Dec. 13, 1949 W. F. FUHRHOP ET AL 2,491,258

MANUFACTURE OF PILE FABRICS

Filed May 12, 1947 3 Sheets-Sheet 1

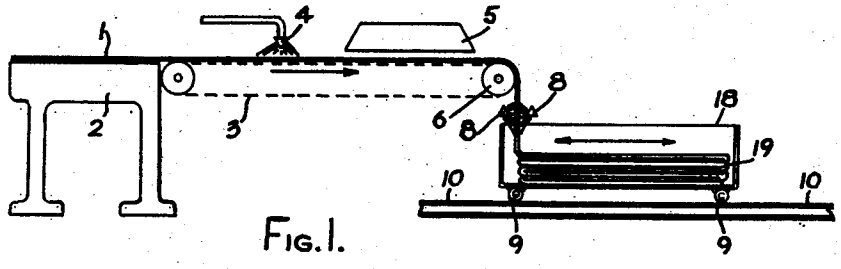

FIG. 1.

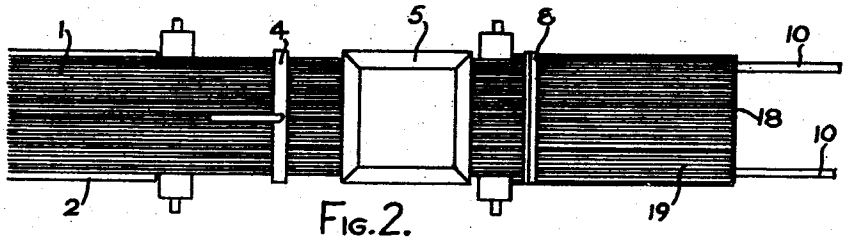

FIG. 2.

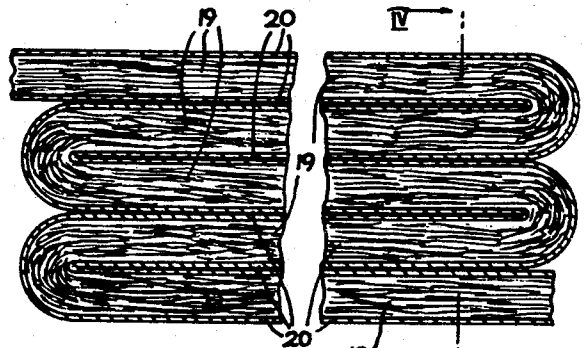

FIG. 3.

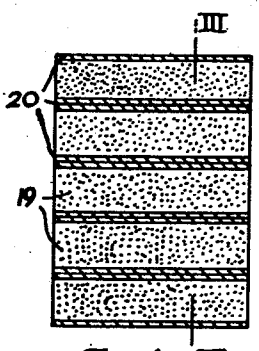

FIG. 4.

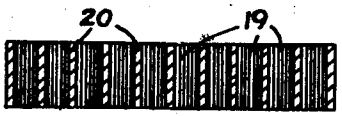

FIG. 5.

FIG. 6.

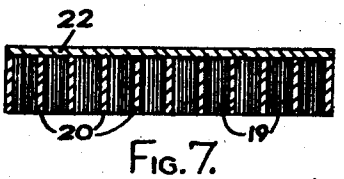

FIG. 7.

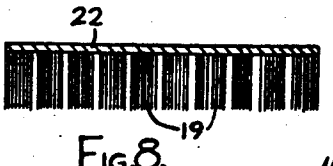

FIG. 8.

INVENTORS.

Wilhelm Friedrich Fuhrhop & Hans Van Issum,

BY

ATTORNEY.

Dec. 13, 1949 W. F. FUHRHOP ET AL 2,491,258

MANUFACTURE OF PILE FABRICS

Filed May 12, 1947 3 Sheets-Sheet 2

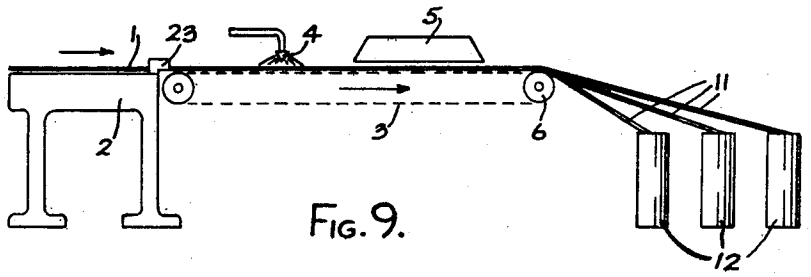

FIG. 9.

