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Bondi

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[54] **METHOD OF MAKING PILE FABRICS FROM A BLOCK OF PILE MATERIAL**

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[21] Appl. No.: **398,560**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 316,740, Dec. 20, 1972, Pat. No. 3,831,232, and a continuation-in-part of Ser. No. 363,832, May 25, 1973.

[52] **U.S. Cl.**..... **156/72,** 156/84, 156/148, 156/204, 156/251, 156/435, 156/516

[51] **Int. Cl.**.... **B32b 5/00,** B32b 31/12, B32b 31/18

[58] **Field of Search**..... 156/72, 84, 177, 148, 204, 156/206, 227, 251, 254, 297, 435, 459, 516, 517, 519; 28/72 P, 72 R; 161/62

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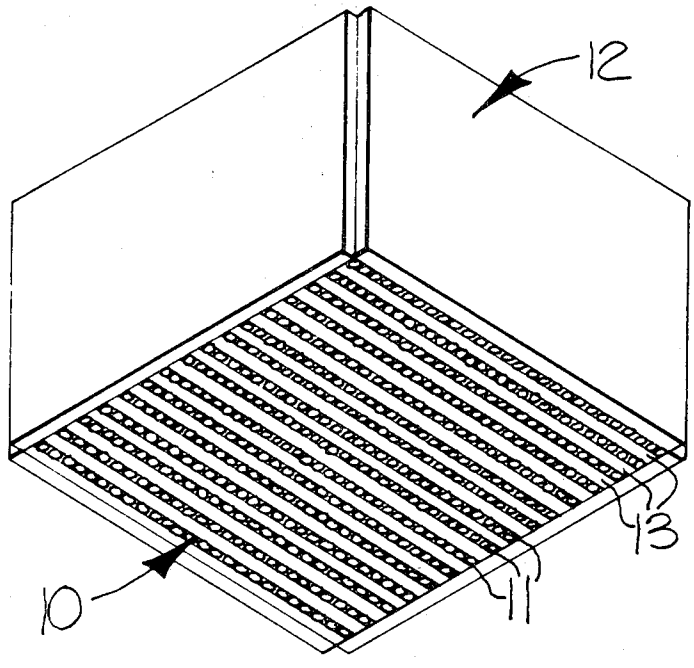
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Assistant Examiner—Michael W. Ball
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[57] **ABSTRACT**

A block of rows of strands of pile forming material is provided in an open-ended container with dividers separating adjacent rows of the strands. The block of pile forming material is incrementally fed from the container, parallel to the strand axes, in successive increments of an amount equal to the desired length of pile, and then the ends of the dividers in the block are treated to cause them to foreshorten relative to the adjacent ends of the strands of pile forming material so that predetermined lengths thereof are exposed and project beyond the adjacent ends of the dividers. Each successive fed increment of the block of strands of pile forming material and foreshortened dividers is severed transversely of the axes of the strands while arranging the severed strands to form cut pile tufts which are secured together in spaced rows.

