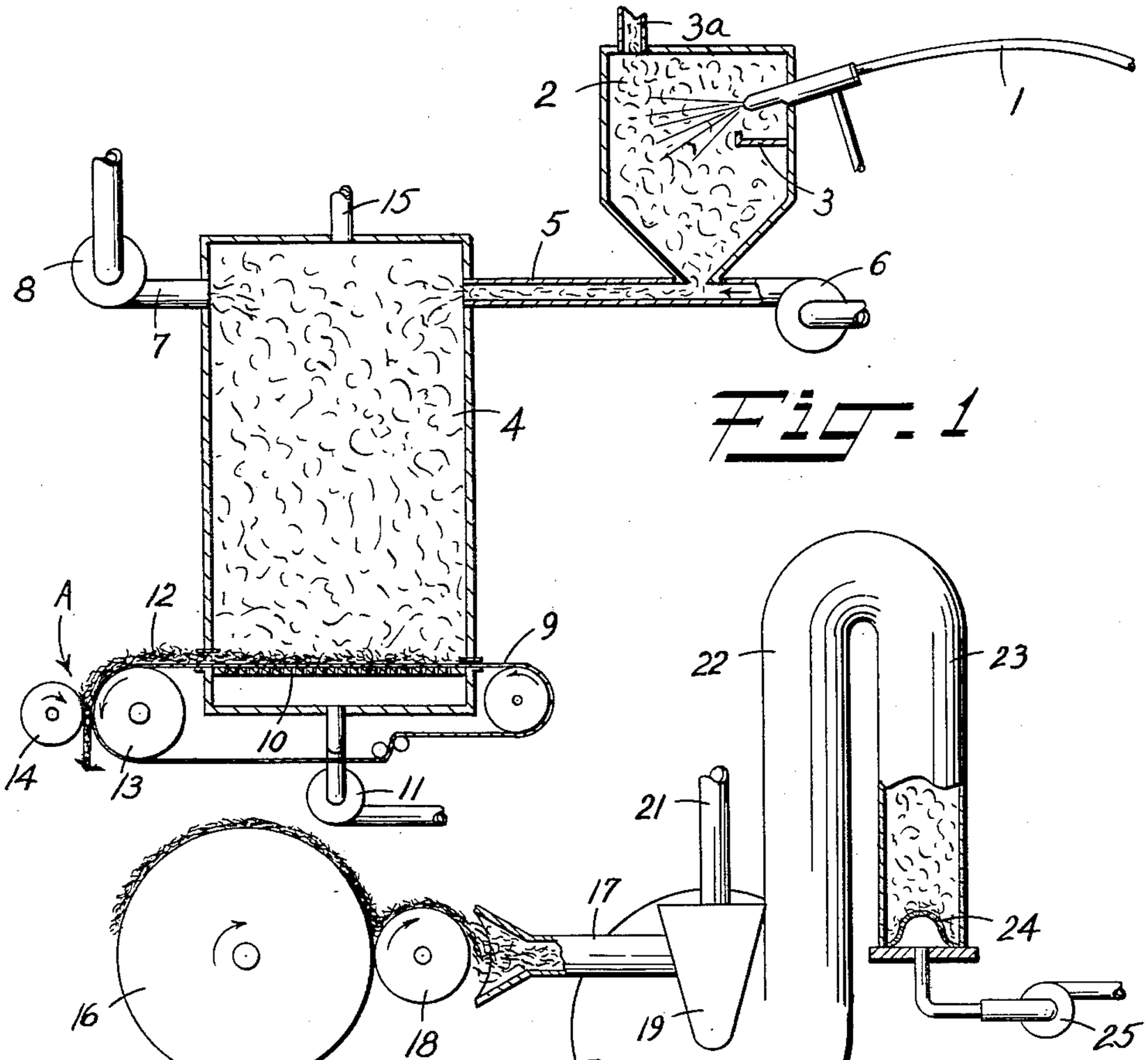

Fig. 1

Fig. 2

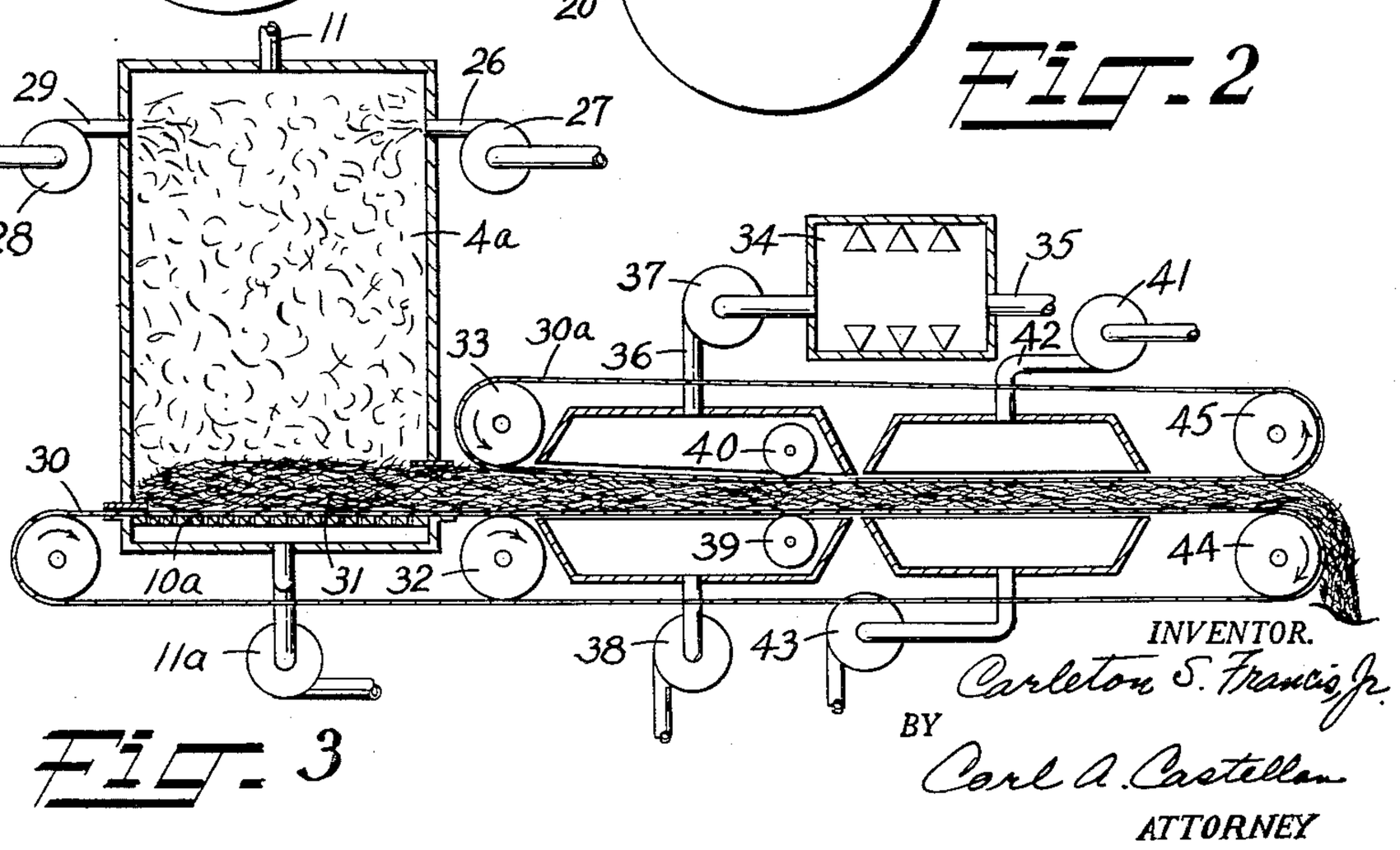

Fig. 3

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FIBER-MIXING AND FABRICATING APPARATUS

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Continuation of application Ser. No. 530,953, Apr. 14, 1944. This application July 20, 1948, Ser. No. 39,784

6 Claims. (Cl. 154—29)

This invention relates to textiles and the like, and more particularly to such products comprising mixtures of potentially adhesive fibers and non-adhesive fibers, and to an improved process for producing the same.

This application is a continuation of my prior application Serial No. 530,953, filed April 14, 1944, now abandoned. That prior application discloses a method of producing textile felts and the like in accordance with which non-adhesive fibers are associated with potentially adhesive fibers concurrently with formation of the latter.

Prior art processes for the production of textile felts and the like, such as webs, mats, batts, etc., have involved carding and/or combing operations which necessitated in every instance the use of comparatively long fibers, since the shorter fibers cannot be carded and/or combed satisfactorily. In such webs coming from the carding machine, substantially all of the relatively long fibers are parallelized in the direction of the longitudinal dimension of the web, and the web is inherently structurally weak and relatively easily torn apart or shredded when subjected to tension applied laterally or transversely thereto, because only a few if any, of the fibers extend across the width or thickness of the web, and hence the web is not nearly as resistant against stress or strain applied in those directions as it is against stress or strain directed longitudinally of the web.

The fibers in such carded webs or mats tend to occur in the form of superimposed layers, and when cut through, the transverse cross-section of the web has the appearance of a more or less laminated structure. For example, it has been found that a felted web formed from carded fibers of "Vinyon" and viscose rayon staple shows, when cut transversely, a large proportion of laminated sections and such webs tend to separate when subjected to even light tension. Furthermore, satisfactory felted fibrous mats or webs of extremely low density and great thickness cannot be obtained by the prior art processes. Thick webs obtained by superimposing a multiplicity of thinner carded and/or combed webs upon one another show only moderately fair tensile strength and tend to peel off in individual layers in use.

It is a general object of the present invention to provide a new process for making felts, comprising admixtures of pre-formed potentially adhesive fibers and pre-formed non-adhesive fibers. The expression "pre-formed potentially adhesive fibers" is meant to refer to fibers which are capable of being rendered tacky or adhesive, either superficially or more completely through the individual fiber body, as desired, but which are not in tacky or adhesive condition at the time of mixing; and the expression "pre-formed non-adhesive fibers" is meant to refer to fibers which, although they may be capable of being rendered tacky or adhesive under some conditions, are not capable of being rendered tacky or adhesive under the conditions obtaining in the process of the present invention.

