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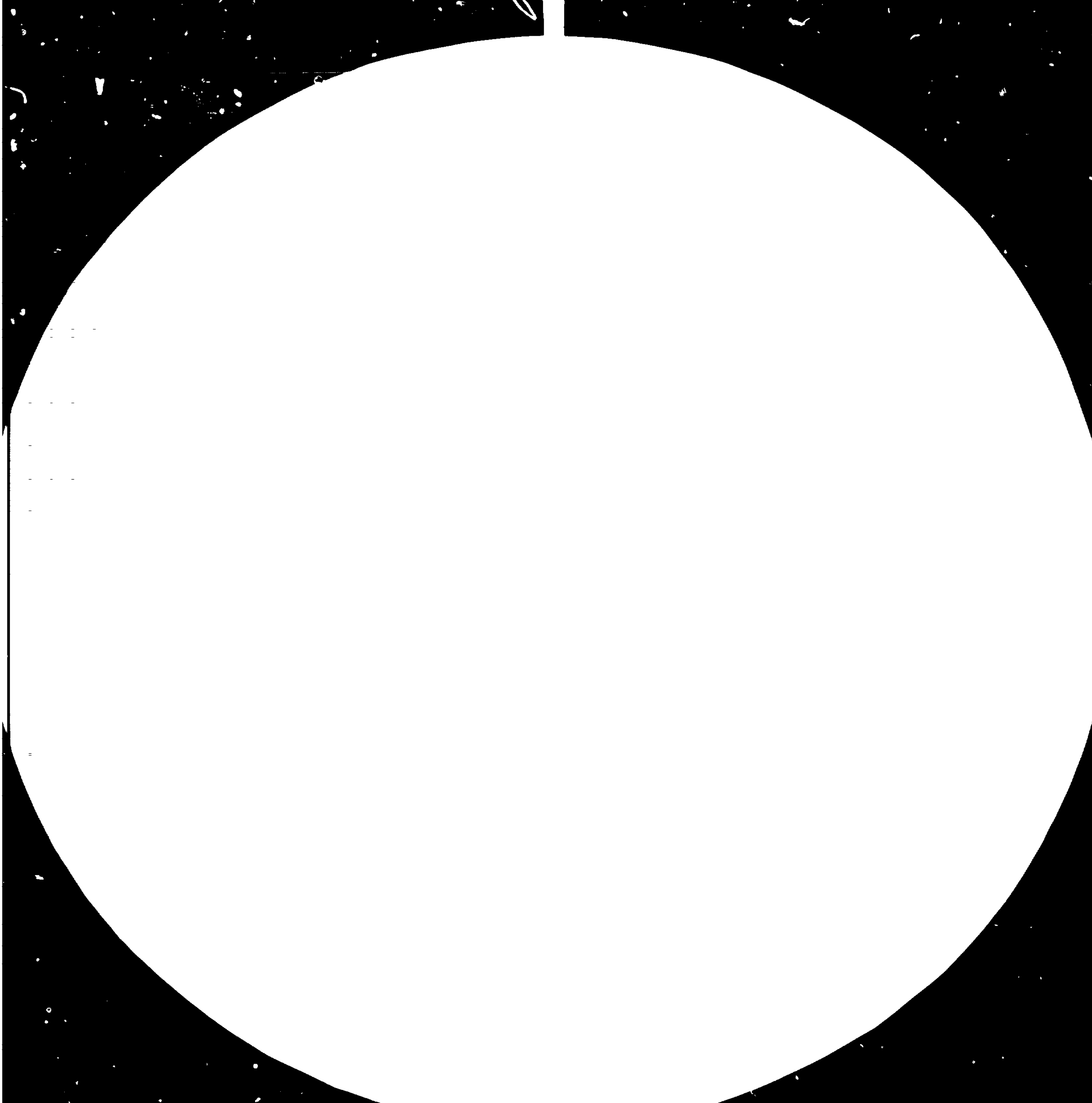
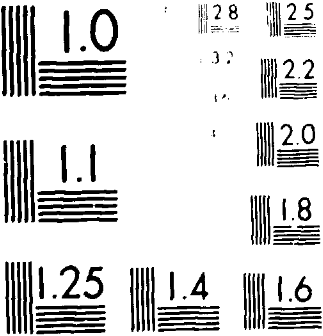




MICROCOPY RESOLUTION TEST CHART

09716 (L)

PROCESSING OF SYNTHETIC FIBERS AND BLENDS: SPINNING, WEAVING.

by

Prof. Dipl.Ing. Johann Hördler

Ladies and gentlemen!

The development of spinning, weaving, knitting and other textile manufacturing processes has been influenced to a great extent by the increasing percentage of synthetic fibres.

Originally synthetic fibres were processed on the same machines as cotton or wool. Therefore it was necessary to adapt fineness and length of man made fibres to those of natural ones. I mention the cotton-type and wool type of cellulosic fibres. The increasing production of synthetic fibres led to the development of new equipment especially adjusted to the processing of synthetic fibres.

The properties of the new fibres enabled the textile men to introduce new methods and new machines which increased the efficiency of processing. A flow sheet will give you a survey of the whole manufacturing process from monomer to fabric (See appendix, Fig. 1)

In my lecture I am not going to tell you about the conventional systems, but my aim is up dating your knowledge about new ways in processing synthetic fibres and blends, but most of these techniques are also applicable to other types of fibres.

In my survey about the properties of synthetic fibres and blends I gave you the reasons for the production of fibre blends. In spinning, weaving and knitting blends are almost as advantageous as synthetic fibres of one type only.

- The spinning process has been shortened by eleminating the preparatory process and by converting tow to top or sliver
- Greater strength guaranties, less downtime in spinning, weaving and knitting.

-New properties have enlarged the range of end uses.

-Certain properties of synthetic fibres have resulted in new methods of processing, such as texturing for high elasticity, crimping and shrinkage for high bulk yarns or fancy cloth design.

My lecture will deal with trends in spinning and weaving.

1. NEW YARN-MAKING TECHNOLOGIES

New yarn-making technologies are blossoming for all kinds of end uses.

From improvements in texturing and introduction of open-end spinning in the 1960s, technology has gone exotic with new ...

...highs in production output.

...engineering of yarns for unique end uses.

...systems to pack more yarn on packages larger than ever dreamed possible.

