United States Patent

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Continuation-in-part of application Ser. No. 793,842, Jan. 24, 1969, which is a continuation-in-part of application Ser. No. 520,402, Jan. 13, 1966, now Patent No. 3,424,632.

[54] **APPARATUS FOR PRODUCING A PILE FABRIC**
4 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **226/104,** 156/72, 226/113
[51] **Int. Cl.** **B65h 17/18**
[50] **Field of Search** ..... 156/72, 591, 594; 226/104, 113—115; 112/79; 28/1.8, 72.15; 16/135

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ABSTRACT: An apparatus for the manufacture of nonwoven pile fabrics suitable for carpeting or the like includes an array of loop-forming members arranged in paired relationship, the array being adapted to travel past a loop-forming station wherein loops of yarn are formed. Each of the loop-forming members comprises a relatively elongated bead portion upon which yarns are disposed to form loops when the yarns are inserted between a pair of said loop-forming members, and a relatively elongated flexible slat portion at one edge integral with the bead portion and adapted to be fixed at the other end to a dimensionally stable carrier.

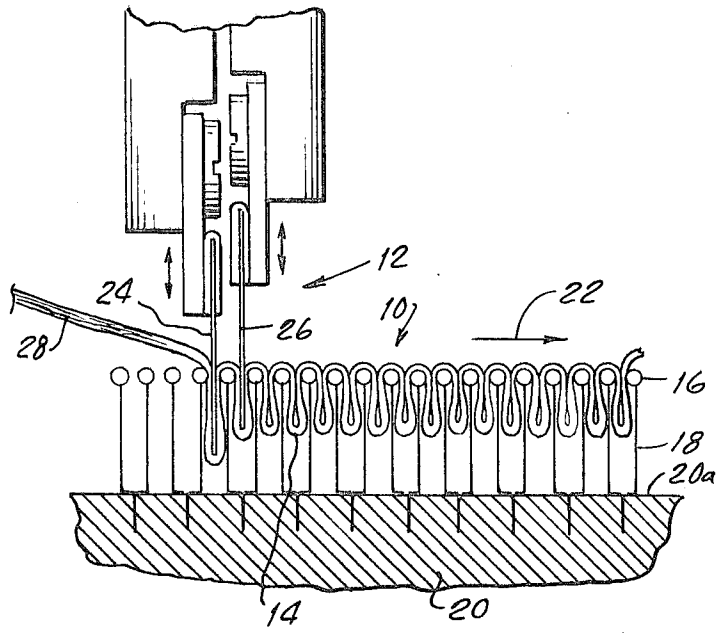
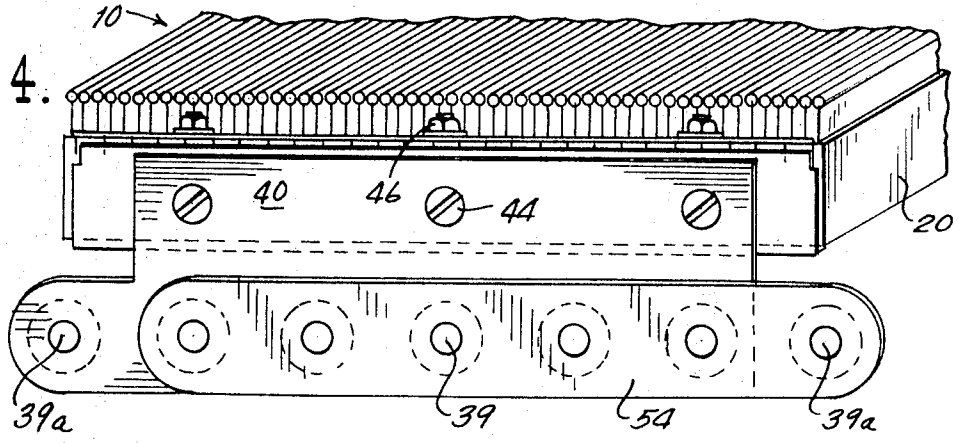


Fig. 4.



