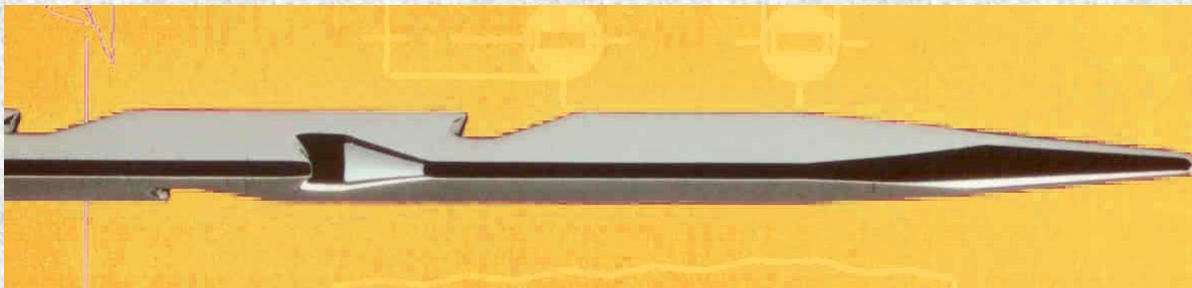


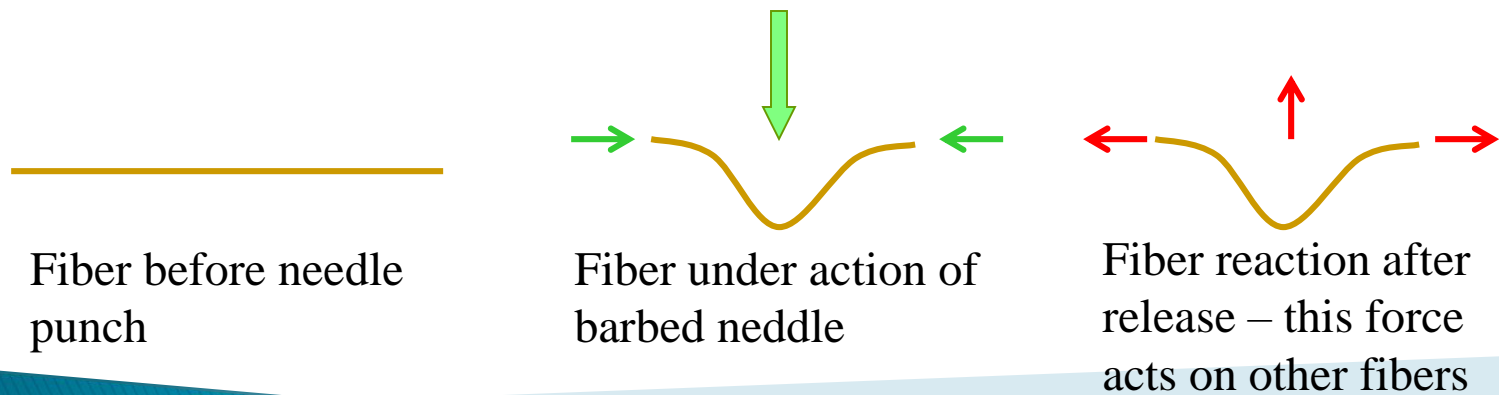
Chapter VI.

Needle punching



Principle

A needlepunched nonwoven is a fabric made from webs or batts of fibers in which some of the fibers have been driven upward or downward by barbed needles. This needling action interlocks fibers and holds the structure together by friction forces (see fig. 1)



Binding point is a set of fibers with various orientation, which are bonded by friction forces.

Parameters of needlepunch process

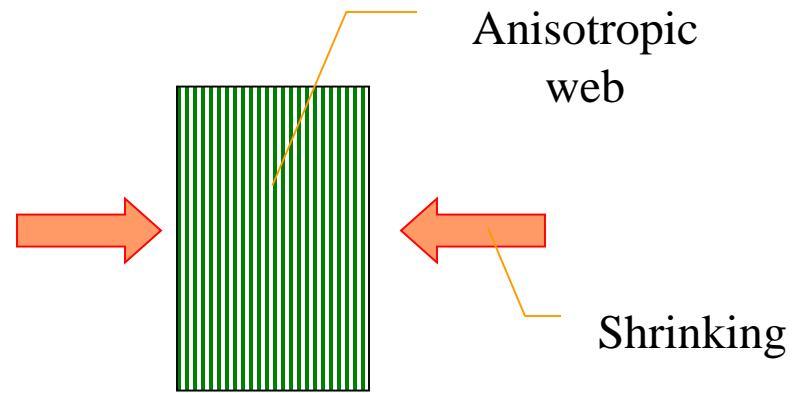
1. Parameters of fibers
2. Parameters of web
3. Parameters of needlepunch machine

Ad 1. Parameters of fibers

- Geometrical properties: fineness, length, cross-section (beware of cotton), crimpiness
- Surface properties: roughness, finishing
- Mechanical properties: strength, elongation (elasticity), relaxation, resistivity against periodic stress.

