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Autor: Furrer, Alfred J.
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Short-staple spinning processes

According to Rieter's business records, the company has been involved in spinning since 1808. Napoleon's continental blockade with its severe obstacles to trade forced Rieter to make repairs to its English spinning machines between 1806 and 1813. This work was performed in the Töss workshops, initially for the company's own use and increasingly also for associated companies. In-house spinning machine manufacture commenced in 1821 on the basis of the experience gained from this.

therefore perform the functions of commander, manager and supervisor. This situation corresponds almost entirely to the development of modern spinning systems.

If the development in operating speeds at the various process stages is also reviewed, the emergence into the current era of high performance took place in the nineteen-fifties. The following **increases in performance** were made at the various process stages between 1950 and 1994:

Machine	from	to	increase
card	3	70 kg/h	= 25times
drawframe	30	800 m/min	= 25times
combing	100	300 nips/min	= 3times
speedframe	600	1 200 rpm	= twice
ring spinning	10 000	25 000 rpm	= 2.5times
rotor spinning	20 000	120 000 rpm	= 6times

Rieter has developed into a systems supplier and leading specialist with these products and installations.

If the development of spinning machines is compared with advances in automobile engineering, it is surprising to note the similarities. For example, the motor car almost totally lacked «intelligence» at the turn of the century, and transport using the new-fashioned vehicle remained at the level of horse-drawn carts. Drivers were therefore responsible for operating this system intelligently. The motor car and motorized transport have developed up to the present day to the level of artificial intelligence. Human beings

If this is compared with systems used in daily life, such as cars, railways, aircraft, refrigerators and washing machines, performance has generally doubled since 1970. Textile machinery manufacture can, incidentally, certainly stand up to comparison with aerospace engineering. Whereas satellites are built to withstand a maximum of 20 g (acceleration constant), spinning machinery manufacture in man-made fibre technology copes with yarn guide loads of up to 300 g. In three-shift operations with long life expectancies, this corresponds to a multiple of the performance achieved in space technology. Similar examples

could also be offered, for example, from the fields of carding, combing, and ring and rotor spinning. These record achievements have necessitated consistent, systematic planning and hard work. Rieter's engineering operations here made use of appropriate functional diagrams, technical guidelines, R&D planning, etc. Value analyses were performed with external partners for purposes of regular assessment and the necessary constructive criticism, and promising approaches for marketing, design and production were sought with the help of competent advisers.

In the course of organizational changes in the early nineteen-nineties the transition was made from the earlier, steep management pyramid to bulbiform structures with sectoral systems and short management lines.

Rieter's market value was boosted considerably in 1987 by the merger with Schubert & Salzer AG in Ingolstadt (Germany). This company had actually commenced textile machinery manufacture as far back as 1883 in Chemnitz (Germany) with a hosiery knitting machine. At the time of its acquisition by Rieter, the company was regarded as a serious competitor in the spinning machinery sector. The subsequent coordination of product ranges has reinforced Rieter's position on the world market.

The stimulus of exhibitions

Development achievements are measured against comparable products manufactured by competitors. This provides the stimulus for innovations which in turn promote sales. The international textile machinery exhibitions held at 2 to 4-year intervals under the headings of ITMA (Europe), ATME (USA) and OTEMAS (Japan) are of special significance here.

Short-staple spinning

Fibres up to 60 mm long are generally processed in short-staple spinning. Special drawframe designs enable medium-staple fibres up to 70 mm to be spun; these are used in niche markets. Cotton is the preferred natural fibre for spinning. The planting, cultivation, harvesting, ginning and baling of this raw material are among the tasks attributable to the textile sector. Soya beans can also be cultivated to utilize fields more efficiently. This interplay between fibres and foodstuffs influences cotton prices. Synthetic/chemical staple fibres such as those mentioned briefly in the chapter on «Manmade fibre machinery and systems» are increasingly being spun as an admixture to cotton or as an independent raw material.

Finally, secondary raw materials obtained from torn and separated fabrics are used to produce fashionably coarse yarns, nonwoven fabrics, fibre webs, etc. In this field there are synergies with insulation materials such as those used by Unikeller for noise control and thermal insulation.

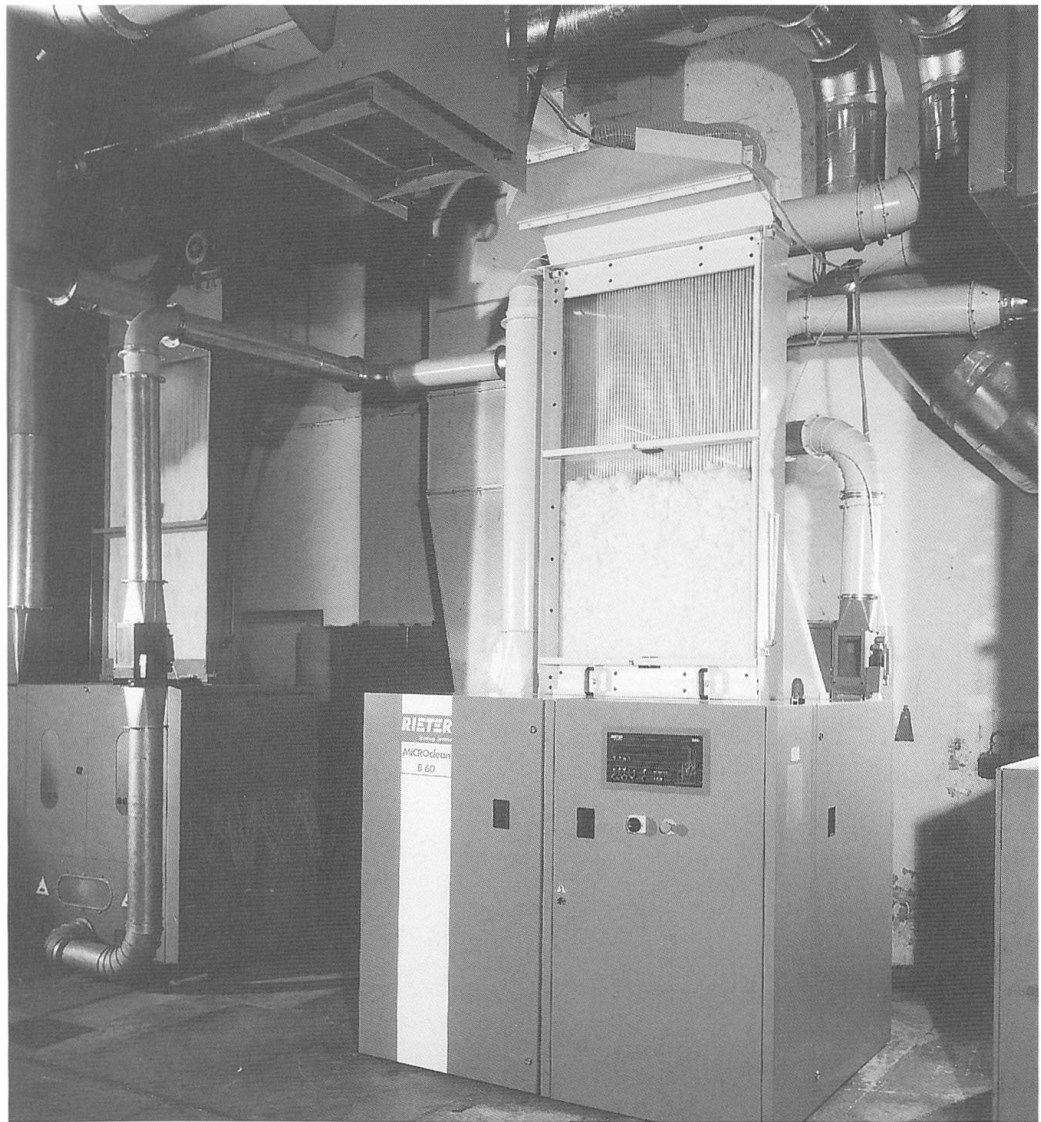
The stages of the process are described briefly below:

Opening and scutching machines; stock feed

The natural or synthetic fibres are delivered to the spinning mill in bales of approx. 200 kg. A wide variety of blends is possible at the feed stage to enable yarns with the most appropriate properties to be spun.

The rotating beater elements of modern opening and scutching machines release open or fixed fibre dust, which is removed by blowing and suction. Vegetable residues and quartz sand are separated out via fixed grids and screens during this process. Flocks of the highest possible cleanliness are produced using machines such as the

The UNIflex B 60 fine cleaning and dust extraction machine



UNIfloc bale opening machines reduce the raw material into flocks of small size.





