The Effect of Yarn Twist and Weave on the General Appearance of a Fabric

By JOSEF FUNKE

It is well-known that with varied illuminations, right and left hand twisted yarns in a fabric give a different color effect to the eye, one yarn appearing lighter than the other. When a piece of goods containing narrow stripes made with yarns twisted in opposite directions, is placed in front of an observer at an acute angle to the direction in which the stripes run, a decided difference in color is noticeable at the stripes (Figure No. 1).

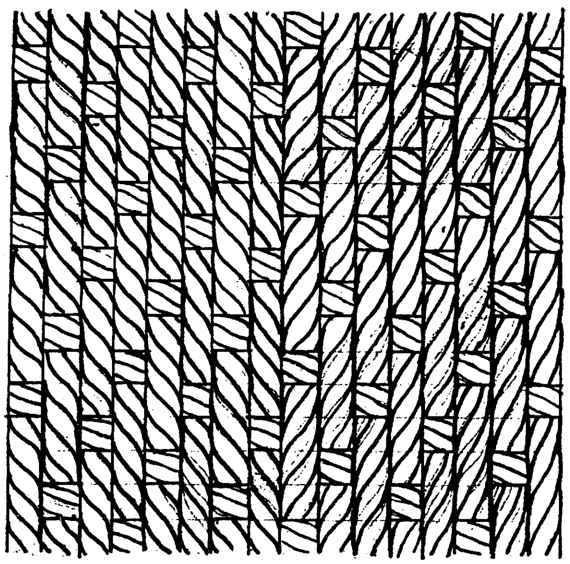

Fig. 1

In dim light, or when looking at the cloth along the line of the stripes, no differences in shade are discernible, and the goods appear of uniform color.

When light strikes the surface of the goods in the direction of the twist, it is reflected from long, uninterrupted lines between the fibers, less shadows are noted, the goods appear brighter and lighter in color. Whenever the light strikes at right angles to the twist, more shadows are caused and the goods appear darker.

When a piece of cloth with a satin (sateen) weave, or satin stripes with right and left twist respectively, in the warp yarns is laid to the right of a source of light, the stripes having left twist yarns appear lighter. If it is laid to the left of the same source of light, the stripes containing right twist yarns appear lighter, because the light is reflected wherever it strikes at right angles. Between the two positions, there is one position where both stripes appear equally bright, but this is not directly under the light, but a little to the left, when the prominent interstices point to the right. In this position, the left twist yarns are closer and tighter, offering the light a smoother surface. In other weaves, the angle of the weave which coincides with the direction of the twist, is not so close and causes greater differences in shadows. For this reason, stripes in a single color material appear different, not for reason of difference in the amount of twist, but because of the left and right angle of the weave. The differences vary, depending on how the light strikes the cloth and with the angle of observation. A cloth with a herringbone weave is a good example of this.

The direction of twist in filling yarns, of course, has the same effect as the warp yarns. But as filling yarns generally have less twist than warp yarns, the effect is not as pronounced. When a fabric is examined in the direction of the warp, or in the direction of the twill, the warp stripes of yarn having twist in opposite directions can be seen readily. Yet, when the same fabric is examined at right angles to the twill line, any difference in color will have disappeared. Any high places in the fabric will appear light. The high or low places in a rib fabric are not changed by the twist in the yarn. The effect of light often can be pre-determined from a diagram of the weave, as shown by figure No. 2. If the weave shown is looked at along the line of the twill, the dark and light sections are very distinct. Yet, if the weave is seen at right angles to the twill line, they are no longer very distinct.

The use of yarns of regular and reverse twist to produce stripe and check effects in designing plain cloths, is used frequently in worsted dress goods, cotton linings, etc. Such materials have the advantage of more uniform density than herringbone constructions, because in cloths with the latter type

Editor's Note: The following article is a most thorough and interesting one on the combined effects of variation in direction and amount of twist, as well as weave in simple and fairly complicated cloths. The illustrations are particularly descriptive.

of weaves, the ends where the weave is reversed generally are crowded together. It can be observed also that at those places, the cloth is not as firmly bound and tears or rips easily.