33 Claims, 13 Drawing Figures



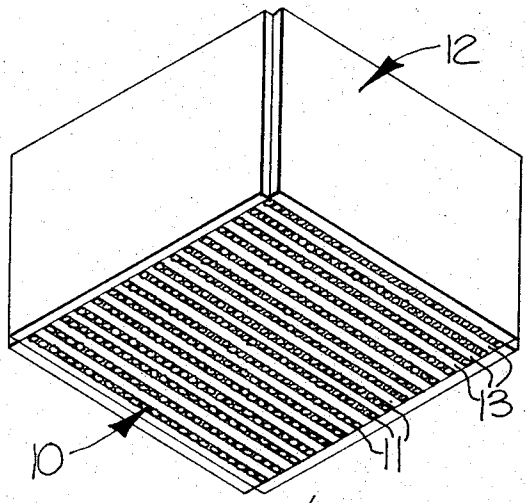


Fig-1

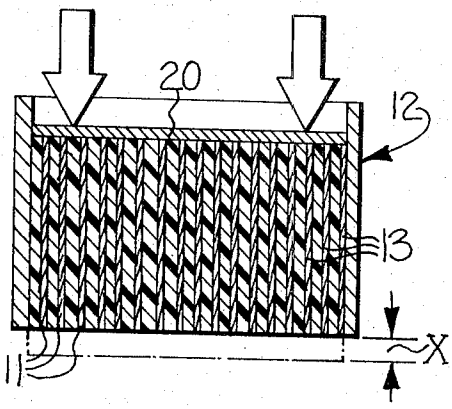


Fig-1A

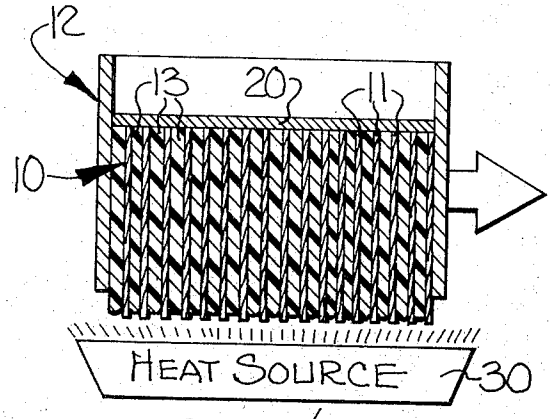


Fig-1B

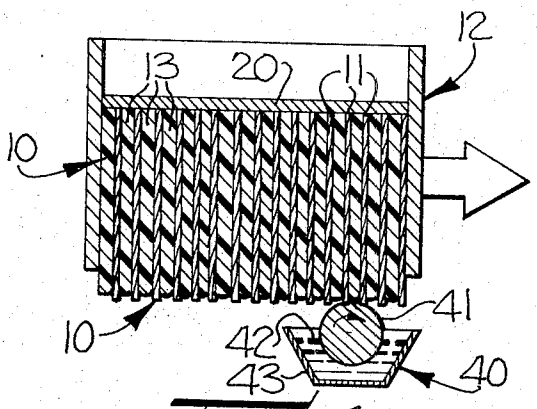


Fig-1C

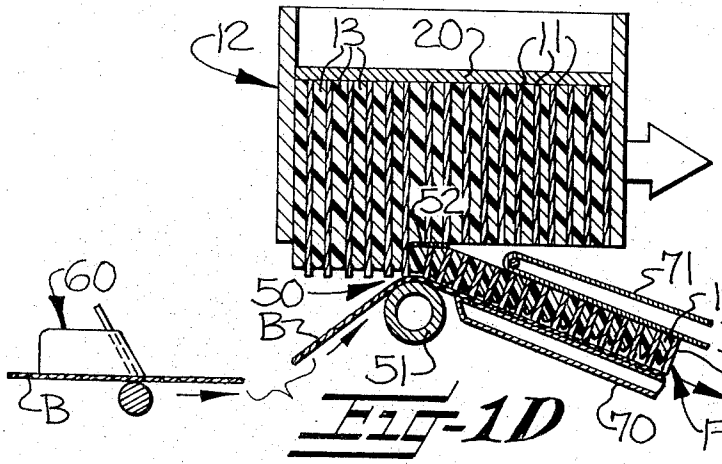


Fig-1D

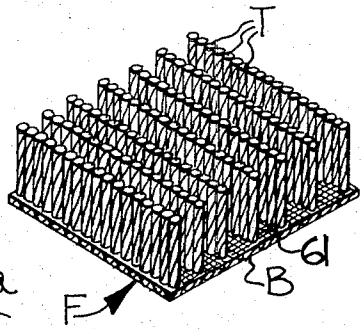


Fig-2

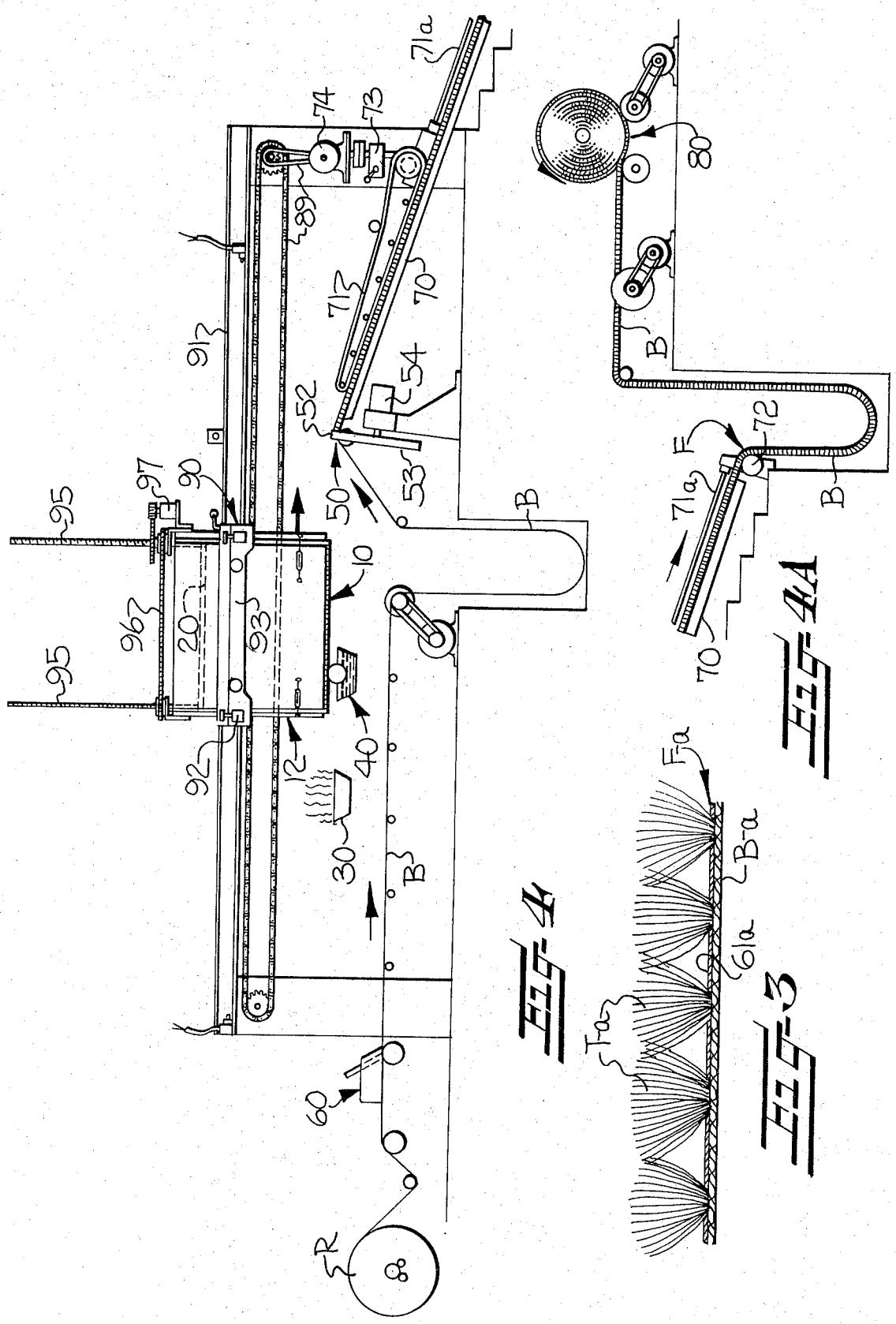


FIG. 4A

FIG. 4

FIG. 3

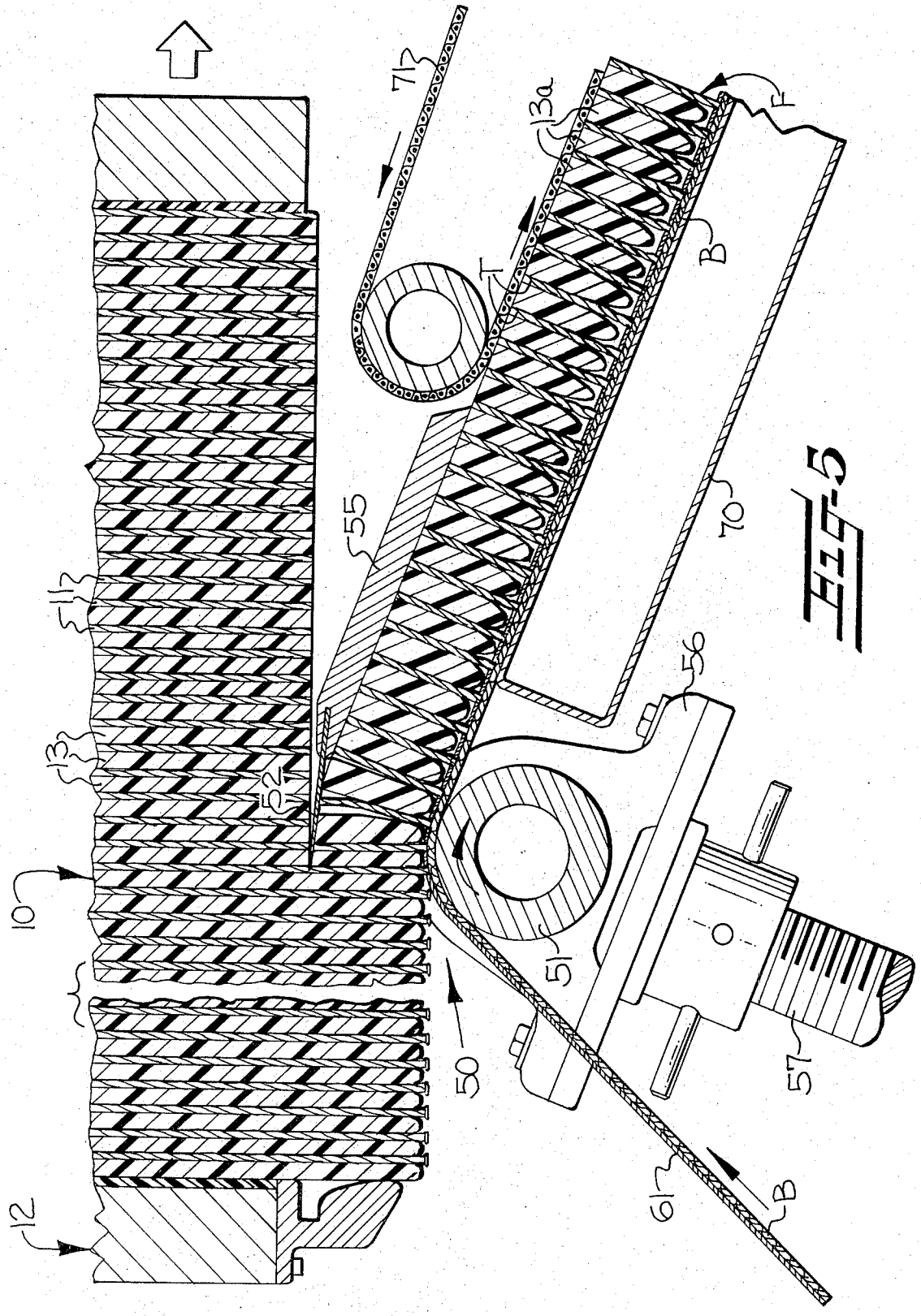


Fig-5

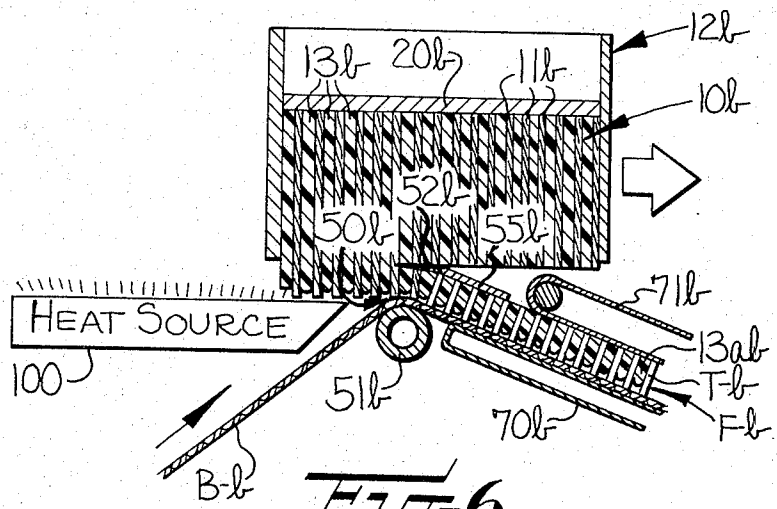


Fig-6

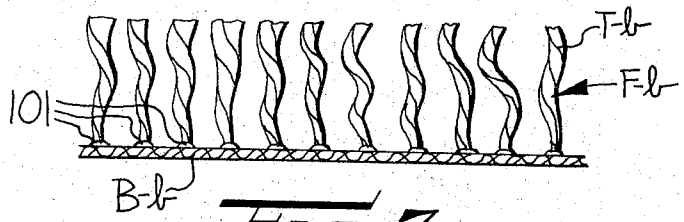


Fig-7

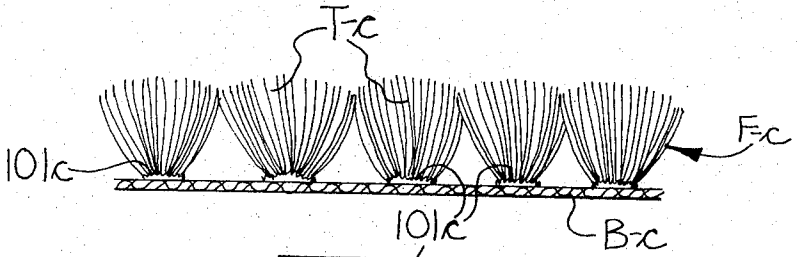


Fig-8

METHOD OF MAKING PILE FABRICS FROM A BLOCK OF PILE MATERIAL

This application is a continuation-in-part of my copending application Ser. No. 316,740, now U.S. Pat. No. 3,831,232, filed Dec. 20, 1972 and entitled METHOD OF PRODUCING PATTERNED BLOCKS OF PILE YARNS IN MAKING PATTERNED PILE FABRICS. This application is also a continuation-in-part of my copending application Ser. No. 363,832, filed May 25, 1973, and entitled METHOD AND APPARATUS FOR MAKING PILE FABRICS FROM A BLOCK OF PILE YARNS.

This invention relates to pile fabrics and more especially to nonwoven pile fabrics of the type having a substrate to which pile yarns are adhesively or fusibly secured.

It is an object of this invention to provide a method of making nonwoven "shag" type carpets or rugs wherein the pile is unusually long as compared to normal height carpet and generally is about an inch or more in height, and wherein the number of rows per inch are few in number and do no exceed 4 per inch. Another object is to provide a method of obtaining a carpet having any desired height of pile while so controlling the pile strands during their placement on a substrate, for adhesive or fusible securement thereto, that the pile strands are arranged in a clearly defined row formation with the pile strands also being maintained in generally perpendicular relation to the substrate when the strands are deposited on the substrate to aid in proper securement of the ends of the pile strands to the substrate.

Briefly stated, the foregoing and other objects of the invention are achieved by providing a block of strands of pile forming material in which layers of strands of the pile forming material are compactly arranged in an open-ended container and are separated from each other by dividers so that, upon successive incremental lengths of the block of pile strands being fed from the container, the dividers serve to maintain the desired parallel spaced relationship of the pile strands in the container. Each successive fed increment of the block of pile forming material is severed in forming the pile fabric. However, prior to the severing of each successive fed increment of the block, the dividers are foreshortened relative to the adjacent ends of the strands of pile forming material so that predetermined lengths of the strands are exposed and project beyond the adjacent ends of the dividers. The severing of each successive fed increment of the block of pile forming material effects severing of the dividers as well as the pile forming material so that the pile forming material then may be deposited on a substrate with the projecting ends of the pile forming material being adhesively or fusibly secured to the substrate.

