

*100th Anniversary of
Maschinenfabrik Reinhausen*
*75th Anniversary of
High-Speed Resistor-Type
Tap-Changers*

From
RIPPING SAWS
to
VACUTAP®

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CHANGERS
**1 THE 100th ANNIVERSARY OF MASCHINENFABRIK REINHAUSEN –
THE 75th ANNIVERSARY MARKING THE INVENTION OF HIGH-SPEED
RESISTOR-TYPE TAP-CHANGERS**

In its 133rd year of existence since it was first established, *Maschinenfabrik Reinhausen GmbH* is proudly celebrating a most rare of occurrences, a double anniversary:

- April 23rd, 2001 will see the 100th anniversary of *Maschinenfabrik Reinhausen*'s (hereinafter abbreviated to *MR*) entry in the commercial register, a company of international standing in the field of high-voltage technology,
- July 13th, 2001 will see the 75th anniversary of the issuance of a patent to *Bernhard Jansen, Dr.Sc.(Eng.)* for his invention of the high-speed resistor-type tap-changer, also known as the 'Jansen' on-load tap-changer.

The present publication's aim shall be to try and retrace MR's development from its formerly modest beginnings as a mechanical workshop for wood working machinery in Reinhausen all the way to becoming today's world market leader in the production of on-load tap-changers for power transformers, while at the same time attempting to shed some light on a most significant chapter in the history of electrical engineering.

Following this synopsis, Chapter 2 will describe the origins of *Maschinenfabrik Reinhausen* as a family-owned business with an excellent reputation as a manufacturer of complex mechanical machinery from its establishment in 1868 until 1929. Chapter 3 intends to briefly outline the history of progress in the field of transformers, from the discovery of magnetic induction in 1831 all the way to the publication of the groundbreaking patents for on-load tap-changers in the early 20th century. Chapter 4 will be dedicated to the collaboration between the *Scheubeck Brothers* and the inventor *Jansen* during the years between 1929 and 1958 and portrays MR's successful metamorphosis into an electrical engineering company. Chapter 5 contains a condensed synopsis of the fundamental milestones of MR's route to becoming today's world market leader in the field of on-load tap-changers and allows glimpses of MR's latest developments.

2 FABRICATION OF COMPLEX MACHINERY

Reinhausen is a district of the city of Regensburg situated at the confluence of the Regen and Danube rivers. Thanks to being situated in a location so favourable to traffic, Reinhausen had started attracting wood-working businesses as early as the mid-17th century. In the course of industrialisation, the 19th century witnessed the settlement of workshops specialising in the repair of steam-actuated sawmills.

In 1868, one of these workshops developed from a repair shop into a manufacturer of so-called ripping saws. The latter were machines featuring vertical saw blades used for cutting tree trunks into boards of different sizes in a single process. These saws used to be set up in ground depressions for two reasons: to ensure that the lumber arriving on track-guided trolleys could be fed into the saw at the proper working height, and to facilitate the removal of the falling wood chips and sawdust generated in the process. A track system went from the lumber yard to the ripping saw, and from there to the sawn timber storage area.

