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No.20

LINEN

Linen is undoubtedly the oldest of all the textile fibers which survived until the present times. e do not claim that it was the first fibre ever used for spinning and weaving, but if there were such earlier fibers they were abandoned a long time ago.

The fiber is obtained from several varieties of the plant Flax (Linum Usitatissimum). The plant reaches a height from 20 to 40 inches. The best fibers are obtained from the smaller varieties, but the quality of the fibers depends also on cultivation, climat, soil, and so on. The most important factor however is the processing of linen.

History. According to one theory (Theodore) linen came to all the civilised countries from central Asia, where it was cultivated several thousands years before Christ. It spread to China, India, later Egypt, and then Europe. But the oldest samples of linen found in Egypt are about 7000 years old, when the linen from the period of Swiss Lake Dwellers must be much older. It is much more probable then that the properties of flax were discovered independently in different parts of the globe. In the historical times the flax was grown practically everywhere in Europe. As far as the quantity is concerned Russia had nearly a monopoly of production until the first great war (90%). But the quality of French, Dutch, and later Irish linen has been much higher.

Contrary to the popular belief that the Irish were always leading in the spinning and weaving of linen, the quality of Irish linen was rather inferior until the beginning of the 18-th century, when a French weaver (Crommelin) introduced to Ireland new methods of weaving.

Since flax can be grown not only for the fiber but for the seed (production of linseed oil) as well, the amount of flax cultivated by a certain country does not give any idea as the amount of the fibre produced. For instance Argentina and USA grow large quantities of flax, but mostly for seed. The cultivation of the plant is different in both cases and it is impossible to get good quality fibre and seed from the same crop.

Physical properties. Linen fibers are from 1 to 2½" long. However, since they do not appear singly but in groups (filaments), the quality of the yarn depends on the size of these groups.

Linen resistance to breaking (tensile strenght) higher than cotton but lower than silk. It is not elastic, and has very small resistance to friction. It is a good heat conductor, therefore linen fabrics are "cool". It has high absorbing power. From this point of view it is better than cotton.

The colour of natural (unbleached) linen varies from pale yellow to very dark grey. It is considered that the darker the colour, the poorer the quality.

The count of linen is based on No.1 which has 300 yards to the pound. Higher numbers, as in the case of cotton, indicate how many times the yarn is finer than No.1. To convert the number of linen from the metric into the English system, we multiply the metric number by 1.65.

Linen can be spun up to No.100 by machine; higher numbers are spun by hand.

Chemical Properties The chemical composition of linen is: Fiber - 72%; Pectic substances - 19%; different celluloses - 5%, Fat - 3%, Ash - 1%.

Linen is resistant to acids about as much as cotton, but it is less resistant to alkalis. It is however hardly affected by bacteriological processes, action of light, humidity, heat and cold.

Dyeing of linen presents special problems. Many dyes do not penetrate the yarn, and stain it only on the outside. Other run or fade. It is advisable to check the quality of dyeing by first untwisting the yarn to see whether the dye penetrated to the core, then exposing it to the sunshine for several days, and finally washing it in hot water with soap.

Processing. This has the following stages: 1) rippling, in which the seeds and leaves are removed from the stalks; 2) retting - or separating of the individual fibers which are stuck together; 3) breaking, 4) scutching, and 5) heckling - three stages of cleaning the fibers. In the last stage the fibers are combed as well.

The most important of these stages is retting. It is a process of fermentation, which softens the impurities around the fibers, and thus liberates the fibers. It may be done by natural or artificial means. In the first case the flax is kept in a stream or river for as many as 15 days (stream retting), or in stagnant water for about one week (pool retting), or it may be exposed to the moisture and sunshine in an open field (dew retting) for as many as 40 days. In the second case the retting is done in a tank (tank retting), where the speed of the process may be controlled, and it takes about 3 days.

In heckling the fibers are divided into short ones called "tow" and long ones, called "line". The spinning of linen yarn is either "dry" or "wet". The latter method is used for finer yarns.

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PATTERNS IN CHENILLE.