Also, the dividers are formed of a compressible sheet material which is in a compressed state in the pile strand block and will expand thereafter when the block is being severed and rows of cut pile tufts formed therefrom are being brought into contact with a moving substrate for securement thereto. Thus, by varying the rate of movement of the substrate relative to the rate at which the pile strand block is being severed, and desirably within the range of expansion of the dividers, pile surfaces of correspondingly varying density may be obtained due to the variance in the number of rows of cut pile tufts per inch being formed.

Although the invention is particularly concerned with the making of shag carpets and rugs, it will be appreciated that the invention has wider utility, since it will be more apparent hereinafter that the dividers may be utilized for making normal height carpets and rugs, if desired, since the dividers serve to maintain the pile forming strands in the desired parallel relationship and in the desired patterned relationship for permitting obtaining enhanced definition of design, particularly where intricate pile patterns are being produced.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds when taken in connection with the accompanying drawings, in which

FIG. **1** is a somewhat schematic perspective view of the bottom and two sides of a confined block of parallel strands of pile forming material with dividers of sheet material separating adjacent rows of the pile strands;

FIGS. **1A**, **1B**, **1C** and **1D** are schematic views illustrating successive stages in a first embodiment of the method of making pile fabrics utilizing the block of strands of pile forming material shown in FIG. **1**;

FIG. **2** is a fragmentary schematic perspective view of a portion of pile fabric having tufts formed of pile yarns, rovings or similar pile strands glued to a backing in accordance with the first embodiment of the method of this invention;

FIG. **3** is a fragmentary sectional view of a portion of pile fabric taken in the longitudinal or machine direction of the fabric, but wherein the tufts thereof are formed of slivers or tows of synthetic filaments glued to a backing in accordance with the first embodiment of the method of this invention;

FIGS. **4** and **4A** collectively illustrate a suitable apparatus for carrying out the successive stages of the method illustrated in FIGS. **1A–1D**;

FIG. **5** is an enlarged fragmentary view similar to FIG. **1D**, but more clearly illustrating the preferred manner in which each successive increment of pile strands and foreshortened dividers is severed transversely of the pile strand axes while the projectings ends of the severed pile strands are brought into contact with an adhesive-coated backing;

FIG. **6** is a view similar to FIG. **1D**, but showing a second embodiment of the method in which the pile tufts are secured to the backing by fusing; and

FIGS. **7** and **8** are longitudinal vertical sectional views through fabrics similar to those shown in the respective FIGS. **2** and **3**, but wherein the cut pile tufts are secured to the respective backing by fusing in each instance.