In fact, in many instances, the major drawback to even higher production throughput is the limited winding speed for machine doff packages.

Yarn making today is enjoying a level of cooperation that's highly unusual in the textil industry. Look at current development work in the area of openend spinning.

This system-with its tremendous economic potential for spinners of yarns in the range of 30s (50 metric) and heavier-has had its share of problems. But cooperation among machine maker, fiber producer and textile manufacturer has already paid off with altered spin-finish application that promises to minimize this problem.

This cooperation is carried over into the exotic technologies.

Some of these are: Friction twisting
Draw - texturing
Fluid texturing
Self-twist (Repco)

Selfil
Bobtex
Fasciated yarns
Electrostatics
Twilo - System
Axispinner
Dref - System

What are these technologies?
How do they currently shape up?
What yarns do they produce?
How do they fit into yarn making's future?
These are critical questions being asked by spinners.

R i n g   s p i n n i n g . Despite the promise of the exotics and continuing gains by open-end, ring spinning still predominates. And there are recent production-increasing innovations and machine improvements that add to the revolution.

In ring spinning, automatic doffing now seems to have arrived, and many frames at the show in Milano had doffers of some kind. Automatic piecing, although still some distance behind, also seems to be making headway, and units of this type were to be seen on several stands. One Italian firm had an automatic piecer as its main exhibit, while another was concentrating on demonstrating a carriage type doffer.

O p e n - e n d   s p i n n i n g . Open-end is still young enough in yarn technology to group itself with the "exotics". Many improvements showed up on open-end frames in the last years. OE-spinning was one of the major features of the last ITMA-show.

In Paris eigth years ago, Suessen showed exhibits relating to OE spinning (but not a complete full-length machine) and now had as more recent developments a well designed spinning box (the Spin Box SPE) together with an automatic piecer (for OE machines) and an automat for cleaning out rotors. Suessen spinning boxes were integral in a number of the OE machines at the show.

The present trend in OE spinning is, of course, towards higher speeds and in 40 mm range machines, 60.000 or 70,000 rpm (nominal) is now by no means exceptional, and some machines are going even faster.

Investa from Czechoslovakia were showing an advanced prototype OE machine with an individual electric motor for each rotor said to be designed to operate at 90,000 rpm. Clearly 100,000 rpm is now within sight, but any substantial further movement beyond this point must appear problematical; it will obviously not be possible to reduce the size of the rotors on OE machines as were the spinners on false twist texturing machines as speeds continued to rise.

It is interesting at this stage to point out that some OE machines were fitted with Zellweger individual end electronic OE yarn monitoring units.

T e x t u r i n g . The field of textured-yarn production is a target for new technologies promising highly significant change. Of vital importance is breaking the barrier of 200 to 250 ypm. (180 to 225 mpm.) output speed associated with conventional false-twist production. Equally important is elimination of the false-twist spindle; for example by using the friction twisting method.

You already have had a lecture about physical modification of synthetic fibers with details of new methods of texturing.

S e l f - t w i s t i n g . The worsted field has been pressed by the self-twist principle, exemplified in the Repco machine. Production output is up to 12 times that of a conventional ring machine, depending on count.

And with a potential return to worsted woven men's suiting, the machine could represent a high-speed approach to handling this demand. A similar technology, presented in Milano was the selfil-process.

B o b t e x . A highly unique machine, the Bobtex, produces composite yarns consisting of a molten polymer, a carrier and a face yarn, at production speeds to 2,000 fpm. (609,6 mpm.) And the count range puts it right in competition with open-end yarns, although yarn characteristics are different. (For example, the Bobtex-yarn is stiffer with a harsher hand at present preliminary data indicate its primary use will be in the upholstery home furnishings field.)

F a s c i a t e d . A proprietary development of DuPont, fasciated yarns offer great production of spun-type yarns from staple with speeds in the range of 500 to 1,000 ypm. (450 to 900 mpm.). The system eliminates many steps in yarn preparation.

E l e c t r o s t a t i c s . Production of yarns through electrostatics, being developed by Rockwell International, is still in the prototpye stage. However, several machines are presently undergoing plant evaluation. Early reports indicate that the primary market is in thread yarns.

T W I L O - s p i n n i n g p r o c e s s . The Twilo-process is a twistless spinning process for making yarn from staple fibers. The necessary cohesion between the fibers to hold the yarn structure together is provided by using an adhesive instead of twisting, as in normal spinning.

A x i s p i n n e r . This unique system, developed by Greenbank, introduces an entirely new concept to spinning and twisting.

One spindle of Axispinner will accomplish the work of 3 ring spindles (2 spinning, 1 twisting) up to a maximum of 15 000 rev./min twist insertion rate into the singles.

D r e f - O p e n e n d s y s t e m . This system is an Austrian innovation by Dr. E Fehrer. It's a mechanical, aerodynamic open-end system working at a production speed up to 150 m/min, depending on material and yarn count. It's an open-end system not working with a rotor as usual.

I am now going to explain some details of these technologies.

S e l f - t w i s t (Repco spinning-system)

A new system for high-speed production of worsted yarns, Platt's Repco Spinner, hit the market a couple of years ago after 10 years of development work.
Its delivery speeds range to 240 ypm. (220 mpm.), so production rate is approximately 12 times that of a ring frame on fine yarns. And since the yarns are two-ply, each winding unit is the equivalent of 24 ring spindles.
The system eliminates the ring and traveler and takes up on a cheese rather than a bobbin. Compared to equivalent ring spinning, floor space is reduced by 80%, power requirements by 55%, doff time by 95% and maintenance by almost 100%.
The self-twist principle involves insertion of alternating S- and Z-twist over short strands of yarn. When two strands are placed side by side so they touch, and the twist restraint is removed, they untwist and ply themselves together, producing a self-twist yarn. (See Figure 2)
The multiple-end drafting zone is a pendulum arm, three-line double-apron system. The top apron roller is recessed to allow slip drafting. The system drafts 100% manmades, manmade-wool blends or 100% wool of 58s quality or finer with an oil content up to 1,5%.
Top and bottom self-twist rollers are hollow cylinders, with a specially developed composition covering. A reciprocating motion of the rollers as they rotate imparts false twist into the strands. The rollers run on external air bearings, with fixed air-bearing support for the bottom roller.