Ad 2. Parameters of web

- Fiber orientation. Change of dimension depends on web anisotropy



- Web density. It is necessary to use sufficient number of fibers to make bonding points.
- Web thickness. For good quality of needlepunch textile is necessary to have probably the same web thickness as is the distance between lower holeplates. Therefore the web thickness must be reduced.
- Web homogeneity

Ad 3. Parameters of needlepunch machine

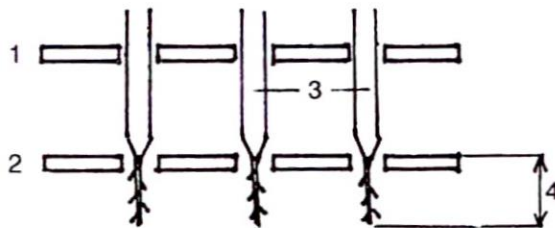
- **Penetration depth**

It changes number of working barbes

It inreases textile strenght (until some value) and decreases textile thickness.

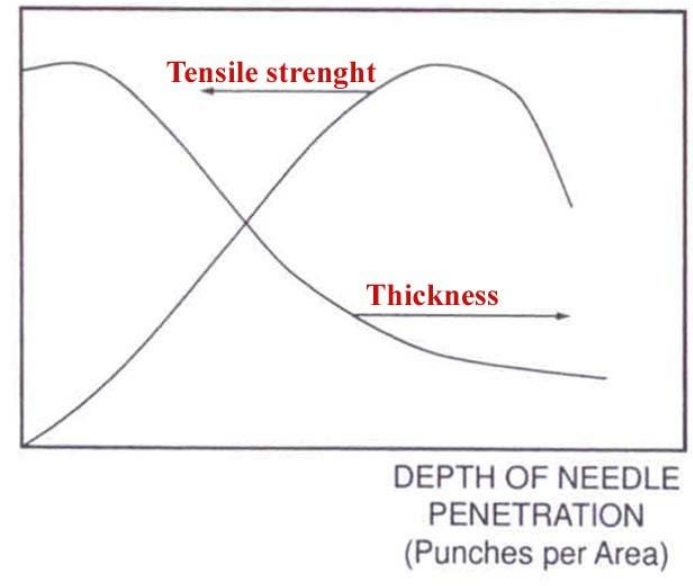
When the penetration depth is too high fibers are pulled through the textile – non uniform textile

Fig. 47: The depth of needle penetration



1. Upper holeplate
2. Lower holeplate

3. Needles
4. Depth of needle penetration



Ad 3. Parameters of needlepunch machine

•Density of punches

The number of punches per area is given by

$$N_p = \frac{a \cdot f \cdot p}{v}$$

where N_p is number of punches per square meter of fabric (m^{-2}), a is total number of needles per 1 meter of working width (m^{-1}), f is frequency of needle board (s^{-1}), p is number of passages through needle loom (or number of needle looms) and v is velocity of web ($m.s^{-1}$).

Higher density of punches causes:

- Higher strength of textile
- higher dimension changes of textile
- higher damage of fibers when density is too high
- lower thickness
- lower permeability of textile

Ad 3: Parameters of needlepunch process:

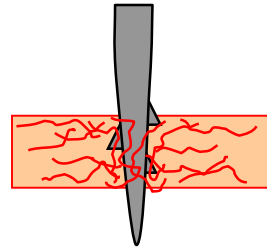
Parameters of needles:

- Proportions (length, diameter, density of barbs, size of barbs...)
- Shape of needle parts (shape of working blade, shape of barbs....)
- Type of needle (felting, structuring)
- Location on the needle board

Types of needles:

