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FABRIC ANALYSIS.

(Continued from October, 1912, Issue.)

VI Ascertaining Arrangement of Threads According to Color and Counts of Warp and Filling.

In the construction of fancy textile fabrics the distribution and arrangement of color, the proper counts of the yarn and the amount of twist for the various threads used are of the same importance as the weave or selection of stock; either item calculated wrong in the construction of the fabric will result in a poor, unsalable cloth.

With reference to the proper selection and distribution of color, a knowledge of the principles upon which the science of color is founded, and of the laws of harmony and contrast of color is of importance to the designer, for which reason an explanation of the rules governing the same will be of interest to refer to.

What is Color?

Science tells us that colors are sensations produced by the action of light upon the nervous tissues of the retina (a screen at the back of our eye) and that they vary with different kinds of light. Color under ordinary day light appears so constantly the same that it is rather hard to understand that it is not some inherent quality of the surface, belonging quite as much to the object as the form we see. This common belief is so strong with some persons that it is rather a hard proposition to make them understand the difference between colors properly called so and the coloring matter or pigments known by the same names.

Color sensations can be divided into *simple* and *compound* sensations, the eye being capable of three simple or elementary sensations of color, except to a person who is what we call color blind and who is deficient of some of the sensations. These color sensations are revealed and can be analyzed by means of the prismatic spectrum.

Theory of Color.

When the subject of color is considered with a view of its practical application to textile work it is advisable to base all combinations on the theory of color established by Sir Isaac Newton and adopted by Chevreul, Brewster, Hay, Field and others, that *red, yellow* and *blue* are the simple or *primary colors*, all other possible shades of color being the resultants of mixing these three primary colors in variable quantities with each other and with black and white, which are known as *compound colors*.

The simple sensations are never excited separately on any part of the retina, but always accompany each other in a greater or less degree, this being the reason for the endless variety of color we observe. When all are excited with an equal intensity at one time, the result of the sensation is then white.

A primary color is a simple element that cannot be separated into parts, but may be reduced to a tint by white, or to a shade by black. The admixture of either of the other two primary colors changes it to a compound (secondary) color.

The compound colors are of two classes, *viz:* secondaries and tertiaries.

The *secondaries* are composed of two primaries and are: *green, orange* and *purple*. Blue and yellow produce green; Red and yellow produce orange; Red and blue produce purple.

A secondary color cannot be changed in character, but by the admixture of its contrasting primary, or by its combination with one of the other secondaries, it becomes a tertiary or hue.

The *tertiaries* are composed of two secondaries and are *russet, citron* and *olive*. Orange and purple produce russet; Orange and green produce citron; Green and purple produce olive.

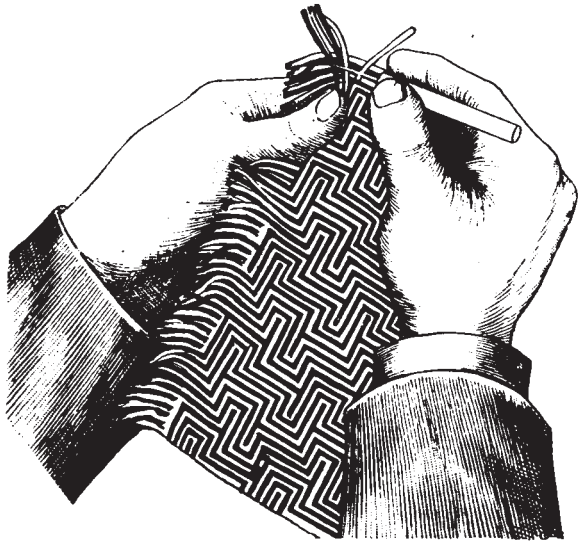


Fig. 41

To return to our former statement that the three primary colors with one predominating are the basis for all other shades, it will be seen that for example Russet contains two parts of red (red is one of the constituents of orange and of purple) in addition to one part yellow and one part blue.

As will be readily understood, the value of each primary color present in any compound color or shade can be either increased or decreased to suit the demand; for example, to produce a bluish-green the value of the blue must be predominating, vice versa, for a greenish-blue the green must predominate, the blue being then the subordinate color. This example will fully explain the indefinite chance of modifying colors, more so when taking into consideration the compound colors, and when there is no end to the subject of modifying colors. For instance take Olive, which in its standard combination consists of

2 parts blue
1 part red
1 part yellow; it can be varied from a deep olive-

green, brownish-olive to a yellowish olive-green, as the blue, red and yellow constituents are increased.