The machine is designed to prevent any of the no-twist zones from coinciding. This is accomplished by varying path length from the nip of the self-twist roller to the point of convergence of the two strands in each pair that make up a yarn. In this manner, when the twist in one strand is zero, the other is twisted and gives a resultant ply twist. This means that every twistless zone in each strand is reinforced by ply or self-twist, and zero ply twist sections are strengthened by the individual strand twists. Sine the yarns coming off the Spinner are two-ply, a new nomenclature for count designation has been developed. And the yarns are classified as self-twist (ST) or self-twist-twisted (ST-T), to indicate if a subsequent twisting step is included. Generally ST yarns are ready for knitting, whereas the extra strains and tensions in weaving require the ST-T yarns.
There are over 1,000 machines in production worldwide.

I C S - B o b t e x (Integrated Composite Spinning)

This unique new concept of spun-yarn production combines three different processes into one:
Extrusion of a polymer matrix that performs the function of a bonding agent.
Incorporation of an oriented multi- or mono-filament strand of any preferred shape to provide continuity and strength.
Introduction of any type natural or manmade staple fibres from short to medium length to provide the desired outer spun texture.

There are many new and engineered yarns possible on the Bobtex For example, suggested compositions of a general-purpose yarn where low cost and satisfactory performance are of primary consideration could be:
F i b e r . 20 to 40% outer texture of any suitable, low-cost staple fibres could include short staple off-grade or off-Micronaire cotton down to and including linters, waste fibres shredded wool, jute, flax or regenerated fibres. These could be bleached, unbleached or cleaned.

C a r r i e r . 30 to 60% inexpensive inner continuous strand such as oriented polypropylene multi-filaments, or substantially fibrillated tape-like strands, or monofilaments to provide adequate strength.

R e s i n . 20 to 30% olefin resin as a bonding agent. There's an almost unending range of yarns you can engineer for almost any end use. For example, there's need for low-elongation yarns for industrial applications requiring low stretch and for filling in primary carpet backing and in household fabrics where dimensional stability is essential. Another need is low-cost, natural-silk surface yarns where the composition of the composite yarn requires only 30% of costly natural-silk surface fibres. There's a wide market range here. Also, exotic special-surface texture is limited only by the designer's imagination: fire-resistant yarns with a combination of a surface yarn such as Nomex, possibly a PVC resin binder and an inner glass multi-filament or other non-flame propagating carrier yarn, or electrically conductive yarns, where use of inexpensive steel wool staple has experimentally demonstrated this possibility. The machine basically consists of three zones.

These are the extrusion, spinning and take-up zones. Basically the extruder zone (melt tank) holds a molten polymer through which the filament carrier yarn passes. Staple fibres are then applied to the polymer-coated filament and a high-speed twisting action consolidates the composite structure prior to package winding.

The machine can, therefore, be also used when there is a shortage of fibers because the face fibre input gives a two or threefold yarn output. Of importance is the fact that all the fibre content is located on the surface and not distributed throughout the yarn.

Twilo-process.

What ist the "TWILO" Process? (see Fig. 4)
The TWILO process is a twistless spinning process for making yarn from staple fibres.
The neccssary cohesion between the fibres to hold the yarn structure together is provided by using an adhesive instead of twisting, as in normal spinning. (see diagram)
-adhesive component: Polyvinyl alcohol is added in the form of fibers during the initial blending operation.
-drafting: The wetted sliver is drafted by a 3 over 3 drafting system. Drafts of 100 are easily possible.
-activating: To activate the polyvinyl alcohol fibres and to strengthen the yarn, a steam-fed false-twist device is used.
-drying: The yarn is dried by means of a drying drum, heated electrically or through gas.
-winding: After drying, the yarn is wound into cylindrical cross-wound cheeses.

Speed: With the TWILO machine, production speeds in excess of 400 m/min are attainable.
Yarn shape: The almost flat shape of the yarn results in a more efficient utilization of raw material.

Axispinner.

The two stages of sequential spinning an twisting. (Fig. 5)
1. A fibre stream is drafted and delivered to a traverse tube which layers singles yarn into a rotating storage cylinder. The yarn thus produced contains real twist and is similar is structure to a conventional yarn.
2. This is the spin/twist stage whereby the axial singles yarn entering the cylinder via the traverse tube is threaded through the cylinder and hollow spindle base by a probe.
In so doing, the yarn from the cylinder wall is now caused to untwist about the axial fibre stream still being delivered at the front rollers. A haul-off roller beneath the hollow spindle base continues to remove two fold yarn from the spin/

twist area at a constant rate for delivery to a take-up winder or as required.
The creel input package and the take-up of the output package are both independent of the spin/twist process itself.
Therefore, the possibility of secondary processes can be considered without the previous restrictions e.g. texturising or heat stabilising prior to spin/twist zone and twist setting, dyeing, printing after spin/twist zone and prior to take-up.
Traditional and well proven drafting techniques can be utilised with a much higher throughput rate, e.g. up to three times greater than conventional spinning on semi-worsted carpet yarns.
The yarn produced is identical to a traditional spun and twisted structure and therefore, unlike other new yarn producing systems, no special adaptations or techniques are required in further processing.
Similarly, no protracted acceptance trials are required for end users and this too must lead to considerable savings in the yarn producers sales promotion and technical service budgets.

D r e f - OE - s y s t e m . This open end system, developed by Dr. Ernes Fehrer, Linz, Austria is not working with a rotor, as usual in open end spinning.
Although this system is said to be capable of handling virtually all types of fibre, initial information relates to wool and comparisons are made with worsted yarns, but since DREF is put forward for spinning in the coarse count range it may be that the woollen spinning range would be more appropriate.
The basic feed is a sliver, the weight range quoted for spinning wool being 20 to 40 gm./m., of course considerably coarser than the usual cotton card or draw frame sliver range. The particularly interesting factor in relation to the feed, however, is that it is suggested that the sliver should be taken directly from a single swift card without any subsequent drawing.