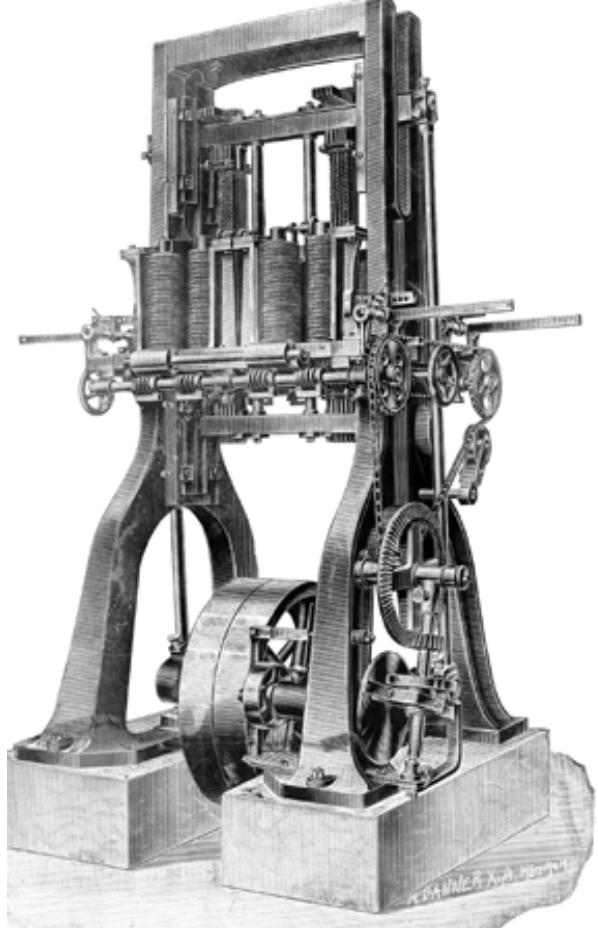
On January 24th, 1891, this business was purchased by Master Sawmill Operator *Carl Dänner* and his wife Katharina, and renamed into *Carl Dänner Maschinenfabrik*. The couple's first-born daughter, Therese, was by that time already the wife of *Andreas Scheubeck*, a mechanic of long-standing experience in wood-working machinery, whom she had married on June 30th, 1889. Regrettably, *Carl Dänner* was not meant to enjoy his newly purchased machine factory for very long. He was only 51 years when he passed away on March 13th, 1893. This tragic event notwithstanding, the company continued to thrive, most notably thanks to *Andreas Scheubeck*'s skill and dedication. On April 1st, 1901, the widow *Katharina Dänner* sold equal portions of the company to her daughter Therese and to her son-in-law *Andreas Scheubeck*. On April 23rd, 1901, the company's name was changed into *Maschinenfabrik Reinhausen Andreas Scheubeck* and entered in the commercial register.

There were a number of ripping saw manufacturers in business at the turn of the century. To improve its competitive edge, *Maschinenfabrik Reinhausen*'s company policy even in those days was based on the following three strategic elements which are as valid today as they were then:

- Distinction from the competition through quality and service rather than low prices,
- Sale of ripping saws coupled with the provision of support services,
- Successful expansion of the production volume through export.

During this time, *Andreas Scheubeck* was faced with a lot of challenges not only as an entrepreneur, but also as head of a large family. Between 1890 and 1911, his wife had given birth to ten children: his sons Max, Oskar, Robert, Richard and Albert and his daughters Ida, Ernestine, Elisabeth, Rosa and Martha.

Between 1914 and 1918, the positive commercial developments in the construction of ripping saws were rudely interrupted by the First World War. During the period following the war, the manufacture of machinery was never again to reclaim the importance it once held and was slowly phased out. Following his wife's passing in 1922, *Andreas Scheubeck* was sole owner of *Maschinenfabrik Reinhausen*.



Double ripping saw by
Maschinenfabrik Reinhausen
Andreas Scheubeck

Considerable personal effort and willingness to do without were required of the *Scheubeck* family to keep above the water during the era of Great Depression by taking on repair jobs, single-piece production jobs, and an occasional series in these difficult times. The production efforts launched during the period until 1929 include bicycle components, fittings and mounting parts, and window frames for railway carriages and ships. Even aircraft construction was not left out. None of these efforts, however, succeeded in the establishment of a sound in-house production. The driving force behind all of these activities and efforts were Scheubeck's sons *Oskar* and *Richard*.



Oskar and Richard Scheubeck

3 THE INVENTION OF THE HIGH-SPEED RESISTOR-TYPE TAP-CHANGER

On August 29th, 1831, *Michael Faraday* was experimenting with a closed magnetic circuit with several windings, thereby discovering the principle of magnetic induction on which all generators and transformers are based. He found that electric current is induced in a conductor whenever magnetic fields are moved in the conductor's proximity. This discovery opened up entirely new ways for the production of electricity.

The initial development to follow this discovery were induction coils (Ruhmkorff coils). The first genuine transformer, however, is attributed to *Lucien Gaulard* and *Josiah Willard Gibbs* who first presented their "secondary generator" in 1883 to a stunned circle of experts in London. This development already encompassed the realisation of a voltage control, featuring a sliding iron core for the induction coils, additionally combined with a turn-to-turn switch. The years to follow saw a rapid and frenzied further development of apparatuses then referred to as "converters" and "voltainductors", a development mentioned in connection with such distinguished names as *Ganz*, *Siemens*, *Schuckert* and *Halske*. The term „transformer“, used for the first time in 1885 in conjunction with patent applications, quickly caught on and prevails until today.



