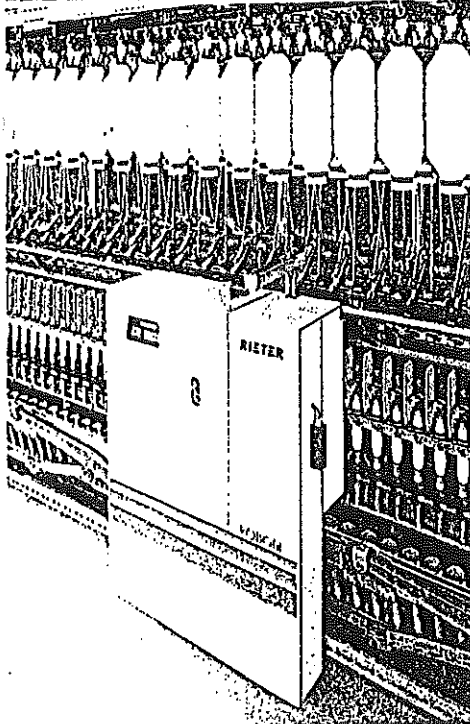
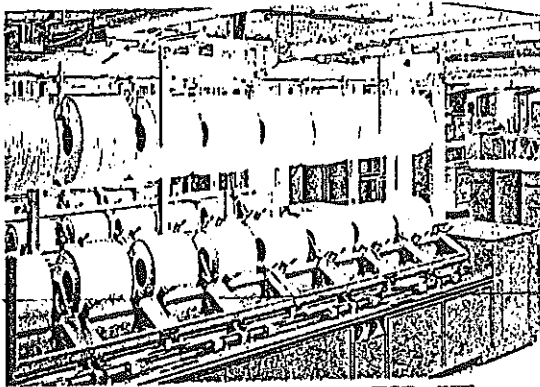
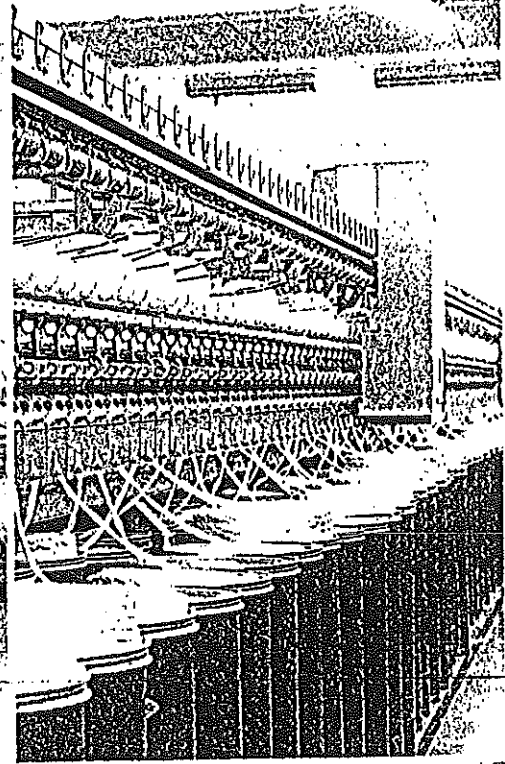
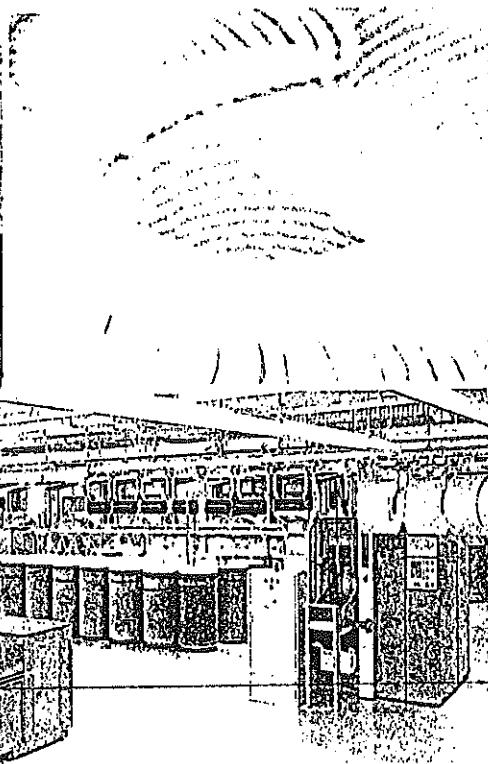