The tertiary colors thus mentioned can be considered as *primary hues* and from which by repeating a combination and proper balancing of their relative powers *secondary hues* are obtained which are known as *brown, maroon* and *slate.*

The tertiary colors, *i. e.,* shades, are those most freely used by the textile designer in his work, they being mostly used for ground work, while the secondaries and the primary colors are used more particularly for toning up, *i. e.,* brightening the pattern—making it look richer. The brighter the color, the more sparingly it should be used in order to produce pleasing results.

Goethe regarded color as a result of a mixture of white and black, ascribing to the different colors a quality of darkness by the different degrees of which they are distinguished, passing from white to black through the gradations of yellow, orange, red, violet and blue. This assertion, though it does not weaken the theory of Newton, is correct, having been proven by Herschel who ascertained the relative intensity of the different colored rays by illuminating different colored objects under the microscope by their means.

Contrast of Colors.

Colors brought side by side in the fabric will more or less modify each other, since they are some mixtures of the three primary colors and the proportion must become altered according to the nature of the previous excitement of the eye.

It thus rests with the designer to understand coloring, *i. e.,* he can make the difference of the two colors appear greater in brightness and hue than they actually are. For instance, a white stripe in the fabric will subtract whiteness from the joining ends of another color, making them appear darker, *i. e.,* showing a deeper color than they actually have but without altering their hue to any extent.

Black threads near white threads will brighten the latter, at the same time making all other colors appear lighter and clearer, similar to white making them darker.

If red threads are placed near orange threads, the red will take red from the orange, making the latter appear yellowish. In the same way, dark green will subtract from light green, etc.

Complementary Colors.

Since white light is composed of the three primary colors, it follows that if a color which is a combination of two primaries, or if a series of colors where one of the primary colors is absent, be presented to the eye, no harmonious sensation can result, on account of the absence of this primary element. For this reason *green* and *red* are *complementary* colors, since green is composed of blue and yellow, the third primary color (which is absent in green) being red. In the same way *blue* and *orange* are *complementary* colors, since orange is composed of red and yellow, blue being the third primary color. *Purple* and *yellow* are *complementary* colors, since purple is composed of blue and red, of which yellow is the missing primary.

Complementary colors, if placed side by side in the fabric will increase in their intensity of color beyond their actual value. For this reason if, for example, red and green are placed side by side in a fabric, both colors are increased in intensity. The same will be the case with any other two colors that harmonize, if placed side by side, since white light is composed of the three primaries, consequently any of the primaries will reflect its own rays with a tendency to create in the vision the rays of the other two, and any of the secondaries will reflect the rays of the two primaries of which it is composed, and tend to create the rays of the primary, complementary to it. For this reason, green will tend to create red rays, and red will tend to create green rays so that when placed in juxtaposition, the result is to heighten the effect of both colors by the tendency of each to create the rays of the other.

Theory of Color Treatment.

There are three primary color sensations which must be present either in their pure or compound form, or in other words these three sensations must be excited in any composition if harmony of color is desired.

In the same way as each color sensation is excited to the eye, it also must in turn be relieved, hence if one is present in its most intense form, the others must also be present in an equal or nearly equal amount, either as to their intensity or area.

Colors related to each other will combine well, but if they partake in a large degree of the same common element they must be divided or separated from each other by some neutral color, or by the intervention of white and black, or light and shadow. The latter intervention need not be as pronounced as the former, but may be present in an admixture of light with one color and shadow with the other. For instance, consider two greens or any other two colors, and place them side by side; possessing the same common element they will tend to detract from each other and in order to produce a pleasing effect to the eye, one of them must be reduced to a tint by the admixture of white and the other to a shade by the admixture of black, and when, just in the degree in which light and shade separate them, their effect will please the eye and produce harmony.

The same principle will apply if we are dealing with gradations of color, whether dealing with one color, from light to dark only, or from one color to another; the more perfect the scale of gradation from one extreme to the other, the more equally balanced the extremes of the gradations will be with each other and the more pleasing the resulting effect. Not only should the gradations be true and regular throughout, but the ends or extremes should be equally striking, and in this way balance or sustain each other.