A further object of the invention is to provide a new process for the production of felted fibrous articles which

insures uniform mixing of the two types of fibers without agglomeration and according to which products of even thickness throughout are obtained and which results in uniform distribution of the commingled fibers from surface to surface of the product.

Another object is to provide a process according to which it is possible to utilize organic fibers of extremely short length, such as normally are considered non-feltable, that is, fibers which cannot be felted by conventional methods. Still another object of the invention is to provide a process for producing fibrous felted products which does not require a carding and/or combing operation.

A further object of the invention is to produce felted products in which the fibers extend haphazardly in all directions and in which there are no cleavage planes regardless of thickness.

These and other objects are attained by the present invention, according to which, generally speaking, the pre-formed potentially adhesive fibers and the non-adhesive fibers are blown together, and thus intimately commingled and admixed, and the mixtures are treated to activate the potentially adhesive fibers to bind fibers in the product. While the potentially adhesive fibers are in the activated state, the product may be subjected to a compacting step, if desired.

In accordance with one embodiment of the invention, the two types of fibers are impelled by blowing them with air or any other gaseous or vaporous, but preferably gaseous medium into a common mixing and depositing chamber, or successively into a mixing chamber and then into a depositing chamber. The pre-formed fibers in suspension in the aeriform current are thus agitated and whirled about in a confined space, so that they freely mix and intermingle without agglomeration, after which they are permitted to settle out on a collecting surface. The thus uniformly mixed fibers fall on one another in a haphazard manner to form a fibrous matted web or batt in which the fibers project in all directions within and throughout the product. The web thus obtained has the appearance of a criss-crossed network of fibers, all of which are interlaced together, in unarranged haphazard distribution, and in which there is relatively little if any distribution of the fibers in exact parallelism or in side-by-side relation. The web is an integrated fibrous structure in which distinct layers of fibers are not detectable, and which in transverse cross-section is practically devoid of laminated sections.

The product is adapted to be treated to activate the potentially adhesive fibers, without damage to the non-adhesive fibers, to bind fibers in the product to form a reticulated webbed structure extending throughout the product. When so treated, the fibers are anchored at their points of contact wherever the potentially adhesive fibers occur throughout the structure, and are firmly set in the non-parallelized condition, the felted product finally obtained having excellent resistance against both compressive, tensile, and shearing stress or strain applied either longitudinally, laterally, or transversely thereof.

The web or mat thus obtained is adapted to be used as such, or it may be shaped into any desired form. Alternatively, the potentially adhesive and non-adhesive fibers may be blown directly onto any desired form, such as a form for producing hat shapes, and then activated and compacted by heat and pressure, and deactivated.

Among the non-adhesive fibers which may be employed are those which although they may be rendered adhesive by some treatment, are not rendered adhesive under the conditions used to activate the potentially adhesive fibers associated therewith, and including natural fibers, such as wood pulp fibers, cotton, linen, jute, kapok, wool, hair, and silk; and synthetic fibers such as cellulose

fibers of the type of cellulose hydrate, cellulose derivatives such as cellulose esters, mixed cellulose esters, cellulose ethers, mixed cellulose ester-ethers, mixed cellulose ethers, cellulose hydroxy-ethers, cellulose carboxy-ethers, cellulose ether xanthates, cellulose xantho-fatty acids, cellulose thiourethanes; natural and synthetic rubber and derivatives thereof; fibers made of alginic acid, gelatine, casein; and mineral fibers such, for example, as spun glass, asbestos, mineral wool, and the like; and fibers made of natural and synthetic resins which should be of such type that they are not rendered tacky when the potentially adhesive fibers are rendered tacky; also fibers and filaments made by slitting, cutting, or shredding non-fibrous films such as cellophane.

The potentially adhesive fibers may be composed of a wide variety of materials and may comprise any material capable of being formed into fibers which have an inherent tackiness under conditions such that the non-adhesive fibers are not damaged or rendered tacky, and which are not tacky at room temperature. Examples of the potentially adhesive fibers are thermoplastic fibers, such as those of cellulose acetate or other cellulose esters and ethers, or mixed cellulose esters such as cellulose acetate-propionate, or cellulose acetate-butyrate, in plasticized condition; also resins as, for example, cheap natural resins such as shellac, dammar, copal and the like, and synthetic resins either permanently thermoplastic or thermosetting, but in the thermoplastic state formed by the polymerization or condensation of various organic compounds such as coumarone, indene or related hydrocarbons, vinyl compounds, styrene, sterols, aldehydes, furfural, ketones, urea, thiourea, phenol-aldehyde resins either unmodified or modified with oils, urea-aldehyde resins, sulfonamide-aldehyde resins, polyhydric alcohol-polybasic acid resins, drying oil-modified alkyd resins, resins formed from acrylic acid, its homologues and their derivatives, sulfur-olefine resins, resins formed from dicarboxylic acids and diamines (nylon type); synthetic rubbers and rubber substitutes herein called "resins," such for example as polymerized butadiene, olefine polysulfides, iso-butylene polymers, chloroprene polymers; and fibers formed from a resin comprising the product of copolymerizing two or more resin-forming monomers, such as copolymers of vinyl halide and vinyl acetate, copolymers of vinyl halide and an acrylic acid derivative, copolymers of vinyl compound and styrol compound; and also a mixture of resins, such as a mixture of vinyl resins and acrylic acid resins or methacrylic acid resins, a mixture of polyolefine resins and phenol-aldehyde resins, or a mixture of two or more resins from the different classes just named. There may be employed also fibers made from rubber latex, crepe rubber, gutta percha, balata, and the like. Further, the potentially adhesive fibers may be mixtures of the cellulose derivatives with resin or rubber, such as, for example, a mixture of cellulose nitrate and an acrylic acid resin, a mixture of benzoyl cellulose and a vinyl resin, or a mixture of ethyl cellulose and shellac.

