

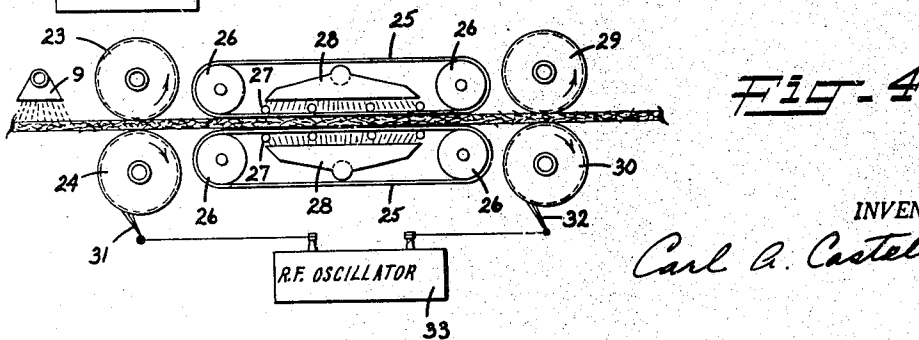
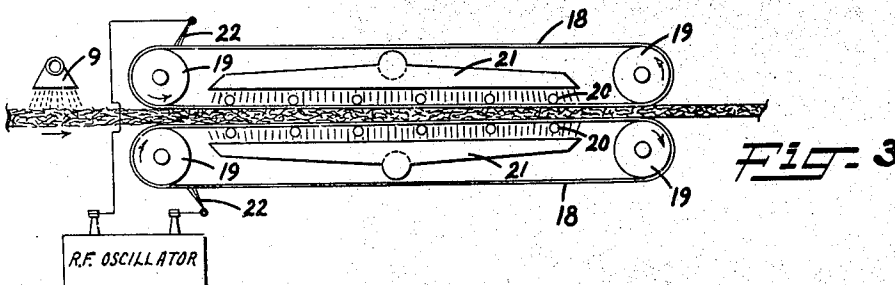
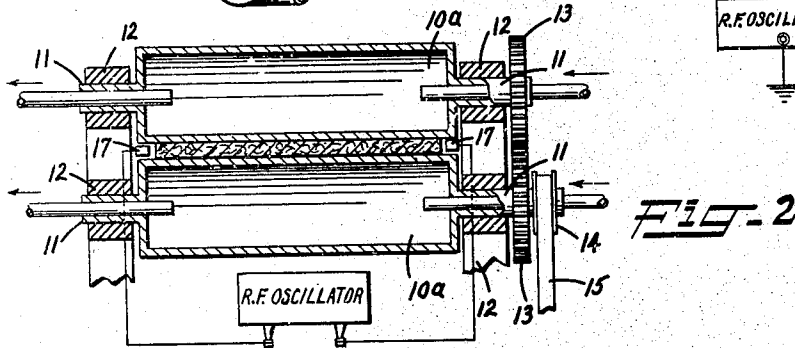
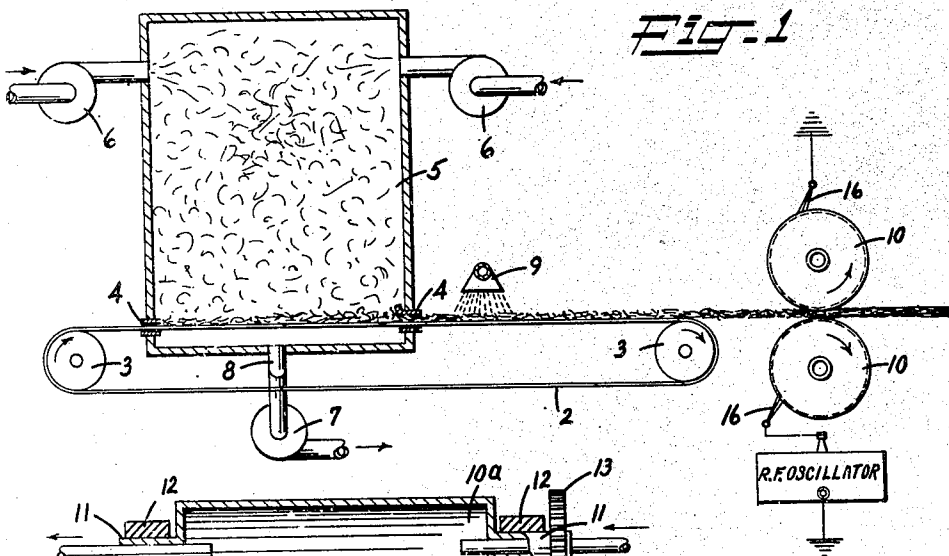
July 19, 1949.

