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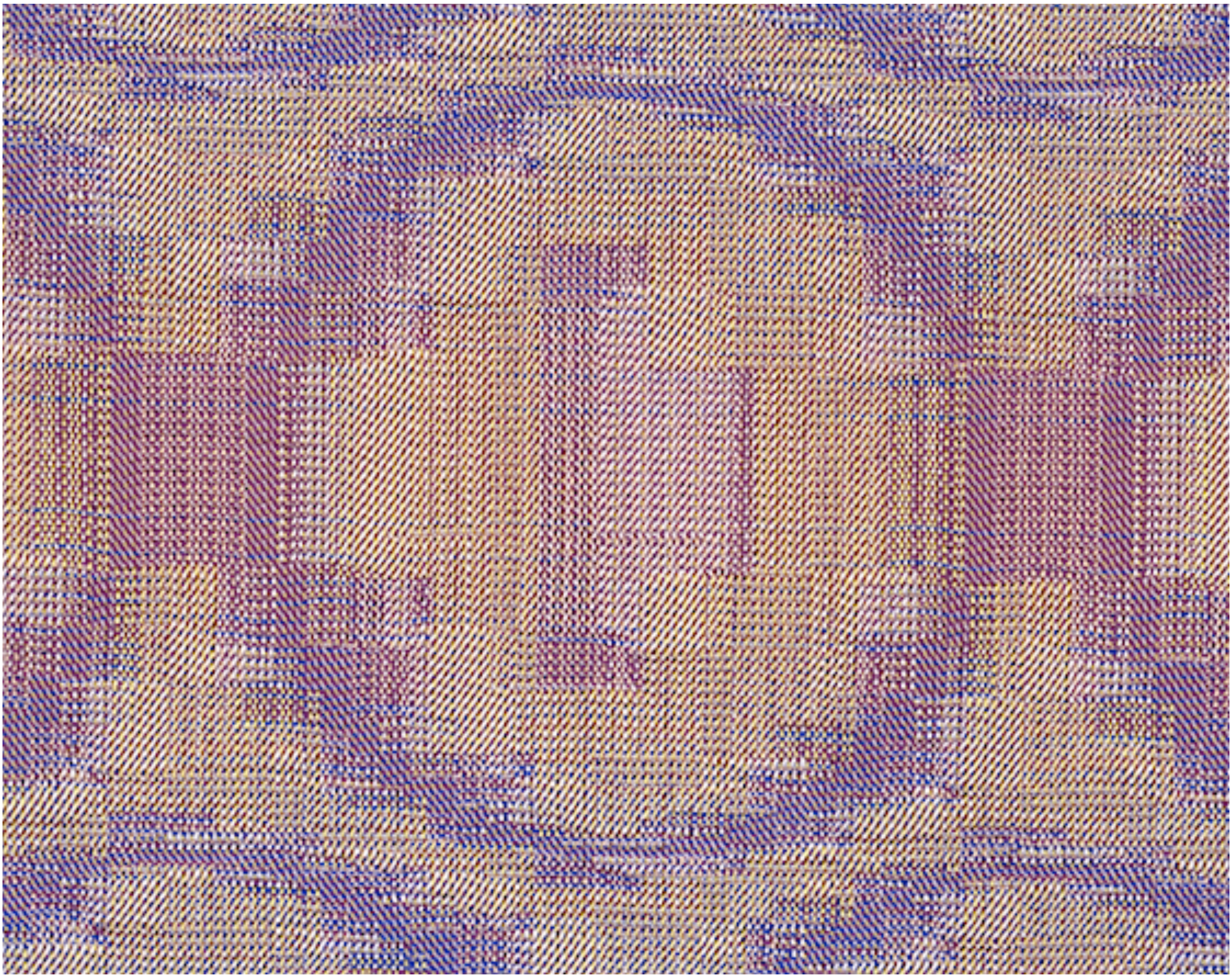
Abstract : An application of the method of initials and telescoping, the collection "Polyvalence" and its implementation in the industry.



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Polyvalence

In August 1987 I met at the "3ième Etats généraux des métiers d'art" in Mâcon an interior designer who sold fabrics for hotels. The regulations wanted these fabrics to be classified as "fireproof" and she told me about the poverty of choice for this type of fabric.
On my side I told her about the increased possibilities of textile creation with computers.
Thus began a collaboration that led us, François Roussel and I, to create a collection of fireproof fabric with large patterns.

François worked as a textile designer for the company Deffrennes-Duplouy Frères for several years and he proposed to his director, Mr Duhamel, to weave a fabric collection in Trevira CS.

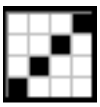
This was the first time we had the opportunity to implement an industrial production of fabric designed with the initials method (1).

We must pay tribute to Mr Duhamel, who trusted us in the creation of this collection and who took the risk of using a method virtually unknown in the north of France at that time.

François and I went to work and thought of a versatile threading to offer a wide variety of patterns ; hence the name of the collection: "Polyvalence" ("Versatility" in English).

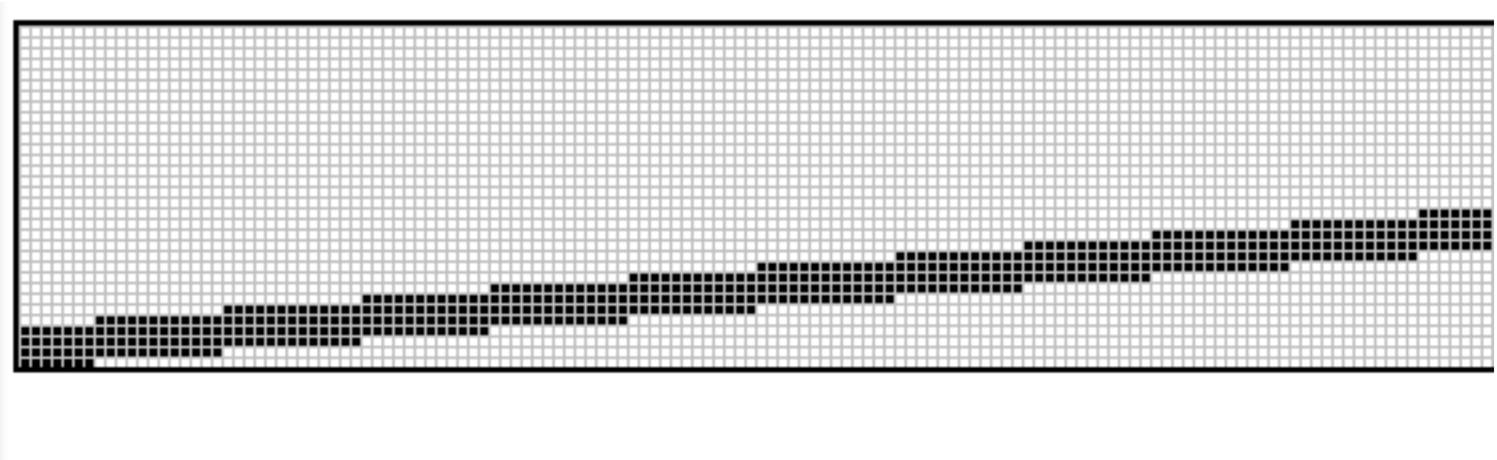
To have a very large repeat, about 400 threads, we combined the flexibility of the initial method and the telescoping [2].

Northern looms had 16 shafts maximum. So we built a threading on initial 4 of 32 shafts and then made a telescoping on 16 shafts.

The initial 4  is a good choice because it already allows, on a repeat of 4x4, a wide variety of weave structures :
The plain weave
Reps.
1/4, 4/1, 2/2 twills
Turkish satin (false satin of 4) and its opposite.
The double plain weave

(1) For more details on the initials method read : "Shaft weaving and graph design"
(2) "Shaft weaving and graph design" page 169

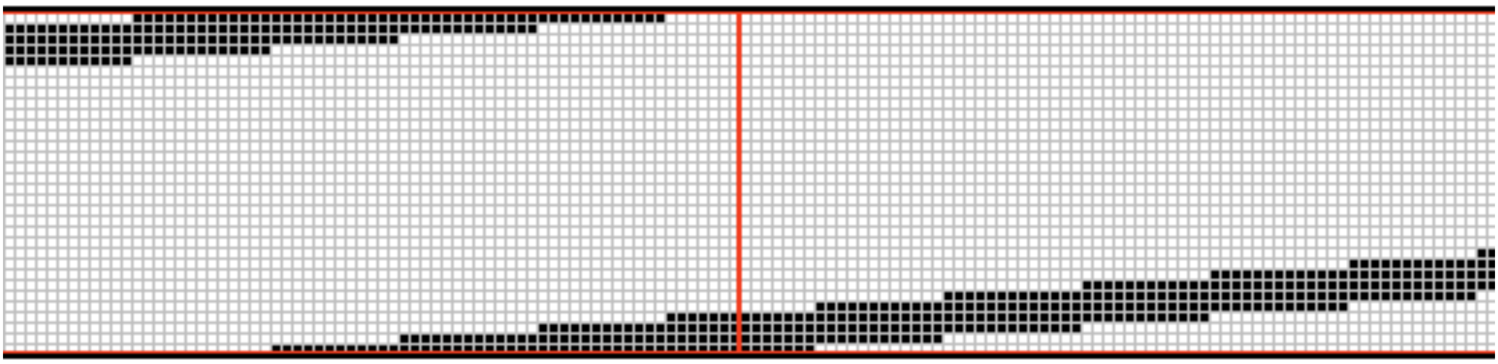
Construction of the straight threading of 400 x 32 :
A linear threading draw must be drawn on a 4 x 4 initial network.



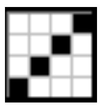
For a straight threading on 400 threads we draw a line with a pencil 1 pixel wide and 4 pixels heigh (4 as the height of the initial 4).

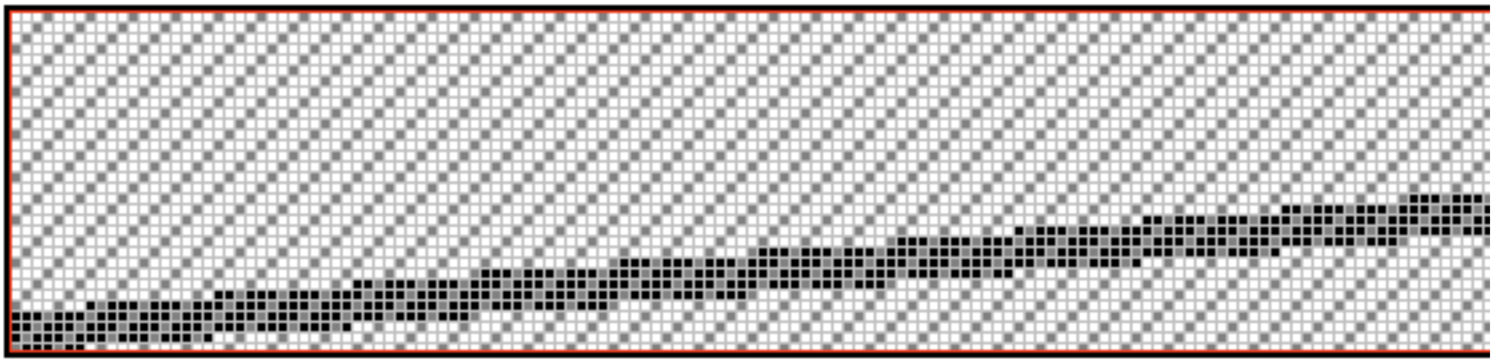
We draw the line in repetition for a good connection at repeat.

the line drawn in repetition mode, from the lower left to the upper right of the tile

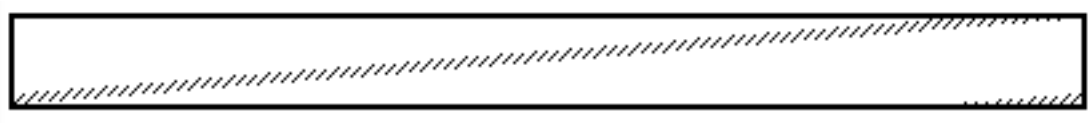


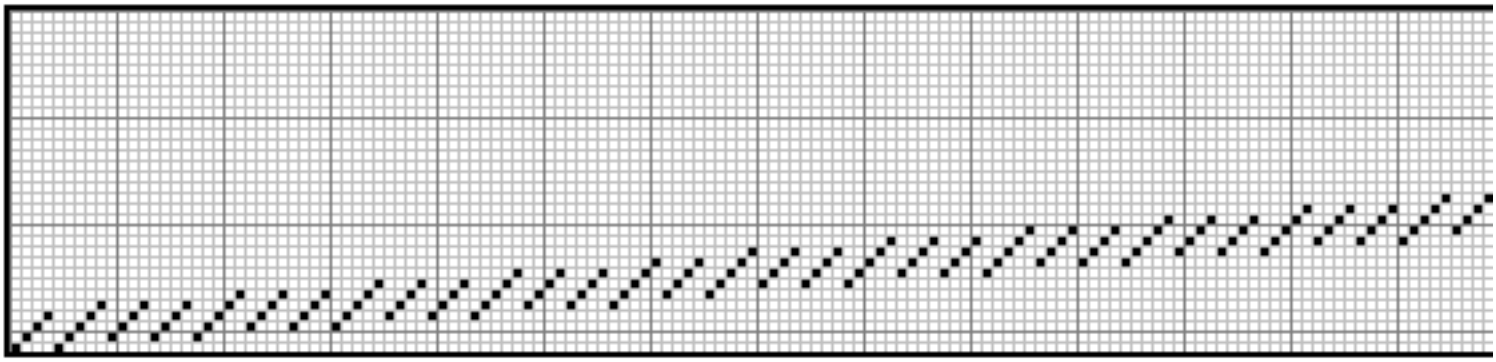
The threading repeat area

We must now make the intersection of this line and the network of the initial 4  i.e. with a network of twill 1/4



Which gives us :





Now how to go from 32 to 16 shafts ; how to telescope ?

It's really about grouping shafts 2 to 2 ; with two shafts actually we made one that groups all threads in the first shaft AND all the threads of the second. We add the shafts in a way.

We will start on the idea of keeping the left part of the threading intact ; this part of the threading is written on the first 16 shafts. We will associate to each of the first 16 shafts a shaft among the shafts 17 to 32. Thus the threads of the left of the threading will be coupled to the threads of the right of the threading.

Each shaft from 1 to 16 is associated with a shaft from 17 to 32
shafts 1 to 16 act on the left side of the threading.
The shafts 17 to 32 act on the right part of the threading.

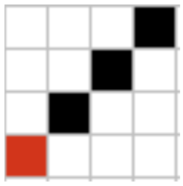
When we telescope two shafts on one, the new shaft will produce "harmonics". When we will lift the threads of the first shaft we will raise at the same time the threads of the second and vice versa. At the graphical level the trace of the threads of the first shaft will be associated with the trace of the threads of the second.

With our approach of associating each shaft from 1 to 16 to a shaft of 17 to 32, we see that a graphic defined in the left zone of the threading (shafts from 1 to 16) will cause harmonics in the right part (shafts from 17 to 32). Conversely a graphic defined in the right part will cause harmonics in the left part.

The idea is that the harmonics should not be generated too close to the graphic, but rather at a distance varying in a half width of threading.

The constraint for telescoping is that it respects the initial. Indeed we want that the final threading telescoped on 16 shafts respects the network of the initial 4. This not to lose the control of the contexture brought by the write on the network of the initial.

From the point of view of the initial (of the network) there are here 4 kinds of shafts



Shafts 1 5 9 13 17 21 25 29 that have their threads on shaft 1 of the initial

Shafts 2 6 10 14 18 22 26 30 that have their threads on shaft 2 of the initial

Shafts 3 7 11 15 19 23 27 31 that have their threads on shaft 3 of the initial

Shafts 4 8 12 16 20 24 28 32 that have their threads on shaft 4 of the initial

For the telescoping respects the network it is necessary and it is enough :
to associate
Shafts from 1 5 9 13 to one of the Shafts 17 21 25 29
Shafts from 2 6 10 14 to one of the Shafts 18 22 26 30 Shafts
Shafts from 3 7 11 15 to one of the Shafts 19 23 27 31
Shafts from 4 8 12 16 to one of the Shafts 20 24 28 32

To be able to associate two shafts they must have the same remainder of the division by 4 (Good at maths will say that their numbers must be congruent modulo 4)

Let's test the simplest telescoping, the one that associates to a shaft "n" the shaft "n + 16"

Shaft 1 associated with shaft 17
Shaft 2 associated with Shaft 18
Shaft 3 associated with shaft 19
Shaft 4 associated with shaft 20
Shaft 5 associated with shaft 21
Shaft 6 associated with shaft 22
Shaft 7 associated with shaft 23
Shaft 8 associated with shaft 24
Shaft 9 associated with shaft 25
Shaft 10 associated with shaft 26
Shaft 11 associated with shaft 27
Shaft 12 associated with shaft 28
Shaft 13 associated with shaft 29
Shaft 14 associated with shaft 30
Shaft 15 associated with shaft 31
Shaft 16 associated with shaft 32

How to telescoping?

We could draw by hand the shaft 17 on the shaft 1, the shaft 18 on the shaft 2 and so on, but it would be tedious.

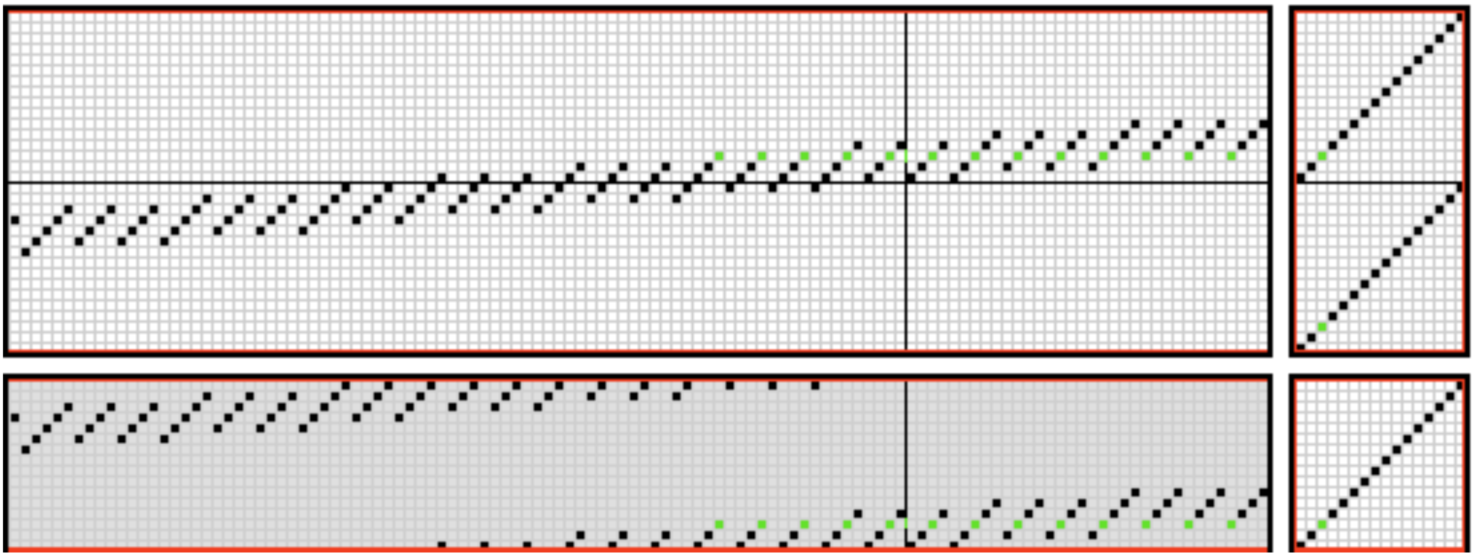
On a Mac version of Pointcarré, before switching to PC, I wrote the calculation of the "super cloth" as used in the book "Shaft weaving and graph design" pages 98-99.
It was an automatic telescoping tool. It was possible to draw in diagrams of the large cloth and the telescopic cloth was automatically updated. The drawing of the tie-up allowed to control the distribution of the harmonics in the space.
This function was accessible only by a combination of keys and hidden to users and I have never taken the time to finalize the user interface.