Referring more specifically to the drawings, the first embodiment of the method is best illustrated in FIGS. **1** to **1D**, wherein there is shown a confined block **10** of substantially parallel strands **11** of pile forming material arranged in rows in an open-ended container **12**, which rows are separated from each other by dividers **13** of any suitable sheet material. The block **10** is utilized for forming pile fabrics according to the method of this invention as will be later described.

The strands **11** of pile forming material, which will be termed as "pile strands" hereinafter, may be of any desired color, kind or size or combinations thereof, and may be of any desired type of pile forming material; e.g., carpet yarns, slivers, rovings and/or tows of synthetic continuous filaments or any desired combinations thereof. The block **10** is formed by arranging pile

strands **11** in substantially parallel relationship to form sheets or layers thereof. Such sheets or layers of pile strands are stacked in alternation with dividers **13** of relatively thin sheet material.

The dividers **13** preferably are compressible with a memory so that they may recover to substantially their original thickness following compression thereof and upon being released from such compression. From time to time during the stacking of the layers of pile strands **11** and dividers **13,** the stack may be compressed so that the block **10** is in compacted condition when it is confined within the open-ended container **12.** Corresponding ends of the pile strands are visible at one open end of container **12** as best shown in FIG. **1.**

The arranging of the pile strands may be carried out by any suitable method. For example, pile strands in the form of carpet yarns or rovings may be formed into a confined block in accordance with the disclosures of my said copending applications, Ser. Nos. 316,740 and 363,832, if desired. As disclosed in said copending applications, a patterned block of pile yarns may be formed by successively interconnecting sections of woven fabric utilizing pile strands for the wefts thereof by selectively interweaving with a plurality of binder warp yarns a plurality of weftwise pile strands of different colors in a predetermined patterned order. Thereafter, a compact stack of layers of the woven fabric is formed by folding the same into equal-length layers to form a stack of superposed fabric layers while aligning the successive layers with each other so that the ends of the pile strands therein collectively form a composite pattern. The compact stack of folded fabric then is enclosed in an open-ended container to form a confined block of the pile strands with the ends of the pile strands exposed and forming the composite pattern at an open-end of the container. However, as indicated earlier herein and according to this invention, as the compact stack of layers are formed of the woven fabric, dividers **13** are alternately arranged with the layers of woven fabric to result in a block **10** of rows of substantially parallel pile strands **11** in the open-ended container **12** with the dividers **13** therein separating adjacent rows of the parallel strands. These dividers **13** are especially useful, as will be later explained, for holding relatively long pile tufts, up to one inch or more in length, in substantially perpendicular relation to a backing during production of shag pile fabrics and thereby greatly facilitating such production.

As stated above, it is preferred that dividers **13** are made from a compressible sheet material; e.g., foam polystyrene sheets or other sheets of material which will compress readily and may be severed easily. Since the pile strands and the dividers **13** are compressed during the formation of the pile strand block **10,** it is apparent that the dividers **13** are maintained in compressed condition while pile strand block **10** is confined within container **12.**

As heretofore indicated, the pile strands **11** may be arranged according to a predetermined pattern which would be visible at the open end of container **12.** If desired, the pile strands **11** may be arranged in a random pattern of different colors, or shades, or all of the strands **11** in block **10** may be white or of the same color and/or kind.

As shown in FIG. **1A,** after the pile strand block **10** is formed, it preferably is positioned so that an open end of container **12** faces downwardly with the axes of the pile strands **11** extending substantially vertically. A downward force then is applied to a pressure plate **20** movable within and relative to container **12** and engaging the upper ends of all of the pile strands **11** and the dividers **13,** with a predetermined incremental downward movement thus being imparted to the compacted pile strand block **10** relative to container **12** so that the pile strands **11** and dividers **13** project downwardly a predetermined distance X below the lower edge of container **12.** The distance X is equal to the desired length of pile.

Following the feeding of each successive increment of pile strands **11** and dividers **13** from container **12,** the ends of the dividers in block **10** are treated to cause them to foreshorten relative to the adjacent ends of the pile strands **11** so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of dividers **13.**

Such treatment may include subjecting the ends of the dividers to a heated liquid or liquid treatment, although it is preferred that the dividers are foreshortened simply by applying heat thereto as by subjecting the same to radiant heat for example.

As indicated in FIG. **1B,** according to the preferred embodiment of the invention, dividers **13** are made from a heat-shrinkable sheet material. The nature of the dividers should be such that, when their lower ends are subjected to heat at an elevated temperature, but which will not burn or scorch the lower ends of the pile strands **11,** the lower ends of the dividers **13** will shrink and recede relative to the adjacent ends of the pile strands **11.** Thus, after the feeding of the desired increment of the pile strand block **10** from container **12,** the container **12** with the pile strand block **10** is moved over and in close proximity to a heat source **30** which may be in the form of infrared lamps and which heat the lower end of the pile strand block **10** the desired amount to cause the dividers to shrink and recede relative to the adjacent ends of the pile strands **11.**

For example, if polystyrene sheets are used as the dividers **13,** it has been found that when the lower ends of the dividers are heated momentarily to a temperature of about 100° to 120° centigrade, the lower ends of the dividers will shrink and recede about 0.025 to 0.050 inch relative to the lower ends of the pile strands. In other words, the lower ends of dividers **13** may shrink and recede approximately one to two millimeters relative to the adjacent ends of pile strands **11** during each movement of pile strand block **10** over heat source **30.** The pile strand block **10** then moves forwardly over an adhesive applying station **40** which applies a liquid adhesive to the exposed lower ends of pile strands **11** as in FIG. **1C.**

The adhesive applying station **40** may take the form of an adhesive applicator roll **41** partially immersed in a supply of adhesive **42** carried by a suitable container **43.** The recession of the lower ends of dividers **13** relative to pile strands **11** permits some of the adhesive from the roll **41,** being engaged by the lower ends of the pile strands **11,** to also be applied to the peripheral surfaces of the lower end portions of the pile strands **11.** It is preferred that dividers **13** do not have an affinity for the particular type of liquid adhesive **42** being used so that, even though the lower ends of dividers **13** may be contacted by the adhesive **42** as it is transferred from roll **41** to the lower ends of pile strands **11,** such adhesive will not bond to the lower ends of dividers **13.**

It has been determined that polyvinyl chloride adhesive, for example, will not bond to the edges of polystyrene sheets when they are used as the dividers **13.**

Following the treatment of the lower ends of dividers **13** to cause them to foreshorten relative to the adjacent ends of pile strands **11,** the corresponding previously fed increment of the pile strands **11** and the foreshortened dividers **13** are severed transversely of the pile strand axes, at a pile strand severing station **50,** while bringing the projecting ends of the severed pile strands into contact with a substrate for securement thereto. The substrate may be in the form of a layer of adhesive without any underlying support and with or without a reinforcement, such as a scrim, embedded therein. However, it is preferred that the substrate, as illustrated in the drawings, is in the form of an adhesive-coated backing B. This forms rows of cut pile tufts T on the backing B and thus forms the pile fabric F. The divider portions 13a between the rows of tufts T then are of lesser height than tufts T so that divider portions **13***a* will not interfere with the pressing of tufts T against the adhesive-coated backing as will be later described and as shown in FIG. 1D.

It can be appreciated that there may be instances in which the application of adhesive to the ends of pile strands **11** prior to securement thereof to the adhesive-coated backing may be omitted. Conversely, there may be instances in which the application of adhesive to backing B may be omitted provided that the projecting ends of the pile strands then have a layer or coating of adhesive thereon. In other words, in this first embodiment of the method, it is necessary that adhesive is applied to either the projecting ends of the pile strands **11** or to the upper surface of backing B, or to both, prior to bringing the respective ends of the pile strands into contact with the backing B so as to insure effective securement of the pile tufts being formed to the backing.

