March 22, 1955 O. W. BERGLUND 2,704,725

METHOD OF MAKING PILE-SURFACED SHEET MATERIAL

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FIG. 1.

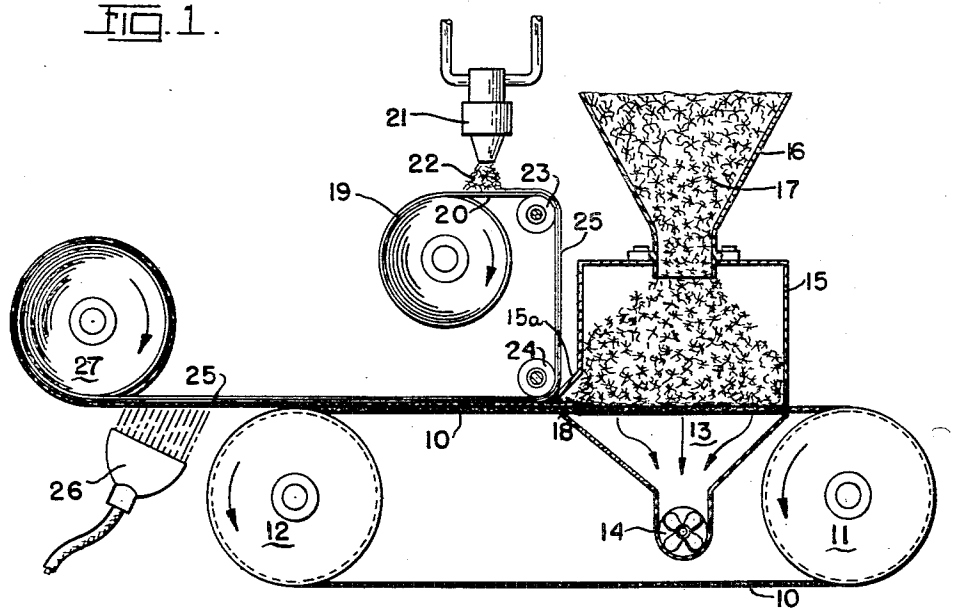
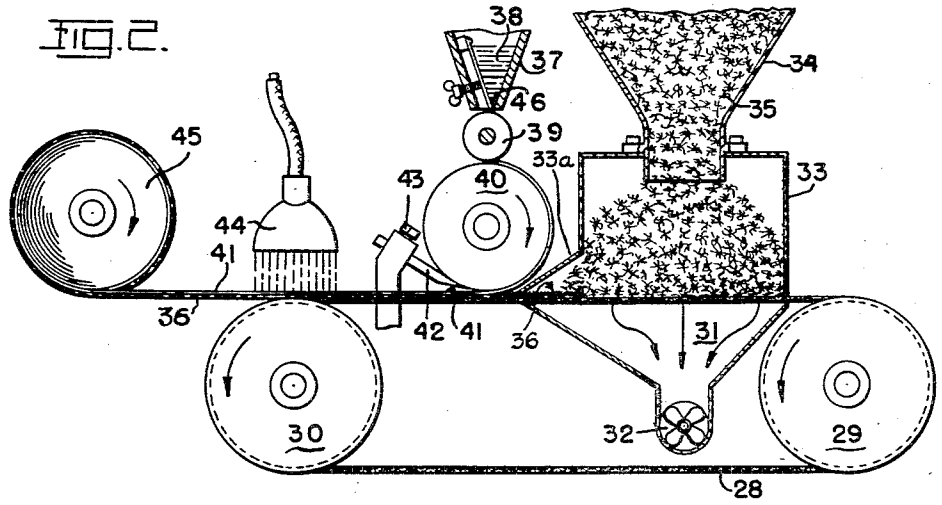


FIG. 2.



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METHOD OF MAKING PILE-SURFACED SHEET MATERIAL

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19 Claims. (Cl. 117—33)

This invention relates to sheet material consisting of a base having a pile-like surface composed of substantially parallelized upright discontinuous fibers.

One object of the invention is to provide sheet material comprising a permanent base having a surface formed by discontinuous or short fibers, particularly fibers as they occur in flock, adhered thereto in parallelized condition substantially at right angles to the base and forming a pleasing napped or pile-like surface on the base.

Another object is to provide sheet material as aforesaid by a simple, relatively inexpensive procedure.

A further object is to provide sheet material having a surface composed of the parallelized upright short fibers and characterized by good tensile strength.

A still further object is to provide sheet material comprising a permanent base having a decorative or patterned surface composed of a layer of parallelized upright discontinuous fibers.

An additional object is to provide sheet material comprising a base having a surface formed of parallelized upright discontinuous fibers, the sheet being normally free from tackiness so that it can be stored in multiple layers, for instance, wound upon itself on a reel or the like, or piled in stacks.