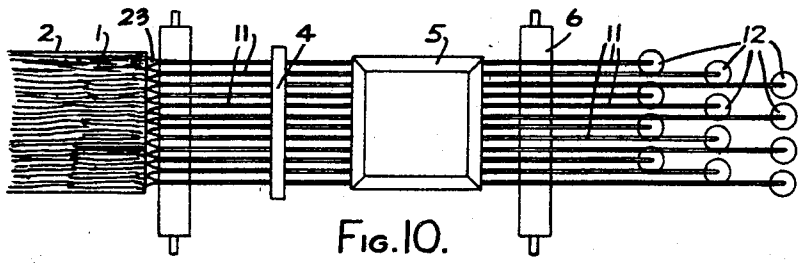

FIG. 10.

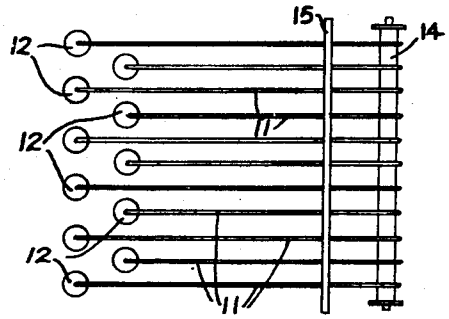

FIG. 11.

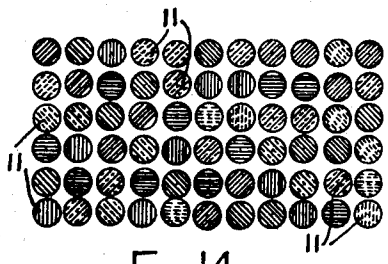

FIG. 14.

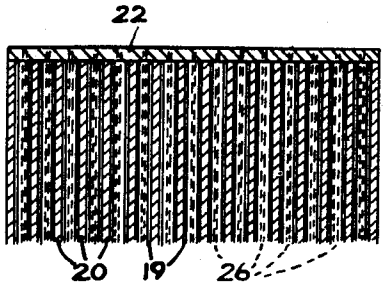

FIG. 15.

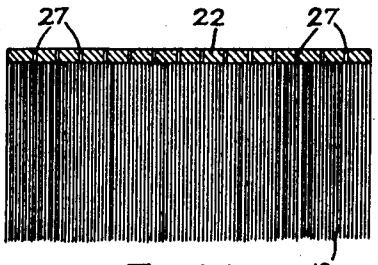

FIG. 16.

INVENTORS.
Wilhelm Friedrich Fuhrhop & Hans Van Issum,
BY
ATTORNEY.

