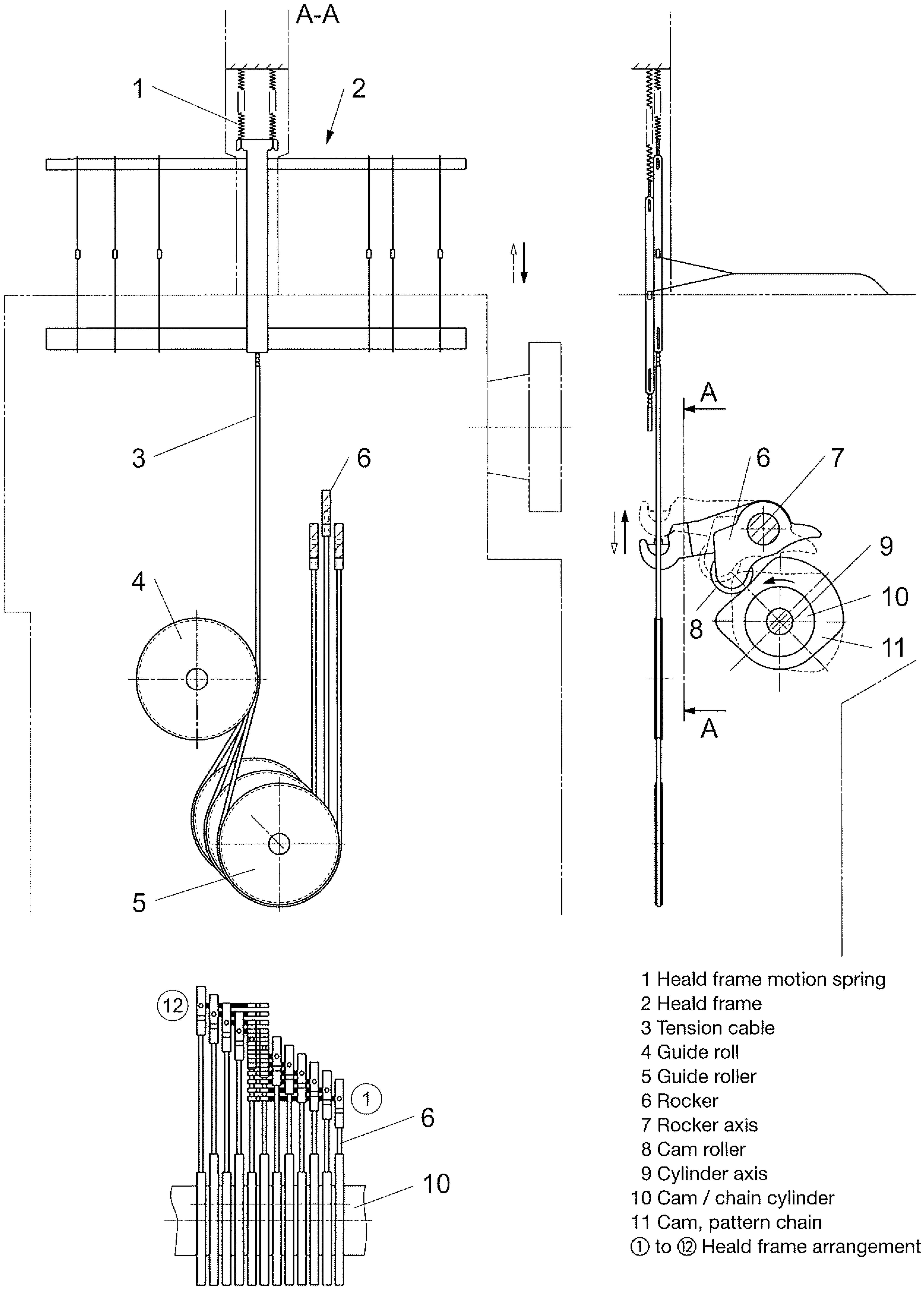
The further the heald frame is from the rocker axis, the longer the rocker and the greater the heald frame stroke. An oblique shed results, with a clean front shed during weft insertion.

Features of the lower shed device on the ND narrow fabric needle loom

Lower shed device ND

- In the default position, the heald frame is in the upper shed.
- The movement of the heald frame is negative in relation to the shape of the cam, i.e. each time the cam moves upwards, it pulls the heald frame into the lower shed position.
- The heald frame tension spring pulls the frame back into the upper shed position once the cam roller on the cam changes to the lower position.



1 Heald frame motion spring
2 Heald frame
3 Tension cable
4 Guide roll
5 Guide roller
6 Rocker
7 Rocker axis
8 Cam roller
9 Cylinder axis
10 Cam / chain cylinder
11 Cam, pattern chain
① to ⑫ Heald frame arrangement

Figure 047: Lower shed device on the ND narrow fabric needle loom

The rocker axis works in the same way as the NB/NC upper shed device. However, rather than pushing the heald frame directly upwards when the cam moves upwards, it pulls it downwards using a cable fed over a guide roller. The shortest rocker for the

The reading-in of the weave program takes place in the lower shed, i.e. whenever a knife has reached the lower shed, the decision is made whether it will bring the hook in the lower shed with it on its way back to the upper shed, or leave the hook in the lower shed.

In the idle position, both hooks are pulled by the lowering spring into the lower shed to the point where they are resting on the hook board. They remain there until one of them is brought with one of the knives into the upper shed as required by the weave program.

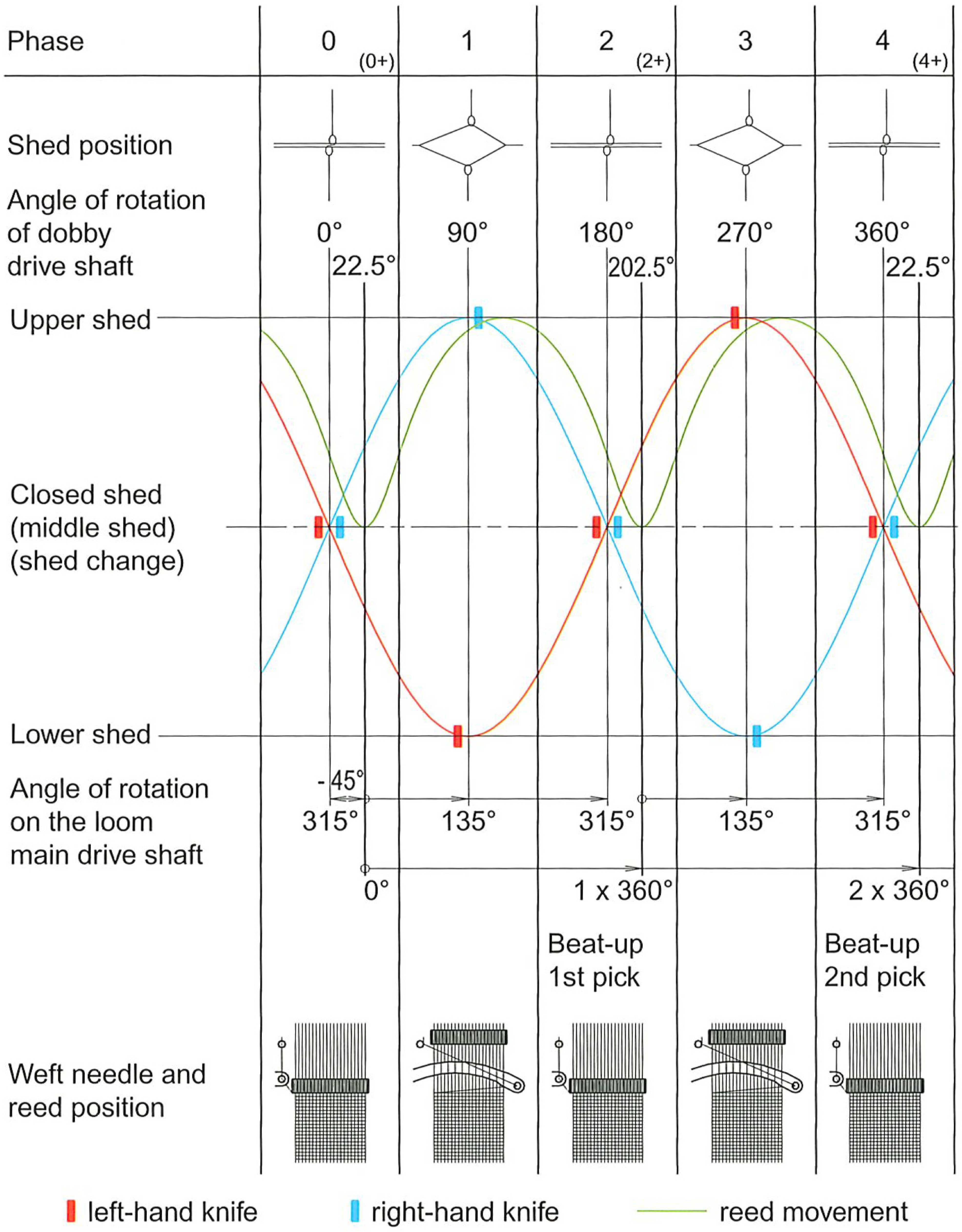


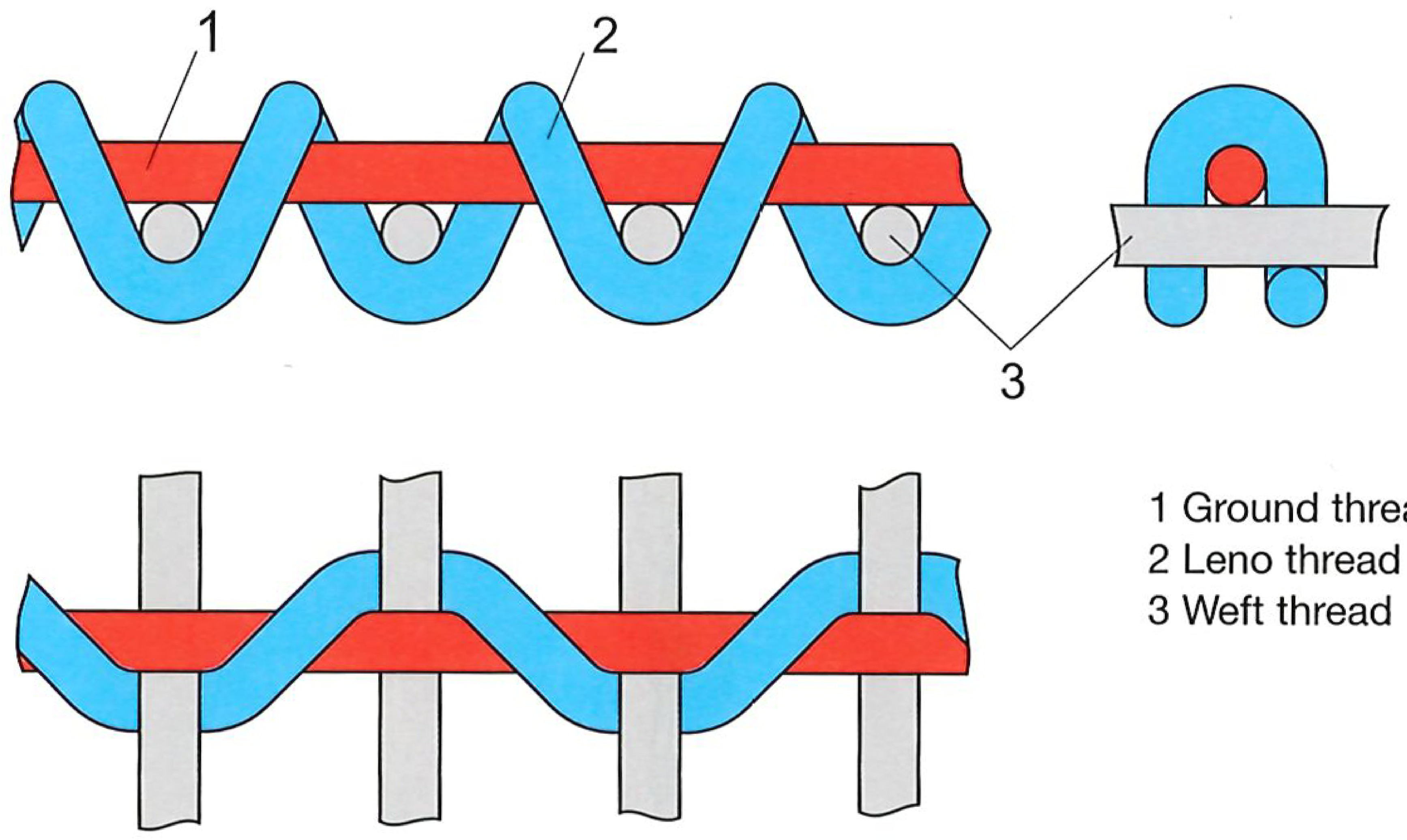
Figure 062: Jacquard machine/loom movement sequence according to the scale on the main shaft and the style-dependent assumption that the shed change (middle/closed shed position) should take place 45° before beat-up.