So I will not use this tool here but a simple calculation of intermediate cloth, corresponding to the 4 diagrams in the upper left of the "super cloth" of the book.
Let's call this intermediate cloth the "Telescoping cloth".

The threading of this telescoping cloth is the threading on 32 shafts.
The treadling is a straight one (it reads the tie-up)
The tie-up of 16x32 indicates the association of the shafts ; shafts on the same vertical are associated.
The cloth diagram, the result of the calculation, is the telescoped threading on 16 shafts.

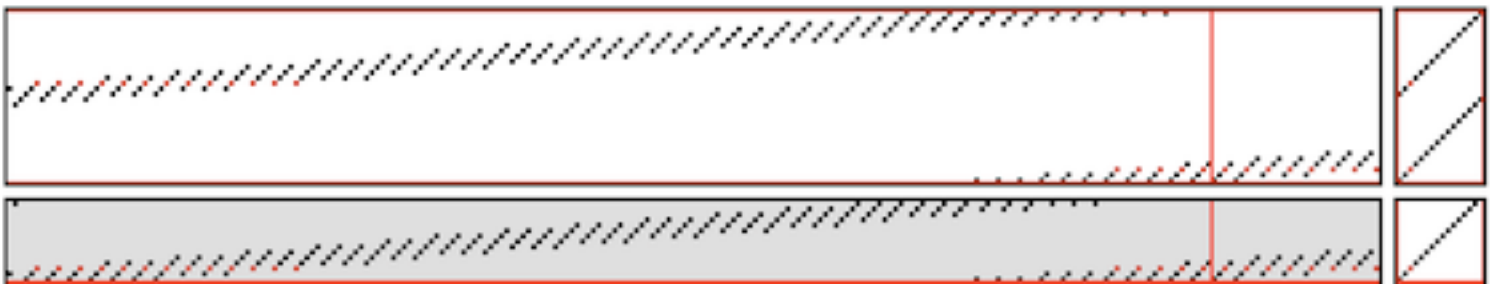
The lower part of the tie-up is straight, which means that the first 16 shafts are simply copied onto the cloth, i.e. on the telescoped threading.
The upper part of the tie-up is also straight, which means that the last 16 shafts are copied onto the cloth, i.e. on the telescoped threading.

Finally it is as if we had cut horizontally the 32 shafts threading in two parts and as if we had copied the upper part on the lower part to get the 16 shafts telescoped threading.

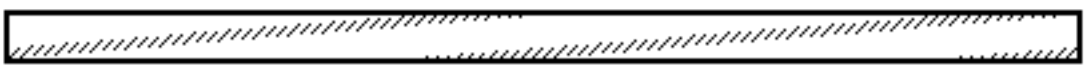


I noted down in green as an example the 3rd pick from the bottom.
The 3rd pick lifts the 3rd treadle in green.
In the tie-up, the 3rd treadle lifts shafts 3 and 19.
The threads worn by the shafts 3 and 19 are accumulated in the cloth, facing the pick 3.
In the drawing we do not see any thread on the shaft 1(they are on the left of the threading), but we can see the threads of the shaft 19 which are found on the shaft 3 of the telescoped threading (on the cloth).

The pick 3 is marked in red in the following drawing, where we see the addition of shafts 3 and 19:

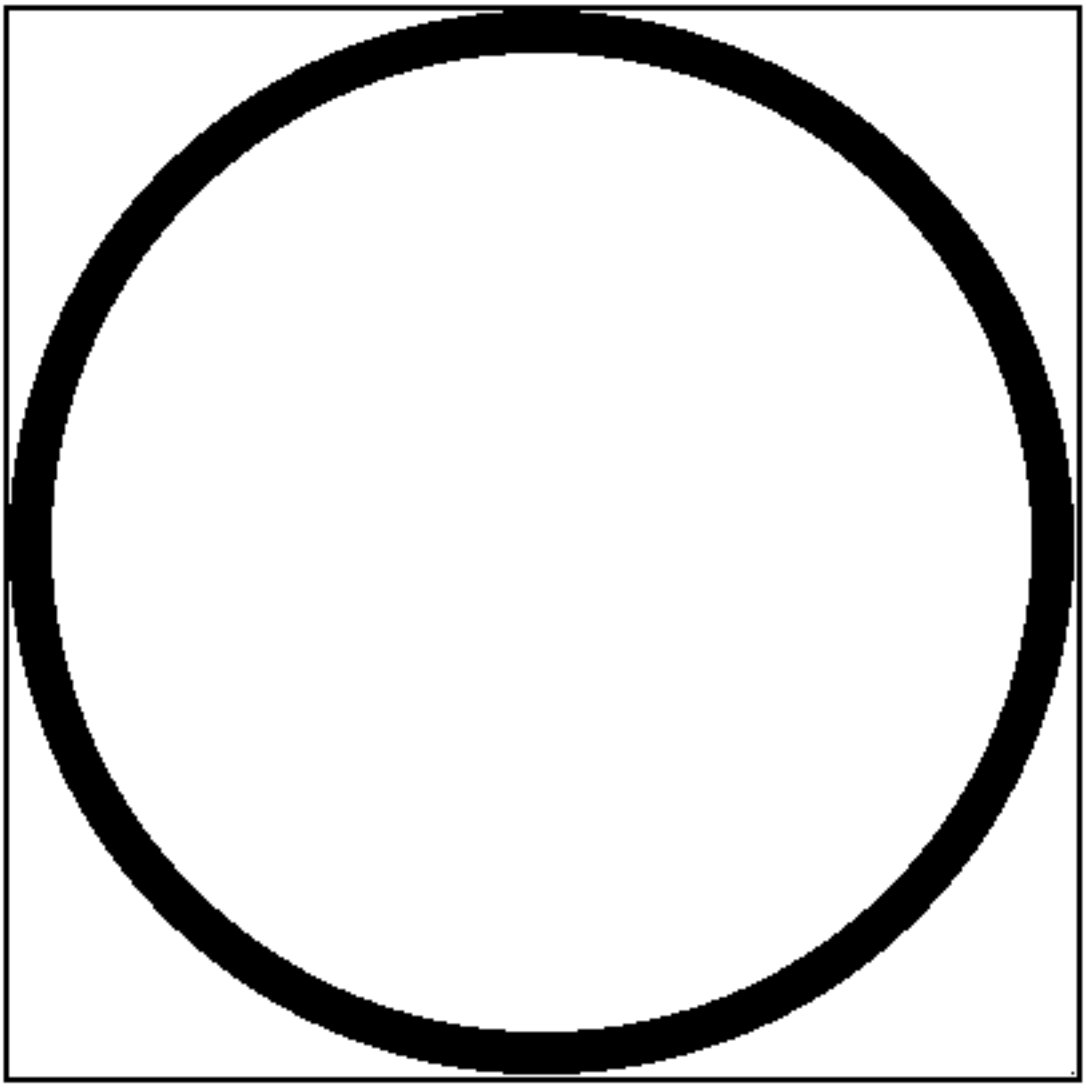


Here is the whole telescoped threading on 16 shafts (400 ends)



Now, let's see how this telescoped threading affects the graphics.

Let's take a simple geometric form to better understand.
Let's draw a circle of 400x400 pixels.



And see what is the peg-plan generated by this circle.

A little reminder about the "peg-plan generated" by a graphic in the cloth :

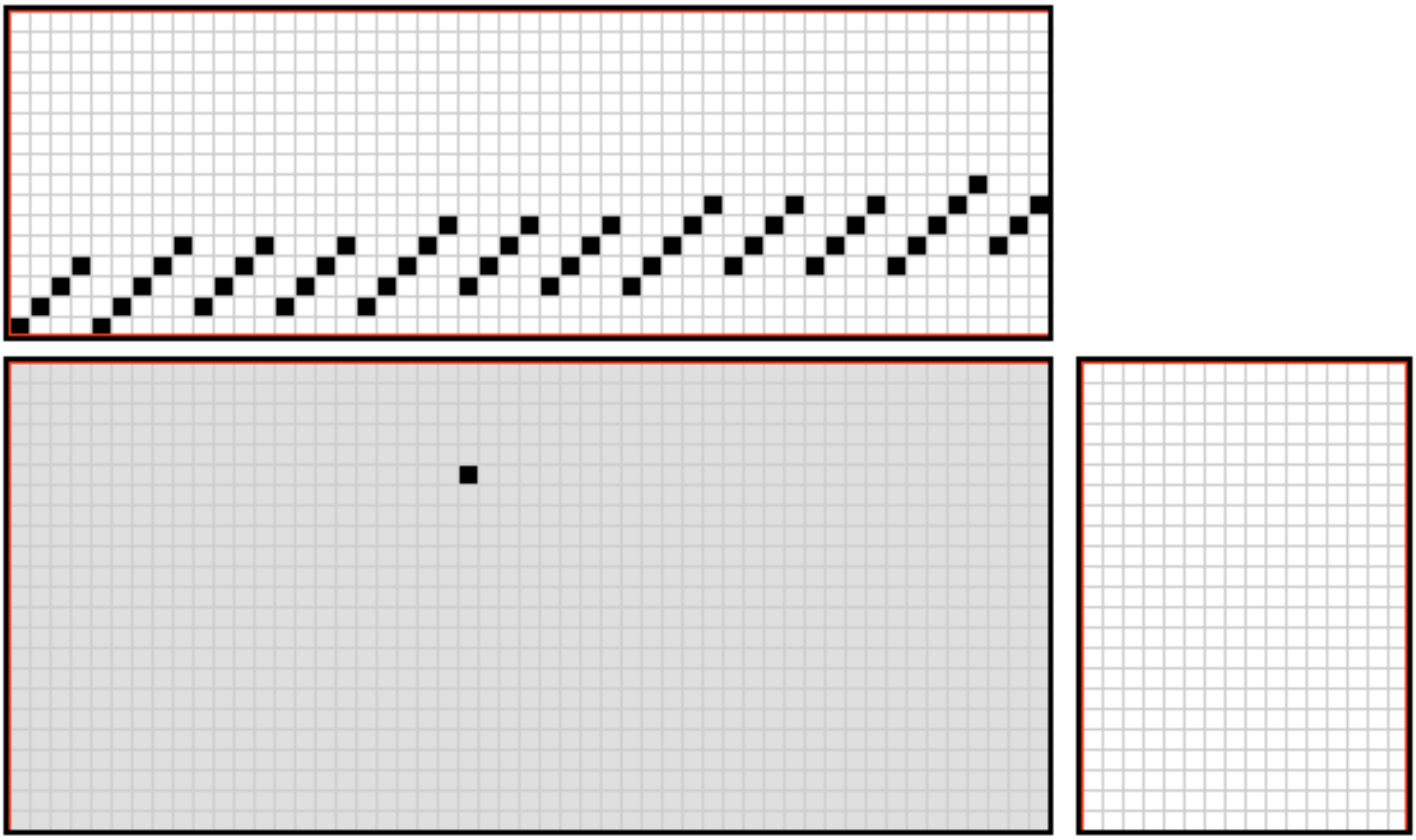
To calculate the generated peg-plan, a reverse cloth calculation is done.

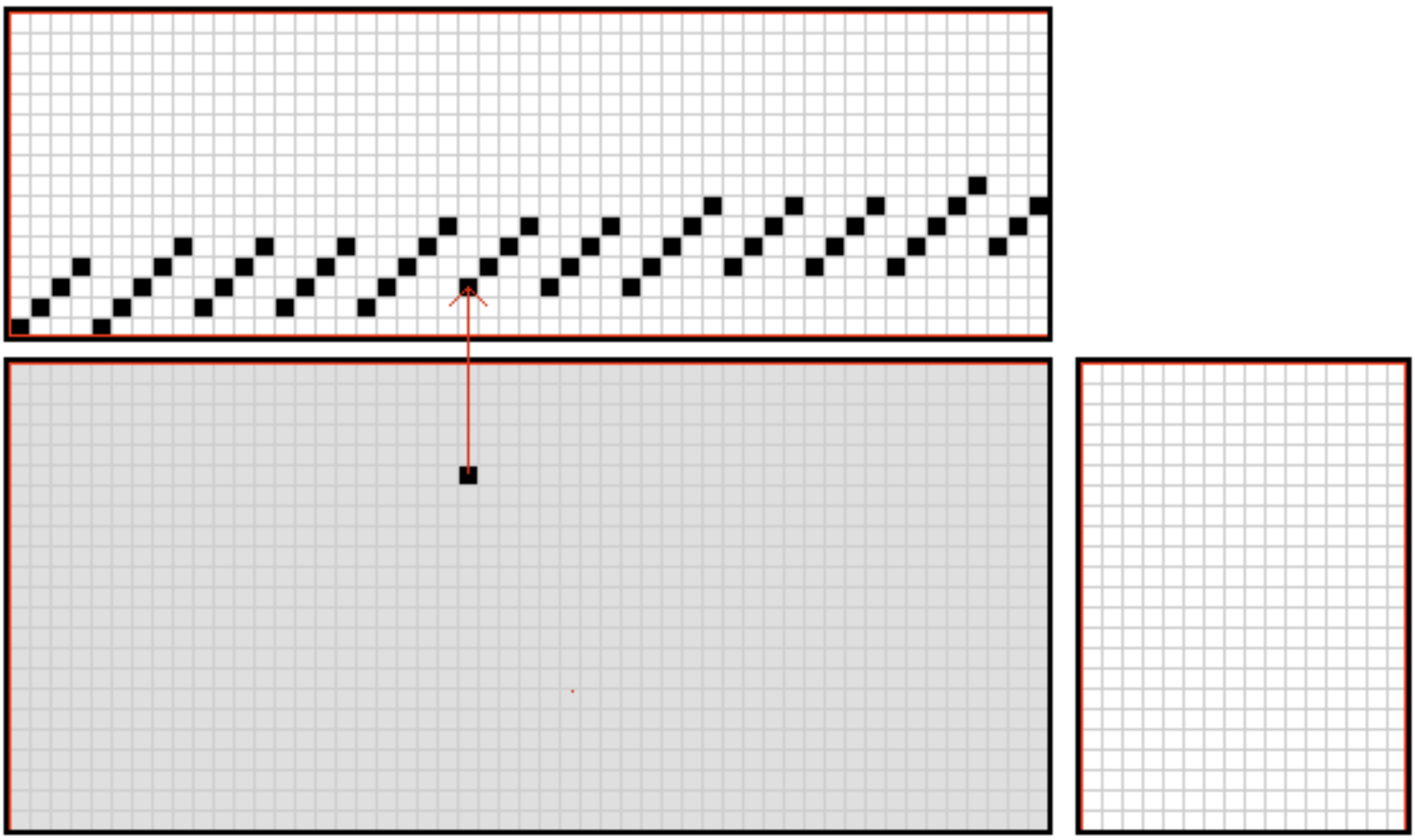
We start from the first pick and we look at the graphic black pixels, i.e. the threads that must be raised to produce the graphic.
For each black pixel we go up vertically in the threading to find the shaft in which is threaded this thread.
Finally we copy the lifting of this shaft in the peg-plan by marking in black the pixel corresponding to this shaft on the first pick.
This is done for all picks.

Then you have to recalculate the cloth in the regular way from the found peg-plan.
Indeed if a graphic pixel requires the lifting of the corresponding thread and thus the shaft in which is threaded, all threads in this shaft will be lifted at the same time ; we can not lift a single thread of the shaft but only the shaft with all the threads it contains. This lift, which will ultimately result in black pixels on the fabric is the "trace" of the shaft.

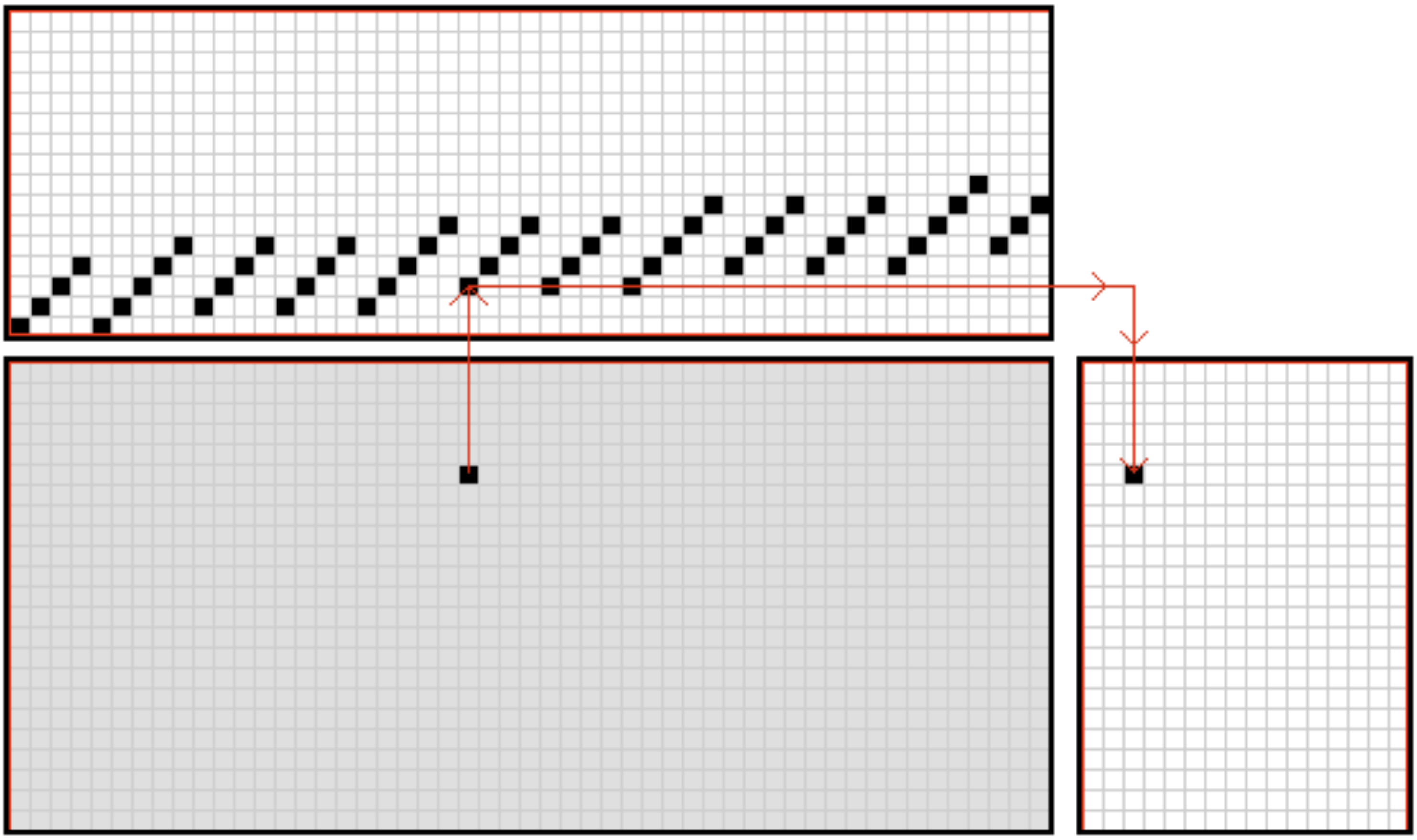
The "generated" peg-plan is the peg-plan which contains the lifts of shafts necessary to produce the graphic to the cloth.