Referring to the effect of twist in goods using a weave producing a diagonal effect, one text-book makes the following statement:

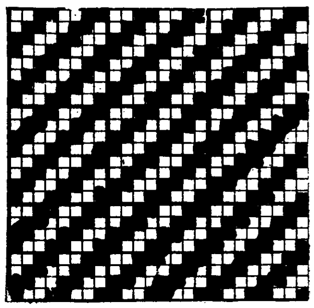

Fig. 2

"The direction of the twill must be opposite to the twist in the yarn, if the effect is to be prominent. The filling yarn must have the same direction of twist as the warp. If a sharp diagonal outline is not required (as in fulled goods), then the twist can be in the same direction as the twill line."

There is really no excellent explanation for a statement as to why the diagonal should stand out any more distinctly when the twist is in opposite direction.

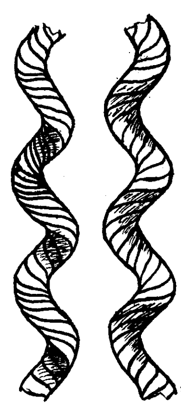

Fig. 3

A freshly spun yarn leans itself toward the same side as its fibers, on account of the unwinding torsion if a yarn is sufficiently twisted and has an opportunity to shorten or crimp the least bit. (Figure No. 3). When sufficiently released from tension, it will form a loop, as shown in figure No. 4, which loop eventually twists around itself. (Figure No. 4a). The torsion due to twist is thereby relieved to a certain extent, and the fibers straighten out somewhat. Only in this way can an easing-up of the torsional force be brought about. Just bending the yarn opposite to the twist is not really an easing-up.

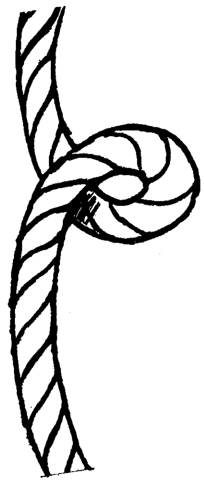

Fig. 4

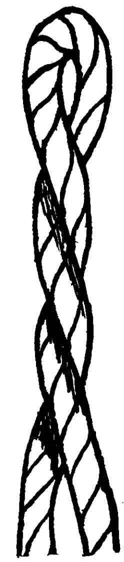

Fig. 4a

The self-looping of a yarn, because of the twist torsion as explained above, would be exactly opposite to the "leaning tendency" when the yarn is woven into a cloth, i.e., with right twist yarns in the upper loop to the right, in the lower loop to the left. (See Fig. 3.) In a fabric, it bends in the upper yarn loop to the left and in the lower loop to the right (Fig. 5).

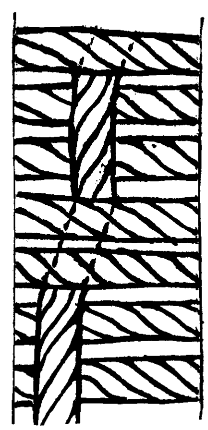

Fig. 5

If a flat ribbon (Fig. No. 6) wound on a spool is pulled off slowly parallel to the core of the spool, the ribbon will receive one turn for every layer of ribbon wound off or better for every single revolution around the bobbin (Fig. 6a). When, however, a yarn is wound off a bobbin, in an opposite direction to its twist, the reverse of the above takes place, the yarn decreasing a turn in twist every time it makes a revolution around the bobbin. It eases up on the twist torsion. It is very evident then that a yarn in an unhindered position will bend in this manner. It also proves that a floating yarn in a cloth cannot bend in that way on account of the torsion. Therefore, there must be other forces which cause it to act differently.