Here we must keep in mind that, when weaving the chenille weft any combination of colours in the vertical direction - will become the same combination of colours in the horizontal direction during the second weaving. Therefore if we could weave only one strand of chenille weft at a time, we could produce any pattern whatsoever. This of course is not very practical, although it could be done, and it would be still faster than making a knotted rug. Fortunately naturalistic ornaments are out of fashion, and the geometrical ones are much more suitable for our purposes.

The proper way to weave a chenille rug with geometrical pattern is to prepare a large number of short strips of weft instead of long, continuous ones. The length of each piece of weft is equal to the width of the rug.

Let us take a very simple example of a rug, or rather of a sample about 6 by 8 inches (fig.1). Each mark on the pattern represents ¼" square. Thus if we have 4 picks of the chenille weft per inch, each line in the pattern corresponds to one pick if weft.

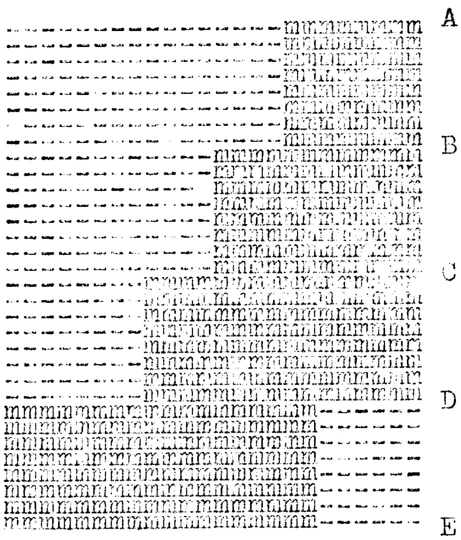

Fig.1

What do we need to make this sample? First: 8 picks of weft which will have white ("-") pile on 4 inches of its length and 2 inches of black ("m") pile (A-B).
Second: 8 picks - 3" white, and 3" black (B-C).
Third: 8 picks - 2" white, 4" black (C-D).
Fourth: 8 picks - 4½" black, 1½" white.

Since there are 8 picks of weft of each kind, we shall figure out our first warp so as to have 10 groups of of warp ends (the first and last being useless). They will be set at a distance <u>twice</u> the length of the pile. If the pile is supposed to be one half of an inch high, then the distance between two "cores" will be one inch or a little more. Using a reed No.14 we shall have 8 ends in one dent, and then skip 14 or better 14 ends. We start weaving with about one inch of "heading". This one inch will be used later on to turn in the ends of each piece of weft. Any old and odd piece of yarn can be used here, since it is going to be ripped off after the cutting. Then come 4" of white pile weft, and 2" of black. Then again 1" of heading or rather spacing. Leave a mark in a different colour here to guide the cutting. This will give us enough weft for the first part (from A to B) of our sample. Then again one inch of spacing, 3" of white pile weft, and 3" of black, plus 1" of spacing. This is the second part of the rug from B to C. The third part will be: 1" spacing, 2" white, 4" black, 1" spacing. The fourth

1" spacing, 4½" black, 1½" white, 1" spacing. This is all.

Now we take the chenille weft off the loom. Cut it first in the vertical direction. We shall have 8 strands of weft about 24" long each. Now we cut each length of weft on the colour marks between spacings. We shall have 32 short pieces of chenille weft in all. Remove gently the filling at each end of every piece of weft. Twist together the free ends of warp (moisten them if necessary) to prevent the pile weft from unravelligg. Now we are ready to weave the sample.

First we arrange the weft in the order in which it will be needed on a small table or an extra bench close at hand. We wind also a bobbin of black weft (darker of the two colours, but always a neutral one if more colours are used) for binder.

If we decided on twisting the pile weft into round chenille (C, fig.2 MW No.19 page 5) no further preparations are necessary. If we shall use flat weft (A, fig.2, and fig.7 in the same issue) we shall need a flat stick longer than the width of the rug as described previously but with a sharp notch in one end (fig.2). We take the first piece of weft, and insert the twisted end (core) in the notch, so that it will be firmly held. Now we flatten the weft on the side of the stick, and held it in the right hand the thumb pressing the free end of the weft to the stick. We put the stick with the weft into the open shed from the right hand side and adjust it so that only the twisted ends without pile will project on both sides of the shed. Now we beat through the stick (warp at low tension), disengage the core from the notch and gently remove the stick from the shed. Then we beat again and change the shed when the beater is still in its forward position.

