J. A. MIGEL.
WOVEN FABRIC AND METHOD OF MAKING THE SAME.
APPLICATION FILED OCT. 25, 1919.

1,338,032.
Patented Mar. 9, 1920.
2 SHEETS-SHEET 1.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Julius A. Migel
Inventor

By Attorney
George C. Heau
To all whom it may concern:

Be it known that I, JULIUS A. MIGEL, a citizen of the United States, and resident of Pelham Manor, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Woven Fabrics and Methods of Making the Same, of which the following is a specification.

My present invention relates to the production of novel silk fabrics of the type in which beauty and novelty of texture rather than structural strength or durability are the desired qualities.

The object is to produce from artificial silk threads such as are derived from cellulose, and from real silk threads such as are derived from the silk-worm, a fabric which is of special, peculiar and distinctive appearance by reason of the peculiar form and structure of the fabric and its method of manufacture.

To this end the cross-running weft or filler threads comprise relatively thick threads of the artificial silk, each such thread having close to it, but separate therefrom and preferably underlying it, a thin thread of real silk. Preferably the thick threads of artificial silk have little or no apparent twist, say not more than 1 to 2½ turns per inch, but it is essential that the thin threads of real silk be very highly twisted, say 75 to 75½ turns to the inch for a thread one to two-hundredths inch in diameter and preferably such twist is either all right hand or all left hand throughout the fabric. In the weaving, the heavy weft threads of the artificial silk are left uncovered by the warp threads at certain points. Preferably they are floated over one or more of the warp threads, while the underlying highly twisted real silk threads are preferably bound in by all the warp threads including those at points where said heavy threads are free.

The artificial silk fibers are relatively stiff and shrink little or not at all in the subsequent washing or dyeing processes while the highly twisted real silk threads being cleansed from the gum that stiffens and holds them straight during the weaving, will then shrink and kink so as to shorten considerably, say 8% to 10% or more of their length. As a result of such differential shrinking, the underlying real silk threads which are bound into the fabric each acts as a contractile spring drawing in on the float portions of the stiff artificial silk and forcing the intermediate portions to bow outward away from the fabric and bulge up in the spaces where they are not bound into the warp. Each such bulge consists of an arching loop or tuft of artificial silk projecting very prominently above the level of the fabric, wholly on one side thereof.

Where the bulge spaces are not predetermined by floating the thick threads over one or more of the warp threads, the bulges are likely to be distributed haphazard, and while this is sometimes desirable, predetermined pattern effects are often preferable.

One difficulty which I have had to overcome in applying my invention to the production of regular pattern effects, has been that artificial silk, the fibers are too stiff and inelastic, but I have succeeded in practically obviating this difficulty by treating the artificial silk thread before weaving with a softening solution, preferably a mixture of distilled water with a sulfonated castor oil known to the trade as "Turkish Red" oil, preferably about 10 parts of water to 1 part of oil.

When definite, suitably proportioned, open spaces are provided for the bulging action said spaces and the resulting arches or loops may be distributed over the surface of the fabric with any desired degree of regularity or irregularity. If desired, the float portions of successive artificial silk threads may be arranged in the same straight line so that the successive arches or tufts constitute a more or less definite ridge.

Where this effect is desired, I prefer to use a corrugated reed to beat up the weft during the weaving, that is to say, the vertical reeds which beat up the weft threads after they are laid in the warp shed by the shuttles, do not have their front edges all arranged in a straight line, those opposite the float of the artificial silk being slightly in advance of the others. The effect of this is to deflect the float parts of the weft, thereby stretching those intermediate parts of the weft that are bound into the warp and at the same time localizing the slack at the float points, thus giving more material for a higher bowing or bulging of the artificial silk, as well as making such bowing or bulging more uniform.

If desired, however, a softer and more irregular appearance may be given by a
very loose weave and by variegated dispositions of the float points of the artificial silk. A great variety of other effects may be obtained by varying the number of warp threads that said artificial threads are floated over, or by varying the number of warp threads by which the artificial threads are bound into the shed or mesh of the warp.