A preferred class of vinyl resin from which the fibers may be formed are the copolymers of vinyl chloride with vinyl acetate or vinyl cyanide, and after-chlorinated copolymers of vinyl chloride and vinyl acetate.

The resins above mentioned may be classified as:

(*a*) Heat non-convertible resins such for example as glycol polybasic acid resins, vinyl resins (particularly those of the preferred class above) and the acid type phenolaldehyde resins, and the like.

(*b*) Heat-convertible or thermosetting resins such for example as glycerol-polybasic acid resins, polyolefine resins, phenol-aldehyde resins and the like.

(*c*) An element-convertible resins (which becomes infusible through the action of certain elements, such as oxygen and sulfur) such for example as glycerol-polybasic acid-drying oils, resins, and olefine-sulfur resins.

The fiber-forming material from which the fibers which

are mixed together by blowing in accordance with the present invention are produced may contain added agents for obtaining special effects. For example, the parent fiber-forming material for the potentially adhesive fibers may contain hardening agents in the case of resins, for instance; while the fiber-forming material for either the potentially adhesive or the non-adhesive fibers may contain latent activating agents, dyes, pigments, mothproofing agents, fireproofing agents, waterproofing agents, and the like.

The fibers may be pre-formed in any suitable manner. Thus, either type of fiber may be obtained by cutting previously formed continuous filaments to the desired length, or, in the case of the potentially adhesive fibers, they may be pre-formed by dispersing the fiber-forming material while in flowable condition, that is, in solution, plastic, or molten condition, under sufficient pressure to form a multiplicity of fibers, into a setting fluid, e.g., a liquid or a gaseous atmosphere, as taught in my copending application Serial No. 381,292, filed March 1, 1941, now Patent 2,357,392. Such pre-formation of the potentially adhesive fibers is carried out in a chamber which is separate from but may be connected with the chamber into which the potentially adhesive and non-adhesive fibers are blown and the intermingled fibers allowed to deposit in the form of a mixed fibrous product.

In order to effect a binding together of the mixed unagglomerated intermingled fibers, the potentially adhesive fibers are activated wherever they occur throughout the entire structure, or at selected points therein, by the application of a bonding agent, such as heat or solvent, to cause at least a partial adhesion between the fibers. Among the methods which may be used for activation, are the following, which methods may be practiced singly or in combination.

(*a*) When the potentially adhesive fibers are thermoplastic, they may be activated by heat applied with or without pressure, and a preferred method of activation is to blow dry hot air through the product. In treating webs of appreciable thickness, the air may be blown first in one direction and then in the opposite direction through the web to avoid non-uniform activation and dislocation of the fibers in the web.

(*b*) The potentially adhesive fibers may be activated by applying to the fibrous mixture a solvent or swelling agent or mixtures thereof with diluents, under such conditions of concentration and temperature as to render the potentially adhesive fibers tacky. For example, fibers of organic cellulose derivatives such as cellulose esters may be rendered adhesive by solvents such as acetone, ethyl acetate, butyl acetate, and the like.

(*c*) A latent activating agent may be combined with the potentially adhesive fibers and/or with the non-adhesive fibers. Such agent may be rendered active by a subsequent treatment, such as by treatment with chemical agents, heat or irradiation, thus producing a simultaneous activation of the potentially adhesive fibers in selected areas. For example, fibers may be impregnated with a liquid which, at room temperature is a non-solvent therefor, but which at a higher or lower temperature is capable of activating the potentially adhesive fibers.

Also, when the mats, webs, or the like comprise thermoplastic fibers, they may be activated by subjecting them to steam, with or without pressure, especially where it is desired to produce a felted web or the like characterized by extreme softness, low density, and relatively great thickness. It is also possible to activate the activatable fibers present in the fibrous web or mat by subjecting the same to a high frequency electric current.

A plasticizer may be applied to the fibers and/or to the product before activation. The plasticizer may function to increase the flexibility of the fibers, and, when employed with thermoplastic fibers, the plasticizer may serve, in addition, to lower the thermal softening point. The plasticized thermoplastic fibers can be rendered ad-

hesive by heating to a temperature below that at which the non-thermoplastic textile fibers associated therewith would be detrimentally affected by such heating. The plasticizer may be allowed to remain in the product, or it may be removed by suitable treatment, such as washing and extraction, thus again elevating the thermal softening point of the thermoplastic material and preventing reactivation upon ironing.