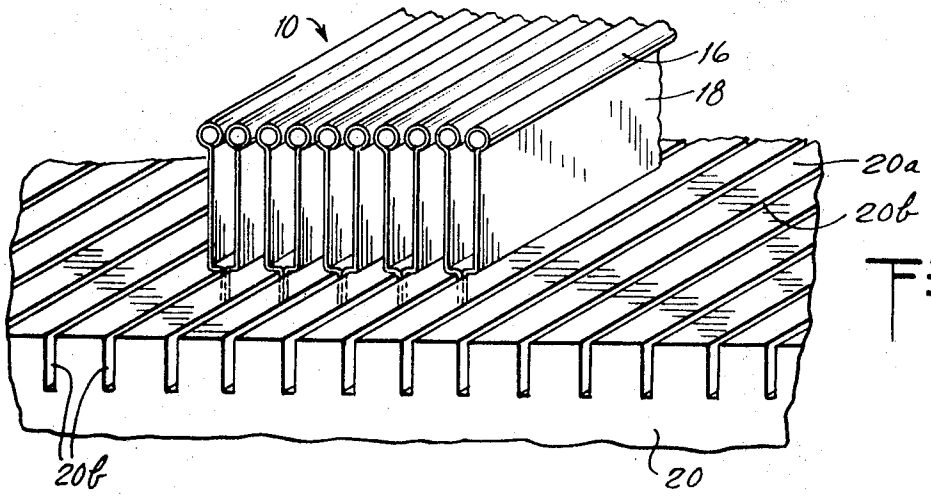
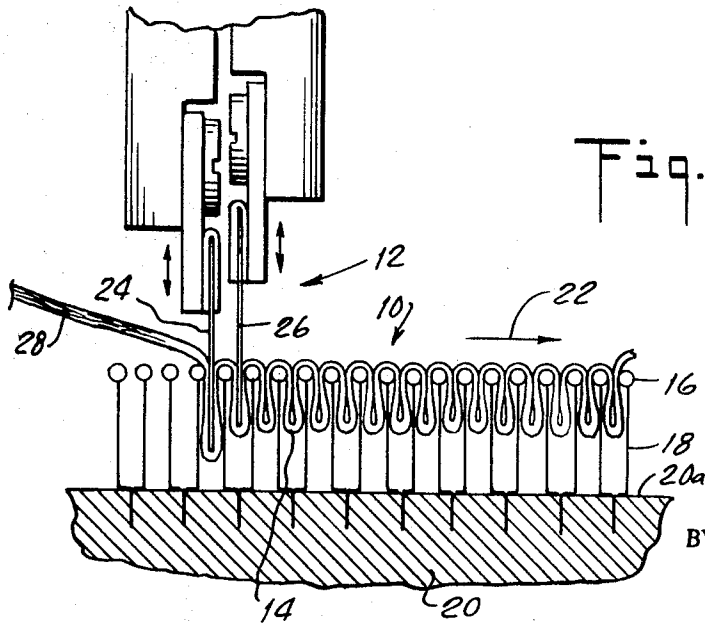


Fig. 5.

Fig. 1.