The principle of the system is illustrated in Figure 6.
The diagram shows that the feed sliver (as noted taken directly from a single swift compact type card) is first passed through a single zone roller drafting system and is then delivered by a pair of feed rollers to a card cylinder oviously analagous to the taker-in of a normal card. It is said that the feed system is specially designed to take care of the drawing and provide effective clamping of the fibres.
The taker-in roller is described as the carding drum and the fibres are thrown off it in succession by means of centrifugal force aided by an air stream from an air jet, it is said.
The opened fibres then pass downwards to a pair of suction drums located below and in front of the carding cylinder or drum (see Figure 2).
According to Fehrer the deceleration of the fibres between the carding and spinning unit (the suction drums) causes the fibres to be aligned across the conveying direction in which orientation they reach the wedge formed between the two suction drums, where they are incorporated into the open end of the yarn being spun. The suction through the surfaces of the drums is localised in the wedge nip.
The two drums rotate in like rather than contrary directions producing a rolling action where they come close together (i.e. in the wedge), and it is said that twist is introduced by mechanical and aerodynamic means supported by the action of an endless rotary spinning belt positioned in line with and off the end of the convergent parts of the suction drums; this belt is not shown in Figure 6.
On leaving the belt the yarn is taken up by a pair of feed rollers and passed upwards to the winding point where it is formed into a cheese by a conventional grooved drum take-up; a cross wound cheese is produced under , it is said, minimal tension.
The yarn produced is said to have a character similar to a worsted yarn, although it would seem that conventional

woollen yarn might well be a better comparison.
Information about the machine was available at the time of the ITMA exhibition held in Milan recently, although no machine was on show. At that time it was suggested that a few problems still remained to be solved, although it was thought that the overall economy of the spinning process and the final quality of the yarn, which was sufficiently voluminous to satisfy to a large extent market requirements of the coarse yarn sector, would provide industrial success.

2. WEAVING

In the past few years weaving has had a successful comeback. Especially the boom in knitwear did not bring about the expected high rates of push-away wovens.
The comeback of wovens is due to their properties, last but not least to those which depend on synthetic fibres and blends. Another reason is that shuttleless weaving stagnating for about forty years has been blossoming for some years.
Shuttleless weaving machines offer weavers improved quality resulting in less wastes, not only in yarn and fabric but in power consumption per unit of production as well.
A wider range of capability is available through weft-insertion mechanisms for handling almost any yarn in any count or denier for almost any fabric desired. And with a world-wide market for loom replacement on the verge of an explosion textile men are turning to shuttleless weaving for fabrics from cotton sheeting to plush goods and carpet backing.
All looms offer increased diversification in working widths for more productivity per loom or more competitiveness per product.
Newer, improved shedding mechanisms permit greater capability for fabric constructions-at speeds never before imagined.
For example: A new type of double-lift Jacquard-machine with rotary hooks, allowing a speed up to 500 picks p.m.

Modular designs and constructions, electric stop-motions, electric operator controls and indicator lighting all contribute to ease of operation. And the fear of inadequate selvages that haunted early models of shuttleless weaving machines is gone-selvage constructions are now strong features as standard equipment. (In fact, most manufacturers offer many types of selvages to help textile men "specialize" the fabrics.)

Shuttle looms: While there can be no doubt that the conventional shuttle loom is losing ground there were still many shuttle looms at the exhibition in Milano (1975).

In general, however, the greatest problem connected with shuttle looms seems to be one of noise rather than any technical or commercial limitations. It seems difficult to visualise how any really important reduction in the noise level of traditional shuttle looms could be achieved.

The trends in shuttle looms at the exhibition can be stated quite simply as a move to wider machines and higher speeds - together, of course, with a growing movement towards electronic monitoring of the shuttle fight, enabeling weft inser on rates up to about 550 m/min.

Gripper shuttles: New types of gripper shuttle looms have been presented, some as a special attachment for converting of classical shuttle looms into projectile weft passing looms with external feeding bobbins.

Probably the best known name in the gripper shuttle field is, of co -se, Sulzer although with their small gripper shuttles or projectiles, its looms are very different indeed from converted conventional looms. Notable however was a loom fitted with a rather heavier-than-normal gripper shuttle to enable it to carry heavy weft of the kind used in upholstery and similar fabrics.

An 197 inch wide loom working at 190 rpm representing a weft insertion rate of 950 m/min was shown.

Rapier looms: The transformation which has taken place in weaving over the last few years is shown quite clearly by the fact that, for exhibition purposes at least, rapier looms are now more prominent than shuttle looms. Various rapier arrangements are of course possible, but it is now much more usual for looms to have two half width rapiers, one at each side; the two rapiers move simultaneously to meet [redacted] in the centre of the loom where now usually the end of the weft pick is transferred from one to the other.
The half width rapiers can be flexible or rigid, the former being perhaps rather more common and generally, for obvious reasons of space, preferred on wide machines. At this exhibition it was noticeable that speeds of the rapier looms had increased, and that some of the rapiers were travelling across the loom while the sley was stationary; such looms were often those working at particularly high speeds.
Some new types of rapier looms showed up, for example with magnetic guide for a flexible rapier (Meteor)
Nearly all types of rapier looms are equipped with multi-colour units and especially in this field of fancy-cloth weaving the conventional shuttle loom will be replaced by shuttleless weaving. It also seems to be a boom in terry-cloth weaving on rapier looms.
Air jet looms: Air jet looms are again attracting considerable attention. Rüti was showing several machines. The Rüti loom has auxiliary jets across the sley. Also the machines of Investa are of interest. The weft insertion rates are now in the range of 800 m/min.
Water jet looms: The water jet loom is, of course, now fully established. Outstanding at Milan, however, in this field was a prototype loom from Ninan operating at no less than 1000 ppm, weaving a 133 cm wide nylon fabric. Maximum reed width seems now to be at 280 cm. Also a four colour jet loom was demonstrated.

Multiphase weaving: These machines represent a second generation in development for shuttleless weaving. The basic principle is logical: Mechanical machine parts can only go so fast and still be able to stand up to the manufacturing pressure of multi-shift operations. So the machines are designed with numerous insertors that move along a progressive wave-shed device for beatup.

In anticipating problems of broken ends, design incorporates pre-winding onto bobbins at tensions higher than those presented during the actual picking operation. So it is likely that the yarn will break before entering the shed.

These multisheds promise speeds in the equivalent range of 750 to 850 picks per minute giving an weft insertion rate of approximate 2200 m/min. The five machines shown, were from Investa, Rüti, Nuovo Pignone, Iwer and Mayer.

