

Nov. 4, 1969

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3,475,926

RAISED WARP KNIT FABRICS

Original Filed May 3, 1963

Fig. 1

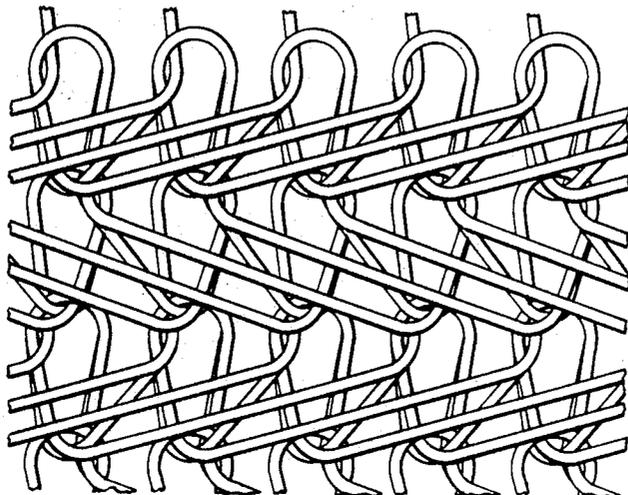


Fig. 2

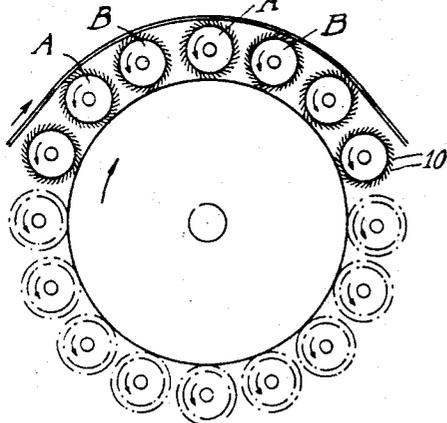


Fig. 3

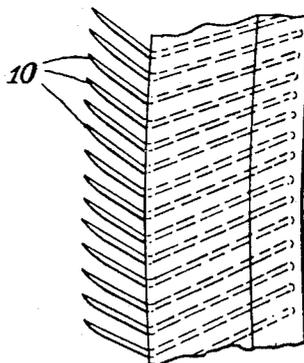
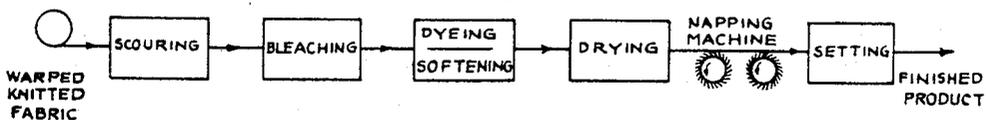


Fig. 4



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RAISED WARP KNIT FABRICS

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Continuation of application Ser. No. 558,147, June 16, 1965, which was a continuation of application Ser. No. 482,996, Aug. 10, 1965, which in turn was a continuation of application Ser. No. 278,528, May 3, 1963. This application June 13, 1967, Ser. No. 645,840

Int. Cl. D04b 7/12, 9/12, 23/08

U.S. Cl. 66—194

7 Claims

ABSTRACT OF THE DISCLOSURE

A warp knitted fabric is provided which comprises a top warp and a back warp. Both the top warp and the back warp have substantially straight floats. The floats of the top warp and the back warp are raised to form a pile of unbroken loops.

The present invention relates to knitted fabrics, and more particularly to fabrics of this type which have velvet-like properties.

This application is a continuation of application for United States Letters Patent Ser. No. 558,147, filed June 16, 1965, now abandoned, which in turn was a continuation of Ser. No. 482,996, filed Aug. 10, 1965, now abandoned, which in turn was a continuation of Ser. No. 278,528, filed May 3, 1963, now abandoned.

In accordance with the invention there is provided a novel, and very advantageous, knitted synthetic fabric which is very similar to velvet, having exceptional properties as regards lustre, feel, draping and handling qualities, durability and the like, and also provided a novel method by which such fabric is produced.