A peculiarity of the fabric is that the heavy artificial silk threads being unbound and practically without twist at the points where they are bowed outward by the tension of the underlying high-twist real silk thread, the resulting fabric is relatively more pliable and softer and when made into a garment hangs more gracefully than would be possible if the big artificial silk threads were woven into the warp throughout, as are the little high twist real silk threads.

Preferably the warp threads are fine threads of real silk, preferably with the fibers entirely untwisted.

It will be observed that when real silk threads are used for the warp, and the highly twisted weft threads are woven into every shed or mesh of the warp, the fabric is, from a structural viewpoint a finely-threaded loosely-woven real silk fabric in which relatively large artificial silk threads are included as a sort of supplemental filler, caught and woven in with the real silk filler at certain points and at other points left free and floated over the same.

Preferably the floats and resulting bulges of the artificial silk filler threads are all on the same side of the fabric so that the fabric appears to be mainly real silk on the back side and on the front side mainly artificial silk characteristically variegated by the real silk warp.

This is of particular importance in case the fabric is dyed in the piece after weaving. In such case, dyes may be employed which color only the real silk fibers but do not have any effect on the artificial silk fibers. In such case the dyed warp threads will give a background and an impression of cloth of the color of the dye, while the white artificial silk shining through the warp threads where it is woven into the warp and bulging above the surface where it is floated over the warp will afford a pleasing and novel contrast.

Vice versa, the cloth may be dyed after weaving with colors affecting the artificial silk and have no effect on the real silk.

A still greater variety of effects may be obtained by first using dyes coloring the real silk a desired color and then utilizing dyes coloring the artificial silk any desired color harmonizing or contrasting with the color of the real silk.

In any of the above cases the smooth wrong side of the cloth as also the background of the front side of the cloth will have the effect of a cloth of the color of the real silk variegated by the artificial silk.

Even where the fabric is merely boiled in soap and water to produce the required shrinkage of the high twist threads, thus leaving the fabric white, there is a pleasing, unique effect due to the bulging of the larger—artificial silk threads through the very fine threads of the warp.

While there is no definite upper or lower limit to the size of the large artificial silk threads, or of the fine higher twist real silk threads, the effects will be particularly pleasing where these sizes are properly selected and proportioned. For instance, the tight-twisted real silk weft threads may be very fine—say one to two hundredths of an inch in diameter—the warp thread, when of real silk and subject to flattening through the stress of weaving may be twice this diameter. The larger artificial silk threads may be say four to ten times the diameter of the higher twist weft threads which underlie them. It will be noted that these proportions will make the cross section of the artificial silk threads 10 to 100 times the cross section of the tight-twisted threads.

While it is very difficult to give precise figures for anything so elastic and variable as silk threads, the above may be considered as illustrative figures.

The same qualities of softness, flexibility, stretchability and slipperiness of the material make it difficult to illustrate the same satisfactorily by drawing, but more concrete ideas of the structure of certain illustrative forms of my invention may be obtained from the accompanying drawings showing largely magnified portions of fabric made in accordance with my invention.

In these drawings—

Figure 1 is a plan view of a magnified fragment of fabric illustrating the principle of my present invention;

Fig. 2 is a section at right angles to the weft and parallel with the warp, taken on the line 2—2, Fig. 1, where the large artificial silk threads and the underlying real silk threads are both caught in the same sheds or meshes of the warp;

Fig. 3 is a sectional view similar to Fig. 2 but taken on the line 3—3, Fig. 1, where the artificial silk threads are floated over the warp and the real silk threads are woven into the warp;

Fig. 4 is a section longitudinally of the weft threads and transversely of the warp threads on the line 4—4, Fig. 1;

Fig. 5 is a view identical with Fig. 4 but showing the bowing or bulging of the artificial silk which results from the shrinking of the adjacent tight-twisted real silk threads;

Figs. 6 to 10 inclusive, are views respec-
tively similar to Figs. 1 to 5 inclusive, but showing a modified embodiment of the principle of my invention.