Phase	Angle of rotation Jacquard machine	Angle of rotation of loom	Knife position loom scale	Shed position	Reed position
0	0°	315°	Middle	Closed	45° before beat-up
0+	22.5°		Middle + 45°	Slightly open	Beat-up
1	90°	135°	Upper/lower shed	Open	Back
2	180°	315°	Middle	Closed	45° before beat-up
2+	202.5°	0°/360°	Middle + 45°	Slightly open	Beat-up 1st pick
3	270°	135°	Upper/lower shed	Open	Back
4	360°	315°	Middle	Closed	45° before beat-up
4+	22.5°	0°	Middle + 45°	Slightly open	Beat-up 2nd pick

5.5 Leno mechanism

The leno mechanism allows at least 2 adjacent and parallel warp threads to be intertwined to make one leno cord. This improves slip resistance in the case of loosely woven narrow fabrics or monofil weft and warp materials with flat surfaces. In some cases, the leno technology is used to achieve special decorative effects.

Of the known models, i.e. full-cross leno, cross leno and half-cross leno, only the half-cross leno is used in the narrow fabrics industry. It is so called because the leno thread is wrapped around half the ground thread once per pick.



1 Ground thread
2 Leno thread
3 Weft thread

Figure 066: Half-cross leno

1 Release spring
2 Leno half heald
3 Ground thread (controlled by lifting heald)
4 Leno cord
5 Weft needle
6 Heald frame 1 lifting heald
7 Heald frame 2 lifting heald
8 Leno thread
9 Ground heald frame (half stroke H-M)
10 Normal shed
11 Compensation for non-elastic leno threads

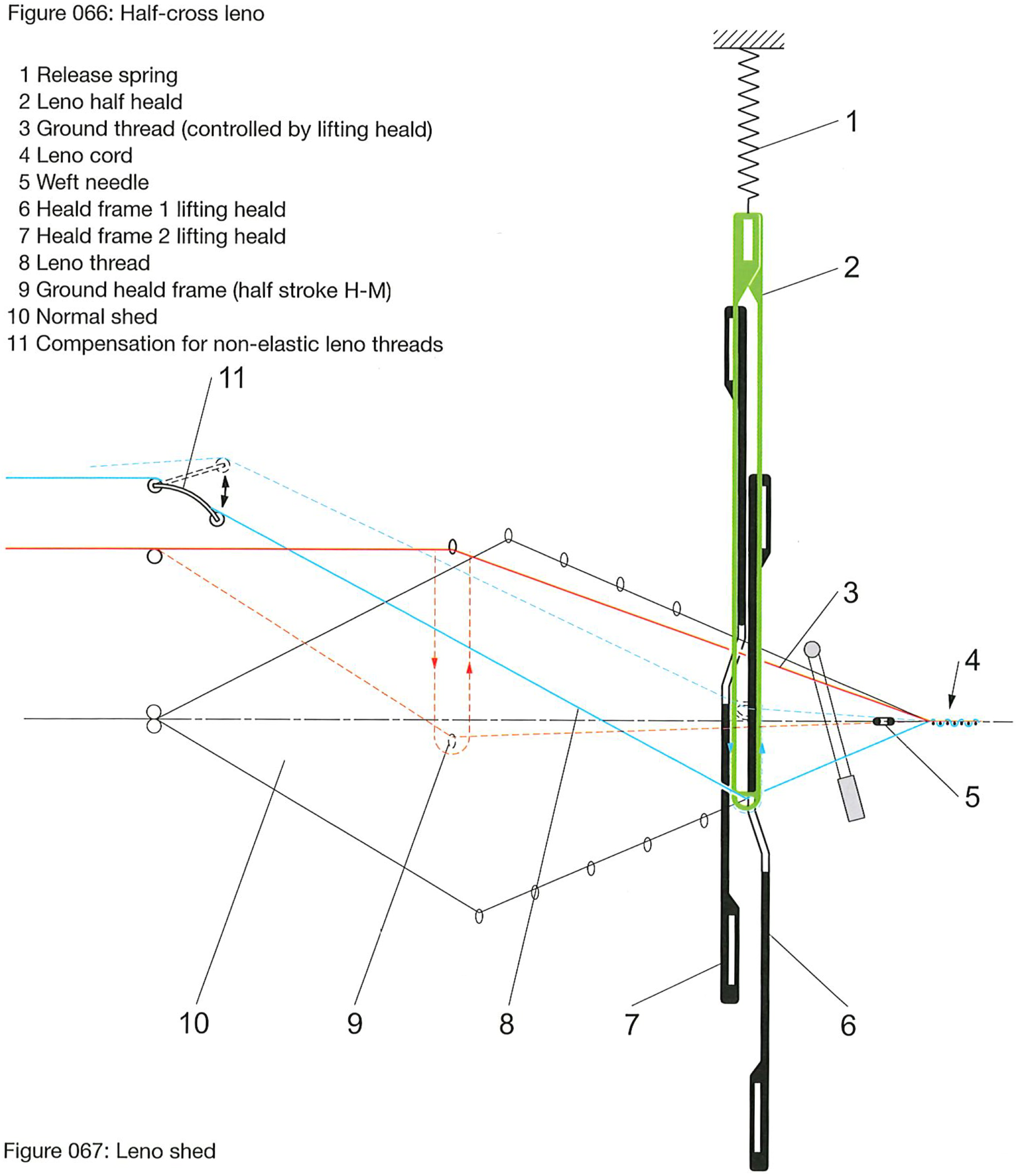


Figure 067: Leno shed

6.2 Z-weaving systems with two weft needles

The "Z" stands for *Zweischuss-Eintragssystem* (two-weft insertion system). Here, two weft threads are inserted into two separate sheds (but into the same tape or ribbon) simultaneously, effectively almost doubling production speed. As with weaving systems 1 to 5, a number of versions are available depending on the design of the fabric and the selvedge requirements.

Weaving systems Z, Z3, Z4, Z5, etc.

Z-type weaving systems can only be used on looms that have been set up accordingly.

Weaving system Z3

The lower weft thread is pulled through the loop in the upper weft thread and hooked into itself.
The advantages and disadvantages are much the same as those for weaving system 1.