Michael Faraday

Another dramatic event to follow in 1889 was the first patent granted on a three-phase transformer in response to a patent application submitted by *AEG's Michael v. Dolivo-Dobrowolsky*. Only a year later, *Charles Brown*, co-founder of the Swiss company *Brown Boveri & Cie.*, was the first to build an oil-filled transformer designed to keep out atmospheric humidity and to bestow outstanding insulating properties. It was discovered only later, quite by chance, that the circulating oil was also an excellent means of dissipating heat. Transformers had triumphed and were here to stay. August 25th, 1891 saw the first-time ever transfer of 100kW of three-phase current with 15kV voltage over a distance of 175 kilometres from Lauffen to Frankfurt on the Main; even then, the power efficiency was as high as 76 %.

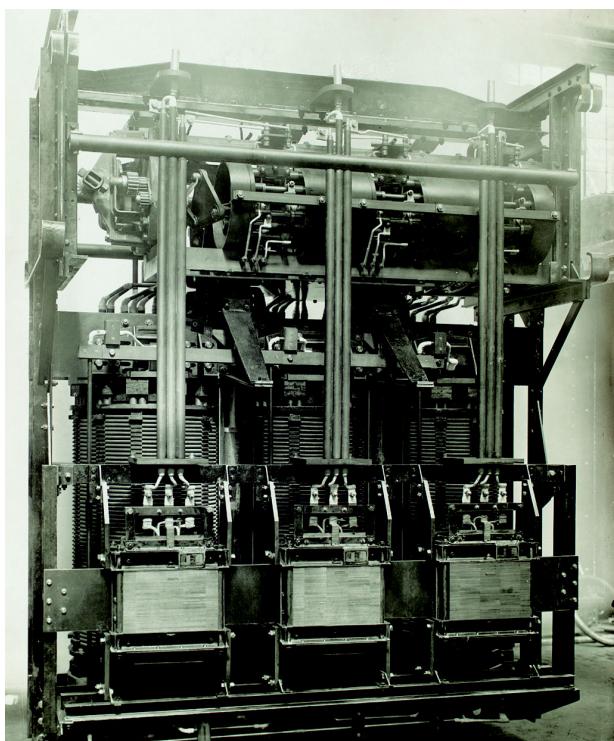
It had become evident very early on that transformers with a rigid actual transformation ratio were only rarely up to standards, and that it would be most welcome if this actual transformation ratio could be modified. Generally, this task could be accomplished in two ways:

- by influencing induction and magnetic circuit or
- by selectively switchable windings and/or winding sections.

Equal effort was given to the examination of both of these technical principles, which commenced as early as the 19th century and were the subject-matter of numerous patents.

Initially, transformers equipped with winding taps – the connection of which entailed significant technical difficulties – even appeared to be the less desirable of the two alternatives. Instead, there followed the development and subsequent application of a vast number of the most diverse and increasingly complicated induction controllers. Also, a combination of the two controlling principles was attempted: With coarse-step control provided by the various winding taps and precision control provided by the induction controller. However, even here the set-ups turned out to be more and more complicated, and it became obvious that the technical development of induction control had come to a dead end.

It had been suggested as early as 1894 by *Siemens & Halske* to do split primary and secondary windings with different interconnections depending on differing loads. One of *AEG*'s patents dating back to 1904 contains an in-depth treatise on the then prevalent principle of tap-changing control according to which „one was compelled to interrupt the power supply during tap-change” if one wished to avoid a short-circuit within any of the winding groups. According to this invention, a genuine uninterrupted tap-change between the individual winding sections was to involve an arrangement of the various winding groups at separate transformers, or at the very least on separate magnetic circuits.



Regulating Transformer 1929
Throughput Rating 15,000 kVA
 $55,000 \pm 6 \times 1,100$ V

Even these types of solutions featuring auxiliary transformers, contactors, or preventive choke coil systems were becoming ever more complex and demanding. In 1924, a patent by Dresden's *Sachsenwerk* was published which casts a revealing light on the situation at that time. It concerns itself with transition resistors and lists a detailed description of damages prone to occur should these resistors, which were not designed for continuous operation, remain switched on in the event of a failure. This is topped by a conclusion smacking a bit of resignation, suggesting that one would be wise to do without danger-fraught tap-changes under load unless a way could be found to eliminate these dangers. The solution presented for this problem was a transition resistor with thermocouple assembly intended for issuing a signal to switch off the transformer on the event of overheating. Seeing as how no-one was able to eliminate the reasons for any of the malfunctions, it was felt at the time that the least which could be done was to find a way of minimising the damage potential. Simply put, the one thing missing was a suitable switch for uninterrupted transformer tap-change.

