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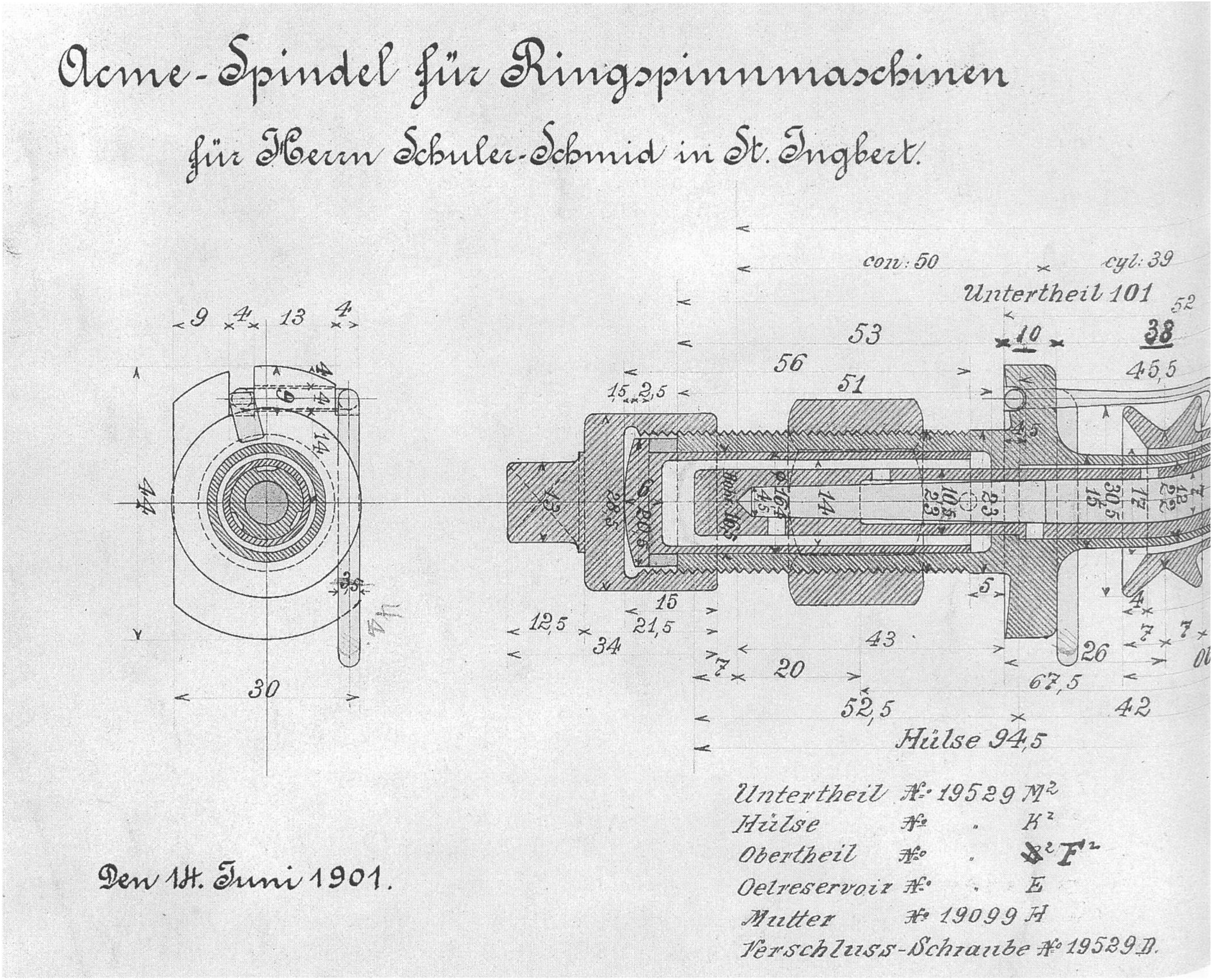
The main partners in coordinated projects in the changing field of research and development

Rieter's machine manufacturing activities in the early 19th century were initially characterized by individual achievements in the sphere of the craft-based operations which were usual at that time. Over the years group-based activities developed, in which partners from different disciplines focused their joint efforts on the project target.