It is apparent that, during forward movement of pile strand block **10** and container **12** in their course over heat source **30** and adhesive applying station **40** of FIGS. 1B and 1C to the pile strand severing station **50** of FIGS. 1D, 3 and **4,** the pile strand block **10** and container **12** pass over a portion of the backing B which also is in its course from a supply source or roll R to severing station **50.** Also, as shown a coating **61** (FIG. **5**) of liquid adhesive is applied to backing B by a suitable adhesive applicator **60** (FIG. **4**). The adhesive applicator **60** may be of any well-known type which will apply a thin coating of liquid adhesive of the desired thickness upon the upper surface of backing B in its course from supply source R (FIG. **4**) to severing station **50.** The thickness of the liquid adhesive-coating applied to backing B may be in the range of about 0.1 to 1.0 millimeter or more, depending upon the type of backing and pile strands being used in forming the pile fabric F.

The preferred adhesives may be thermoplastic or thermosetting materials, or mixtures of thermoplastic and thermosetting materials. The adhesive may conveniently be a plastisol or latex, or if desired, may be in granular or powder form. Illustrative but non-limiting examples of suitable adhesives include polyvinyl chloride, polyurethane, natural or synthetic latex, urea resin, melamine resin, and/or any other suitable resin.

As the backing B advances forwardly it passes upwardly in converging relation to the path of travel of container **12** and then passes downwardly in diverging relation to the path of travel of container **12.** As the backing B approaches severing station **50,** it passes over a suitable supporting roll **51** which is a part of severing station **50** and is spaced a predetermined distance below a severing means embodied in a stationarily mounted endless band type of cutter blade **52.** Cutter blade **52** is positioned closely adjacent and beneath the path of container **12** and is arranged to sever the lower ends of the pile strands **11** and the foreshortened dividers **13** in the portion of pile strand block **10** projecting from the open lower end of container **12** so as to form the pile tufts T during each forward movement of container **12** past cutter blade **52.**

As heretofore stated, it is preferred that dividers **13** are made from a compressible sheet material which has been compressed during formation of pile strand block **10.** Accordingly, it is important to note that, if the backing B then is being advanced faster than the rate at which successive rows of pile strands **11** are being severed by cutter blade **52;** i.e., if the forward speed of backing B is greater than that of container **12,** the previously compressed divider portions **13***a* will expand substantially concurrently with the severing of the same from the main body portions of the dividers **13** remaining in pile strand block **10.** Thus, the transverse rows of pile tufts T may be spaced apart from each other a greater distance than that of adjacent rows of pile strands **11** in block **10.**

By way of example, each divider **13** may be in the range of about one-sixteenth to five-sixteenth inch thick before it is assembled and compacted with strands **11** and formed into block **10.** Also, dividers **13** may be compressed to about 25–30 percent of their original thickness during formation of pile strand block **10.** In such instances it follows that, if the rate of forward movement of backing B is 25–30 percent greater than that of container **12,** the distance between adjacent transverse rows of tufts T in fabric F will be 25–30 percent greater than the distance between adjacent rows of pile strands **11** in block **10.**

Therefore, assuming that dividers **13** are of a sheet material, such as polystyrene, and are each about five-sixteenths (0.3125) inch thick before being compressed 30 percent or about three thirty-seconds (0.0938) inch during formation of pile strand block **10,** and also assuming that dividers **13** are capable of recovery to their original thickness following release from such compression thereof, the dividers **13** in block **10** will be about seven thirty-seconds (0.2188) inch thick while in block **10.** However, adjacent rows of tufts T will be about five-sixteenths inch apart if backing B is being advanced 30 percent faster than container **12** during the severing of tufts T from block **10.** If desired, it is contemplated that backing B may be advanced relative to block **10** at a rate exceeding the range of expansivity of dividers **13** if greater spacing is desired between the rows of tufts T.

On the other hand, since adjacent lower end portions of dividers **13** in block **10** and the severed divider portions **13***a* between tufts T may effectively oppose expansion of each other during the severing operation and as long as adjacent divider portions **13***a* remain in the pile fabric F, the backing B may be advanced relative to container **12** at any desired rate less than the expansion range of the previously compressed dividers. However, backing B should advance no slower than the forward speed of container **12** to insure effective trans-

fer of the tufts T being severed from block **10** to backing B.

Accordingly, utilizing dividers of the type mentioned in the foregoing example, it can be seen that the distance between adjacent rows of tufts may be anywhere in the range of about seven thirty-seconds (0.2188) inch to five-sixteenths inch or more. Thus, under such conditions, if backing B is advancing 20 percent faster than container **12,** adjacent tuft rows will be spaced approximately seventeen sixty-fourths (0.2626) inch apart from each other. It is to be understood that at least some of the compressible dividers **13** may be of different thickness than others in block **10,** or several different thicknesses of dividers **13** may be provided in block **10,** so as to obtain rows of tufts T which are spaced various distances apart from each other, if desired.

The severed divider portions **13***a* may be removed from between the rows of tufts T manually or by any suitable means, now shown, any time after the adhesive, which secures the tufts to the backing, has been cured or set, it is apparent that any divider portions **13** then under compression in the pile fabric F may expand to their original thickness as they are removed from the pile fabric F. The resulting pile fabric then may appear as shown in either of the FIGS. **2** or **3,** depending upon the type of pile strands of which the pile tufts are formed. For example, the tufts T of the pile fabric F in FIG. **2** are formed of pile strands such as carpet yarns or rovings of relatively low bulk. The fabric F-*a* of FIG. **3,** on the other hand, has relatively bulky tufts T-*a* secured to its backing B-*a* by an adhesive **61***a*. The latter tufts T-*a* may be formed of relatively bulky pile strands such as synthetic continuous filament tows or slivers, for example.

Referring again to severing station **50,** with the exception of blade **52** having a smooth or straight cutting edge which faces rearwardly with respect to the direction in which container **12** is moving during the severing operation, the severing apparatus may be in the form of a conventional band saw assembly with the endless blade **52** being mounted on a pair of pulleys **53,** only one of which is shown in FIG. **4,** and which may be driven by an electric motor **54.** Pulleys **53** are arranged so that cutter blade **52** occupies a substantially horizontal position transversely of the path of travel of pile strand block **10** projecting from the lower end of container **12.** As shown in FIG. **5,** blade **52** may be guided and maintained in the latter position during movement thereof by a suitably slotted guide bar **55** overlying the path of travel of backing B and the cut pile tufts T of the now formed pile fabric F.

Since the severing station **50** may be constructed and operated in substantially the same manner as disclosed in my said copending application Ser. No. 363,832, a further detailed description thereof is deemed unnecessary. It should be noted, however, that the backing supporting roll **51** at the pile strand severing station **50** is journaled in suitable bearings **56,** only one which is shown in FIG. **5,** and which are adjustable by respective screws **57** for adjusting roll **51** so that the path of travel of backing B over roll **51** is very nearly the same as the path of travel of the lower surface of pile strand block **10** in the course of forward movement thereof. This facilitates the progressive depositing onto backing B of tufts T and divider portions **13***a* being severed from block **10.** Also, the height of roll **51** may be adjusted to accommodate changes in the extent X (FIG. **1A**) of each incremental feeding of pile strand block **10** as effected for obtaining different heights of pile tufts T on backing B.