In designs where gradations contrast and single colors are present, there should be an equivalence between them, and the distribution should be such that the eye is not attracted too much by one part to the depreciation of the rest. Again, the whole should occupy sufficient surface so that the eye can take in the whole of the composition at once, or if not, such parts as do come within the range of vision must be so arranged that they do not suffer in effect by the absence of the other, or that the eye can travel from one part to another without any great effort, so that the absence of one part from the range of vision is compensated for to some extent by the facility given for viewing the whole group.

Counts of Yarn Used.

This is another point to be taken carefully into consideration by the textile designer, both when planning new styles as well as when duplicating by analysis, since the heavier the count of yarn, the more prominent its effect in the fabric, providing the interlacing of the threads is uniform. As a rule, in woolen

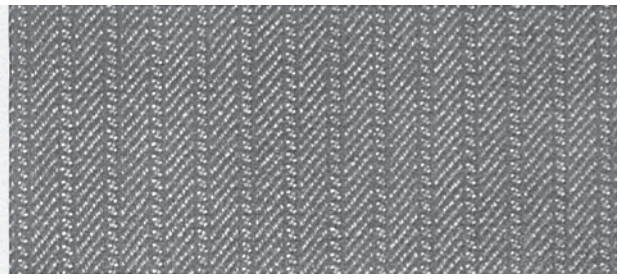


Fig. 42

and worsted fabrics for men's wear, loud colors, used for brightening up the design, are spun of a higher count than the yarn used for the bulk of the fabric or they are interlaced differently from the rest of the pattern, so as not to show too prominently, and in this way differ from women's wear (cotton, silk, woolen and worsted) and where a louder coloring is often desired. This also refers to twisted yarn effects and mixes, the preference in men's wear being always given to the dark color. For instance, considering two kinds of 2-ply twist worsted yarns, black and white, say 2/32's black and white twist, compared to a 2-ply thread in which 26's black is twisted with 36's white. Both threads have the same value as to their 2-ply count, *i. e.*, 16's single. The latter combination (26 and 36) provided it is used to any extent in the repeat of the pattern, will produce a more pleasing effect.

Explanations given as to the importance of color and count of yarn used in the construction of fabrics will indicate that when analyzing a sample as to its weave, notice of the different warp-threads and picks handled must be taken, and at the same time properly recorded on the point paper, particularly when dealing with two or more colors, or counts of yarn, or both, in warp and filling, since in that instance a third item comes under consideration, technically known as color effects, *i. e.*, color-design, in addition to the weave in the fabric.

How to Proceed at the Analysis.

During the process of picking out the weave from the fabric sample (see Fig. 41) indicate at the right hand side on your point paper for each filling thread as picked out next to the weave, its color, or other remarks as to its count, twist, etc., as the case may require.

After you have ascertained the interlacing of the first pick, indicate on the top or bottom of the space of the point paper you have reserved for the weave plan, in its proper position, the arrangement of the warp for one or two repeats of the pattern.

In most fabric structures the weave and the color arrangement for warp and filling repeat on a corresponding number of threads; in some instances one is a multiple of the other. If the color effect is the smaller number, indicate it once, or repeat it over the entire weave. If the weave is the smaller number, carry on the indicating of the color effect up to its repeat on the point paper, or if dealing with a large repeat of a dressing, write out the respective color or twist arrangement of warp and filling on note paper, beginning each list (warp or filling) with its start as you have marked it on the point paper.

We will now explain subject with two samples, both referring to a fancy color arrangement of the warp-threads; the first having one kind of filling (stripe), the other dealing with three different kinds of yarn used for warp and filling.

Fig. 42 is a photographic view of the sample to be handled, being a worsted trousering.

Fig. 43[a] shows the analysis of the weave on point paper, also the color arrangement of the warp on top of the weave; the filling is all black, hence no notice taken.

The arrangement of the warp, technically known as the *dressing,* reads thus:

2 ends (*B*) 2/42's worsted, Black
1 end (*L*) 2/48's worsted, Light gray
2 ends (*M/G*) 2/48's worsted, Medium Gray
1 end (*L*) 2/48's worsted, Light gray
2 ends (*B*) 2/48's worsted, Black
10 ends (*L/M*) 2/48's worsted, Light and Medium gray.

18 ends, repeat of pattern, two repeats shown.