The latest Investa model seems as one of the best developed today, said to go into factory production.

The Rüti-machine - the principle remained unchanged - become more like a conventional modern loom in form than earlier models.

A new entrant to the multi-phase, field was Nuovo Pignone which has a completely new machine hoped to be ready for the market by 1977. Based on research carried out in Russia , this loom is not unlike the Kontis in basic arrangement although the details of the weft replenishment system are different. The present model (it was shown in a well-developed form) weaves plain fabrics up to 330 cm. (130 in.) wide at a theoretical weft insertion rate up to about 2.2oo m./min. The beat-up is by a rotary disc.

The ONA-loom by IWER is still seemed to be last described as a prototype. The calculated weft insertion rate is quoted as about 3000 m/min.

A completely new approach to circular weaving, however, was a prototype loom shown by Mayer & Cie (the West German knitting machine makers). This loom is of relatively large diameter and has 32 weft carriers which are charged at one point round the periphery; the weft insertion rate is quoted at 1.2 m./sec. or around 2,000 m./min.

The machine can produce four flat fabrics up to 1.67 m. (66 in.) wide at the same time, the fabric take-up being upwards.

At present multi-phase looms weave only relatively simple cloths, but since these make up the bulk of all fabrics woven, ths limitation may not be too serious even if, as seems likely it cannot be overcome.

You can find a figure, showing the approximate today weft insertion rates in the appendix.

The near future will show, how for the new machines will become hits in textile industry or not.

Ladies and gentlemen, my aim was to tell you something about technical news and I hope I could meet your interest.

I thank you for listening.