For the early Rieter designs the representation and drawing of the components was in itself a special challenge. For example, parts were then depicted life-size on boards, which were then used as working guides in the workshops. The detailed engineering drawing customary today did not evolve until the beginning of the 19th century. Incidentally, the Swiss engineer and inventor Johann Georg Bodmer (1786–1864) played a major part in this. He developed the fundamentals for this innovation during his engineering work in Bolton (England), thus opening up completely new potential for structural design. As the historical archives of Maschinenfabrik Rieter AG show, drawings of masterly precision were produced, which in line and colouring were reminiscent of Zurich's minor masters such as Johann Heinrich Füssli. A single drawing was used for sales and marketing. It was also used for manufacturing the component, specified checking procedures, was the basis for assembling the workpiece together with neighbouring components, accommodated instructions and modifications, and finally was used for the spare parts service. In this versatile form it could be described as the forerunner of modern information technology, which stores all the available data on a component in a central database.

In the development of textile machines Rieter progressed from empirical craftsmanship (based on experience) to systematic, scientific research and development, which was characteristic of the state of the art, especially from the nineteen-fifties onwards. Originating from the goldsmith's craft, the company's founders had a deep appreciation of the craftsman's art and the personal nature of manufacturing tolerances. Technical development followed the historical route from the «cylinder house» in Obertöss to the research centre in Niedertöss. The research centre was built and came into operation in 1963 in Niedertöss, where Rieter's spinning development had started in 1825 in a modern fine spinning mill.

From the business point of view, first-rate products are an excellent insurance for the future. Specialist research work has to be performed for this purpose, and imaginative personnel are often extremely sensitive, appreciating a good supply of information but wishing to be left in peace to pursue their projects. It was precisely this vital environment which was created so successfully in Niedertöss. Since the saying «time is money» also applies to research work, demands for shorter development lead times are ex-