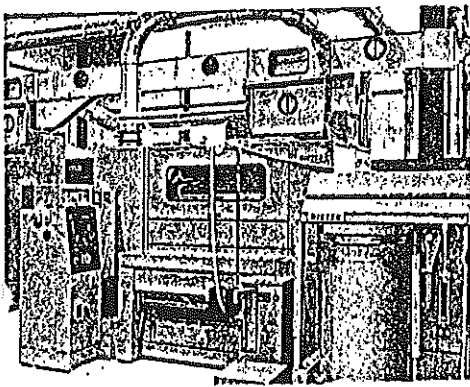
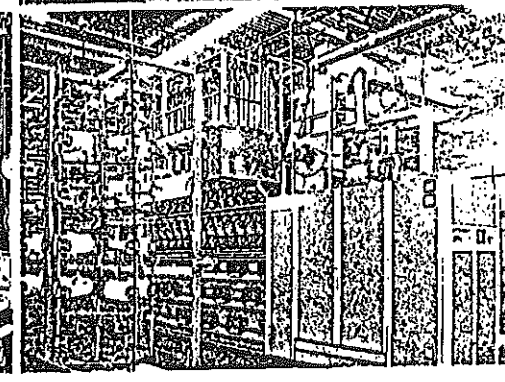
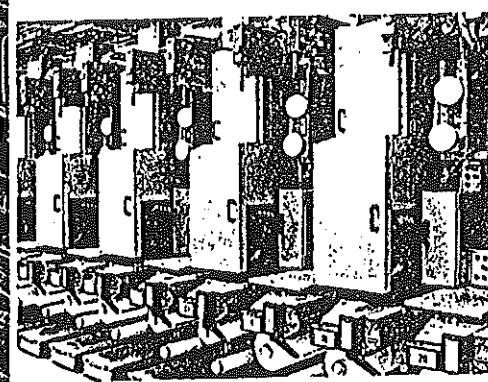
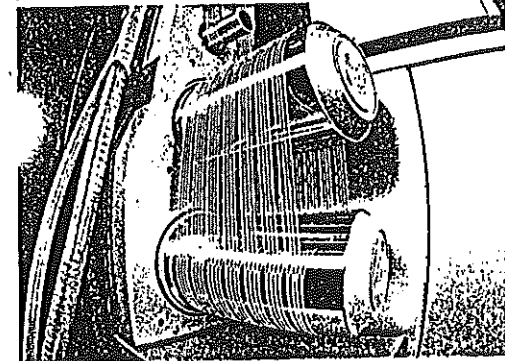