Weaving system Z3

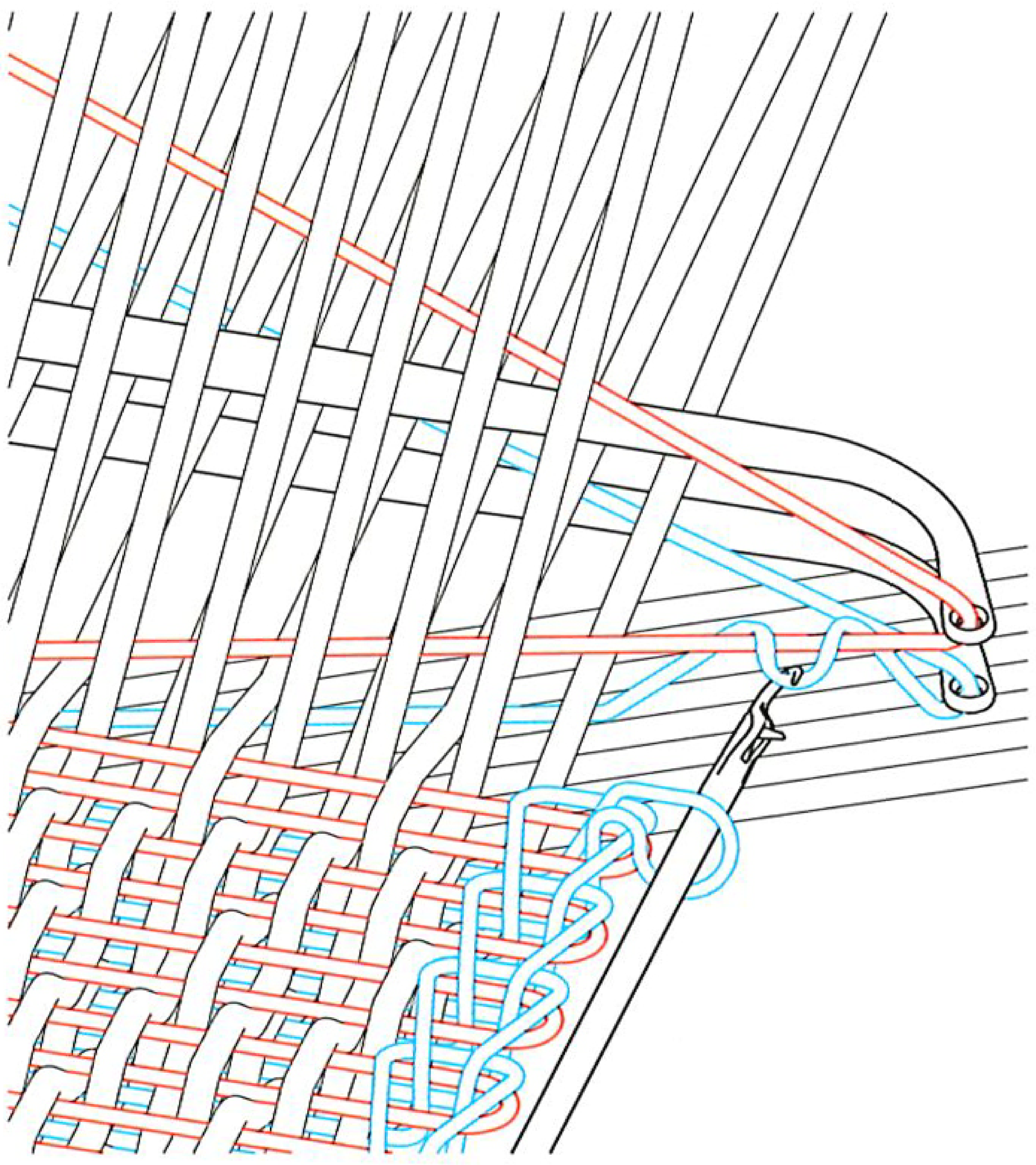


Figure 077: Weaving system Z3

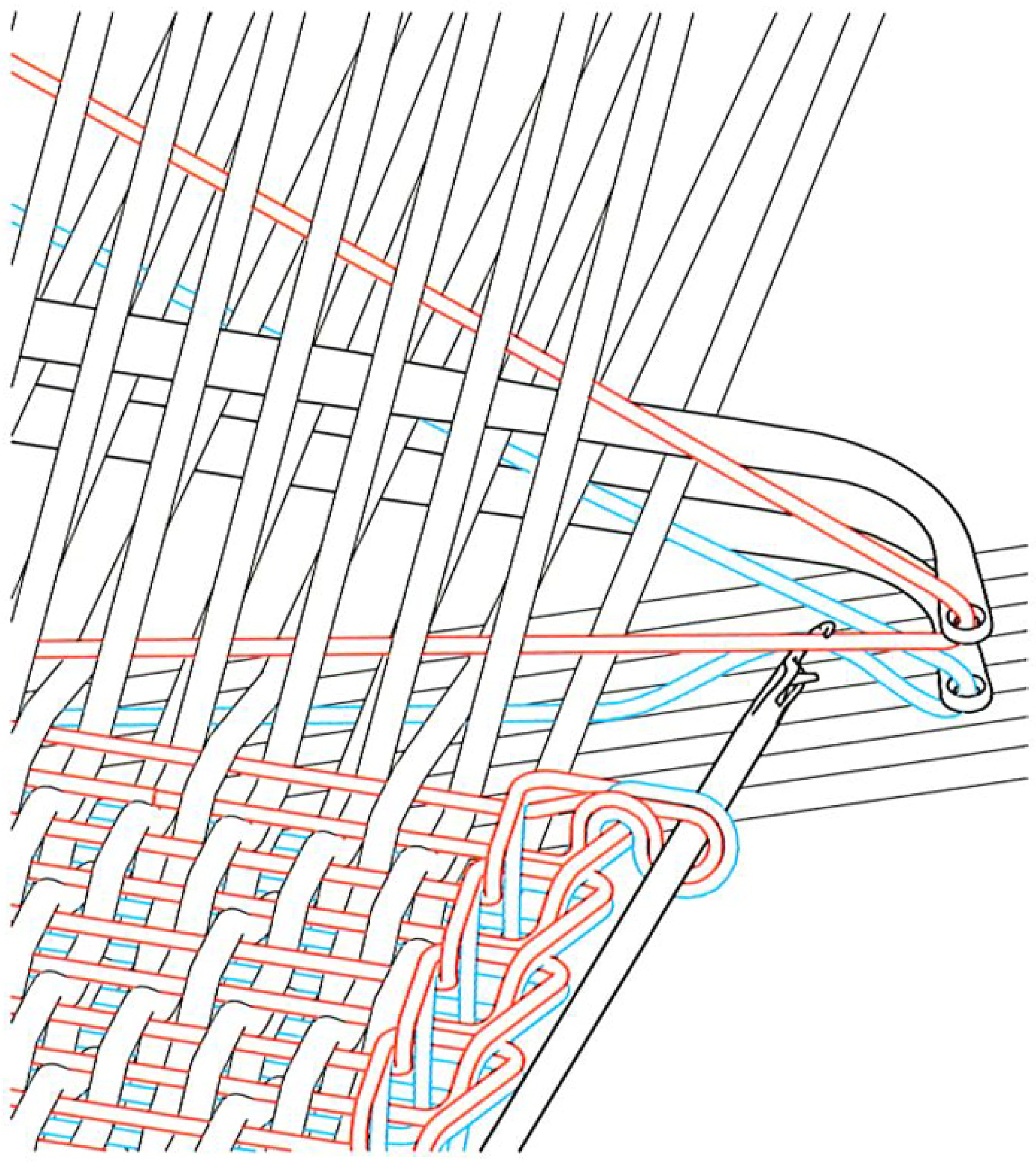


Figure 078: Weaving system Z4

Weaving system Z4

The two weft threads are hooked together on a latch needle.
The selvedge is thicker, but exhibits greater ladder resistance.

Weaving system Z4

Weaving system Z5

A binder thread is pulled through the two weft thread loops and hooked into itself.
The advantages and disadvantages are much the same as those for weaving system 2 (see 6.1).

Weaving system Z5

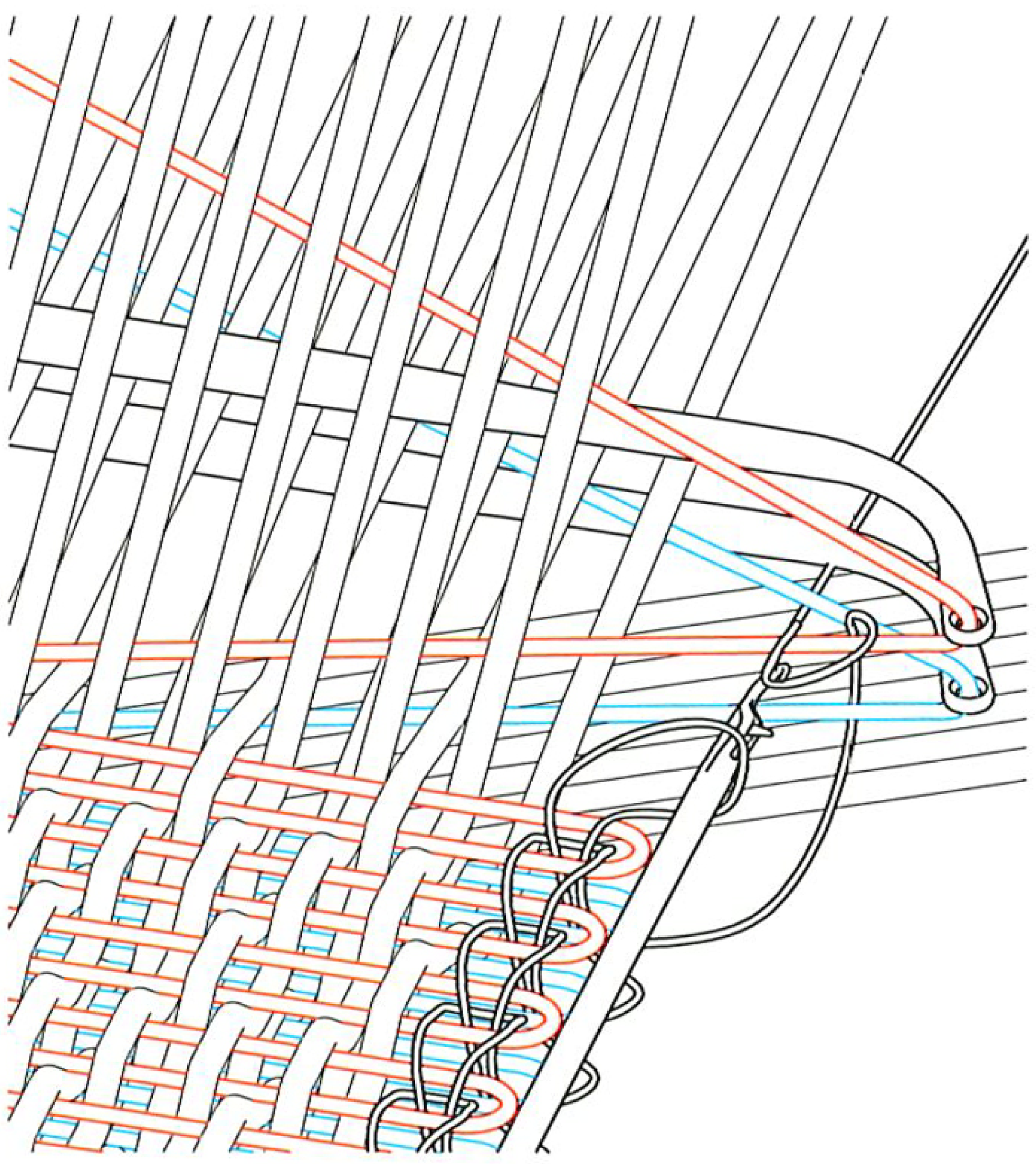


Figure 079: Weaving system Z5

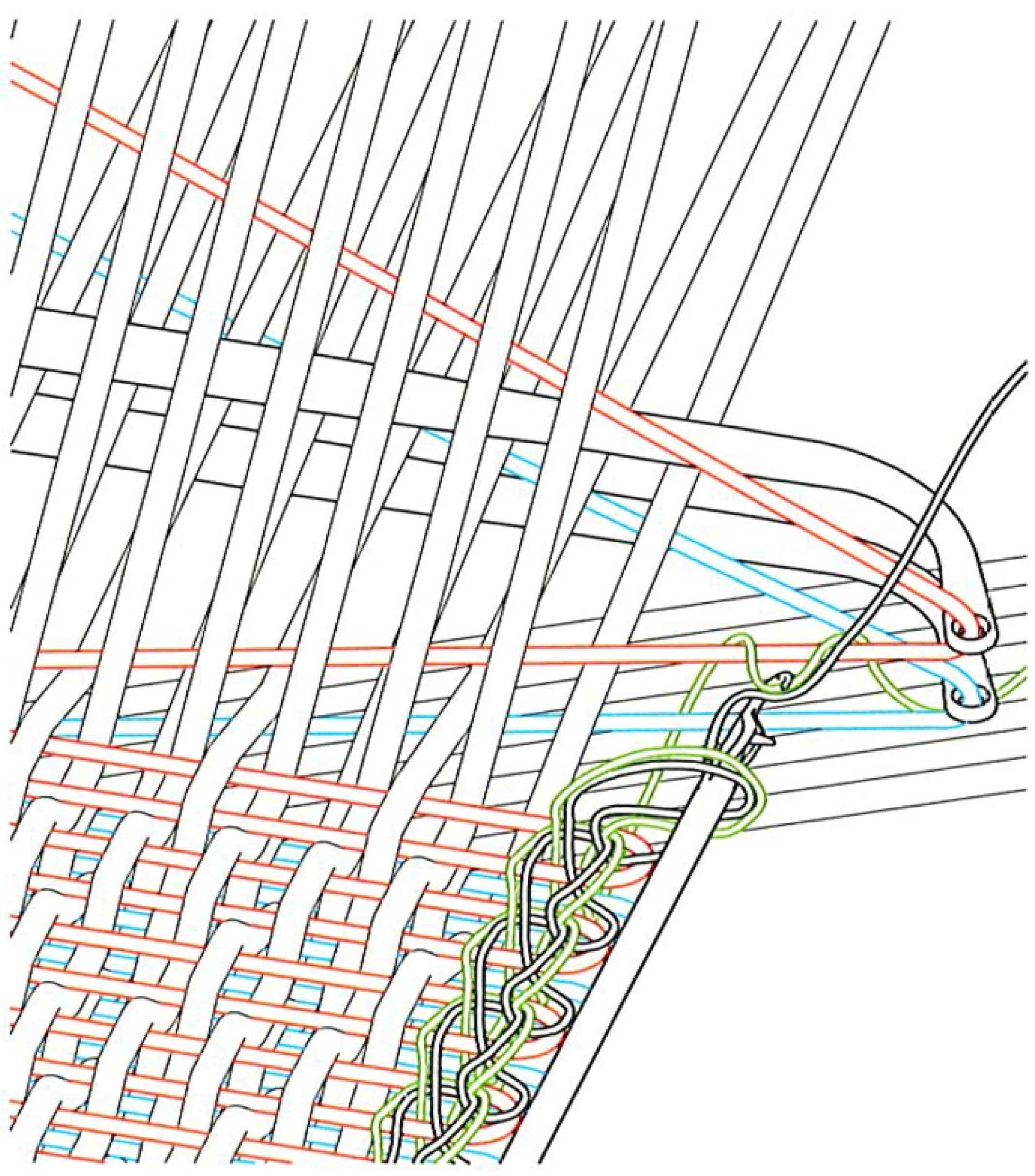


Figure 080: Weaving system Z5/S5

weft needle automatically when the needle withdraws from the shed. The next pick insertion is controlled using exactly the same principle by the 2nd heald frame.
The alternating insertion of 2 weft threads means that the non-inserted weft thread is only left floating on the left selvedge above the pick immediately following it. If longer floating repeats are acceptable, 3 or 4 weft threads could be inserted in the sequence 1-2-3-4, 1-2-3-4 or similar.