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2,476,282

TEXTILE PRODUCTS AND PRODUCTION THEREOF

Filed Jan. 9, 1945



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2,476,282

TEXTILE PRODUCTS AND PRODUCTION
THEREOF

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Application January 9, 1945, Serial No. 572,075

23 Claims. (Cl. 154—101)

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This invention relates to improved textile products, and methods and apparatus for producing them, of the type which consist of or comprise potentially adhesive fibers, some of which are bonded to adjacent fibers by virtue of coalescence induced by heating.

It has heretofore been suggested to mix non-adhesive fibers with thermoplastic fibers, to fabricate the mixture into a textile, such as a knotted, woven, braided, netted, or knitted fabric, spun or continuous filament yarn, felts or papers, and the like, and either during or after fabrication of the mixed fibers, to set the structure of the fabric by heating. In utilizing the conventional arrangements for heating such fibrous products, difficulties arise in obtaining uniform activation of the thermoplastic fibers within the mass of the fibrous product, particularly when the fabric is heavy and thick, such as pile fabrics, coarse woven fabrics, thick felts and heavy papers, such as card-board. When applying heated surfaces to the surfaces of the textile product, the activation of the inner portions of the product is retarded by the resistance to heat transfer afforded by the portions of the fabric intervening between the central portion and the heating surfaces. In addition, the opposed potentially adhesive fibers at the surface of the product which contact with the heating surfaces tend to stick to such surfaces and when the product after activation is removed, it is frequently torn and disrupted adjacent the points of sticking. Even when applying internal heat by means of high frequency induction, the exposed thermoplastic fibers have the opportunity of sticking to whatever surfaces upon which the product may rest, or between which it may be held during such activation.

In accordance with my copending application, Serial No. 572,076, filed January 9, 1945, the textile product is supported in contact with one or more cooled surfaces, while it is being heated internally by high frequency induction, either inductively or capacitatively coupled therewith. By thus applying the heat, thorough activation of the interior of the product is obtained, while at the same time, the thermoplastic fibers in the surfaces of the product are prevented in one or both surfaces from attaining their fusion point. The resulting product has a bound-fiber structure, giving increased strength and setting it against shrinkage, creasing, wrinkling and the like, while the exposed surfaces of the fabric retain a soft pleasing handle and are as porous as the unactivated product.

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In the case of felts consisting of thermoplastic fibers or comprising a mixture of such potentially adhesive fibers with non-adhesive fibers, it has been found that extremely high potentials are necessary to provide sufficient heat internally of the product to bind the fibers when operating in accordance with the disclosure of the above-mentioned copending application. This is particularly true when high melting thermoplastic fibers are used since they have relatively high thermal tacking points. In accordance with the present invention, the internal heating effect is increased such as by increasing the I^2R characteristic of the thermoplastic fibers within the product or of the product as a whole. In the expression I^2R , I represents the electric current and R represents the resistance in accordance with the conventional electrical terminology. This increase of internal heating effect may be accomplished by several expedients, taken separately or in combination. For example, the electrodes may be off-set laterally and parallel to the surface of the felt so that they are not directly opposite each other on opposite sides of the felts. Such off-set electrodes may be placed adjacent the felt either on the same or opposite surfaces thereof. In some cases, the electrodes may be placed along opposite edges of the felt. The accomplishment of increased internal heating by such off-set electrodes has the additional advantage of reducing power loss since the energy is concentrated upon the intervening fibers of potentially adhesive character rather than on heating of the air space between the electrodes by dielectric losses therein.