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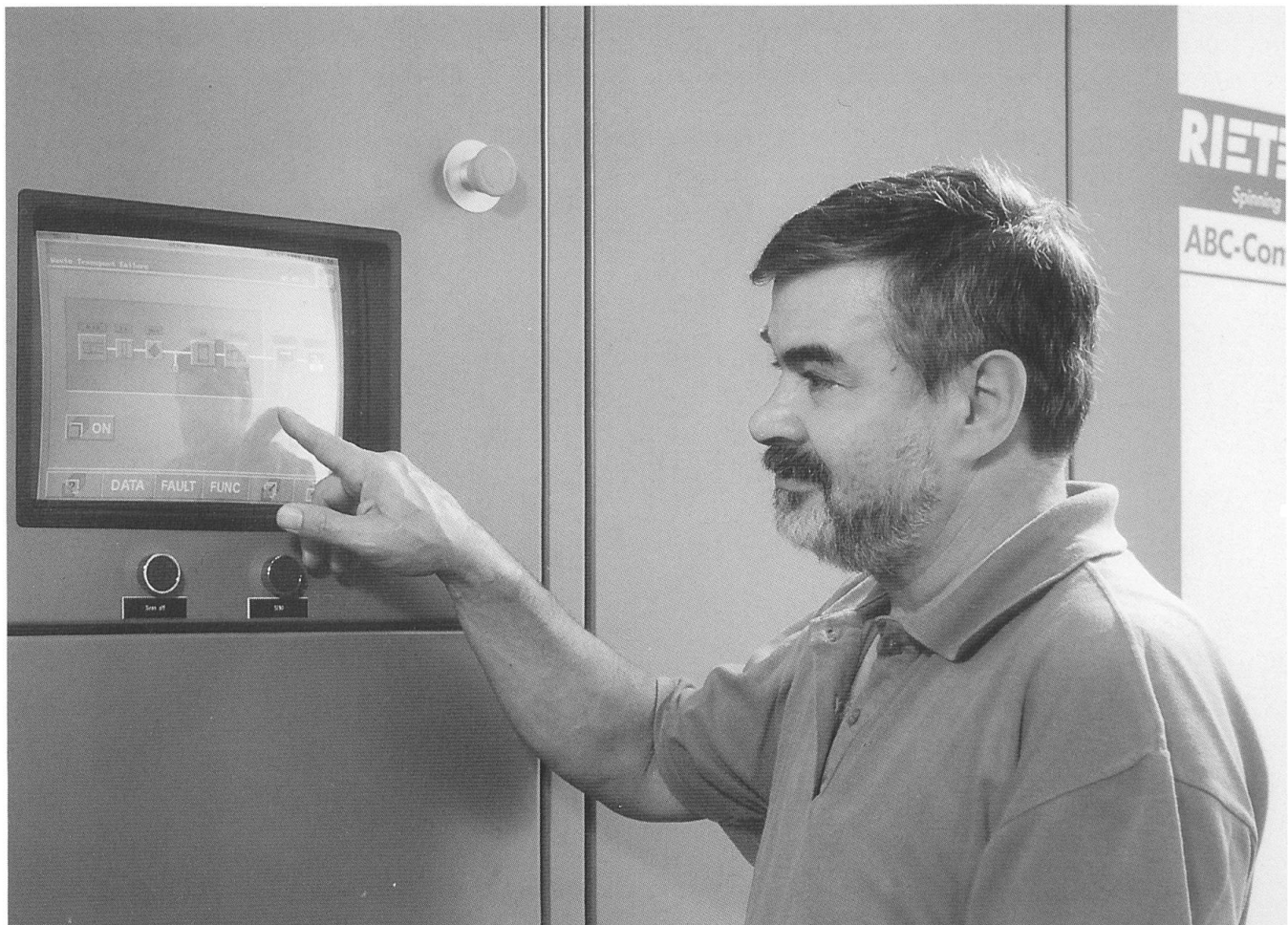
Maschinenfabrik Rieter AG, Winterthur

Verfahren und Vorrichtung zur Messung des Volumens bzw. des Gewichtes von in der Regel nicht gleichzeitig einen Kanalquerschnitt durchtretenden Körpern, insbesondere solchen ungleicher Größe oder Ansammlungen von solchen, z. B. Faserflocken

Hansruedi Lamparter, Winterthur, ist als Erfinder genannt worden

The patent specification for the «Flockmeter»

The modular ABC control system makes provision for customer-specific approaches for all monitoring functions.



UNI-floc A10, the UNIClean B1 or the B4/1 monoroll cleaner, the B3/4 blending opener or the UNImix B7/3, the Contimeter B0/1 fibre metering machine, the B50 or B60 fine cleaner as the successor to the ERM B5 standard cleaning machine, fans, dust and solids separators, etc. Additional systems such as spark monitors, etc., check the safety of the processes.

The classical line of development in blending technology has brought forth the bale opener or blending hopper bale opener, which is loaded by hand with layers of fibre from the bales. The fibre blends depend here on the reliability of the spinning mill personnel. The Rieter Contimeter was the first continuous blending machine which satisfied the high quality requirements in full. Automation of the opening machines using entire bales has been the target since 1950 with a view to improving blends and thus assuring quality. The bale disintegrator thus emerged in the nineteen-sixties as the forerunner of the carousel, which appeared around 1965 and was finally followed by the UNIfloc A1 about 1976. This latter machine satisfied requirements for process flexibility, on-line quality manufacture, and operation with minimum personnel. Via the A1/2 series in 1983, by 1994 its development reached the UNIfloc A10, which could handle four varieties at a maximum of 1400 kg/h.

In earlier times, the classical opening and scutching systems reflected the technology utilized by English machine manufacturers. Manually fed blending hopper bale openers and, for example, perforated cage cleaners, Crighton openers, suction boxes and double scutchers produced metre-wide laps, which fed «pressed» flocks to the cards until the nineteen-sixties. In modern blowing rooms, by contrast, the fibres are converted very gently

from pressed bales into approx. 50 mg (milligrams) flocks suitable for carding. The volume of flocks is metered by the Rieter flock meter, which introduced electronics to opening and scutching operations in 1959. The ducts of the U Aerofeed system, which are free of fibre drag, enable flocks to be fed to the cards with a high degree of flexibility.

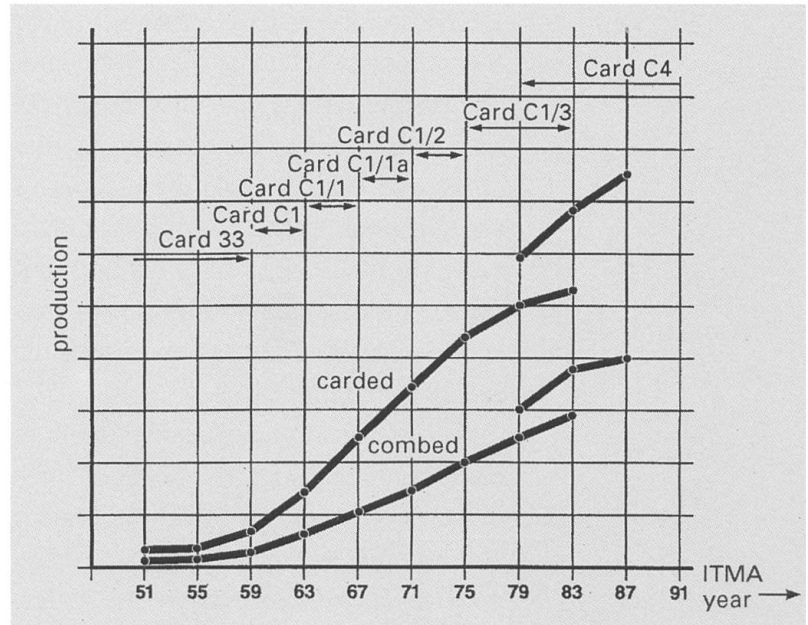
Cards and sliver conveyors

Carding the fibres is the main task of the spinning mill. Fine opening of the stock takes place on the card. The rotating elements of the machine, on which wire clothing is mounted, draw the fibres over blades and clothed bars or segments. Counter-rotating, clothed rollers can also be used instead of bars for longer staple fibres. A narrow gap of 0.15 to 0.2 mm is set for the passage of the fibres between the carding elements. The tips of the precision saw-tooth wires used for the clothing have hardnesses of 800–900 HV (Vickers). They are manufactured with a height tolerance of 0.02 mm. The carding bars or covers are also equipped with clothing in which sharply ground wire staples are embedded in multi-layer materials. The carding process between the high-speed main cylinder of the card and the very slow-moving carding bars, stationary segments or rotating rollers collects non-fibrous impurities, clumps of immature or agglutinated fibres, and removes them. The combing motion parallelizes the tangled fibres for the first time in the spinning process and forms them into a state capable of being drawn. This leaves the card as a very thin fibre web, and at the outlet of the machine is combined into a sliver, which is moved on to further processing coiled in transport cans. The quality of the carding process has a direct influence on the quality of the yarn.

Increase in card productivity

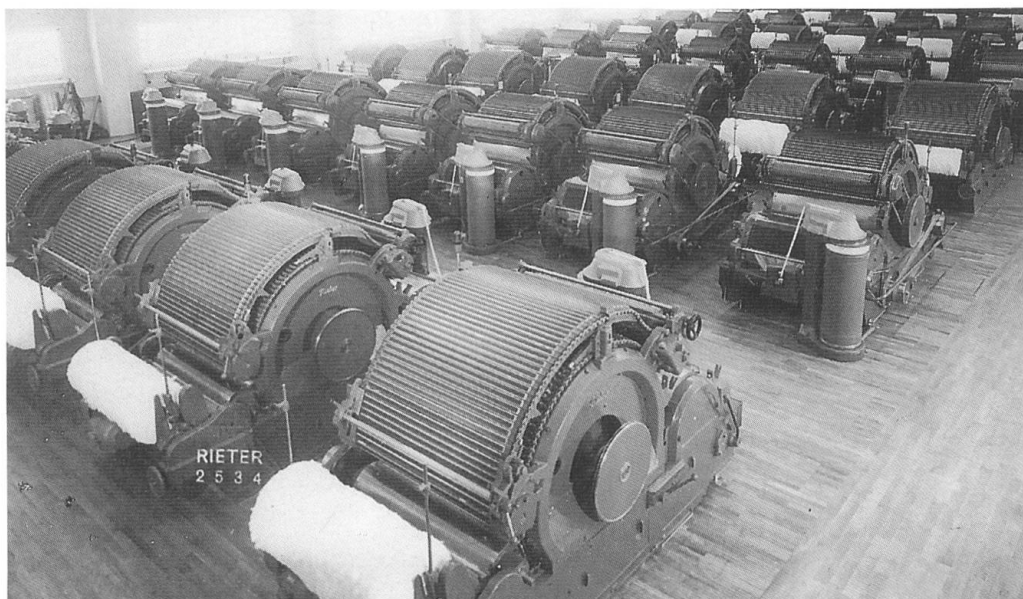
According to the doctrine of spinning technology, the saying: «Properly carded is half spun» is still applicable.

The following **models of cards** have been produced since about 1925:



Date	Series	Cylinder dia.	Cylinder rpm	Output kg/h
until 1932	24	1200	150	1,5–3
1933–1960	33	1000	180	1,5–5
1960–1984	C1	1290	180–250	up to 20 and more
	C1/1	1290	360–450	up to 45 and more
	C1/2			
	* C1/3			
1979–1993	* C4	1290	up to 600	up to 70 and more
from mid-1993	* C10	1290	up to 600	up to 70
ab 1994	* C50	1290	up to 600	up to 80

*) • Optional regulating system for long-term and short-term variations in the sliver
 *) • Sliver coiling for max. 250 m/min. in cans from 600 to 1000 mm in diameter



C1 card in the spinning mill. Version with lap feed ca. 1960

As befits the importance of the carding process, the card is usually equipped with a Rieter long-term and short-term regulating system with a view to achieving high online sliver quality.

The product of carding – the carded sliver – is deposited at 100–250 m/min. in transport cans, which are moved on castors. Since the nineteen-seventies these cans have grown from a maximum diameter of 300 mm to 600–1000 mm. Large amounts of capital are thus tied up in the material containers for the process. A sophisticated operational management organization must therefore ensure rapid throughput with automatic conveyors.