TEXTILE

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**Creative Rieter
Spinning Systems
for the 90s**



1990

Short staple yarn spinning to the end of the century

Alan Parker

This is a major contribution and a most penetrating piece. It is provocative and will make people stop and think about just what is happening in spinning. The author is now developing his own spinning system and has spent a great deal of time researching current trends. He identifies problematic areas which offer potential opportunities for development, or may never be resolved.

Alan Parker graduated from Manchester Institute of Science and Technology in 1963 with a degree in textile technology. He has worked on the development of a wide range of textile machines. Early in his career he was responsible for project teams in warp knitting, texturing, tow cutting, synthetic doubling and long staple preparation and spinning machinery. For the past 10 years he has assisted in development of machinery for new types of spinning machines for short staple yarns. Since 1986 he has concentrated his attention on the design of an advanced form of friction spinning machine which is now at the prototype stage.

There are two principal methods of producing yarn, ring and rotor. More correctly, to compare the two spinning methods one should consider how the two systems convert sliver into packaged yarn. To achieve this on ring requires three stages: a single roving, spinning and winding, whereas on rotor it now requires a single stage.

Table 1 shows typical production figures for ring and rotor machines based on anticipated machine maxima.

The advent of splicing is now allowing ring spinning to capitalise on its advantages and follow a definitive development path. Until splicing, ring frame development was hindered by the conflicting demands of large packages to minimise knots and small packages to increase productivity.

Rotor spinning has increased production speeds, automation and yarn quality, to what most believe is approaching the limits of the technology. In much the same way as automatic winding superseded manual winding even in low labour cost countries so today automated rotor spinning has gained universal acceptance.

I will now discuss the three stages necessary to produce a ring spun yarn.

Roving

There have been relatively minor changes in roving machine speeds for the past 20 years or so. The industry cannot be criticised for this, indeed our ancestors should be complimented for having performed the extremely difficult task of densely packaging a very weak, low twist product very effectively into a small area. (Approximately three times denser than sliver in a can).

An input package has been de-

veloped which can be fitted into a ring frame creel within the floor space required for the drafting and twisting elements and permitted a double sided ring spinning concept to be applied.

Those people who still believe that short staple ring frames will eventually be fed from sliver cans are, in my opinion, out of touch with reality. A typical roving machine would have 100 spindles with a maximum delivery speed of 30 metres/min. An average doff cycle would be two to three hours, with a can change frequency of 10 to 40 hours.

The critical features of a roving machine are:

- Every time a roving or sliver break occurs the entire machine stops
- Doffing is a tedious job and because 100 or so bobbins have to be doffed at any one time, the time taken can severely affect machine efficiency, and
- The roving on the roving bobbin is easily damaged even by contact with other rovings.

The need to automate doffing and minimise roving handling has long been realised and Rieter exhibited a prototype automated roving machine about 10 years ago.

Marzoli has been the first to introduce a production autodoffing and roving handling system which is already operating in a number of installations. What I consider to be the major impact of this I discuss in the ring frame section.

It will be difficult to justify, on economic grounds, an automatic can changing and sliver splicing at the creel with such a low frequency of occurrence when block creeling is applied either to a full or part machine.

Block creeling is standard, because every end runs the same length of time and a sliver or roving break requires the whole machine to stop, and to have random changes causes too high an incidence of machine stoppages.

To make complete automation even more unlikely the roving process is sensitive to slubs which will inevitably be created by a sliver jointing. It would be imprudent to allow sliver jointings to pass through the roving frame without an operator in attendance to check for misdrafting, and to remedy any roving break that may occur. It is my belief that automatic piecing up of a roving frame is unlikely ever to be developed because of the cost, complexity and minimum savings offered. The improvements in sliver quality that continue to be made will further reduce the incidence of roving breaks and the incidence of machine stoppage could be reduced still further by the use of even larger input cans.

Ring spinning

Much has recently been written about the re-awakening of interest in ring spinning, and sales have picked up over the past two years from what was in fact a pitifully low level, considering the size of the industry.

Within recent years the following features have become available on ring spinning machines:

- An increase in the number of spindles on a machine to around 1000
- An increase in maximum spindle speed up to 25 000 rpm
- A facility to have a slower speed on the first few layers to reduce the incidence of end-breaks
- Roving break detector
- Yarn break detector
- Fully automatic doffing
- A fully automatic link between the ring spinning and winding machine (link spinning), and
- Transfer of autodoffed roving bobbins directly to ring frame creel area.

To achieve full automation requires:

- Replacement of empty by full roving bobbin at the ring frame
- Piecing up a broken roving, and
- Piecing up after a yarn break.

There is sound evidence that some of the machine manufacturers are very active in trying to develop these features.

Automatic roving replacement

Automatic roving replacement is already available for coarse count single-sided spinning machines supplied by James Mackie. It is known that

companies are already working on automatic roving replacement for short staple ring frames. The task is more difficult because the gauge is smaller and the machines are double-sided.

On a 1000 position machine on average one roving runs out every two minutes on NE 20s and every six minutes on NE 40s.