Dec. 13, 1949 W. F. FUHRHOP ET AL 2,491,258

MANUFACTURE OF PILE FABRICS

Filed May 12, 1947 3 Sheets-Sheet 3

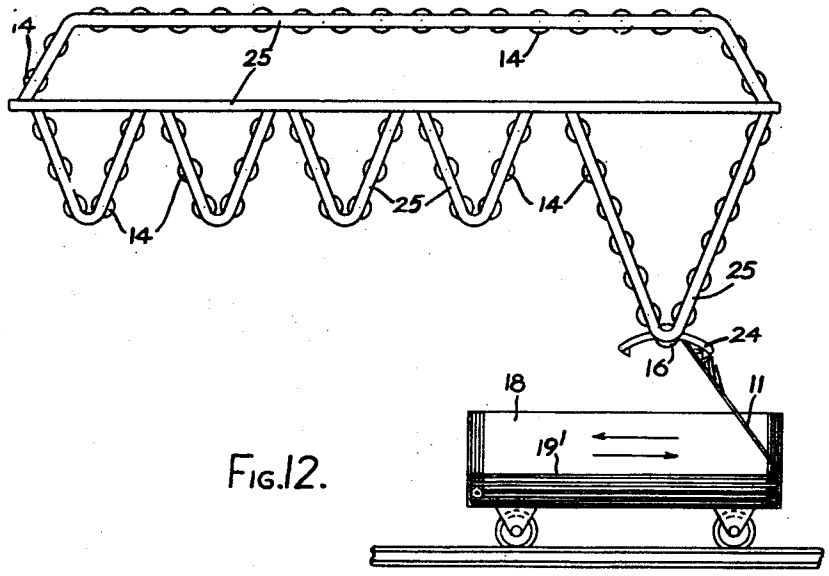

FIG. 12.

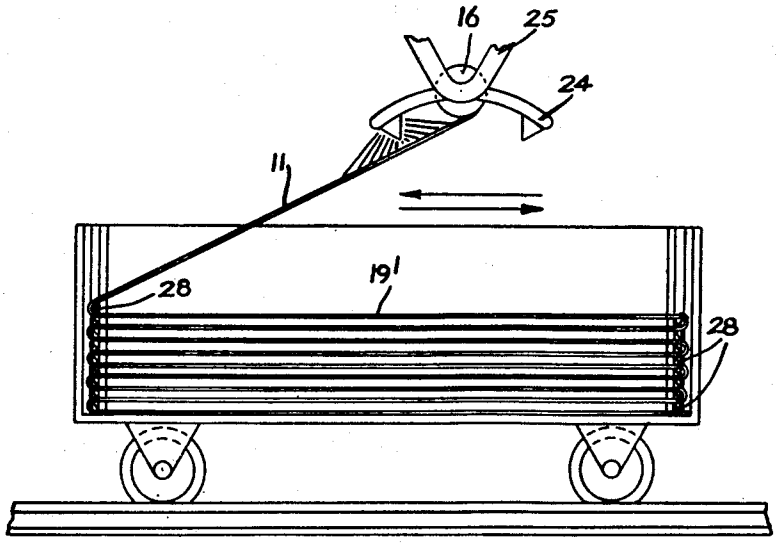

FIG. 13.

INVENTORS:
Wilhelm Friedrich Fuhrhop
& Hans Van Issum;

BY

ATTORNEY.

Patented Dec. 13, 1949

2,491,258

UNITED STATES PATENT OFFICE

2,491,258

MANUFACTURE OF PILE FABRICS

Wilhelm Friedrich Fuhrhop, London, and
Hans Van Issum, Bradford, England

Application May 12, 1947, Serial No. 747,544
In Great Britain February 28, 1946

11 Claims. (Cl. 154—77)

1

The invention relates to the manufacture of pile fabrics.

In the pending application for patent Serial No. 642,958 a method of manufacturing a pile fabric is described according to which yarn is arranged in parallel or approximately parallel multi-linear formation, consolidated by means of a consolidating medium to form blocks which are cut transversely of the parallel arrangement of the yarn into sections, the tips or ends of the yarn of the sections being provided with a backing, and the consolidating medium being removed from the yarn or pile of the section.

In the method according to the present invention the pile is formed from fibres or filaments of any suitable kind of either natural or artificial origin, or mixtures of these and in the following description and claims the term fibrous substance is used with this general meaning.

An important advantage of the invention is that it avoids the necessity for the use of yarn, i. e. spun fibre, as unspun fibre can be used so long as it has been combed or carded, or treated with any other of the usual processing machines, for the purpose of arranging the fibres longitudinally or approximately so. Nevertheless in some cases yarn, i. e. spun fibre, may be used.

According to the invention the fibrous substance, after combing, carding or similar processing, either in a web or divided into strands of any desired thickness, or in some cases in the form of yarn, is laid in superposed layers, the fibrous substance being impregnated or coated with consolidating medium during or after the laying so as to form a consolidated block or pack, which is subsequently cut, transversely of the run of the fibre, into sections.

The sections are then operated on in a manner such as that described in the specification above referred to, so as to expose the tips or ends of the fibrous substance on one surface of each section, to fix the tips in a backing, and to remove the consolidating medium from the fibrous substance which with its backing thus constitutes the required pile fabric.