The "generated" peg-plan generates a cloth that contains all the graphic, PLUS the trace of the different shafts raised.
Take the example of a graphic on the cloth reduced to a single black pixel :

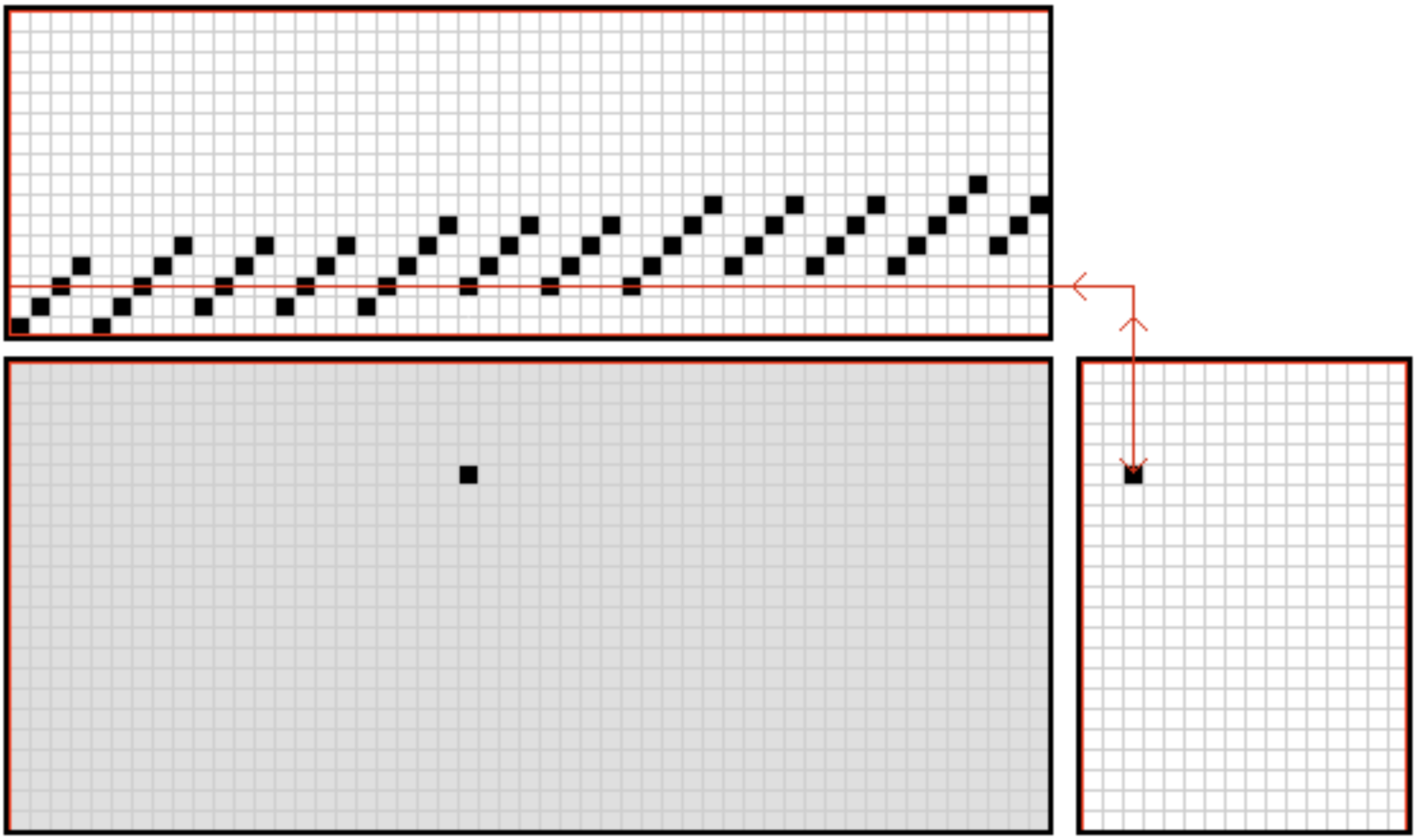




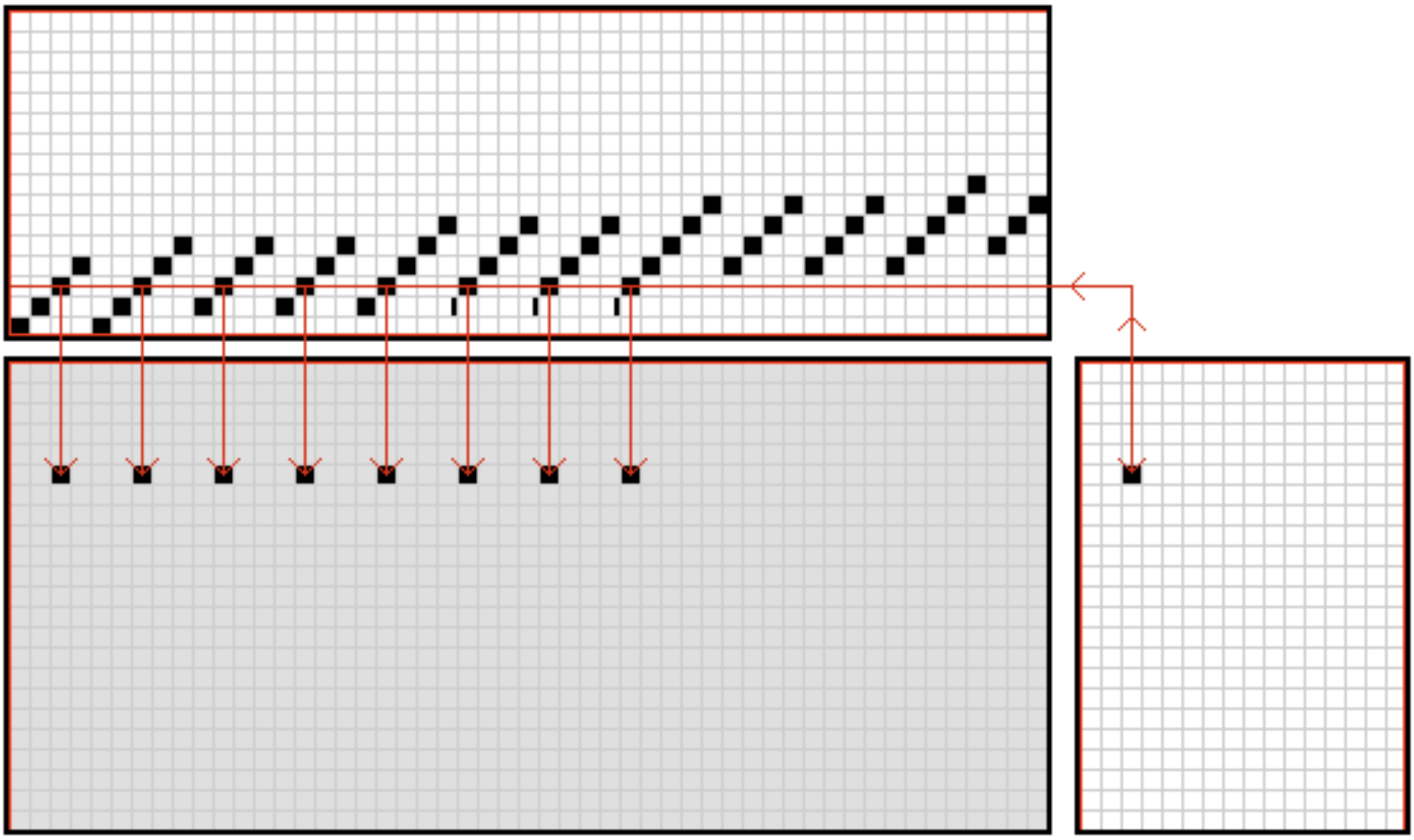
To obtain this pixel to the fabric it is necessary to raise the thread which is threaded in the threading in the shaft 3



To lift this thread you must raise the shaft 3 in the generated peg-plan.



If we now calculate the cloth in the regular way.
If you lift the shaft 3 in the peg-plan, it lifts all the threads in the shaft 3



To the cloth we will have as graphic all threads threaded in the shaft 3 as black pixels, it is the "trace" of the shaft 3.
The initial graphic, the unique black pixel of the start graphic is included in the generated graphic.

To provoke the calculation of the generated peg-plan in Pointcarré software, it is sufficient to drop (by drag and drop) the graphic onto the cloth diagram.
To see the trace of a pixel of the cloth just use the peg-miss tool.

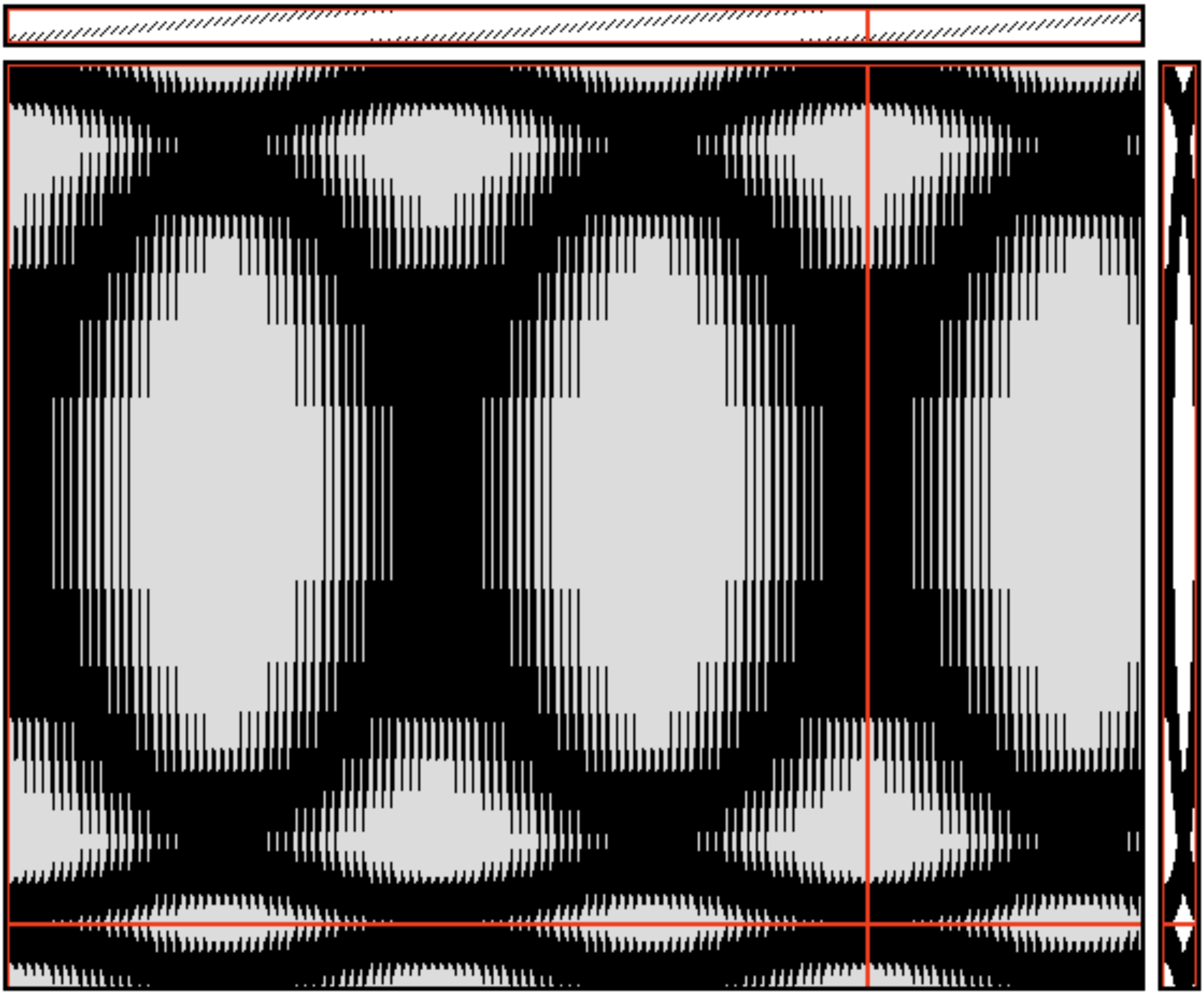
Here is the cloth and peg-plan generated by the circle graphic :

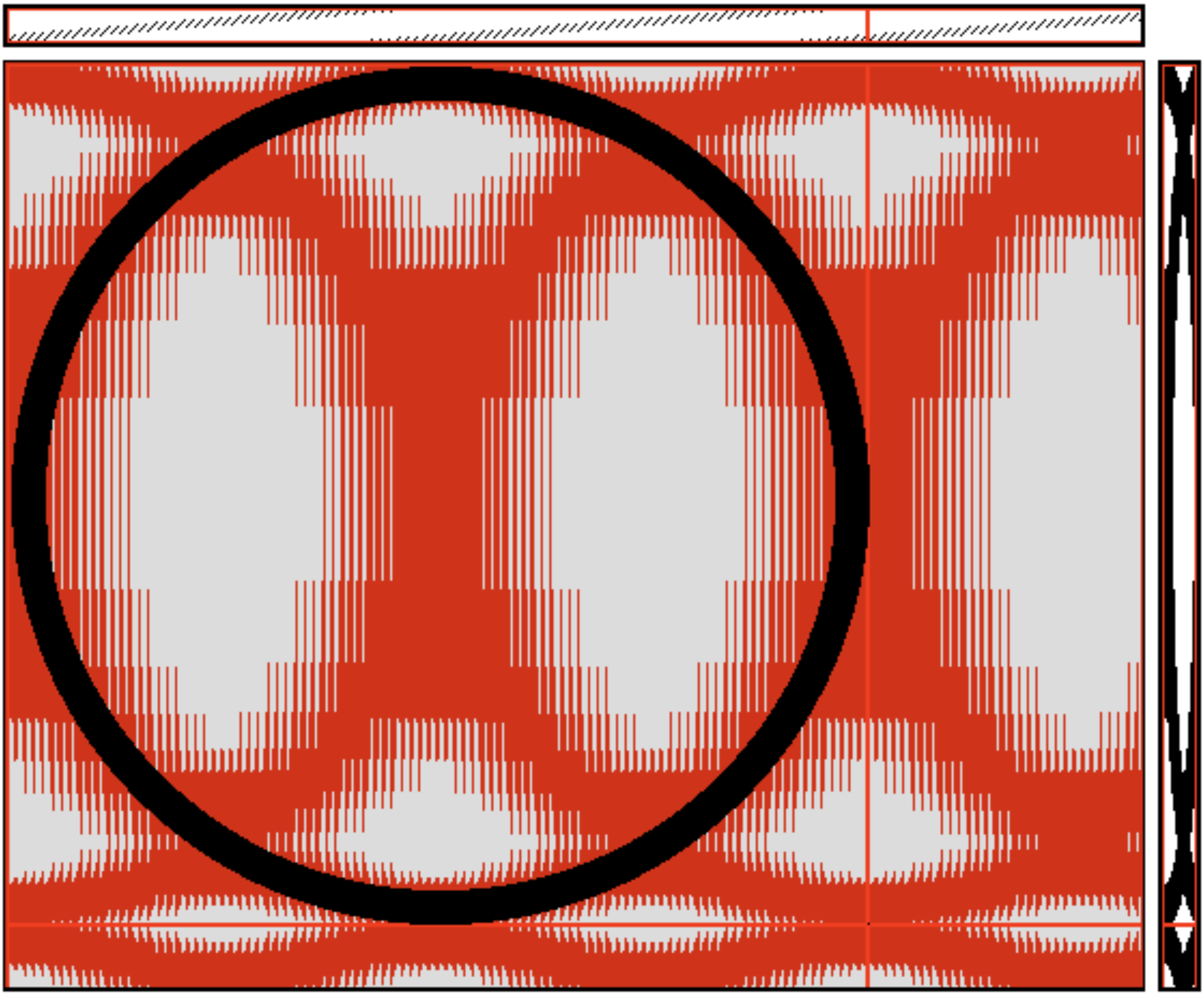
The trace is characteristic of this type of threading where each shaft contains about ten consecutive threads every 4 pixels (because of the initial 4)

This threading will engender for all the graphics this kind of shadow which corresponds to the trace of the shafts.

Here we are interested in the harmonics of telescoping, that is to say the additional graphics generated by the grouping of shafts two by two.

The left side of the graphic acts on the right side and vice versa.

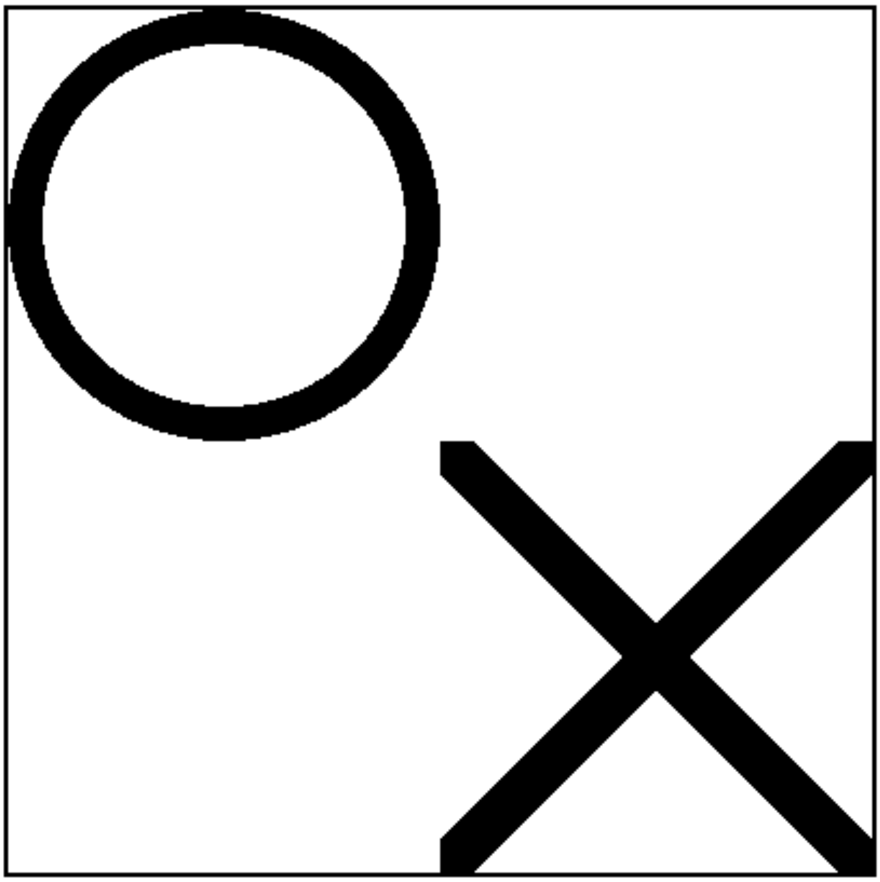




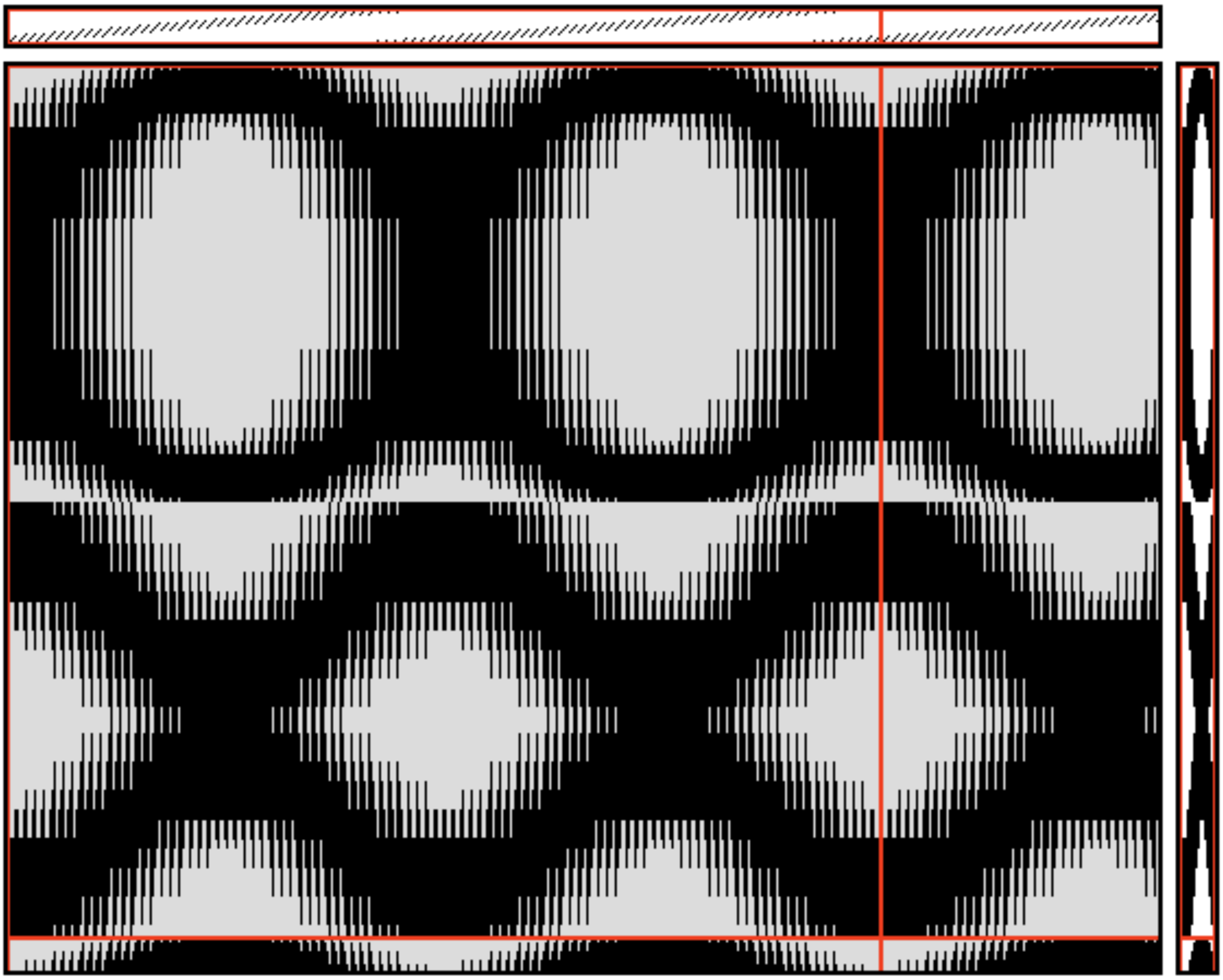
We find in the cloth the requested graphic, the 400x400 circle in black, plus the trace of the initial around. In red we see the harmonics created by the telescoped threading, the circle appears a second time, translated a half threading. The left part of the graphic has been copied on the right and the right on the left (or right in the next repeat).
This is not surprising when you look at the telescoped threading; we clearly see the left half of 200 threads that repeats right on the next 200 threads.

