Aug. 14, 1956 J. W. KRADOSKA 2,758,355

APPARATUS FOR PRODUCING A DESIGN IN PILE FABRIC

Filed Feb. 11, 1953

2 Sheets-Sheet 1

Fig. 1

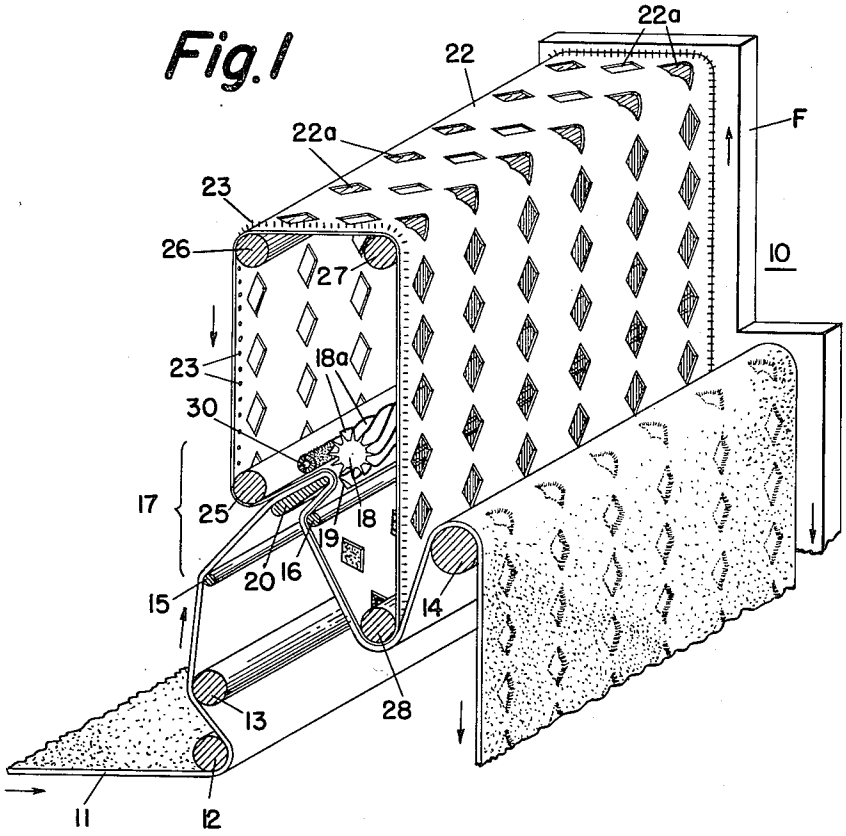


Fig. 2

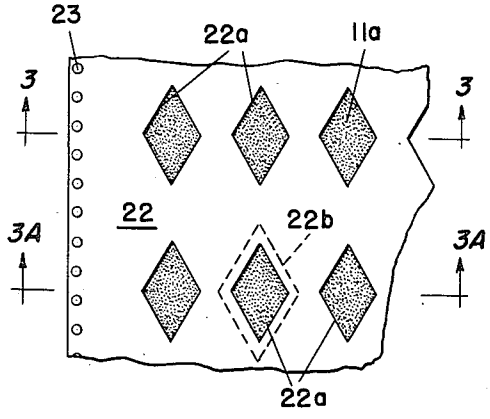


Fig. 3

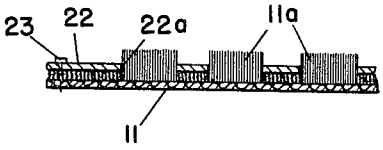
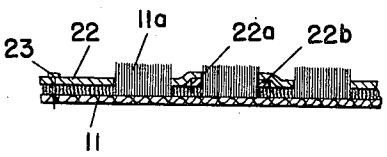