As explained in the specification referred to the sections of pile fabric so produced may be secured to a canvas or other common foundation, or the sections after exposure of the tips may be assembled and a common backing be applied to them before the consolidating medium is removed.

A carded or like processed fibrous substance generally does not offer much resistance to disintegration when handled or subjected to tension and for this reason the fibrous substance whether in the form of a web or divided into strands is first impregnated with a binding agent such as size or other adhesive and dried.

2

This not only enables it to resist any tension put upon it while it is being impregnated or sprayed with consolidating medium and while it is being laid in superposed layers, and also insulates the fibres from the consolidating medium, but it has the further advantages that before these operations when a plain fabric is to be produced from a web it may be actually stretched or tensioned to straighten any fibres not straightened or put into parallelism by the carding or processing machines; and also that when a web is divided into strands these can be collected, for instance, into cans, wound on to spools, beams, hanks or cheeses or the like which can be used selectively when they are being impregnated or coated with consolidating medium and are being laid into a pack or block, thus enabling determined patterns to be obtained. For example, spools so wound with strands of different colours or quality can be set in determined order in a carrier similar to that adopted with an Axminster spool loom, the strands being taken from the spools, impregnated or coated with consolidating medium and laid in superposed layers, or if desired after assembly consolidated with a consolidating medium. The binding agent may be of such a nature that when consolidation is effected it swells and enables the consolidated block to be even more rigid.

When the fibrous substance is a mixture of short, medium and long fibres the resulting pile fabric closely simulates fur.

The density or like quality of the pile fabric to be produced can be varied by varying the thickness of the layers of the fibrous substance, by varying the distance or spacing between the layers, for instance by interposing spacing rods, or by both means.

The thickness of a web of fibrous substance can be determined by regulating the carding machine or subsequent processing machine.

The thickness of the layers of strands may be varied also by dividing the web into strands of the desired thickness.

The spacing may be effected by the use of spacers for example rods inserted at each end of each layer during the laying; or by regulating the supply of consolidating medium sprayed on the layers so that the thickness of consoli-

dating medium between the layers may be as required.

When the pile fabric produced according to the invention is to be used for clothing, or for floor covering, and is provided with an impervious backing such as "plastic," the backing may be perforated or rendered porous so as to provide for ventilation in the case of clothing, or in the case of floor covering to facilitate vacuum cleaning of the floor.

While the "plastic" backing may be perforated by any suitable mechanical means it may be rendered porous by mixing or laying with the fibrous substance, numerous fibres or filaments of a substance which will resist the consolidating medium and the "plastic," but can be dissolved out by a suitable solvent, or can be brushed or beaten out of the backing, so leaving minute holes in the backing previously occupied by such filaments.

In the accompanying diagrammatic drawings:

Figures 1 and 2 are, respectively, a side view and a plan of one form of apparatus used in carrying out the invention.

Figures 3 and 4 are, respectively, a side sectional view and a cross section of a consolidated block of superposed layers formed from a web of fibrous substance, the sections being taken on lines III—III (Figure 4) and IV—IV (Figure 3).

Figures 5 to 8 illustrate a slab or section in its various stages during the application of a backing.

Figures 9 and 10 are, respectively, a side view and a plan of another form of apparatus used in carrying out the invention.

Figure 11 is a diagrammatic plan illustrating the winding of a spool.

Figure 12 is a diagrammatic side view illustrating the laying of strands from spools in a carrier.

Figure 13 is a sectional side view illustrating the laying of strands with the aid of rods as spacers.

Figure 14 is a diagrammatic cross section of a consolidated block of strands illustrating an arrangement of strands of different colours, for the production of a pile fabric with a determined pattern.

Figures 15 and 16 are sectional views, respectively, illustrating a section or slab of consolidated strands and the same slab or finished product after removal of consolidated medium and soluble filaments.