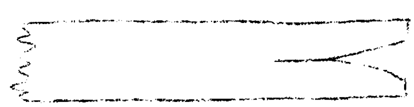
Fig.2

A few shots of binder follow. How many depends on how thick the pile is supposed to be When weaving the binder it is very important to leave enough weft in the shed so that the edges won't be pulled in. Here the whole take-up is on the weft - none on the warp, and unless we are careful the rug will get narrower than the proposed width, which may distort the pattern.

When opening the next shed for the pile weft, before we make the second pick of chenille weft we must tuck in both ends of the first pick. This is the main purpose of of the free pieces of core left at each end of the weft in the first weaving. Without these ends, or if we clipped them after weaving at the edge, hardly anything would hold the pile, and it would pull out near the edges later on.

Thus one repeat of weaving has the following stages:
1-st. Open the proper shed.
2-nd. Take the next piece of weft, insert its end into the notch in the stick, and flatten it out.
3-rd. Put the stick and the weft in the shed.
4-th. Beat through the stick.
5-th. Remove the end from the notch, and the stick from the shed.
6-th. Beat again and change the shed.
7-th. Make a few shots of the binder.
8-th. Tuck thefree ends of the chenille weft into the next shed.

If the rug is rather wide we can use the stick even with round chenille weft. The only changes then are: in stage 2 we do not stretch the weft flat on the stick, but after securing its end in the notch, we twist the other end until the weft is reasonably round. Then the stage 4 is not necessary at all. It may be remarked here that the twisting of the weft makes it shorter, therefore the pieces of weft must be made slightly longer in the first weaving. On no account should one stretch a twisted weft back to its original length - it will behave like an elastic and pull in the edges.

When we attempt more complicated patterns, the only difference is in planning the first warp. The remaining operations are always the same. Let us take as another example a rug on fig.3. Here one square of the draft corresponds to one inch square, and the rug will have 18 by 21 inches. It has seven different "blocks" of pattern: A to B, B to C, C to D, etc. Each of them is made of 12 picks of weft (if 4 picks per inch in the second weaving are planned). Consequently our first warp may have 14 groups (12 + 2 for the edges). It will be about 13" wide (for ½" pile) and 140" long (7 times 18+2).

```
------oooooommmmmm  A
------oooooommmmmm     1
------oooooommmmmm
----oooooommmmmmoo  B
----oooooommmmmmoo     2
----oooooommmmmmoo
--oooooommmmmmoooo  C
--oooooommmmmmoooo     3
--oooooommmmmmoooo
oooooommmmmmoooooo  D
oooooommmmmmoooooo     4
oooooommmmmmoooooo
oooommmmmmoooooo--  E
oooommmmmmoooooo--     5
oooommmmmmoooooo--
oommmmmmoooooo----  F
oommmmmmoooooo----     6
oommmmmmoooooo----
mmmmmmoooooo------  G
mmmmmmoooooo------     7
mmmmmmoooooo------
                    H
```

Fig.3

But we may notice than the first block (A-B) is really the same as the 7-th (G-H) only reversed; then these two blocks can be woven together. Also block 2 (B-C) is the same as 6 (F-G), and 3 (C-D) the same as 5 (E-F). Only the central part (D-E) has no counterpart.

In such a case we have an alternative of weaving 24 strands of weft at a time instead of 12 - an obvious economy in time. It is true that we shall have to make **block** No.4 double, and use only half of it. The leftovers can be used for experiments, samples etc. If we decide on this latter method, the plan for the first weaving will be as follows: Warp - 26 strands (the first and the last may contain only 4 ends of coarser warp) 25" wide. Length: 80" plus wastage as usual. If "-" is red, "o" - white, and "m" - black, then the order of colours in the first warp will be: 6" red, 6" white, 6" black, 2" space, 4" red, 6" white, 6" black, 2" white, 2" space, 2" red, 6" white, 6" black, 4" white, 2" space, 6" white, 6" black, 6" white.