The forked weft needle requires a wide shed opening. Floating or sticking warp threads will be snagged by the fork and torn off. A clean shed is essential for efficient production. If it is not possible to create a clean shed, then the SNO_B system will have to be used instead.

MC2 weft colour control (4/6) for Jacquard machines

Weft colour control MC2 (4/6)

(**M**ULTI**C**OLOR **2**, **4** or **6** weft colours)
The rightmost harness cords in the comberboard are reserved for colour control. The MULTICOLOR slotted weft needle with carrying hooks has been specially developed for multi-colour weft insertion applications. After the weft threads have been drawn in through the colour control heald they are fed into the slot in the weft needle. The selected weft thread is raised by the colour control heald, picked up by the carrier hook and inserted into the shed. The other weft threads remain in the bottom of the slot. They float on the rear of the fabric until they are inserted again into the shed.

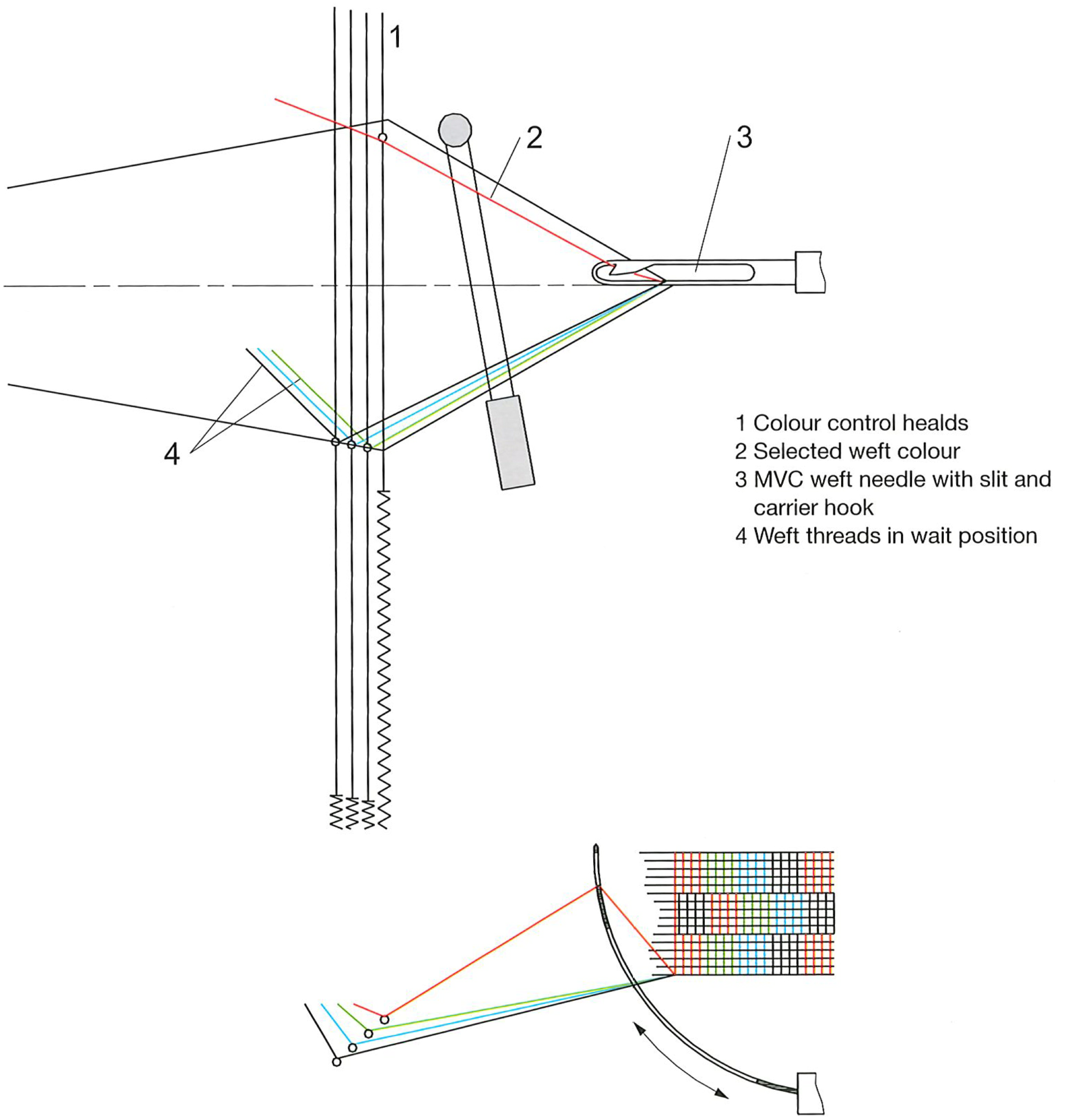


Figure 097: MC2 weft colour control (4/6)

Weft and reed drive NF

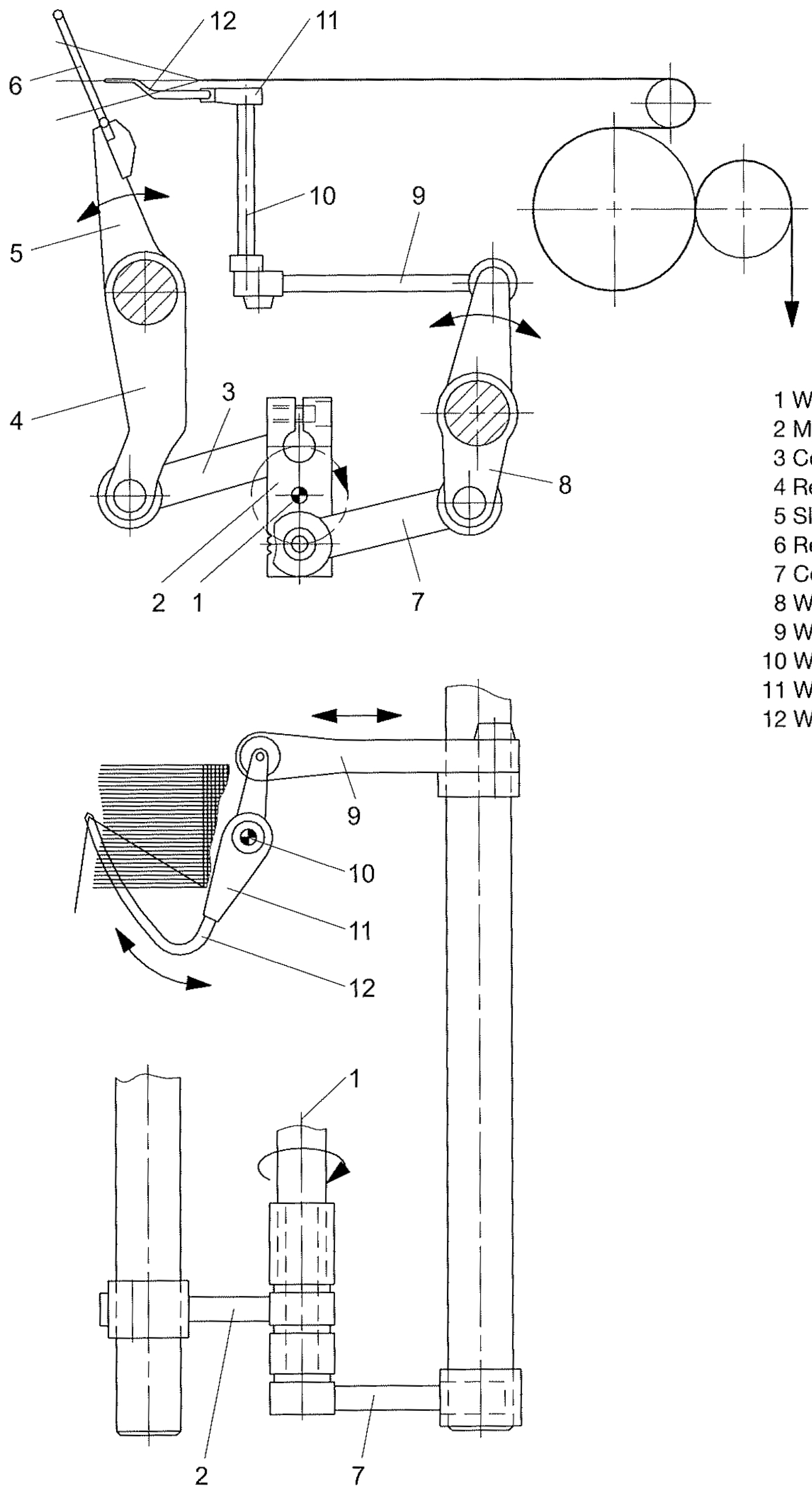
A crank is fitted to the main shaft. It converts the rotary movement of the drive shaft and connecting rod into a swivelling motion, both for the weft needle and the reed. The movements of both drives are coupled. Changes to the settings of one drive automatically change the settings of the other drive as well.