In one mode of carrying out the invention in the manufacture of a plain pile fabric and as diagrammatically illustrated by Figures 1 to 4, a web 1 of fibrous substance, for example wool, is taken by a conveyor 3 direct from a carding machine, gill box or other processing machine only the delivery end 2 of which is indicated, as these machines are well known in the art. The fibres of the carded or processed web 1 are brought by these machines approximately parallel and in longitudinal formation in the direction of travel of the conveyor. The web 1 is passed by the conveyor 3 under a sprayer 4 from which a binding agent or adhesive such as size is sprayed, the sprayer having a sufficient number of spraying orifices or nozzles to ensure that the binding agent is well distributed across the whole width of the web.

The web 1 is next passed under a suitable heater 5 to dry the web. If it be desired that tension be applied to the web, (which not only straightens

out any fibres not brought into parallelism by the carding or processing machine but also hold each fibre in position when tension is applied when assembling and consolidating or when assembling before consolidating) it can be delivered by the conveyor 3 for this purpose before it is consolidated and laid, but if the web 1 is in adequate condition as regards straightness of the fibre it is delivered over the end of the conveyor to a trough 18 which is provided with wheels 9 so that it can be reciprocated on rails 10. The reciprocation of the trough causes the web to be folded or laid in superposed layers 19.

On its way to the trough the web 1 is sprayed with consolidating medium on one side or on both sides simultaneously by sprayers 8. It is thus impregnated and coated with consolidating medium and by regulating the sprayers 8 the thickness of the coating and consequently of the layers of consolidating medium between the superposed layers of web in the trough 18 can be varied which will determine the spacing between the layers of web of fibrous substance in the resulting consolidated block so produced. Figures 3 and 4 diagrammatically indicate such a block or pack. In these figures the layers of fibrous substance are indicated by the reference numeral 19 and the consolidating medium by 20. The thickness of the layers of consolidating medium 20 between the layers 19 thus determines the spacing of the layers 19.

It will be understood that when the web 1 is delivered from the conveyor 3 to be stretched before being impregnated with consolidating medium and laid to form a block these operations are carried out in the same way as just described.

In either case whether the web 1 has been stretched or not the consolidated block or pack so produced is then cut transversely into sections or slabs. A section or slab is shown in Figure 5. A face view of this would be as shown in Figure 4. One surface of each section has some of the consolidating medium removed to expose the tips or ends 21, Figure 6, of the fibres or filaments of the fibrous substance to which a backing 22, Figure 7, is applied. The remainder of the consolidating medium is next removed from the fibrous substance of the section leaving the fabric as shown in Figure 8. These operations on the sections of the block are explained in the specification of application Serial No. 642,958 before referred to.

In the manufacture of a pile fabric with a determined pattern the web of fibrous substance is preferably divided into strands, for example, as indicated in Figures 9 and 10, the web 1 from the machine end 2 is passed through a series of funnels 23 on its way to the conveyor 3, which divide the web into strands 11. The size of the funnels will determine the thickness of the strands. The strands 11 are carried by the conveyor 3 beneath a sprayer 4 the nozzles or delivery orifices of which are arranged to ensure that each strand is well impregnated with a binding agent or adhesive. The details of the sprayer are not indicated as any suitable device known in the art can be used, for example sprayers of the well known spray gun type. The impregnated strands 11 pass under a heater 5 so that they are dried. They are delivered over the end roller 6 of the conveyor 3 and collected individually in cans 12. The cans 12 of a collection of strands so treated either of the same or of different colours or quality, that is, having different characteristics, are ranged in any desired order as indicated diagrammatically

in Figure 11 and the strands 11 wound on to spools 14, the strands passing through a reed 15.

The wound spools 14 can then be set in any determined order in a carrier 25 such as that adopted with an Axminster spool loom. The carrier 25 is only diagrammatically indicated in Figure 12 its construction being well known in the art; suffice it to say that the spools 14 are carried round to a point 16 where part of the content of each spool is drawn off.

In Figure 12 the strands 11 of the spool at 16 are indicated as being laid in the reciprocating trough 18.

As they are drawn off the spool they are impregnated and coated with consolidating medium by sprayers 24 which direct the medium on one side or both sides of the strands simultaneously. In order to regulate the spacing of the layers 19' and also to facilitate the laying of them under a slight degree of tension, spacers in the form of rods 28, Figure 13, are inserted between the ends of the folds of the yarn in forming the layers.