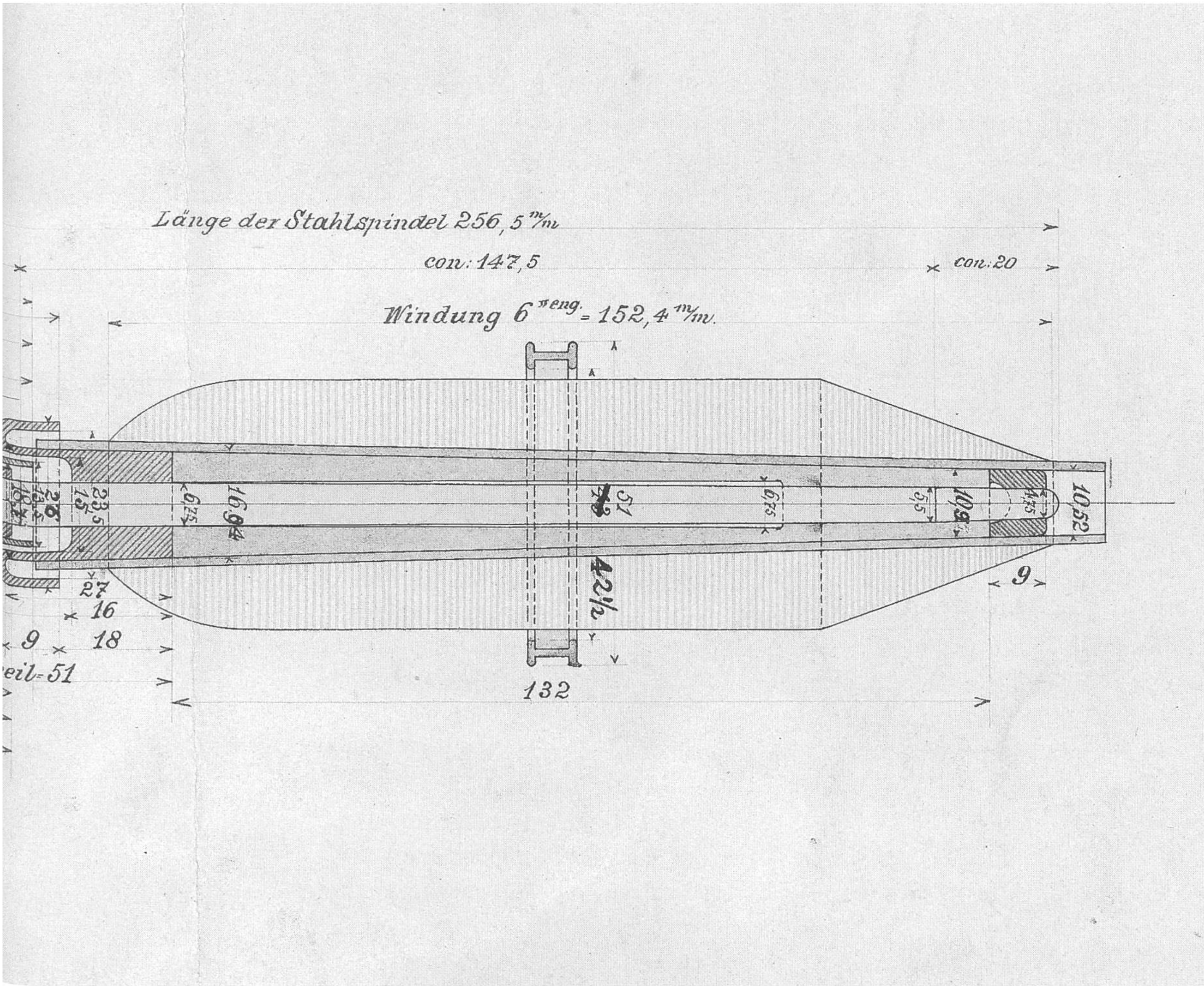


This drawing of a spindle dating from 1901 was used as a design drawing, a document for discussions with customers and tube manufacturers, and as manufacturing documentation.

pressed more or less loudly, depending upon the overall business situation. While recognizing the competitive demands of the market, it must not be forgotten that it is also essential for advanced engineering products to be subjected to the necessary long-term tests.

Long-term endurance tests are especially important in developing textile machinery for three-shift operations. A thorough knowledge of the effects of textile dust, for example, is also essential. Momentary observation often indicates dust emissions of virtually zero, but accumulated over a period of months they can bring machines to a standstill.

From the outset, textile machines have consisted of long-lived basic elements, wearing parts and accessories. In all development considerations, wearing parts in particular are dependent on a well-organized spare parts service. Accessories such as tubes should be obtainable worldwide and therefore defined in good time on the basis of international standards. First-class standards are therefore of particular ecological importance for the successful long-term operation of machinery and systems. Leading companies therefore have every reason to strive for a leading role in international standards bodies.



Patents and industrial property rights

Technical development is often measured by the number of patents and industrial property rights issued. According to these statistics, technical knowledge actually increased only insignificantly in the first half of the 19th century. Technical progress only began to gather pace as surges in development in manufacturing technology took place in the mid-twentieth century. Perhaps the financial advantages of industrial property rights were responsible for the explosive growth in patent applications. While technology transfer and the exchange of industrial property rights in Rieter's early history were mainly based on «handshakes between gentlemen», «contracts between legal entities» later became much more frequent. Even as late as the nineteen-sixties, patent applications were submitted almost exclusively when the proposed approach had proved effective. The patent lawsuit was then a rare event in textile machinery manufacture. Modern judicial practice, and especially rulings by American courts, have resulted in an increasing number of tactical or strategic applications, especially for modern spinning processes (for example openend). Inventors are therefore ill-advised to exercise polite restraint in their claims for patent protection nowadays. In the author's view, excessive litigation demands on financial and market issues put the gentlemanly practices of earlier days in an even more favourable light; a return to these methods would be desirable, but nevertheless extremely risky. The patent lawyer is thus an essential partner in technical development. He protects intellectual property and through his skill in broadly defining claims creates scope for projects to be developed further. Patent and legal advisory services also provide significant support for technical work through agreements covering, for example, exclusive rights and claims for protection.

Production

The company's development history places on record the major importance of manufacturing technology and production engineering. These have been influenced significantly by personalities such as Henri Daniel Gross (1871–1945), Dr. Oskar Halter (1883–1939), Heinrich Steiner (1895–1954), Dr. Kurt Hess (1910–1984), Max R. Epprecht (*1916), Hans Probst (1926–1993), Dr. Kurt E. Stirnemann (*1943), Erwin Stoller (*1947) and Rolf Häfliger (*1932). These production managers have always been supported by outstanding supervisory personnel and advisers, among whom Samuel Bagdasarjanz and Dr. Gustav Stähli deserve special mention. While Bagdasarjanz paid particular attention to manufacturing and assembly technology, and was also involved in the pictorial arts, Stähli – in his scientific work on wear-resistant surfaces, fatigue strength and ring/traveller technology – successfully tackled challenges which were recognized worldwide. In partnership with foundry manager Eugen Sinner, Rieter's castings achieved top quality standards which also enabled sales to be maintained in shrinking markets.

This publication cannot by any means do justice to every aspect of Rieter's production engineering achievements. Milestones in production engineering are therefore summarized briefly below.

When Rieter celebrated its 150th anniversary in 1945, the company was at the level of a pioneer operation in the large-scale metalworking trade. Average piece weights were then 4.8 kg. Machine components and subassemblies were produced in complete workshop operations. Production lines were only used in the Effretikon machine works for special know-how components such as spindles, top rollers and rings. Similar methods have been used since the nineteen-seventies in the manufacture of fluted rollers in Winterthur. Product quality was influenced significantly by personnel. These working methods were ideally suited to Rieter's craftsmen. However, the signs of a transition from man to machine were becoming increasingly obvious. The main targets were defined in the new production concepts of 1983: cut workshop costs, reduce inventories, reduce set-up times and batch sizes, plan manufacturing cells, define standard tool kits, bring dispatch and assembly closer together, make assembly planning more detailed.