Direct belt conveyors were also used at an earlier development stage. The carded sliver was then fed to a buffer, the C7 sliver storage unit, and from this via a conveyor belt preferably to an autoleveller. The rise in card delivery speed to 150–250 m/min.

meant that this approach became increasingly less suitable due to the intake speed of the drawframe (only some 100 m/min.).

Combing machines and lap handling

Natural staple fibres such as cotton contain short fibres which are not fully incorporated in the spinning process. They thus protrude partially from the bundle and affect the hairiness of the yarn or cause pilling in the fabric. Short fibres are now combed out on the combing machine. The proportion combed out is between 10 and 18 percent (14 to 18 percent with full combing and 10 to 12 percent with semi combing). This creates the prerequisites for producing top quality yarns. Even 15 to 20 years ago the combing process was subject to wide fluctuations in demand. More recently this interplay has given way to an increase in demand. This is probably due in

The C50 card is the latest model in a successful series.

Inset: With the side panel removed, the robust drum bearing and multiple air extraction facilities are visible.



part to the warmer climate and the increase in the air conditioning of premises and vehicles, with the consequence that lighter clothing is being worn. However, the influence of current fashion maintains the relationship between carded and combed yarns, textured filaments and natural silk.

Technical advances in combing machinery

Rieter can look back on three generations of combing machines.

The 15 Series combing machine, built in accordance with Joshua Heilmann's inventions in 1846, operated very successfully around the turn of the century with 80 nips/min. The improvements made by John William Nasmith between 1895 and 1925 made a significant contribution to this.

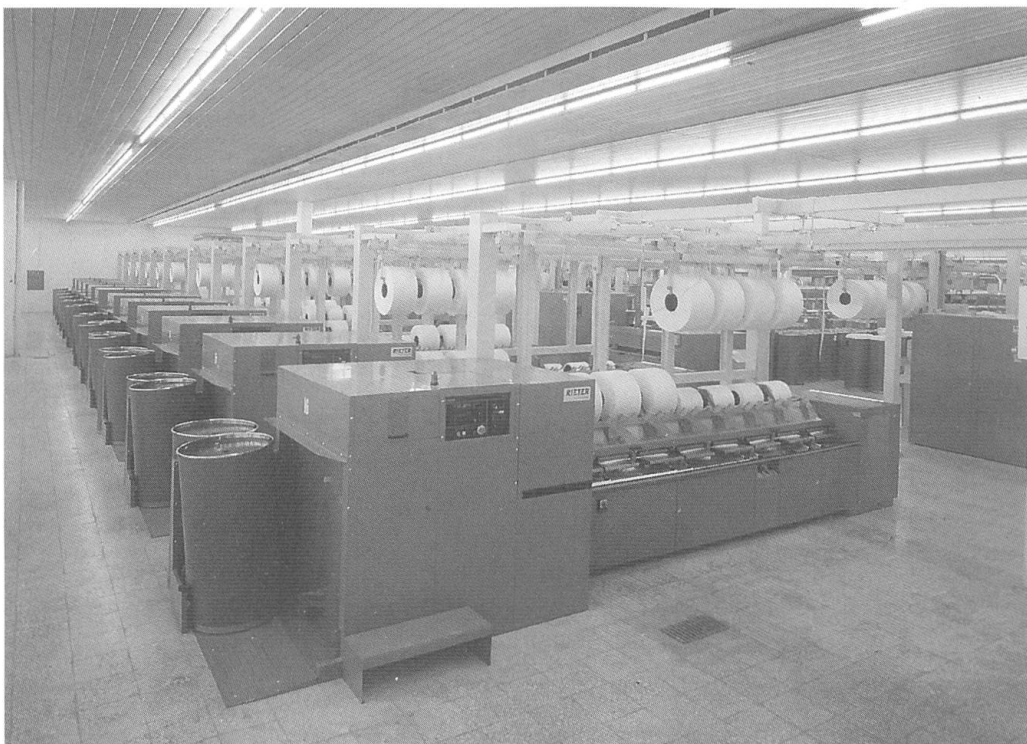
The follow-up model was the 39 Series combing machine. This in-house design, which increased performance to 120 nips/min., also achieved recognition in mill operations.

Finally, we come to the technological leap made in the nineteen-fifties,

ushered in by the American Whiting company with its Model J comber, a completely new design which achieved 160 nips/min. Rieter analysed this innovation, discovered its weaknesses, and responded with its E7 combing machine, which operated at 160 to 180 nips/min. and was systematically developed to full mill maturity. The subsequent E7/1–E7/6 models bear witness to the company's success as world market leader in terms of production, quality and sales volumes. The 350 nips/min. run nowadays are still the target being aimed at by Rieter's main rivals, but Rieter's development work is continuing.

The entire combing process is based on balanced combing preparation. Two main processes are customary in this field of operations:

- Ninety percent of the installations supplied are intended chiefly for vertically integrated operations which control the process from the raw material through to the store counter. The flow of fibres passes via card – drawframe –



E7/6 combers with lap transport

UNIlap 3 (sliver lap machine) – comber – autoleveller, etc.

- Rieter supplies the remaining ten percent of preparation lines for top-quality yarns, i.e. for commercial spinning mills. Here the machine sequence is: card – UNIlap 2 (blower and spreader) – UNIlap 4 (ribbon lap machine) – comber – autoleveller.

Until around 1975 the E2/4 blowers and spreaders for lap weights of approx. 60 g/m, package weights of some 15 kg and delivery speeds of up to 65 m/min. were regarded as classical preparation machines. The follow-up machine was the E4/1 ribbon lap machine with similar performance statistics. A further leap in development at the end of the nineteen-seventies was made possible by massive research effort in lap formation. The new generation – UNIlap E5/2 (blower and spreader), UNIlap E5/3 (sliver lap machine) and UNIlap E5/4 (ribbon lap machine) – currently operate with lap weights of up to 80 g/m, delivery speeds of up to 120 m/min. and packages of up to 25 kg.

These huge increases called for the E6/4 conveyor system to make operations more user-friendly. This system links preparation operations with the comber. Its extensive automation reduces the heavy work involved in package handling to a reasonable level and supports quality targets.

Finally, a reference to the short fibres combed out in the process – the combing noils – which are supplied as valuable secondary raw material to OE rotor spinning operations for coarser yarns, processed into heavier yarns in the ring spinning process, or extend appropriate fibre blends as a filler component.

Drawframes

In the spinning process, drawframes are used to ensure uniformity of the slivers and improve the parallel orientation of the fibres. Six slivers are usually fed in and then drawn to six times their length. This compensates for the periodic faults in combing. The drawing process also extends front and rear hooks of the individual fibres. These drawframe slivers are thus used

Combing room with UNIlap units and lap transport



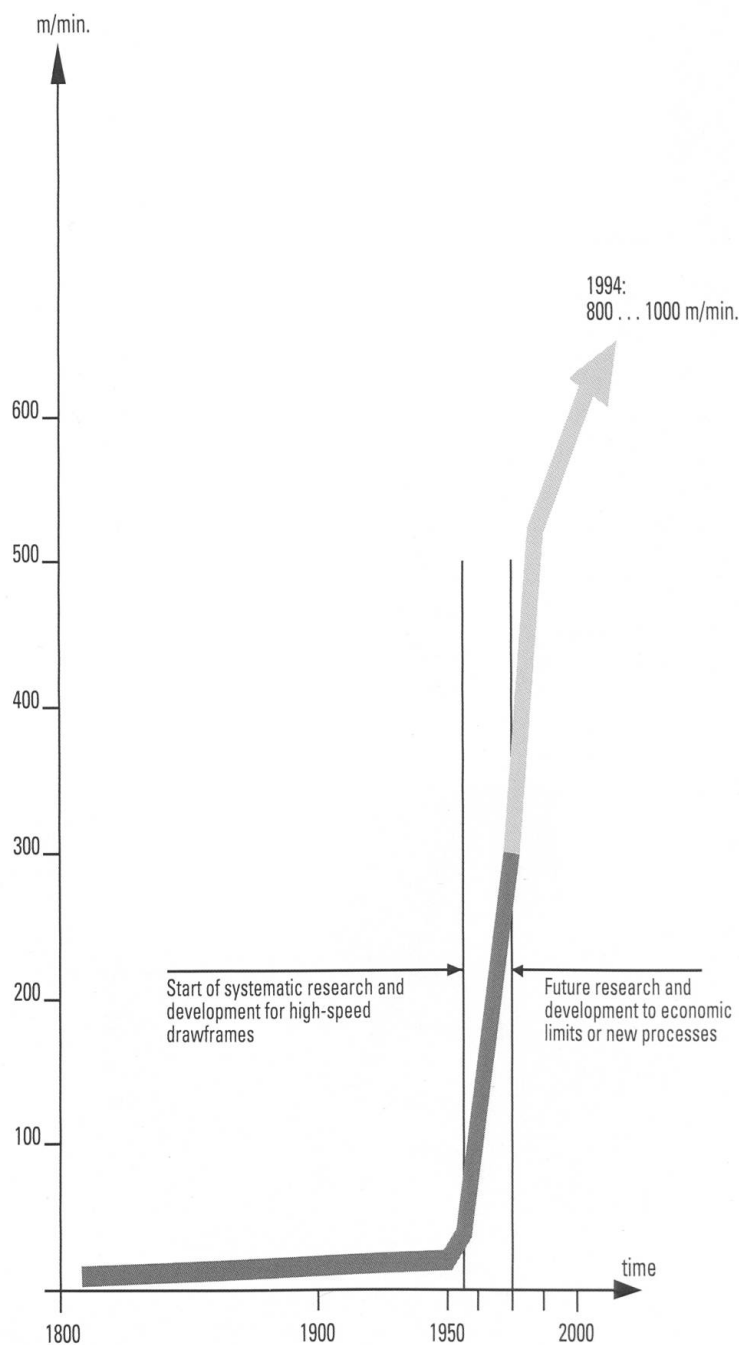
for the classical process with speedframes and ring spinning frames, OE rotor spinning and direct sliver-to-yarn spinning. Historically, the drawframe is the oldest machine manufactured by Rieter. By analogy with French terminology, it bore the name «laminoire» in the classical spinning mill. Over many decades of development the drawframe grew from a single-head version to an eight-head machine in the 44 Series. Its numerous variations have been further increased by twin versions. The rise in operating speed reflected advances in manufacturing assembly and bearing engineering. Current speeds of 800–1000 m/min. developed from the original delivery speeds of 10 to 20 m/min. in the 19th century. Production performances have therefore been achieved which require coordination within the process as a whole. Rectangular drawframe cans which permit long running times due to the density of the feed sliver have been developed since 1990 for feeding OE rotor machines.