An alternative expedient for increasing the internal heating effect is to apply to the potentially adhesive fibers a conductivity increasing coating or to incorporate within such fibers a conductivity increasing material. Such materials as graphite or titanium dioxide of any crystalline variety or metal powders or electrolytic dissociating compounds such as salts may be incorporated within the fibers either by soaking the fibers in solution or melted masses of the conductivity increasing materials and subsequently drying or cooling or, in the case of potentially adhesive fibers of artificial nature the conductivity increasing material may be incorporated in the mass to be spun, whether this is a molten mass for melt-spinning, or a solution adapted for dry or wet spinning. The potentially adhesive fibers, whether natural or artificial, can be coated with the conductivity increasing material.

A modification of the latter expedient is to

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moisten the felt comprising the potentially adhesive fibers prior to activation by the high frequency induction current. This moistening may be accomplished by padding, steaming (especially with wet steam) or atomizing water with a spray directed to the felt. In such event, the moisture is removed simultaneously by the heating activation by the high frequency induction current. A modification of this expedient is to apply a volatile or sublimable electro-conductive substance such as ammonium carbonate or ammonium carbamate which may be incorporated either in the body of the felt or on the surface of the thermoplastic fibers prior to their formation into a felt so that during the subsequent heating activation, the auxiliary material is evaporated and thus is removed. The effect may be increased when such agents are of electrolytic nature by operating under humid conditions or by briefly steaming or moistening the felts containing the treated fibers just before the felt enters the region of high frequency induction or simultaneously therewith.

Instead of steam or water, a liquid having a selected boiling point, somewhat above the adhesive or tacking point of the thermoplastic fibers may be used so that during evaporation of the liquid, the proper temperature of the adhesive fibers is assured and controlled. After boiling off of the liquid, the decreasing conductivity reduces the current and tends to lower the temperature of the thermoplastic fibers, allowing them to become set and preventing over-activation. Examples of such liquids are esters, such as ethyl lactate, ethyl orthocarbonate, ethyl orthoformate and tricresyl phosphate. To obtain predetermined temperatures, it is especially advantageous to make use of the alcohols such as hexenyl alcohol, heptyl alcohol, hexyl alcohol, any of the amyl alcohols, butyl alcohol, isobutyl alcohol, normal propyl alcohol, iso-propyl alcohol, and the like. Such liquids may or may not be plasticizers for the thermoplastic materials of which the fibers are formed. In case they are plasticizers, they generally lower the thermal tacking point of the fibers and consequently this is taken into consideration in selecting the liquid of this character to be applied. The application of a plasticizing liquid has the advantage of assuring that after the liquid has been removed by evaporation, the fibers lose their tackiness even on continued application of high frequency induction so that setting of the fibers in the textile occurs without any possibility of excessively high temperatures being obtained which would destroy the fiber identity. Such plasticizers may be incorporated in the mass to be spun when making artificial thermoplastic fibers or the plasticizer may be applied to the potentially adhesive fibers before or after formation of the felt-like mat by carding, blowing, or the like as herein-after more particularly described. Such application to the mat may be performed by spraying or atomization.

As in my copending application, the felt may be and preferably is supported upon or between cool surfaces while subjected to high frequency induction, thereby preventing one or more of such surfaces from being rendered adhesive. This permits the attaining of any degree of activation internally of the felt or felt-like product while maintaining a good feel, soft hand, and porosity of at least one or of all of such surfaces. Besides obtaining soft surfaces, there is avoided any possibility of damage by sticking of the sur-

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faces to the supporting members and consequent tearing of the felt upon removal therefrom. It is also possible to use relatively higher proportions of thermoplastic fibers or such fibers exclusively while obtaining felt-like products having any desired internal stiffness, tenacity, resistance to tearing, impermeability, or permeability while exhibiting a soft, porous surface or surfaces.

The textile product may consist entirely of the thermoplastic potentially adhesive fibers which are activatable by heat, or it may comprise such fibers with non-adhesive fibers. Again, it may comprise a mixture of two types of thermoplastic fibers, one of which has a lower tacking point than the other type.