The cloth or fabric of the invention is not only characterized by a rich velvet-like appearance and feel, but it has a surprisingly high lustre and good drape, with a soft and full handle. The finished fabric, when made of relatively light denier yarn such as 30 or 40, is especially suitable for use in the manufacture of blouses, sweaters, negligees, housecoats, bed jackets and the like, whereas when heavier yarn, such as 60, 100 or 150 deniers, is used it has utility in the furnishing field.

As provided herein, the fabric is preferably warp knitted of nylon or like threads and is characterized by a raised pile constituted of a multiplicity of unbroken loops. To enable this to be done, in the knitting operation the fabric is especially constructed with floats which can be pulled out to appreciably raised positions as unbroken loops. As will be later more fully explained, this knitting operation in conjunction with the special loop-raising operations provide the unique fabric structure which produces the unusual velvet-like appearance, texture and feel, as achieved by this invention.

Therefore, an object of the invention is to provide a novel and improved velvet-like synthetic fabric having exceptional lustre and texture, and good draping and handling qualities.

A further object of the invention is to provide a novel, knitted, synthetic fabric which is characterized by a large multiplicity of unbroken loops of appreciable size, constituted from the warp threads of the fabric, whereby an advantageous, velvety quality, feel and texture are produced, both in relatively light and relatively heavy materials.

An additional object of the invention is to provide an improved, velvet-like knitted synthetic fabric as above set forth, which may be readily produced in various

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colors and finishes, and which is sturdy and durable in use, resistant to wear, capable of being readily handled, worked, sewn, etc., and which has the ability to retain its shape under various conditions of use.

Another object of the invention is to provide a novel and advantageous method by which the exceptional, velvet-like synthetic fabric of the invention can be made.

A feature of the present invention resides in the provision of a novel fabric as above set forth, which may be produced with presently existing machinery and equipment suitably modified in accordance with the teachings of the invention.

Other objects and advantages of the invention will become apparent from the following description and explanation thereof.

To provide a better understanding of the present invention, reference will be had to the accompanying drawings wherein:

FIGURE 1 is an enlarged diagrammatic representation of the weave employed in producing the basic fabric with special floats, for the purposes of the invention;

FIGURE 2 is an end elevational view of a portion of a loop raising device used in the process of the invention, showing rollers having prongs provided with drill-point ends;

FIGURE 3 is an enlarged side elevational view of the prongs carried by the rollers of the present invention; and

FIGURE 4 is a schematic block diagram of the equipment, illustrating the process of the invention.

Synthetic fibres which have been found especially suitable for use in producing the fabric of the present invention are the polyamide type, although the invention is not to be limited to this specific group of materials. The polyamide used widely in industry today is known as nylon, which is produced from adipic acid and hexamethylene diamine alone or modified with other bifunctional groups such as sebacic acid or the like. Another polyamide of notable characteristics is known in the trade as Perlon, which is made from caprolactam. These synthetic fibers are available in various sizes, and as indicated hereinabove, yarns of 30–150 denier are suitable for the present purpose; however, the size can be varied even further depending upon the application for which it is to be used.

An unfinished or basic fabric suitable for the purposes of the invention may be produced on a standard tricot machine. Such a machine employs a needle bar containing knitting needles which move as a unit. Two guide bars are arranged one in front of the other. They are connected to permit movement through the needles as a unit; however, each guide bar can move laterally and independently of the other. The guide bars are furnished with yarn by respective warp beams, which are mounted one above the other at the back of the machine.

The tricot machine employs one or more warps similar to weaving, but differing from it in that no weft thread is employed to bind the fabric together. Instead, each warp thread is connected to the warp threads adjoining either side of it. A detailed description of the operation may be found in "Tricot Fabric Design," by Thomas H. Johnson, McGraw-Hill Book Company, Inc., 1946.

Knitting of the basic fabric as provided by the invention is accomplished on fine or coarse gauge warp knitting machines, a 28 gauge machine being particularly effective. For the purposes of the invention it is essential to provide a knitted basic or initial fabric structure with floats so arranged that they can be easily raised to form a pile of unbroken loops. In the knitting operation, a plain tricot structure is preferably knitted by the back guide bar (1–0, 1–2) whereas the front guide bar, similarly threaded, preferably produces the special floats by

laying the yarn over three needles (1-0, 3-4). The front and back guide bars are parallel to each other. The knitting ratio between the two guide bars or warps is about 2 to 1.