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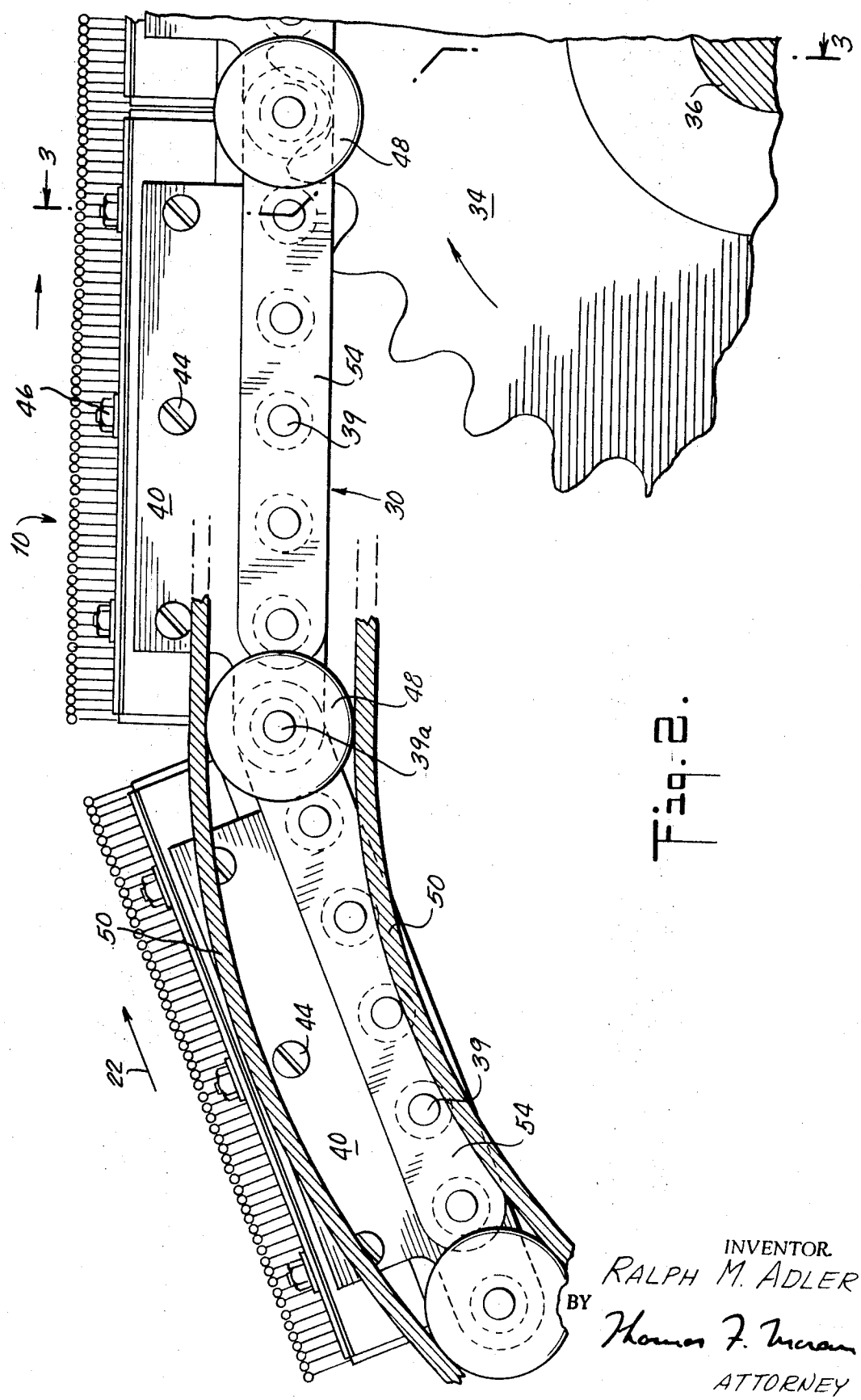


Fig. 2.