These ambitious targets could only be achieved by significant developments in tools and manufacturing processes. The cutting tool made from hardened tool steel therefore soon became a thing of the past. New carbide alloys produced markedly higher cutting performance with longer service lives. Finally, these successes were again overtaken by ceramics technology.

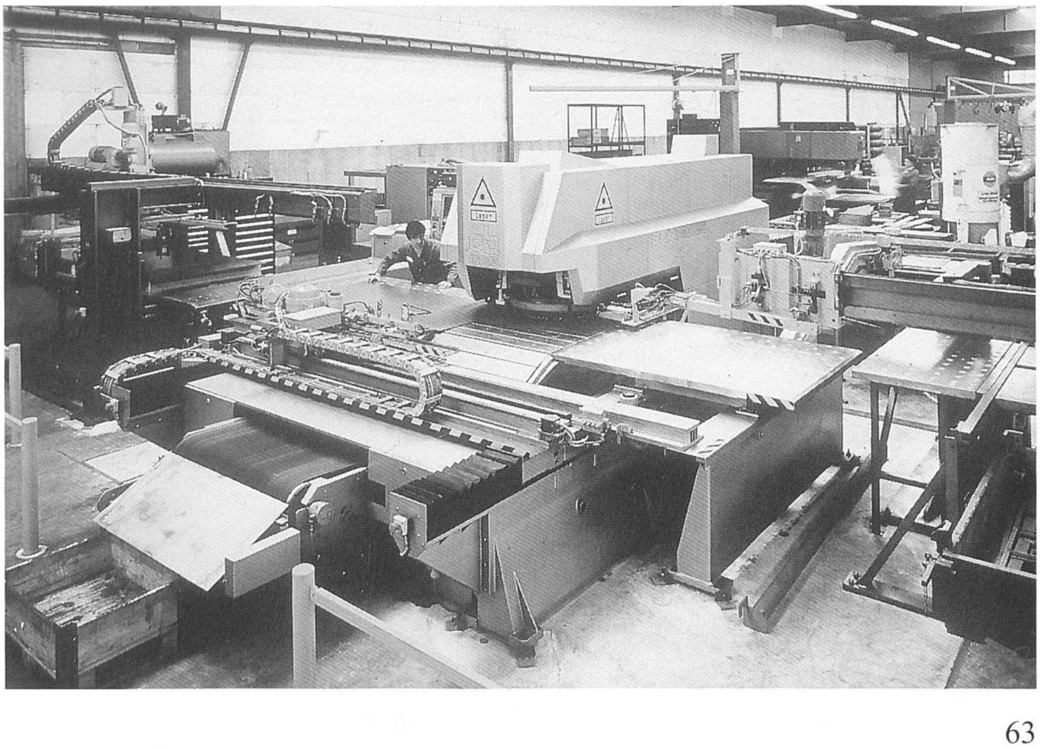
In sheet metal processing, laser technology became an obvious competitor for oxyacetylene cutting apparatus. While the rough edges produced