Examples of potentially adhesive fibers are those of cellulose acetate or other cellulose esters and ethers or mixed esters, such as cellulose acetate propionate or cellulose acetate butyrate, in plasticized condition; also, 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, polyethylene, vinyl compounds, styrene, sterols, 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, sulfurolefine 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 co-polymerizing two or more resins, such as copolymers of vinyl halide and vinyl acetate, co-polymers of vinyl halide and an acrylic acid derivative, 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 resins or rubber, such for example, as a mixture of cellulose nitrate and an acrylic acid resin, or a mixture of benzyl cellulose and a vinyl resin, or a mixture of ethyl cellulose and shellac.

A preferred class of vinyl resins 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 resin (which becomes infusible through the action of certain elements, such as oxygen and sulfur, such for exam-

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ple as glycerol-polybasic acid-drying oil resins and olefine-sulfur resins.

Among the non-adhesive fibers which may be used are wood pulp fibers, cotton, flax, jute, kapok, silk, and the like, or synthetic filaments of cellulosic compositions, such as a cellulose or regenerated cellulose, 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 xanthofatty acids, cellulose thiourethanes; natural and synthetic rubber and derivatives thereof; alginic acid, gelatine, casein; mineral fibers such as spun glass, asbestos, mineral wool and the like; 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 by heating; and the fibers made by slitting, cutting or shredding non-fibrous films, such as waste cellophane.

For the production of the felt-type fabrics, such as textile felts, papers, paper and pulp products, such as cardboard, the laying of the potentially adhesive fibers or of the mixtures of the two types of fibers may be effected by carding or by heating the two types of fibers together in a suitable liquid suspension. Alternatively, the fibers may be blown into a vessel and allowed to deposit by gravity upon a travelling conveyor such as a belt and, in this procedure, the fibers or at least one type thereof, when a mixture is involved, thus thrown into the vessel may be produced in situ at that time by spraying or electrostatic methods. The felt-like mat or sheet thus produced may be subjected to an electrostatic field between cooled insulated electrodes which may be pressed together against the sheet with any desired amount of pressure, as in Figure 1.

The felt-like product being subjected to the electric field may be passed continuously through the region where it is subjected to high frequency induction while being passed over a cooling support or between two such cooling supports, or it may be held stationary during such treatment. Alternatively, the product may be cut into pieces and formed into a pile which is subjected to the electric or electromagnetic field. Again, the product may be wound upon itself into a convoluted form or shape in which form treatment may be effected.

Prior to subjection to the high frequency electric or electromagnetic field, the products to be treated may be impregnated or coated with any desired agent for the purpose of imparting a desired finish, hand, pliability or appearance to the final product.

Any suitable high frequency oscillator may be employed for the purposes of the invention and the voltage at which it is operated may be varied widely within the limit determined by the development of a corona discharge between the electrodes. A frequency of from ten to thirty megacycles per second is entirely satisfactory, the particular frequency employed in any particular case depending upon the allowable voltage and the amount of power desired. Similarly, any high frequency alternator may deliver its current through a coil through which the felt may be passed axially while supported on a cooling surface or between two such surfaces pressed together. The cooled surfaces may be those of hollow platens or platforms through which a cooling fluid is forced.

As stated hereinabove, pressure may be applied

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to the felt-like product while it is being subjected to the high frequency electric or electromagnetic field and such pressure may advantageously be applied through the medium of the electrodes themselves when applying an electrostatic field, such electrodes being preferably insulated in such case, or the pressure may be applied by the cooling supporting surfaces. While the application of pressure is by no means necessary, it generally serves to more reliably and effectively control the extent of adherence between the adhesive fibers and adjacent fibers in the product. Whereas the application of the activation heat by means of the ordinary procedures of radiation, convection and conduction has tended to give rise to glazed surfaces and non-uniform heating throughout the body of the mass, the use of the high frequency electric or electromagnetic field for generating heat within the body of the individual fibers by dielectric, eddy current or displacement current losses therein completely eliminates this difficulty.