Two versions are available:

Boxer drive

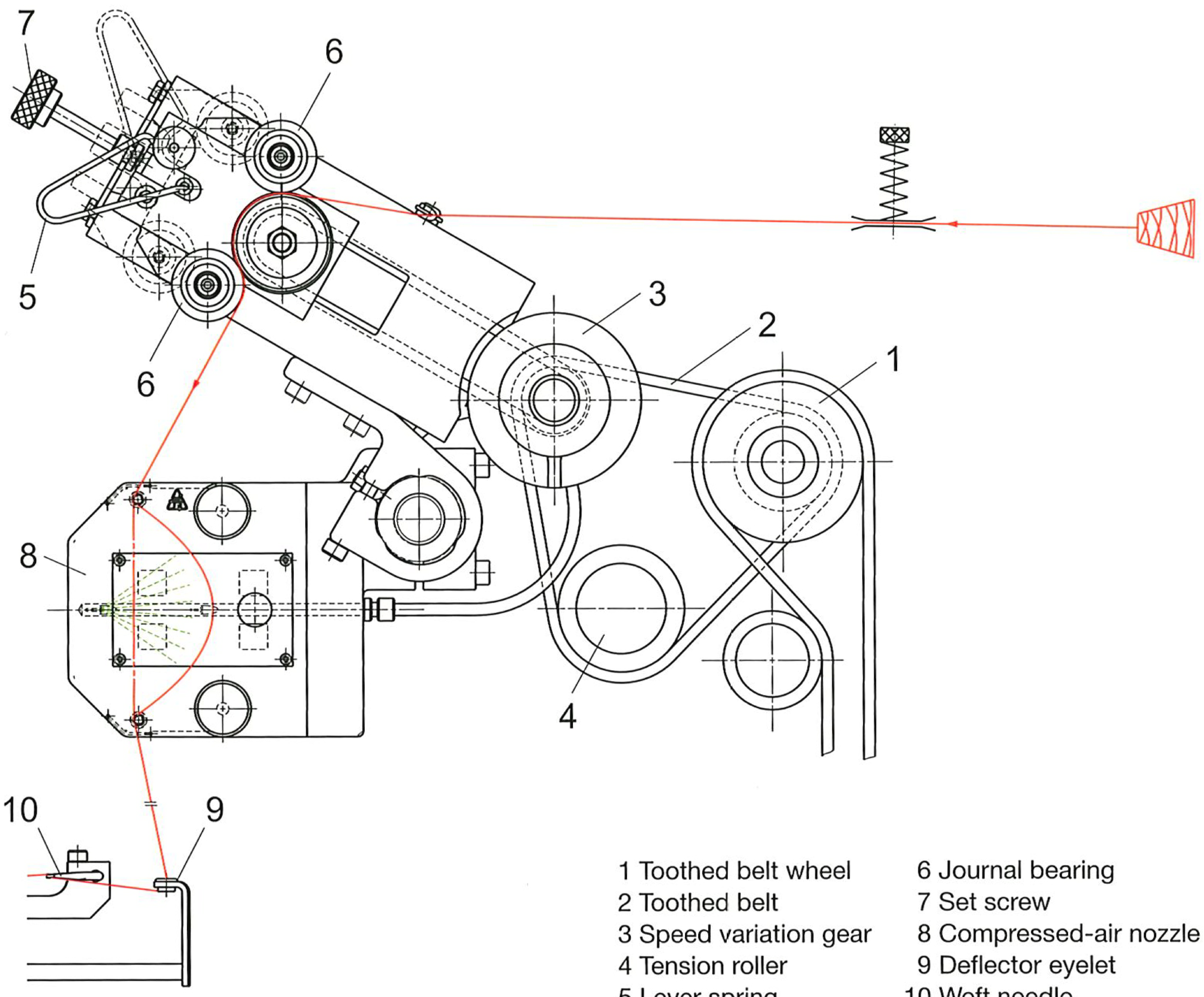
Boxer drive

The crank has two arms for narrow ribbons that are woven at very high speeds. The two connecting rod attachment points are offset by 180° around the edge of the crank. The rotation of the main shaft causes the reed and weft drive lever to swivel in opposite directions. The imbalance in one drive is to all intents and purposes countered by that of the other and the machine is practically free of any vibration.



1 Weft/reed shaft
2 Main crank
3 Connecting rod
4 Reed drive lever
5 Sley
6 Reed
7 Connecting rod
8 Weft drive lever
9 Weft connecting rod
10 Weft shaft
11 Weft needle holder
12 Weft needle

Figure 102: Boxer drive



1 Toothed belt wheel
2 Toothed belt
3 Speed variation gear
4 Tension roller
5 Lever spring
6 Journal bearing
7 Set screw
8 Compressed-air nozzle
9 Deflector eyelet
10 Weft needle

Figure 117: Weft transport NG

6.8.2 Discontinuous weft transports

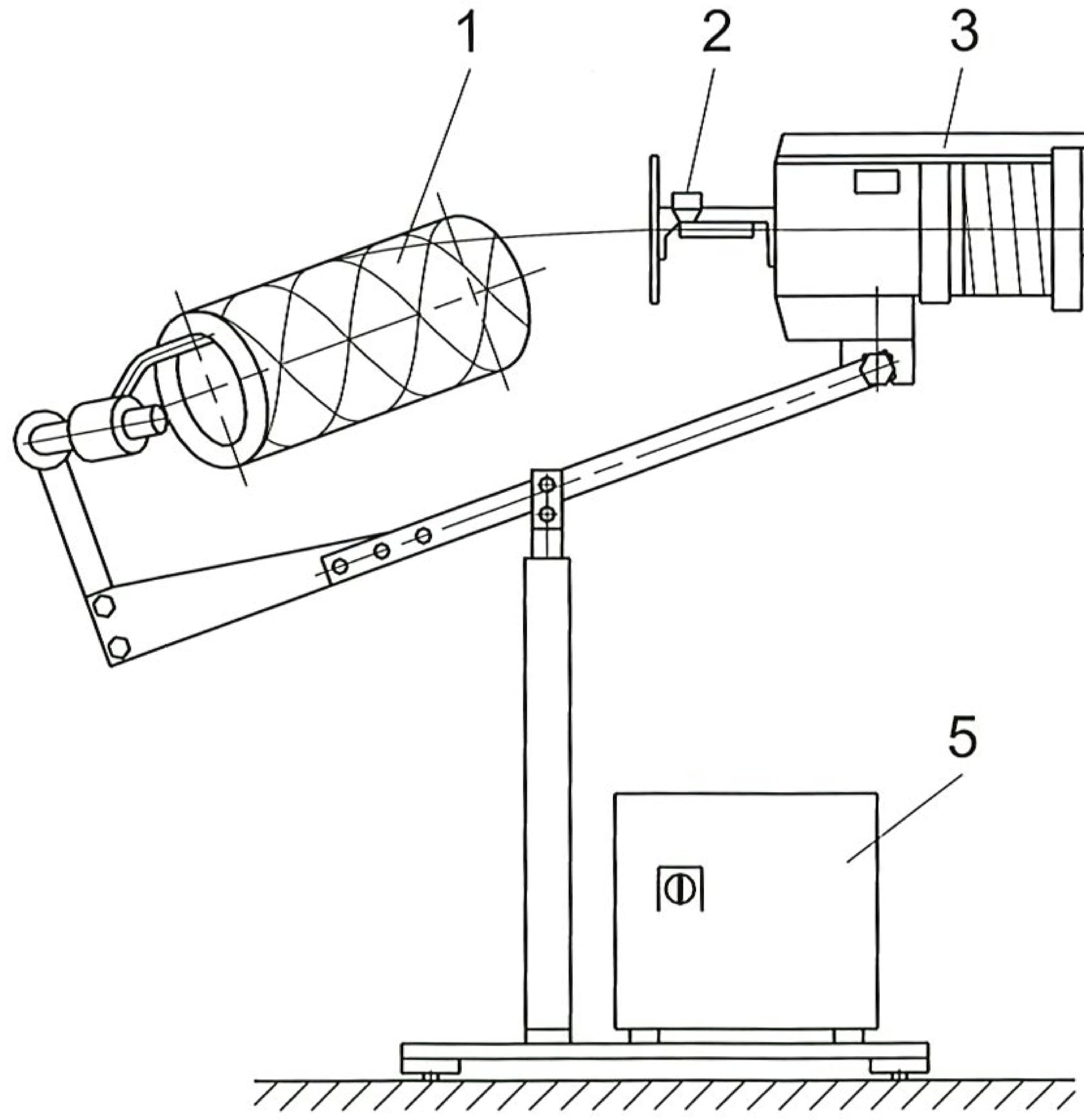
Weft transport, discontinuous

Discontinuously operating weft transports are required for ribbons wider than 130 mm, for special weft threads and multi-colour weft insertion.

Weft feeder

Weft feeder

A weft feeder is used for single-pick ribbons wider than 130 mm. The feeder pulls the weft off the weft bobbin and winds it as a reserve for the next pick on a conical cylinder. The weft brakes release the weft as soon as the weft needle starts to insert it. The weft then pulls easily off the cylinder and is inserted into the shed.



1 Crosswound bobbin
2 Entry brake
3 Weft feeder
4 Exit brakes
5 Control box

Figure 118: Weft feeder

4. The rubber thread is tied so tightly by the covering fibres that is cannot return to its original position when released, so there is always a residual tension inside the ribbon.
5. The rubber thread remains invisible within the ribbon if the colour of the covering threads is the same as the one of the warp threads.

The covering threads must be included in all weight calculations. See figure 214, style card.

1.8 Calculations for non-elastic, monofil threads

Non-elastic, monofil threads made of synthetic or metallic materials are used in the narrow fabrics industry to increase longitudinal and lateral strength, to bind the reverse sides of figure wefts, and as a binder or decorative thread, etc. The cross-section of the thread can be measured and, taking the material density into account, used as the basis for calculating the fineness.

The weight per 1,000 m of thread is obtained, as with round rubber threads, by multiplication: Basic area (cm^2) · thread length (cm) · density ρ (g/cm^3).

$$\text{Fineness tex} = \frac{\pi \cdot d^2 \cdot l \cdot \rho}{4}$$

Example:
1,000 m polyamide, Ø 0.3 mm, density PA 6.6: $\rho = 1.14$.
Calculate: mass

$$m = \frac{3.14 \cdot 0.3^2 \cdot 1{,}000 \cdot 1.14}{4} = 80.54 \text{ g} = \sim 81 \text{ tex}$$

1,000 m wire, Ø 0.4 mm, density steel: $\rho = 7.5$
Calculate: mass

$$m = \frac{3.14 \cdot 0.4\,[mm^2] \cdot 1{,}000\,[mm] \cdot 7.5\text{ g}}{4} = 942 \text{ g} = 942 \text{ tex}$$

10,000 m of the same wire weigh 9,420 g = 9,420 dtex

1.9 Calculating loom output

The output L of a ribbon weaving machine is measured according to the number of metres of ribbon produced in a specified period of time.
Parameters:

– Number of runs	G
– Speed n	rpm
– Efficiency	η
– Run time in hours	h
– Pick count per metre	1/m

Example:
Ribbon needle loom with 2 runs, speed 1,800 rpm, working hours 40 hrs, efficiency 0.94, pick count 2,500 picks/m
Machine output = ?

$$\text{Machine output } L = \frac{G \cdot n \cdot 60\,\text{min} \cdot h \cdot \eta}{p/m} = \frac{2 \cdot 1{,}800 \cdot 60 \cdot 40 \cdot 0.94}{2{,}500} \triangleq 3{,}248.64 \text{ m of ribbon}$$

IV Woven structures

1 Introduction

A variety of methods can be used to produce narrow textile fabrics. The most important of these are:

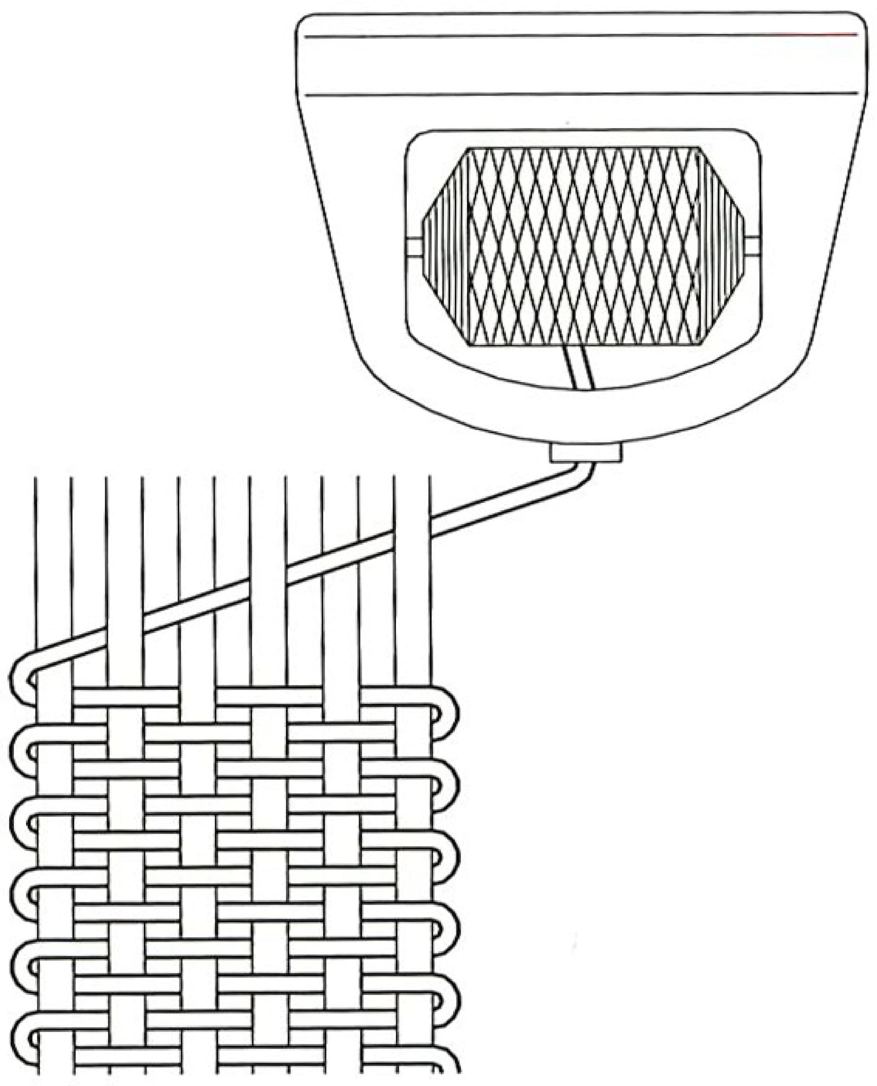


Figure 001 (recapitulation):
Shuttle ribbon weaving
(for special styles only)