New partner Schubert & Salzer AG added its drawframes to Rieter's technology package in 1987. The simple SB 51 and 52 models from Ingolstadt and the RSB 51 and 851 autolevellers carried the day against the sophisticated Mechatronic features of Rieter's latest D1 model. Ingenious, robust simplicity was thus reflected in market success. In autolevellers the objective was again to aim for «as good as necessary» online quality, since refinements in the drawframe sliver were unlikely to pay off in the process as a whole.

Speedframes – Ring spinning frames – Ring twisting frames

This set of machines is one of the oldest stages of the mechanical spinning process; its origins go back to hand spinning and the spinning wheel.

Rising productivity of cotton drawframes





44 Series drawframes in the spinning mill

Drawframe models

Date	Model	Specification	Operating speed in m/min.
until 1959	34 Series	sliver drawframe	20–50
	44 Series	2–8 heads	
	DB Series	sliver drawframe	
	DZ Series	double sliver	
from 1959	D0, D0/1	sliver drawframes	up to 200
1961–1985	D0/2	sliver	up to 300
1969–1972	D7/1	autoleveller	up to 300
1971–1982	D7/2	autoleveller	up to 300
from ca. 1975		can dia. at delivery up to 600 mm can dia. at feeding up to 1000 mm	
1973–1985	D0/5	sliver drawframe / 1 head	up to 500
1978–1991	D0/6	sliver drawframe / 2 heads	up to 500
1982–1992	D1/1 D1/2	sliver drawframe / 1 head	up to 800
		sliver drawframe / 2 heads	
from 1987	SB 51	sliver drawframe / 1 head	500
from 1993			up to 1000
from 1987	SB 52	sliver drawframe / 2 heads	500
from 1993			up to 1000
from 1987	RSB 51	autoleveller	600
from 1994	RSB 851	autoleveller	up to 1000



Due to the influence of modern processes, speedframes and ring spinning frames are those sectors which have probably been declared defunct and resurrected again more often than any other. If speedframes and ring spinning used to be notorious as «anti-automation», Rieter's achievements and/or acquisitions in the past twenty years have made them into successful lines which have gradually regained top rankings. They are regarded as shining examples of the systematic concentration of resources, and have provided Rieter with tough, but nevertheless very digestible daily bread.

The speedframe – the spindle roving frame – produces the roving or slubbing for the ring spinning frame. In Rieter's recent history the 23 Series speedframe was produced until 1935. The 35 Series in particular was used until 1969 in versions ranging from fine speedframe FN to intermediate frame MN and slubbing frame GN/GS. Machines for finer rovings

did not initially come into consideration. The F3/1 speedframe, which was first unveiled as a state-of-the-art innovation at the 1979 ITMA, was intended to be the great leap forward. However, the expected flyer speed of 1800 rpm, the total textile air management, the electronic motion control and the high degree of automation were an overloaded programme which, like the new design launched in the eighteen-forties, could not be completed within a reasonable period of time and had to be cancelled. Incidentally, at that time twenty innovations were simultaneously being developed. All resources were finally concentrated on the new D1 high-speed drawframes and M1 rotor spinning lines. The speedframe gap was then bridged with the improved F1/1 Series, which produced excellent technology with 120 spindles and 1300 rpm with stand-up flyers. This was superseded in 1992 by the F4/1 Series, which had come into production in 1988. With a maxi-

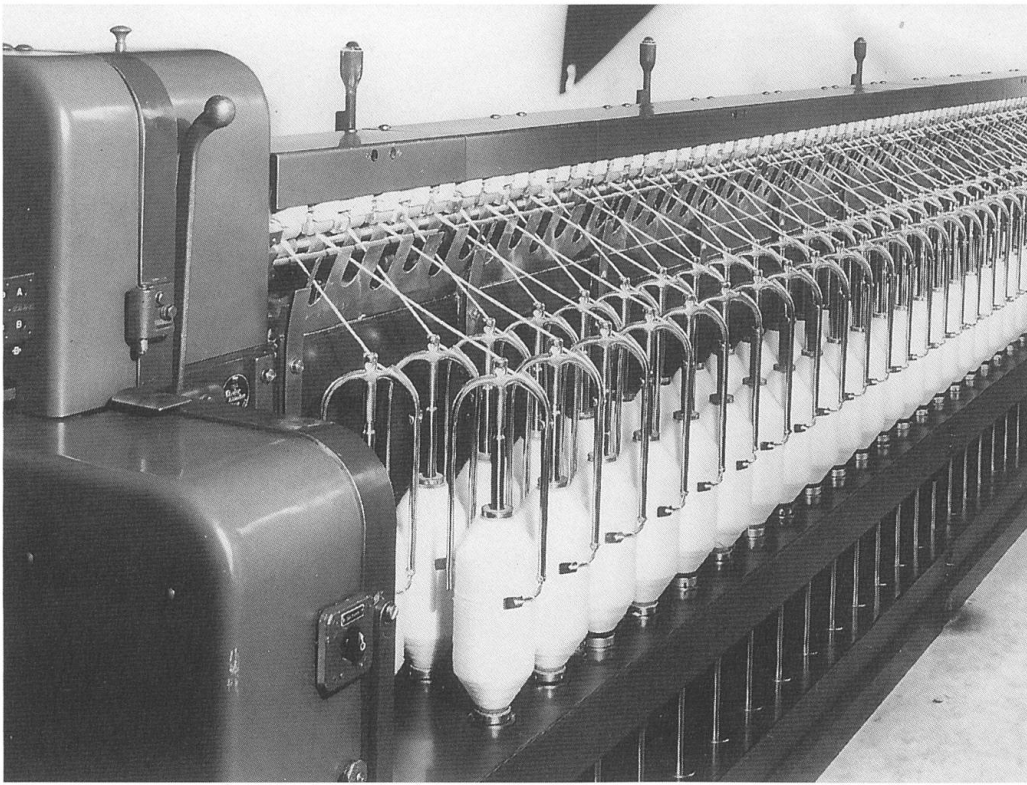


F1/1a speedframe with 355x178 mm (14 in. x 7 in.) packages and cast aluminium flyers ca. 1990

imum of 120 spindles operating at 1300 rpm, it had a carriage-borne doffing aid. Bottlenecks were overcome by a partnership agreement with Marzoli. Finally, the F5 Series with 120 flyers operating at a maximum of 1500 rpm also became available in 1992. The hard labour involved in changing packages was very much reduced by the integrated doffer. Toothed belts for driving the flyers kept the machine's noise level within bearable limits.

These machines were followed in the spinning process by the G ring spinning frames which Rieter, in contrast to its competitors, equipped with components produced in-house, such as spinning rings, travellers and drawframes. This proven and well-balanced design has been modernized systematically in many small steps in recent generations. This resulted in slim-line machines which were a mere 600 mm wide across the spindle axes. The four-

spindle belt drive has been able to hold its own against modern tangential belts, since it requires about 25 percent less energy. The flexible main drive has been modified from interchangeable belt pulleys via V-belt variable drives to frequency controlled drives and the power consumption guaranteed in a limited space. The integrated doffer considerably facilitates package change, and robotics made its breakthrough with the Robofil thread piecer with splicer for knot-free yarn, and the Robocreel. Systematic development of rings and travellers resulted in a maximum spindle speed of 25 000 rpm. The hybrid machines with smaller packages and total integration with winding machines abruptly increased the profitability of ring spinning. Further developed double apron drawframes and balanced thread run geometry brought the main objective of zero broken ends within realistic reach.

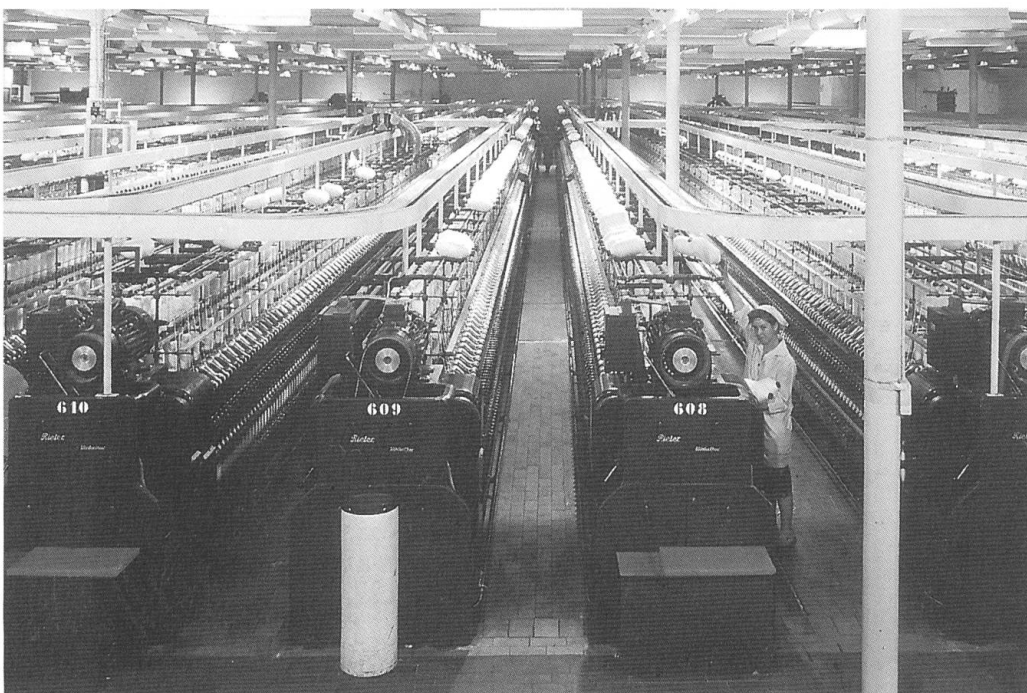


GS speedframe with forged steel flyers

These key statistics for ring spinning in our jubilee year completely overshadow the figures of the nineteen-fifties, with – for example – 10 000 spindle rpm and 20 m/sec traveller speeds. However, they also evoke memories of developments such as the Hebucofil extractor system for broken ends and fly fibre, which was ready for sale at a time when Rieter customers in general were not prepared to invest

heavily in overall textile air management.