It should be noted that, not only do the divider portions **13***a* aid in insuring that the tufts T are deposited on backing B in the desired spaced relationship to form transversely extending parallel rows of tufts thereon, but the divider portions **13***a* also support adjacent rows of tufts T in substantially perpendicular relation to the downward and forward path of travel of the backing B forwardly of roll **51** during the curing of the adhesive. This insures that the pile tufts T, even though they may be quite long as in forming shag pile fabrics, will not tilt or bend and become matted in the adhesive at other than the desired lowermost end portions thereof during production of the pile fabric F.

In this regard, it will be observed in FIGS. **1D, 4** and **5** that, immediately after the backing B passes over the supporting roll **51** at severing station **52,** the backing passes over and in close proximity to or in engagement with a heated hollow platen or plenum **70** whose upper surface is of a width at least about equal to that of the pile fabric F being formed and which may be heated by any suitable heating means, such as an electrical heater, a circulating hot oil, or other hot fluid. For example, if a polyvinyl chloride plastisol type of adhesive is being used for the coating **61,** platen **70** may be heated up to about 220° centigrade or higher for effectively curing or setting the adhesive on backing B. Thus, the heated platen **70** forms a curing zone thereabove through which the pile fabric F is advanced from severing station **50** for curing the adhesive coating previously applied to the upper surface of backing B. It follows that the heated platen **70** must be of such length and must be heated to such a temperature as to effectively cure the adhesive coating so that the tufts T will be firmly anchored to the backing B. As disclosed in said copending application Ser. No. 363,832, a cooling platen may be disposed forwardly of the heated platen **70** for forming a cooling zone thereabove through which the pile fabric F passes for cooling the same to facilitate subsequent take-up and handling of the pile fabric.

To aid in securing the tufts T to the adhesive coating **61** on backing B as the tufts are being progressively deposited on the advancing backing B, a suitable pressure applying belt or conveyor **71** is suitably supported above and extends throughout the width of the pile fabric F as it moves above heated platen **70.** The conveyor **71** is driven intermittently at a rate corresponding to the rate at which the pile fabric F is being advanced forwardly over the heated platen **70.** Also, the lower run of conveyor **71** is spaced above platen **70** a distance corresponding substantially to the desired height of the pile tufts T combined with the thickness of the backing B of the pile fabric F. As shown in FIG. **5,** the lower run of conveyor **71** is disposed immediately downstream of the blade guide bar **55** and cooperates therewith to press the deposited cut pile tufts T into the adhesive coating **61** on backing B.

Since the air above platen **70** is maintained at a relatively high temperature, this causes the lower edges of severed divider portions **13***a* to shrink and recede further relative to the cut pile tufts T and backing B as shown in FIG. **5.** This insures that the severed divider portions **13***a* will not interfere with the pressing of the

tufts T toward backing B by the lower run of conveyor **71**.

Conveyor **71**, (FIG. **4**) as well as a suitable advancing roll **72** (FIG. **4A**) for the backing B and pile fabric F, may be interconnected through shaft **71***a* and both then intermittently driven by a suitable clutch mechanism **73** coupling the conveyor **71** and advancing roll **72** to an electric motor **74**. As shown in FIG. **4A**, after passing over advancing roll **72**, the pile fabric F may be taken up by a suitable take-up mechanism generally designated at **80**, all of which is fully described in my said copending application Ser. No. 363,832 and need not be described further herein.

It will be observed in FIG. **4** that motor **74**, which is preferably a reversible motor, imparts reciprocatory motion to a carriage **90** through intervening chain and sprocket connections **89**. Carriage **90** may be of the type disclosed in my said copending application Ser. No. 363,832 and, thus, only a general description thereof will be given herein. Carriage **90** is mounted for forward and rearward movement in a substantially horizontal path on tracks **91**, only one of which is shown in FIG. **4**. Carriage **90** is adapted to support container **12** therein and is also provided with suitable fluid operated rams **92** thereon for engaging a frame **93** in which the container **12** is suitably secured. The rams **92** operate in a manner fully disclosed in same last-named copending application for elevating container **12** and its block **10** of pile strands **11** as they reach the right-hand end of a stroke in forward movement thereof so that the lower ends of the pile strands **11** (FIG. **5**) will pass above and out of engagement with cutter blade **52** in the course of rearward movement of container **12** from right to left in FIGS. **4** and **5**.

As shown by way of example in FIG. **4**, incremental downward feeding movements may be imparted to pressure plate **20**, to feed the pile strand block **10** from container **12** adjacent the end of each rearward stroke of carriage **90**, by suitable screws **95** which are operatively interconnected by suitable sprockets and chains **96**, which, in turn, are driven by an electric motor **97**. Screws **95** are suitably mounted on the upper portion of container **12** or frame **93** of carriage **90**, and the lower ends of screws **95** engage the upper surface of and apply downward force to pressure plate **20**. Thus, screws **95** move the pile strand block **10** downwardly within container **12** a predetermined distance each time carriage **90** and the container **12** therein are positioned adjacent the rearmost position in movement thereof and rearwardly of heat source **30**.

It is apparent that, each time carriage **90** and container **12** move rearwardly of severing station **50** in the course of each rearward stroke of carriage **90**, the rams **92** are so controlled as to permit frame **93** to move downwardly against carriage **90** and thereby return container **12** to its normal level preparatory to a succeeding slice of tufts being prepared and positioned on the backing in the manner heretofore described. It is preferred that the backing B is stationary in the interim between successive slices of tufts T being severed from the pile strand block **10** so that each successive slice of tufts T may be positioned in proper relation to the immediately preceding tuft slice to facilitate the forming of a continuous pile fabric of any desired length.

In this regard it will be observed in FIGS. **1A–1D** and **5** that block **10** includes the same number of dividers **13** as there are rows of pile strands, with a row of pile strands **11** defining the front of the block **10** and a divider **13** defining the rear of the block **10** within container **12**. This arrangement of the pile strands **11** and the dividers **13** is desirable so that, when desired, the leading row of pile strands **11** in each slice severed from block **10** may be positioned against the trailing divider portion **13***a* of the slice previously deposited onto backing B. Also, the trailing divider **13** in block **10** serves as a back-up to stabilize the rearmost pile strands during both the incremental feeding of block **10** and the severing of the rearmost row of pile strands.

Since the apparatus shown in FIGS. **4**, **4A** and **5**, including carriage **90**, platen **70**, conveyor **71**, advancing roll **72** and take-up mechanism **80** may be arranged in the manner disclosed in said copending application Ser. No. 363,832, and the latter application also discloses control means for effecting the desired operations of carriage **90** and the stepwise advancement of the backing B and the fabric F in the manner heretofore described, a further detailed description thereof is deemed unnecessary.

Referring now to FIG. **6**, there is shown a second embodiment of the invention in which securement of the pile tufts to a substrate is effected by fusion instead of by adhesive. In other respects, the method carried out by the apparatus of FIG. **6** is substantially as described with respect to the first embodiment with particular reference to FIGS. **1**, **1A–1D**, **4**, **4A** and **5**. Therefore, those elements of FIG. **6** which are similar to elements of FIGS. **1**, **1A–1D**, **4**, **4A** and **5** will bear the same reference characters with the letter *b* added, where applicable, to avoid repetitive description.