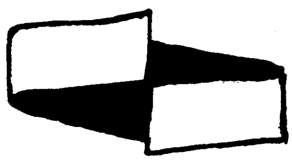

Fig. 6

Fig. 6a

When a yarn is taut in a cloth, it has a tendency to bend in one way or another, dependent on the interlacing, the adjacent yarns, as well as the weave. It has the same characteristics as a screw. In cloth, warp yarns are forced either up or down because of the filling, and also because of the side pressure existing between them. This causes a deviation in the twill line to the right or to the left, forward or backwards, as the case may be. Sometimes, when the pressure on and resistance of the yarns to each other is unequally distributed in the fabric, a bulging of one or more yarns takes place in the direction of least resistance.

In a honeycomb weave, for instance, the yarns are interlaced in such a way that they float for a distance in the cloth, and then are tightly woven in. Wherever the yarns are not bound tightly, they are free to bend in whatever direction they can. This is impossible when the yarns are firmly interlaced and they stay in their normal position (Figs. 7 and 7a). In mock lenos (Figs. 8, 8a, 9, 9a) figured weaves with plain ground (Figs. 10 and 10a) and with huck weaves (Figs. 11 and 11a), the yarns are diverted purposely from a straight line. Such fabrics possess great elasticity because they have open gaps or spaces at intervals. These spaces cause a shrinkage in width, length, or both, permitting stretch in finishing.

Such yarn deviations as described above, are not welcome in a fabric where warp and filling effects are matched more or less irregularly (Figs. 12, 12a and 13). The deviation

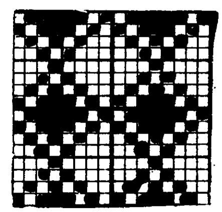

Fig. 7

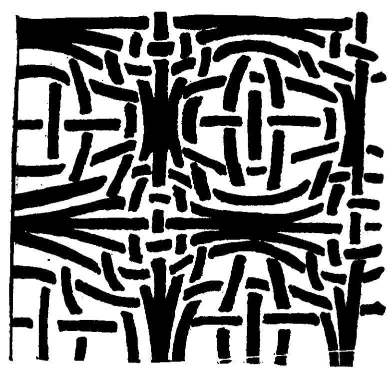

Fig. 7a

from proper horizontal or vertical line produces a distorted appearance of the pattern. The heavy interlacing in one place and the floating of yarns in others, causes an immediate curling of the yarns and a bulging of the adjoining ends and picks towards the side offering the least resistance. Many of these deviations are due to weave rather than the twist in the yarns, and should be corrected by the designer.

It is different, however, with deviations in weave pattern due to yarn structure, which are neither wanted nor preventable. Let it be assumed, for instance, a cloth is made with right hand twist yarns. Whenever a warp yarn crosses a filling yarn, the fibers in each yarn are at right angles to each other. As the reed beats-up, the result is

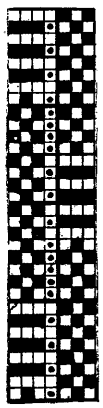

Fig. 8

Fig. 8a

the same as if a coarse screw with steep threads were forced to revolve by the pressure on it (Fig. 14). But turning is not possible to any appreciable degree, therefore a pressure to the left results, the yarn yields

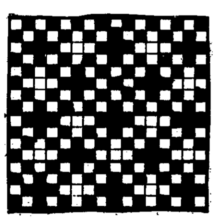

Fig. 9

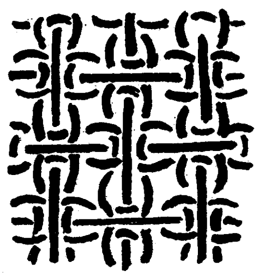

Fig. 9a

and goes to the left on the surface opposite to its spirality.

In the case of a plain weave, the next pick changes this situation and directions are reversed, neutralizing the effect. The even distribution of the yarns in a plain woven fabric cannot tend to produce "bowing," because the yarns are bound too tightly and lay too straight in the fabric. In goods having longer floats, this is quite different. There, the fiber coil pressure of the adjacent yarns exerts the same pressure in the same direction on the face and on the back of the cloth in the opposite direction. This is demonstrated by Fig. No. 14a. The opposite condition is shown by Fig. 15.