By varying the knitting arrangement at given intervals, or by omitting warp threads from the front or top beam, it is possible to create a multitude of patterned effects in the finished fabric of the invention, such as squares, diamonds, etc. The basic fabric structure, before the raising of the floats, is loose in form as it leaves the machine, but it becomes sturdy and may be readily handled and worked as a result of the finishing operation provided in the method of the invention. For a better understanding of the nature of the knitted basic fabric, reference may be had to FIGURE 1 of the accompanying drawings.

The unset or basic fabric may be cleaned or scoured of dirt and/or stains. The scouring or cleansing operation is preferred, because the fabric thus treated responds better to the loop raising procedure provided by the invention. Various methods may be employed to clean the fabric, just so long as no harm is done or appreciable structural changes effected. For example, the fabric may be formed into an endless belt and passed through a cleansing bath, or simply laid in a cleansing bath with essentially the same effect. However, in any of the methods used, care must be taken to avoid creasing the material. For cleansing actions, an alkaline reagent such as NaOH, Na₂CO₃ or the like is added to the bath to raise the pH to about 8 to 12. A detergent, preferably of the non-ionic type, may also be used. The non-ionic detergent may be derived from the reaction of ethylene oxide with fatty alcohols, alkyl-substituted phenols, fatty acids, resin acids, etc., and may contain about 4 to 40 repeating units of ethylene oxide. Pine oil or pine oil soap is preferably used in the cleaning step when operating facilities are not particularly clean.

For optimal results, in the next step of the process of the invention, the fabric may be bleached. This may be accomplished by any of the conventional methods, and for that reason skilled persons would readily appreciate the conditions involved. Bleaching may be supplemented by a treatment with optical or whitening agents.

Thereafter the fabric is dyed, and in dyeing the fabric conventional techniques may be employed. For this purpose, any of the well known disperse dyes including nitro-arylamine, azo or anthraquinone dyes may be used. Specific examples are 1,4-diamino-2, 3-anthraquinone dicarboximide (blue), 1,4,5,8-tetraamino anthraquinone (blue), 2,6-dichloro-4-nitro-4¹ (N,N-hydroxyethylmethyl) amino benzene (Brown), 4,4¹-diamino-azobenzene (orange), 1-hydroxy-4-aminoanthraquinone (red), etc. Such dye-stuffs in general constitute about .1% to 2% by weight of the dye bath.

After the polyamide fibre is knitted into the basic fabric above set forth, and the fabric treated as explained, its loops are then raised, in accordance with the present invention. The loop raising process is preferably facilitated by a special chemical treatment provided by the invention, which softens the fibers and favors the raising of the unbroken loops. The chemical treatment involves the use of an aqueous solution of a non-ionic detergent. The non-ionic detergent may be any one or more of those derived from reacting ethylene oxide with fatty alcohols, alkyl substituted phenols, fatty acids, resin acids, etc. There may be present from 4 to 40 repeating units of ethylene oxide in the molecule. The fatty acid esters are preferred for this purpose, particularly those having eighteen carbon atoms in the acid. The softening agent preferably constitutes a mixture of stearic-ethylene oxide and oleic acid-ethylene oxide. The treatment is effected by using about 25% to 3% softening agent in aqueous solutions, with or without the presence of a weak acid, such as acetic acid, and submerging the fabric therein at a temperature of about 100° to 120° F. and for about 10 to 30 minutes. The softening treatment may optionally consti-

tute part of the rinsing operation which follows the dyeing above described.

Where a treatment has been effected resulting in the fabric having a water content, the next step is to remove the water. For such purpose a padder or the like is utilized to remove at least 80% of the water. Thereafter the fabric is fed with pin frames through an oven heated to a temperature of about 180°-220° F. This completes the drying operation and provides the fabric with a uniform width prior to the loop raising process hereinafter described. In any of the procedures, prior to raising the unbroken loops it is important to avoid creasing the material, because otherwise the resultant product may be defective. It should be also understood at this point that the loops of the knitted fabric containing the special floats may be raised without any of the foregoing preliminary treatments and still be within the scope of the present invention.