Appendix, Fig 1

FLOW SHEET MONOMER TO FABRIC
NYLON • POLYESTER • PVA • PVC • ACRYLIC

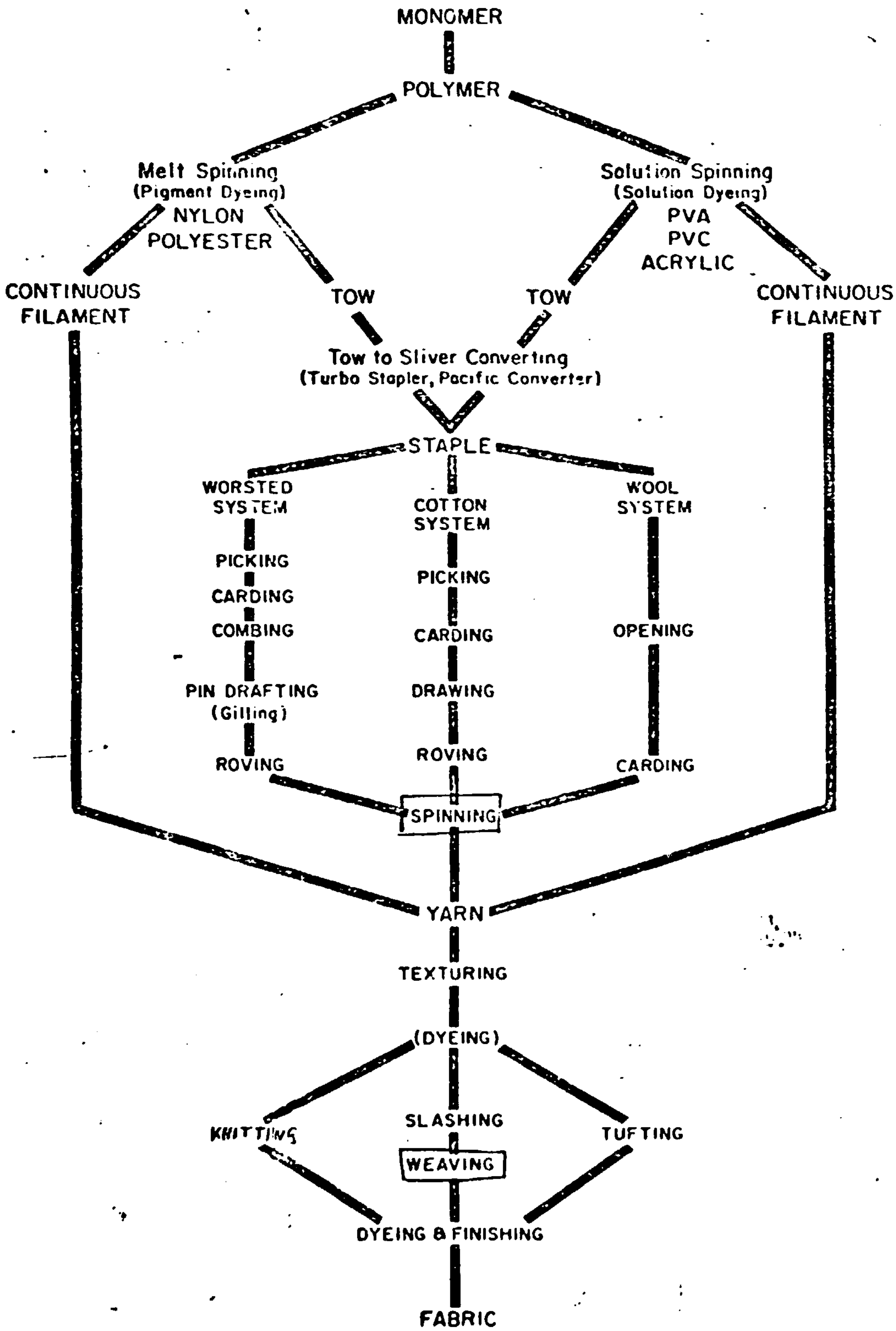


Fig 2 Self-twist

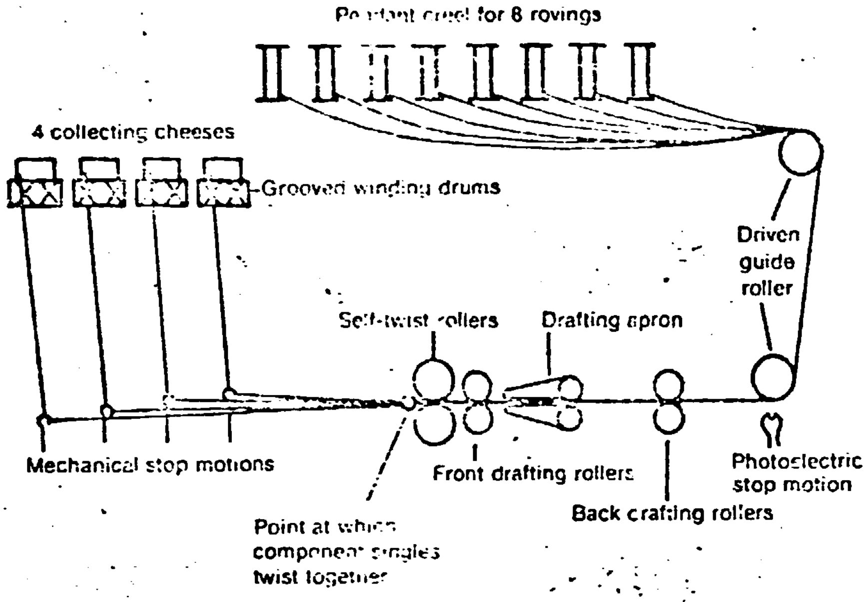


Fig. 2: Diagram showing the structure of the combined synthetic filament and staple wool yarn produced by the Selfil machine. The upper illustration shows the yarn with a single binding filament as produced by the first twisting stage, while below is the completed yarn after leaving the second twisting stage; this yarn, of course, has two filament binders.

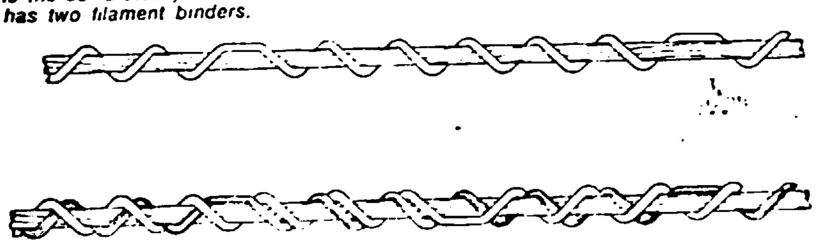


Fig 3 Bobtex

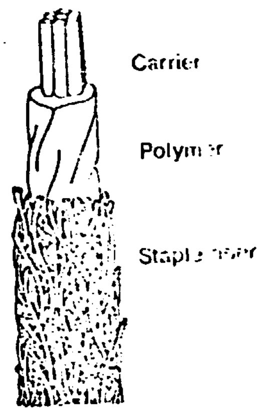


Fig 3a Bobtex-system

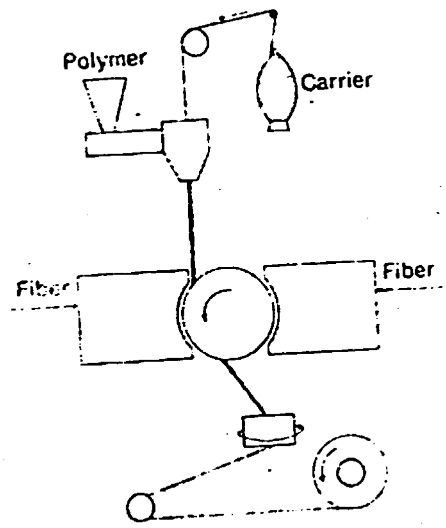
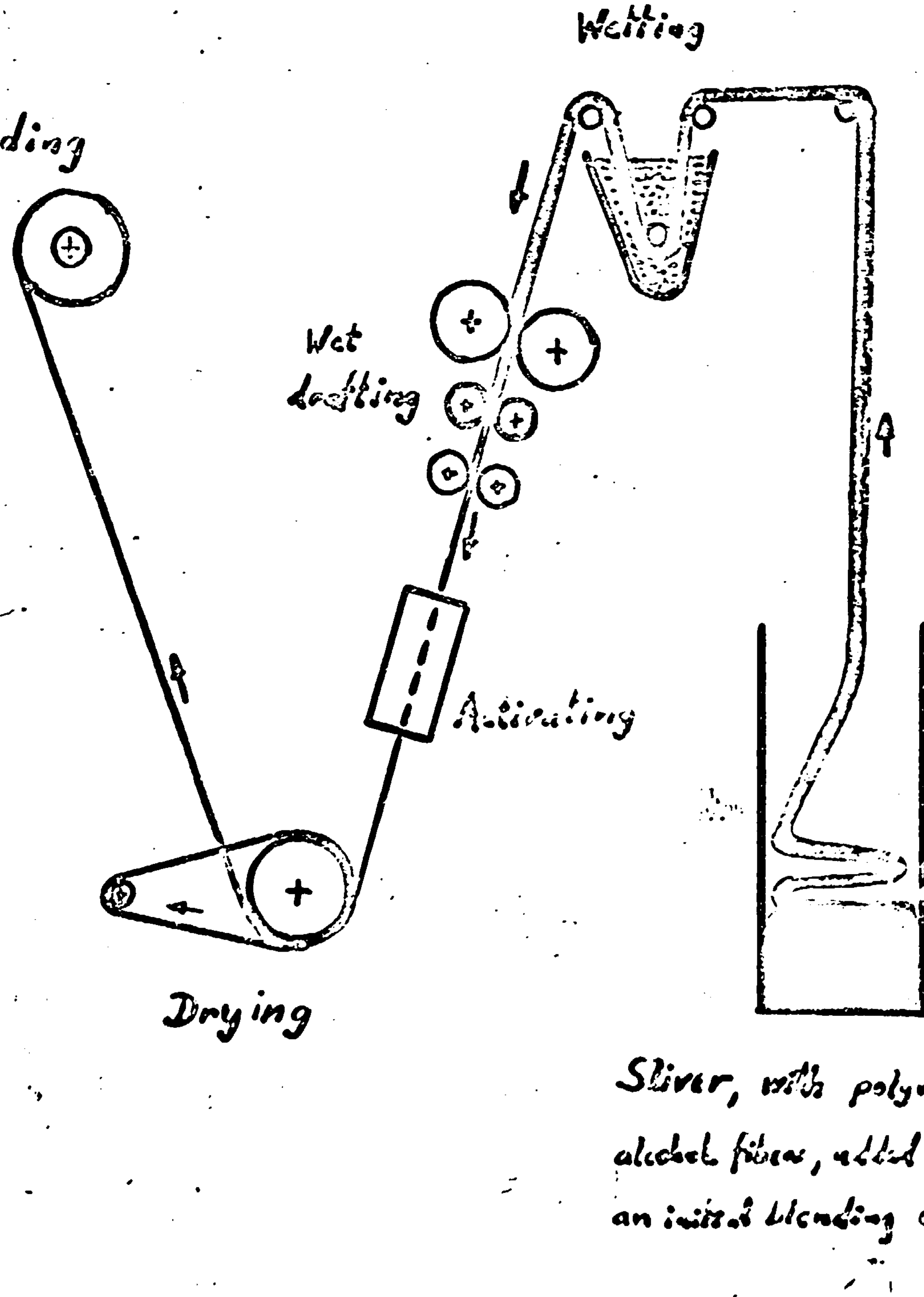