These and other objects are accomplished by feeding the discontinuous fibers, preferably flock, into a chamber having a bottom constituted by an endless travelling belt or the like which may itself serve as a temporary base for the fibers, or support such a temporary base, applying suction below the belt to pull the fibers down to the base and orient the individual fibers in upright condition on the base, solely as a result of the suction, and, while the short fibers remain in the oriented upright position, superimposing a sheet having an adhesive surface as the permanent base thereover, with its adhesive surface in contact with the fibers, whereby the parallelized upright fibers are transferred to the permanent base, removing the permanent base having the fibers adhered to it from the temporary base, and drying or cooling the fiber-coated permanent base, as may be required to set the surface in non-adhesive condition and depending on whether the permanent base has been treated with an extraneous adhesive binder or is inherently tacky, as will be discussed in detail below. There is thus obtained a sheet material having a suede-like or pile-like surface formed by the discontinuous or short fibers permanently anchored to the selected base.

Various types of materials may be used as the temporary base. For example, the endless belt on which the short fibers are pulled down and oriented in upright condition by the suction may be formed of a "Vinyon" (vinyl chloride-vinyl acetate copolymer) fabric or such a fabric may be supported on a belt of other material. A 100-mesh metal screen has also been found satisfactory as the temporary base and if the screen has a patterned surface the fibers conform to the pattern which is then transferred to the permanent base.

The permanent base may be a fabric, leather, non-fibrous film, paper or a paper-like material or non-woven fabric. This permanent base may be impregnated and/or coated with any suitable adhesive for anchoring the upprighted fibers to it, or it may consist of or comprise a plastic material activatable to adhesive or tacky condition by heat or solvent treatment to permit autogenous bonding of the base to the fibers. In one preferred embodiment, the permanent base is paper or a paper-like

material which may be impregnated and/or coated with an adhesive binder for the fibers, or comprise potentially adhesive fibers in the adhesive condition so that the base is self-anchored to the fibers when it is pressed down on the fibers disposed on the temporary base. The article comprising the paper or non-woven fabric base and having the parallelized upright fibers bonded, as a layer, to a surface thereof, is inexpensive and yet has good tensile strength and other desirable characteristics rendering it useful for a variety of purposes.

When an extraneous adhesive is employed, it may be of any suitable type and may be selected from resinous solutions of different kinds. For example, it may be a solution of a vinyl resin such as polyvinylchloride in cyclohexane, a solution of polystyrene in carbon tetrachloride, a solution of nitrocellulose, or a solution of a thermosetting resin in the partially condensed state, such as a solution of an alkyd resin, the resin being set in the thermoset infusible condition on heating of the permanent base after transfer of the fibers to it. While the adhesive may be applied to the permanent base as an impregnant or coating, the more simplified procedure involves the use of a permanent base which is potentially adhesive or comprises a potentially adhesive material or fibers of the same. The permanent base may be a sheet or film of plastic material, for instance a film of plasticized cellulose acetate or of a vinyl or other resin the surface of which is softened or made tacky by heat or by the application of a limited amount of a solvent for the plastic. The permanent base may also be of fibrous character and consist of or comprise fibers of a material, such as plasticized cellulose acetate or a vinyl resin which, on heating or after application of a solvent or swellant for the plastic material, becomes sufficiently tacky to adhere to the fibers. Non-woven fabrics formed of two types of fibers, one of which is non-adhesive and the other potentially adhesive, such as mixtures of regenerated cellulose fibers and plasticized cellulose acetate fibers may be used as permanent backing. When a potentially adhesive permanent base or backing is used, the surface thereof to be pressed against the fibers on the temporary base is brought to the adhesive condition just before the permanent base is pressed onto the fibers. After the transfer of the fiber layer has been effected, the permanent base having the fibers bonded to it, is treated to set the adhesive. If an extraneous adhesive is employed simple drying will set it in the firm non-adhesive condition in which it will retain the fibers in bonded relation to the base. Thermosetting resins of the alkyd type are set in the hardened infusible condition by baking the final sheet at elevated temperatures for short periods of time. If the permanent base is of the potentially adhesive type, cooling will serve to restore it to the hardened, non-adhesive state.