When a consolidated block has been formed by laying the strands as above described, it is cut transversely of the strands into slabs or sections which are operated on in the same way as the slabs or sections hereinbefore described with reference to Figures 5 to 8.

Figure 14 indicates the arrangement of the strands in the consolidated block. Each strand 11 is diagrammatically indicated as of circular cross section, the different hatch lines denoting different colours or quality.

It is an advantage to use as a consolidating medium an alginic substance and to remove it subsequently by means of a solvent.

Solidifying substances can be prepared from alginic acid or from alginates by the following processes:

(1) By precipitating alginic acid to a gelatinous form with mineral acids or organic acids such as citric, lactic, tartaric, oxalic and picric acid. Alginic acid is in itself insoluble in water but swells to about three times its dry volume, and adsorbs even more water to form a continuous, gelatinous substance by precipitation with aforesaid acids.

Example 1

7—alginic acid
4—o-phosphoric acid s. g. 1.75
89—water in part weights.

Such solidifying substance may be dissolved with strong alkaline solutions as for instance with an aqueous solution of sodium carbonate.

(2) By converting water soluble alginates such as ammonium, barium, lithium, magnesium, potassium or zinc alginate into water insoluble or sparingly water soluble alginates such as aluminium, calcium, copper, iron or other metal alginates.

The conversion occurs by adding to the aqueous alginate solution a predetermined quantity of a soluble metal salt of a mineral acid or of organic acids such as named under (1).

Such alginate solutions can be converted into semi-solid or into rigid gels depending on the amount of metal ions present. The reaction of metal ions with alginates can be delayed or inhibited by addition of substances which precipitate or sequester the gelling ions. Such inhibitors like sodium carbonate, trisodium phosphate or sodium hexa metaphosphate may be added to such an extent that the gelling is delayed to a convenient working time.

To increase the speed of gelling small amounts of a mineral acid or of an organic acid such as named under (1) may be added, controlling carefully the pH value of the compound to avoid any rapid precipitation of alginic acid.

Example 2

5 p. w. ammonium alginate.
6 p. w. calcium citrate.
20 p. w. calcium carbonate.
1 p. w. sodium hexa metaphosphate.
68 p. w. water.

The solidifying substance of precipitated calcium alginate can be dissolved with solutions of sodium carbonate or trisodium phosphate.

(3) By precipitating the water insoluble metal alginates with solutions of sparingly soluble metal salts containing the metal ions necessary for the precipitation. This is brought about by using a slurry of the metal salt added to the insoluble metal alginate which has been slurred with preferably warm water. In the above preparation an appropriate amount of an inert filler as under heading (2) may be incorporated.

Example 3

5 p. w. calcium alginate.
7 p. w. sodium citrate.
12 p. w. asbestos powder.
76 p. w. water.

Strong alkaline solutions dissolve such preparations.

It will be appreciated that by winding spools with strands of different colours or of different quality of fibrous substance and in any desired order on the spools, and then arranging the spools in the carrier 25 in the required order any determined pattern can be produced in the pile fabric manufactured in the manner above described.

When a tough and impervious backing material is used, for instance a plastic backing, it is sometimes desirable that the backing shall be rendered porous, particularly when the pile fabric produced is to be used for wearing apparel, to permit of ventilation, or for floor coverings to facilitate vacuum cleaning of the floor.

The porosity may be effected by perforating the backing mechanically as by a pin roller. One method is to lay with the strands fine strands of soluble fibre or filaments, which can be eventually washed or brushed out when the consolidating medium has been removed.

An example of soluble fibre or filament is one composed of an alginate, when gelatine is used as the consolidating medium.

In another example formaldehyde treated gelatine may be used for the soluble fibres or filaments and gelatine may be the consolidating medium.

In a further example methyl cellulose, hydroethyl cellulose, or resin may be used for the soluble fibres or filaments and an alginate as a consolidating medium, or again an alginate as a soluble fibre and gelatine as the consolidating medium. Glass fibres could be used with any consolidated medium.