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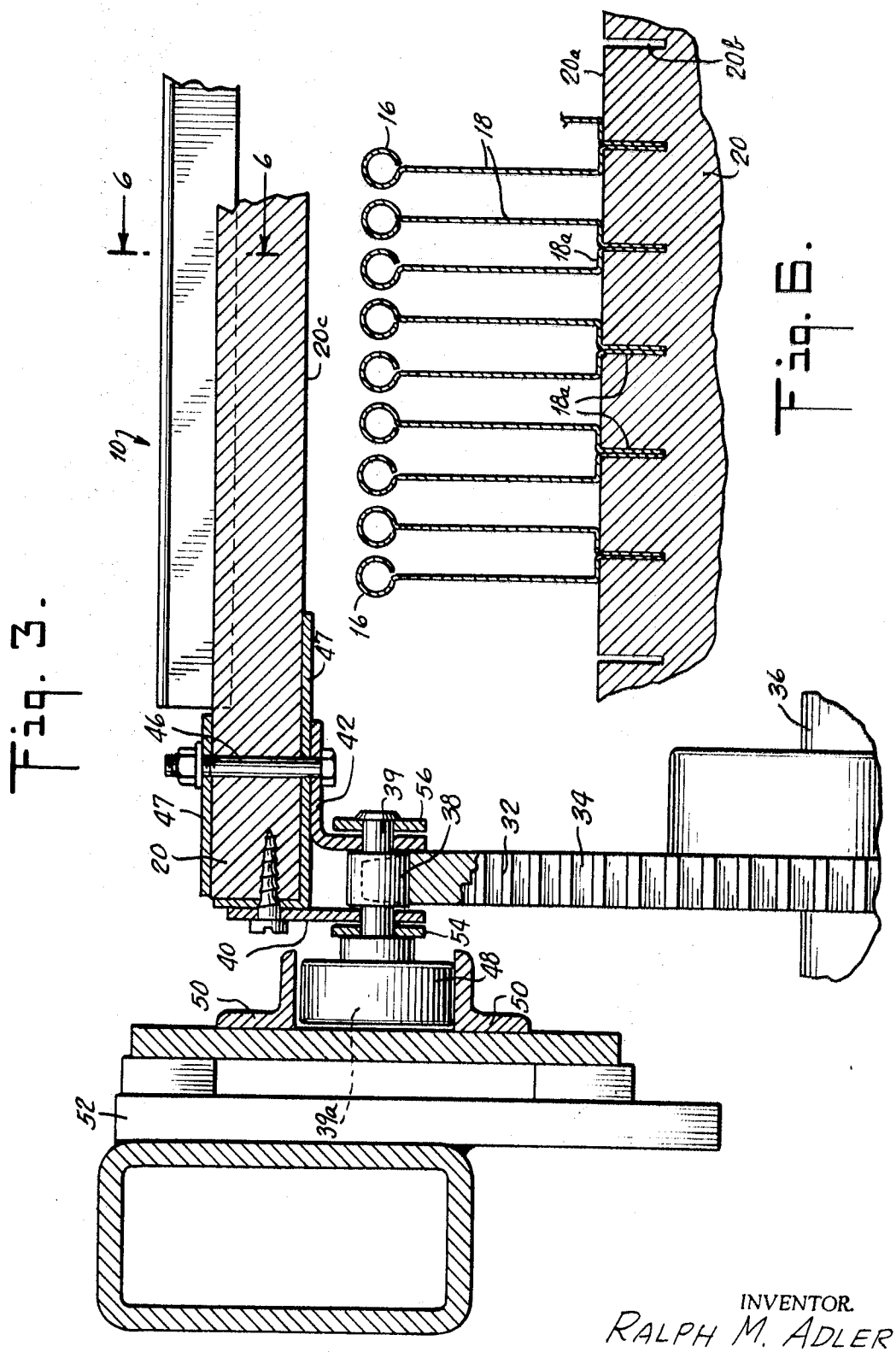


Fig. 3.

Fig. 6.

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APPARATUS FOR PRODUCING A PILE FABRIC

CROSS-REFERENCES TO RELATED APPLICATIONS

The present application is a continuation-in-part of copending application Ser. No. 793,842 filed Jan. 24, 1969, for "Method and Apparatus for Production of Pile Carpeting and the Like," which in turn is a continuation-in-part of application Ser. No. 520,402 filed Jan. 13, 1966, entitled "Method and Apparatus for Production of Pile Carpeting and the Like," now U.S. Pat. No. 3,424,632. The above-identified disclosures are herein incorporated and made part of this disclosure.

BACKGROUND OF THE INVENTION

This invention relates to nonwoven pile fabrics and to apparatus for producing same. More particularly, this invention relates to the loop-forming members employed in apparatus for manufacturing nonwoven pile fabrics, such as carpeting, rugs, and the like.

Various methods and apparatus are employed for the production of pile fabrics. Those methods and apparatus employing a weaving technique are capable of producing quality pile fabrics having a dense pile and a long service or wearing life. Woven pile fabrics, however, are relatively expensive to produce and as a result woven pile fabrics are costly. Pile fabrics and carpeting have also been prepared by utilizing nonweaving techniques, such as knitting and tufting. Pile fabrics produced by such techniques, however, generally exhibit a relatively loose pile and are usually less attractive. Such pile fabrics, however, are capable of being produced at a relatively high rate and are usually less expensive than woven pile fabrics.

The textile industry, and particularly that portion involved in the production of pile fabrics, such as carpeting and rugs, has long been interested in a fast, practical, inexpensive method and apparatus for the production of pile fabrics having a relatively dense pile and exhibiting a long wearing life while simulating a woven-pile fabric. Techniques employed and suggested heretofore for the manufacture of such nonwoven fabrics, however, have not been entirely satisfactory.