After activation, the fibers may be de-activated by cooling. This may be accomplished merely by interrupting the supply of power to the electrodes in the case of the electrostatic arrangements or by interrupting the alternating current in the cool of the electromagnetic arrangements. Alternatively, the textile structure may be removed from between the electrodes or from within the high frequency coil and cooled outside their influence.

Depending upon the particular desideratum in the final felt to be produced, the percentage of activatable fibers therein may be varied widely. For simple stabilization of the felt, a range of activatable fibers between 5 to 25% of the entire weight of the felt is generally adequate, the balance being non-activatable. When considerable stiffening of the felt is also desired, higher percentages up to 100% of activatable fiber may be present in the felt.

The drawing illustrates various arrangements of apparatus for accomplishing the invention.

Figure 1 is a side elevation, partly in section, of one embodiment of the invention.

Figure 2 is an elevation partially in cross-section of a modification.

Figure 3 is a side elevation of a modification, and

Figure 4 is a side elevation of still another embodiment.

In Figure 1, a continuously traveling permeable belt 2 driven by and about rolls 3 passes through suitable openings 4 in the walls of a chamber 5 in which one or more types of fibers are deposited. The fibers may be introduced by one or more blowers 6 and if desired a suction may be induced below the belt 2 by means of a pump or fan 7 connected by the conduit 8. The width of the belt 2 corresponds with the width of the chamber 5 so that it partitions the chamber into an upper depositing region and a lower suction region. As the mat of fibers proceed from the depositing chamber 5 on the belt 2 they may be sprayed by means of the device 9 with an atomized liquid or steam. The mat proceeds between opposed cylindrical electrodes 10, which may be arranged to exert any desired pressure on the fibrous mat as it proceeds therebetween.

The electrodes 10 are preferably hollow and arranged to receive and discharge through their opposite axles cooling medium, such as liquids or gases including air, oxygen, nitrogen, carbon dioxide at any desired low temperature. Liquid

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air or liquid gases may be used. If desired, water alcohol or hydrocarbon in liquid form or the like may be used. Preferably, the liquid that is used is one that does not tend to ionize and has a minimum polarization under the influence of the high frequency induction current. Preferably the electrodes are of insulating material except that their circumferences are provided with a conducting coating to which the opposite poles of an oscillator may be connected such as by brushes 16. As actually shown in Figure 1, the brush associated with the upper electrode is grounded as is also one pole of the oscillator. The essential construction of the electrodes 10 is shown in Figure 2 with the sole exception that in Figure 2 the electroconductive coating on the drums 10a is omitted and electrodes 17 are arranged to extend a short distance longitudinally of the felt passing between the drums 10a.

As shown in Figure 2, the drums 10a of insulating material (which correspond with electrodes 10 of Figure 1 except the electroconductive coatings on the circumferential peripheries are omitted) are hollow and have trunnions 11 extending from each end for rotatably supporting them within bearings 12. Gears 13 fixed to the trunnions at one end serve to drive the drums, a pulley 14 and belt 15 transmitting the power necessary. The electrodes 17 have conductive material extending a short distance along the length of the felt adjacent the nip between the drums 10a and are connected to opposite poles of radio frequency oscillator. As shown, the electrodes 17 are disposed between the drums 10a but they may be arranged laterally thereof where the felt is compacted to such a narrow thickness as to make it preferable to have wider electrodes within the thickness of the felt.

In Figure 3, a mat proceeding either from a card or from a depositing chamber such as shown in Figure 1, and passing under a moistening device 9 proceeds between two foraminous electroconductive belts 18 supported and driven by rolls 19. The adjacent courses of the belt are preferably maintained in substantially flat condition by a plurality of rolls or rods 20 spaced longitudinally of the belt courses. Cooling means are provided in the form of blowers 21 for directing cold air through the foraminous belt to maintain the adjacent surfaces of the belt in a cool condition. The opposite poles of the radio frequency oscillator are connected to the electrodes 18 by brushes 22. This arrangement is preferably used for the production of relatively compact and thick felt masses in order to prevent too great penetrations of the air into the felt.