Fig. 3A



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Fig. 4

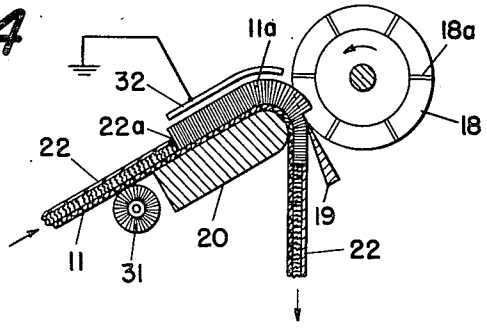


Fig. 5

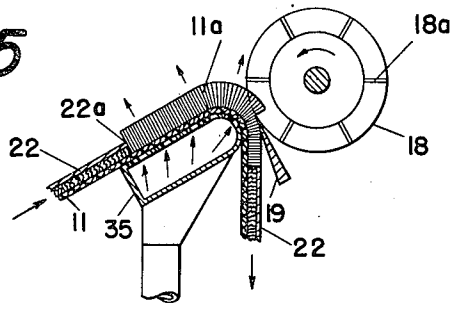


Fig. 6

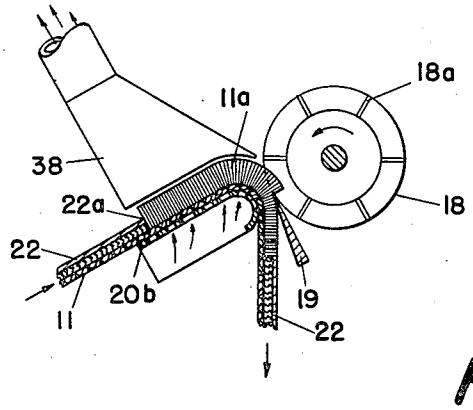


Fig. 7

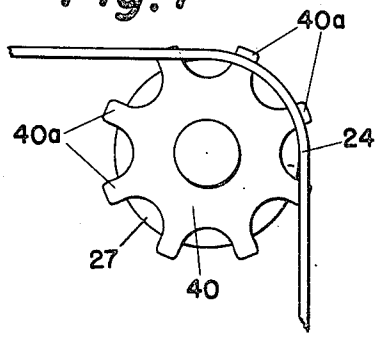
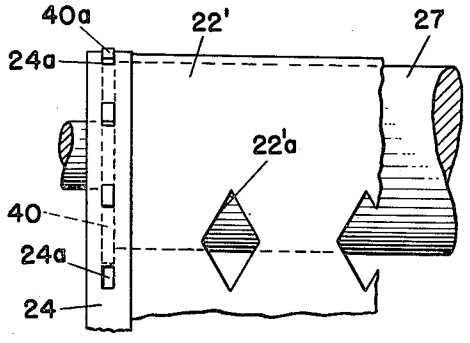


Fig. 8



United States Patent Office 2,758,355 Patented Aug. 14, 1956

2,758,355

APPARATUS FOR PRODUCING A DESIGN IN PILE FABRIC

Joseph William Kradoska, Philadelphia, Pa.

Application February 11, 1953, Serial No. 336,426

1 Claim. (Cl. 26—16)

This invention relates to apparatus for applying a design to, or producing a design in, pile fabric by creating variations in the height of the pile, and has for an object the provision of methods and apparatus for rapidly and accurately shearing a design on pile fabric wherein the design may be substantially unlimited as to variations in a controlled manner.

Heretofore designs have been applied to pile fabrics wherein the design is accomplished by variations made in the height of the pile during the weaving or by cutting the pile to different heights after the fabric has been woven. Weaving a design into a fabric to provide a pile of different heights is an expensive operation and is limited to woven fabrics and is not applicable to the many pile fabrics that are made through other operations such for example as needle operations as distinguished from being woven. Examples of such needle type fabrics are the various types of tufted fabrics including chenille and the like.