Although techniques of making pile fabrics by forming loops of yarn between spaced, parallel, slatlike machine elements or loop-forming members have been investigated, there has been relatively little commercial utilization of these techniques. Apparently the previously known and suggested techniques have failed to meet the very demanding requirements of a commercially acceptable operation. It would appear that in order to gain commercial acceptance, a method and apparatus for the production of nonwoven pile fabrics must be capable of rapidly and continuously producing pile fabrics from diverse materials, natural and synthetic fibers, and spun, twisted or monofilament yarns, as well as in a variety of controlled pile heights, densities and patterns without requiring extensive alteration of the existing apparatus and basic method.

The apparatus and methods disclosed in U.S. Pat. No. 3,424,632 and in copending application, Ser. No. 793,842, filed Jan. 24, 1969, overcame many of these industry problems. The disclosures of this patent and patent application show loop-forming members arranged in a closed array in parallel side-by-side disposition. The loops of yarn are formed between the loop-forming members and are then cut and a backing material applied thereto. Thereafter, the resulting nonwoven pile fabric or carpet is removed from the array of loop-forming members.

In the structure of the aforementioned patent application, the array of loop-forming members is moved continuously beneath a loop-forming station, wherein a bladelike element descends so as to press yarns, which are continuously supplied to the loop-forming station, between adjacent loop-forming members directly beneath the bladelike element. When the yarns are pressed by the bladelike element between the loop-forming members to form loops of yarn therebetween, the blade is withdrawn. Associated with the loop-forming station and the bladelike element is a gauge blade which serves the purposes of maintaining the previously formed loops of yarn between the loop-forming members and determining the height of the pile in the produced nonwoven fabric or the length of the yarn loops between the loop-forming members.

In operation, before the loop-forming element is moved downwardly to form loops, the guage blade is moved downwardly and inserted between two adjacent loop-forming members containing the immediately previously formed yarn loops. The guage blade descends into those loops to a distance not greater than and preferably less than the depth of the yarn loops. When the gauge blade has entered into the previously formed yarn loops, the loop-forming blade descends and produces newly formed yarn loops. In the instance where the gauge blade does not descend into the previously formed yarn loops to the full depth of the yarn loops, as the loop-forming blade descends, some of the yarn material making up the previously formed yarn loops is taken away or "robbed" to make up the newly formed yarn loops. When the loop-forming blade has fully descended, preferably to a distance greater than the gauge blade, both the loop-forming blade and the gauge blade are removed.

A further problem in the prior art concerned the design of an array of loop-forming members which would yield a commercially acceptable product, particularly considering that it is commercially desirable to produce continuous length pile fabric having a width of about 15 feet.

The slatlike, loop-forming members making up the closed array must be in closely arranged parallel relationship with the pitch or center-to-center distance between successive loop-forming members being approximately three-sixteenths inch, more or less, depending upon the thickness of the yarn. As a result, it is apparent that when the slatlike, loop-forming members are long, thin members, they must have substantial depth to prevent sagging. Because of the construction and dimensions of the loop-forming members and the resulting array, means must also be provided to provide support, alignment and transport of the loop-forming members and the array.

Means must further be provided for synchronizing the arrival of the loop-forming members at the loop-forming station so as to assure proper positioning of the loop-forming members relative to the blade which descends to press the yarn or warp material between adjacent loop-forming members to form loops of yarn therebetween. If the loop-forming members are disposed in a rigid, fixed, parallel, spaced relationship with respect to each other, at best only a given thickness of warp material or yarn will be accommodated and satisfactorily retained therebetween. Thinner warp material or yarn will tend to escape from between the loop-forming members. If thicker warp material or yarn is desired, excessive force is required to locate the yarn between the loop-forming members. Such excessive force tends to cause yarn damage and breakage and the resulting formed loops tend to force or wedge the loop-forming members apart into a nonparallel relationship, the nonparallelism rapidly accumulating to a critical level. Even when the loop-forming members are disposed in a hinged, substantially parallel relationship, which arrangement requires force to be continuously applied to the array so as to retain the looped warp material between the loop-forming members, the total aggregate force required, if supplied from outside the structure by means of springs and the like, becomes enormous and substantially impractical of achievement.