It is obvious from the above examples that when planning a pattern we should have our blocks either of the same width, or as multiples of the same width, as in fig.4. Here block No.2 is twice as wide as 3 or 4. No.1 is used twice, but then if we decided on weaving all blocks of the same size as 1 or 2, there would be too much waste on 3 and 4. Consequently we shall weave all blocks as 3 or 4, but we shall repeat (weave twice) No.1 and 2. In this way there will be no waste at all.

```
mmm---------mmm
mmm---------mmm  1
mmm---------mmm
------mmm------
------mmm------
------mmm------
------mmm------  2
------mmm------
------mmm------
---mmmmmmmmm---
---mmmmmmmmm---  3
---mmmmmmmmm---
mmmmmm---mmmmmm
mmmmmm---mmmmmm  4
mmmmmm---mmmmmm
mmm---------mmm
mmm---------mmm  1
mmm---------mmm
```

Fig.4

Are diagonals possible? Yes, provided that in one block they all go in the same direction, as in fig.5. Instead of making every pick of weft with a different sequence of colours, we make all of them the same but several inches longer than the width of the rug.

```
------mmmmm----
-----mmmmm-----
----mmmmm------
---mmmmm-------
```

Fig.5

In our case if one square on the draft is one inch, the weft must be woven: 6" white, 6" black, and 7" white. In the second weaving we start with the first pick exactly fitting the left hand edge of the rug, and then shifting the next one about ¼" to the left, and so on, until the last one is reached when it should come even with the right hand edge of the rug. The projecting ends are stripped of the pile, after the binder is woven but before the next shot of the pile weft, then cut to about 1" from the adge and tucked in as usual.

The Locked Wefts technique (MW 4, page 7) is an excellent method of weaving chenille rugs. Here it is better to use commercial chenille weft. Home made chenille does not slide very easily when interlocking. And in any case here we need only one solid colour on each side.

The best results are obtained with rather fine chenille. We wind it on ardinary bobbins, but if we can get larger shuttles it is so much the better, since the weft will last longer. Flat shuttles are of little use. The bobbins on the rack can be standard warping ones. Here we cannot hope to weave as fast as with plain, more slippery yarns. To keep the edges straight we must help the weft from the rack to unwind by pulling it with the left hand, and the shifting of the interlocking point cannot be done by pulling on the shuttle alone. The right hand edge must be straightened with fingers to prevent too much of pulling in. This obviously slows down the weaving , but on the other hand the size of the weft makes it so much faster, that all in all this is about the easiest way of producing pattern rugs, or for that matter - any pile fabric.

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FROM THE CLASSICS.

"The Linen Manufacturer" by Alexander Peddie, Glasgow 1822.

The Art of Weaving is of very ancient origin: the many fabulous stories concerning it, such as the story of Penelope,s web; and also the frequent mention of it in the sacred writings, clearly show, that the making of cloth from thread of wool, flax, hair, silk &c. is a very ancient invention. Like other arts, it has undergone an infinite variety of changes, and, consequently, improvements as to the preparation of the material and modes of operation followed by the artist. No person can ever practically be employed in all the branches of it; and, although each part bears strong analogy to the rest, yet a knowledge of the various parts can only be obtained by minute investigation, experience and reflection.

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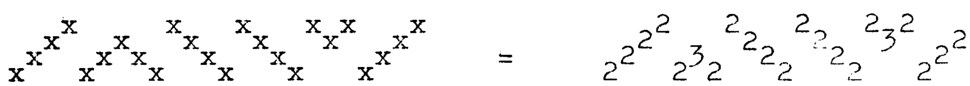
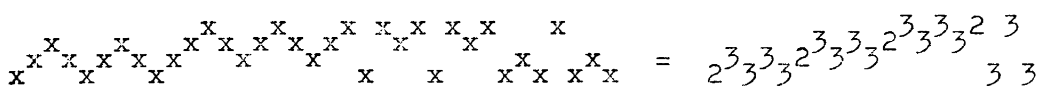
DRAFTING

The system of writing short drafts described in the previous lesson cannot be used without certain changes for other weaves, unless they are woven on overshot drafts as in case of colonial honeycomb, corduroy, or swivel on overshot. For instance if we try to apply it to twill or crackle, we gain hardly anything in space taken by the draft (fig.1).