While the pile strands **11** of the first embodiment may be of any desired type, the second embodiment differs in this respect in that each of the pile strands **11***b* of FIG. **6** must be at least partially thermoplastic capable of being melted, and strands **11***b* preferably are entirely thermoplastic. Also, although dividers **13***b* of FIG. **6** may be the same as dividers **13** of the first embodiment, they may be of foam polystyrene sheet material formulated to include fillers or additives which will impart thereto a higher temperature shrinkage point than that of the dividers **13**, because the melting point of thermoplastic strands may be about twice the temperature of heat required to shrink the foam polystyrene dividers **13** of the first embodiment of the invention. It should be noted, however, that the divider portions **13***ab* may expand from their previously compressed state to aid in supporting and effecting the desired spacing between successive transverse rows of tufts T-*b* during production of the pile fabric F-*b*. Thus, in addition to permitting varying spacing of the rows of tufts T-*b* in production of various pile fabrics, the divider portions **13***ab* facilitate the forming of tufts one inch or more in length for making shag type fabrics, for example.

The method of FIG. **6** also differs from that of FIGS. **1** and **1A–1D** in that, during each forward movement or stroke of pile strand block **10***b* and container **12***b*, the lower surface of the increment of block **10***b* last fed downwardly from container **12***b* passes over and in close proximity to a suitable heat source **100** which melts the free projecting ends of the pile strands **11***b* while causing the lower ends of dividers **13***b* to shrink and recede relative to the free ends of pile strands **11***b*.

Heat source **100** is disposed rearwardly of but in close proximity to severing station **50***b* in FIG. **6** so that

the heat applied to the exposed projecting ends of pile strands **11***b* may be effective closely adjacent cutter blade **52***b*, or at least, the free ends of pile strands **11***b* will still be in melted condition when they are being severed by blade **52***b* and progressively brought into contact with and deposited as tufts T-*b* on, substrate B-*b* to be fusibly secured thereto. The fusible or previously melted lower end portions of tufts T-*b* fused to substrate B-*b* are indicated at **101** in FIG. **7.**

Since the severing of successive rows of pile strands **11***b* and dividers **13***b*, the progressive depositing of the pile tufts T-*b* and divider portions **13***ab*, and the pressing of tufts T-*b* against substrate B-*b* by conveyor **71***b* may be effected in substantially the same manner as that described with respect to pile strands **11,** dividers **13,** tufts T, divider portions **13***a* and conveyor **71,** a further description in this respect is deemed unnecessary.

To aid in the fusion of the tufts T-*b* to substrate B-*b* during forward movement thereof, platen **70***b* may be maintained at a temperature approximating the melting temperature, or less than the melting temperature, of the thermoplastic-containing cut pile tufts T-*b*. Additionally, for obtaining better securemnt of the pile tufts, it is contemplated that the substrate B-*b* may be entirely of a thermoplastic or fusible material or it may be in the form of a non-fusible backing having a fusible material in the form of a film, for example, defining the upper surface thereof.

As indicated above, heat source **100** may shrink the lower portions of dividers **13***b* concurrently with the melting of the free ends of pile strands **11***b*. If desired, since the pile strand block **10***b* is moved rearwardly, from right to left in FIG. **6,** at a higher level than that in which it is moved forwardly, the heat from heat source may be so controlled as to effect shrinkage and recession of the lower ends of dividers **13***b* during rearward movement of block **10***b* and without melting the lower ends of pile strands **11***b* at that time. Thus, relatively short lengths of pile strands **11***b* would be exposed and projecting beyond the adjacent ends of dividers **13***b* prior to each time sufficient heat is applied to the ends of the pile strands in block **10***b* to effect melting thereof. It is contemplated that the heating effect of heat source **100** may be reduced or heat source **100** may be rendered inoperative during each rearward pass of block **10***b* thereover, and that a separate source of heat, not shown, may be provided rearwardly of heat source **100** to effect the shrinking of dividers **13***b* before block **10***b* passes forwardly over and is subjected to heat from heat source **100** for melting the free ends of pile strands **11***b*.

Of course, as explained heretofore with respect to dividers **13** of the first embodiment of the invention, the lower edges of dividers **13***b* may be subjected to a treatment other than that effected by heat source **100** so as to foreshorten the dividers **13***b* relative to strands **11***b* prior to melting their free lower ends.

The fabric F-*b* shown in FIGS. **6** and **7** is provided with tufts T-*b* of carpet yarns or rovings, for example. The fabric F-*c* of FIG. **8** also is produced according to the method of FIG. **6** and includes a backing B-*c*, tufts T-*c* and fusible connections **101***c* between tufts T-*c* and backing B-*c*. Fabric F-*c* differs from fabric F-*b* however in that the tufts T-*c* are formed of synthetic continuous filament tows or slivers and thus may flare or blossom outwardly to a greater extent than tufts T-*b* of FIG. **7.** In other respects, the fabrics F-*b*, F-*c* may be the same and, therefore, a further description thereof is deemed unnecessary.

It is thus seen that I have provided a method of making pile fabrics, such as carpets, rugs and the like, and especially shag type pile fabrics, permitting the use of practically any kind of textile strand material for the pile regardless of whether the material is highly compacted such as highly twisted yarns, or the material is a very bulky material such as crimped tow of fine denier monofilaments, or slivers of synthetic or natural stable fibers. More specifically, it can be seen that I have provided a method of making pile fabrics in which a block **10** or **10***b* of rows of substantially parallel strands **11** or **11***b* of pile forming material is provided in an open-ended container **12** or **12***b* with the block having dividers **13** or **13***b* of sheet material therein separating adjacent rows of the parallel pile strands, and wherein the pile strand block is incrementally fed parallel to the pile strand axes from the container **12** or **12***b* in successive increments of an amount equal to the desired length of pile, then the ends of the dividers are treated to cause them to foreshorten or shrink and recede relative to the adjacent ends of the pile strands so that predetermined lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, whereupon each fed increment of pile strands **11** or **11***b* and their foreshortened dividers **13** or **13***b* are severed transversely of the pile strand axes while bringing the projecting ends of the severed pile strands into engagement with a substrate for adhesive or fused securement thereto to form rows of cut pile tufts on the substrate.

In the drawings and specification, there has been set forth preferred embodiments of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

That which is claimed is:

1. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of pile forming material in an open-ended container with the block having dividers of sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, treating the ends of the dividers in the block to cause them to foreshorten relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, and severing each fed increment of pile strands and the foreshortened dividers transversely of the pile strand axes while bringing the projecting ends of the severed pile strands into contact with a layer of adhesive for securement thereto and to form spaced rows of cut pile tufts thereon.

2. A method according to claim **1,** which includes applying an adhesive coating to the exposed projecting ends of the pile strands of each fed increment prior to the severing thereof to aid in the subsequent securement of the severed pile strands.

3. A method according to claim **1,** wherein the severing of each fed increment of pile strands is effected progressively, and wherein the bringing of the projecting ends of the pile strands into contact with the layer of adhesive comprises progressively depositing the sev-

ered pile strands onto the layer of adhesive while advancing the layer of adhesive relative to the block of pile strands.

4. A method according to claim 1, in which the step of incrementally feeding the pile strand block includes feeding the pile strand block in successive increments of about one inch or more for making high pile fabrics such as shag carpets and rugs.

5. A method according to claim 1, which includes the step of pressing the severed pile strands and the layer of adhesive together to aid in the securement of the severed pile strands to the layer of adhesive.

6. A method according to claim 1, which includes moving the layer of adhesive in a predetermined path beneath the pile strand block, and wherein the step of severing each fed increment of pile strands includes moving the pile strand block over the layer of adhesive in the same general direction as that of the layer of adhesive while also moving the pile strand block past a stationarily mounted severing means so that the severed pile strands are progressively brought into contact with the layer of adhesive.