During or after activation, the products may be compacted, if it is desired to produce a web of increased density, and the compacting may be effected in any suitable manner, as by pressing, squeezing, and tensioning. For example, the mechanically applied pressure exerted on the activated material during and/or after activation, and/or during calendering, embossing, printing, or dyeing will effect compacting of the fibers. Also the fibrous mat or web, in activated condition, may be passed between pressure rolls to compress the mixed fibers, or it may be subjected to tension in one or both directions.

After activation and compacting, if the latter is employed, the fibrous product is treated to deactivate the adhesive fibers, that is, to render the adhesive fibers nontacky, so as to fix the new relationship of the mixed fibers. The nature and extent of the deactivation treatment depends, inter alia, upon the nature and extent of the activating treatment and upon the proportion and kind of potentially adhesive fibers used. If activation has been accomplished by heat, deactivation may be accomplished by heating for a prolonged period, or to a higher temperature in the case of thermosetting resins or by cooling; and if activation is by means of a solvent, deactivation may involve extraction of the solvent as by washing, evaporation or decomposition. The removal of the activating agent depends upon whether its presence in the product is desirable or objectionable.

The activation, compacting, and deactivating treatments may be carried out independently of or simultaneously with various treatments common to the fabrication and finishing of felts, or the laminating and sealing of sheet materials when the products are applied to the latter purposes.

The properties of the finished product depend upon various factors, including the nature and proportion of the potentially adhesive fibers present in the product, the extent to which such fibers have been activated, whether or not the product is compacted by pressure or the like, and if so compacted the relative adhesiveness of the fibers during compacting, as well as the nature of the deactivation treatment, and all such factors may be pre-selected and controlled for the production of products of any degree of pliability, firmness, density or porosity, as may be desired.

The relative proportions of potentially adhesive and non-adhesive fibers used depends upon the final product desired, and may vary within quite wide limits, but where either or both types of fibers are much shorter than average length, it may be desirable to utilize a comparatively large proportion of the potentially adhesive fibers, in order to insure a firm binding together of the short fibers in the product.

The extent of activation may be varied considerably. Thus the potentially adhesive fibers may be rendered adhesive while maintaining their fibrous form, and may be present in such quantity that the resulting product, with or without compacting thereof, is characterized by a high degree of porosity, and is useful for many purposes, including battery separators, filtering media, or as insulating material or the like. On the other hand, the potentially adhesive fibers may be rendered sufficiently fluid to spread under pressure to form a film in which the non-adhesive fibers are firmly embedded, thus yielding an impermeable product which may be used in fabricating waterproof articles such as raincoats, for example.

The process of the invention is adapted for the production of various types of flat felts, per se, such as webs, mats, batts, etc., of any desired degree of thickness which may be obtained by a single deposition of the fibers commingled by blowing, and which products may be used as such, or subsequently shaped into any desired form. Thus, there may be obtained shaped gaskets for liquid seals in mechanical equipment, shaped oil and gas filters, shaped washers, etc. There may also be obtained shaped products in which abrasive particles are included in the fibers or embedded in the surface thereof, such as abrading devices suitable for abrasive purposes, as for grinding, polishing, buffing or like operations, and including grinding and polishing wheels, flexible abrasive discs, sanding and polishing belts, blocks, pads, and other shapes. The abrasive materials may include any of the abrasive particles commonly in use, such as silicon carbide, diamonds, boron carbide, fused aluminum oxide, flint, corundum, emery, rouge, and similar substances. The size of the abrasive particles may vary from the finest polishing or buffing powders to the coarser grit sizes used in grinding.

The fibers commingled by blowing in accordance with this invention, may also be collected directly on any suitable form, such as the forms used in the manufacture of hats, for example, and then compacted by heat and pressure, and deactivated. Thus, it is possible to produce directly such felted bodies as hats or the like, and since the activation and compaction of the mixed fibers is effected after deposition thereof on the form, the shape of the desired article is permanently preserved.

The process is also advantageous for the production of high quality papers, since when fibers of paper-making length are blown together and then permitted to deposit, the papers obtained are softer and fluffier than those which can be obtained by conventional water-laying methods.

In the case of flat felts, such as batts or webs, if the product first obtained is capable of further activation under appropriate conditions, it may be used in the production of laminated products. In the laminating art, the web containing the potentially adhesive fibers before or after such further activation and preferably the former, may be disposed between a layer of a textile fabric, felt, paper, wood, film, glass or the like, and a layer of the same or of different material, and the composite product may be subjected to sufficient solvent or heat and pressure to activate the potentially adhesive fibers and unit the layers to each other. In the sealing art, the web containing potentially adhesive fibers may be inserted between the overlapping or contiguous surfaces of a wrapper or carton, or between the folds or overlapping area of a fabric, and the same closed and sealed by the application of heat and pressure, or by the application of pressure and a solvent for the fibers with or without the use of heat. Instead of placing the web between two layers, as above described, the web may be superimposed on the surface of any material which it is desired to coat. The product is then treated to activate the potentially adhesive fibers to cause the web to adhere to the material with which it is in contact. In this instance, it may be desirable to activate the web to a sufficient extent to cause the potentially adhesive fibers to flow to form a continuous film. While the fibers are still adhesive, pressure may be applied to insure the production of a smooth, glossy surface.