This analysis of the color arrangement of the warp placed on the point paper in its proper position to the weave, will readily explain the wisdom of the procedure when we take into consideration that any misunderstanding in the weave room might be the cause of a mistake in the woven cloth, until discovered.

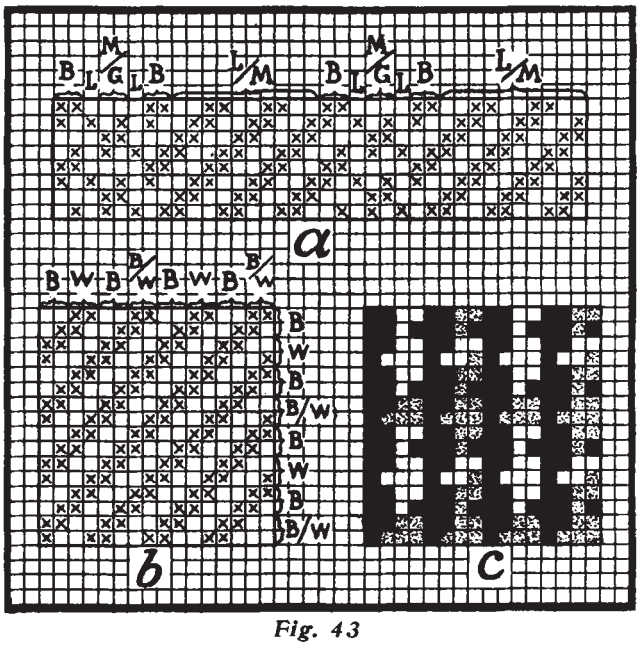


Fig. 43

L means one end 1 up 3 down

M/G means two ends 2 up 2 down taken in rotation, having one end *L/G* on either side.

B and *L/M* are fourteen ends of 2 up 2 down twill of which the first and last two ends are black. (*B*)

Letters of reference for colors have been and are used to simplify work, other indications can be substituted.

Fig. 44 shows the weave executed in four kinds of type, being somewhat of a color effect of the fabric.

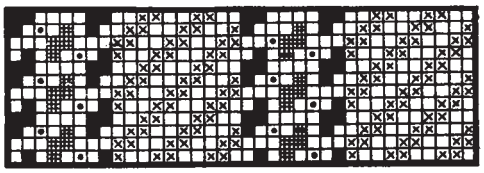


Fig. 44

Full type = *B*
Dot " = *L*
Shaded " = *M/G* and
Cross " = *L/M*.