In the drawings Figs. 1 and 6 may be taken as a fairly correct magnified picture of a fragment of fabric as first woven but in Figs. 2, 3 and 4 and in corresponding Figs. 1, 5 and 9, the weave is spread out and the distortion of the threads by the weaving, due to their softness, pliability and slipperiness. In Figs. 5 and 10 no attempt is made to show the kinking of the tight twisted real silk weft threads nor the lateral shifting or distortions of the warp threads, both of which commonly result from the shrinking process and are usually more or less apparent in the finished product.

In all the figures, warp threads a, a, a, etc. alternate with the threads b, b, b, etc., the threads a, passing over those weft threads which the threads b, b pass under, and vice versa.

The weft threads comprise the thin tightly twisted real silk threads adjacent to the large artificial silk threads d, d.

Fig. 1 shows the large artificial silk threads d having two portions of their length bound in the warp by three pairs of warp threads a, a, a, b, b, and an intermediate portion floated over six pairs of warp threads a, b, a, b, etc.

Fig. 2 shows how, where the large threads d are bound in the shed or mesh of the warp, there is an adjacent, cooperating, underlying, thin, tight-twisted real silk thread also bound in the same shed or mesh.

Fig. 3 shows how, where the large threads d are floated over the warp, the corresponding thin threads e are bound into the regular weave of the warp thus preserving the weave of the fabric at these points where the large threads are left free.

Fig. 4 shows how the fabric is relatively flat when first woven, although the large threads d may show a certain amount of slack as at a, particularly where a corrugated reed is used. It also shows how the underlying fine threads c and also the weave of the warp threads prevent the large threads d from bulging downward. Adjacent threads d prevent bulging sidewise as shown in Fig. 1. Consequently the bulge must be substantially upward as shown in Fig. 5.

Fig. 5 is supposed to show the bulge caused by shrinking. A shrinking of about 10% is indicated by the fact that the twelve pairs of warp threads a, as shown in Fig. 5 are crowded into a distance widthwise of the cloth which is about one-tenth less than that indicated in Fig. 4. In Fig. 5, as before stated, no attempt is made to show any kinking of the thin, fine-twist tension threads c nor any lateral shifting of the warp threads, both of which are likely to occur in actual practice.

The corrugated reed, which may be used to beat up the weft, is diagrammatically indicated at the top in Fig. 1. Here it will be noted that the blades 1, 2, 3, 4, 5, 6, 7 have their front edges all in the same straight line, while the intermediate blades have their front edges extended a considerable distance in front of said line. The latter blades being opposite the float portions of the heavy threads d, tend to stretch the warp threads and to localize slack at said portions.

The shape and size of the bows or bulges produced by the shrinking will depend upon what lengths of the large threads are bound in the warp as compared with the lengths that are left unbound. In Figs. 1 to 5 inclusive, the length of the unbound portion is about twice the length of the bound portion and this gives a relatively long span for the bowing caused by the shrinking.

It will be evident, however, that if the large threads d are bound into the warp for most of their length, and only a small portion left free to bulge, the total shrinkage of the tight twisted threads c being about the same as before, the same amount of bulge will be localized in a short length of the thread d and its curvature will be proportionally sharper.

This is illustrated in Figs. 6 to 10 inclusive where the various threads correspond to those shown in Figs. 1 to 5 inclusive and are indicated by the same reference letters. In Figs. 6 to 10, however, only a short length of thread d is left free from the warp and the resulting bulge at a' is correspondingly short, high and distorted.

In these figures, part of the bulge space is provided by spacing apart the warp threads. This gives inferior results but may be practised within limits provided care be taken to have the high twist threads directly underlying the large artificial silk threads so as to hold the latter from bulging rearwardly in said spaces between the warping threads.