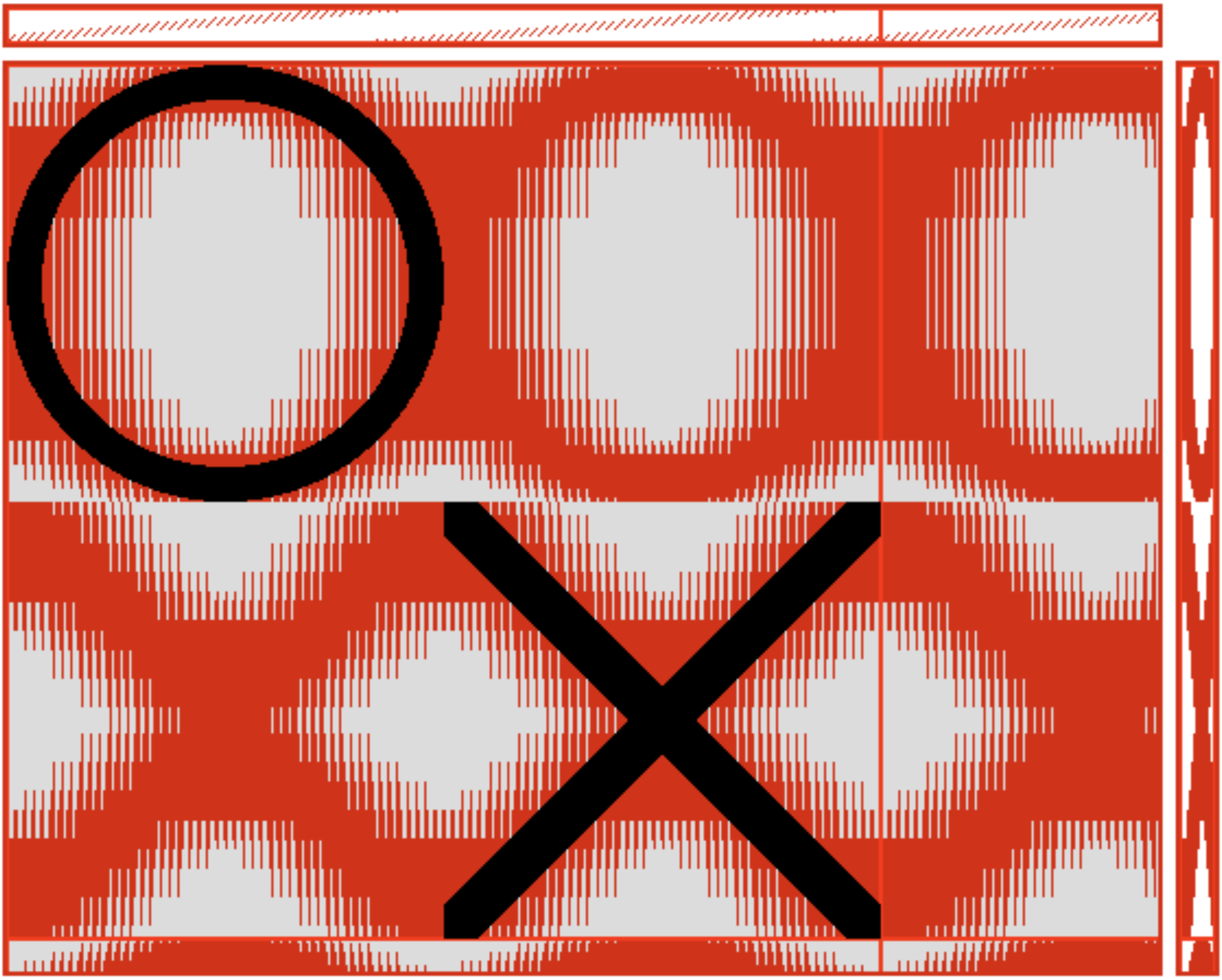
If we limit ourselves to a graphic on the first 200 pixels the harmonics will be completely outside the initial graphic. The graphic is simply repeated next.
It's like having a total freedom over 200 yarns wide.

Let's take a graphic with a circle on the 200 pixels on the left and a cross on the 200 pixels on the right:



Here is the generated cloth :

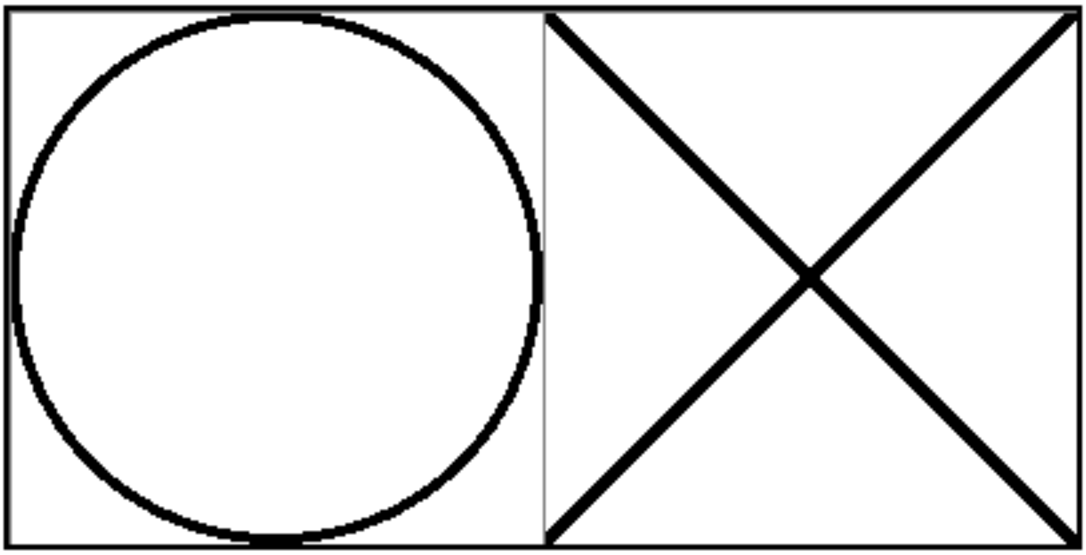




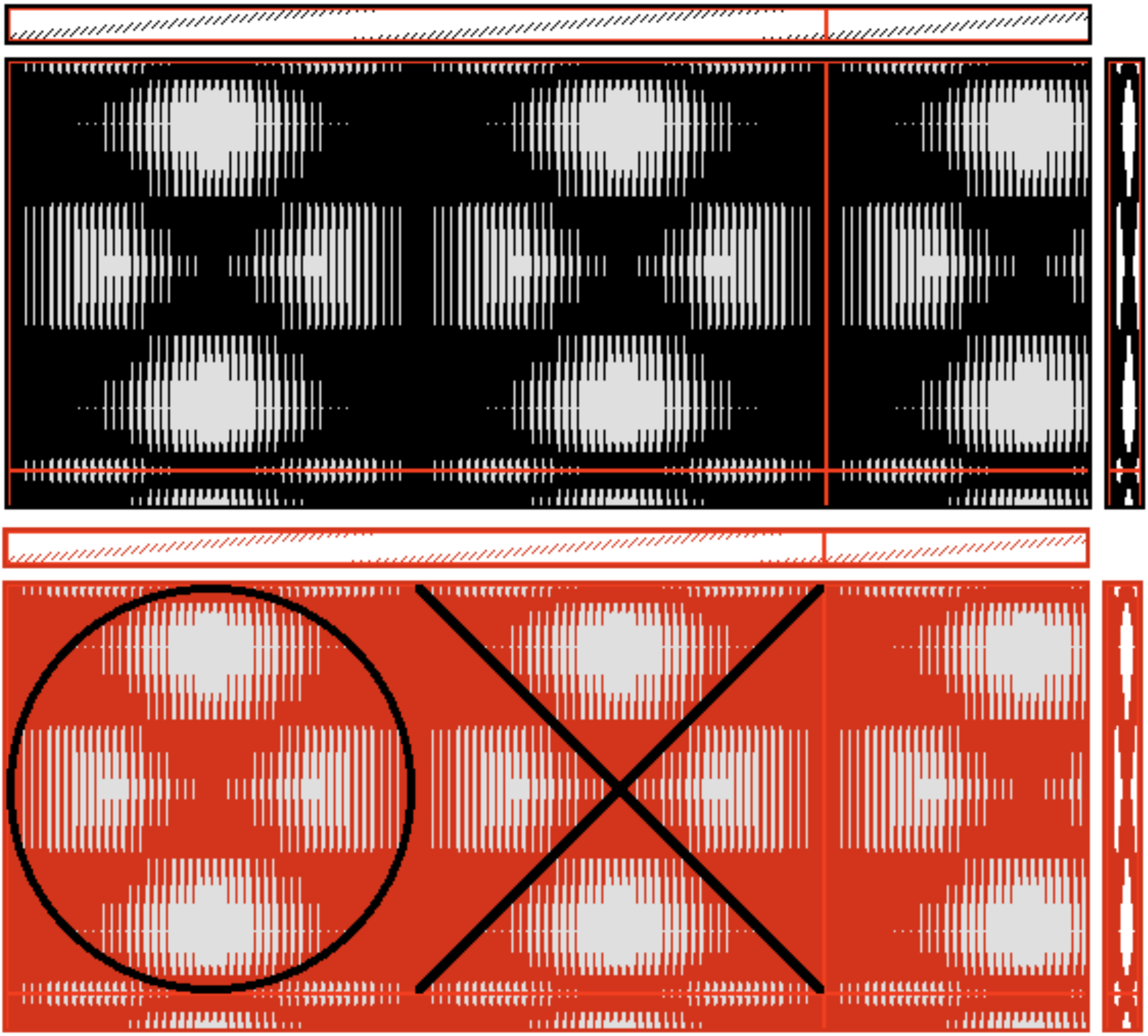
The graphic of the circle is not destroyed by the harmonics, its harmonic is simply the circle recopied on the right.
The graphic of the cross is not destroyed by harmonics, its harmonic is simply the cross copied to the left (or shifted right on the next repeat).

If we use a graphic on the width of the 400 pixels, then, as for the first big circle, the left part creates a harmonic on the right and the right part a harmonic on the left.

Take as a graphic a circle and believe in the width of 400 pixels



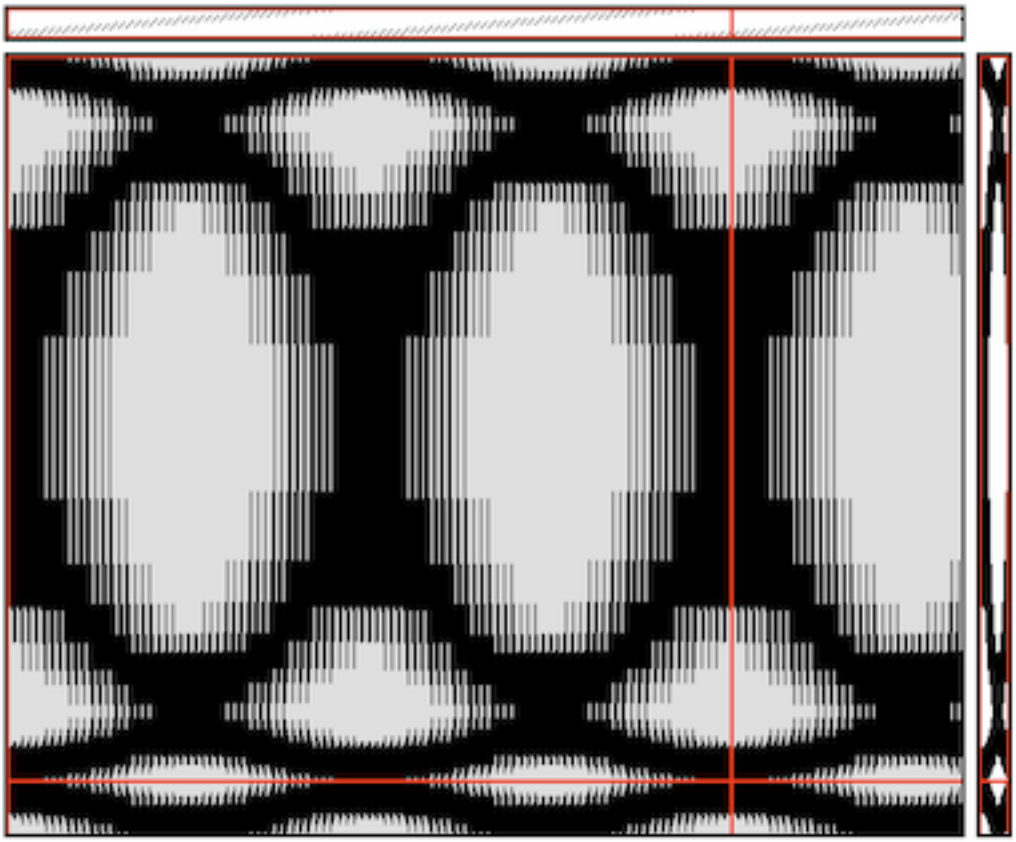
Here is the generated cloth :



the left part (the circle) creates a harmonic on the right and the right part (the cross) a harmonic on the left.

This type of telescoping, which results in a simple copy of the graphic has the big disadvantage of creating harmonics as perceptible as the initial graphics.

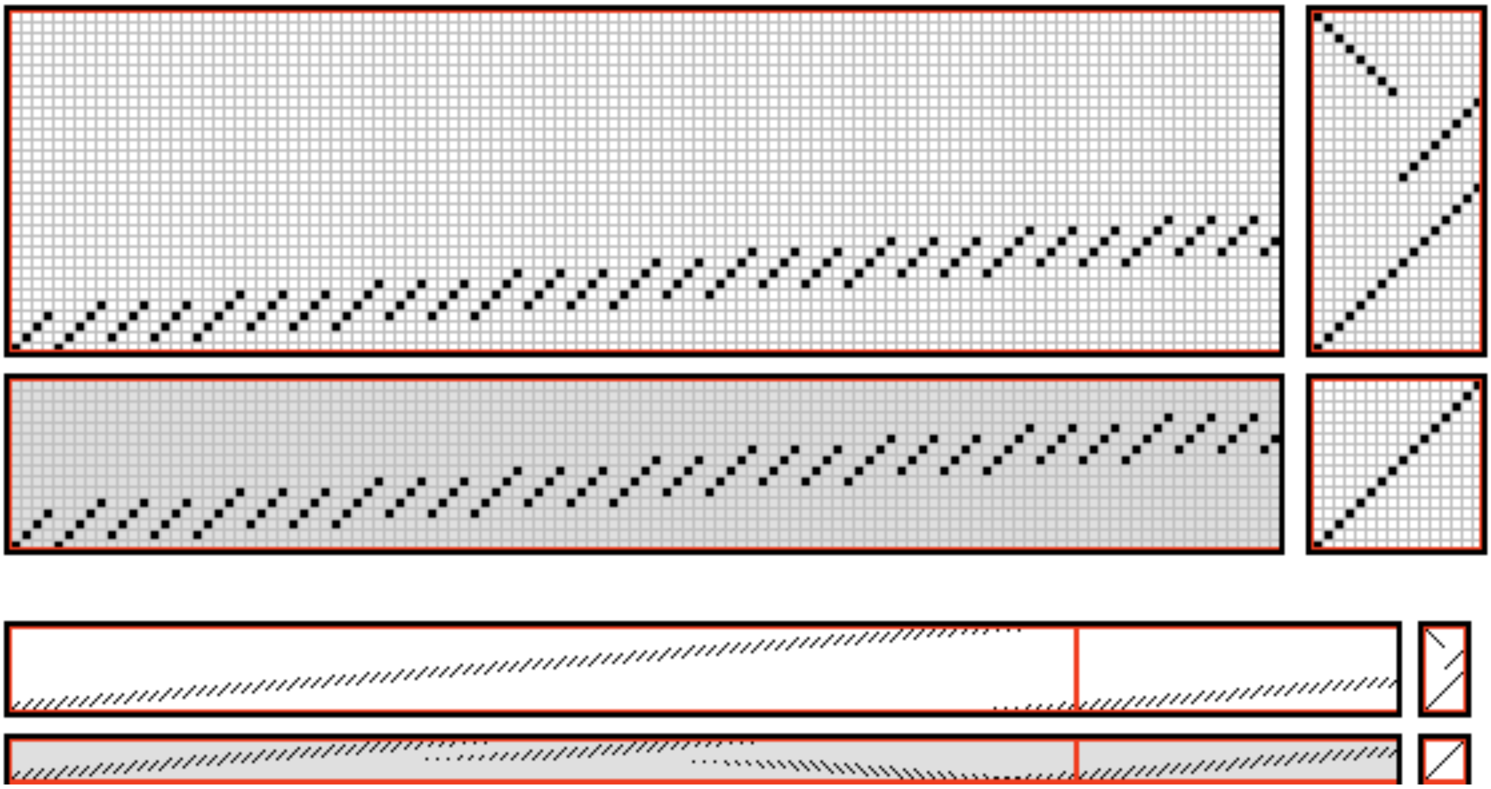
In the first example of the big circle:



What distinguishes the initial graphic (the big circle), of its harmonic (the big offset circle) ?
You can also perceive this drawing as a circle drawn on the right and shifted to the left.
The initial graphic and the harmonic have the same visual weight.

We will see that by choosing another telescoping we will be able to fragment the harmonic so that it is more discreet.