Finally, in 1928, the first patent dealing with this issue was published by *Bernhard Jansen, Dr.Sc.(Eng.)* under patent no. 467 560. In this patent, he is suggesting a solution featuring only a single circuit-breaker which is moved along the individual winding taps in conjunction with a transition resistor – and the selector switch principle, valid to this very day, was born. In addition, *Dr. Jansen* is granted yet another patent, no. 474 613, first submitted for application on July 13th, 1926, and published on April 6th, 1929, dealing with the uninterrupted tap-change under load featuring two circuit-breakers moving in opposing directions, with preliminary contacts. This ground-breaking patent, which until this very day continues to remain the basic principle of all high-speed resistor-type tap-changers manufactured worldwide, has been written about at such great length that this issue requires no further elaboration. On May 21st, 1930, *Dr. Jansen* was the first to introduce an energy accumulator in his Patent no. 496 564 which is charged by the movement of the driving shaft and ensures full operation of the diverter switch “briefly and unstoppably upon activation”. Another visionary invention which also continues to remain the chief principle upon which nearly all of the on-load tap-changers produced worldwide are based. Consequently, all functional groups of an on-load tap-changer have been known since 1930 and have remained essentially unchanged in their application until this day.

Bernhard Jansen, Dr.Sc.(Eng.)



4 THE COLLABORATION OF SCHEUBECK-JANSEN

At the time of the publication of his ground-breaking patents on high-speed resistor-type tap-changers, *Bernhard Jansen, Dr.Sc.(Eng.)* was also dedicating himself to the construction of the corresponding prototypes. Having been a resident of Regensburg since late 1928 in his capacity as a technical director of *Oberpfalzwerke* (today's *OBAG* – East Bavarian power company), he had been awarding tenders also to local companies established in the area. In 1929, toothed wheels without boreholes were required, which turned out to be impossible to procure in the required standard of quality. A suitable supplier recommended at that time was *Maschinenfabrik Reinhausen Andreas Scheubeck*. The proprietor's son, *Oskar Scheubeck*, took the order and delivered the toothed wheels, manufactured by apprentice *Franz Bauer* in perfect compliance with the requested design parameters, on that very same day.

Impressed by such evident efficiency, *Dr. Jansen* paid a personal visit to the company on the following day and promised further work. In light of the unfavourable economic climate in Germany and following the phasing-out of the ripping saw production, exacerbated by the ever-prevailing absence of a series fabrication product, the brothers *Oskar and Richard Scheubeck* placed high hopes on this new business relationship. Consequently, they dedicated all of their energies and all of their available means to the issue of on-load tap-changers.



Richard Scheubeck, Anton Schunda, Oskar Scheubeck
in front of type C selector switches

The years to follow saw the construction of test specimens for selector switch type C 100 which were subsequently delivered to *Dr. Jansen*'s licensees, all of them transformer manufacturers, either as masters or for installation in transformers. Since *Dr. Jansen* was forced to devote a lot of his time to his main occupation, he increasingly transferred the supervision of prototype construction into the hand of his co-worker, *Anton Schunda*. It was he who in 1938, without the inventor's knowledge, provided *Maschinenfabrik Reinhausen* with the documentation on the newly developed type D on-load tap-changer. The Brothers *Scheubeck* produced the first prototype of this new switch at their own expense. This prototype made a huge impression, and starting in 1939 *Dr. Jansen* arranged the procurement of smaller-sized production series for the C type, followed by single units of the D type starting in 1941. The clients were various regional utilities who in turn provided these on-load tap-changers to the various transformer manufacturers of their choice.

Andreas Scheubeck passed away in September 1942. Shortly before his death, he had signed over equal shares of the company to his sons Oskar and Richard, effective retroactively as of January 1st, 1942. His sons continued the company under the name of *Maschinenfabrik Reinhausen Gebrüder Scheubeck oHG*. The company's economical situation continued to remain strained throughout the Second World War. It was during those first few post-war years, however, that acknowledged capabilities in the repair and manufacture of mechanical devices were in particularly high demand, and thus followed the repair of machinery and technical plants of the most diverse kinds, even the manufacture of aluminium combs, fishing line spools, and tobacco-cutting apparatuses. Work on the on-load tap changers was continued likewise, to the extent that the materials required were still available or could be procured in some way or another.