In Figure 15 the fibrous substance 19 to form the pile is indicated in full lines and the soluble fibre or filaments 26 in dotted lines. 20 and 22 indicate the consolidating medium and the plastic backing respectively.

In Figure 16, which shows the fabric after the consolidating medium has been removed and the soluble filaments washed or brushed out, the resulting perforations are indicated by 27.

Instead of impregnating or coating the fibrous substance, whether in the form of a web or strands, by means of spraying as hereinbefore described, the consolidating medium may be applied to the layers during laying.

In such a case a consolidating medium in the form of powder, flakes or sheets may be introduced between the layers during laying and then the pack or block so formed be heated, advantageously by electrical high frequency energy in an electrical condenser field, to melt the medium and thereafter be allowed to cool so that the medium can set.

Alternatively, a soluble medium which sets under heat can be used.

In the above examples the consolidating medium is eventually removed from the fibrous substance of the sections cut from the block, in the first example by heat and in the second by solution in a suitable solvent.

Heating of the medium in the block composed of the layers is advantageously effected by electrical high frequency apparatus of the ultra short wave generator type.

Yarn, that is spun fibrous material, wound on spools either alone or mixed with strands of unspun fibrous material can be laid in superposed layers and consolidated with consolidated medium during laying or after.

The term processed fibrous substance used in the claims is intended to include fibrous substance which has been passed through a carding machine or other processing machine to bring the fibres parallel or approximately parallel.

The term yarn is intended to cover spun fibrous material as yarn either alone or mixed with unspun fibrous substance can be laid in superposed layers and consolidated to form the required block.

We claim:

1. A process for manufacturing a pile fabric, which comprises forming a web of processed fibrous substance with the fibres extending longitudinally in parallel relation, dividing the web into strands, selectively superposing said strands in layers with the strands in approximately parallel relation, consolidating the layers of strands with a consolidating medium interspersed through and between said strands to form a consolidated block, cutting the consolidated block transversely of the strands into sections, removing a portion of the consolidating medium from each section to expose the ends of the fibres, applying a backing to the exposed ends of the fibres of each section, and removing the remaining consolidating medium.

2. A process for manufacturing a pile fabric, which comprises superposing layers of processed fibrous substance with the fibres of adjacent layers in approximately parallel relation, applying a consolidating medium to said fibrous substance as each layer is applied to form a consolidated block of superposed layers, cutting said block transversely of the run of the fibres into sections, removing a portion of the consolidating medium from each section to expose the ends of the fibres, applying a backing to the exposed ends of the fibres of each section, and removing the remaining consolidating medium.

3. A process for manufacturing a pile fabric, which comprises superposing layers of strands of processed fibrous substance with the strands of each layer in approximately parallel relation, spraying said strands with consolidating medium as each layer is applied to form a consolidated

block, cutting said block transversely of the strands into sections, removing a portion of the consolidating medium from each section to expose the ends of the fibres, applying a backing to the exposed ends of the fibres of each section, and removing the remaining consolidating medium.

4. A process for manufacturing a pile fabric, which comprises applying a binding agent to a processed fibrous substance, drying the agent and fibrous substance, stretching said fibrous substance to straighten the fibres thereof, forming said stretched fibrous substance in layers, assembling said layers in parallelism, consolidating said layers with consolidating medium to form a consolidated block, cutting said block transversely of the run of the fibres into sections, removing a portion of the consolidating medium from each section to expose ends of the fibres, applying a backing to the exposed ends of the fibres of each section, and removing the remaining consolidating medium.

5. A process for manufacturing a pile fabric, which comprises superposing layers of processed fibrous substance with the fibres of the layers in approximately parallel relation, applying a consolidating medium to said layers as they are laid to form a consolidated block, varying the quantity of medium applied to said layers to vary the spacing between the layers, cutting the consolidated block transversely of the run of the fibres in said layers into sections, removing a portion of the consolidating medium from each section to expose the ends of the fibres, applying backing to the exposed ends of the fibres of each section, and removing the remaining consolidating medium.