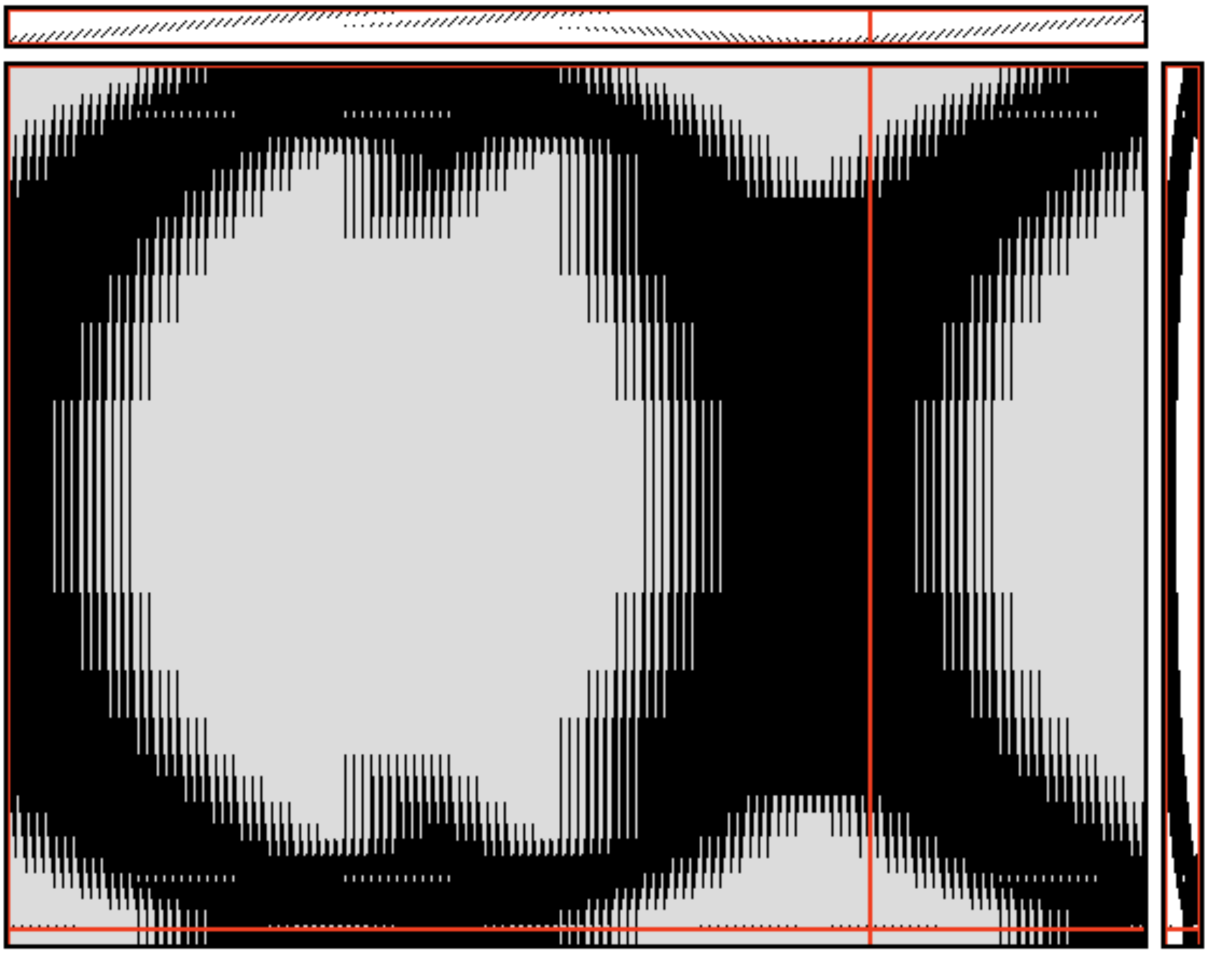
Here is the telescoping cloth:

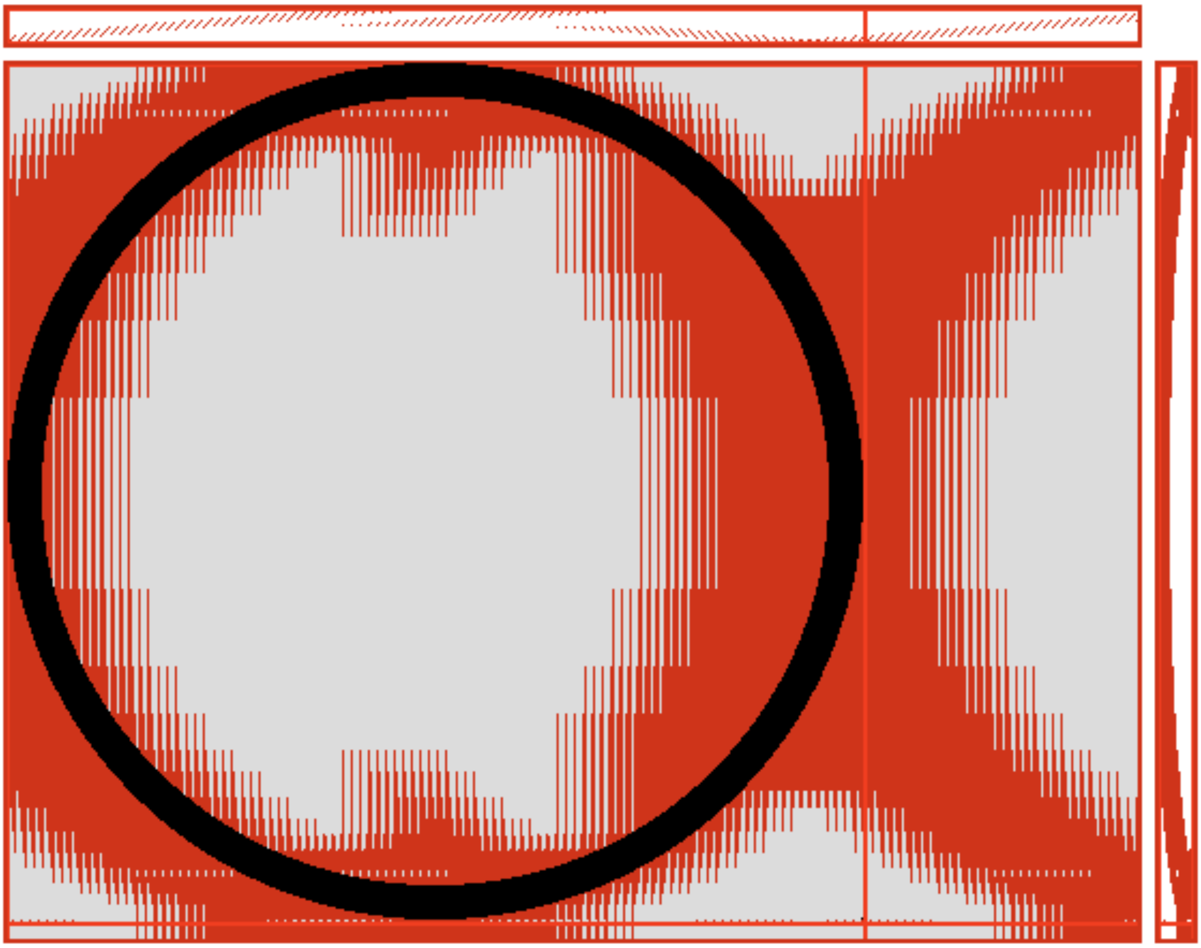


Shaft 1 associated with shaft 32
Shaft 2 associated with shaft 31
Shaft 3 associated with shaft 30
Shaft 4 associated with shaft 29
Shaft 5 associated with shaft 28
Shaft 6 associated with shaft 27
Shaft 7 associated with shaft 26
Shaft 8 associated with shaft 25
Shaft 9 associated with shaft 17
Shaft 10 associated with shaft 18
Shaft 11 associated with shaft 19
Shaft 12 associated with shaft 20
Shaft 13 associated with shaft 21
Shaft 14 associated with shaft 22
Shaft 15 associated with shaft 23
Shaft 16 associated with shaft 24

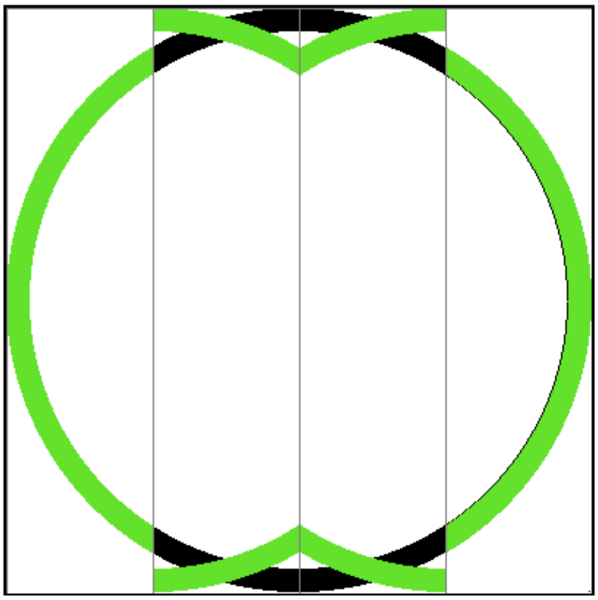
The shafts associated with shafts 1 to 16 do not follow each other as before.
The first 8 shafts are associated with shafts in descending order, which will cause symmetry and the following are associated in the same order with shafts from the beginning of 17 to 24.
This will cause fragmentation of the initial.

Let's go back to the same big circle as at the beginning on this new telescoped threading.

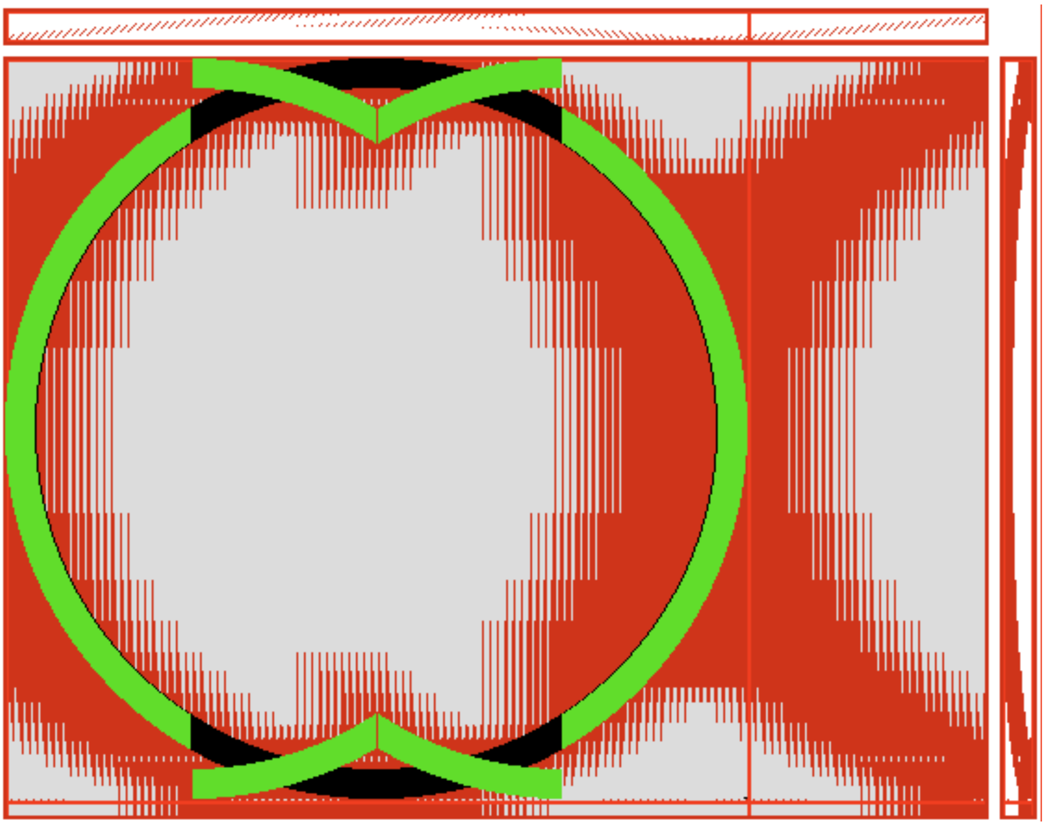




Harmonics are harder to understand.

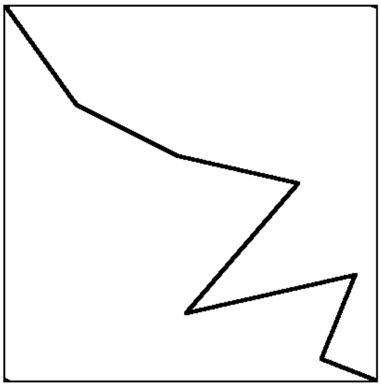


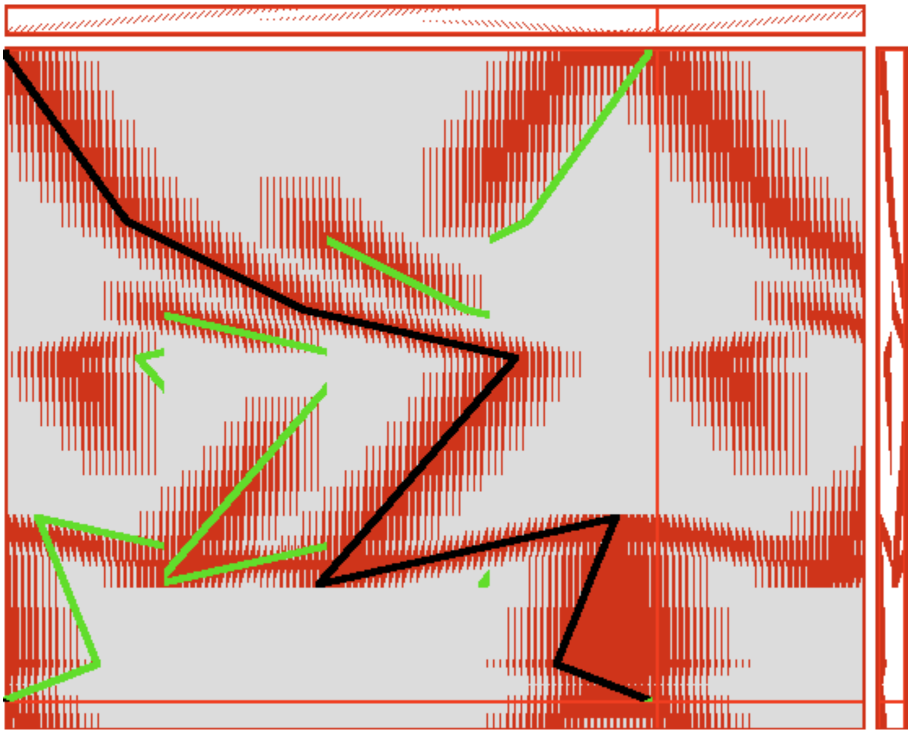
One can reason here by quarter of drawing. I noted down in green the harmonics.
The left quarter of the great circle is copied as harmonic on the right quarter with a symmetry with respect to a vertical and therefore exactly on the right part of the big circle. The harmonic generated is copied exactly on the initial graphics, we do not see it.
Reciprocally, the quarter-right is copied to the left quarter with symmetry ; here again the harmonic is superimposed on the original graphic.
For the second quarter on the left it is copied without symmetry on the third quarter and conversely the third quarter is copied to the second.
The harmonic is perceptible up in the middle of the circle.



The fact that the harmonic disappears is due to the fact that our initial graphic contained a symmetry.

To better understand the harmonics of this telescoping, let's try a non-symmetrical graphic.

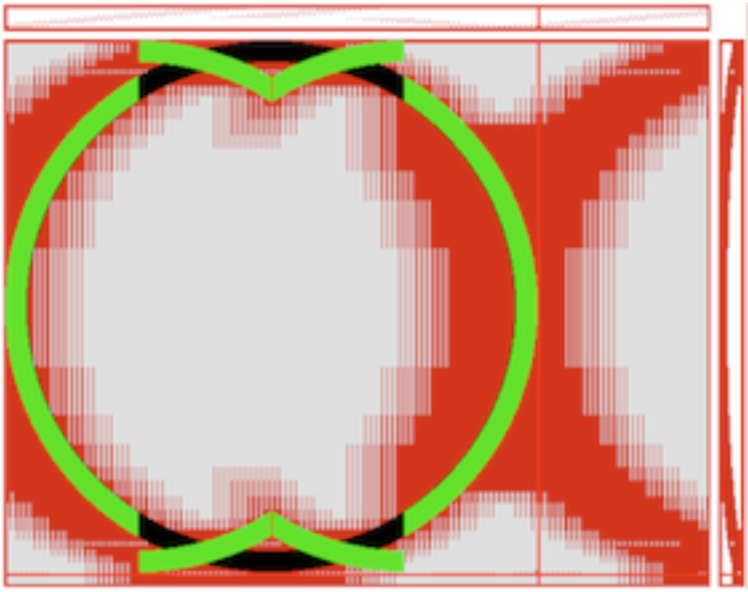




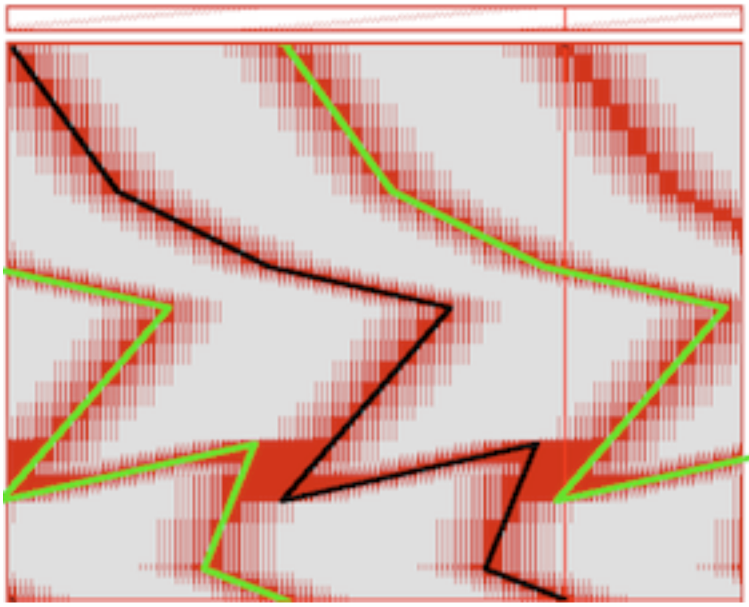
The harmonics are noted down in green. We see better here the quarter shift of graphics with or without symmetry.

Let us compare the first telescoping and the second
:

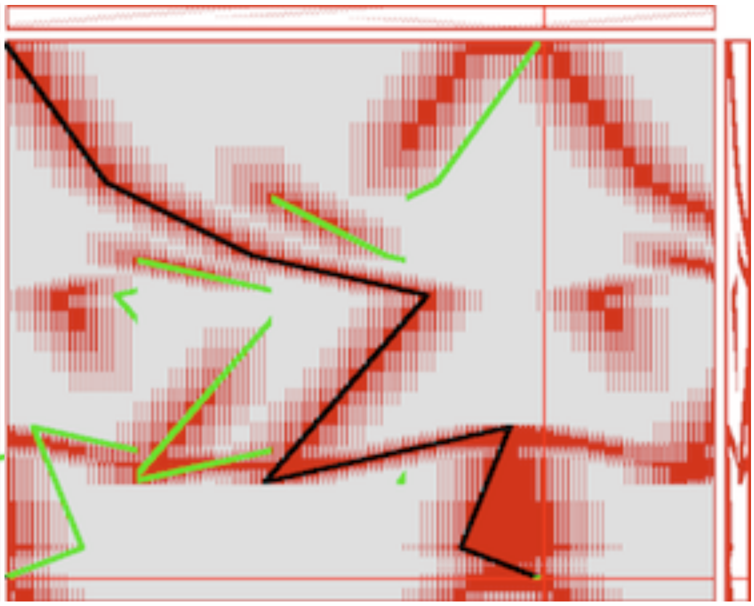
First straight telescoping



Second fragmented telescoping



First straight telescoping



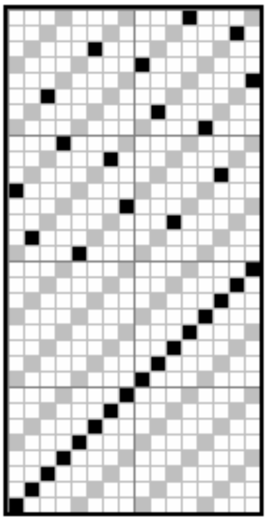
Second fragmented telescoping

Clearly, in the second telescoping, the initial graphics is better respected. The harmonics are more discreet because the starting line has been broken into several small lines.

The importance of the telescoping appearing to us as fundamental we sought for the Polyvalence collection to define a telescoping the most fragmented possible, which respects the initial 4.