Assembly line for E7 combers in Sirnach

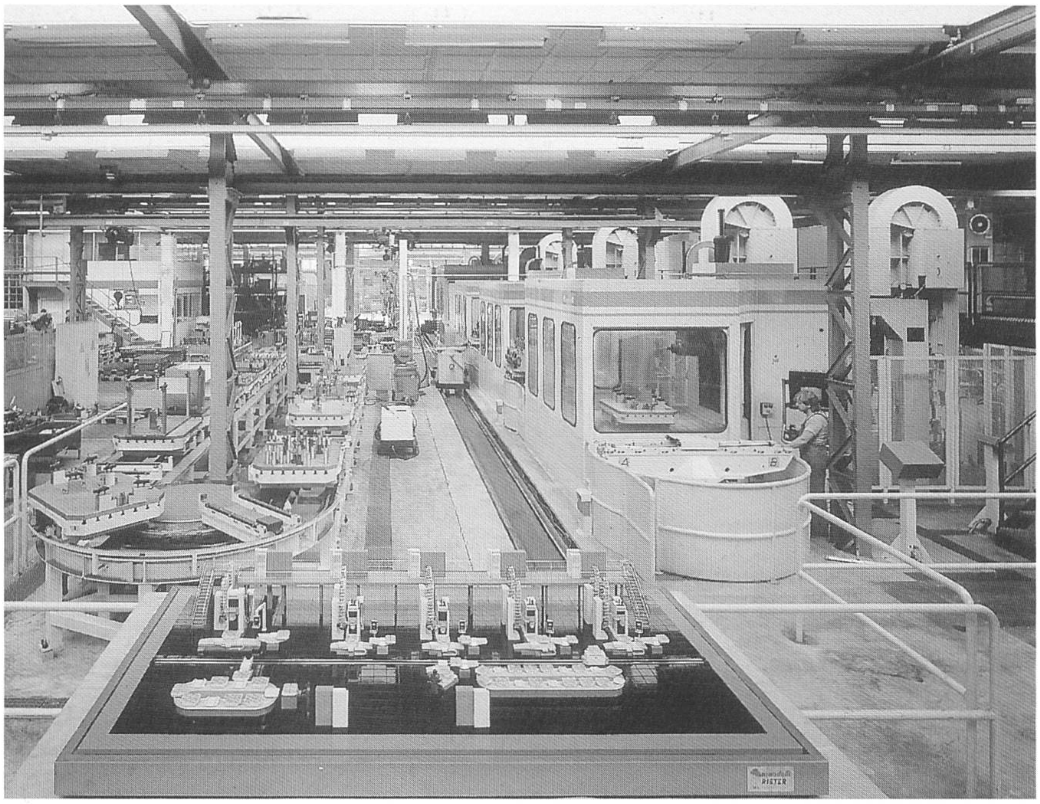
by oxyacetylene cutting were ill-suited to textile technology, laser technology produced almost clinically clean edges, which were ideally suitable for textile machinery manufacture.

In the mid-nineteen-seventies plasma coating was a process which enabled noble materials to be applied to rotating elements, especially in filament machinery manufacture. Conditions of high quality and long service life could therefore be created for the area of contact between the fibre and the processing element. This opened up new horizons for manufacturing technology.

NC/CNC technology brought a genuine leap in development for efficient manufacturing tolerances in the early nineteen-sixties. As Max Epp-



Behrens sheet metal stamping and laser cutting machine, 1980



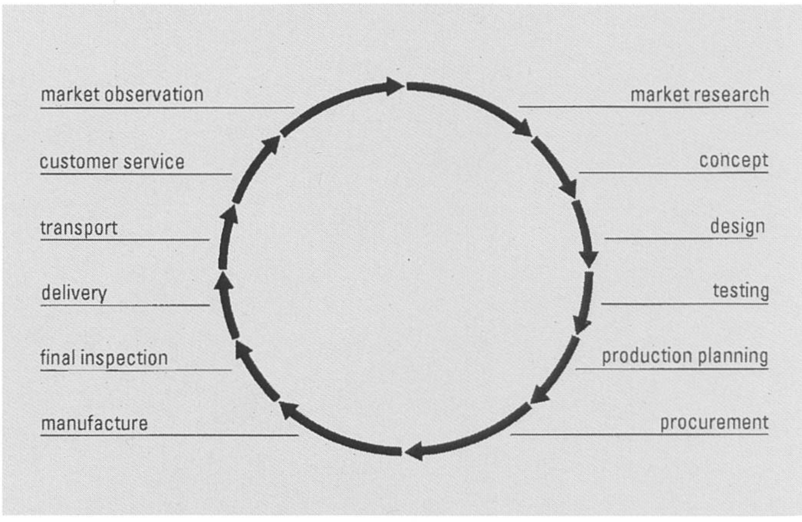
Mandelli flexible manufacturing system, 1988