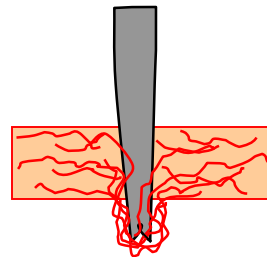
Felting needles

To mechanically compact fibrous material



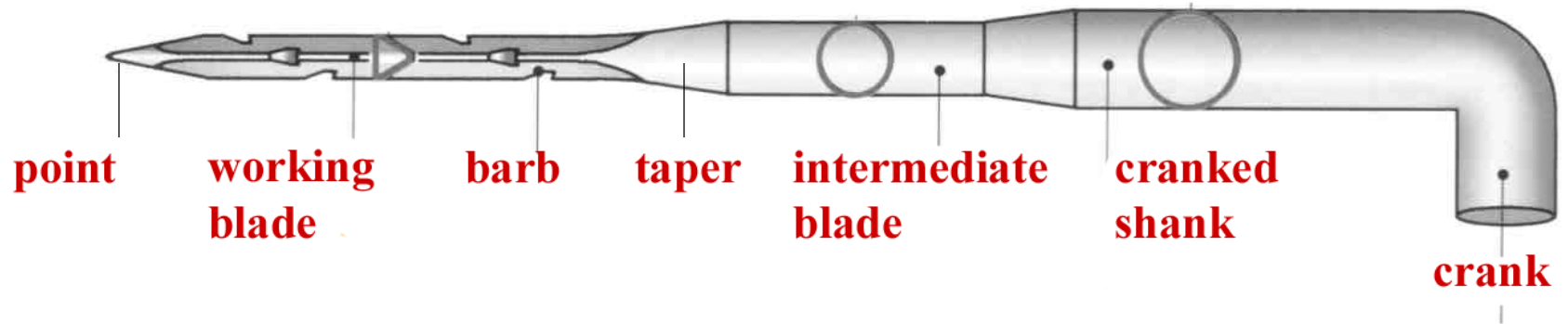
Structuring needles

To prepare surface structure with a velour or rib effect

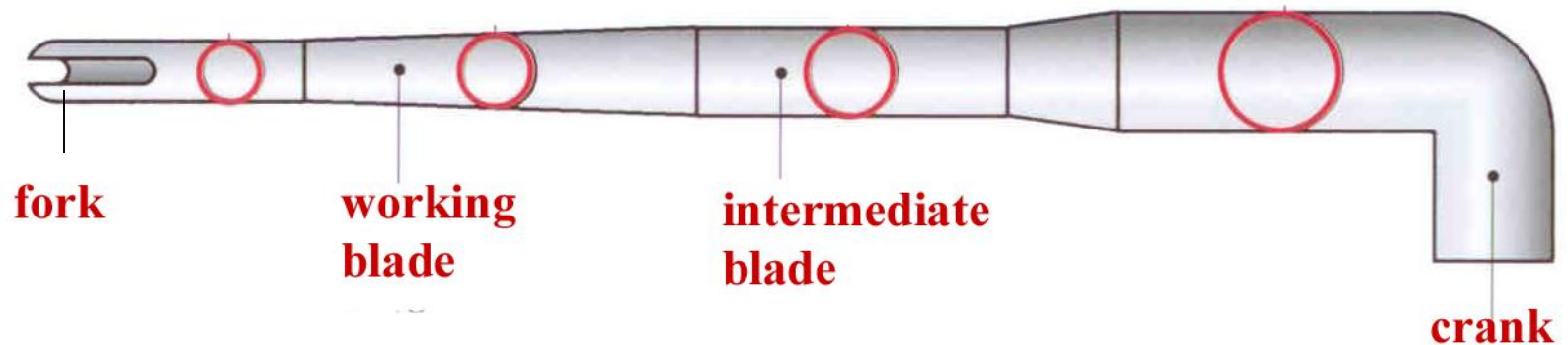


Description of needles:

•Felting needles



•Structuring (fork) needles



Parts of needles:

1. **Point:** Sharp or ball point depends on the felted textile (ball point is more fine for fibers)
2. **Working blade:**

Length: 20 – 30 mm, diameter 0,33 – 2,5 mm;

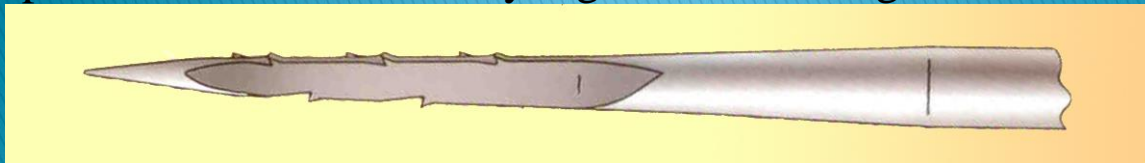
Special shape of working parts:

•Vario barb needle

Barbs are smaller towards the point. The needle is deflected to a lesser extent – reduced risk of breaking. Suitable for natural fibers and waste.

•Conical needle

Working part smoothly passes into the reduced part. Thus the fibrous material is penetrated with less resistance. Suitable for waste materials and products with area density higher than 1000 g/m².