Twill

Fig.1



Crackle

Therefore all other weaves must have their own methods of drafting. We can distinguish here two groups of weaves:

The first will contain such weaves as pattern twills, plain spot (or Bronson), all-over-spot (Barley Corn), swivel.

The second: crackle, modern overshot, huckaback and its derivates, spot lace (Bronson Lace), summer-and-winter, turned twills and damasks, double weaves. With certain reservations we can count here also swivel, pile weaves (velvet, chenille), and cross-weaves (leno).

We shall start with the first group and take pattern twills first. We have seen in fig.1 that replacing the full draft with numbers representing floats is useless, because the floats are short, and there are too many of them. Since however the threading draft is made of ascending or descending sequences of heddles, like: 12341234, or 43214321 etc., we can replace the heddles with continuous lines either going up or down as in fig.2.

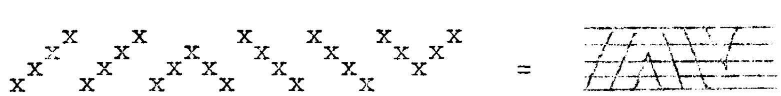


Fig.2

With a larger number of harness-frames the economy becomes still more obvious (fig.3).

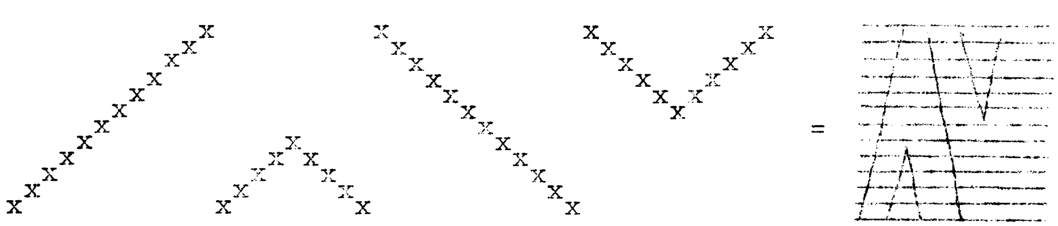


Fig.3

As long as the line of heddles is going up or down there is no need of precision. However the turning point of the diagonal must show exactly the frame on which it changes the direction. Therefore this kind of short drafts must have horizontal lines marking the frames. Otherwise finding of the turning point will be purely guesswork.

Unfortunately this method, good as it is with twills, is not universal. It cannot be used with crackle for instance (fig.1) because here the diagonal changes the direction too often, and it would be out of the question with overshot, where there are hardly any diagonals. It may be (and often was) used with turned twills as in fig.4.

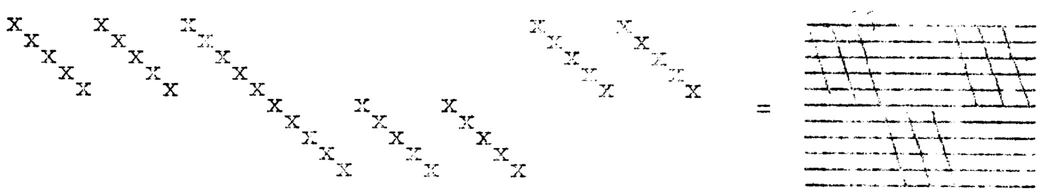


Fig.4

However there is another method for this group of weaves, much more economical. If we mention here this application of the diagonal lines, it is only because this system of notation may be still found in old English books.

Spot weaves and swivel have similar threading drafts: one half of the warp is carried by frame No.1, so that all odd or all even numbered warp ends are on No.1 Therefore this frame can be entirely omitted or represented by a continuous line (fig.5). This gives exactly 50% economy in space. It is again an obsolete system but found in many books:

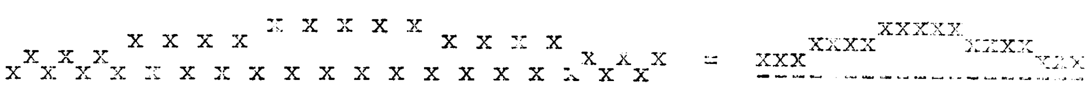


Fig.5

There is just one step from this system to a more modern one of replacing the "x" with a number (fig.6).