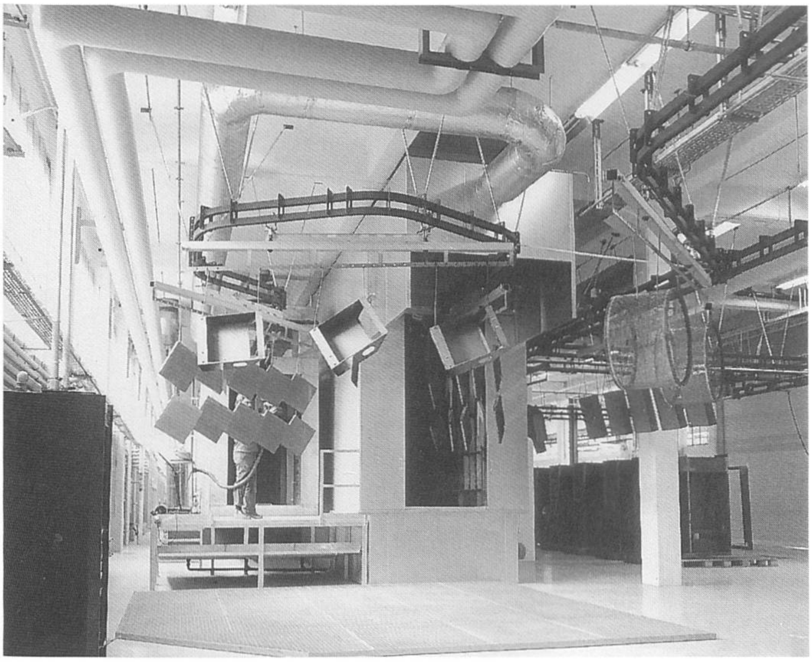
recht liked to recall, so many salesmen advised him against CNC machine tools in those days that in 1965 he decided to order an NC drill from Cincinnati to be used for study purposes at Rieter. The subsequent trials were the equivalent of pioneer work, which finally also provided the basis for ordering Moriseiki automatic lathes from Japan. After 1975 these replaced the classical manual capstan and turret lathes. Further advances then resulted in the award of a large order for FFS-Mandelli flexible manufacturing systems, which satisfied the requirements of Rieter's 1987 manufacturing concept in full. At the celebrations of 20 years of NC technology, Rieter's speakers pointed out that NC technology upgrades the workshop trades and even improves component quality at lower manufacturing cost due to good process control.

CAD/CAM/CIM technology was introduced to the Rieter workshops at the same time as the Behrens laser metal-cutting system. CAD geometry could then be transferred from the drawing board to the production machine by telecommunications, and a two-dimensional metal component cut to size with high precision within minutes by means of the automatic NC machines. This technology has been available to manufacturing operations since the early nineteen-eighties, and has attained a high level of perfection in Trumpf systems such as those used by Rieter in Ingolstadt.

According to the tenets of modern manufacturing technology, quality must be achieved during the manufacturing process itself. Subsequent improvement is uneconomic and destroys

The quality circle shows the relationships at all stages of product development. Quality must therefore also be effectively assured at all these stages.





Powder coating metal components with environmentally friendly total utilization of colouring materials

productive time. In this context reference must be made to the further development of tolerances, which at Rieter were aimed at the system of the standard shaft from an early stage. Earlier, one-sided tolerances were first transformed into average values, thus markedly improving the interchangeability of components. In an effort to enable machines to be assembled without using files, in the nineteen-seventies Rieter aimed for rough tolerances corresponding to the system of the Swiss Working Party for Quality Assurance (SAQ) of Dr. E. Soom. With this important step Rieter abandoned previous standard assembly methods in which almost every component had exhibited individual fine dimensions as a result of adjustment.

The quality of the spinning machines is significantly influenced by the ability to produce surfaces which are free of fibre drag and protected against corrosion. The application of coatings is very important for these efforts. As early as the nineteen-forties, production operations had, for example, incorporated the wet spray technology used in the automotive industry. A valuable advance in the seventies was the electrophoretic coating bath for castings. In the late eighties came powder coating with its especially environmentally friendly features. At the same time Rieter continued to develop and use electroplating and plasma coating methods.

A sound knowledge of materials data is essential for innovative machine manufacturing and production technology. Rieter's materials research team under Dr. Gustav Stähli and Fritz Goebe successfully tackled the core problems in this field. Important know-how on new materials was gathered, especially on castable metals, and the results enabled giant steps in development to be taken for material combinations in mangle lubrication operations. This enabled ring/traveller combinations to be found for the ring spinning frames which produced outstanding operating data. In partnership with the watch industry and Sulzer-Medica, highly wear-resistant metal surfaces were developed which offered new potential in textile machinery manufacture, for example in the production of yarn guides. Progress was also made in the localized hardening of metal components. In cooperation with universities and engineering colleges, the knowledge of long-term alternating load behaviour – among other things – has been expanded to such an extent that it paved the way to objective findings in the search for the cause of shaft breaks.

The past fifty years have also brought marked advances in development in the field of component design technology. The enormous potential opened up by flexible manufacturing systems resulted in the combination of individual parts into multiple components which can be machined very precisely in a single chucking on five levels. Closer tolerances have simplified assembly techniques. Production

Ring spinning assembly operations in 1945 (top) and 1987

Concept 91 also provided the basis for «Just in Time» (JIT) delivery and lean production. This involved producing only what was immediately required, if necessary with batch size 1, and keeping the amount of working capital to a minimum by maintaining minimal or zero inventories.