Working blade cross-sections [1]:

Triangular



Tri STAR



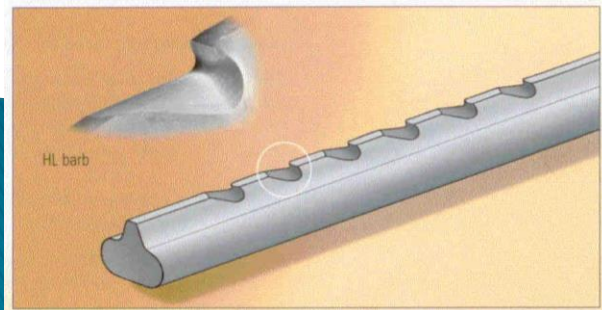
Cross STAR



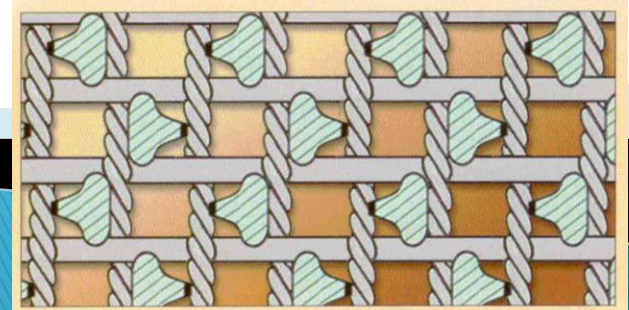
Tear drop shape



- **Triangular** – standard for the most of applications
- **Tri STAR or Cross STAR** – more efficient fiber holding – more efficient needling proces with the same needle density (suitable for manmade fibers); Cross STAR is suitable for high density materials (geotextiles)
- **Tear drop shape** – for woven fabrics (to obtain special properties – adhesion for subsequent fixing, roughened appearance...)



Machine
running
direction

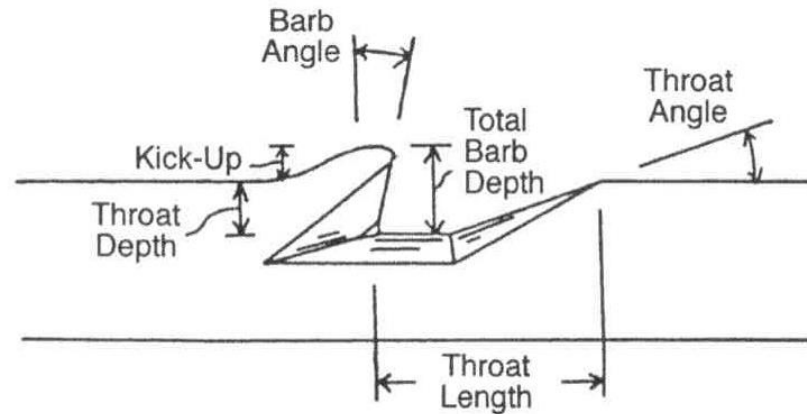


Preferred arrangement of needles in the fabric

3. Barbs:

Distance between nearest barbs: 0,1 - 2 mm, distance between successive barbs: 1,4 – 7 mm;
Shape and size depends on used fibers (especially fiber diameter)

Shape:



4. Intermediate blade:

Length 1,2 – 1,6 mm; It is used to obtain smaller holes in felted textile, to obtain lower weight of the needle board and to obtain better mechanical properties of the needle.

5. Cranked shank:

Length 1,2 – 2,6 mm

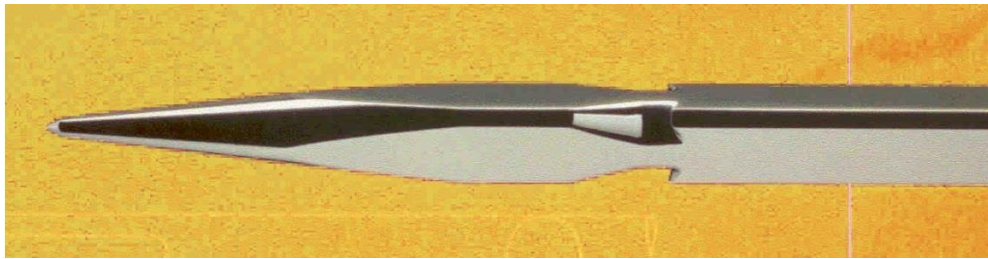
6. Crank

For needle with the tear drop shape of working blade is important the orientation of crank on the needle board.