It has heretofore been proposed to cut designs in pile fabrics either by hand or by machine operations. However, such prior art arrangements have left something to be desired. Probably the earliest form of cutting a design into a pile fabric was performed by hand operations, and such operations are exceedingly slow and expensive. The prior art machines for cutting a design in a pile fabric with which the applicant is familiar have also involved relatively slow operation, and the arrangements have been such that the design variation has been limited. For example, in one prior art arrangement it was proposed to prepare a looped-pile fabric with a design by first applying a sizing compound to the fabric so that the loops would become stiffened and stand erect when the size was dry. After this, certain areas of the pile fabric were depressed by means of a roll or die having projecting surfaces corresponding in shape with the design to be produced. While depressed, the remaining areas were cut. After this operation the size was washed out of the fabric, thus permitting the previously depressed uncut pile loops to be raised and stand in a surrounding field of cut pile to provide the desired design.

Another prior art arrangement for cutting an ornamental design in a pile fabric was to use a roller for pressing down certain areas of the pile, and while these areas were depressed, to cut off the remaining standing areas by means of a belt-knife skiving machine.

The various prior art arrangements have been subject to a number of limitations when considered in connection with present day methods of manufacture of pile fabrics, and rugs in particular. For example, in recent years cotton rugs of the pile type have become increasingly popular, particularly where wall-to-wall installations are desired as they are less expensive than wool rugs. Many of these cotton rugs are not woven, but instead comprise a tufted fabric produced by needle operations, and at present no practical arrangement has been devised to produce a design during the manufacture of the rug. Thus, to produce a design in such tufted cotton pile rugs, it is necessary to cut the design in the pile. This operation when accomplished in accordance with prior art methods has a number of disadvantages. For example, cotton pile does not have the resiliency of wool pile. Cotton pile tends to lie down, and thus a clear-cut design cannot be applied to the cotton pile merely by pressing down certain areas, such for example, by an embossed roller as utilized in the prior art, and then cutting or clipping the pile that is not depressed by the roller. While it is possible to assist the cotton pile in standing up by applying a size to the pile in accordance with the prior art, such an operation is impractical both from a time and expense standpoint.

Another disadvantage in the prior art arrangements has been the limitation in design variations, such limitations being imposed by the physical size of the design roller. As many pile fabrics, such for example as cotton pile rugs, are available in 18 foot widths, in order to utilize a design roller of the prior art, it would be necessary to provide a roller 18 feet long. Even with a small diameter, such for example as 6 inches or 8 inches, a roller of such size would be very difficult to handle. Thus, it will be seen that the limitations imposed on prior art arrangements as to design variation varies directly with the diameter of the design roller.

In accordance with the present invention the foregoing disadvantages of the prior art have been eliminated by providing a method of applying a design to pile fabric comprising preparing a pattern with design openings, applying the pattern to the pile side of the fabric to permit the pile to extend through the design openings in the pattern, applying a force to the pile opposite the design openings in the pattern to cause the pile to extend therethrough and to stand substantially erect, and shearing the pile extending through the design openings in the pattern.

Further in accordance with the invention, there is provided apparatus for applying a design to, or producing a design in, pile fabric comprising means for passing a pile fabric through a working zone, template means perforated in accordance with a predetermined design for engaging the pile side of the fabric within the working zone to permit the pile opposite the perforations to extend therethrough and to cause the pile between the perforations to be depressed, and means for shearing the pile extending through the perforations of the template means.

Further in accordance with the invention, there is provided means for controlling the lay of the pile extending through the perforations of the template means, wherein said controlling means may comprise an electrostatic-producing means, pressure-producing means or suction-producing means, as hereinafter set forth.

The template means perforated in accordance with a predetermined design may be in the form of a sheet of material, either metallic or non-metallic, and the sheet material may be provided in the form of an endless belt. As will hereinafter be pointed out in detail, the endless belt may be substantially unlimited in length, and thus the design to be applied to the pile fabric is accordingly substantially unlimited in variation.