These problems were solved in the devices of the aforementioned patent application by imparting magnetic properties to the slatlike, loop-forming members. For example, the slatlike, loop-forming member is made of magnetic material or has magnetic material fixed or otherwise attached thereto such that the loop-forming member attracts adjacent loop-forming members with the result that the array of the loop-forming

members is magnetically held together. The magnetic attraction between adjacent loop-forming members provides the force for retaining the looped material therebetween. At the same time the magnetic attraction between adjacent loop-forming members permits these members to be, in effect, hingedly separated to readily accommodate the entry of the blade and looped yarn therebetween during the loop-forming operation.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a commercially feasible apparatus for the production of a nonwoven pile fabric suitable for use as carpeting, rugs, and the like.

Another object of the invention is to provide an apparatus for the production of nonwoven pile fabric which is simple in construction and operation.

To these and other ends, the present invention contemplates an apparatus for producing a nonwoven pile fabric including loop-forming members, each comprising a relatively elongated bead portion and a relatively elongated, flexible slat portion integral with the bead portion and adapted to be connected or fixed to a supporting plank or carrier. The loop-forming members are arranged in paired relationship and pairs of the loop-forming members extend along the length of one side of the plank or carrier. Means are further provided for moving the loop-forming members together with the planks or carriers fixed thereto in a desired path.

The bead portions of the loop-forming members are shaped or formed as elongated cylinders which extend to the entire length of the loop-forming member. Integral with each bead portion and adapted to connect the bead portion to a means of support is a flexible slat portion. Each slat portion is of the same length as its associated bead portion and maintains the bead portion at a sufficient height above the means of support or carrier so that loops of fabric may be formed between pairs of loop-forming members. As the loop-forming members are designed to be in paired relationship, pairs of slat portions have diametrically opposing offsets at their ends or edges opposite the bead portion ends or edges so that the slat portions may be mutually secured together and to a means of support.

Carriers or planks of lightweight, dimensionally stable material are preferably the means of support. The loop-forming members are disposed substantially entirely on one surface of the plank so that their longitudinal axes are substantially parallel to the longitudinal axis of the plank, the planks being approximately the same length as the loop-forming members. A series of planks are arranged to be continuously advanced in a direction substantially transverse to their longitudinal axes past a loop-forming station, where loops of fabric are created upon the loop-forming members by loop-forming and gauge elements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic elevational view of an array of loop-forming members advancing past a loop-forming station to form loops of yarn in accordance with the present invention;

FIG. 2 is an elevational view of several arrays of loop-forming members and the means for continuously advancing same;

FIG. 3 is a cross-sectional elevational view taken along the line 3–3 of FIG. 2;

FIG. 4 is a perspective view of an array of loop-forming members;

FIG. 5 is an enlarged perspective view of several pairs of loop-forming members arranged in the preferred means of support of the present invention; and

FIG. 6 is a cross-sectional elevational view of the loop-forming members taken along the line 6–6 of FIG. 3.

DETAILED DESCRIPTION

Referring to FIG. 1 of the drawings, there is shown an array of loop-forming members generally indicated by reference numeral **10** advancing past loop-forming station **12** wherein loops of yarn **14** are formed. Loop-forming members **10** each comprise bead portion **16** and slat portion **18** integral therewith and adapted to be connected or fixed to supporting carrier or plank **20**. Loop-forming members **10** are preferably arranged in paired, opposed relationship and extend lengthwise over one side **20***a* of supporting plank **20**. The array of loop-forming members **10** is continuously moved in the direction of arrow **22** past loop-forming station **12**.

Loop-forming station **12** comprises loop-forming element or blade **24** and gauge element or blade **26**, both elements being operatively connected to a cam-operated pushrod (not shown) for movement therewith. Loop-forming element **24** and gauge element **26** are adapted and positioned to descend between adjacent loop-forming members **10** as loop-forming members **10** move beneath the elements. A plurality of yarns or warp material **28** is continuously inserted and held between loop-forming members **10** so as to form loops **14** of yarn therebetween. As the downward movements of loop-forming element **24** and gauge element **26** are synchronized with the motion and position of loop-forming members **10**, plural strands of yarn or warp material **28** are inserted downwardly by loop-forming element **24** between adjacent loop-forming members **10** and the immediately previously formed loops of yarn or warp material **28** may be held between corresponding loop-forming members **10** by gauge element **26** inserted thereinto. There is thus formed an array of loops **14** from yarn **28** between loop-forming elements **10** which are adapted to move with the array of loop-forming members **10**.