Variants of structured needles:

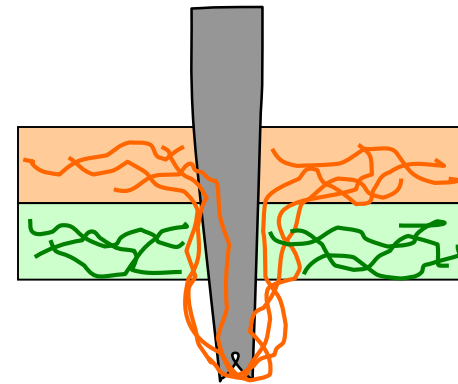
Crown needle:

For more uniform velour surface and a high standard of quality (automotive industry)



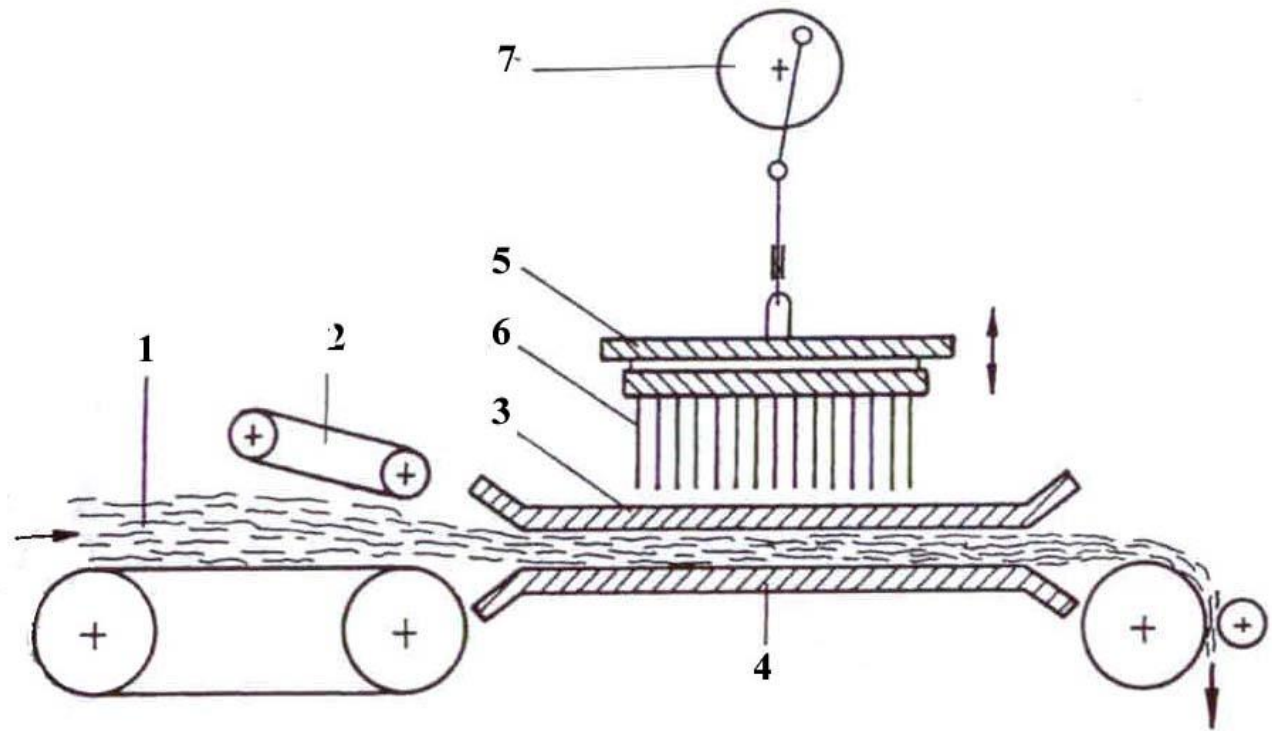
Colour effect of the fork needle:

Patented location of fork needles makes colour pattern of the textile. It is possible to do discontinuous process.



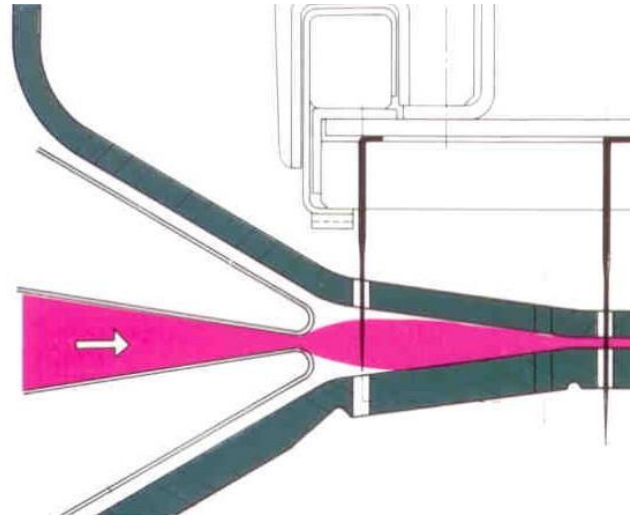
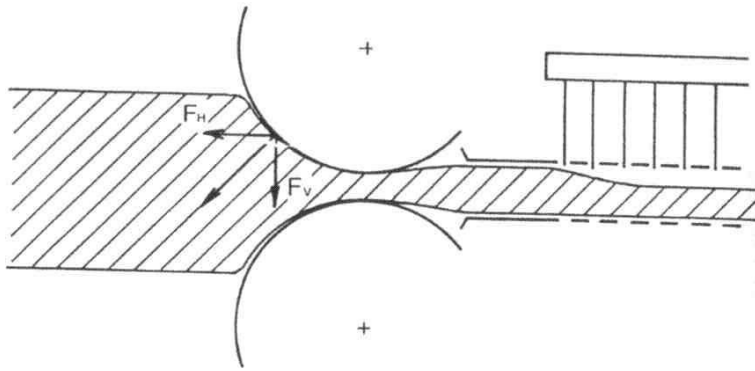
Parts of needlepunch machine:

1. Fiber layer
2. Input device
3. Upper holeplate
4. Lower holeplate
5. Needle board
6. Needles
7. Main drive



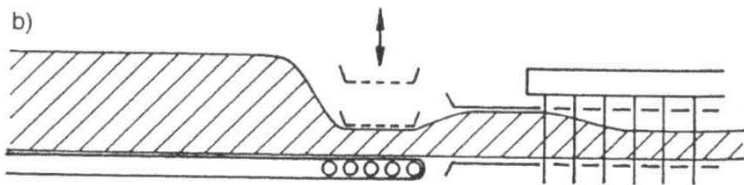
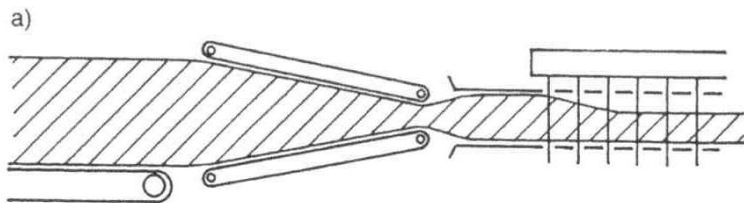
Variants of needlepunch machine I: **Devices to reduce textile thickness**

Fig. 44: Two-roller feeding



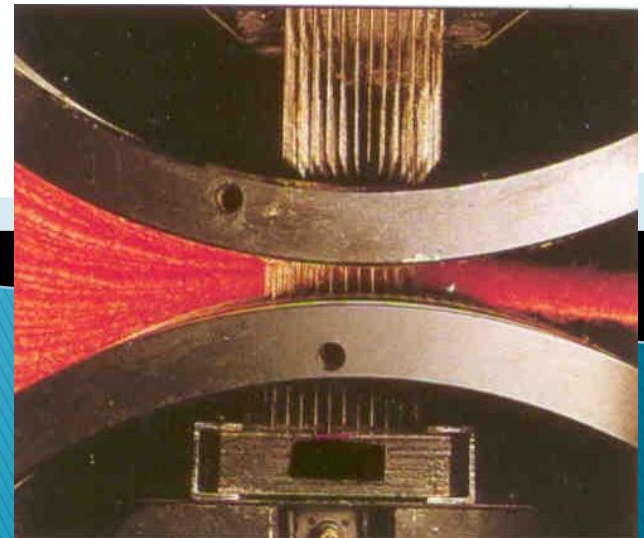
Feeding belt with pre-needling zone

Fig. 45: Feeding devices



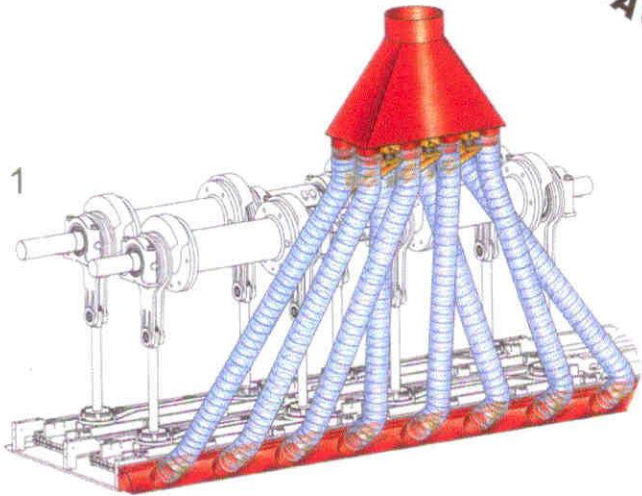
a) Slanted belts

b) Vibrating screen

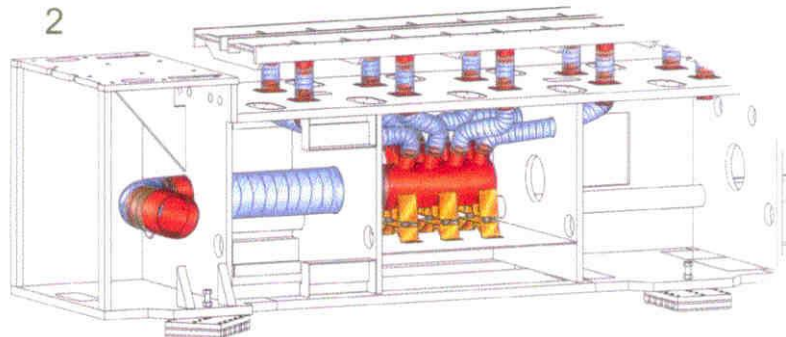


Preneedling machine