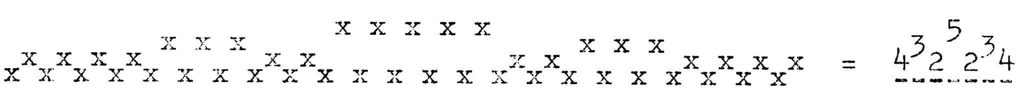


Fig.6

This is a perfectly satisfactory method, since it is not only the shortest one, but the presence of the continuous line indicates clearly what kind of weave is represented by the short draft.

There is still a third system of drafting, particularly useful in case of analysis, which shows the length of floats, exactly as in the case of overshot. The lowest line shows floats obtained by combination of frames: 1+2, the second: 1+3, the third: 1+4, etc. This system is used very seldom.

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CREPE.

The purpose of crepe weaving is to produce an uneven surface of the fabric, or a surface which appears to be uneven, as if the fabric were crumpled in a very irregular manner. There is not even a suggestion of a pattern.

The difference between the three-dimensional fabrics such as described in MW No.17, and crepe is that the latter has a uniform thickness. In case of a 3D fabric the variations in thickness produce the desired effect, when in case of crepe it is the whole fabric which ondulates. Fig.1 gives cross-sections of both fabrics. The difference is obvious.

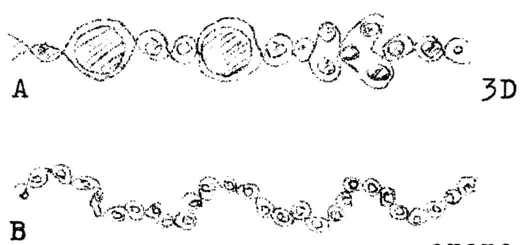

Fig.1

The crepe can be produced in many ways: by physical or chemical agents, as well as by special methods of weaving. We are hardly concerned with the first two, and we shall describe them in a few words only.

As an example of the first method of making crepe we can take the following one. A finely woven and smooth fabric is passed between two metal cylinders with slightly uneven surfaces. They "iron" the fabric in presence of moisture and heat, and under a high pressure, so that the fabric becomes stamped with the impression of the uneven metal surface. The distortion of the fabric may be not quite permanent but it will last reasonably long.

A better method is the chemical one. A smooth cotton fabric is mercerized, but only in spots. Let us imagine that we sprinkle the fabric (lying flat but not stretched) with the solution of caustic soda. The spots affected by soda will shrink when the rest of the cloth will remain unchanged. This will produce a permanent distortion of the fabric, which will remain crumpled regardless of washing and ironing.

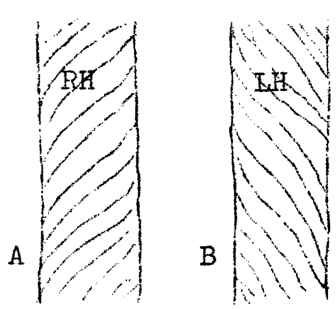

Fig.2

In weaving we can get either real distortion as in fig.1 B, or an illusion of this distortion. In the first case we speak about crepe, in the second - about crepe effect. We shall describe first methods of producing real crepe.

It is a fact that many beginners weave crepe without realising that they are doing it, and sometimes they are disappointed at the unexpected results.

To get good quality smooth cloth of any kind, but particularly in case of wool woven in tabby, we must have two kinds of yarn: the one used for warp must have the direction of twist opposed to the one used for weft. For instance the right hand twist for warp (fig.2 A), and the left hand twist for weft (B). If we enlarge one repeat of tabby as in fig.3 we shall see that with the same direction of twist in both warp and weft the fibers on the surface of the fabric go in two different directions at an angle to each other, which does not make the fabric to look smooth. But even worse than this is the fact that inside of the cloth, whenever a warp end crosses a pick of weft, the fibers lie parallel and interlock each other. This interlocking prevents the fabric from being smoothed out by ironing it later on.