Figure 4 illustrates an embodiment in which the mat proceeds from the moistening means 9 between a pair of cool drums 23 and 24, then between pressing foraminous or permeable belts 25 driven by rollers 26. Adjacent courses of the belt may be pressed into contact with any desired pressure by rolls 27 spaced longitudinally of the belts and a cooling medium, such as cold air may be directed along the surfaces of the felt by rollers 28. After emerging from the belts, the felt passes between two opposite rolls 29 and 30 similar to 23 and 24 in that they are hollow and provided with internal cooling fluid as in Figure 2. The circumferential peripheries of rolls 24 and 30 are provided with an electroconductive coating or sheet and brushes 31 and 32 connect the opposite poles of the oscillator 33 with the peripheries of the rolls 24 and 30 respectively. In this fashion, the electrostatic cur-

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rent is capacitatively coupled with the felt by means of electrodes spaced longitudinally thereof as distinguished from laterally thereof as shown in Figure 2.

Example I

A mixture of 85% of viscose rayon staple fiber and 15% of a copolymer of vinyl chloride and vinyl acetate fiber having a thermal tacking point of 130° C. was formed into a bat by carding and the bat was passed directly from the card between electrodes arranged laterally of its path while simultaneously being subjected to pressures between cooled drums substantially as shown in Figure 2. After the bat emerged from the influence of the induction field, it was found to have good coherence and resistance to tearing due to bonding of fibers in the central portions thereof but its surfaces exhibited a soft porous character similar to that of the bat prior to activation.

Example II

A carded bat of the same composition as that of the preceding example was passed through the arrangement shown in Figure 4, a spray of ethyl lactate being applied by the atomizing device 9. After emerging from the apparatus, the felt was substantially free of liquid, was bonded internally, but free of any tendency to stick to the various rolls of the apparatus and had porous soft surfaces.

Example III

A mixture of 80% viscose rayon staple fiber and 20% of cellulose acetate fiber plasticized by incorporation in the mass originally spun of tricresyl phosphate was passed through the apparatus of Figure 3 except that the spray means 9 was not utilized. The fabric exhibited internal strength due to bonding of fibers but was free of bonded fibers adjacent to surfaces.

Example IV

A mixture of 85% viscose rayon staple fiber and 15% of a fiber made of a vinyl chloride with vinyl acetate copolymers having a thermal tacking point of 160° C. was formed by blowing the separate fibers into the depositing chamber 5 of Figure 1. As it emerged from the chamber 5, the bat was subjected to wet steam by means of the device 9 and was then passed between the high frequency electrodes 10 as shown in Figure 1. After emerging from the apparatus, the product exhibited internal strength and bonding of fibers internally but there was no difficulty with sticking of fibers to the pressing surfaces and the surfaces exhibited a soft porous hand.

Example V

A mixture of 45% cotton and 55% of an after-chlorinated copolymer of vinyl chloride and vinyl acetate having a thermal tacking point of 175° C. and delustered by 20% by weight of titanium dioxide was carded and the resulting bat was passed through the apparatus of Figure 2 but in which the spray means 9 was not used. The titanium dioxide greatly increases the effective dielectric losses of the heat activatable fibers containing it so that a lower potential is needed to obtain satisfactory activation. The final product exhibited internal bonding of fibers with accompanied increased internal strength while its surfaces were fully porous and soft.

By the invention, it is possible to activate the interior portions of the textile products to effect stabilization thereof by the bonding of fibers

therein without at the same time bonding fibers in the faces of the felts. In this manner, by controlling the cooling effect of the surfaces in contact with the product in relation to the heating effect thereupon, a preferred handle and porosity may be present in the surface layers, regardless of the proportion of potentially adhesive fibers in the product, while at the same time any degree of activation of the fibers within the interior of the structure can be accomplished to stabilize the structure either by merely bonding the fibers without loss of fiber identity, or to render an interior layer of the felt substantially impermeable by causing the fibers therein to flow freely and thereby form a film through which the non-adhesive fibers extend. Stabilization of the interior of the structure may be accomplished by heating only sufficiently to soften the thermoplastic fibers enough to cause them to shrink and to become deformed about the non-adhesive fibers without actually becoming adhesively bonded thereto. Again any degree of activation between the extremes stated can be accomplished to obtain various properties in the product.