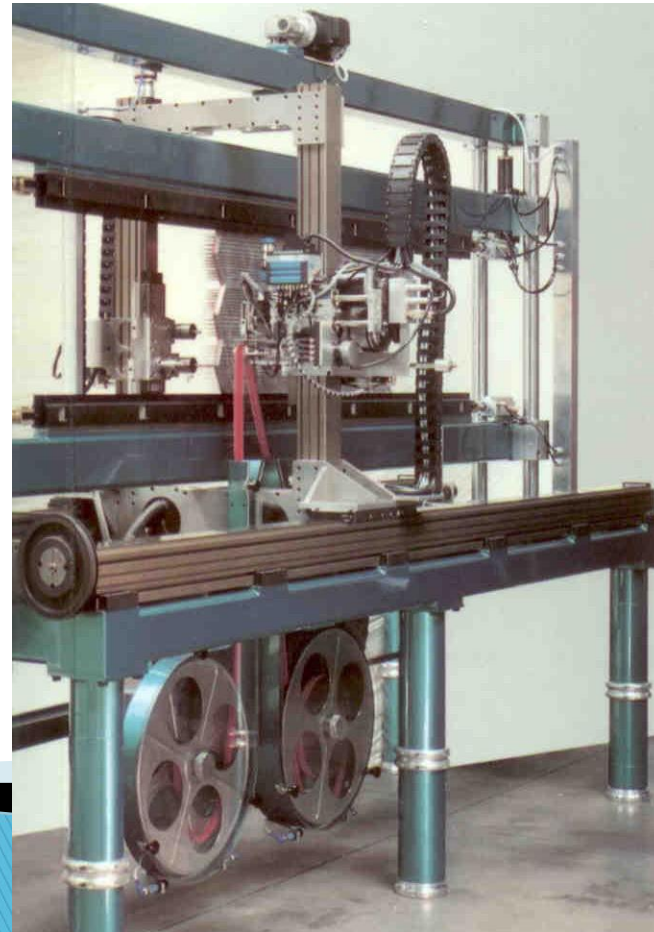
Variants of needlepunch machine II: **Air cleaner** for waste or natural fibers processing (jute, hemp, flax...) and **automatic maintenance of needleboard**.



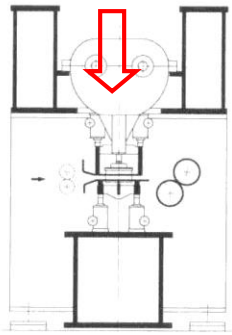
CHINA



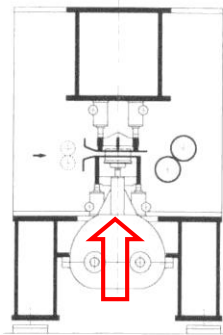
2 - IN THE BOTTOM SIDE OF THE MACHINE THE SUCTION AREA IS THE BENCH SHEET. THE DUST GOT DURING NEEDLE PENETRATION WORKING IS SUCKED BY VACUUM THROUGH THE



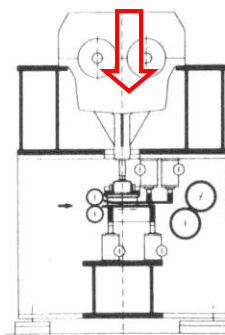
Variants of needlepunch machine III: Needleboard location