Since warp yarns generally have more twist than filling yarns, the angle of the fibers in the former is more acute, i.e., is

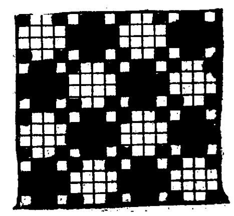

Fig. 10

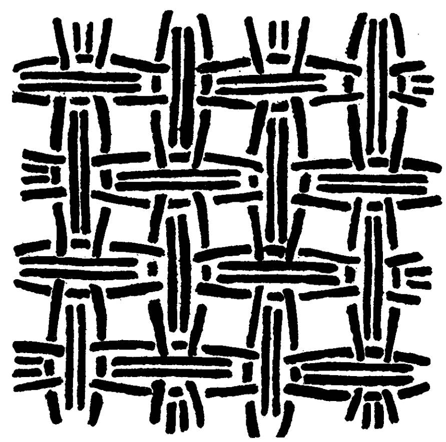

Fig. 10a

flatter and less pronounced. In the crossed position of warp and filling yarns in a cloth having the same amount of twist, the angle of the fibers in the two yarn groups fit fairly into each other. The uniform position and interlocking of the coils of fibers secures this yarn position in the cloth, and does not allow so readily a shifting of the coils. The filling yarn, therefore, is bent or bowed very little. This is prevented by the beating-up of the reed. Any bowing only could be occasioned by a particular weave.

All yarns have a tendency to remain in a position where there is the least tension. It is especially the case when they can interlock fiber coils with those of interlacing yarns. This is especially noticeable when a hard twist yarn is used for warp and a soft twist yarn for filling.

In cloths where the two sets of yarns are left and right for warp and filling respec-

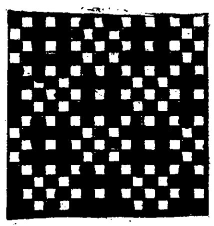

Fig. 11

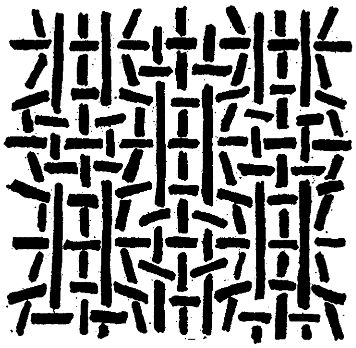

Fig. 11a

tively, the coils of fibers (or twist coils) are crossed at the contact points (Fig. No. 16), irrespective of whether the warp or the filling is on the face. By casual observation, one might be led to believe that this relative position of the yarns would make it harder to beat-up the filling. This, however, is not the case. On the contrary, it is not

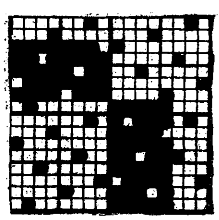

Fig. 12

easier when the coils of the yarns lie parallel to each other, as this necessitates a brushing past and rolling over each other when beating-up the filling. See No. 16a. Line K designates the direction of the twist of a warp yarn as it rests against the lower side of a filling yarn. Line S denotes the direction of the filling yarn twist as it lies against the warp yarn. When the filling has been brought forward to the point where the second dot on the line of the coil comes

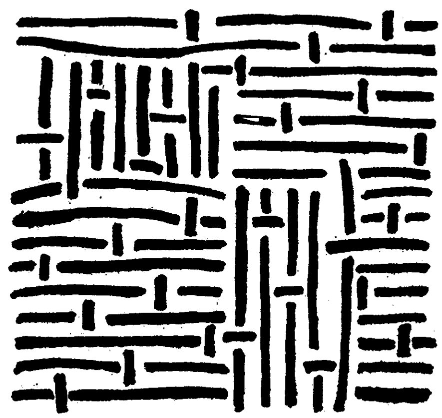

Fig. 12a

in contact with the corresponding point on the coil of the warp yarn, the point of contact moves constantly to the right and no interlocking can take place. It is just like the two parts of a scissors sliding past each other. The two coils cannot possibly affect each other