The products of the invention may at any time be embossed, calendered, molded, or otherwise shaped, in whole or in part, to deform the surface while the potentially adhesive fibers are still tacky or in a softened state, and then subsequently treated to deactivate the fibers to set the product in the desired form or surface condition to produce effects such as grain, luster, smoothness or designs, by suitable means, used hot or cold, and with or without the aid of agents which soften, swell, or plasticize the material acted on.

Further, the fibrous products produced according to the invention may be colored before, during or after activation, compaction and/or deactivation, by dyeing, printing, for example with inks containing pigments or dye-

stuffs which are resistant to the activating, compacting, and deactivating treatments. If desired, where the activating and deactivating agents are solvents, they may be added to the dyebath or the printing ink.

In the accompanying drawing illustrative of the invention—

Figure 1 is a side elevation of one embodiment of suitable means for blowing pre-formed fibers together in accordance with my invention,

Figure 2 is a side elevation of another embodiment of means for carrying out the invention, and

Figure 3 is a side elevation of still another embodiment of suitable means for carrying out the invention.

When using the apparatus shown in Figure 1, a composition suitable for forming potentially adhesive fibers is dispersed by means of the spray gun **1** into a gaseous atmosphere contained in chamber **2**. Any material which is not formed into fibers is caught on shelf **3** and may be removed at intervals. Solvent is removed from chamber **2** through a screened vent **3***a*, by means of a suction device (not shown). The potentially adhesive fibers thus formed are withdrawn from chamber **2** and blown into chamber **4** through conduit **5** by blower **6**. Simultaneously a multiplicity of non-adhesive fibers are blown into chamber **4**, preferably in a direction opposite to that of the other fibers through conduit **7** by blower **8**. The fibers are scattered about in the chamber by the turbulence of the air streams, and are thoroughly mixed together before settling out. The two types of fibers are thus brought together at a point sufficiently removed from the point of deposition to permit good commingling during deposition. The mixed fibers then come to rest on the surface of an endless belt **9** made of flexible material such as textile, metal, leather or the like, which belt is preferably positioned in a horizontal plane at the base of chamber **4**, and serves as a collecting surface. Preferably, belt **9** is provided with a multiplicity of small uniformly distributed perforations and runs over a similarly uniformly perforated false bottom or screen **10**. A suction pump **11**, is connected to the region below the belt in chamber **4**, to create a down draft through endless belt **9** as it passes through the chamber. As the fibers are deposited on one portion of the belt, the suction at other points thereof is increased so that the intermingled fibers are drawn downwardly through chamber **4** onto successive portions of belt **9**, which assists in a uniform distribution of the fibers over the belt surface, and results in the production of a web or batt of uniform thickness throughout. The mat **12** is carried on the belt from the chamber and through pinch rolls **13** and **14**, which compress or compact the mat and enable it to be removed from the belt for activating or finishing operations. If the potentially adhesive fibers are thermoplastic, the rolls **13** and **14** may be heated sufficiently to activate the thermoplastic fibers to any desired extent, the activated fibers being deactivated when the mat **12** passes from the rolls and becomes cool. Air may be permitted to escape from chamber **4** through a screened exhaust pipe **15**, if the suction pump is not used. When potentially adhesive fibers which are activatable by means of an organic solvent are used, the solvent may be sprayed on the fiber batt **12** as it is carried on the belt, as at point A, so that the fibers are in an adhesive condition when passing through the pressure rolls **13** and **14**. In the manufacture of paper tissues, the belt **9** may be considered as comprising the wire screen of the paper-making machine.

Referring now more particularly to Figure 2, one type of the fibers may be passed over the card **16**, and a suction tube **17** may be arranged to receive the fleece taken from the card by the doffer roll **18**. The tube **17** is connected to a hopper **19**, feeding directly to the suction side of a blower **20**. The hopper is closed otherwise, except for a duct **21** by which the other type of fibers may be introduced. The fibers may be introduced into duct **21** by any suitable means, such as by another card and doffer system. Alternatively the duct **21** may be omitted and the two types of fibers, after mixing may be passed over the card **16** and sucked therefrom.

Blower **20** discharges upwardly into an inverted U-shaped duct. The fibers are blown upwardly through one leg **22** of the duct, and then fall downwardly through leg **23** thereof onto a perforate form **24**. A suction pump **25** is positioned under leg **22** to assist in drawing the commingled fibers onto the form **24**. The fibrous shape or form thus obtained may then be activated and compacted by heat and pressure and the activated fibers deactivated.