The present invention may be applied in the production of textile felts, or industrial felts for use as packing material and gasket material for sealing relatively moving or stationary parts of machinery of any kind, or in similar form as wicks for transmitting liquids to elements or surfaces to be lubricated or otherwise coated. The invention may also be applied for the production of felt-type products for making hats or other textile products or for use as battery separators, heat-insulation material, sound-insulation material, cushioning, padding, or as filtering materials either for gaseous or liquid suspensions, etc.

The description herein is intended to be illustrative only and it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, at least some fibers in the mat carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, continuously passing the mat longitudinally through a path, inducing internal heating of the mat along a portion of the path by a high frequency current to render the activatable fibers adhesive, and simultaneously cooling at least one surface of the mat as it passes through the heating portion of the path to prevent the thermoplastic fibers in the surface from becoming adhesive.

2. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, at least some fibers in the mat carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, continuously passing the mat longitudinally through a path, capacitatively inducing internal heating of the mat along a portion of the path by a high frequency electric field to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling the mat as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

3. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, continuously passing the mat longitudinally through a path, capacitatively inducing internal heating of the mat along a portion of the path by a high frequency electric field having terminals spaced apart in a direction generally transverse of the thickness of the mat to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling the mat as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

4. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, continuously passing the mat longitudinally through a path, capacitatively inducing internal heating of the mat along a portion of the path by a high frequency electric field having terminals spaced apart in a direction generally widthwise of the mat to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling the mat as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

5. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, at least some fibers in the mat carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, continuously passing the mat longitudinally through a path, capacitatively inducing internal heating of the mat along a portion of the path by a high frequency electric field having terminals spaced apart in a direction generally longitudinally of the mat to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling in the mat as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

6. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, continuously passing the mat longitudinally through a path, increasing the electroconductivity of activatable fibers in the mat along a portion of the path, capacitatively inducing internal heating of the mat along a second portion of the path by a high frequency electric field having terminals spaced apart in a direction generally transverse of the thickness of the mat to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling the mat as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

7. A method of making a felt-like product comprising continuously forming a mat comprising heat-activatable thermoplastic fibers, continuously passing the mat longitudinally through a path, inducing internal heating of the mat along a portion of the path by a high frequency current to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling the mat as it passes through the heating

portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive and controlling the temperature induced upon activatable fibers in the mat by incorporating an evaporable medium with them prior to their passing through the heating portion of the path, said medium evaporating at a temperature above the thermal tacking point of the thus treated activatable fibers.

8. As an article of manufacture, a textile product formed from a fibrous mass comprising heat-activatable fibers containing titanium dioxide, at least some of the fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of all of said fibers which lie in, and in close proximity to the surfaces of the product being unadhered.

9. A method of making a fibrous product comprising forming a mass comprising heat-activatable thermoplastic fibers into a fibrous product, at least some fibers in the product carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, and inducing internal heating of the product by a high frequency current to render the activatable fibers adhesive while cooling at least one surface of the product to prevent the thermoplastic fibers in the surface from becoming adhesive.

10. A method of making a fibrous product comprising continuously forming a mass comprising heat-activatable thermoplastic fibers into a fibrous product, continuously passing the product longitudinally through a path, capacitatively inducing internal heating of the product along a portion of the path by a high frequency electric field having terminals spaced apart in a direction generally transverse of the thickness of the product to render the activatable fibers adhesive, and simultaneously pressing and superficially cooling the product as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

11. As an article of manufacture, a textile product formed from fibers comprising heat-activatable fibers carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, at least some of the fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of said fibers which lie in, and in close proximity to, the surfaces of all of the product being unadhered.

12. As an article of manufacture, a felt-like product formed from a mat comprising heat-activatable fibers carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, at least some of the fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of said fibers which lie in, and in close proximity to, the surfaces of all of the product being unadhered.