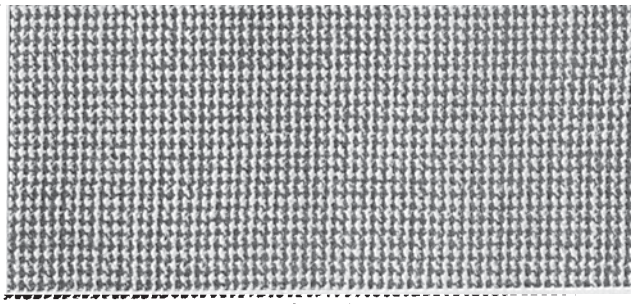


Fig. 45

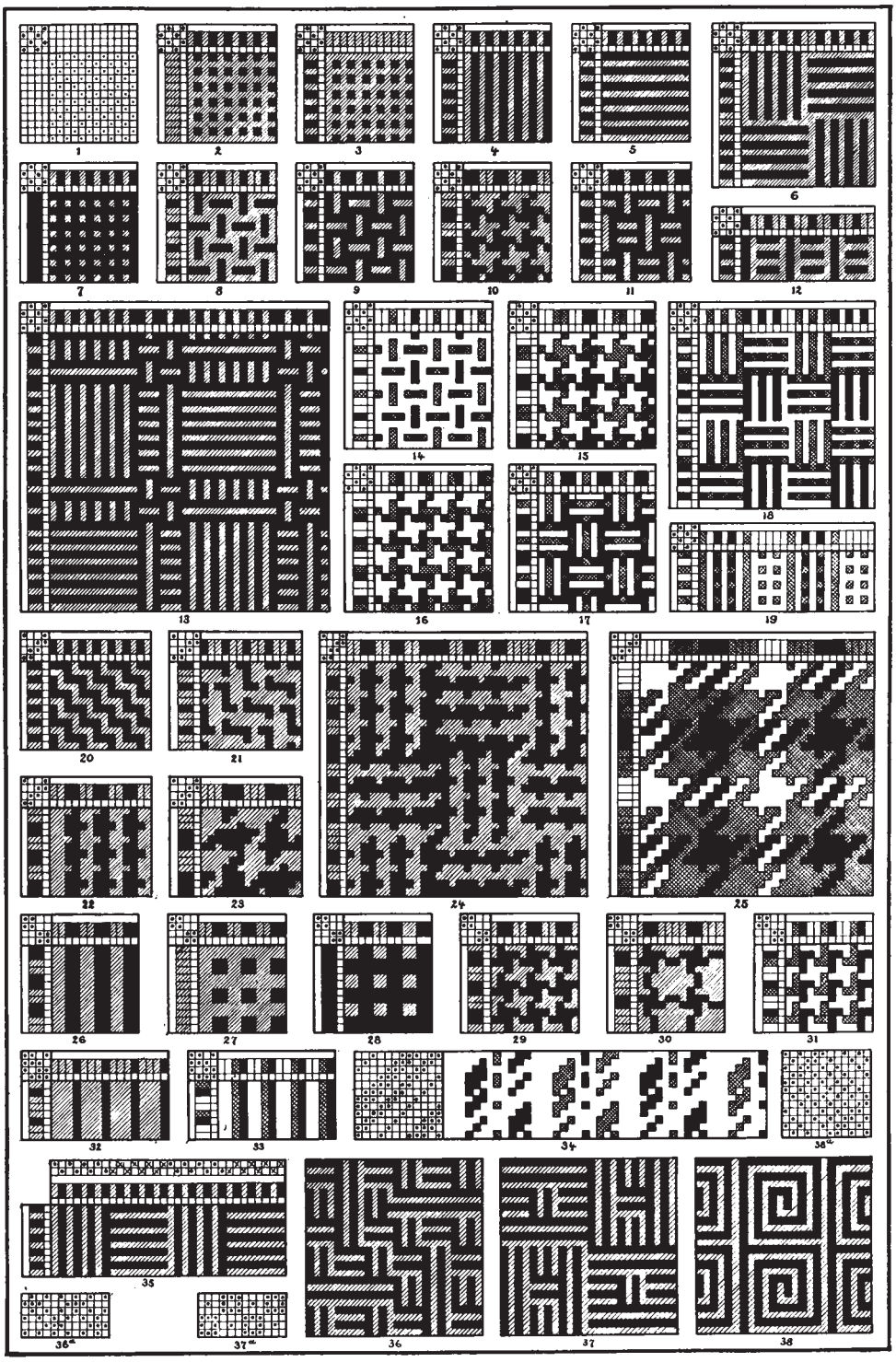


Fig. 46

Fig. 45 is a photographic reproduction of a worsted Suiting, *i. e.,* the other fabric structure previously alluded to; being given to illustrate a fancy arrangement of warp and filling.

Fig. 43[b] shows the analysis of the weave (or pick-out as we technically call it) also the color arrangement of warp and filling, both being the same *viz:*

2 ends	(*B*)	2/60's worsted		Black
2 "	(*W*)	"	"	White
2 "	(*B*)	"	"	Black
2 "	(*B/W*)	"	"	Black and White twist.

8 ends in repeat of pattern for the warp and filling.

Fig. 43[c] shows the color effect, laid out in the previously quoted diagram, executed on point paper thus:

Black worsted in warp and filling is indicated by *full* type, white worsted by *empty* type and black and white twist worsted by *shaded* type.

From color scheme Fig. 43[c] it will be readily understood that the proper placing of the different colors in warp and filling is a most important item in planning the design for a fabric and that any mistake (even if only one thread out the way) would spoil the effect aimed at and in turn make the fabric second, hence the importance of indicating the proper warp-threads and picks in connection with the weave on the point paper.

On account of the importance of these color effects, *i. e.,* the influence of color and weave combined upon the fabric, the collection of diagrams, Fig. 46 is given, showing a collection of some of our standard color effects. In these diagrams the square in the upper left hand corner shows the weave used. The upper rectangle shows the arrangement of warp, and the left lower rectangle that of the filling. The large square (or in some instances rectangle) shows the color effect produced.

Diagram 1 shows weave placed in effect section with small dots.