At a spindle gauge of 70mm a double bank of roving bobbins per side would improve accessibility for the automated mechanisms. This would require roving bobbins of maximum diameter 125mm (5ins) instead of the 150mm (6ins) or 175mm (7ins) normally used today. As this could also increase the productivity from an automatic roving frame by allowing higher spindle speeds to be used, I believe it would be logical to revert to small roving bobbins if automatic roving replacement is applied.

It could significantly reduce the inventory by having less roving in a creel. For example, on a 30 000 spindle plant there would be about 45tons of roving

in a creel with 3kg roving bobbins, which could be reduced to about 25tons with smaller roving bobbins. If one assumed roving to be valued at £2 per kilo this represents a reduction in inventory of £40 000 on a plant of this size, which is not inconsiderable. A further advantage is that when changing quality, the rundown time could be reduced.

This system could clearly be adapted to deal with a roving break if the frequency of occurrence justifies it. One robot per machine would be able to perform the necessary workload even on smaller roving bobbins. I consider automatic roving replacement linked to an automatically doffed roving machine and roving transfer to ring frame will become commonplace, irrespective of whether the yarn is pieced automatically.

Piecers

Automatic ring frame piecers have been around for short staple yarns for a

Ring: Spindle speed 25 000 TF 3.5

	Ne 20cc (29.5Tex)	Ne 30 (19.7Tex)	Ne 40 (14.8Tex)
Delivery Speed (m/min)	40	32.6	28.2
Production (kg/hour)	0.07	0.038	0.025
Production for 1000 position machine (kg/hour)	70	38	25

Rotor: 120 000 rotor TF 4.25

	Ne 20	Ne 30	Ne 40
Delivery speed (m/min)	158	129	111
Production (kg/hour)	0.276	0.150	0.098
Production for 200 position (kg/hour)	55.2	30	19.6

	Ring combed	Ring carded
Elongation	Similar	Similar
Strength	Better	Better
CV strength	Similar	Worse
Regularity	Similar	Worse
Defects	Similar	Worse
Hairiness	Different	More
Cleanliness	Similar	Worse
Cover	Less	Less
Handle	Softer	Softer
Dye uptake	Less	Less
Lustre	Better	Better (marginally)
Fabric regularity	Similar	Less regular
Effect of clearing	More splicings than piecings	More splicings than piecings
Spinning limit	Finer	Finer
Abrasion resistance	Worse	Worse

Table 1.

	Ne 20 (29.5Tex)			Ne 30 (19.7Tex)			Ne 40 (14.8Tex)		
100% cotton 4.2 μ	180			120			90		
100% cotton 3.8 μ	200			133			100		
	poly	cot	total	poly	cot	total	poly	cot	total
50% cotton 4.2 μ 50% 1.5 den polyester	88	90	178	59	60	119	44	45	89
35% cotton 4.2 μ 65% polyester 1.5 den	115	63	178	77	42	119	58	31	89
50% cotton 4.2 μ 50% polyester 1.2 den	110	90	200	74	60	134	55	45	100
50% cotton 4.2 μ 50% polyester 0.9 den				98	60	158	73	45	118
50% cotton 3.8 μ 50% polyester 1.2 den							55	50	105
50% cotton 3.8 μ 50% polyester 0.9 den							73	50	123

Table 2.

long time, but so far nobody, as far as I know, is operating a commercial system satisfactorily. There is little doubt that commercial systems will be operating before the end of the century. Whether, as on the integrated doffer, all manufacturers will arrive at a similar solution, only time will tell. The system will undoubtedly be a travelling piecer servicing one full-length machine of some 1000 spindles and it should have a similar workload as a piecer on a 200 position rotor spinner.

A reduction in ring size and the controlled slow start of empty tubes allows higher spindle speeds to be achieved with a reduced level of end-breaks. Automatic piecing, when commercially available, is going to be difficult to justify in low labour cost countries, particularly because it is preferable for all piecings to be replaced by splicing, and it does not improve quality.