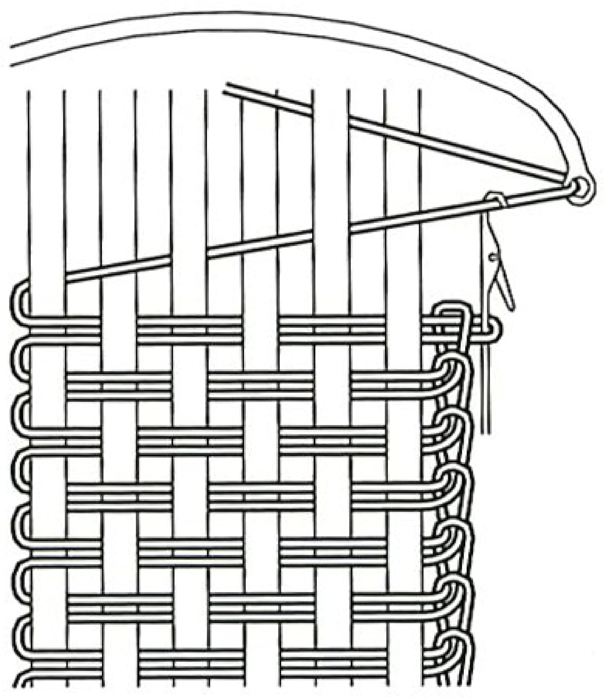


Figure 004 (recapitulation):
Needle ribbon weaving

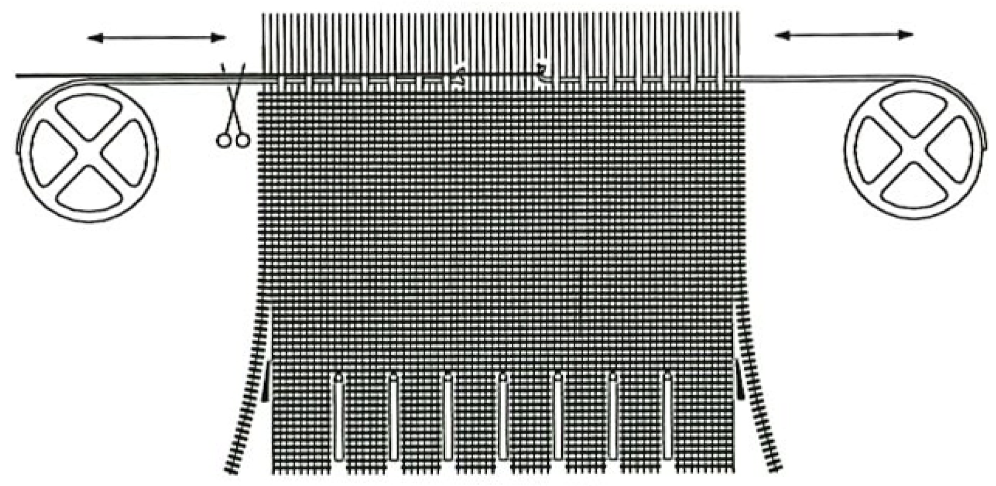


Figure 215: Wide weaving and cutting

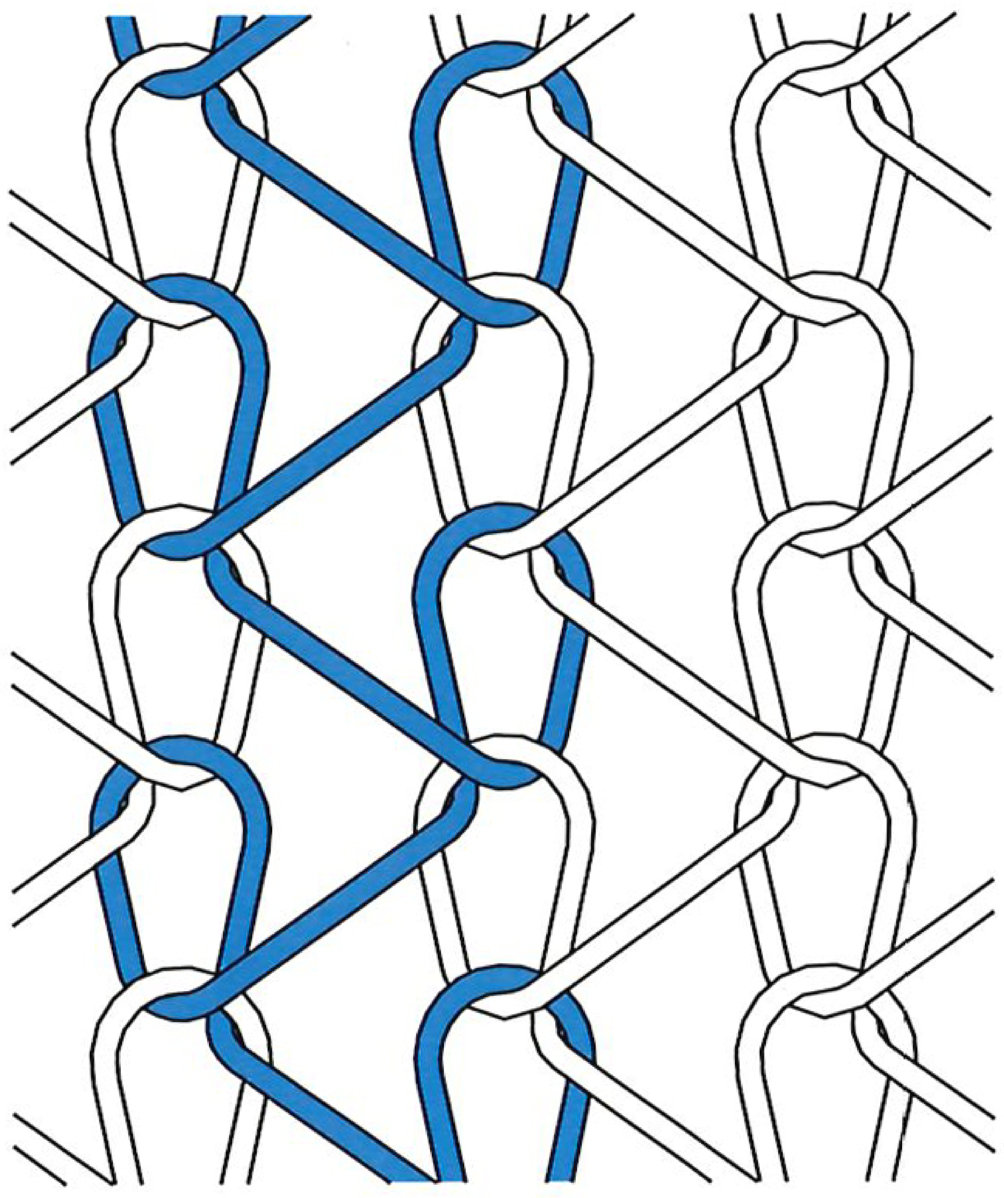


Figure 216: Warp knitting

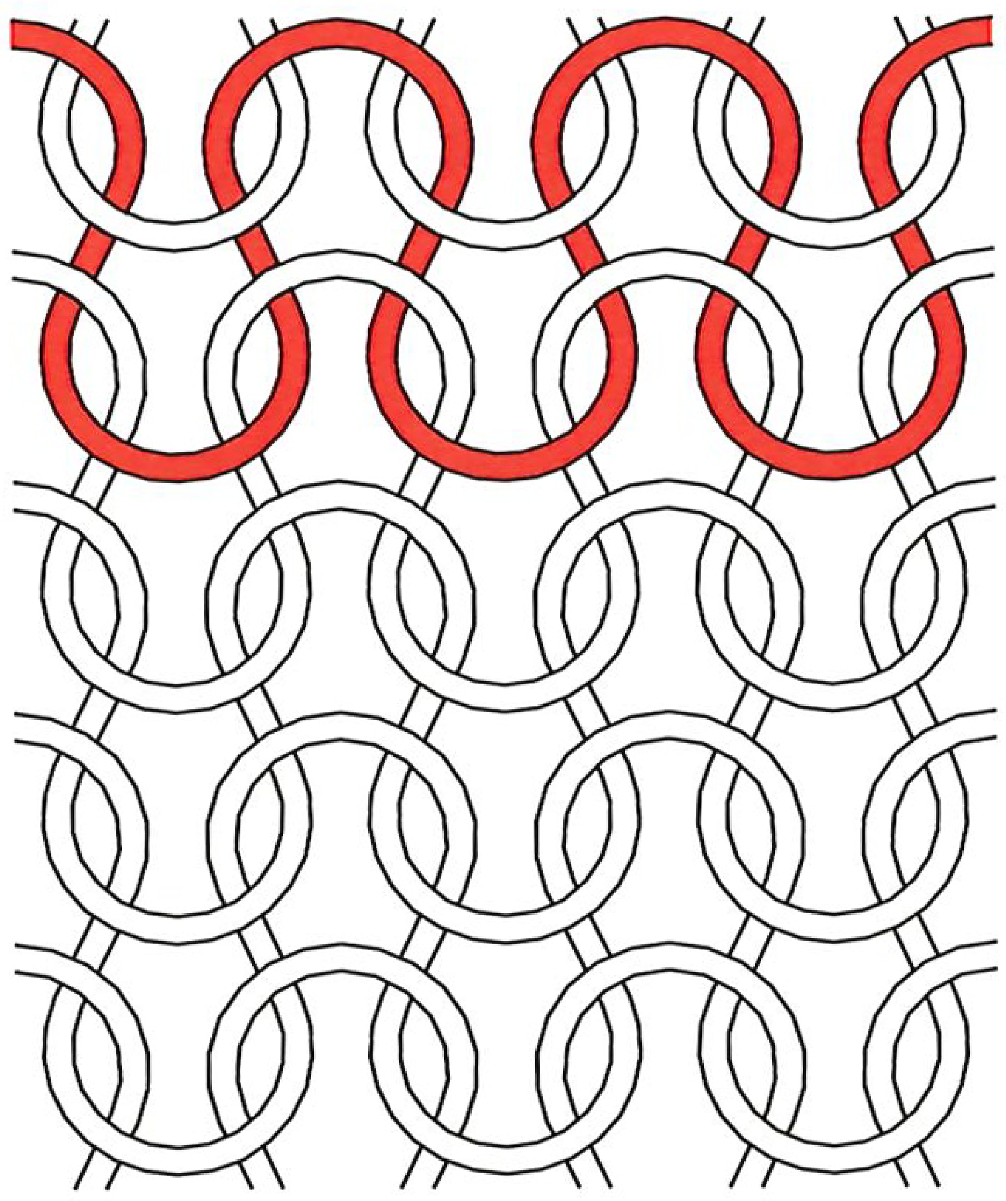


Figure 217: Knitting

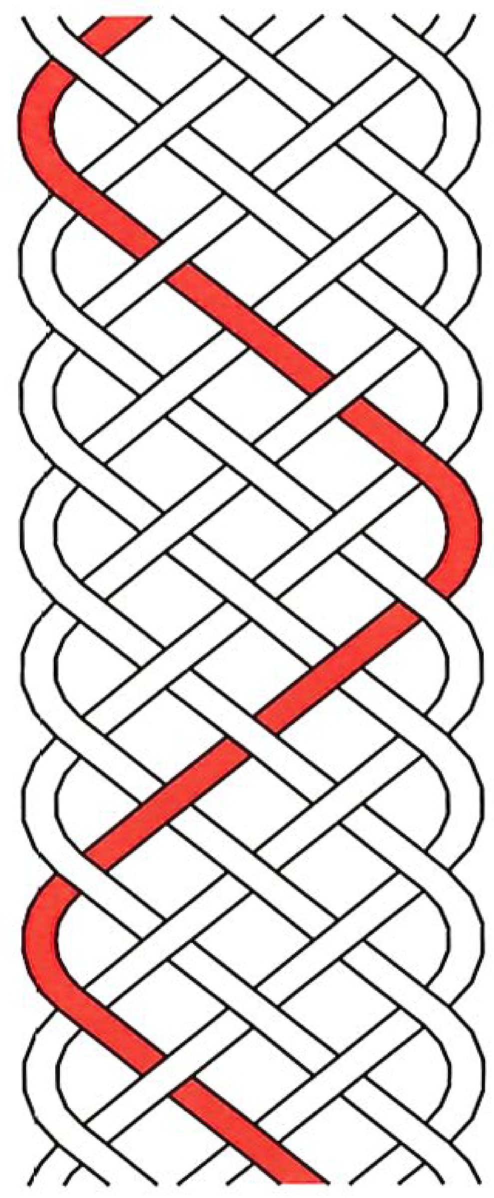


Figure 218: Braiding

The fabric patterns above illustrate the methods used. This study of cloth construction focuses on needle ribbon weaving, in which the weft loop in the shed is treated as one weft thread. The symbols for the weft needle and knitting needle in the weave pattern indicate that the weft is inserted from left to right.

2.3 Rearrangements of twill weaves

Rearrangements of twill weaves

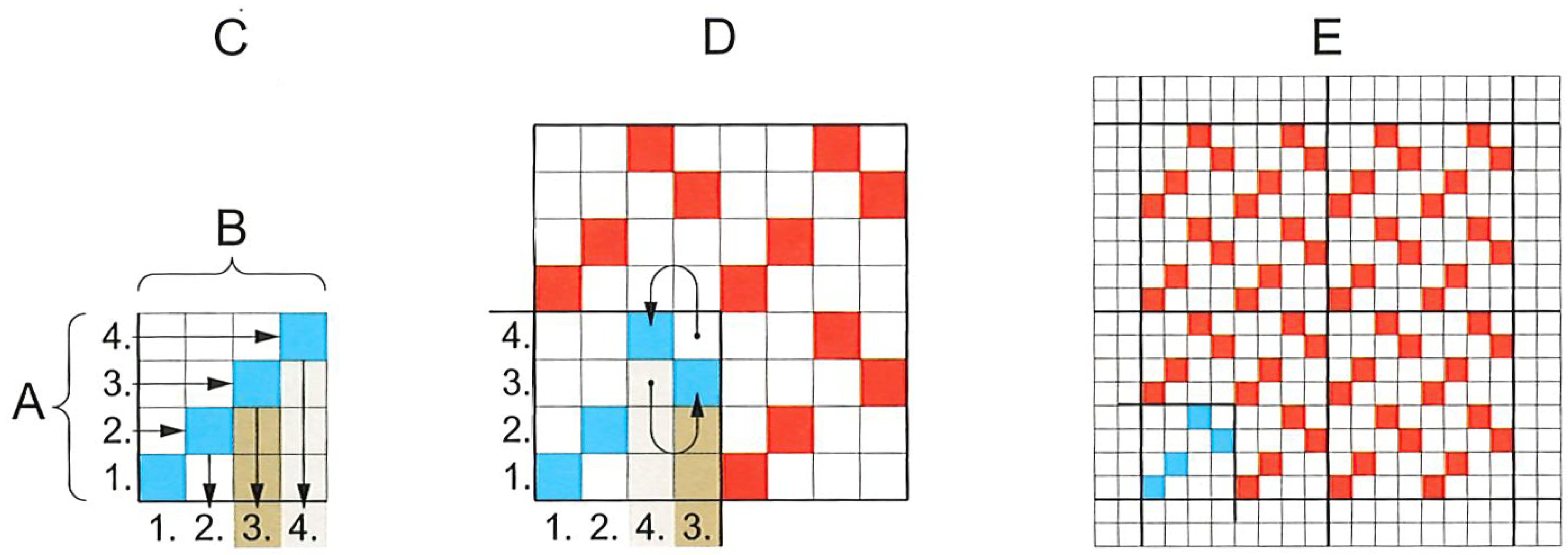
There are already a good number of pure twill weaves, but once you start to introduce variations the number of different weave effects that can be achieved becomes almost limitless. Taking the ground weave as the starting point, the sequence of warp or weft threads can be changed together with their interlacing points. The ground weave and all the variations based on it can always be woven using the same loom. When designing rearrangements, for the sake of clarity the ground weave repeat is also drawn in the pattern draft to the right of the weave pattern.

In the narrow fabrics sector the following rules are generally observed for rearrangements.

Broken twill

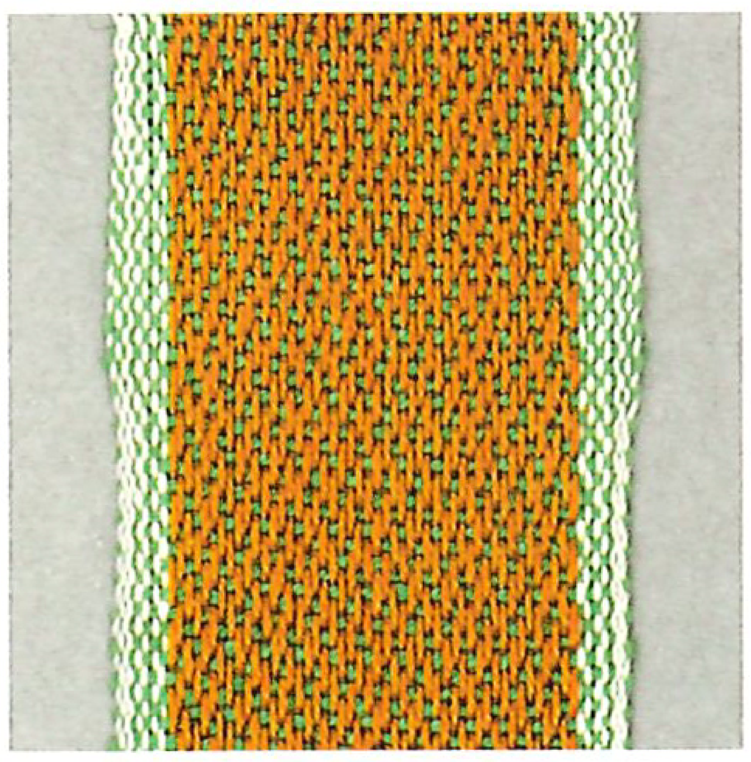
Broken twill

In a broken twill the first half of the interlacing points are arranged opposite the second half in the form of a cross. This weave pattern is produced by using the interlacings for the first half of the warp threads from the ground weave, then attaching the warp threads for the second half in reverse order.



A Weft sequence
B Warp sequence
C Weft twill repeat $K\frac{1}{3}Z$
D Broken twill weave pattern $K\frac{1}{3}X$
E Broken twill, expanded weave pattern