The discontinuous fibers erected on the surface of the temporary base under the influence of the suction may be natural, artificial, or synthetic fibers including those of cotton, wool, silk, nylon, casein, "Dacron," asbestos and glass. Those fibers may be of usual "staple" length or they may be shorter. Fibers having a length of ⅛ to ½-inch are suitable, in general. In a preferred embodiment, flock is used. Normally, flock consists of very short fibers or fibrils and occurs in the form of more or less compacted tangled fiber masses or clumps. Surprisingly, when flock comprising the fiber clumps or aggregates is fed into the suction zone, at a point above the travelling belt or temporary base, the clumps are broken up under the influence of the suction and the individual fibers are pulled down and individually oriented in the upright condition on the surface of the temporary base. It is thus possible to use the flock in forming the sheet material without subjecting it to prior treatments for breaking up the clumps or masses and disentangling the fibers. In order to obtain a final sheet material having a distinctive and/or texture effect, flock of different colors, or comprising fibers of different types, may be used. The properties of the final sheet material are influenced by, and may be predetermined by, the choice of flock utilized. For instance, if asbestos flock is used, and permanently bonded to both sides of a paper or other base, a flame-resistant sheet material is

obtained. A permanent base sheet having a layer of short glass fibers bonded to both surfaces thereof is suitable for use as insulation. So-called "rock-wool" fibers may be bonded to the permanent base in the manner described. Short leather fibers obtained from leather scrap may be permanently anchored, as a layer, to any suitable base, for example a paper or non-woven fabric sheet, to obtain a leather substitute which may be used, for instance, in making inexpensive types of luggage and the like.

In the drawing:

Figure 1 is a diagrammatic elevational view of an apparatus for carrying out my invention; and

Figure 2 is a diagrammatic elevational view of another embodiment of my invention.

Referring to the drawing in detail, and particularly to Figure 1, reference numeral **10** designates an endless belt consisting of a 100-mesh metal screen mounted for continuous movement on the rollers **11** and **12** driven by any suitable means (not shown). A suction box **13** provided with a suction pump **14** is arranged under the belt, and a casing or housing **15** is arranged above the belt for confining the fibers fed to the belt from the hopper **16** containing flock **17**, such as regenerated cellulose flock, and for concentrating the suction effect to which the fibers are subjected. Under the influence of the suction, the fiber agglomerates of the flock leaving hopper **16** are disrupted and the individual fibers thereof are pulled down onto the belt and oriented in an upright position thereon. Casing **15** is provided with a curved wall **15***a* so that the fibers remain under the influence of the suction, and thus remain in the substantially parallelized upright condition until they reach the point at which the sheet material **20** fed from reel **19** is superimposed on them.

A nozzle **21** is arranged to apply the selected adhesive **22**, such as a 15% solution of polyvinylchloride in cyclohexane, to the surface of sheet material **20** which is to contact the fiber layer. The adhesive-treated sheet, designated by numeral **25**, is led over two guide rolls **23** and **24**, and then superimposed on the layer of upright, parallelized fibers **18** on screen **10**. The fibers, as a layer, are thus transferred to and held by the sheet **25** while remaining in the upright position. An infra-red lamp **26** provides the heat necessary for drying the adhesive to thereby set the fibers and base in the bonded relation before the sheet material is wound on reel **27**.

The embodiment illustrated in Figure 2 differs from that of Figure 1 in that the permanent base is of the potentially adhesive type, and takes the shape of a non-fibrous film formed directly on the fiber layer to be bonded thereto. In this embodiment, as in Figure 1, a 100-mesh metal screen **28** is driven by two drive rolls **29**, **30**, and a suction box **31** provided with a pump **32** is arranged below the belt with casing or housing **33** having the sloping walls **33***a* being mounted above the belt for confining the fibers dispensed from hopper **34** containing the flock **35**, concentrating the suction effect, and, as a result of wall **33***a*, maintaining the fibers in upright position until they are transferred to the permanent base. In this embodiment, the permanent base is a film, for instance a film of a vinyl resin. A funnel **37** having an adjustable opening **46** dispenses the film-forming material **38**, which may be, for instance, a solution of polystyrene of suitable concentration, the film-forming solution being deposited on the layer of fibers carried on screen **28** by means of a vibrator roll **39** and a spreader roll **40**, the thickness of the deposit (and of the film) being adjusted and equalized by means of a doctor blade **42** which may be adjusted as required by means of the screw device **43**. While the film **41** is in the adhesive condition, that is before complete removal of the solvent, it bonds with the layer of fibers on the belt. It is then set in firm, non-adhesive condition by passing it under the infra-red lamp **44**, after which the sheet as an entity is removed from screen **28**. The final article consists of the plastic film **41** having autogeneously bonded to one surface thereof, the layer of discontinuous upright fibers imparting a napped or pile-like surface effect thereto. As in the embodiment of Figure 1, the final sheet material is wound up on a reel **45**. It is non-tacky and does not adhere to itself on the reel, although the permanent backing may be again rendered adhesive in use for bonding to other articles, if desired.

It will be understood that, in either embodiment, both surfaces of the permanent sheet may have a layer of the discontinuous uprighted fibers or fibrils bonded thereto.