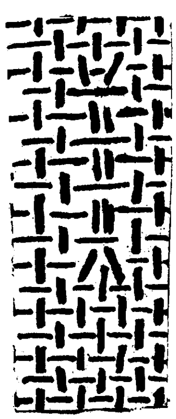

Fig. 13

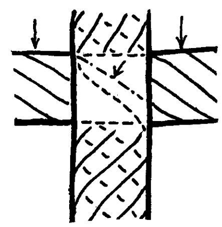

Fig. 14

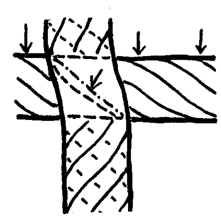

Fig. 14a

in the least, because they have no occasion to interlock or sink into each other. To visualize it still further, Fig. 17 was drawn, from which it can be observed that the high spots pass each other. No pressure is set up between them and they do not interfere with each other in any way, nor do they drive each other out of their respective planes. In

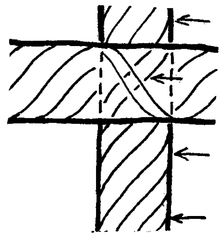
Fig. 15

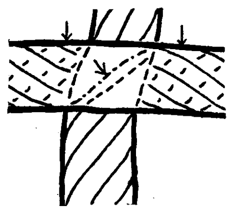
Fig. 16

other words, a very smooth beating-up of the pick occurs. The position of the coils of fibers with equal twist in warp and filling

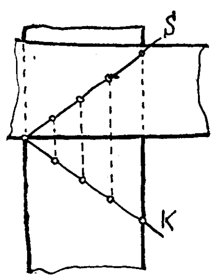

Fig. 16a

can be understood better by referring to Fig. 18.

In weaving, the yarns, in an endeavor to adjust themselves and lower their torsional

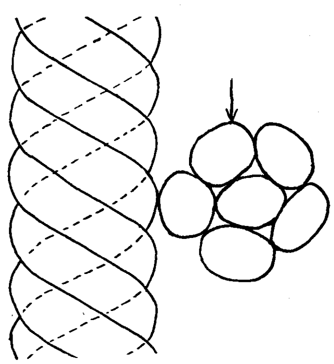
Fig. 17

tension, have a tendency to coil or curl, and consequently yield to whatever chance they have to turn, i.e., untwist. This tendency is particularly noticeable in plain woven goods, where the interlacing changes with each pick. Difference in the amount of twist in warp and filling here is found beneficial, as it tends to offset the angle which the yarn coils the fibers in respect to each other, and permits a better and firmer position for the yarns in the fabric (Fig. 19). It can be realized, therefore, that in some fabrics having a plain weave, the yarns somewhat bend out of a straight line, and give the material

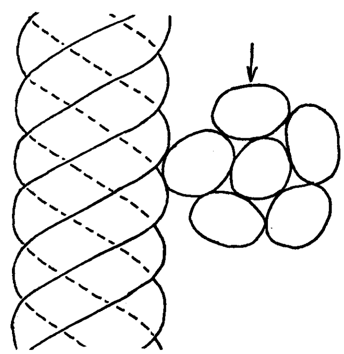
Fig. 18

a different appearance and surface, as compared to other previously mentioned twist relations. In cloths having long floats, less variation and out-of-line moves on the part of the yarns are noted in this relationship of the twist. The result is that when yarns of opposite twist are used in warp and filling, the same deviations of the yarns in their relative position in the fabric are noted as when the same direction of twist is used in warp and filling.