If we look at the sequence of ring spinning frames in this century, the chronicle starts with the 18 Series, which was on sale until 1951. The subsequent 31 Series, the first with a moving spindle rail, met with an encouraging response on the market. The moving spindle rail was an important selling point. The G3 and G4 Series of



Ring spinning mill with G4 Series and overhead blowing systems for the machine cleaning, ca. 1960

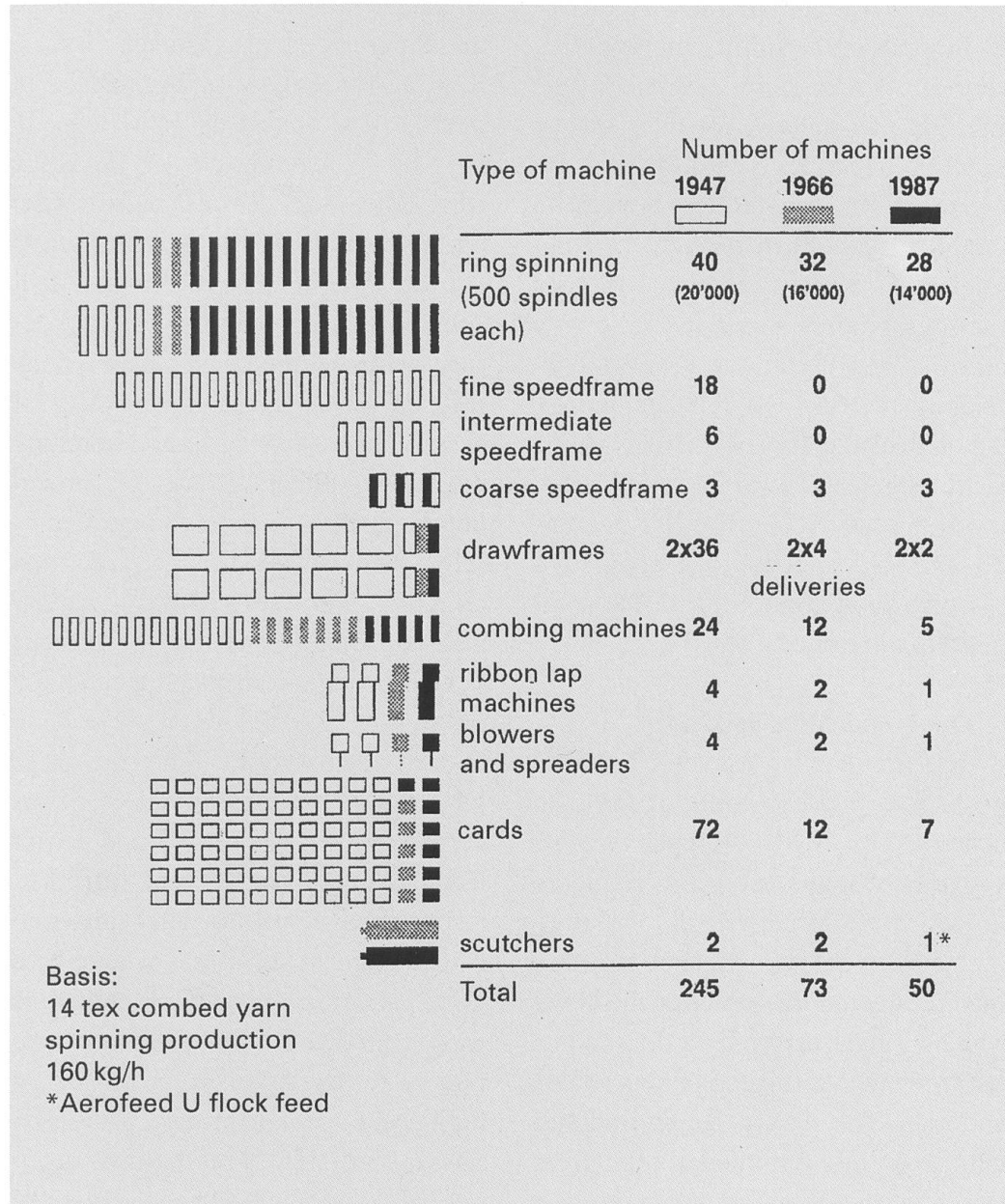
ring spinning frames, the latter once again featuring a moving spindle rail, superseded the 18 and 31 Series, and were in use until 1965 and 1962, respectively. The G0 Series was on sale until 1982. Production of the G5 Series ring spinning frame, which was operated with a high level of automation as the G5/1 or G5/2, began in 1979. The hybrid version which significantly improved efficiency with package transport to the integrated winding machine, was also available from 1984. The Rieter integrated doffer for automated package change has been available since 1972. Many customers also upgraded their G

Series machines with Maier carriage doffers.

Recently the G30 Series with doffer and frequency controlled main drive has ushered in the new generation of ring spinning frames. Successes in the field to date point to a profitable future for this innovation.

Attention can also be drawn to specialities in the field of ring spinning, such as the Cutdrafil cut-and-spin process. This process is described in the chapter on long-staple fibres and requires no further mention here. Reference can also be made to direct sliver-to-yarn spinning, which converted light drawframe slivers precisely and

Changes in the number of machines in a spinning mill for combed yarns between 1947, 1966 and 1987



directly into coarse to medium yarns via adapted drawframes. In the case of this speciality Rieter confined itself largely to comparative laboratory tests and relinquished the market to the German Pfenningberg company and others.

The quality of the ring spinning yarns and the profitability of automated hybrid systems mean that the ring spinning process cannot be looked upon as obsolete. Furthermore, the quality and flexibility of the ring spinning system are still exemplary for all new spinning systems.

In the period between 1918 and 1966 Rieter, like many of its rivals, also manufactured ring twisting frames. These incorporated the drives and frames of the similar ring spinning frames, which were equipped with twisting mechanisms for their special function. The J2 Series, a new in-house design, was the last attempt to retain a foothold in the ring twisting market. Finally, it was acknowledged that this process was a niche activity and that the trend was towards two-for-one twisting, so this technology was left to the specialist firms in the field. This withdrawal from ring twisting was accepted by Rieter's customers and also improved the company's existing good relations with the competitors concerned.

Open end rotor spinning

The first patents for rotor spinning go back to the beginning of the 20th century. The first prototypes of what was then still an unconventional technology were produced in the mid-nineteen-sixties by Rieter's research laboratories. In this process, the sliver was no longer drawn by a drawframe, but by means of spiked opening rollers and nips. The system fed the individual fibres into spinning rotors, from which twisted yarn was removed via a

central outlet tube. The open yarn end which gave the process its name was therefore in the rotor. The cross-wound bobbin was chosen as the most efficient yarn package. This started cut-throat competition on the market between «spinners and winders». The manufacturers of spinning and winding machines did battle over patent protection for the relevant know-how in bitter legal disputes. This presaged the conflicts between the rival parties to maintain their positions.

The leading manufacturers of spinning machinery, who knew and respected each other from the international textile machinery exhibitions and symposia which they all attended, already conducted a useful exchange of experience on research issues. Regular meetings also took place at international standards gatherings, in the TC 72 committee of the ISO, which Rieter has chaired since the ISO was founded in 1948. Technical terms and definitions have been standardized in this cooperative work. Very successful agreements have been reached on standard dimensions, for example for sliver cans and spinning tubes. An understanding on procedural questions therefore suggested itself. Well aware of the fact that research and development require time and money, and that these needs were growing as advanced technology progressed, the OE issues were dealt with in a consortium. From the range of fair competitors, Platt (UK), Schubert & Salzer (Germany) and Rieter (Switzerland) finally got together. Rieter's participation also included Elitex (Czechoslovakia), which held significant basic patents. Negotiations were conducted with accessory suppliers - for example, on the subject of high-speed rotor bearings, with SKF, Süssen and INA. This narrow selection of consortium partners provoked

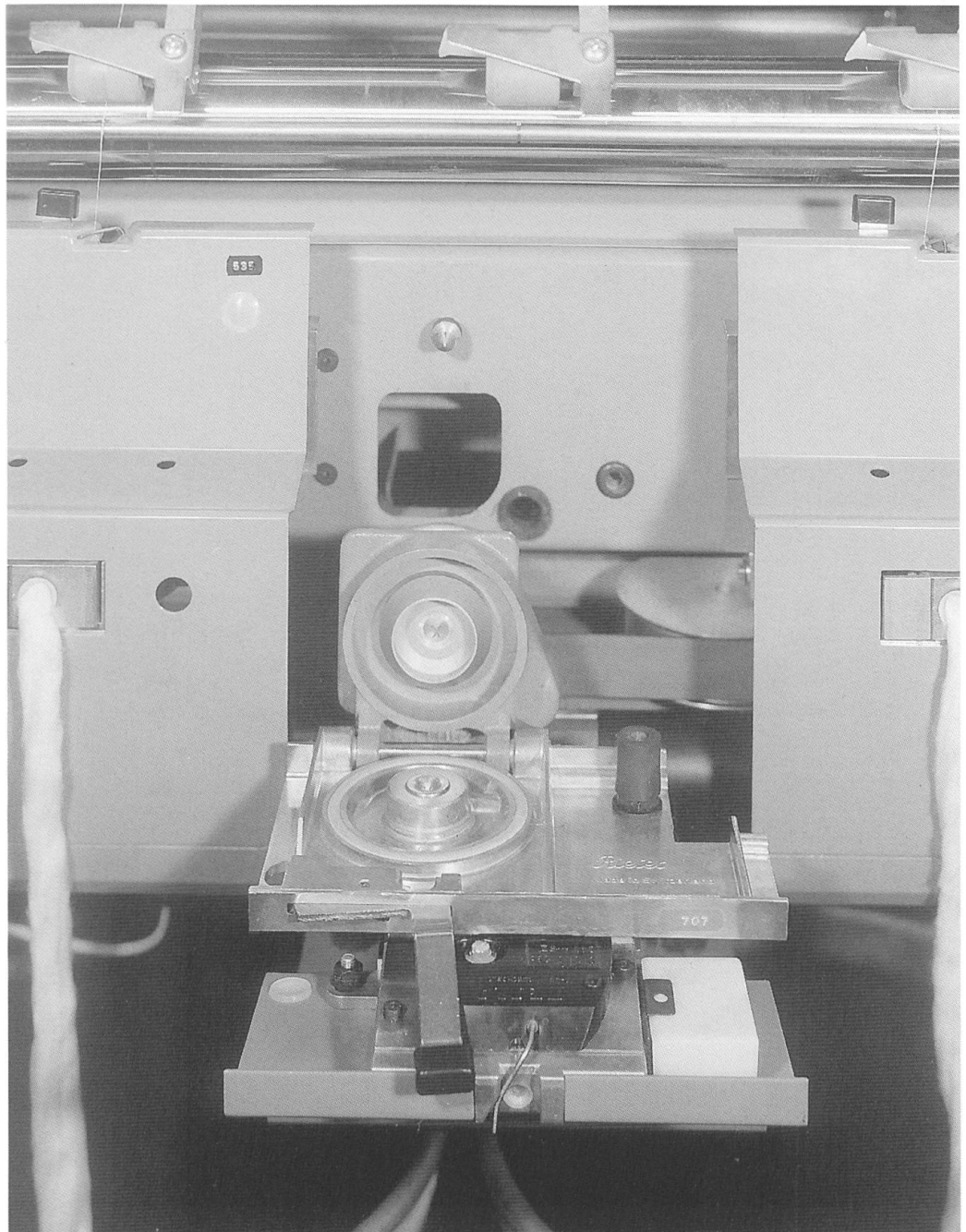
subsequent attacks on patents and related lawsuits. Bearing supplier Süssen in particular sought contacts with other manufacturers after being excluded from the consortium and pursued a very aggressive patent policy vis-à-vis Rieter. Although Rieter finally won and was compensated accordingly, the payments could not replace in full the loss of reputation which had been suffered.