The means for conveying the arrays of loop-forming members **10** continuously past loop-forming station **12** is shown in FIGS. **2** through **4**. Each supporting plank **20** for an array of loop-forming members **10** has secured thereon at its longitudinal end portions sprockets mechanisms **30**, which are continuously engaged by sprockets **32** of large driving gear **34** rotated on shaft **36** by means of a drive chain (not shown). It should be noted that as the axes of the sprockets of sprocket mechanism **30** lie in a plane parallel to the surface **20***a* of supporting plank **20**, driving gear **34** must be located on a straight portion of the conveyor rather than on the curved portions thereof. Sprocket mechanism **30** includes a plurality of sprockets **38** designed to mesh with sprockets **32** of gear **34**. These sprockets **38** depend from supporting plank **20** and are held between parallel plates **40**, **42**, each sprocket **38** being permitted to rotate on pin **39**. Plate **40** may be connected to the longitudinal end portion of supporting plank **20** by any suitable means, e.g. screw **44**, while plate **42**, which is actually an angle, may be connected to lower surface **20***c* of supporting plank **20** by any suitable means, e.g. bolt and nut **46**. Preferably, reinforcing plates **47** are disposed between plates **40**, **42** and supporting plank **20**.

Disposed at each corner of supporting plank **20** is a wheel or roller **48** which is located on the most outward pin **39***a* of sprocket mechanism **30**, but which lies in a plane outward from the plane of sprocket mechanism **30** and gear **34**. Extension plates **54**, **56** extend beyond the end of supporting plank **20** in order to journal pin **39***a* which serves as the shaft for wheel **48**, pin **39***a* thereby being disposed between two adjoining arrays of loop-forming members **10**. Wheels or rollers **48** ride within parallel tracks **50** of the conveyor so that the arrays of loop-forming members **10** are continuously advanced in a straight line toward loop-forming station **12**. Parallel tracks **50** are sufficiently spaced outward from the arrays of loop-forming members **10** so that the arrays may travel freely despite the curvature of the tracks in the conveying apparatus. It is an advantage of the present construction that as supporting planks **20** of the arrays of loop-forming members **10** are relatively rigid, no support for the lower or returning section of the conveyor is necessary. Track support **52** is provided for track **50**, however.

As best seen in FIGS. **5** and **6**, loop-forming members **10** upon which loops of yarn are formed each comprise bead portion **16** and slat portion **18** integral therewith. Bead portions **16** are illustrated as elongated hollow cylinders (although they

may be solid), extending to the entire width of the pile fabric to be produced and nearly to the entire length of supporting plank **20**. Thus, bead portions **16** may be approximately one-eighth inch in diameter and anywhere from a few feet to 15 feet in length, depending upon the width of the pile fabric to be produced. Bead portions **16** are disposed in parallel relationship so that yarn or warp material **28** may be formed into loops **14** therebetween in order to form pile fabric.

Bead portion **16** is formed by rolling a longitudinal edge of slat portion **18**. Thus each bead portion **16** is integral with its associated slat portion **18**, of the same length, and fabricated from the same material, e.g. sheet stainless steel approximately 0.018-inch thickness. Slat portions **18** are dimensioned to maintain bead portions **16** at sufficient height above supporting plank **20** that loops of yarn **14** may be formed between adjacent bead portions **16**. If the general range of pile heights of the produced fabric is to be relatively high or deep, slat portions **18** will be of relatively greater height and if the pile height is to be relatively low, slat portions **18** will be relatively short. The pitch of loop-forming members **10** is preferably approximately three-sixteenths inch with about one-sixteenth to one-eighth inch spacing between loop-forming members **10**. With this spacing arrangement, there will be approximately **68** loop-forming members **10** per linear foot of the array.

It is presently preferred that loop-forming members **10** be disposed in parallel paired relationship. Each slat portion **18** is offset at its end opposite bead portion **16** to form offset **18***a* and each offset portion **18***a* is secured to supporting plank **20** together with the diametrically opposed offset portion **18***a* of its paired member. Despite the fact that slat portions **18** are offset at their lower ends, slat portions **18** and hence bead portions **16** are disposed in the array at substantially equal distances from each other and thus loops of yarn of substantially equal size may be formed therebetween, regardless of whether the loops of yarn are formed between bead portions **16** of a pair of loop-forming members **10** or between bead portions **16** of adjacent pairs of loop-forming members.