Figure 262: Principle for broken twill rearrangements



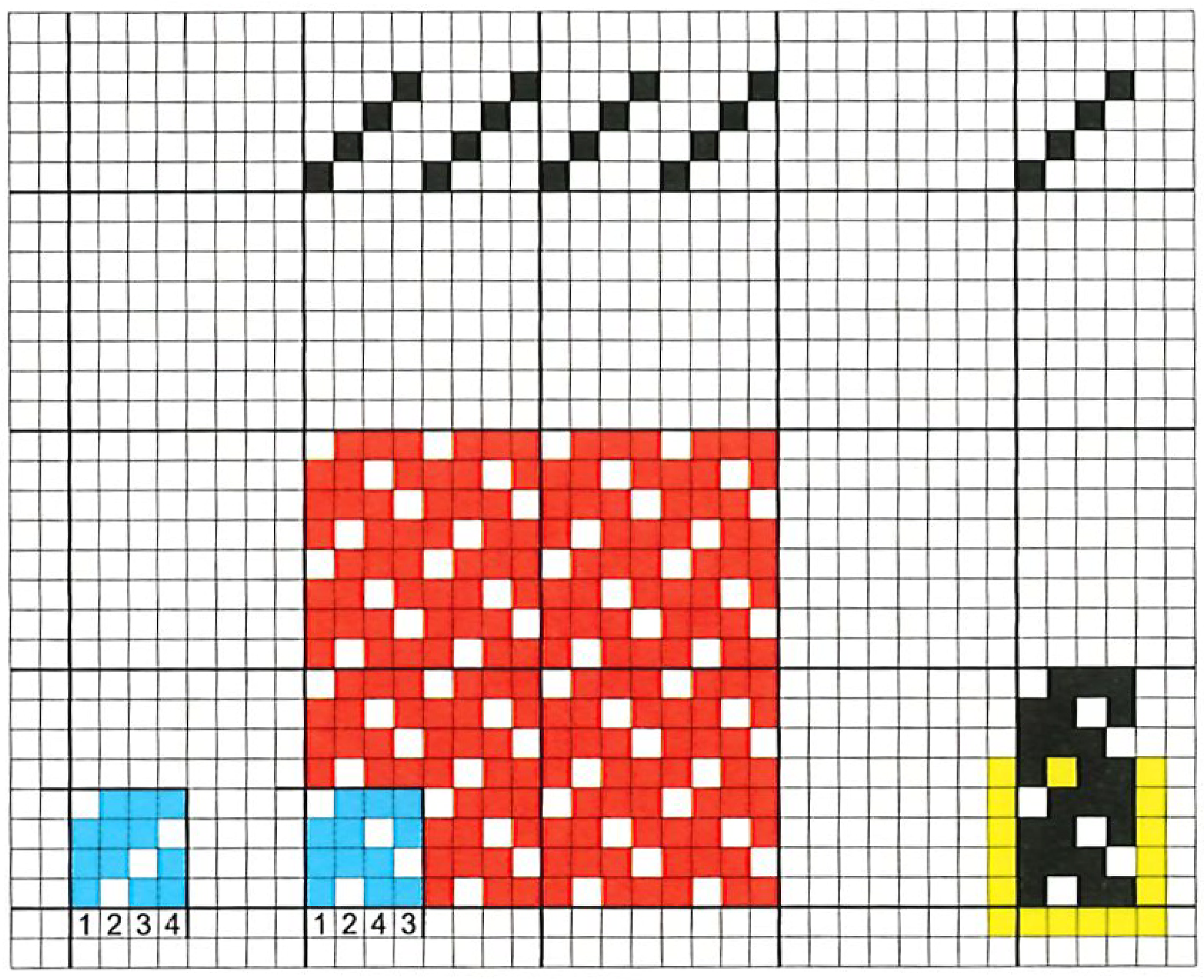
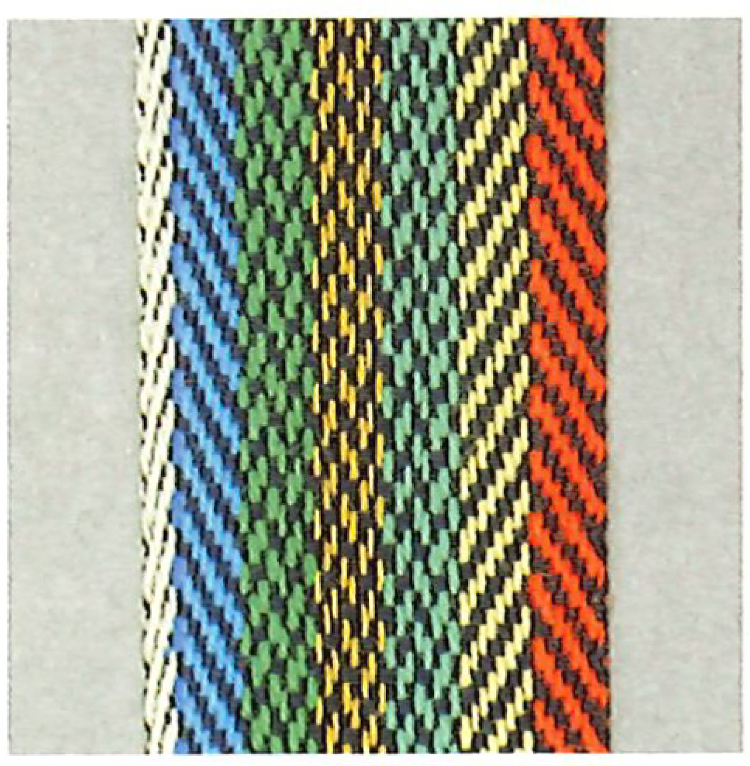


Figure 263: 4-end broken twill (variation on single-ridge warp twill) $K\frac{3}{1}X$

When the threads are compact, this broken twill presents a satin-like fabric appearance, which accounts for the fact that it is sometimes called 4-end satin.



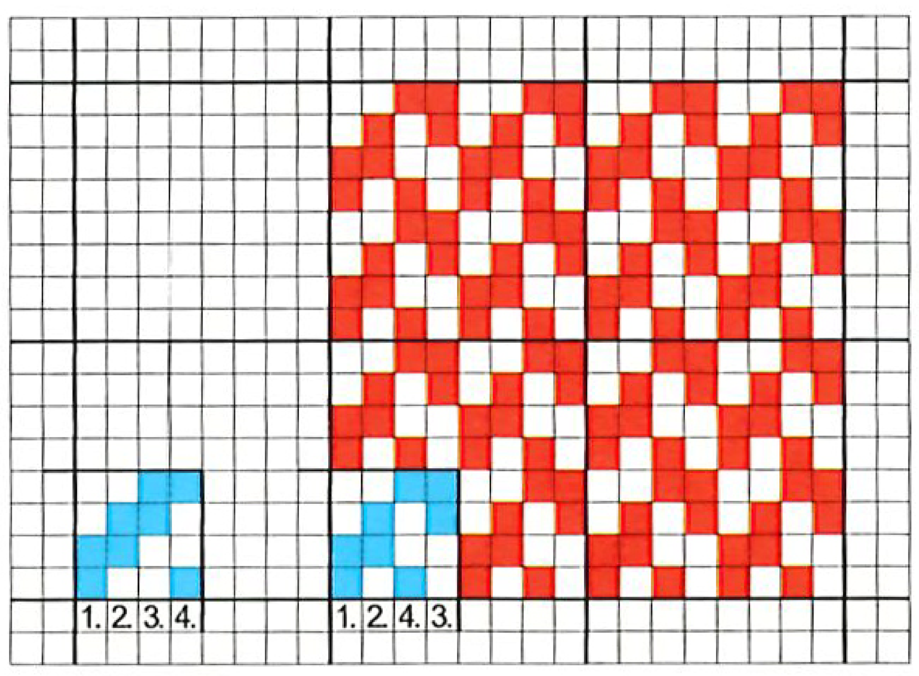


Figure 264: 4-end broken twill (variation on uniform line twill) $K\frac{2}{2}X$

2.14 Double-weft insertion (Z-weft)

When producing fabrics with double-weft insertion, using two weft needles, one pick is inserted simultaneously into each of the two sheds (upper and lower), which are positioned one above the other. On the right-hand selvedge the two weft threads are hooked in according to one of the Z-systems described in section 6.2, “Z-weaving system with two weft needles” (Z3 to Z10).

As the weft is inserted simultaneously in two sheds positioned one above the other (this arrangement is sometimes called a double shed or Z-shed), three heald frame positions are necessary. The heald frames for the upper shed travel a half stroke from the middle to the upper shed position (M-H), and the heald frames for the lower shed likewise travel a half stroke from the middle to the lower shed position (M-L). The position of the warp threads on the inside is indicated in the weave pattern by a diagonal line through the square representing the weave point.

If there are warp threads holding the face and back of the fabric together, for instance for a common insert or selvedge, then their heald frames work across both (upper and lower, H/L) sheds. The three heald frame positions in the dobby are obtained with an add-on device, or in the treadle motion with whole-stroke and half-stroke eccentrics / pattern chain elements. When double-weft insertion is used, production rates can be achieved that are twice those of single-weft insertion.

Warp thread positions for double-weft insertion are explained using figure 366.

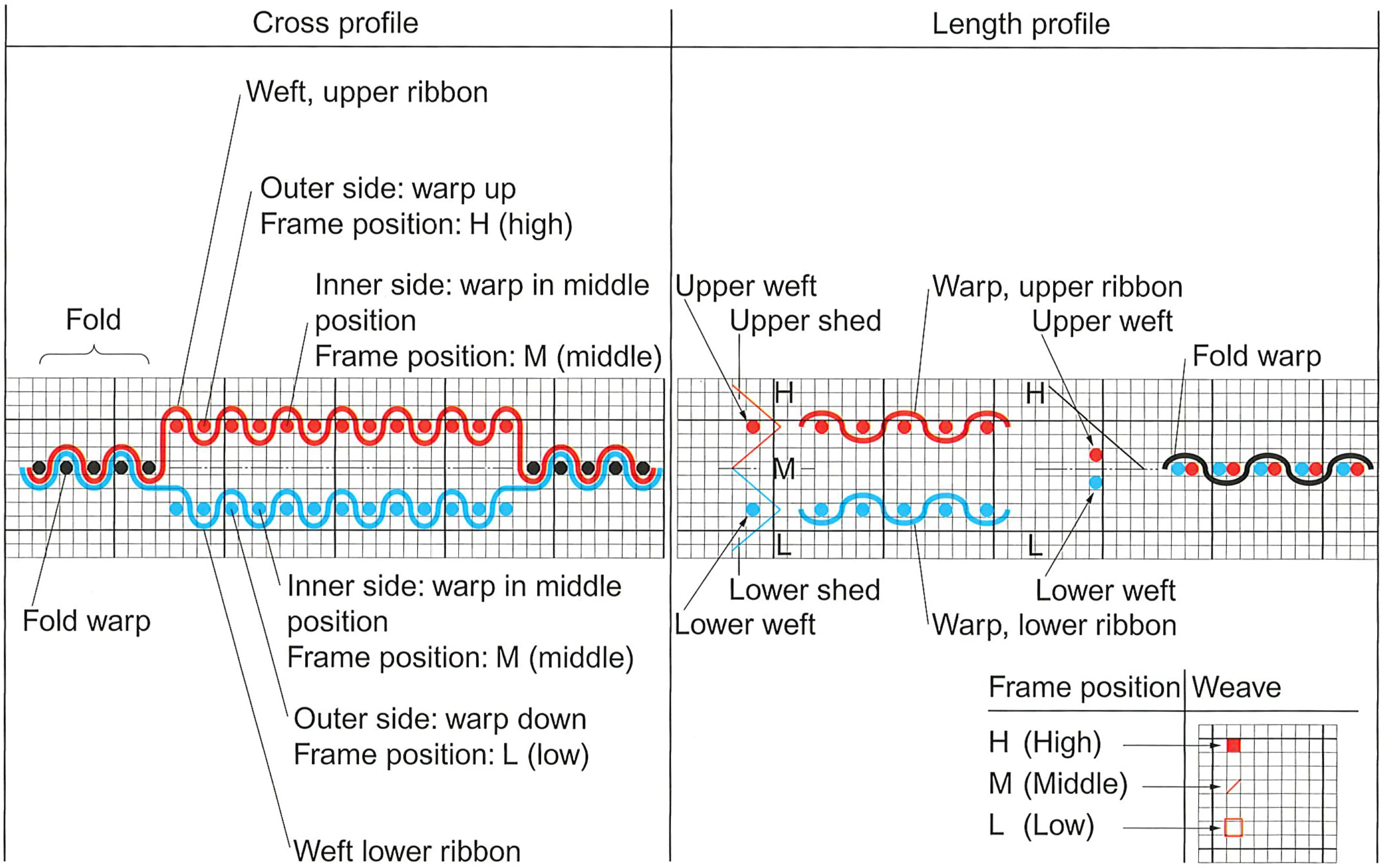


Figure 366: Warp thread positions in a double-weft (tubular) fabric