In retrospect, the consortium sought to bring together joint know-how efficiently to obtain joint patents. This was aimed at speeding the pace of R &

D and establishing links across the EFTA/EC divide. Joint, efficient material procurement in order to cut costs was not ruled out. However, in order to conform to legal requirements, a precondition was that the subsequent products of the companies had to bear their independent technical signatures.

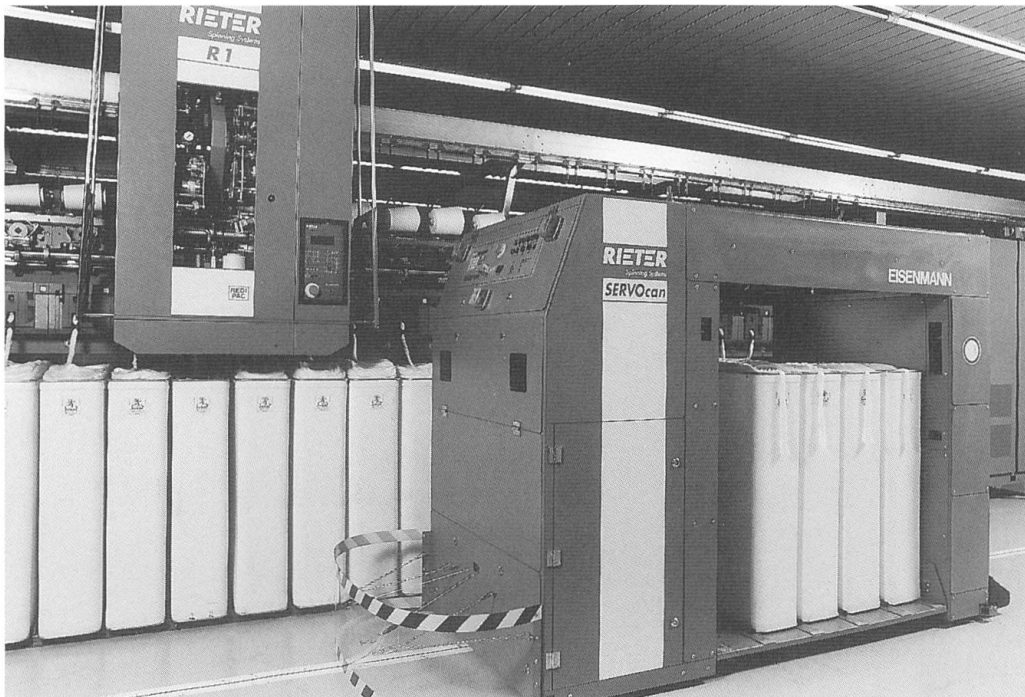
A glance at the development history of rotor spinning reveals initial prototypes in the nineteen-sixties, which were used primarily to gain experience. Major production efforts involved the M0/5 Series between 1972 and 1979, while from 1975 to 1988 it was

M1/1 OE rotor spinning machine with a universal spinning box for all fibres up to 60 mm long

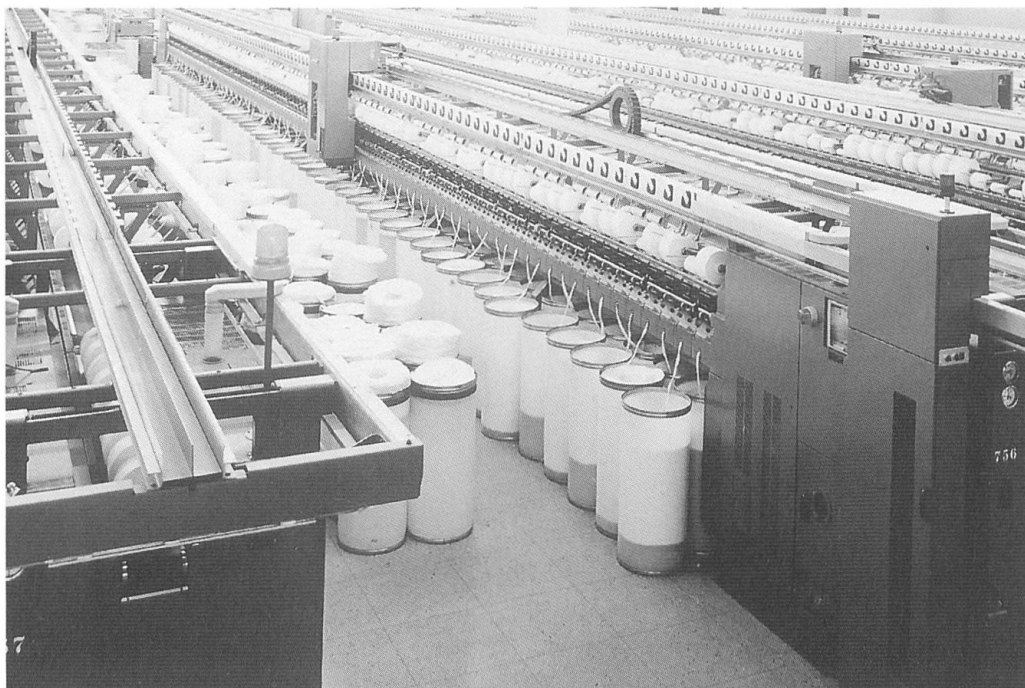


the M1/1 on which automation problems, especially thread break piecing and package changing, were solved together with specialists from Schweiter, which subsequently became Rieter Automatik. The M2/1 Series was in operation from 1983 to 1988. As a result of the acquisition of Schubert & Salzer the SSI models were preferred as technically superior. In this new SSI OE range the RU 04 was the manual machine for 100 000 rotor rpm. However, the main focus of interest was the

SPINCOMAT RU14 and the RU14-A. These extensively automated models operated at 100 000 rpm with rotors which had a minimum diameter of 32 mm, were equipped with Spincontrol machine controls and had two automatic travelling units for thread break clearance and package change, as well as the tube loader for supplying yarn bobbins. Finally, in the battle against the company's main rival, the top model R1 was produced, which in addition to the advantages of the



RU14 SPINCOMAT rotor spinning machines (bottom) and the advanced R 1 rotor spinning machine with CUBIcan system (top)



RU14-A achieved a maximum of 130 000 rpm with rotors only 30 mm in diameter and utilized the space under the machine especially efficiently with rectangular cans.

As regards the rotor drives, the subject of important patents and legal action, three versions were under discussion in the course of development:

Direct bearing support with tangential belt drive was a component part of Rieter's M generation. These INA super bearings for a maximum of 100 000 rpm were regarded as an outstanding piece of engineering, but also involved risks.

Direct rotor bearing with individual motors, pursued doggedly by Brown Boveri (BBC/ABB), a scientific flight of fancy which underestimated the start/stop behaviour of the system and the textile dust in continuous operation, and wore itself out on this problem.

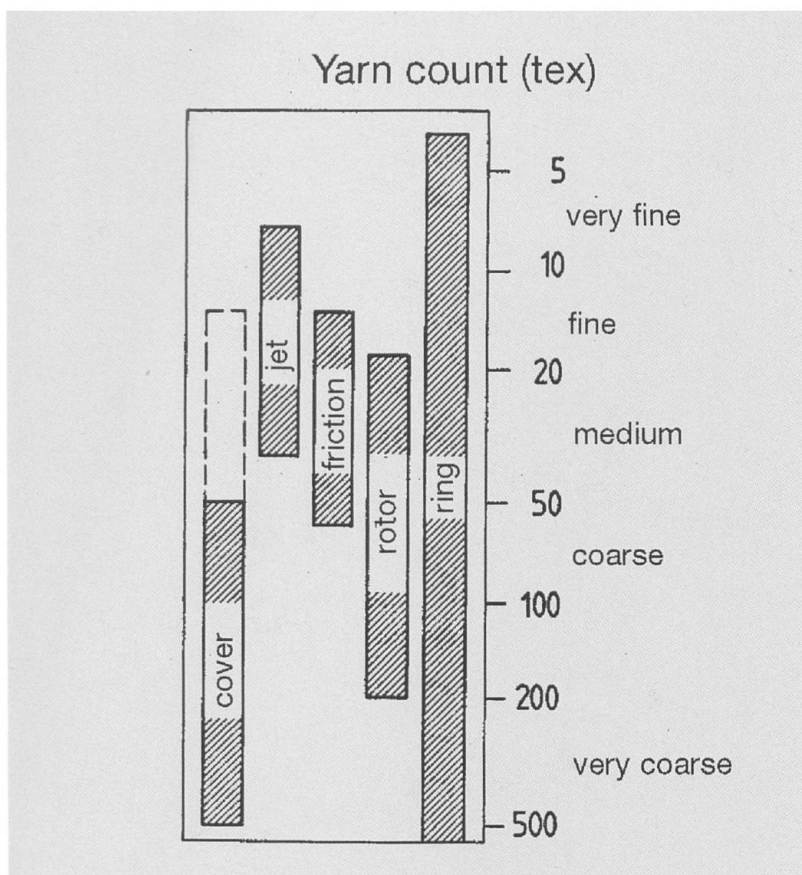
The indirect bearing of the rotor on supporting rings – an approach pur-

sued by Süssen with Schlafhorst and by Schubert & Salzer alone – represented the triumph of so-called «simplicity» with proven precision mechanics and reliable bearings in the range from 10 000 to 15 000 rpm. This permitted 100 000 rotor rpm and more without complicated risks.