For further objects and advantages and for a more complete understanding of the invention, reference is to be had to the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view showing a portion of a shearing machine embodying the present invention;

Fig. 2 is a plan view showing a portion of the template of Fig. 1 having the predetermined design cut therein and disposed against the pile surface of the fabric;

Fig. 3 is a sectional view taken along the lines 3—3 of Fig. 2 showing the pile exposed to shearing extending through the openings in the template and the other pile being held down by the template;

Fig. 3A is a sectional view taken along the line 3A—3A of Fig. 2 and showing a modification of the invention for varying the depth of cut of the pile;

Fig. 4 is a fractional view on an enlarged scale showing the working parts and their relation to the pile fabric and template within a working zone similar to that of Fig. 1, and includes electrostatic-producing means for causing the pile extending through the perforations in the template to stand substantially erect;

Fig. 5 is a fractional view on enlarged scale showing a working zone similar to that of Fig. 1 but including pressure means disposed beneath the pile fabric for causing the pile extending through the perforations in the template to stand substantially erect;

Fig. 6 is a fractional view on enlarged scale showing a working zone similar to that of Fig. 1 and including suction means disposed above the pile surface of the fabric for applying suction to the pile extending through the perforations in the template; and

Figs. 7 and 8 are fractional views of a modification of the template driving means illustrated in Fig. 1.

Referring to Fig. 1, the present invention while not limited thereto has been shown as applied to a shearing machine **10** of the conventional and well-known type, such for example as a Curtis and Marble machine. The pile fabric **11** to which the design is to be applied is fed from left to right in Fig. 1 from a supply roll (not shown) over a series of rollers **12—14** supported at their ends as by frame F. One or more of the rollers **12—14** may be driven for feeding the pile fabric through the working zone **17** of the machine. Included in working zone **17** is a cutting roller or revolver **18**, upon the periphery of which is a series of continuous spiral cutting edges **18***a* and a stationary blade or ledger-blade **19**. The pile fabric is fed continuously through the machine **10**, passing rollers **12—14** and tensioning devices **15**, **16** which smooth it and pass it over a straight edge member indicated at **20** where it is sharply bent, and the fibers **11***a* of the pile fabric **11**, Figs. 4–6, are projected outwardly in substantially a single line across the machine and caught between the spiral blades **18***a* of rotary cutter **18** and the straight knife **19**, whereupon the pile **11***a* is reduced in length.

In accordance with the present invention, in order to control the pile **11***a* to be sheared or cut off by the cutting members **18** and **19**, there is provided a template means **22** in the form of sheet material having a predetermined design cut therein. The template means **22** has been shown in the form of an endless belt passing over a series of rollers **25—28**. The belt **22** may be made of any suitable sheet material, either metallic or non-metallic, such for example, as sheet metal, fiber, leather, rubber, fabric, plastic, paper, spun glass with resinous binder, and the like. The endless belt **22** engages the pile surface of the fabric within the working zone **17** and between rollers **25** and **28**. As the template **22** and pile fabric **11** pass through the working zone **17** of the machine, the pile **11***a* opposite the openings **22***a* in the template is permitted to extend therethrough, whereas the pile beneath the solid portions of the template will be depressed and thus not exposed to the cutting knives **18** and **19**, such for example, as shown in Figs. 2 and 3. The endless belt **22** moves through the working zone **17** of the shearing machine **10** in synchronization with movement of the pile fabric **11**. The endless belt **22** may be driven in synchronization with pile fabric **11** in any suitable manner, for example, by driving one or more of rollers **25—28** or by providing the edges of the endless belt **22** with a series of spikes **23** for engaging the edges of the pile fabric **11**, and thus causing the template or endless belt **22** to move through the working zone **17** in synchronization with the movement or travel of pile fabric **11**.

Another arrangement for controlling the template as it passes over its rollers **25—28** and through the working zone of the machine is illustrated in Figs. 7 and 8. The template **22'**, having design openings **22'***a* therein, is provided at its edges **24** with a series of perforations **24***a* for cooperation with a series of projections such as the teeth **40***a* on sprocket wheel **40**. Each of rollers **25—28** preferably is provided with a similar sprocket wheel **40** in the manner shown in Fig. 7 in connection with roller **27**. As pointed out above, one or more of rollers **25—28** may be driven and thus the template **22'** will be passed through the working zone of the machine by the sprocket wheel **40**, thereby assuring uniform alignment and repeats of the patterns with respect to the pile fabric. The edges **24** are formed integral with the template **22'** and may be of the same or different material. Preferably, however, the edges **24** are formed of metal even though the remainder of the template **22'** may be non-metallic.