In Figure 3 there is shown a chamber **4***a*, into which potentially adhesive fibers are blown through conduit **26** by blower **27**, and into which non-adhesive fibers are blown by blower **28** through conduit **29**. The fibers settle out and come to rest on the surface of endless belt **30**, which is preferably of the same type and arranged on a false bottom over a suction pump, in the same manner as described in connection with Figure 1. The mat **31** is carried on the belt from chamber **4***a*. Positioned along the path of travel of the web or mat on belt **30** is an endless screen belt **30***a*. The web and belts pass between rollers **32** and **33** and through a heating zone. As it passes through such zone, air drawn into heating cabinet **34** through inlet **35** is directed to the web by means of conduit **36** through the action of blower **37**. The heated air is drawn downwardly through the mat by means of the exhaust pump **38** and discharged to the atmosphere. Mat **31** in activated condition passes from the heating zone between rollers **39** and **40** and directly into a confined cooling or deactivating zone, at which point cool air is directed on the web by blower **41** through conduit **42**, and drawn downwardly therethrough by means of exhaust blower **43**. Web **31**, which may be very thick (as much as eight inches or more) after it leaves chamber **4***a* undergoes a certain amount of compacting, and hence decreases in thickness, as it passes through the heating zone, and the rollers **39** and **40** may be suitably adjusted to take into account such changes in the web due to the force of the air current thereon and the confronting reaches of the belts between rolls **32**, **33** and **39**, **40** are converging, as shown. Rolls **39** and **40** may be spaced apart, so that they serve merely to assure confinement and contact of the web **31** between the belts in the heating zone without exerting substantial pressure thereon. Or they may be adjusted to apply a substantial compacting pressure to reduce the web to any thickness and density desired. Rolls **44** and **45** are preferably spaced apart the same distance as rolls **39** and **40**, so that these two pairs of rolls co-operate to maintain the proper thickness of the web **31** during cooling. Additional pairs of rolls may be interposed between the pairs **39**, **40** and **44**, **45**, so that the belts **30** and **30***a* have confronting or opposed parallel reaches and to assure that the desired thickness of the web, mat or batt is produced.

Fibers of any suitable length may be admixed to form a felted product in accordance with the invention, and the fibers may be blown together without resort to carding and/or combing operations; or if preferred for any reason, the fibers may be pre-carded or combed either in admixture or individually and then blown together. Fibers of spinnable length, or of carding or paper-making length may be blown together, and the potentially adhesive fibers may be of the same length as, or of a different length from the non-adhesive fibers. However, the invention is particularly useful where it is desired to combine and mix fibers the average length of which is less than normal feltable length, that is, fibers which are so short that they cannot be successfully combined and felted by prior art conventional methods. Thus it becomes possible, because of my invention, to used fibrous material which previously has been considered as waste and discarded, such waste including shear flock, that is, the fuzz removed from fabrics and felts during shearing operations, cotton linters, so-called "leather dust," that is, short

leather fibers, the short fluffy waste thrown out of carding and/or combing machines, the waste from reeling, warping, winding, weaving and cop bottoms, the waste from slubbing, roving, and wool tops, and in fact all short fibers or fibrils which ordinarily do not find use in the manufacture of commercial products.

It is particularly advantageous to blow the two types of fibers into a chamber or the like separately but simultaneously, and preferably at a point considerably removed from the depositing surface and from opposing points outside the chamber, as specifically illustrated, since the confluence of the air streams creates eddies and cross-currents which facilitate mixing of the fibers in suspension.

By way of illustration but not of limitation, there are given the following examples of products produced in accordance with the invention.

Example I

Viscose rayon staple and fibers consisting of a copolymer of vinyl acetate and vinyl chloride, which were from about two inches to two and one-half inches long, were blown together and allowed to settle. The web thus obtained, which comprised 20% rayon staple and 80% copolymer, was activated, compacted and deactivated, using the apparatus shown in Figure 3. A compressed web was obtained in which the rayon fibers were firmly bonded together by the resin fibers, and when cut transversely, the web was found to be substantially free of laminated sections, and was characterized by excellent resistance to tearing under tension applied laterally, transversely or longitudinally.

Example II

Cotton linters (40%) and fibers consisting of a copolymer of vinyl acetate and vinyl chloride (60%) and which were $\frac{3}{16}$" long, were blown together and permitted to settle out in the form of a matted web. The web was activated by blowing hot air therethrough in one direction, after which the web was deactivated by cooling. The product was a soft porous mass.

Example III

Cellulose acetate fibers about one-half inch long (30%) and viscose rayon staple (70%) were blown together and then permitted to settle out. The web thus formed was heated to activate the cellulose acetate fibers, compacted and deactivated. The conditions were such that a comparatively stiff fibrous web was finally obtained.

Since changes may be made in practicing the above invention without departing from the spirit and scope thereof, it is to be understood that the foregoing description and specific illustrations are illustrative only, and the invention is not to be limited except as defined by the appended claims.