Providing the means of support for loop-forming members **10** are planks **20** of lightweight, dimensionally stable material. Planks **20** are preferably fabricated from a wood composition comprised of wood chips compressed and bonded together under pressure. Although such a support is preferred, it is within the scope of the invention to employ supporting planks of other materials which are lightweight and dimensionally stable. Loop-forming members **10** are disposed on upper surface **20***a* and fitted and fixed within longitudinal grooves **20***b* cut into the surface of supporting plank **20**. Loop-forming members **10** are arranged so that their longitudinal axes are substantially parallel to the longitudinal axis of supporting plank **20**, planks **20** being of approximately the same length as loop-forming members **10**. As supporting planks **20** are arranged so that they are continuously advanced in a direction substantially transverse to their longitudinal axes, i.e. in the direction of their short dimension, planks **20** rapidly move past loop-forming station **12** where yarn or warp material **28** is inserted between loop-forming members **10** to form loops of yarn therebetween.

In operation of the present apparatus for producing a pile fabric, a plurality of strands of yarn or warp material **28** are disposed over bead portions **16** of loop-forming members **10** as the members are continuously advanced in the path of the array. Loop-forming element **24** is moved downwardly so as to form loops of yarn **14** between bead portions **16** of loop-forming members **10** and is withdrawn. Gauge element **26** moves downwardly into the formed loops **14** to a distance preferably slightly less than the depth of the loop. Then loop-forming element **24** again moves downwardly to create a subsequent loop **14** between the following pair of loop-forming members **10**, simultaneously "back robbing" the previously formed loop **14** to the extent the depth of penetration of the loop-forming element exceeds the depth of penetration of gauge element **26** between loop-forming members **10**. Subsequent to formation of loops of yarn **14**, loops **14** may be cut by a blade (not shown) and a suitable film-forming binder material may be applied to the top surface of the array of cut loops. Then backing material may be supplied to the surface upon which the binder material has been placed and pressed into firm adhesive contact with the cut yarn loops. After a cooling or chilling operation, the resulting pile fabric is removed from the array of loop-forming members **10** as a substantially finished pile fabric product. Thus, the present invention provides a desirable and commercially acceptable apparatus for producing nonwoven pile fabrics for carpeting or the like.

As will be apparent to those skilled in the art in the light of the foregoing disclosures, many modifications, alterations and substitutions are possible in the practice of this invention without departing from the spirit or scope thereof.

I claim:

1. A pair of slatlike elements useful in an apparatus for producing a pile fabric, each of said elements comprising a bead portion extending along one edge of said element, a slat portion integral with said bead portion and extending therefrom, said slat portion having an offset portion along that edge thereof remote from said bead portion, the aforesaid offset portion having a section or length parallel with respect to said slat portion, the parallel section of one of said pair of elements being fixed in contact with and opposed to the parallel section of the other of said pair of elements and the bead portions of said elements being disposed in adjacent, parallel relationship.

2. A pair of elements in accordance with claim 1 including a carrier, the slat portions being fixed together at their offset portions to said carrier.

3. An array of pairs of elements in accordance with claim 1 wherein said pairs are fixed to a carrier and wherein said pairs of elements making up said array are disposed equidistant from each other.

4. Apparatus for producing a pile fabric comprising an array of pairs of elements in accordance with claim 1, planklike support means, said planklike support means carrying said array of pairs of elements, the elements making up said pairs being fixed to said planklike support means at the parallel sections of said elements, means for continuously moving said support means past a loop-forming station, loop-forming means at said loop-forming station adapted for up-and-down movement relative to said pairs of elements for inserting and pressing downwardly yarn between each of said pairs of elements to form loops of yarn therebetween and gauge means associated with said loop-forming means and adapted for up-and-down movement relative to said elements for insertion between a pair of said elements containing the previously formed loops of yarn therebetween to a distance not exceeding the distance said loop-forming means was previously inserted thereinto so as to cause said previously formed loops of yarn to be withdrawn to an amount determined by the depth or distance to which said gauge means is inserted between the following pair of said elements to form additional loops of yarn therebetween.