In this connection, it is to be noted that in actual practice all the warp threads are usually separated more widely than indicated in Fig. 1, the spacing being usually more like that shown in Figs. 4, 5, 9 and 10; and since the warp threads are likely to shift their positions more or less during the shrinking or dyeing processes, the spaces between warp threads may become considerable.

Hence it is highly desirable that the thin highly twisted threads, c, be always laid directly beneath the large threads, preferably by a separate shuttle, so that they will be in position to hold the large threads against rearward bulging even if by acci-
dent the warp threads get far enough apart to permit it.

It is to be noted that the fine tightly twisted real silk threads are all twisted in the same direction. Uniformity in this particular is important since it tends to regularize the kinds and directions of the distortions that result from the shrinking or dyeing processes.

The tight twist is an important factor in the shrinking of these threads in such processes, as will be evident from the fact that when untwisted threads of real silk are used for the warp, the lengthwise shrinkage of the fabric is only about 2% as against the 8% or 10% lengthwise shrinkage of the tightly twisted threads.

It will be evident to those skilled in the art of weaving that the points where the artificial silk will be left free to bulge may be varied both in extent and position so as to produce definite patterns, figure effects, or pictures, as well as the striped or corded effects above referred to; also that any of the fabrics involving my invention may be combined with woven or plain fabrics or patterns of an entirely different style of weave, a simple illustrative combination being ordinary plain woven silk or satin stripes alternating with other stripes having any of the above described bow or bulge effects characteristic of my invention.

I claim:

1. A woven fabric comprising fine warp threads in combination with weft threads including fine, tightly-twisted threads and relatively large threads of artificial silk having softened fibers assembled with but slight twist, one of said tightly twisted threads being arranged closely adjacent to but separate from each of said large artificial silk threads, said tightly twisted threads being shrunken after weaving, to force bowing or bulging of portions of said artificial silk threads on one face only of the fabric.

2. A woven fabric comprising fine warp threads in combination with weft threads including fine, tightly-twisted threads and relatively large threads of artificial silk having oil softened fibers assembled with but slight twist, one of said tightly twisted threads being arranged closely adjacent to but separate from each of said large artificial silk threads, said tightly twisted threads being shrunken after weaving, to force bowing or bulging of portions of said artificial silk threads on one face only of the fabric.

3. A fabric comprising fine, untwisted, real-silk warp threads and fine, tightly-twisted real silk weft threads, in combination with a supplemental weft or filler comprising relatively large artificial silk threads practically without twist, bound in the warp, each in the same shed or mesh with one of said fine weft threads but at certain points only, and at certain other points being floated over both the warp and weft. Said thin, tightly-twisted weft threads being shrunken after weaving thereby causing the unbound portions of said large artificial silk threads to bulge outward from one surface only of the fabric.

4. A fabric comprising fine warp threads and fine, tightly-twisted real silk weft threads in combination with relatively large artificial silk threads bound in the warp, each in the same shed or mesh with one of said fine weft threads, but at certain points only, and at certain other points being floated over both the warp and weft, said tightly-twisted weft threads being shrunken after weaving thereby causing the unbound portion of said large artificial silk threads to bulge outward from one surface only of the fabric.

5. A woven fabric comprising warp threads in combination with weft threads including fine, tightly-twisted, real silk threads and relatively large artificial silk threads practically without twist, one of said fine tightly-twisted threads being arranged closely adjacent to but separate from each of said large artificial silk threads, said large artificial silk threads being bound in by the warp at certain points only, and said tightly twisted threads being shrunken after weaving to force bowing or bulging of the unbound portions of said artificial silk threads, the arrangement of the threads being such that said bowing or bulging is all on one face of the fabric and is restrained in other directions.