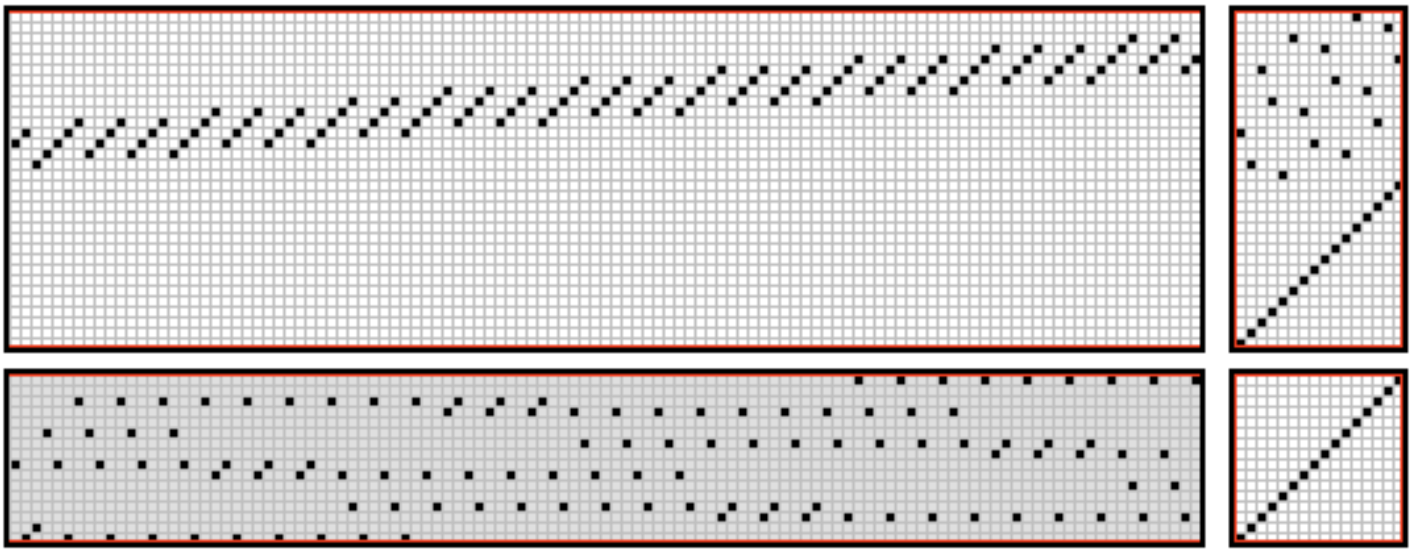
To respect the initial 4 we saw that it was necessary to associate shafts whose number have the same remainder of the division by 4.
Graphically this simply means to draw the tie-up on the same initial network.

I drew in gray the network and in black tie-up.
By obliging oneself to draw on the network, one is sure to associate shafts of the same type.
The first column shows for example only the shafts 1 and 29, all the numbers whose remainder of the division by 4 is 1.

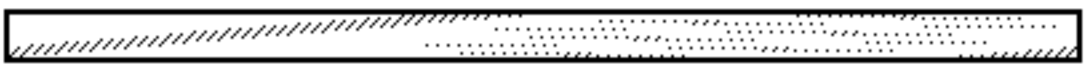


The telescoping of the "Polyvalence" collection.

This telescoping looks like a satin that we would have forced to write on the network. The binding points are farthest from each other ; which will lead to a maximum fragmentation of the harmonics.

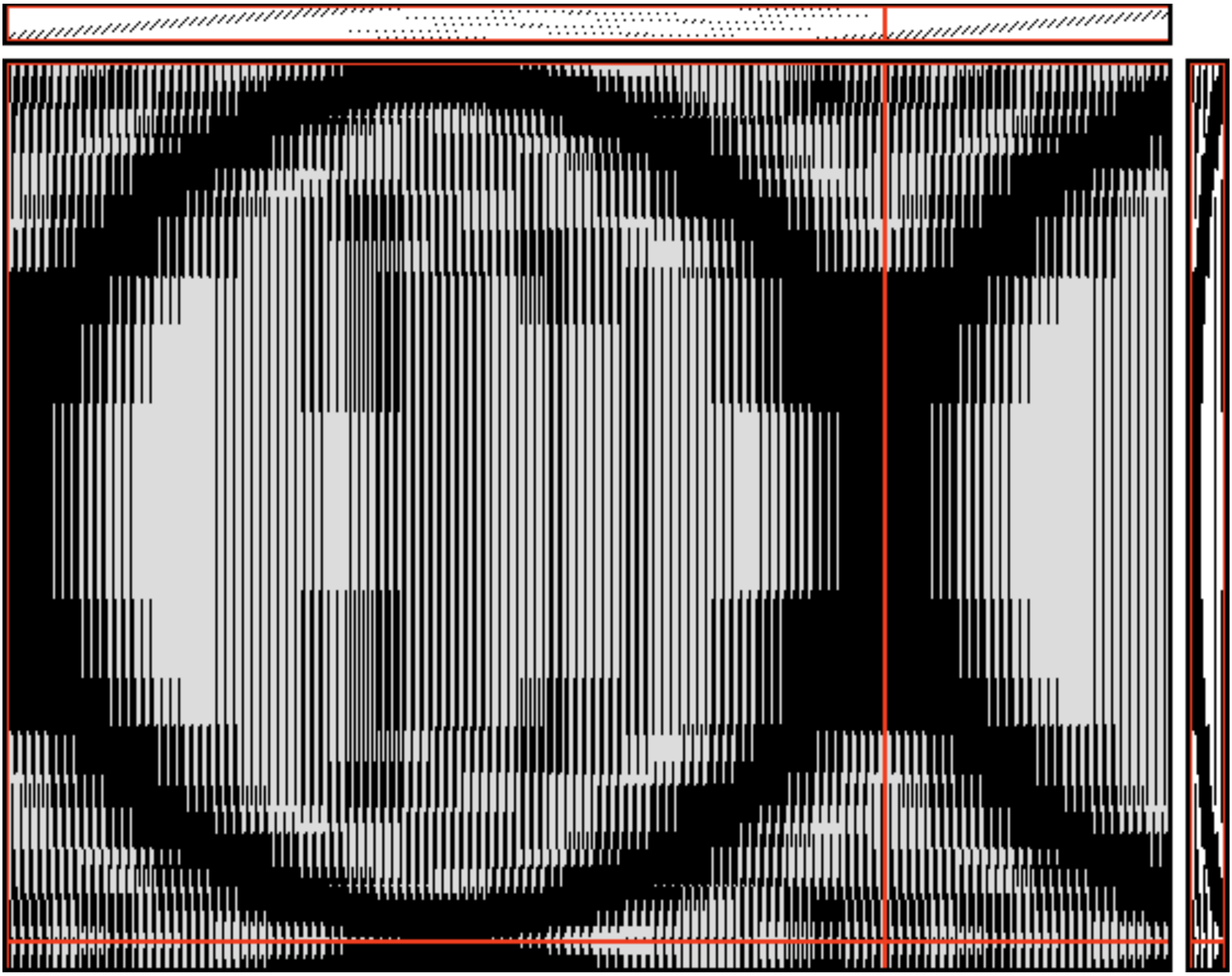


The telescoping cloth from the collection "Polyvalence"
The top of the 32 shaft threading was completely broken by telescoping.

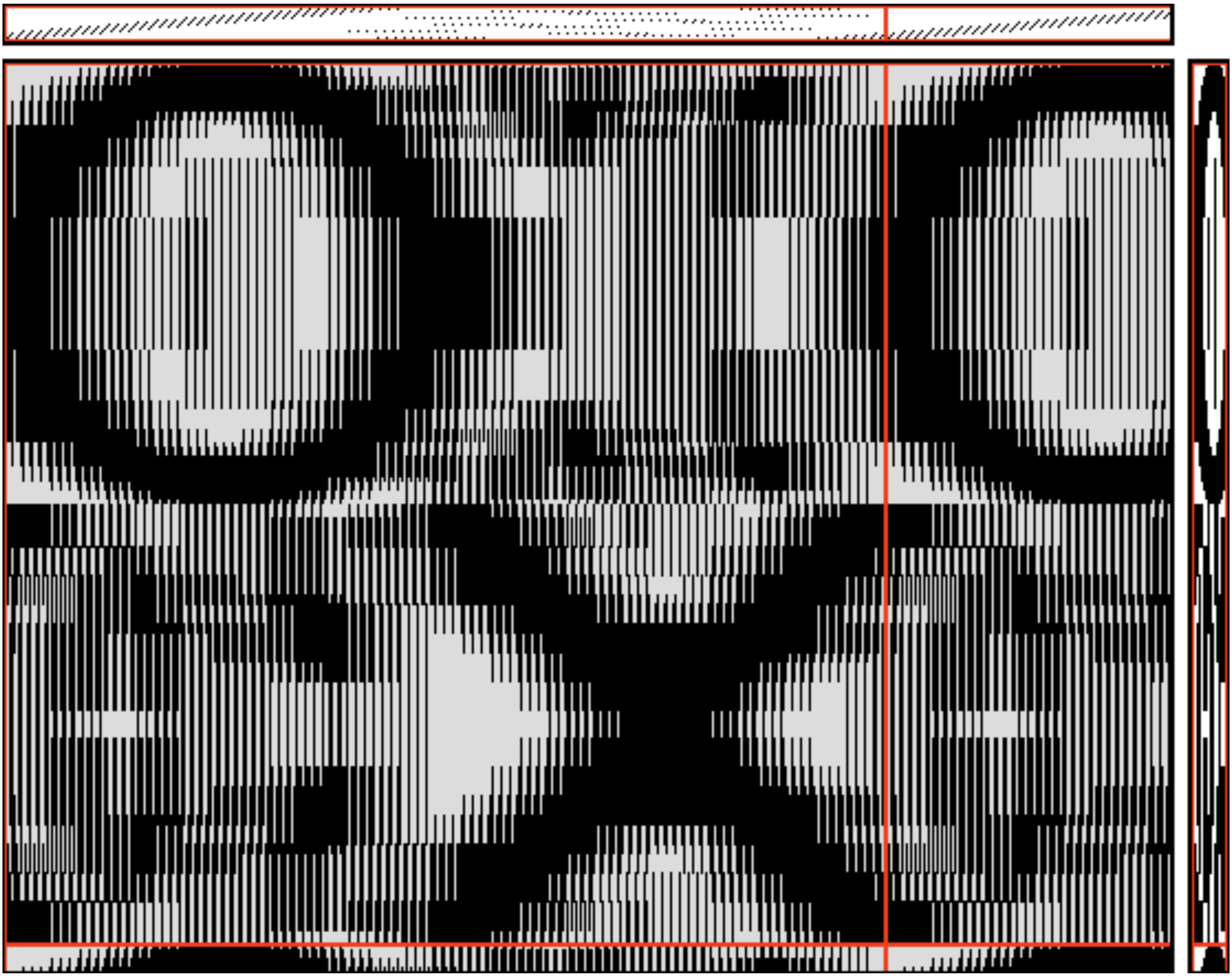


The 16 shafts threading of the "Polyvalence" collection.

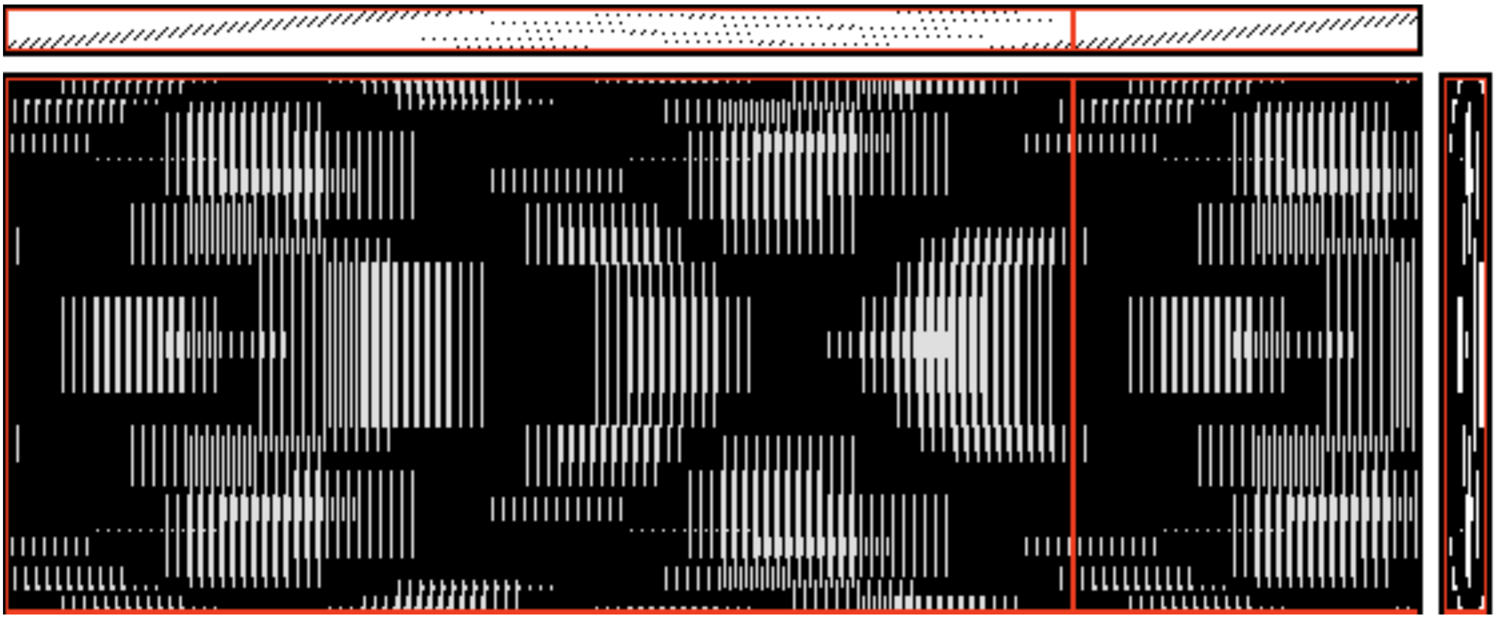
Let's look at the harmonics created by this telescoping, by taking again the same graphic examples :



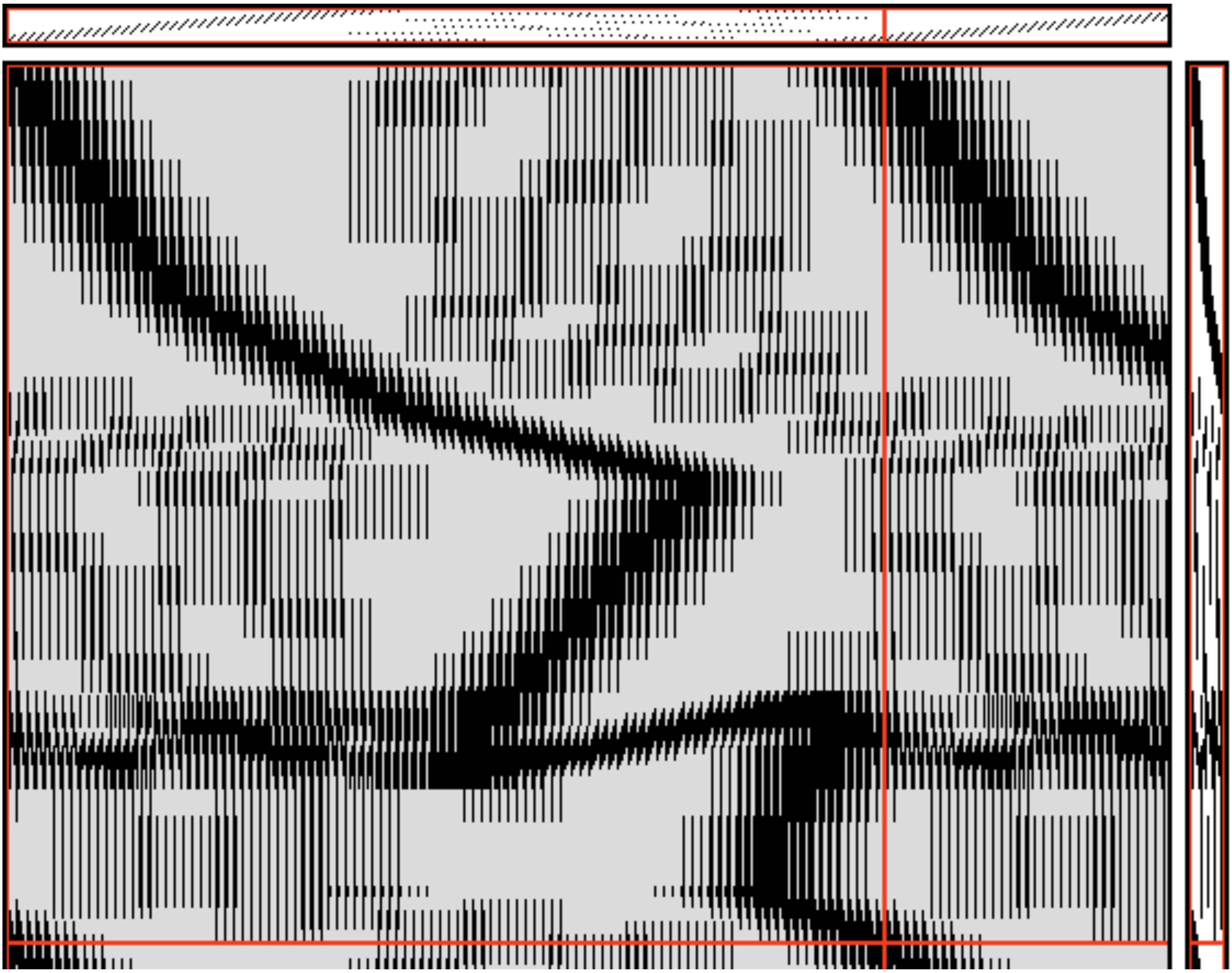
The graphics are very well respected, the harmonics are lost in a broken background



Here too a very good respect for the initial graphic.



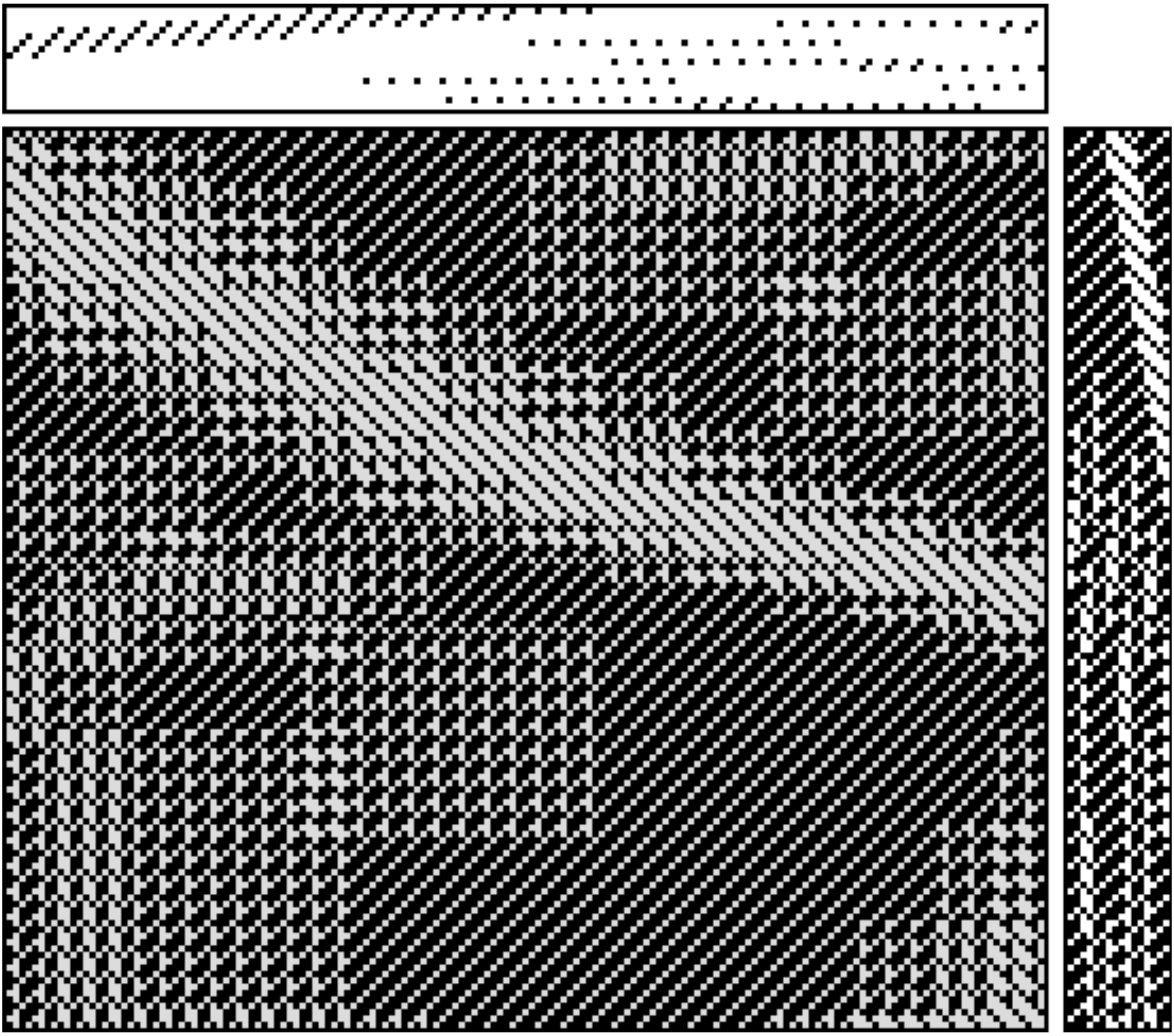
Here the harmonics of the circle and the cross are superimposed, but we still see the initial graphic



The line of the initial graphic is perfectly clear and the harmonics gives a character to the background.