In the field of OE yarns, only counts coarser than Nm 50 were possible originally. RICOFIL technology, i.e. the feeding of combed slivers with 8 to 12 percent combed out, enabled yarn counts to be increased to Nm 70, thus considerably expanding the range of application for rotor yarns.

As we have already said, the development route of rotor spinning was characterized by very costly patent proceedings, especially in the American legal system. This blocked the market and caused delays in product sales. However, with the settlement of the legal issues and above all the advent of the new R1 rotor spinner, Rieter's breakthrough on the American market finally became unstoppable.

The yarn count range of the four new processes compared with ring spinning



New spinning processes

The increasingly rapid development of mechanical spinning and winding since the 18th century has been unmistakable. Research and patent literature, and the design drawing archives, have recorded development steps which often foundered on material, manufacturing or bearing technology. As an example, Rieter archives inform us of a completely enclosed card with circulating air fed through varnished wooden hoods. Contraction of the wood and cracked varnish caused yarn obstructions, and only modern sheet metalwork in the 20th century with air feed free of fibre drag enabled these earlier ideas of the engineers to be implemented.

The same applies to the final stage of yarn formation, which has been de-

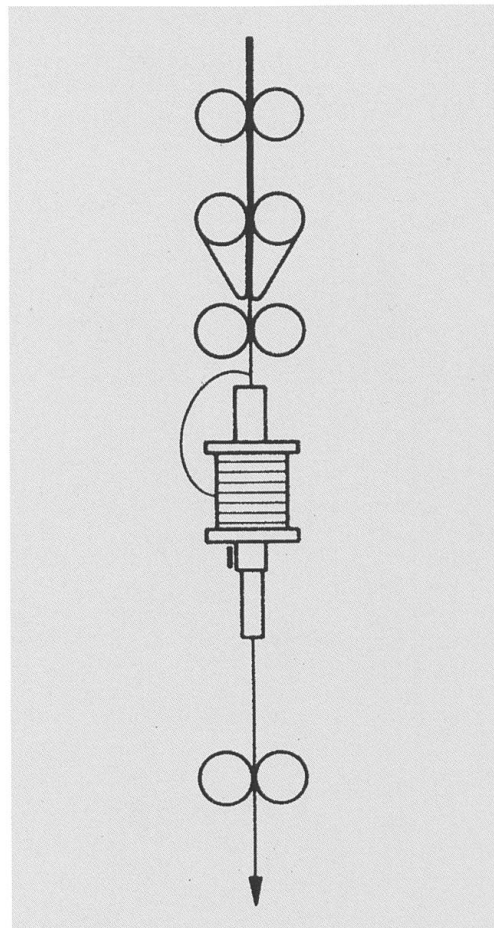
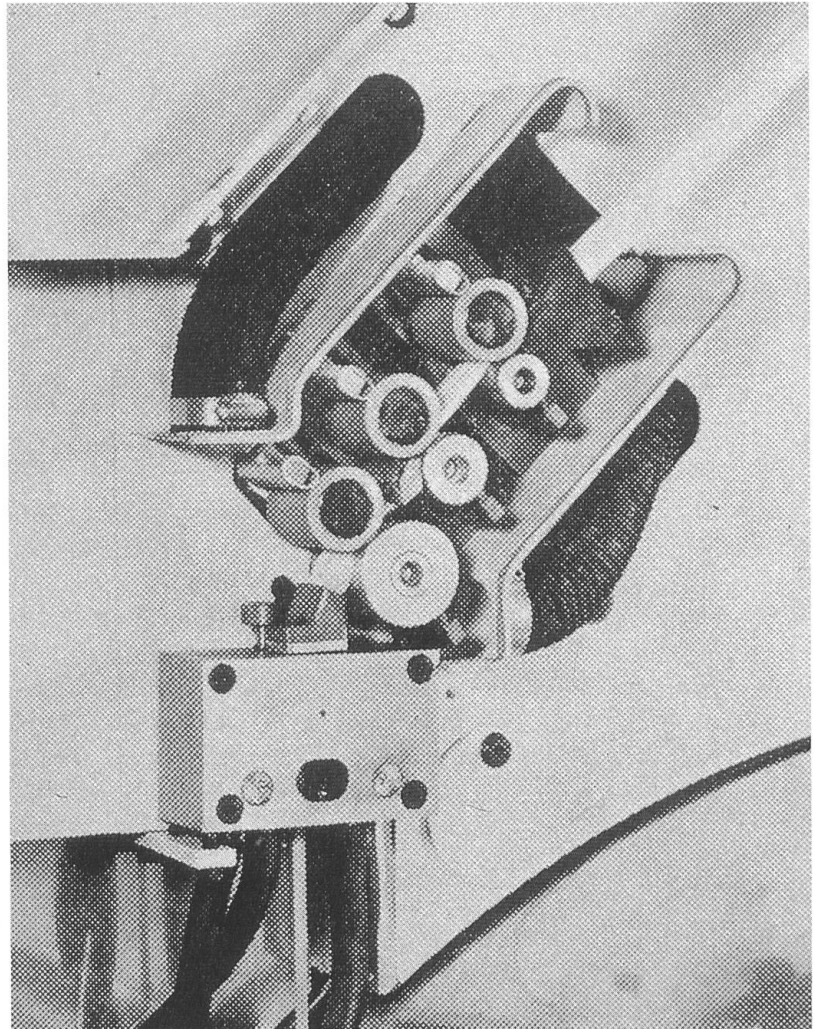
veloped via the hand spindle, the spinning wheel and the mule to the ring spinning frame. Ideas also arose for new spinning processes which could be described as unconventional in comparison with ring spinning. We refer here only to the Pavena process, rotor spinning, cover spinning, jet spinning and friction spinning.

The Pavena process, in which Rieter took a close interest in the nineteen-sixties and seventies, was a completely new approach to the development of draft on the drawframe. It introduced novel adhesives into the fibre bundle, which as pigment vehicles also served to dye the fibres and supported the fibre bundle during the drawing process. Rotary dryers were used to process Pavena slivers impregnated in this way. The adhesive technology meant that a single-zone drawframe could be used on the ring spinning frame. However, despite completely new potential for home textile yarns, the arguments in respect of the energy balance, especially the input required for evaporating the solvent, could not be dismissed. Even the considerable interest shown by a few specialist spinning mills was insufficient to ensure the success of the Pavena process, and production had to be discontinued in the mid-nineteen-seventies.

The comparable Canadian Bobtex ICS system suffered a similar fate, and was abandoned around 1970.

OE rotor spinning has had the greatest market success to date of the new spinning processes.

Cover spinning set new standards, for example, for coarse carpet yarns and finer special yarns. The distinguishing feature of this spun thread was the covering of the body of the yarn with a fine, synthetic filament; this discouraged Rieter from utilizing its relevant laboratory know-how for



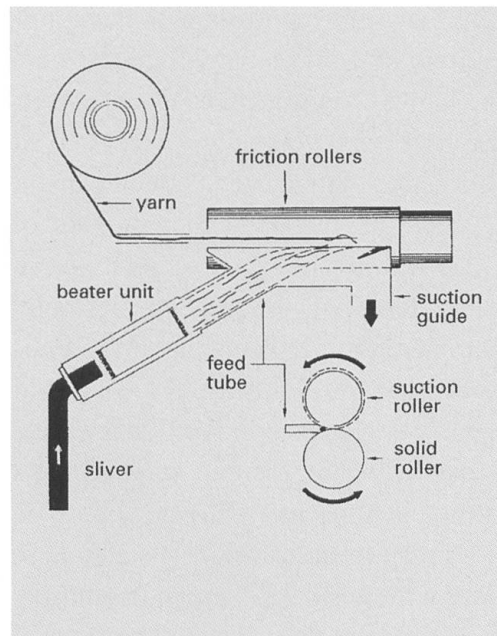
The drawframe as a basic process in Pavena technology

Cover spinning

volume production, since the filament component severely limits the applications of the yarn.

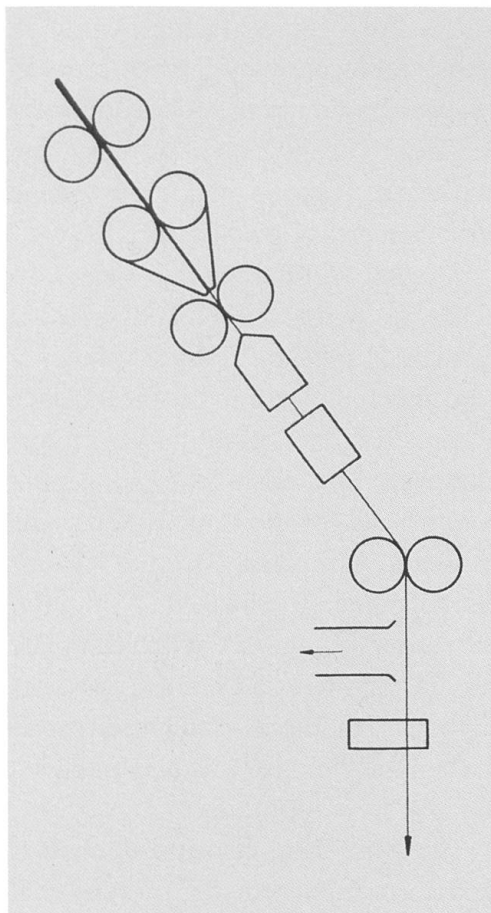
Jet spinning was also scientifically studied and tested by Rieter. However, the arguments for embarking on volume production were insufficiently convincing, since the efficient range of application is currently limited to finer yarns.

In friction spinning the opportunities for the medium yarn range from 10 to 50 Tex are entirely realistic. Rieter therefore entered into a cooperative development venture in 1993 with Dr. Ernst Fehrer AG in Linz (Austria) with a view to bringing the DREF conden-



Friction spinning

Jet spinning



sor spinning process to the volume production stage.

The search for improved profitability of the spinning process remains one of the permanent tasks of any company seeking to maintain a position as a leading supplier. Within the framework of these efforts, the auto-

mation of ring spinning, rotor spinning and other new spinning processes is under constant study.

The criteria for yarn quality are still set by ring spinning yarns and «as good as necessary» requirements. Vertically integrated textile mills have the best chances of achieving efficiency and success here.