Fig. 4

'Twilo' - Process



Sliver, with polyvinyl-alcohol fibres, added during an initial blending operation

Fig. 57

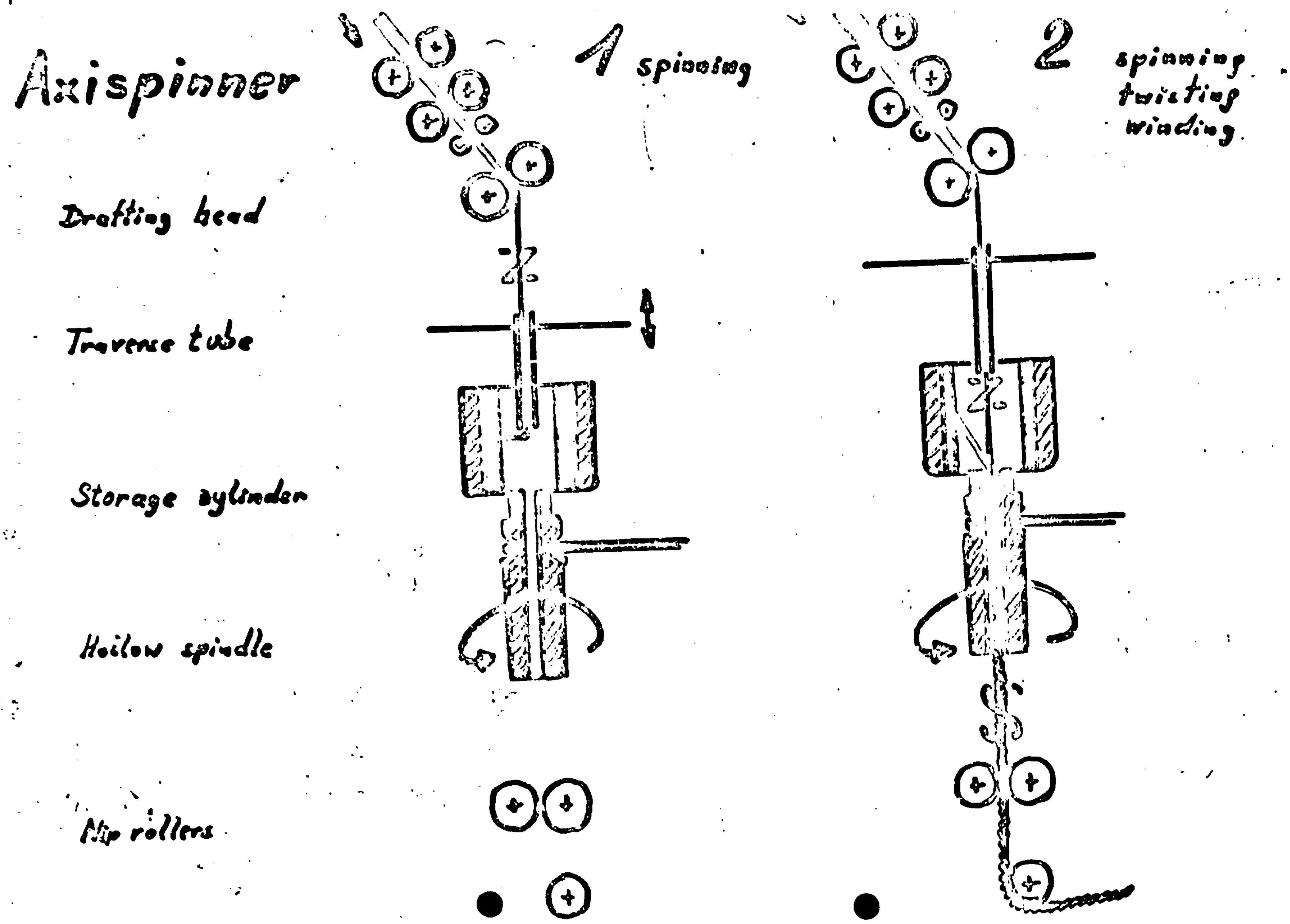

Axispinner
Drafting head
Traverse tube
Storage cylinder
Hollow spindle
Nip rollers
1 spinning
2 spinning
twisting
winding