The warp knitted fabric is processed, in accordance with the invention, by a technique which appreciably raises or pulls out the floats into raised positions, forming unbroken loops. It has been found that a large multiplicity of such raised loops constituting the pile impart a soft velvety appearance to the synthetic fabric which is unlike any previously known synthetic cloth material. The luster, draping characteristic and handling qualities of such a raised fabric are outstandingly better than any other synthetic fabric used for decorative or clothing purposes, and compares favorably with velvet made from natural fibers.

In raising the loops, according to the present invention, modified forms of carding equipment may be used. In the conventional way, napping is usually done by passing fabrics over rollers covered with wire cards which are nothing more than wires projecting from a base and having their free ends formed into the shape of burrs or provided with spurs. By the present invention, in place of the cards being formed of wires having burred ends they are formed of prongs or wires constituted in the form of drill points. The prongs protrude from the base of the roller at an angle of about 60° and are uniformly distributed over its surface. When the prongs comprise metal wires of for example 26/28 gauge, about 20 wires are provided per square inch of the surface of the roller. It will be understood that the number of prongs utilized in the carding rollers will vary dependent upon their fineness or coarseness.

FIGURES 2 and 3 of the accompanying drawings are illustrative of the rollers having prongs 10 provided with drill point ends in accordance with the present invention and also of the loop raising process. In this loop raising operation, the fabric is contacted by the upper portion of the prongs on the rollers. The rollers are carried by a rotating cylinder which turns, as shown by the illustrated arrows, in the same direction as the direction of travel of the fabric. The fabric is not driven by the cylinder or rollers but rather by means separate therefrom. The rollers rotate about their axes independently of the cylinder in the direction also illustrated by arrows in FIG. 2, with adjacent rollers turning in directions opposite to each other. The rollers A rotate in the same direction as the cylinder rotates while the rollers B turn in a direction opposite to the rotation of the cylinder. The prongs of roller A are slanted downwardly away from the surface of the fabric at their point of contact while the wires of roller B are slanted upwardly away from the surface of the fabric at their point of contact. With this arrangement the particular loop raising prongs of the present invention brush against the fabric in such manner as to cause the loops to be gently raised without severing the same or damaging the fabric. It is preferable to urge the fabric in the manner described twice in opposite directions over the roller. It will be understood however that the fabric may be passed over said rollers as many times as is necessary to achieve a desired result.

The novel initial formation of the fabric and the uniquely constructed loop raising prongs utilized as described provide a fabric of superior and highly desirable texture, appearance and durability.

One of the features of the present invention is the ability to utilize existing carding or napping equipment which has been modified in accordance with the present disclosure. Thus, cylinders, drive mechanisms and cards of present carding or napping machines may be utilized with the modifications herein described.

Following the loop raising operation, the fabric is subjected to a setting treatment in which the fabric is heated in an oven of about 360° to 390° F. and for a period of about 1 to 2 minutes. The raised loops are thus set permanently, and the fabric may be subjected to conditions of use or handling without retraction of the loops into the fabric.

The fabric used as a specific example of the invention is a nylon yarn of 30 denier, with 10 fibers, produced on a warp knitting machine 28 gauge fineness, and the yarn may be twisted or not.

The nylon fabric is initially about 168 inches in width, with floats, stretched on three needles. The machine is operated by the formula:

Front guide bar: 1-0, 3-0 and back guide bar: 1-0, 1-2. The knitting ratio between the two guide bars is approximately 2 to 1.

The fabric contains about 4664 threads.

To enable the fabric to be accommodated by conventional sized carding machines for the purposes herein set forth, the fabric is divided into two equal parts each about 84 inches in width. This division can be accomplished in any known manner as for example, while knitting the fabric by initially omitting several threads at a point midway across the width thereof, or by initially knitting the fabric across the entire width thereof and then physically cutting the same with a cutting tool.

A specific treatment of the fabric is as follows:

The pieces of such fabric are sewn into tubular form and laid in a dye box for cleaning. After the fabric is placed in the box, cold water is added, along with sodium hydroxide, 2 cc. per liter of water and pine oil, 1 cc. per liter of water. The temperature is raised to 149° F. and the entire operation takes about 1 hour. The scoured fabric may then be bleached by a solution of 2 gm. of peracetic acid per liter of water and 2 gm. of a wetting agent such as an ethylene oxide condensate per liter of water, to the extent that 1.5% of clarity and 0.5% of wetting agent are employed, based on the fabric. The bleaching is effected at 167° F. for about 1 hour.