Winding is a highly developed process, already substantially fully automatic with a throughput speed of up to 1500 metres per minute. As filament yarn can be wound, using similar principles, at speeds up to 6000 metres per minute the restrictions on delivery speed are associated with technological limitations of both unwinding staple yarn from cops and forming this yarn into a package.

I only expect to see a modest increase in delivery speed in the foreseeable future, but do expect to see continuous refinement in the quality of splicing.

There are only three European rotor spinning machine manufacturers today (excluding licensees); Schlafhorst, Schubert and Salzer, and Strojimport, each offering different options. To fully automate the rotor spinning machine requires the replacement of empty by full cans and the piecing up of sliver after a sliver break or after a can

change.

Although a number of patents have been taken out in this area the high quality of sliver which can now be produced, and a can replacement cycle of only about twice a week for yarns of Ne 24s, would make such a system difficult to justify for anything but coarse yarns.

Automation

I consider that for yarns of Ne 16s (37Tex) and coarser, rotor spinning will continue to dominate new machinery sales, and it is here that I expect to see the first fully automatic spinning plant.

Automation to card sliver is now complete. For those slivers which can be used directly off the card an automatic transfer of full cans and a return of empty cans is needed to tie in with the completion of rotor spinning automation (already discussed) to fully automate the process. The coarser the count, the more this can be justified on economic grounds.

A rotor yarn and a ring yarn are very difficult to compare directly because they differ in almost every aspect. This is particularly true with a cotton yarn or yarn containing cotton. In effect, to make a particular yarn one would invariably select a different cotton specification for an optimum ring yarn than for an optimum rotor yarn.

Different end-uses place different emphasis on the positive and negative features of the two yarns. Fashion trends and changes in weaving or knitting processes can work to the advantage of one or the other.

If one took a typical carded American cotton of 4.1-4.2 micronaire and compared ring spun carded and ring spun combed with rotor spun carded, Table 1 gives a guideline as to what would occur if one assumed the rotor

spun yarn to be standard.

It has been established that rotor yarns, because of their lower coefficient of strength variation, perform acceptably in knitting and weaving at much lower average strengths than would be required for a ring spun yarn. Therefore for many applications the strength difference is not a major factor today for up to medium count yarns.

I believe that most observers would agree that if rotor spinning is to continue to increase its share of the medium to fine count yarns it will be primarily due to factors other than improvements in the rotor spinning machines themselves. Undoubtedly a major factor preventing rotor spinning competing in fine yarns is that the number of fibres in a cross-section needed to produce an acceptable rotor yarn is far higher than that needed to produce an acceptable ring yarn. As there are many other factors which determine rotor yarn properties one could not give a precise number of fibres, but it would appear to vary between 90 and 130 and today's typical figure normally used is 110 fibres. The last few years have seen this drift down from about 125 fibres. Table 2 shows the effect of cotton micronaire and polyester staple denier on the number of fibres in a yarn cross-section.

It is my belief that if improvements in preparation, involving a reduction in short fibre content, can be achieved it will allow acceptable rotor spinning of 100 per cent cotton yarns of the right fibre type with an average of 100 fibres in a cross-section. Thus for a typical American cotton fibre of 4.2 micronaire a yarn as fine as NE 36s should be possible, and Ne 40s for a 3.8 micronaire fibre of the right type. I do not expect to see any major increase in rotor yarn strength and I consider that acceptable weaving yarns will occur at several counts below these limits.

The movement towards finer dpf polyester fibre, if it achieves a 0.9 denier or 0.8 denier level, without any major price increase in fibre or preparation costs, will have a major impact on the type of yarn that a rotor spinner can produce.

I believe it will allow polyester/cotton yarns using 4.2 micronaire cottons of Ne 45s at the 50 per cent blend level, and even finer with a 65 polyester content suitable for weaving yarns.

There is an ever increasing level of quality control and automatic features being applied to spinning machinery. The very modest delivery speeds achievable on either ring or rotor compared with the 1000 plus metres/min achievable on texturing machines provides a great opportunity for new technologies able to operate at significantly higher delivery speeds than rotor to gain widespread acceptance. □

Editor's note: polyester staple of 0.8d tex is now commercially available.