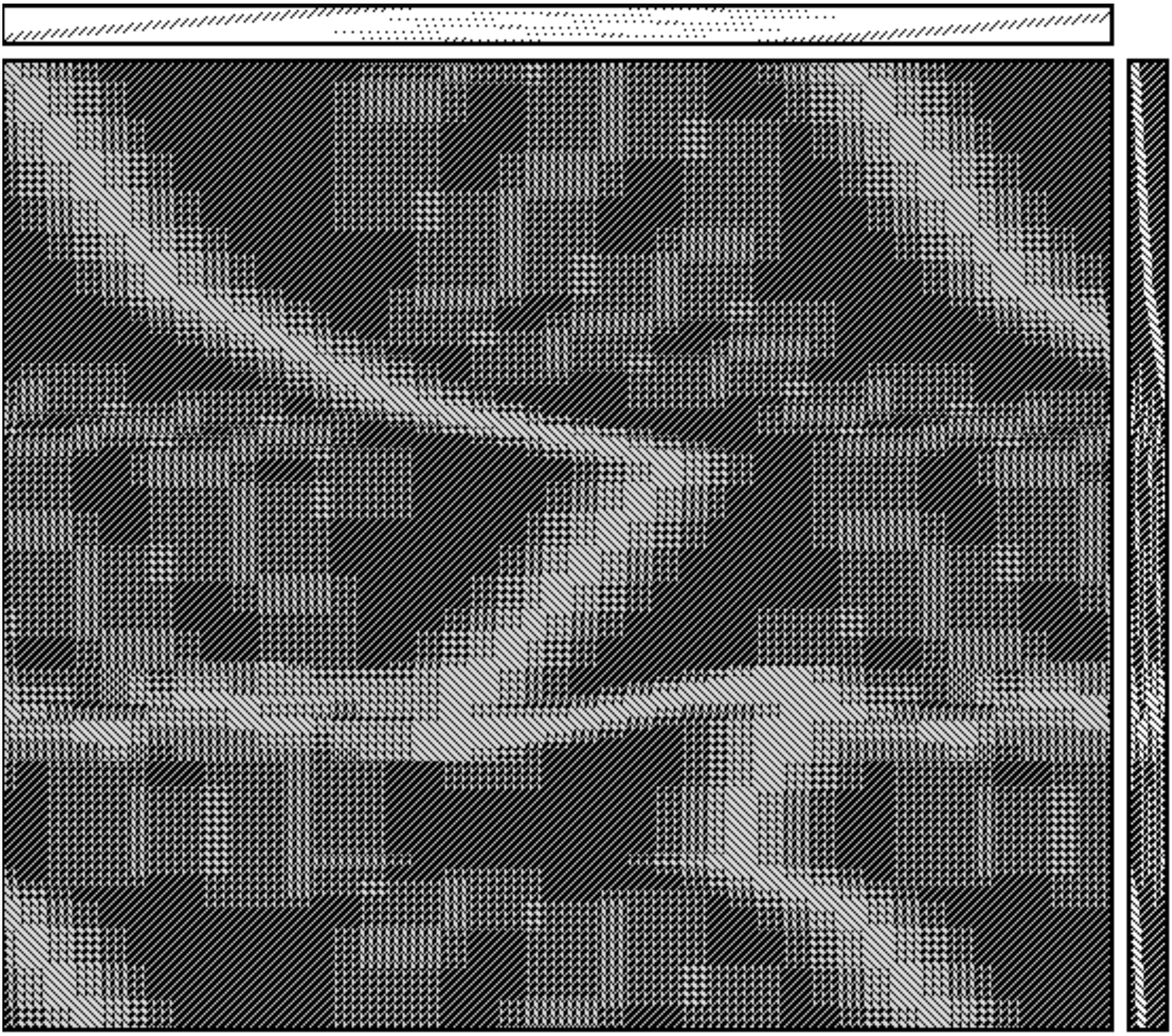
This threading therefore has a very great versatility, on a very large repeat of 400 threads, while ensuring a contexture without risk of floats using the method of initials.

I will not dwell on the contextualization in this article.
Let's just put two 1/4 and 4/1 twills to fill the white and black of the peg-plan and get a real cloth.



No floats greater than 3 thanks to the initials method

The entire cloth:



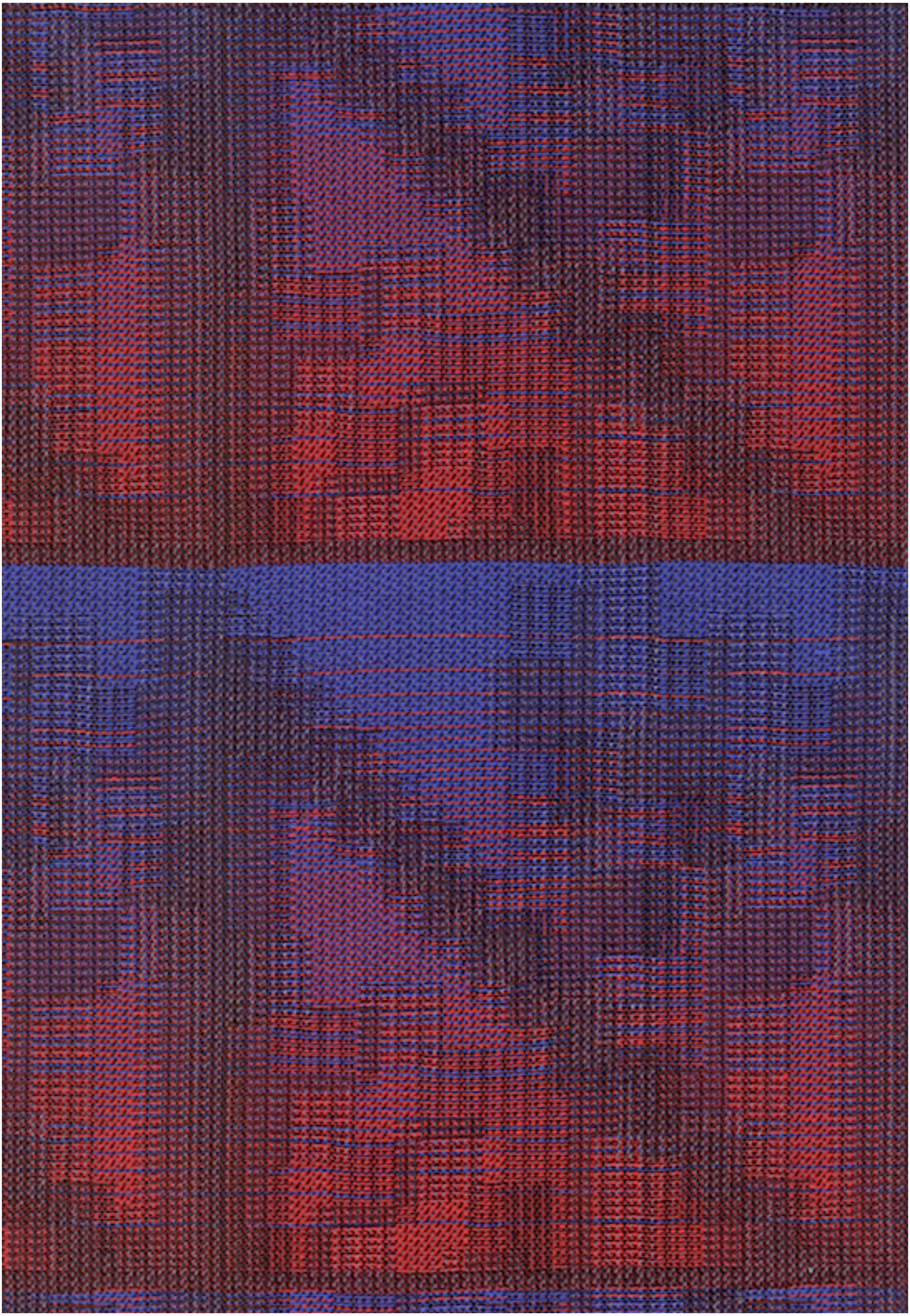
Double the graphics thanks to the telescoping of 32 to 16 shafts

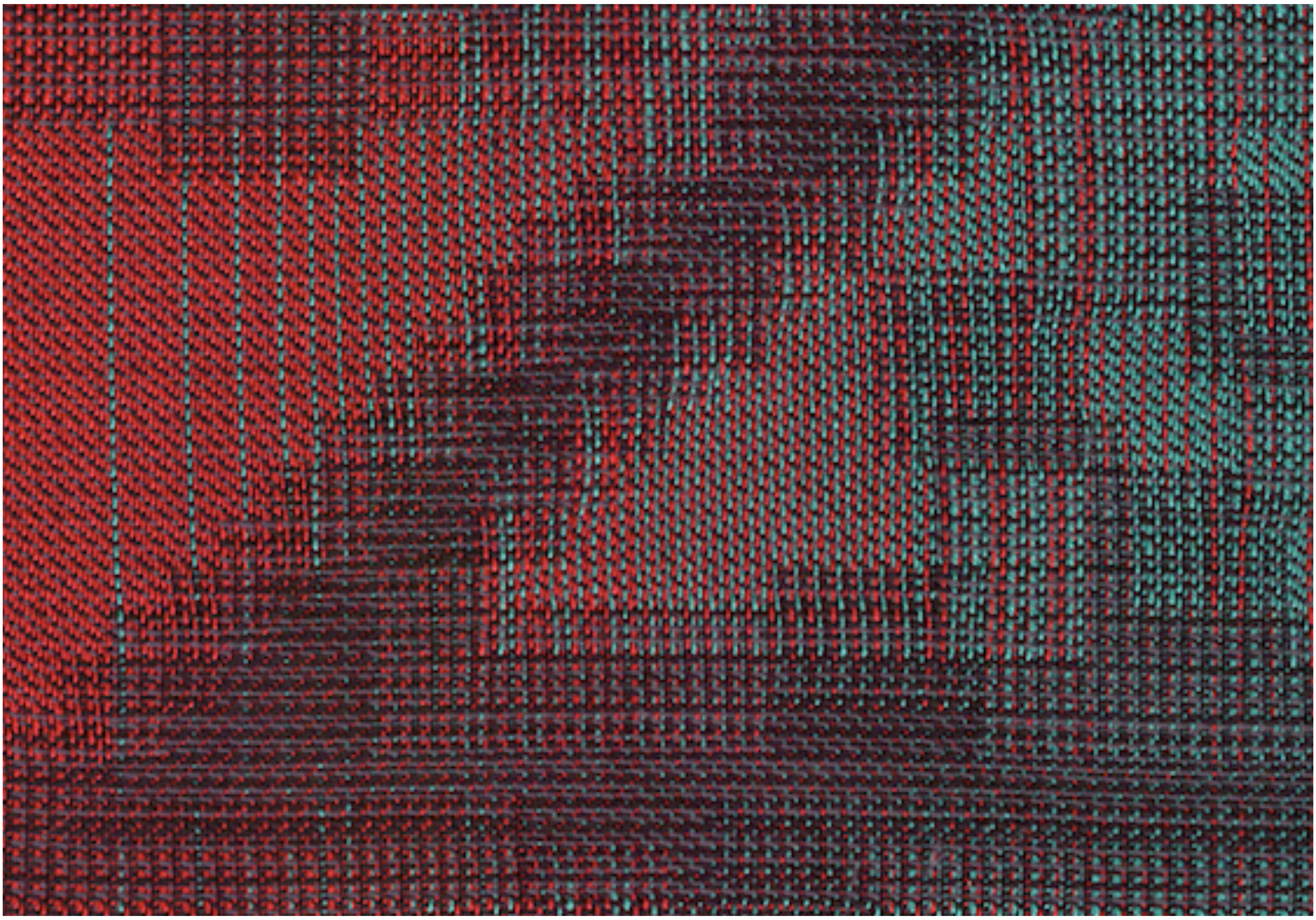
For those who are not yet convinced of the flexibility offered by such a threading I will end with photos of the "Polyvalence "collection.

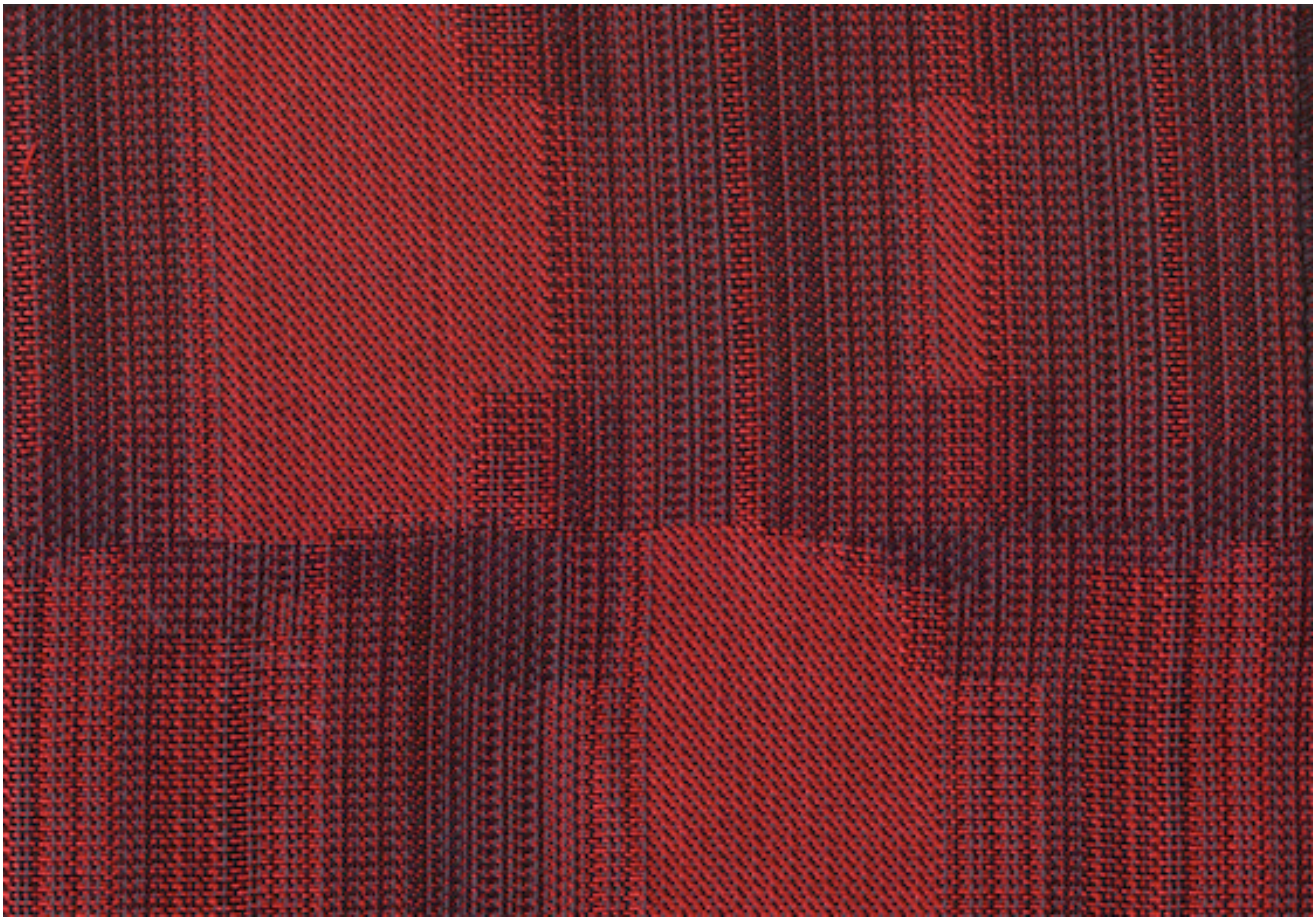
François Roussel and I independently design a series of fabrics on this same threading.
There is a family air of course but especially two different styles that have been expressed.

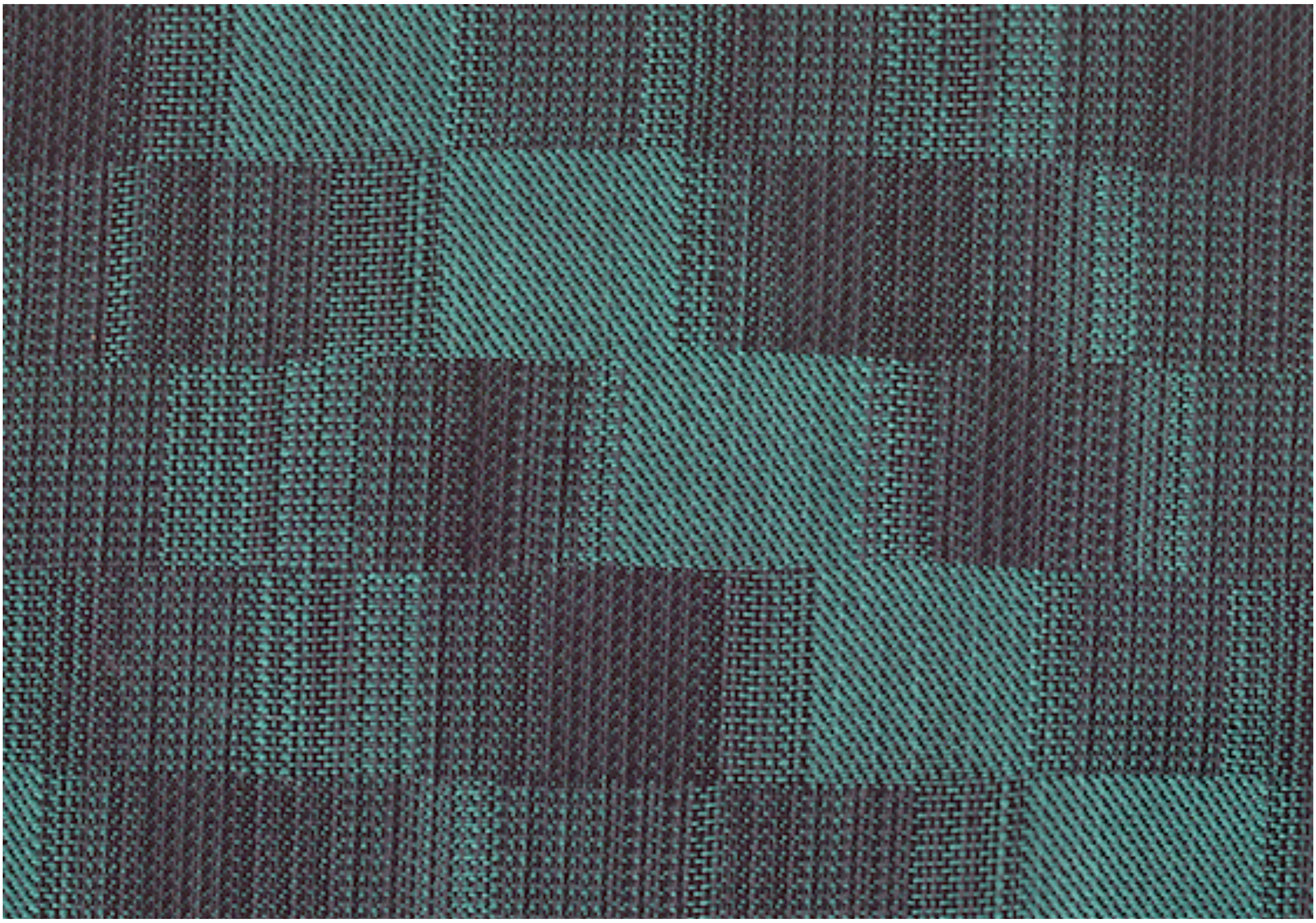
Most of the weavers we showed these fabrics thought it was Jacquard fabric ; while they were indeed woven on 16 shafts.