In order to present a clear-cut design in the finished fabric, it is necessary during the shearing operation that the lay of the pile opposite the perforations be such that substantially all the fibers of the pile opposite the perforations **22***a* extend therethrough and stand erect so that they may be uniformly sheared by the shearing members **18** and **19**. With pile fabrics where the pile is of relatively high resiliency, the foregoing will be accomplished more or less automatically when the template **22** is pressed against the pile surface of the fabric. However, in some pile fabrics, such for example as cotton pile fabrics, the pile is of relatively low resiliency and has a tendency to lie down. Thus, it is desirable to provide means for controlling the lay of the pile **11***a* opposite the perforations **22***a* of the template **22** to insure that the pile will extend therethrough and to cause the pile to stand substantially erect. Accordingly, there has been illustrated in Fig. 1, as one type of such means, an electrostatic-producing means which, for example, may be in the form of a rotary brush **30**. The brush **30** may be driven at a suitable speed to create a static field, for example, 300–400 R. P. M., or above, and acts on the pile opposite the openings **22***a* in the template **22** within the working zone **17**. The static field created by the brush **30** causes the pile opposite the openings **22***a* in the template to extend therethrough and to stand substantially erect as it is being sheared by the shearing means **18** and **19**, thus providing for a uniform cutting of the pile and imparting a clear-cut design to the pile fabric.

In Fig. 4 there is shown a modification of the electrostatic-producing means of Fig. 1. A means for creating an electrostatic field, such as a rotary brush **31** similar to brush **30**, is disposed beneath the pile fabric **11** at the working zone **17** and there is provided a grounded means or plate **32** above the pile fabric for concentrating the electrostatic field in a direction to cause the pile **11***a* opposite the perforations **22***a* to extend therethrough and to stand substantially erect.

In Fig. 5 there has been illustrated another means for causing the pile extending through the perforations in the template **22** to stand substantially erect as it passes through the working zone. This means has been illustrated as a pressure means **35** in the form of a pressure head extending transversely of the shearing machine **10** and parallel to the shearing roller but at the opposite surface of the pile fabric from the shearing roller **18**. The pressure means or head **35** is designed to be connected to a suitable source of compressed air (not shown) for directing a flow of compressed air against the under surface of the pile fabric **11** to cause the pile **11***a* opposite the perforations **22***a* in the template **22** to extend therethrough and to stand substantially erect as it is being sheared in the working zone by the shearing members **18** and **19**.

Another means for controlling the lay of the pile with respect to the perforations in the template **22** within the working zone of machine **10** has been illustrated in Fig. 6 in the form of suction means **38**. The suction means **38**

is disposed above the pile surface of the fabric in a position similar to that illustrated in Fig. 1 for the brush **30**, and as the template **22** and pile fabric **11** pass through the working zone over member **20***b*, suction is applied to the pile **11***a* opposite the openings in the template **22**, thus causing the pile **11***a* to extend therethrough and to stand substantially erect so that it may be readily and uniformly shared by the cutting or shearing members **18** and **19**. The member **20***b* preferably is perforated to permit the air readily to be drawn through the pile fabric **11** by the suction means **38**.

While the invention has been described as particularly applicable to applying a design to cotton pile rugs, it is to be understood that it is not limited to cotton pile fabrics, but is applicable to all types of pile fabrics including wool, mohair, plush and the like. Since the invention is applicable to different pile fabrics, and since some pile fabrics react differently than others, that is one of the reasons applicant has provided a plurality of means and methods for extending the pile within the working zone, such for example as the static, pressure and suction arrangements described above. While all of these arrangements are effective on the various materials, it is to be understood that one or more of these arrangements may be more effective than the other, depending upon the material being operated upon.