Warp yarn, whenever it comes to the face

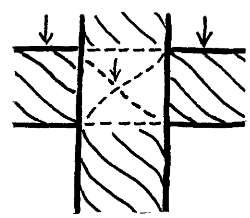
Fig. 19

of the goods, is forced to conform to the coils of fibers of the filling yarn which it touches. If it is left twist, the coils on the underside run to the right, it deviates to the right from the vertical, i.e., it deviates in the opposite direction to the direction of its inherent twist, as one looks on the face of the goods. The same is true of the filling yarn.

The deviation will be so much greater as the yarn twist is increased and the more pronounced the coils become. Approximately the same effect will be obtained if the filling yarn only has very little twist.

If a heavy embroidery yarn or a roving is wound loosely around a narrow strip of cardboard, exactly parallel to the length, no deviations from a straight position will be noted. If the tension is changed, or holes are made in the cardboard, no change occurs. Yet, if the same yarn is sewed on a plain woven foundation fabric, such as used for embroidery for instance, the stitched yarn tends to bend in coordination with the fiber coiling.

In a cross stripe, where there are adjacent floats, it is quite noticeable how the upper part of the float bends to the right (Fig. 20). In diagonals and twills, which run in the same direction as the twist, a wider and much looser ridge can be noticed than when the twist is opposite.

The effect produced by a deviating position of floats in such cloths is well-known.

Fig. 20

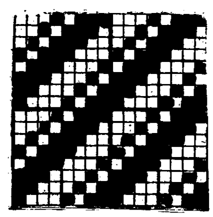

Fig. 21

Cross-ribs in a zigzag line are obtained when a one and one arrangement of left and right hand twist yarns is used. In such cloths, the diagonals are broader and looser, or narrower and crowded, according to whether the diagonal runs in the same direction as the coils of fibers in the yarn or runs against them. The cloth will show either a very pronounced twill, or a uniform flat appearance.

It is possible to reduce the effectiveness of a diagonal effect and even make it appear opposite in direction. When a soft twisted yarn of long fiber material is used, the presence of the coil lines are not so evident. The weave will produce most of the diagonal effect in a cloth. Even with a normal amount of twist in the yarns or hard twisted yarns, the weave can control the situation. In the twill shown in figure No. 21 for instance, the position of the floats is influenced by the fact that a fine twill runs along one side of the strong twill line and breaks up any tilting or leaning of the filling float, occasioned by any excessive twist. In Fig. No. 22, the heavy twill line has a fine twill running each side of it. The warp floats at the binding press to the left and

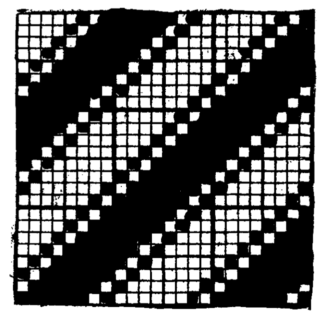

Fig. 22

at the upper binding to the right. Every filling float inclines down at the left end of the float and to the right at the right end, leaving openings where a needle can be inserted easily.

A very close and uniform appearing twill can be created only when a plain weave is used between the twill. This served to check any tilting, turning or crimping, as is shown in Fig. No. 23. In weaves for diagonal gabardines, such as shown in Fig. No. 24, well raised and heavy twill lines are obtained in the same manner. Close binding, as well as the variation and equal distribution between long and short floats, has a bearing here. The longer floats slide under the shorter floats and press up, hence a full, elevated twill line.

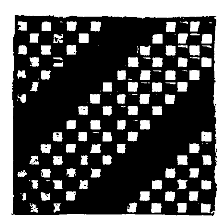

Fig. 23

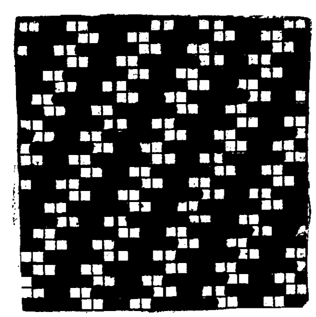

Fig. 24