7. A method according to claim 1, including the steps of curing the layer of adhesive while pressing the tufts of severed pile strands and the layer of adhesive together to aid in the securement of the severed pile strands to the layer of adhesive.

8. A method according to claim 1, wherein the pile strand block is formed by arranging layers of pile yarns in alternation with sheets of compressible material serving as the dividers of the block.

9. A method according to claim 1, wherein the pile strand block is formed by arranging layers of synthetic continuous filament tows in alternation with sheets of compressible material serving as the dividers of the block.

10. A method according to claim 1, wherein the sheet material of the dividers is compressible and expansible to substantially its original thickness following being compressed, and wherein the dividers in the block are in compressed condition, and the method further comprising progressively depositing on the layer of adhesive the severed pile strands, while permitting at least partial expansion of the severed divider portions by advancing the layer of adhesive relative to the pile strands.

11. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of pile forming material in an open-ended container with the block having dividers of sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, treating the ends of the dividers in the block to cause them to foreshorten relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, applying an adhesive coating to the exposed projecting ends of the pile strands, and severing each fed increment of pile strands and the foreshortened dividers transversely of the pile strand axes while bringing the adhesive-coated projecting ends of the severed pile strands into contact with a backing for adhesive securement thereto to form rows of cut pile tufts on the backing.

12. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of pile forming material in an open-ended container with the block having dividers of heat shrinkable sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, heating the ends of the dividers in the block to cause them to shrink and recede relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, and severing each fed increment of pile strands and the shrunken dividers transversely of the pile strand axes while bringing the projecting ends of the severed pile strands into contact with a layer of adhesive for securement thereto and to form spaced rows of cut pile tufts thereon.

13. A method according to claim 12, which includes applying an adhesive to the exposed projecting ends of the pile strands of each fed increment prior to the severing of each increment to aid in the subsequent securement of the severed pile strands.

14. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of pile forming material in an open-ended container with the block having dividers of heat shrinkable sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, heating the ends of the dividers in the block to cause them to shrink and recede relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, and severing each fed increment of pile strands and the shrunken dividers transversely of the pile strand axes while bringing the projecting ends of the severed pile strands into contact with an adhesive-coated backing for adhesive securement thereto to form rows of cut pile tufts on the backing.

15. A method according to claim 14, which includes applying an adhesive to the exposed projecting ends of the pile strands of each fed increment prior to the severing of each increment to aid in the subsequent securement of the severed pile strands to the adhesive-coated backing.

16. A method according to claim 14, in which the step of incrementally feeding the pile strand block includes feeding the pile strand block in successive increments of about one inch or more for making high pile fabrics such as shag carpets and rugs.

17. A method according to claim 14, which includes the step of pressing the tufts of the severed pile strands and the backing together to aid in securement of the tufts to the backing.

18. A method according to claim 14, which includes moving the adhesive-coated backing in a predetermined path beneath the pile strand block, and wherein the step of severing each fed increment of pile strands includes moving the pile strand block over the backing in the same general direction as that of the backing while also progressively bringing the severed pile strands into contact with the adhesive-coated backing.

19. A method according to claim 14, including the steps of curing the adhesive on the backing while pressing the cut pile tufts and the backing together to aid in securing the tufts and the backing together.

20. A method according to claim 14, wherein the pile strand block is formed by arranging layers of pile yarns in alternation with sheets of foam polystyrene serving as the dividers of the block.

21. A method according to claim 14, wherein the pile strand block is formed by arranging layers of synthetic continuous filament tows in alternation with sheets of foam polystyrene serving as the dividers of the block.

22. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of pile forming material in an open-ended container with the block having dividers of heat shrinkable sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, heating the ends of the dividers in the block to cause them to shrink and recede relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, applying an adhesive coating to the exposed projecting ends of the pile strands, and severing each fed increment of pile strands and the shrunken dividers transversely of the pile strand axes while bringing the adhesive-coated projecting ends of the severed pile strands into contact with a backing for securement thereto to form rows of cut pile tufts on the backing.

23. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of pile forming material in an open-ended container with the block having dividers of heat shrinkable sheet material therein separating adjacent rows of the pile strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, heating the ends of the dividers in the block to cause them to shrink and recede relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, successively severing each fed increment of pile strands and the shrunken dividers transversely of the pile strand axes by advancing the block past a stationarily mounted severing means, while advancing an adhesive-coated backing and the pile strand block in the same general direction closely adjacent each other, and while also progressively depositing the projecting ends of the severed pile strands onto the adhesive-coated backing for securement thereto to successively form rows of cut pile tufts on the backing.

24. A method according to claim 23, including applying an adhesive to the exposed projecting ends of pile strands of each fed increment prior to the severing of each increment to aid in the subsequent securement of the severed pile strands to the adhesive-coated backing.

25. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of thermoplastic pile forming material in an open-ended container with the block having dividers of sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, treating the ends of the dividers in the block to cause them to foreshorten relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers, applying heat to the exposed projecting ends of the pile strands to effect melting thereof, and severing each fed increment of pile strands and the foreshortened dividers transversely of the pile strand axes while bringing the projecting melted ends of the severed pile strands into contact with a backing for fusible securement thereto to form spaced rows of cut pile tufts on the backing.

26. A method of making pile fabrics, such as carpets, rugs and the like which comprises providing a pile strand block of rows of substantially parallel strands of thermoplastic pile forming material in an open-ended container with the block having dividers of heat shrinkable sheet material therein separating adjacent rows of the strands, incrementally feeding from the container the pile strand block parallel to the axes of the pile strands in successive increments of an amount equal to the desired length of pile, applying heat to the end of the pile strand block to cause the dividers therein to shrink and recede relative to the adjacent ends of the pile strands so that relatively short lengths of the pile strands are exposed and project beyond the adjacent ends of the dividers while also causing the adjacent ends of the pile strands to melt, and severing each fed increment of pile strands and the shrunken dividers transversely of the pile strand axes while bringing the projecting melted ends of the severed pile strands into contact with a backing for fusible securement thereto to form spaced rows of cut pile tufts on the backing.

27. A method according to claim 26, wherein the severing of each fed increment of pile strands in effected progressively, and wherein the bringing of the projecting melted ends of the pile strands into contact with the backing comprises progressively depositing the severed pile strands onto the backing while advancing the backing relative to the block of pile strands.

28. A method according to claim 26, in which the step of incrementally feeding the pile strand block includes feeding the pile strand block in successive increments of about one inch or more for making high pile fabrics such as shag carpets and rugs.

29. A method according to claim 26, which includes the step of pressing the severed pile strands and the backing together to aid in the fusible securement of the severed pile strands to the backing.

30. A method according to claim 26, which includes moving the backing in a predetermined path beneath the pile strand block, and wherein the step of severing each fed increment of pile strands includes moving the pile strand block over the backing in the same general direction as that of the backing while also moving the pile strand block past a stationarily mounted severing means so that the severed pile strands are progressively brought into contact with the backing for fusible securement thereto.

31. A method according to claim 26, wherein the pile strand block is formed by arranging layers of pile yarns

in alternation with sheets of compressible material serving as the dividers of the block.

32. A method according to claim **26,** wherein the pile strand block is formed by arranging layers of synthetic continuous filament tows in alternation with sheets of compressible material serving as the dividers of the block.

33. A method according to claim **26,** wherein the sheet material of the dividers is compressible and expansible to substantially its original thickness following being compressed, and wherein the dividers in the block are in compressed condition, and the method further comprising progressively depositing on the backing the severed pile strands for fusible securement thereto, while permitting at least partial expansion of the severed divider portions by advancing the backing relative to the pile strands.

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