In one embodiment of the invention, the rotary cutter **18** had a diameter of between 6 inches and 14 inches and traveled at a speed of about 700 R. P. M. The speed of the fabric within the working zone was about one yard per minute, and the depth of cut was approximately ¼ inch. It is to be understood that the speed of the cutter and the speed of the fabric may be regulated so that it can be varied with different types of fabrics. While a rotary shearing machine has been described and illustrated in connection with this invention, it is to be understood that the cutting or shearing means is not limited to a rotary shearing machine, but is applicable to other arrangements for cutting or shearing the ends of the pile extending through the template means **22**. For example, the cutting knife need not be of the rotary type but may be any equivalent cutting or shearing means, such for example as a pair of clipper blades, one of which is a serrated knife reciprocating shearwise with a similar blade stationary or also reciprocating, or a flat blade as utilized in a conventional belt-knife skiving machine, or the like.

In view of the foregoing description, it will be seen that the template means **22** or **22'** provided by applicant has a number of advantages not heretofore found in the prior art, and at the same time has none of the disadvantages of prior art arrangements. For example, to apply a design of pile fabric, such as carpet material 18 feet in width, it would be impractical to use a roller of any sizable diameter, and since the diameter of a roller is limited, this necessarily limits the extent of variation that may be provided in the design. In the applicant's arrangement, it has been pointed out that the template means **22** or **22'** may be widely varied as to length, and thus the design to be applied to the rug may likewise be widely varied. This feature is of considerable importance in installations where a carpet of relatively great length is utilized, such for example, in hotels or other public buildings or in pullman cars, or the like, where it may be desired to vary the design for the full or a substantial length of the carpet. While carpet material is supplied in widths less than 18 feet, nevertheless this size has become increasingly important from a commercial standpoint due to the increasing popularity of wall-to-wall installations in the home.

A further advantage provided by applicant's arrangement is that the depth of cut may be varied individually with respect to each design perforation. While it is possible in applicant's arrangement uniformly to vary the depth of the design to be cut in the rug by raising or lowering the cutting members and thus varying the spacing between the cutting members and the pile surface of the rug, it is likewise possible to control the depth of each element of the design to be cut into the rug. This feature may be attained as shown in Figs. 2 and 3A by varying the thickness of the template means **22** surrounding a predetermined number of the perforations **22***a*, such for example, as by applying a patch **22***b* to each of those sections of the template **22** and thus decreasing the height that the pile will extend through the openings in those areas of the template. To avoid interference between the template **22** and the cutter **18**, due to the patch portions **22***b*, the cutting blades **18***a* preferably may be notched at locations corresponding to the disposition of the patches across the template **22**. By selectively varying the depth of cut in the foregoing manner, different design effects are created due to changes in color in the pile fabric resulting from the different lengths of pile presented in the finished design.

The term "template" has been used generically in the specification and in the claim and is intended to include any means having perforations through which the pile of a pile fabric can extend in order that it may be sheared by a suitable shearing means, such as a stencil, matrix, pattern, or the like. The term "shearing" has been used generically in the specification and claim and is intended to include any equivalent means for cutting, severing, clipping, or the like, for operating on the ends of the pile of a pile fabric.

It is also to be understood that other changes and modifications of the invention may be made within the scope of the appended claim and that the invention is not limited to the specific arrangements shown.

What is claimed is:

Apparatus for applying a design to pile fabric comprising means for passing a pile fabric through a working zone, sheet means perforated in accordance with a predetermined design for engaging the pile side of the fabric within the working zone to permit the pile opposite the perforations to extend therethrough and to cause the pile between the perforations to be depressed, means on said perforated sheet means for synchronizing said sheet means with movement of the pile fabric through the working zone, said last-named means comprising a series of spikes extending along the edge of said sheet means, means for causing the pile opposite said perforations to extend therethrough and to stand substantially erect, and means for shearing the pile extending through the perforations of said sheet means.

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