When considering systems in the context of assembly philosophy, the close relationship with the requirements of dispatch operations was identified. Although the traditional, solid Swiss box was in heavy demand from spinning mill personnel, especially abroad, the transition to pallets, cartons, polystyrene and crates was inevitable. The new shipping unit, the container, set new standards and helped to cut costs. In this concept the dispatch of fully assembled machines and subassemblies also assumed greater importance. The use of suitable cushioning elements and actual transport settings opened up opportunities which were worth seizing.

These development steps and the comprehensive specialist know-how in production and manufacturing technology were utilized increasingly in engineering projects. The designer at the computer screen and his manufacturing partner thus developed into a coordinated technical environment (a «technotope») without which it is impossible to imagine successful project management. An easy-to-manufacture design improves the quality of the products, thus enhancing reliability and forming the basis for demonstrating the value of our machines and systems in practical operations.

Finally, the efforts to conclude licensing agreements involving technology transfer, and more recently joint ventures, must not be forgotten when writing the history of Rieter's production operations. Lakshmi Machine Works (LMW) has been a clear example of this since the mid-nineteen-sixties. Rieter Elitex in the Czech Republic, part of the Rieter Group since 1994, could assume similar importance. In the field of technology transfer, cross references to international standards are very important. Rieter's commitment to this field of activity is therefore well-founded. Clear manufacturing drawings as a basis for unequivocal understanding and up-to-date manufacturing documents are also extremely useful. Experience with LMW has also underlined the value of Rieter liaison specialists on the spot for technology transfer. With a view to future developments, technology transfer assumes considerable importance in «make-or-buy» decisions, issues of the extent of in-house manufacture, and decisions on lean production.

Marketing, service and training

Marketing partners are very important for project management, especially to ensure close contacts with the market and service operations. They incorporate the customer and his needs in the project, thus ensuring the feasibility of innovative plans. Manufacturer's warranties for key technological and output statistics in the form of guarantees of performance are a precondition for the successful operation of spinning mills. Rieter has been able to collect valuable experience here through its trial plant for customers. Processing customers' raw materials in the customers' presence with subsequent scientific evaluation of the results reinforces mutual confidence. This policy of cooperation started at Rieter around 1825 with the Niedertöss fine spinning mill and has been continued successfully in various forms. Finally, the Rieter research and development centre was set up in the converted Niedertöss spinning mill in

Customer training in the Training Centre: «grasping» things, physically and mentally

Training on the card

Training in machine control and electrical engineering

Training on the ring spinning drafting system

Training on the OE rotor spinning machine and its technology

1963, and also fulfils these requirements.

The training of specialists and supervisory personnel is very important for confidence and customer contact. The proper operation of Rieter systems is assured by the special know-how passed on to them. Specialist know-how prevents incorrect operation and thus eliminates complaints. Rieter training also boosts the standing of the trainees. The training centre in Obertöss was built for this purpose.

As the volumes of correspondence preserved in Rieter's archives clearly show, the company's founders themselves were most concerned to establish close contacts with their customers and earn their confidence. The efforts in this direction have been intensified, and in the nineteen-sixties a «complaints unit» was set up. This developed into customer service, which collected and evaluated reports from the front line of spinning operations, organized by issue, machine and system. These data were used for prompt, on-the-spot service, and also provided the factual basis for the constructive further development of Rieter products. Valuable experience from the used car market was also utilized at Bertschinger AG, a company trading in used machinery.

Electrical engineering

Between 1890 and 1906 the Rieter Machine Works took an intense interest in electrical engineering in the shape of motors, generators, electric-powered rail vehicles, etc. When production of these products was discontinued, Rieter's electrical engineering activities were reduced to maintaining the factory installations. On the company's 150th anniversary in 1945 only one electrician was still employed for the factory's needs and to meet the requirements of research and design work. Modern drive technology, process control, security systems, and especially the potential offered by electronics, boosted the number of personnel employed in new electrical activities to some 200 at the company's 200th anniversary. Development surged with the purchase and expansion of Schaltag AG and the integrated electronics of the filament machines. The manufacture of switching and control units has become a definite in-house operation as choices are made between in-house manufacture and purchase. Meanwhile, motors and rotation electronics have continued to be largely bought-in items. The integration of control technology in the data processing operations of control units has become increasingly close with the help of networks and telecommunication links. This mixture of different systems is in line with the development trend of artificial intelligence, for which a potentially wide field of development remains.