Fig 6

DREF - System

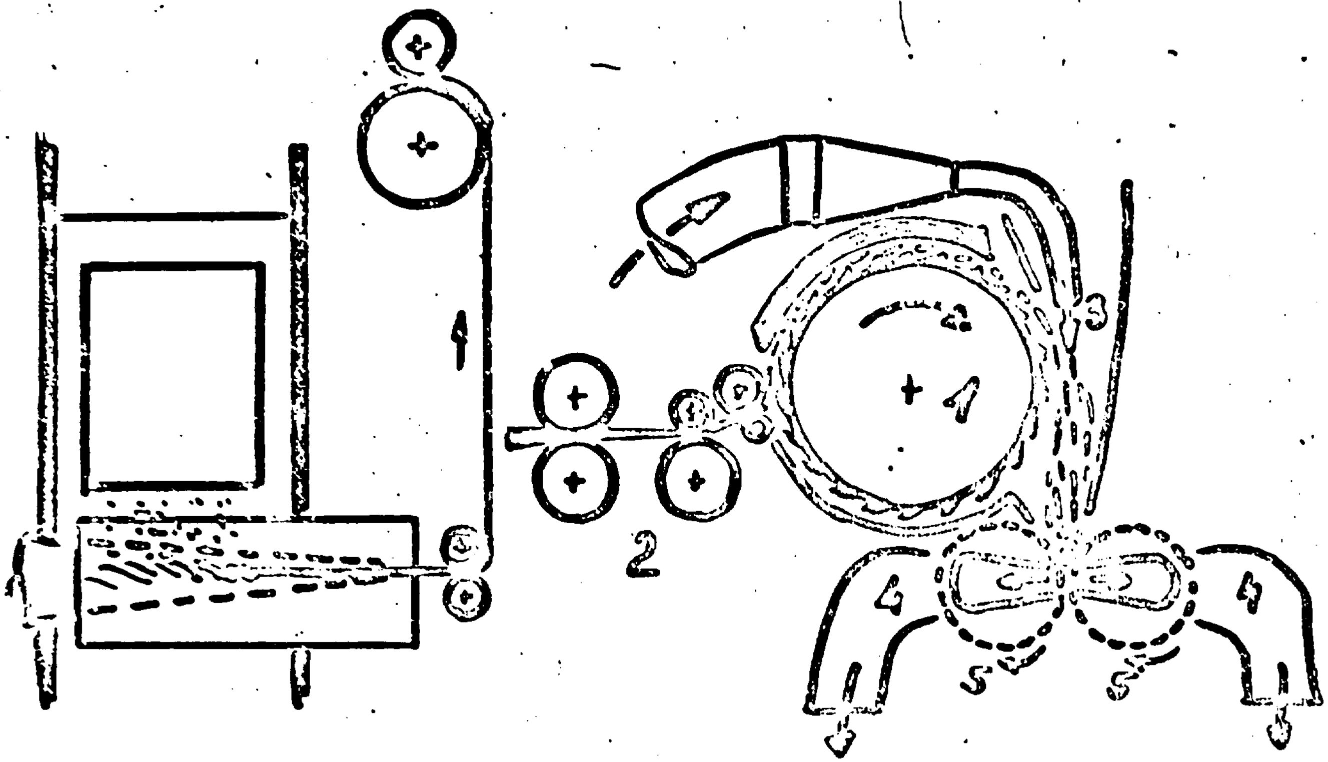
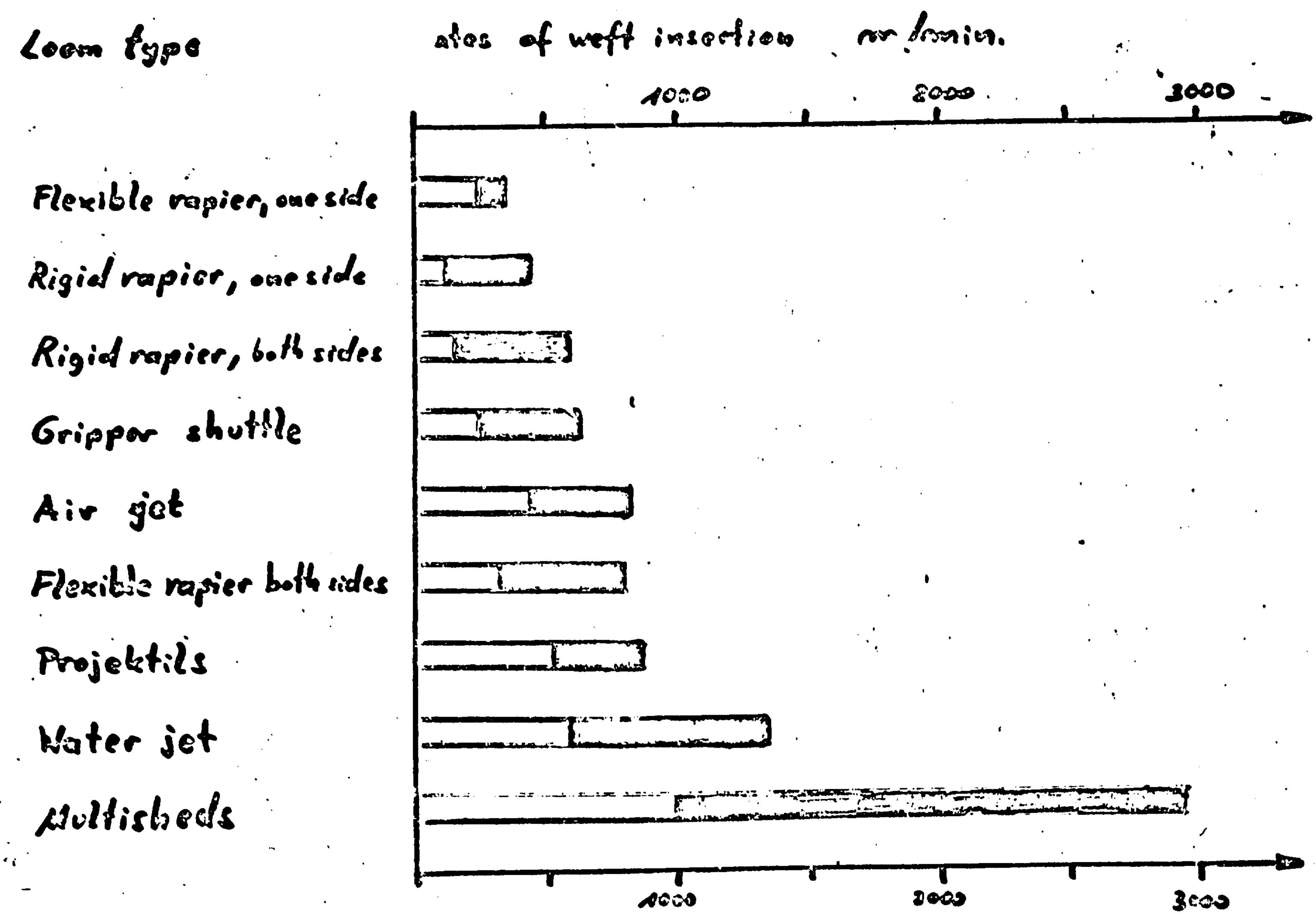


Fig 7


Loom type
ates of weft insertion per/min.
1000
2000
3000
Flexible rapier, one side
Rigid rapier, one side
Rigid rapier, both sides
Gripper shuttle
Air jet
Flexible rapier both sides
Projektils
Water jet
Multisheds