MOVEMENT DOWN

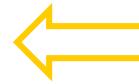


MOVEMENT UP

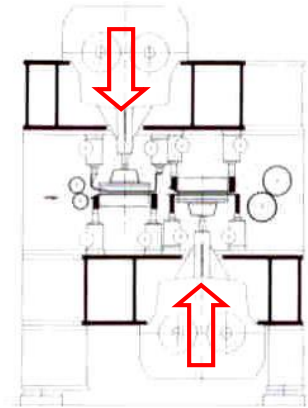


VERTICAL AND HORIZONTAL MOVEMENT

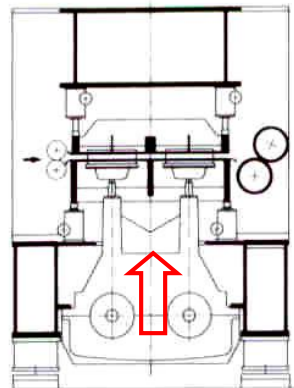
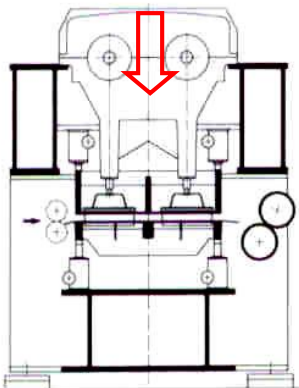
Single board system



Tandem board system



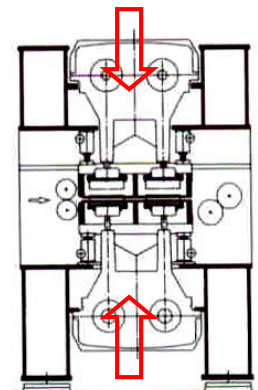
TANDEM PUNCH SYSTEM



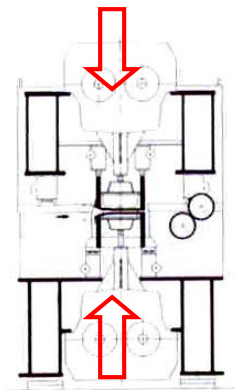
Double board system



Twin and quadro punch system



QUADRO PUNCH SYSTEM
(double sided needling
with two board pairs)

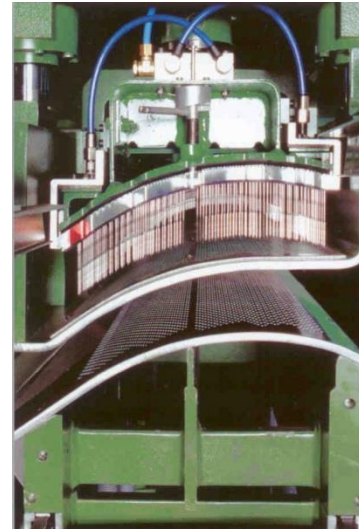


TWIN PUNCH SYSTEM
(double sided needling
with one board pair)

Variants of needlepunch machine **IV**:

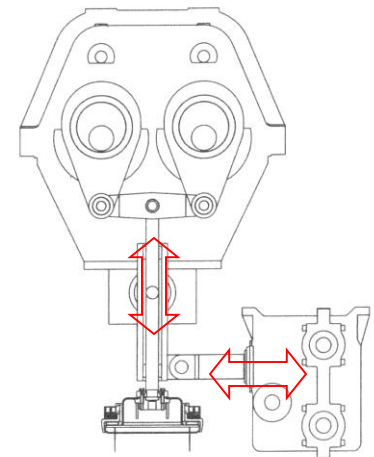
Special shape of needle board – angled needle penetration:

Penetration is achieved by means of an asymmetrically curved needling zone and straight needle movement. As advantage is possibility of more random orientation of punched fibers and longer needle path through the web, which creates better fiber reorientation. Thus textile strength is better.



Multi motion drive system for needle board:

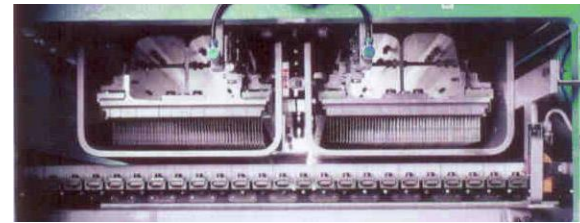
Principle consist of a synchronised vertical and horizontal movement of needle board, which results elliptical needle tip path. The result is maximum product uniformity.



Variants of needlepunch machine V. Structuring machines

Different shape of lower plates:

- Lamella plate for ribbed products
- Brush plate for velour products



Patterned location of needles on needle board:

For patterned carpets where the fabric movement is discontinuous.

Needlepunch products

1. **Geotextiles:** Road and railway construction, dams, roofing felts, drain felts, shore protection, reinforcing felts...
2. **Automotive fabrics:** Head liners, carpets, door trim, parcel shelves, moulded components, insulation felts

Needlepunch products

- Hometex: Carpets, wall coverings, decor felts, wipes, blankets...
- Synthetic leather: Shoe, automotive and upholstery industry, luggage, bags, sport goods
- Clothing and furniture: Shoulder pads, waddings, mattresses
- Filters for gases and liquids,
- Other technical felts: polishing felts, abrasive felts, mineral fiber felts for insulation

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