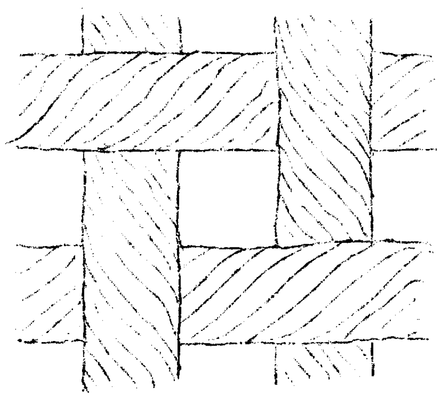

Fig.3

Thus whenever we use the same direction of twist for warp and weft, we produce involuntarily a crepe fabric. This effect is negligible in coarse weaving of cotton, rayon and linen, and not too obvious in woolen twills. But if we take two ply wool of a rather hard twist, and use it for warp and weft, we can hardly miss the peculiar appearance of the finished fabric. And hard as we try, no amount of ironing will smooth out the surface.

In case of plain tabby woven all in one colour it may be an advantage. The cloth has an interesting texture. But with different colours in both directions it may look untidy. At any rate, whether intentionally or not, this is the easiest way of producing crepe in weaving.

When a more pronounced effect is desired, we can use both twists Rh and LH, alternating them in warp and weft. Thus the warp may have one RH twist end, and then one LH twist end, and so on. Or 2 RH followed by 2 LH. Or 3 RH by 3 LH. The same order which has been used in warp should be followed in weft. The warping, beaming, and threading will be a little more difficult than usual, because when two threads of opposite twist touch one another, they usually wind around each other, and stay that way. The only remedy is to work always under tension (warping mill) except for threading of course, where we have to pull the twisted ends one after another before getting them free.

Another method based on a different principle is to use two warps for the same simple weave. One of them will have a higher tension than the other. Therefore the amount of the take up on both will be not uniform, not only in warp but in weft as well. Let us take as an example a fabric woven entirely in tabby with 16/2 cotton set at 32 ends per inch. We shall alternate the two warps every quarter of an inch or every 8 warp ends. Where the warp is tight, the take up will be all in the weft; where the warp is slack - it will be in the warp. Consequently we shall have stripes of fabric parallel to the warp alternately tight and loose. The loose part will wrinkle after a while and thus produce the crepe.

Working slowly we could get the same effect in weft. Make 8 shots of very loose weft, leaving in the shed as much yarn as possible without producing loops. Then another 8 shots keeping the weft very tight. Both methods (different tension in both warp and weft) combined should produce a fabric evenly wrinkled in all directions.

Still another method does not require two warps, but a single one made of two very different yarns, like linen and cotton. We can make a warp of alternate stripes of single linen No.20 and cotton 16/2. The stripes should be about ½" wide. Then in weaving we shall use the same sequence in weft: ½" of cotton, and ½" of linen. During weaving the warp should be kept very tight. This will make the linen stretch, when cotton which is elastic will remain unaffected. This method can be used alone or in combination, e.g. the linen in the last case may have the twist opposite to the cotton.

The difference of tension in warp may be produced not only by using two warps on two warp beams, or two different yarns, but also by weaving alternate stripes in two different weaves. One of them must be rather loose and the other very firm. A classical example is tabby and satin. This is however not very easy to weave since it requires 10 treadles (fig.4). We shall get similar results by weaving at the

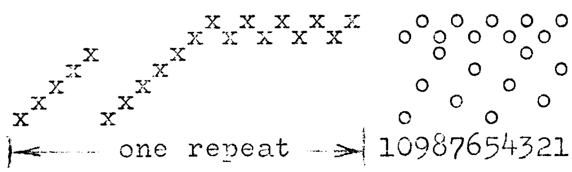

Fig.4

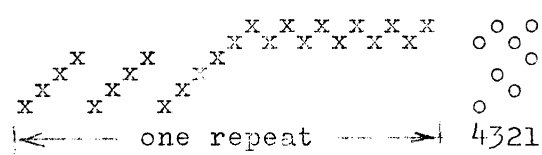

Fig.5

same time tabby and satinet (broken 1:3 twill). This requires only 6 harness-frames and 4 treadles, as in fig.5. At first it does not produce any crepe. It takes a few inches of weaving before the difference in take-up between tabby and satinet becomes visible. With elastic warp and high tension during weaving it may not show until the woven piece is taken off the loom. If the yarn used is not elastic, then the weaving should be done at a very low tension of the warp.