I claim:

1. A machine for making felt-like fibrous webs, mats, bats, or the like comprising a pair of air-pervious belts having confronting parallel reaches preceded by confronting converging reaches, means for moving the belts through the confronting reaches in the same direction, a chamber having a discharge opening immediately adjacent the entrance to the confronting converging reaches of the belts, means for delivering fibers through the chamber and its discharge opening into the space between the confronting reaches of the belts, and means for blowing a heated gaseous medium through the confronting reaches of the belts and the fibrous material therebetween, said fiber delivering means comprising blowers having their discharge ducts connected to opposite walls of the chamber, and separate means for supplying fibers to the suction ducts of the blowers.

2. A machine for making felt-like fibrous webs, mats, batts or the like comprising a pair of air-pervious belts having confronting reaches moving in the same direction,

a plurality of pairs of rolls spaced apart in the direction of movement of the confronting reaches, the confronting reach of one of the belts passing over one roll of each pair, the confronting reach of the other belt passing over the other roll of each pair, the spacing between the individual rolls of at least two pairs other than the pair adjacent the entrance of the belts to their confronting reaches being substantially the same and being less than the spacing between the rolls of the pair adjacent said entrance to thereby provide a converging portion followed by a parallel-spaced portion between the confronting belt reaches, a chamber having a discharge opening immediately adjacent the entrance to the confronting converging reaches of the belts, means for delivering fibers through the chamber and its discharge opening into the space between the confronting reaches of the belts, and means for blowing a heated gaseous medium through the confronting reaches of the belts and the fibrous material therebetween, said fiber delivering means comprising blowers having their discharge ducts connected to opposite walls of the chamber, and separate means for supplying fibers to the suction ducts of the blowers.

3. A machine for making felt-like fibrous webs, mats, batts, or the like comprising a pair of air-pervious belts having confronting parallel reaches preceded by confronting converging reaches, means for moving the belts through the confronting reaches in the same direction, a chamber having a discharge opening immediately adjacent the entrance to the confronting converging reaches of the belts, means for delivering fibers through the chamber and its discharge opening into the space between the confronting reaches of the belts, and means for blowing a heated gaseous medium through the confronting reaches of the belts and the fibrous material therebetween, said chamber having an air-pervious member extending transversely of the chamber adjacent the discharge opening, means for directing one of said belts over the pervious member immediately before entering its confronting reach, and means for applying suction to the side of the pervious member opposite that over which the belt passes.

4. A machine for making felt-like fibrous webs, mats, batts or the like comprising a pair of air-pervious belts having confronting reaches moving in the same direction, a plurality of pairs of rolls spaced apart in the direction of movement of the confronting reaches, the confronting reach of one of the belts passing over one roll of each pair, the confronting reach of the other belt passing over the other roll of each pair, the spacing between the individual rolls of at least two pairs other than the pair adjacent the entrance of the belts to their confronting reaches being substantially the same and being less than the spacing between the rolls of the pair adjacent said entrance to thereby provide a converging portion followed by a parallel-spaced portion between the confronting belt reaches, a chamber having a discharge opening immediately adjacent the entrance to the confronting converging reaches of the belts, means for delivering fibers through the chamber and its discharge opening into the space between the confronting reaches of the belts, and means for blowing a heated gaseous medium through the confronting reaches of the belts and the fibrous material therebetween, said chamber having an air-pervious member extending transversely of the chamber adjacent the discharge opening, means for directing one of said belts over the pervious member immediately before entering its confronting reach, and means for applying suction to the side of the pervious member opposite that over which the belt passes.

5. A machine for making felt-like fibrous webs, mats, batts, or the like comprising a pair of air-pervious belts having confronting parallel reaches preceded by confronting converging reaches, means for moving the belts through the confronting reaches in the same direction, a chamber having a discharge opening immediately adjacent the entrance to the confronting converging reaches of the belts, means for delivering fibers through the chamber

and its discharge opening into the space between the confronting reaches of the belts, and means for blowing a heated gaseous medium through the confronting reaches of the belts and the fibrous material therebetween, said chamber having an air-pervious false bottom extending transversely of the chamber adjacent the discharge opening, means for directing one of said belts over the pervious false bottom immediately before entering its confronting reach, and means for applying suction to the side of the pervious false bottom opposite that over which the belt passes.

6. A machine for making felt-like fibrous webs, mats, batts or the like comprising a pair of air-pervious belts having confronting reaches moving in the same direction, a plurality of pairs of rolls spaced apart in the direction of movement of the confronting reaches, the confronting reach of one of the belts passing over one roll of each pair, the confronting reach of the other belt passing over the other roll of each pair, the spacing between the individual rolls of at least two pairs other than the pair adjacent the entrance of the belts to their confronting reaches being substantially the same and being less than the spacing between the rolls of the pair adjacent said entrance to thereby provide a converging portion followed by a parallel-spaced portion between the confronting belt reaches, a chamber having a discharge opening immediately adjacent the entrance to the confronting converging reaches of the belts, means for delivering fibers through

the chamber and its discharge opening into the space between the confronting reaches of the belts, and means for blowing a heated gaseous medium through the confronting reaches of the belts and the fibrous material therebetween, said chamber having an air-pervious false bottom extending transversely of the chamber adjacent the discharge opening, means for directing one of said belts over the pervious false bottom immediately before entering its confronting reach, and means for applying suction to the side of the pervious false bottom opposite that over which the belt passes.

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