The bleached fabric is dyed in an open box. The fabric is placed in the box, cold added, a dye such as 4.4' diaminobenzene is added, and the dye bath temperature is raised to 149° F. within 1 hour. Following, the dye bath is brought to boil and held there for 3 hours. At the conclusion of dyeing, the fabric is cooled by rinsing with cold water. The last rinse is achieved with 1% of polyethoxy stearate detergent, ½% of polyethoxy oleate detergent and 2% acetic acid in water, at 104-113° F. for 20 minutes. The cloth is then padded to remove water and fed through a drier with pin frames at about 190° F. to complete the drying operation and provide a fabric uniformly approximately 60 inches in width.

As hereinabove set forth, after the fabric is dried, the loops are raised while the fabric is traveling in the same direction as the direction of rotation of the cylinder. The cylinder rotates at 120 revolutions per minute and the fabric is passed through the loop raising mechanism at the rate of about 24 yards per minute. As aforesaid, the loop raising mechanism may comprise presently existing but modified carding or napping equipment. In this form, the rollers are rotated about their own axes by means independent of the supporting cylinder with adjacent rollers turning in opposite directions. Roller A rotates in the same direction as the cylinder rotates and is provided

with prongs which are angularly disposed downwardly away from the contacted surface of the fabric. Roller B rotates in a direction opposite to the cylinder rotation and is provided with prongs which are angularly disposed in the opposite direction or upwardly away from the contacted surface of the fabric.

The relatively gentle brushing action to which the fabric is subjected in the aforementioned manner, raises the loops without severing the same or in any way damaging the fabric itself. To obtain the desired result it is preferable to pass the fabric through the loop raising device at least twice in one direction and thereafter in the opposite direction. It will be understood however that the number of passages of the fabric may vary as desired.

After the loops are raised the fabric is preferably set by its passage in approximately one minute through an oven which is heated to about 340° F. The fabric is then cooled and is ready for manufacture into finished goods.

Although the invention has been described in detail, it will be understood that the description is intended to be illustrative rather than restrictive of the spirit or scope of the invention.

Having thus described my invention I claim:

1. A warp knitted fabric having top and back warp yarns, each of said yarns comprising a plurality of continuous filaments, said top warp yarns knitted to form floats extending over two, or three wales between each knitted stitch, said back warp yarns knitted 1-0, 1-2, and the plurality of filaments in said floats being raised to form a pile of unbroken loops.

2. A fabric according to claim 1 wherein the top warp yarns are knitted 1-0, 3-4.

3. A fabric according to claim 1 wherein the top warp yarns are knitted 1-0, 4-5.

4. The warp knitted fabric of claim 1 wherein said warp knitted fabric is made of synthetic material of the polyamide type and wherein said fabric has been heat set to impart the appearance of velvet thereto.

5. The warp knitted fabric of claim 4 wherein said synthetic material of the polyamide type is a nylon yarn of about 30 denier with about 10 fibers.

6. A warp knitted synthetic fabric of claim 1 in which said fabric has been heat set to impart the appearance of velvet thereto, comprising a top warp and a back warp, said top warp and said back warp having substantially straight floats, said floats being raised to form a pile of unbroken loops.

7. The warp knitted fabric of claim 3 wherein said synthetic material of the polyamide type is a nylon yarn of about 30 denier with about 10 fibers.

References Cited

UNITED STATES PATENTS

466,642	1/1892	Woelfel	-----	26-29
668,510	2/1901	Forrester.		
1,672,712	6/1928	Dulligan.		
2,173,404	9/1939	Ubbink.		
2,338,945	1/1944	Just et al.		
2,705,880	4/1955	Kinzing.		
3,026,596	3/1962	Kuppers et al.		
3,090,097	5/1963	Ruckstuhl	-----	28-72

FOREIGN PATENTS

672,741	10/1963	Canada.
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OTHER REFERENCES

- Press, J. J. (Ed.), "Man-Made Textile Encyclopedia," New York, Textile Book Pub., 1959, pp. 456 to 466.
- Paling, D. F., "Warp Knitting Technology," London, Harlequin, 1952, pp. 42 to 50.

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U.S. Cl. X.R.