6. A woven fabric comprising warp threads in combination with weft threads including fine, tightly-twisted, real silk threads and relatively large artificial silk threads practically without twist, one of said fine tightly twisted threads being arranged closely underlying but separate from each of said large artificial silk threads, said large artificial threads being bound in by the warp at certain points only and said tightly twisted threads being shrunken after weaving to force bowing or bulging of the unbound portions of said artificial silk threads, the arrangement of the threads being such that said bowing or bulging is all on one face of the fabric and is restrained in other directions.

7. A woven fabric comprising fine warp threads in combination with weft threads including fine, tightly-twisted, real silk threads and relatively large artificial silk threads practically without twist, one of said tightly twisted threads being arranged closely adjacent to but separate from each of said large artificial silk threads, said tightly twisted threads being shrunken after weaving to force bowing or bulging of portions of said artificial silk threads, the arrangement of...
the threads being such that said bowing or bulging is all on one face of the fabric and bulging rearwardly is restrained by said fine warp and weft threads.

5 A woven fabric having woven therewith, pairs of cooperating thread elements, each pair comprising a relatively large non-shrinking thread and, separate from but underlying the latter and bound in the same meshes of the fabric, a fine tightly-twisted thread adapted to shrink and kink as and for the purpose described.

9 A woven fabric having woven therewith, pairs of cooperating thread elements each pair comprising a substantially non-shrinking thread and, separate therefrom but underlying the latter and bound in the same meshes of the fabric, a finer, highly-twisted thread adapted to shrink and greatly decrease its length for the purpose described.

10 A woven fabric having woven therewith, pairs of cooperating thread elements, each pair comprising a relatively large non-shrinking thread of artificial silk and, separate therefrom but closely adjacent thereto, a fine thread adapted to shrink and decrease its length for the purpose described.

11 A woven fabric having relatively fine silk threads practically without twist running in one direction, and, transversely thereto, pairs of cooperating thread elements, each pair comprising a relatively large non-shrinking thread of artificial silk and, separate therefrom but closely adjacent thereto, a fine thread adapted to shrink and decrease its length for the purpose described.

12 The method of making silk fabrics, which consists in weaving into a warp of fine, practically untwisted real silk threads successive pairs of weft threads, each pair comprising fine, highly twisted, real silk threads, held approximately straight and free from kinking by adhesive material and cooperating therewith relatively large, practically untwisted threads of artificial silk, the former being laid in and bound by all the warp threads and the latter separately laid in and bound by the same meshes of the warp threads at certain points, and floated over the same at other points; washing the thus woven fabric in a suitable solution to cleanse said fine, tightly-twisted weft threads from said adhesive material, to shrink and shorten the same and thereby cause bulging of the float portions of said large artificial silk threads.

13 The method of making silk fabrics, which consists in weaving into a warp including fine non-kinking threads, successive pairs of weft threads, each pair comprising fine, highly twisted threads held approximately straight and free from kinking by adhesive material and cooperating therewith relatively large threads of artificial silk having softened fibers assembled with slight twist, said highly twisted threads being laid in and bound by all the warp threads and said artificial silk being separately laid in and bound by the same meshes of the warp threads at certain points only; then washing the thus woven fabric in a suitable solution to cleanse said material, to shrink and shorten the same and thereby cause bulging of the unbound portions of said large artificial silk threads.

14 The method of making silk fabrics, which consists in weaving into a warp including fine non-kinking threads, successive pairs of weft threads, each pair comprising fine, highly twisted threads held approximately straight and free from kinking by adhesive material and cooperating therewith relatively large threads of artificial silk having oil softened fibers assembled with slight twist, said highly twisted threads being laid in and bound by all the warp threads and said artificial silk being separately laid in and bound by the same meshes of the warp threads at certain points only; then washing the thus woven fabric in a suitable solution to cleanse said material, to shrink and shorten the same and thereby cause bulging of the unbound portions of said large artificial silk threads.

Signed at New York city, in the county of New York and State of New York, this 22d day of October, A. D. 1919.

JULIUS A. MIGEL