Information technology (EDP/CIM)

Rieter's first steps in data processing go back to September 1943, when a first system was ordered from Kardex/Powers AG; this came into operation in 1947. Rieter bought a «UCT 1 Univac Calculation Tabulator» from Remington Rand AG as early as 1957. This set new standards with a printout speed of 36 000 lines per hour. The rapid development of data processing resulted in its expansion to the UCT II model, and in 1965/66 the follow-up model Univac 1004 came into operation, to be upgraded to the Univac 1005 one year later. In 1968 Rieter built its computer centre with the Univac 1108 system, which was designed in partnership with Sperry Rand AG and operated for the joint needs of Sperry and Rieter.

Keen competition between the computer manufacturers led to the merger between Sperry and Burroughs to form UNISYS, whose mainframe computers and networks gave excellent service to Rieter. An NCR computer was also used for financial management assignments and for Schaltag management until 1992.

Rieter kept an extremely critical eye on the important fields of CAD/CAM, i.e. the entire CIM complex, and encountered many a queer fish. Finally, suppliers with interesting names joined the familiar manufacturers to form a short-list of competitors. Rieter's decision to choose the products of Digital Equipment Corp. (DEC) in 1985 was based on the fact that at that time more than sixty percent of the NC machine tools were equipped with DEC computers and the CAD software was already of the very highest standard. Assurances given by DEC's development engineers also indicated that software programs could be expected which would satisfy in full Rieter's needs for machine manufacturing and electrical software. Since Rieter was planning to enter the field in a big way after many years of observing the market and carefully evaluating its needs, and aimed to transfer data from CAD to CAM from the outset, this project involved heavy financial expenditure. The first workstations came into productive operation by mid-1986. Acceptance by the personnel concerned was encouragingly high, since this system represented the first steps towards an IT-focused future.

In its continuing efforts to keep pace with short IT life cycles and to make improvements, Rieter also sought to concentrate on a uniform, top-flight system in this field. Finally, IBM's turn came, and a 3090 mainframe commenced operations in 1988, superseding the UNISYS, NCR and other systems, which were progressively taken out of service by 1993. As this text was being written the global economy was in the grip of a severe recession. Rieter's home base did not escape the consequences of this market situation, and in 1994 studies conduct-ed into outsourcing had produced definite results. Rieter disposed of its information technology activities in July 1994. Generally speaking, special software developed in-house will be the exception in future. Bought-in standard software with individual extensions marks the way into a future in which data processing needs will have to be satisfied with fewer personnel.

Financial management and controlling of projects

Since development engineers can probably be allocated to the artistic professions, their partners from the controlling field complement the project teams very well for the financial management of their assignments. Since inventors usually substantially underestimate the cost of their own work, the financial specialists have the important task of drawing up realistic cost estimates. Calculation of expenditure on components, machines and systems must be very prudent and neutral. Key figures for cost effectiveness must also be defined together with the marketing organization. The reliable calculation of the return on investment is especially important. This assumes the function of a «third pillar» alongside process technology and engineering warranties. Nicolas Henggeler and Kurt Feller have focused special attention on this important issue.

The changing face of quality assurance

The start of machine manufacturing at Rieter reflected the attitude to work in the 19th century. Quality was characterized by reliability in the craft and trade context. This basic attitude resulted in the manufacture of good machines with individual features. Individual components were adjusted manually relative to each other, using hand tools. The fitting of spare parts also required adjustment procedures. Over the years the principle has developed that quality must be produced directly by first-class manufacturing processes, and should not be «tested into the product» by subsequent checking procedures. The processes typical of today's lean production practices only became possible with this change in philosophy.

This concept of high quality was by no means only applicable to the manufacture of machine components. Metaphorically, it also provided a guideline for all partners involved in the creation of a product. A project team was therefore well advised to submit to inspections by quality specialists and utilize the findings from these for purposes of product reliability, operating simplicity, etc.

Recycling and disposal

Steel, castings, light and non-ferrous alloys, paints and varnishes, electroplating products, glass and many other materials are used in building textile machines. Operation of the machines and installations generates dust, exhaust gases and waste water, which can also contain the usual service-related products such as lubricating oils and chemicals. These accompanying phenomena can have an adverse effect on human beings and the environment and create cumulative ecological problems. The project partners must therefore seek to identify these situations at an early stage and select materials for use in construction and operation which impose the least possible burden on the environment. Besides using suitable structural materials and bearing in mind their disposal and the opportunities for recycling, special encouragement must be given to thinking in terms of entire systems. An example worth imitating in textile machinery manufacture are, for example, the plastic tubes of Gretener AG in Cham, where the plastic covers are removed from textile tubes, shredded and dyed, and formed into new shapes.

In order to advise the project team, Rieter set up a chemical unit in its material research team which applied its full-time expertise to these issues. These services performed important partnership functions in development procedures.