Both of the embodiments shown illustrate continuous production of the sheet material. It will be understood that the sheet material may also be produced in a discontinuous manner.

The final sheet material, depending on the permanent base and the kind of fibers adhered to the surface or surfaces thereof, may be adapted to a variety of purposes including use as leather substitutes, the manufacture of "oilcloth," insulating material, and so on. The use of flock and of suction as the sole means for opening the fiber clumps, disentangling the fibers, and orienting the fibers in upright position on the temporary base permits of the rapid manufacture of the sheet material on a continuous scale at relatively low cost.

This application is a continuation-in-part of my pending application Serial No. 225,301, filed May 1, 1951, and now abandoned.

It will be understood that while certain embodiments of the invention have been described herein, it is not intended to limit the invention to the specific details given since the invention is susceptible of various modifications and changes within the spirit of the disclosure and the scope of the appended claims.

What is claimed is:

1. In a method of making a sheet material having a surface formed of a layer of discontinuous substantially parallelized upright fibers, the steps of (*a*) pulling discontinuous fibers downwardly onto a temporary non-adhesive base by means of suction applied below the base to cause the fibers to be deposited substantially as individual fibers oriented in upright position on the base solely as the result of the suction, (*b*) superimposing a sheet having an adhesive surface as the permanent base over the fibers on the temporary base with the adhesive surface thereof in contact with the fibers, while the fibers are maintained in the parallelized upright position, whereby the fibers are transferred to the permanent base without loss of their parallelized upright relation, (*c*) removing the permanent base having the fibers bonded thereto from the temporary base, and (*d*) treating the sheet material thus obtained to set the adhesive surface in non-adhesive condition.

2. The method according to claim 1, charactherized in that the permanent base is a fabric.

3. The method according to claim 1, characterized in that the permanent base is a paper sheet.

4. The method according to claim 1, characterized in that the permanent base is a non-fibrous sheet of plastic potentially adhesive film-forming material.

5. The method according to claim 1, characterized in that the permanent base is a paper sheet comprising potentially adhesive fibers.

6. The method according to claim 1, characterized in that the permanent base is a non-woven fabric comprising potentially adhesive fibers.

7. The method according to claim 1, characterized in that the permanent base is a fabric comprising potentially adhesive fibers.

8. The method according to claim 1, characterized in that the permanent base is a sheet of plastic material a surface of which, when said base is superimposed on the fibers, contains solvent for the plastic rendering said surface tacky.

9. The method according to claim 1, characterized in that the permanent base is a sheet comprising an adhesive binder for the fibers which occurs at the surface of the sheet to be superimposed on the fibers.

10. The method according to claim 1, characterized in that the permanent base is a sheet a surface of which has applied thereto an adhesive comprising a solution of a vinyl resin.

11. The method according to claim 1, characterized in that the permanent base is a sheet of a surface of which has applied thereto an adhesive comprising a cyclohexane solution of a vinyl resin.

12. The method according to claim 1, characterized in that the permanent base is a sheet a surface of which has applied thereto an adhesive comprising a carbon tetrachloride solution of polystyrene.

13. A method of making sheet material having a surface formed by a layer of discontinuous substantially parallelized upright fibers which comprises (*a*) moving a temporary base through a zone in which suction is ap-

plied below the base, (*b*) feeding flock comprising masses of fibers into the space above said base to disrupt the fiber masses, pull the individual fibers of the flock downwardly onto the surface of said base and erect the individual fibers in upright position on said surface solely by the action of the suction thereon, (*c*) superimposing a sheet having an adhesive surface as the permanent base over the layer of substantially parallelized upright fibers on the temporary base with the adhesive surface thereof in contact with the fibers, whereby the fibers are transferred to the permanent base without substantial loss of their parallelized, upright condition, (*d*) removing the permanent base having the fibers adhered thereto from the temporary base, and (*e*) treating the sheet material thus obtained to set the adhesive surface in the non-adhesive condition.

14. The method according to claim 13, characterized in that a surface of the permanent base is coated with a cyclohexane solution of a vinyl resin.

15. The method according to claim 13, characterized in that a surface of the permanent base is coated with a carbon tetrachloride solution of polystyrene.

16. The method according to claim 13, characterized in that the permanent base comprises a potentially adhesive material which is in the adhesive condition when the base is superimposed on the fibers.

17. The method according to claim 13, characterized in that the permanent base is a paper sheet.

18. The method according to claim 13, characterized in that the permanent base is a paper sheet, comprising potentially adhesive fibers which are in the adhesive condition when said base is superimposed on the fibers.

19. The method according to claim 13, characterized in that the permanent base is a non-woven fabric comprising potentially adhesive fibers which are in the adhesive condition when said base is superimposed no the fibers.

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