13. As an article of manufacture, a textile fabric formed from yarns comprising heat-activatable fibers carrying an inductive material hav-

ing the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, at least some of the fibers in the fabric exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of said fibers which lie in, and in close proximity to, the surfaces of all of the fabrics being unadhered.

14. As an article of manufacture, a felt-like product formed from a pressed mat comprising heat-activatable fibers carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, at least some of said fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of all of said fibers which lie in, and in close proximity to, the surfaces of the product being unadhered.

15. As an article of manufacture, a felt-like product formed from a mat comprising a mixture of non-adhesive fibers and potentially adhesive heat-activatable fibers carrying an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, the activatable fibers being generally homogeneously distributed throughout the thickness of the mat at least some of said fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of all or said fibers which lie in, and in close proximity to, the surfaces of the product being unadhered.

16. As an article of manufacture, a felt-like product formed from a fibrous mass comprising heat-activatable fibers containing titanium dioxide, at least some of the fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of all of said fibers which lie in, and in close proximity to, the surfaces of the product being unadhered.

17. As an article of manufacture, a textile fabric formed from yarns comprising heat-activatable fibers containing titanium dioxide, at least some of the fibers in the body of the product exhibiting a strong and substantially permanent adhesion due to the thermal tackiness after heating thereof, and those portions of all of said fibers which lie in, and in close proximity to, the surfaces of the product being unadhered.

18. A method of making a fibrous product comprising the steps of incorporating within thermoplastic fibers an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, forming such fibers into a mass, and inducing internal heating of the mass by a high frequency current to render the activatable fibers adhesive to bind fibers in the body of the mass while cooling at least one surface of the mass to prevent the development of adhesiveness in the fibers therein.

19. A method of making a fibrous product comprising the steps of incorporating within thermoplastic fibers an inductive material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, forming such fibers into a mass, and inducing internal heating of the mass by a high frequency current to render the activatable fibers adhesive to bind fibers in the body

of the mass while cooling opposite surfaces of the mass to prevent the development of adhesiveness in the fibers therein.

20. A method of making a fibrous product comprising the steps of incorporating within thermoplastic fibers an inducteous material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, forming such fibers into a mass, inducing internal heating of the mass by a high frequency current to render the activatable fibers adhesive to bind fibers in the body of the mass, and subjecting the mass to pressure and superficial cooling to compact it to a predetermined extent while the activatable fibers are in an adhesive condition and to prevent the development of adhesiveness in the fibers adjacent the surfaces of the mass.

21. A method of making a fibrous product comprising the steps of commingling at least two types of fibers at least one of which is of potentially adhesive heat-activatable character, supplying to the activatable fiber an inducteous material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, forming the mixture of fibers into a fibrous product and inducing internal heating of such product by a high frequency current to render the activatable fibers adhesive to bind fibers in said product while cooling at least one surface of the product and to prevent the development of adhesiveness in the fibers adjacent the surfaces of the mass.

22. A method of making a felt-like product comprising the steps of commingling at least two types of fibers at least one of which is potentially adhesive heat-activatable character, at least some of the commingled fibers carrying an inducteous material having the characteristic of increasing the heating effect developed in the fiber through induction by a high frequency current, forming the mixture of fibers into a mat, subjecting the mat to a high frequency electric field to render the activatable fibers adhesive to bind fibers in the mat, and subjecting the mat to pressure and superficial cooling to compact it to a predetermined extent while the activatable fibers are in an adhesive condition and to prevent the development of adhesiveness in the fibers adjacent the surfaces of the mass.

23. A method of making a felt-like product comprising continuously forming a mat compris-

ing a mixture of heat-activatable thermoplastic fibers and non-adhesive fibers heterogeneously distributed throughout the mat, continuously passing the mat longitudinally through a path, steaming the mat along a portion of the path, inducing internal heating of the mat along a second portion of the path by a high frequency current to render the activatable fibers adhesive, and simultaneously pressing and cooling the surfaces of the mat as it passes through the heating portion of the path to effect bonding of the fibers in the body of the mat while preventing the thermoplastic fibers in the surface from becoming adhesive.

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