Crepe effect as well as real crepe require as a rule a large number of frames. There is only one satisfactory draft for 4 frames which gives a large number of variations (fig.6). It is based on the principle that one half of the draft produces slightly different

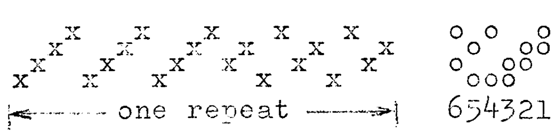

Fig.6

Treadlings:

1) 5656165613131313;
2) 1234123452645264;
3) 1243124352465246;
4) 1526453621436153;
5) 5615635613513613;
6) 1526152635463546;
7) 1231231235465465 46;
8) 4625462541234123;
9) 152615264536 4536;
10) 1526453615264536;

floats than the other.

To get good results with any crepe weave the yarn used must be fine and set very closely. For instance about the coarsest yarn for the draft in fig.6 will be 16/2 cotton set at 36 ends per inch, better 20/2 cotton at 40 ends/". There may be a slight difference in colour between warp and weft, but only slight. Still better is to have mercerized warp and plain weft.

As far as multiharness weaving of crepes is concerned there is quite a choice. Oelsner gives about 350 different crepe weaves for any number of frames from 6 to 40. Here are a few examples.

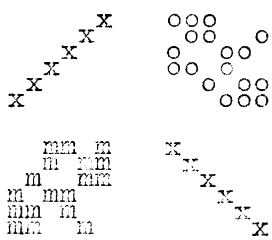

Fig.7

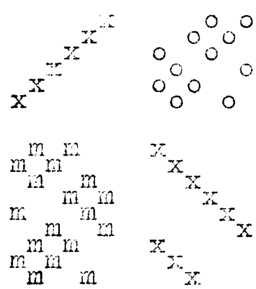

Fig.8

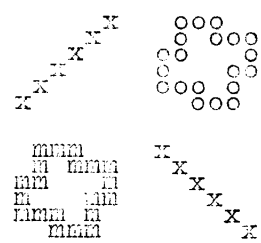

Fig.8

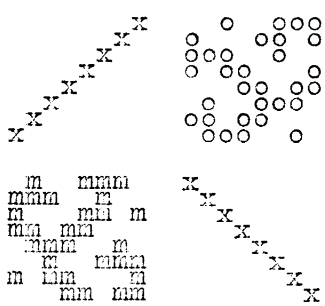

Fig.10

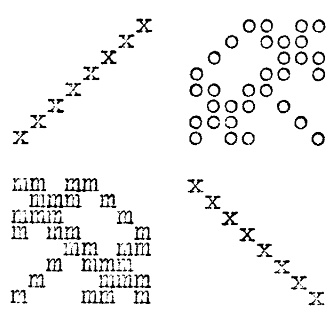

Fig.11

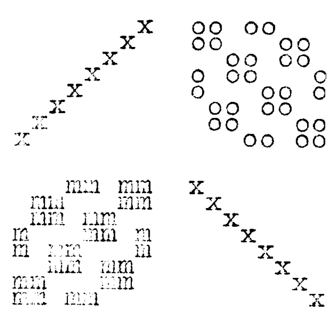

Fig.12

In each case only one repeat of threading and treadling is given (even in fig.8). The same general principles of weaving apply here as in case of the draft No.6. Fine yarn, closely set; similar colours in warp and weft.

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BOOKS.

"HANDWEAVERS' REFERENCE" by Mary E.Black.

An excellent subject index of English weaving literature. It classifies all technical terms in nearly one hundred books, pamphlets and periodicals. The index is alphabetical and larger subjects are again subdivided alphabetically. Thus in matter of seconds one can find everything written on any particular weaving subject in modern times.

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