6. A process for manufacturing a pile fabric, which comprises superposing layers of processed fibrous substance with the run of the fibres in the layers approximately parallel, applying meltable consolidating medium in solid form to the layers as they are superposed, heating the superposed layers and medium to melt the consolidating medium, cooling the layers and melted medium to produce a consolidated block, cutting said block transversely of the run of fibre in the block into sections, removing a portion of the consolidating medium from each section to expose the ends of the fibres, applying backing to the exposed fibre ends of each section, and removing the remaining consolidating medium.

7. A process for manufacturing a pile fabric, which comprises forming strands of processed fibrous substance in layers with the strands in substantially parallel relation and securing said strands together with a binding agent, superposing said layers with said strands in substantially parallel relation, consolidating said superposed layers with a consolidating medium to form a consolidated block, cutting said block transversely of the run of the fibre of the strands into sections, removing a portion of the consolidating medium from each section to expose the ends of the fibres, applying a thermoplastic in softened condition to each section to surround said exposed fibre ends, hardening said thermoplastic to form a backing having the fibre ends embedded therein, removing the remaining consolidating medium, and perforating said backing to render said backing porous.

8. A process for manufacturing a pile fabric, which comprises interspersing filaments with processed fibrous substance with the filaments and fibre extending in substantially parallel relation, consolidating said filaments and fibres with

a consolidating medium that is resisted by said filaments to form a consolidated block, cutting said block transversely of the run of the fibre into sections, removing a portion of the consolidating medium from each section to expose the ends of the filaments and fibres, applying in softened condition a thermoplastic that is resisted by said filaments to each section to surround said exposed filament and fibre ends, hardening said thermoplastic to form a backing having the filament and fibre ends embedded therein, removing the remaining consolidating medium, and removing the filaments from the backing to render said backing porous.

9. A process for manufacturing a pile fabric, which comprises interspersing soluble filaments with processed fibrous substance with the filaments and fibre extending in substantially parallel relation, consolidating said filaments and fibres with a consolidating medium to form a consolidated block, cutting said block transversely of the run of the fibre into sections, removing a portion of the consolidating medium from each section to expose the ends of the filaments and fibres, applying in softened condition a thermoplastic to each section to surround said exposed filament and fibre ends, hardening said thermoplastic to form a backing having the filament and fibre ends embedded therein, removing the remaining consolidating medium, and dissolving the filaments to render said backing porous.

10. A process for manufacturing a pile fabric, which comprises superposing layers of processed fibrous substance with the fibres of adjacent layers in approximately parallel relation, consolidating the layers with an alginic substance to form a block, cutting the block transversely of the run of the fibres into sections, removing a portion of the alginic substance to expose the ends of the fibres, applying a backing to the ends of the fibres of each section, and removing the remaining alginic substance by means of a solvent.

11. A process for manufacturing a pile fabric, which comprises applying a binding agent to a processed fibrous substance, drying the agent and fibrous substance, stretching said fibrous substance to straighten the fibres thereof, forming said stretched fibrous substance in layers, assembling said layers in parallelism, selectively spacing said layers in assembly, consolidating said layers with consolidating medium to form a consolidated block, cutting said block transversely of the run of the fibres into sections, removing a portion of the consolidating medium from each section to expose ends of the fibres, applying a backing to the exposed ends of the fibres of each section, and removing the remaining consolidating medium.

WILHELM FRIEDRICH FUHRHOP.
HANS VAN ISSUM.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,012,389	Marche	Dec. 19, 1911
1,047,822	Marche	Dec. 17, 1912
1,313,012	Poetzsch	Aug. 12, 1919
1,467,693	Scribner	Sept. 11, 1923
1,656,828	Powell	Jan. 17, 1928
1,710,977	Herbener	Apr. 30, 1929
2,081,060	Modigliani	May 18, 1937
2,087,441	Metcalf et al.	July 20, 1937
2,324,466	Bowen et al.	July 20, 1943
2,332,738	Meade	Oct. 26, 1943
2,435,543	Johnson et al.	Feb. 3, 1948

FOREIGN PATENTS

Number	Country	Date
450,689	Great Britain	July 23, 1936

OTHER REFERENCES

Journal of the Society of Dyers and Colourists, Apr. 1946, page 97.