Short-staple installations and systems

Short-staple spinning has been in a continuous process of development, as the comparative survey of progress from 1947 to 1994 has shown. The performance of the individual machines has increased continuously, and steadily fewer personnel have become necessary to operate the installations. The example of the card is especially illustrative of this development. After the spinning process had originally consisted of separate machines and groups of machines supervised by the mill foreman and his staff, technical progress proceeded via complete machine and group controls, such as those which were used initially in opening and scutching operations.

Full electronic controls with the applications of artificial intelligence were the logical consequence. Modern mills are therefore generally supervised at different, interlinked management levels. These start with elements of sliver or yarn monitoring, continue in subsystems of the machine, finally cumulate the performance of the individual groups of machines and control the key statistics of the mill as a whole. Links with commercial requirements complete a modern CIM system.

Transport automation has also kept pace with this development in controls over the past fifty years. The laps of the double scutcher, which used to be the last scutching machine, made way for flock conveyors and conveyor channels which fed the raw material gently to the cards. The carded slivers were moved to the subsequent combing rooms or drawframes in large volume cans by automated conveying systems. The laps from the combing machines were moved with assured quality in the system. Finally, speedframe packages were fed to the ring spinning frame on automatic conveyor systems and the small packages from the ring spinning frames were processed into cross-wound packages via winding machines integrated in the hybrid system. Cross-wound packages in efficient formats for further processing were therefore produced directly in the OE process.

A similar development took place in quality control, which clearly favoured the online production of quality over the old methods which sought to «test quality into the products».

Finally, the development of splicers permitted the knot-free joining of yarns, thus opening up new horizons for automatic package changers. It remained the declared aim of Rieter development staff to increase and secure the profitability of installations, as

well as continuing to press ahead with automation and to identify and prepare new processing systems for new materials.

The future

In the short-staple process Rieter is the comprehensive, one-stop supplier offering competent hardware and software for ring spinning and OE technologies. The objective here is to replace wage costs by capital costs through reliable automation. This benefits customers in high-wage countries in particular. Since 1960, Rieter has also sought to take full advantage of different markets and wage levels. This is clearly demonstrated by its joint venture with Lakshmi Machine Works in India and recently by the project with Jingwei for combing room equipment in China. The importance of the Asian markets in general with their low wage costs is increasing constantly.

A comparison of personnel numbers employed in short-staple spinning between 1960 and 1994 shows that the incremental improvements have brought a reduction in the workforce. However, this positive trend cannot compensate for the wage differentials between Asia and Europe. Rieter's market potential is backed up by suitably located outposts with complete service facilities and rapid spare parts supplies. Trading in used machines, as in the motor industry, is also intended to make its contribution.

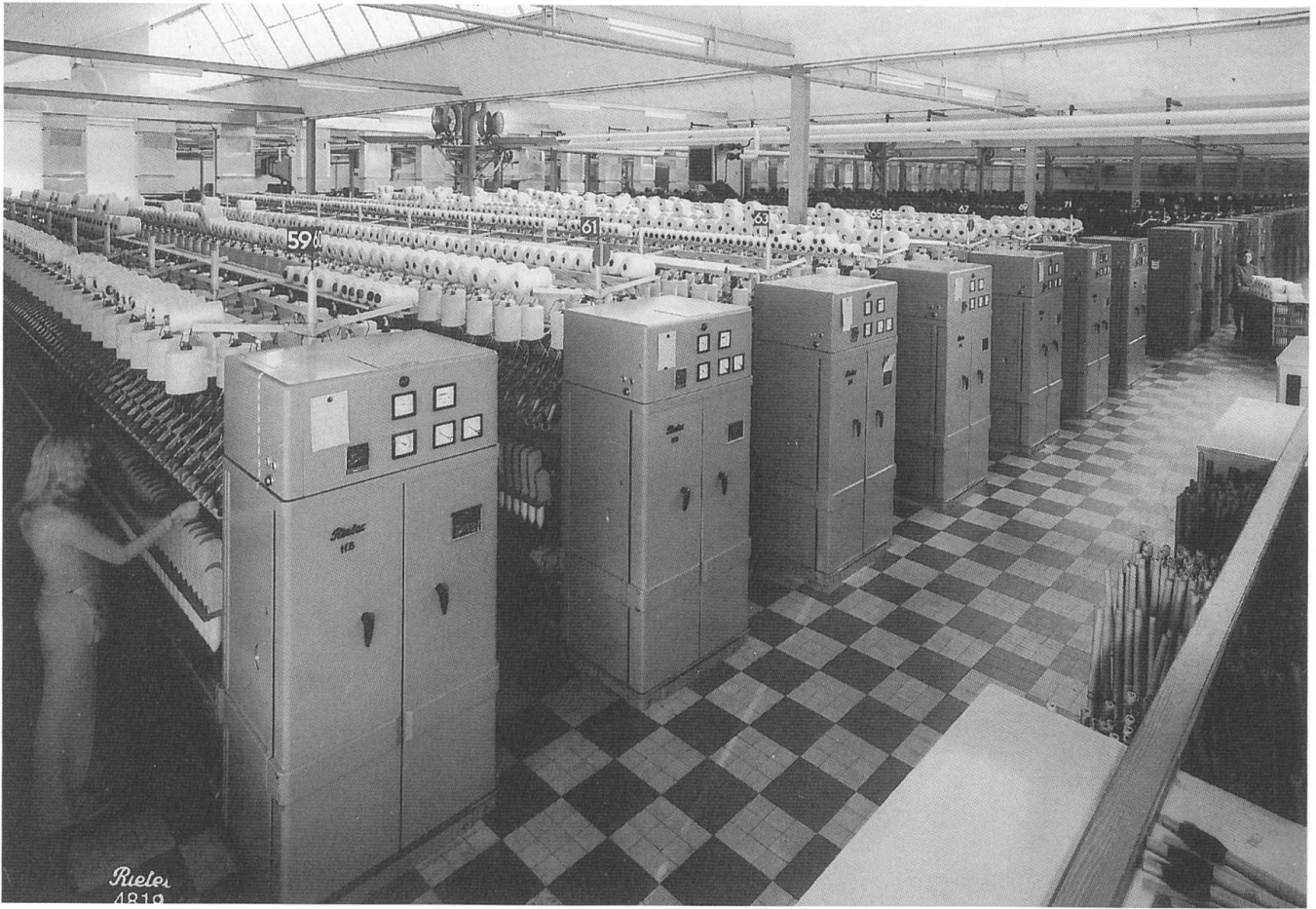
The yarn manufacturing processes described here provide for classical further processing via weaving or knitting into fabrics. In the search for competing processes one is certain to encounter non-woven systems, which also produce fabrics from fibrous webs. This type of fabric is ideal, for example, for disposable hospital linen, fashionable bed and table linen for hotel use, filter mats and other technical

applications. The original idea of using non-wovens, for example, for ladies' outerwear, has foundered on quality standards, and is also likely to re-

main utopian for the future. In the absence of new, replacement processes, the futur of short staple thus seems assured.

*Conversion formulae
for specific yarn
weights*

	1	2	3	4	5	6	7	8
Metrische-Nummer Metric count	Nm	$\frac{NeB = 0,590541}{Nm}$	$\frac{NeL = 1,65352}{Nm}$	$\frac{NeK = 0,885812}{Nm}$	$\frac{NeW = 1,93771}{Nm}$	$\frac{Td = 9000}{Nm}$	$\frac{T_s = 29,0291}{Nm}$	$\frac{Tt (tex) = 1000}{Nm}$
Engl. Baumwollgarn-Nr. English cotton count	$\frac{Nm = 1,69336}{NeB}$	NeB	$\frac{NeL = 2,80000}{NeB}$	$\frac{NeK = 1,50000}{NeB}$	$\frac{NeW = 3,28125}{NeB}$	$\frac{Td = 5314,87}{NeB}$	$\frac{T_s = 17,1429}{NeB}$	$\frac{Tt (tex) = 590,541}{NeB}$
Engl. Bastfasergarn-Nr. English linen count	$\frac{Nm = 0,604772}{NeL}$	$\frac{NeB = 0,357143}{NeL}$	NeL	$\frac{NeK = 0,535714}{NeL}$	$\frac{NeW = 1,17188}{NeL}$	$\frac{Td = 14881,6}{NeL}$	$\frac{T_s = 48,0000}{NeL}$	$\frac{Tt (tex) = 1653,52}{NeL}$
Engl. Kammgarn-Nr. English worsted count	$\frac{Nm = 1,12891}{NeK}$	$\frac{NeB = 0,666667}{NeK}$	$\frac{NeL = 1,86667}{NeK}$	NeK	$\frac{NeW = 2,18750}{NeK}$	$\frac{Td = 7972,31}{NeK}$	$\frac{T_s = 25,7143}{NeK}$	$\frac{Tt (tex) = 885,812}{NeK}$
Engl. Streichgarn-Nr. English woollen count	$\frac{Nm = 0,516072}{NeW}$	$\frac{NeB = 0,304762}{NeW}$	$\frac{NeL = 0,853333}{NeW}$	$\frac{NeK = 0,457143}{NeW}$	NeW	$\frac{Td = 17439,4}{NeW}$	$\frac{T_s = 56,2500}{NeW}$	$\frac{Tt (tex) = 1937,71}{NeW}$
Internationaler Titer Internat. denier count	$\frac{Nm = 9000}{Td}$	$\frac{NeB = 5314,87}{Td}$	$\frac{NeL = 14881,6}{Td}$	$\frac{NeK = 7972,31}{Td}$	$\frac{NeW = 17439,4}{Td}$	Td	$\frac{T_s = 0,00322545}{Td}$	$\frac{Tt (tex) = 0,111111}{Td}$
Schottischer Titer Scottish count	$\frac{Nm = 29,0291}{T_s}$	$\frac{NeB = 17,1429}{T_s}$	$\frac{NeL = 48,0000}{T_s}$	$\frac{NeK = 25,7143}{T_s}$	$\frac{NeW = 56,2500}{T_s}$	$\frac{Td = 310,034}{T_s}$	Ts	$\frac{Tt (tex) = 34,4482}{T_s}$
Feinheit im Tex-System Fineness Tex-System	$\frac{Nm = 1000}{Tt (tex)}$	$\frac{NeB = 590,541}{Tt (tex)}$	$\frac{NeL = 1653,52}{Tt (tex)}$	$\frac{NeK = 885,812}{Tt (tex)}$	$\frac{NeW = 1937,71}{Tt (tex)}$	$\frac{Td = 9}{Tt (tex)}$	$\frac{T_s = 0,0290291}{Tt (tex)}$	Tt (tex)



H6 ring spinning frames at Filature de Laine peignée Alle SA (Flasa)