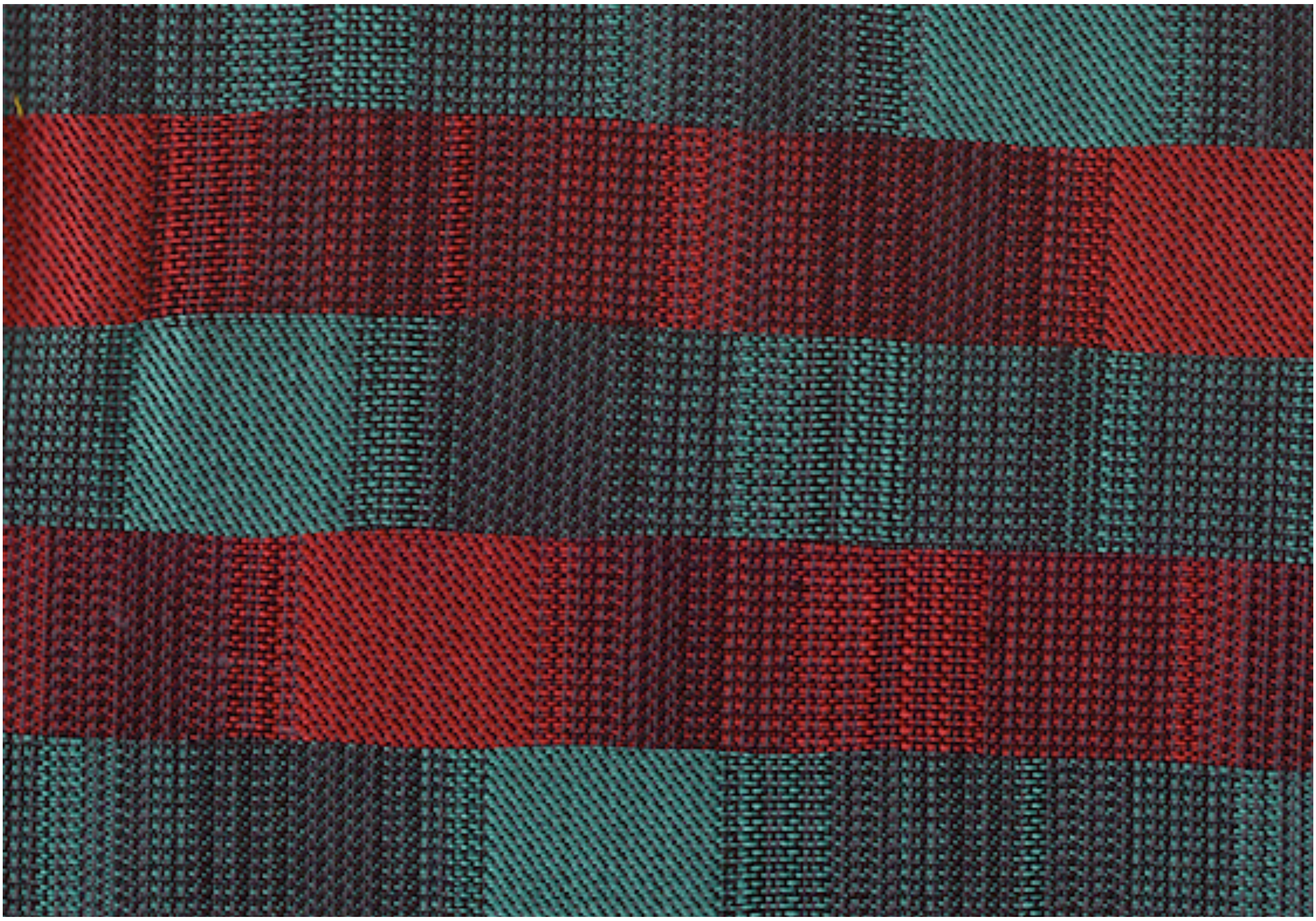
Fabrics designed by Olivier Masson :

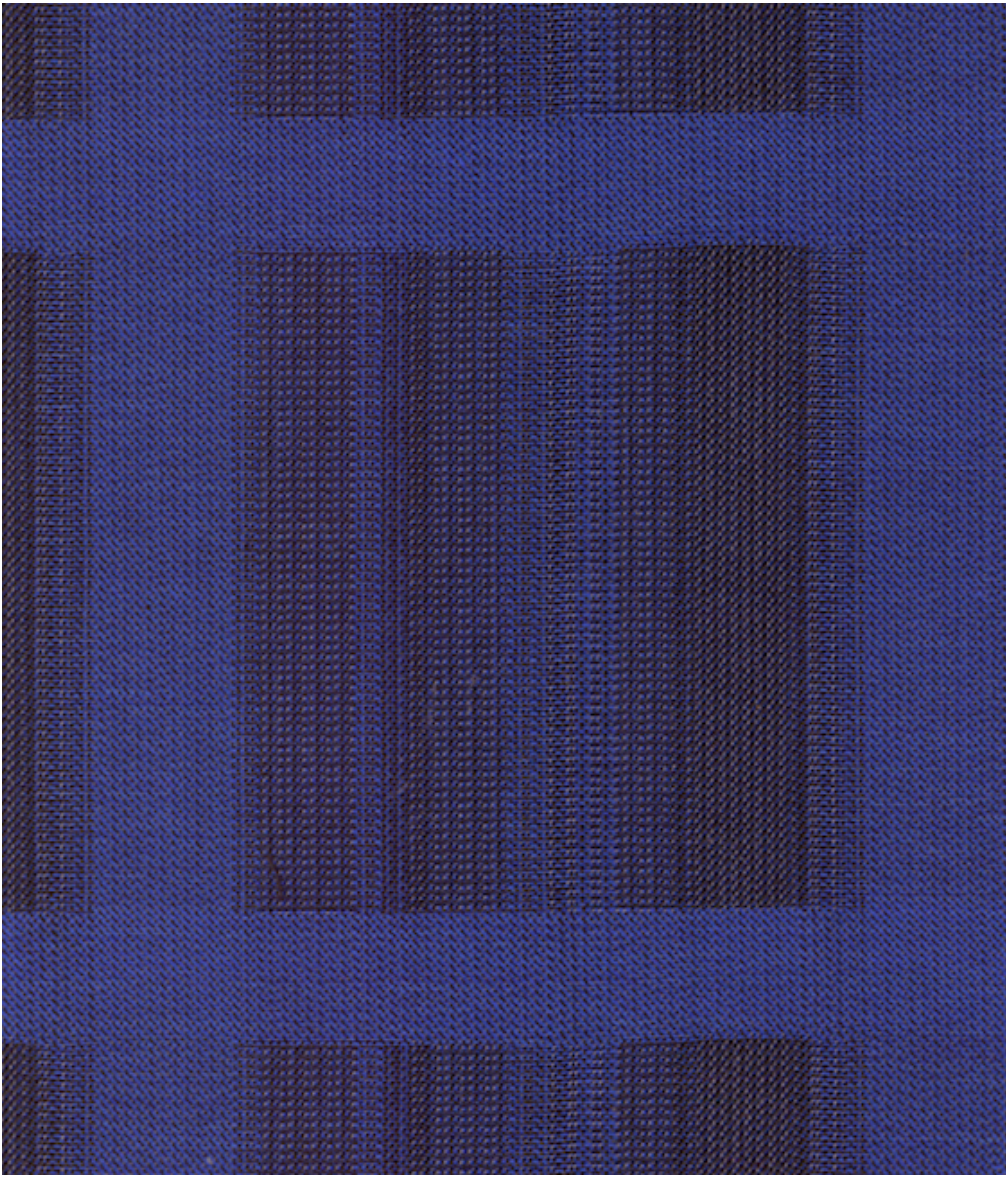




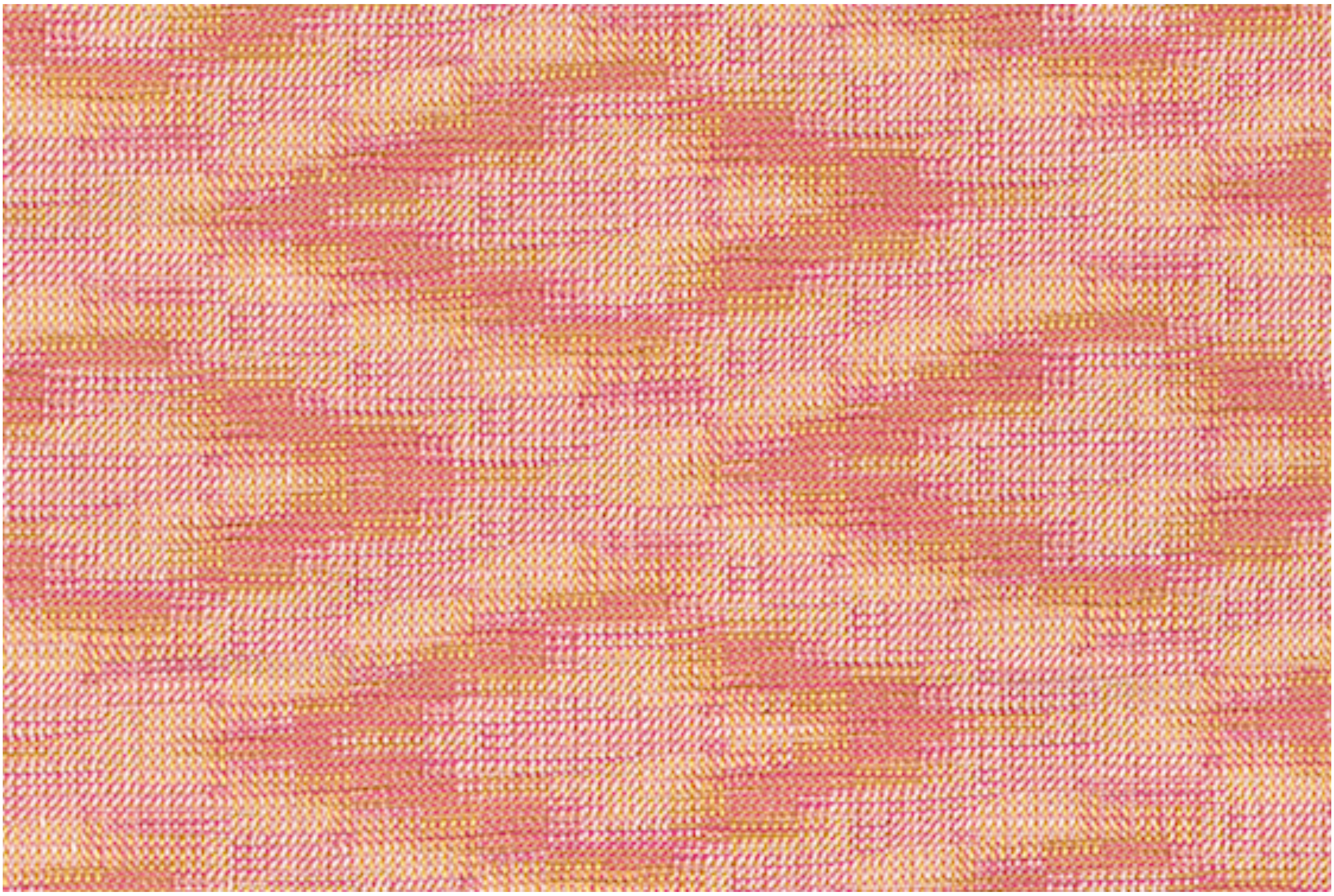


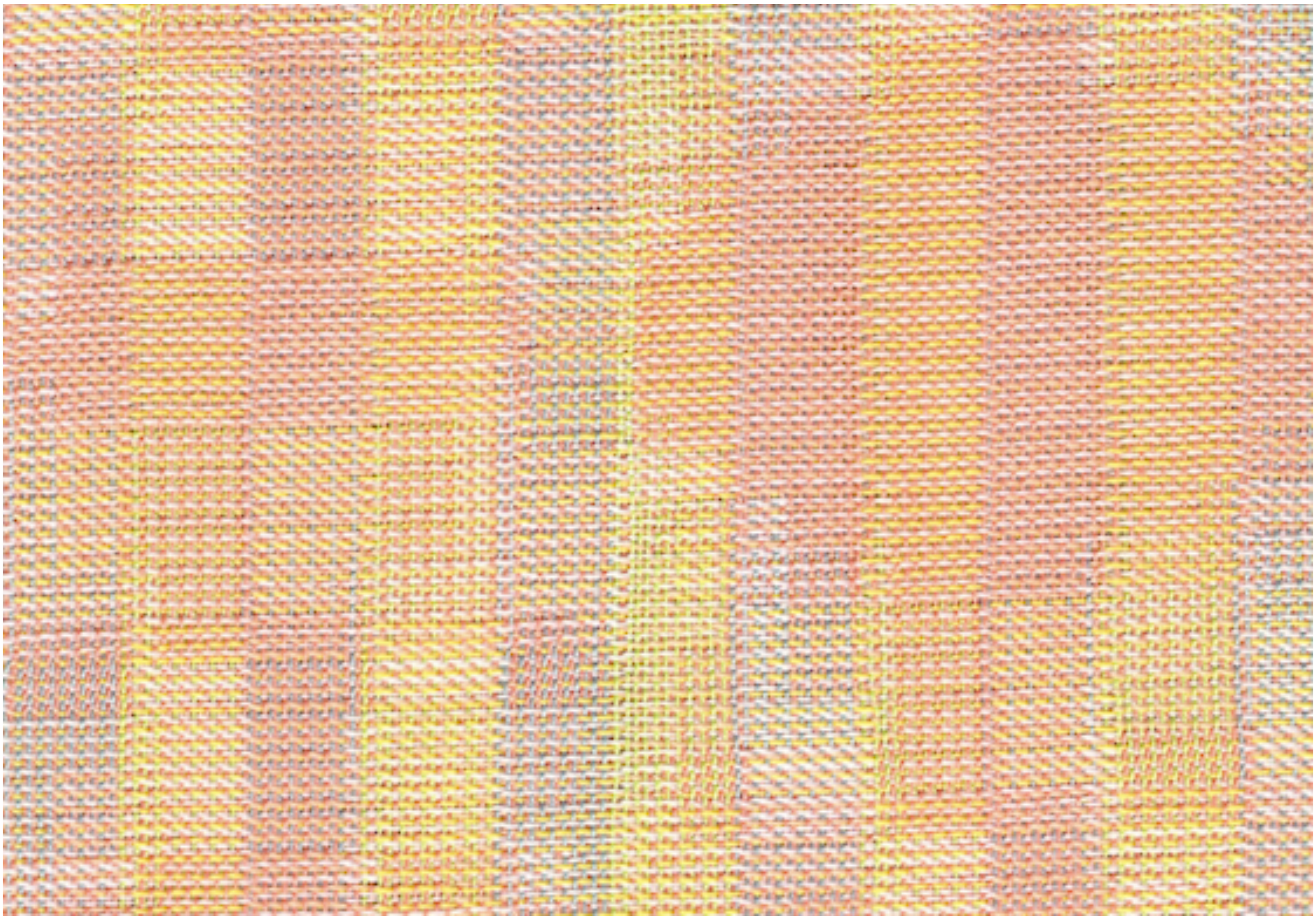


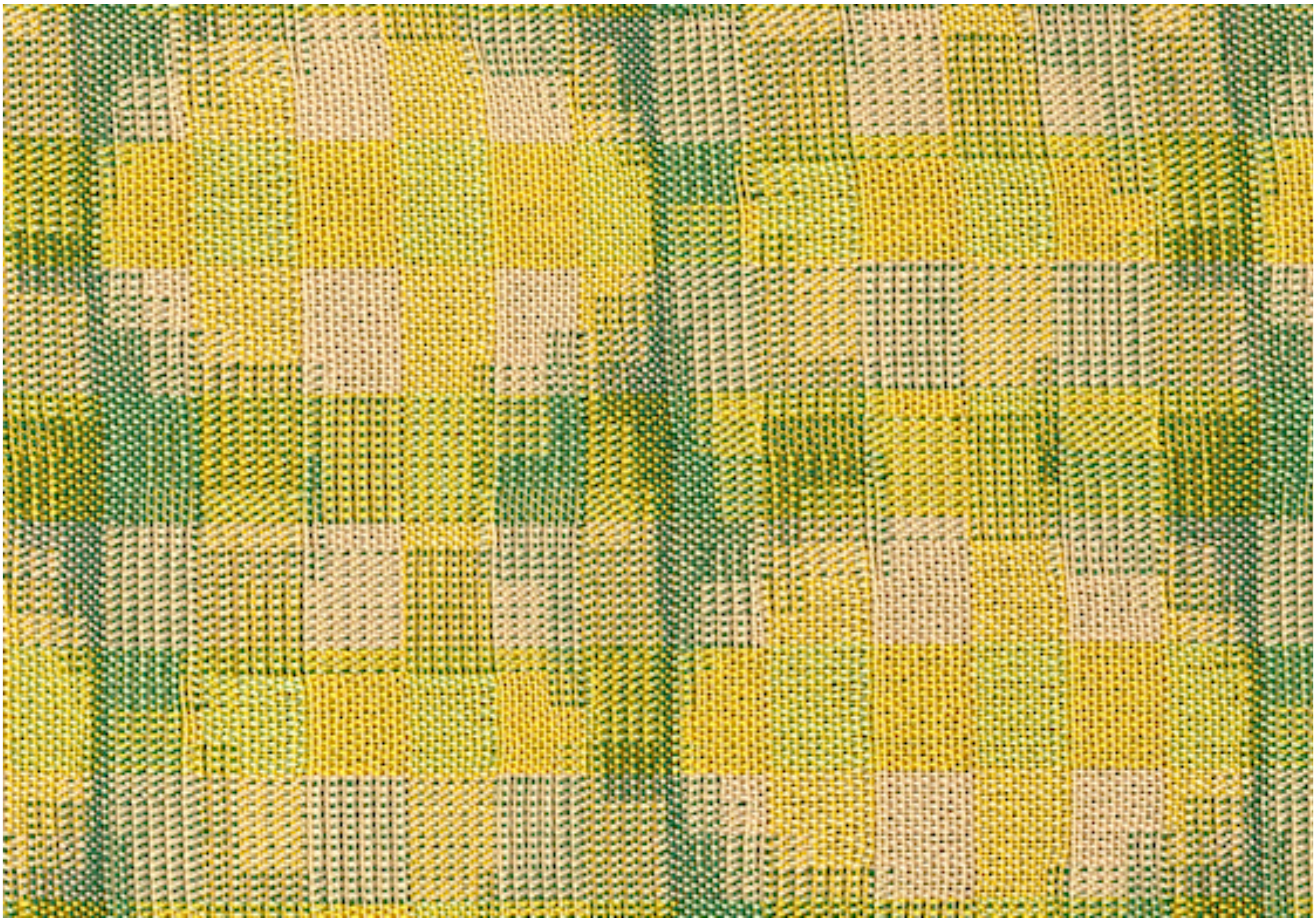




Fabrics designed by François Roussel :







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