Rule for ascertaining color effect: Warp shows where there are Risers, filling where there are Sinkers.

Diagrams 2 to 13 show plain weave with 2 colors; Diagrams 14 to 19 show plain weave with three colors. Diagrams 20 to 24 show four-harness even-sided twill with two colors, and Diagram 25 the same weave with three colors. Diagrams 26 to 30 show four-harness basket with 2 colors and Diagram 31 the same weave with 3 colors. Diagram 32 shows four-harness broken twill with 2 colors, and Diagram 33 the same weave with 3 colors. Diagram 34 shows twill stripe (warp 3 light, 3 dark, 1 light, 1 medium, 1 light, 3 dark, 3 light, 3 medium, 1 light, 1 dark, 1 light, 3 medium). Diagrams 35 to 37 show warp and filling 1 end light to alternate with 1 end dark, plain weave, reversed according to motives given respectively on top of Diagrams 35 and in Diagrams 36[a] and 37[a]. Diagram 38[a] shows fancy weave and Diagram 38 the effect produced by arranging this weave with warp and filling 1 end light to alternate with 1 end dark.

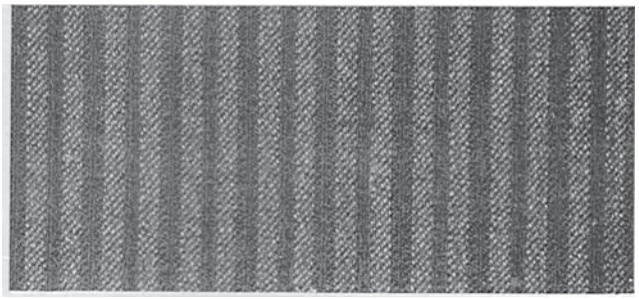
(*To be continued.*)

Fancy Worsted Trousering.

(*Stripe Effect.*)

WARP: 7560 ends.

WEAVE: Repeat 56 warp-threads and 6 picks; to be drawn on 13-harness fancy draw as shown below the weave, *full* type referring to the harnesses carrying the face warp-threads, *cross* type to that for the back warp-threads, and *dot* type to the harness for carrying the seven threads of stuffer warp, for forming the filling effect rib.



ACTUAL REPRODUCTION OF FABRIC
from which details of fabric structure are taken.

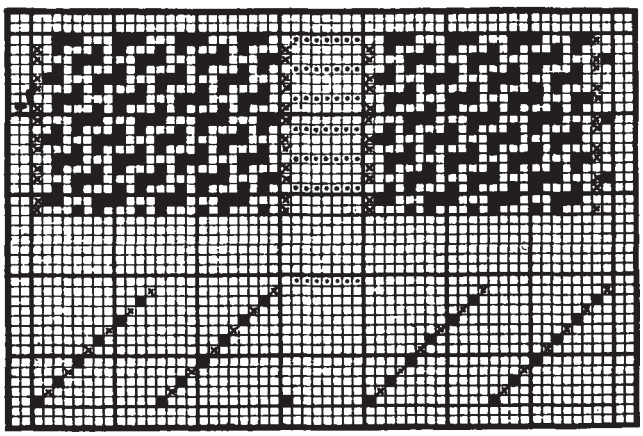
REED: 14¼ with 8 ends per dent; 66¼ inches wide in reed.

DRESS: 15 Sections, each containing 9 patterns = (9 × 56) 504 threads.

ARRANGEMENT OF WARP:

1 end 2/56's worsted, black, extra hard twist.
6 ends 2/56's worsted, black.
16 " 2/56's worsted, med. and dk. gray tw.
1 end 2/56's worsted, black.
1 " 2/56's worsted, black, extra hard twist.
7 ends 2/42's worsted; black, soft twist.
1 end 2/56's worsted, black, extra hard twist.
16 ends 2/56's worsted, med. and dk. gray tw.
5 " 2/56's worsted, black.
1 end 2/56's worsted, black, extra hard twist.
1 " 2/56's worsted, black.

56 ends in repeat of pattern.



WEAVE AND DRAWING-IN DRAFT.

Extra hard twisted threads are shown in weave by *cross* type.

Stuffer or soft twisted threads are shown in weave by *dot* type.

FILLING: 65 picks per inch, all 2/56's worst., black.

FINISH: Worsted finish, clear face; 56" wide.