The workshops where the majority of the German transformer manufacturers had been producing the on-load tap-changers required for their own needs had for the most part been destroyed during the war. Upon resumption of transformer production, the means, which were available only to a limited extent, had to be concentrated on the best possible purposes of utilisation. At the same time it was realised that the production of the mechanical device of a "on-load tap-changer" did not necessarily harmonise with the manufacturing principles of a static transformer. It was therefore just about inevitable that the concept of a centralised production of the required on-load tap-changers should be born. Correspondingly, *Dr. Jansen* offered *Maschinenfabrik Reinhausen* to take over the production of on-load tap-changers for the German transformer factories, most of whom were in possession of license agreements on the right to use Jansen control technology, coupled with the option of being authorised to eventually deliver to foreign transformer manufacturers further down the line.

The Brothers *Scheubeck* recognised the unique, once-in-a-lifetime opportunity that was presented to them. The reconstruction of the power supply system and the foreseeable continued expansion of the power network were crucial prerequisites for the German economic miracle which was soon to follow, and an enormous demand for on-load tap-changers was to be expected. Of likewise glaring evidence were the nearly insurmountable problems in connection with the actual commencement of production. However, it was their unconditional belief in the product "on-load tap-changer", enhanced not least by their know-how and experience in production techniques gained in the past at great expense, which compelled the brothers to put all their eggs in one basket and to accept the offer.

During the first post-war years, the incoming orders would regularly exceed production capacities. The old machine construction shop in Holzgartenstrasse was reconstructed as early as 1948, followed by the building of annexes to the East and South in the subsequent year, and an additional annex to the West in the year thereafter. The rebuilding and extension of the production facilities necessitated the hiring of additional personnel and led to a rapid increase in personnel between 1948 and 1951, from an initial staff of 25 (including 4 apprentices) to a staff of 137 (including 17 apprentices).

Finally, on December 28th, 1951, a written license agreement was concluded between *Dr. Jansen* and *Maschinenfabrik Reinhäusen*. In view of the necessary investments, a long-term solid basis for the production and sale of on-load tap-changers was to be established. Consequently, the agreement was to be terminable for the first time on December 31st, 1968. Essentially, *MR* was granted the right of delivering to any customer of their choice, both national and international, in return for the payment of considerable license fees and the obligation to rapidly build up capacities in order to meet the foreseeable demands. *Dr. Jansen* assured *MR* that he would henceforth discontinue having on-load tap-changers built on his own, and refrain from bestowing further building licences for future reference. Since *Dr. Jansen's* licensees up to that date used to be transformer manufacturers, *MR* became the first and only licensee operating independently of the transformer construction business.

Even after the conclusion of this fundamental agreement, *Dr. Jansen* continued in his efforts to spread his invention all over the globe. Even today it seems remarkable that the on-load tap-changers invented by him were authorised for use in France as early as 1952; after all, the Second World War had not been over for very long when the French Allied Forces started to build upon basic technology from Germany for the development of their own power supply system. During that very same year, *Dr. Jansen* was able to procure for *Maschinenfabrik Reinhäusen* the conclusion of identically worded license agreements with the French electrical engineering conglomerates *Alstom* and *Savoisienne*. As the French licensees' interest lay predominantly in assembly, *MR* managed to secure an order volume for component deliveries of considerable size within the closed French market.

However, the capacities of the Holzgartenstrasse works were by now exhausted for good. The new plans and ideas, forged mainly by *Oskar Scheubeck* and his authorised signatory *Adam Huppmann*, were of such a bold and daring nature that it took a lot of powers of persuasion on his Brother's part to get *Richard Scheubeck* to agree: the entire factory was to be built up anew and at the same time be considerably extended at the Falkensteinstrasse location, also situated in Reinhäusen. Moreover, property reserves were to be maintained for later building expansions. The construction of the workshop was commenced right away in 1952.

Due to limited capital resources, which were nowhere near sufficient, coupled with a lack of access to capital markets typical of this post-war era, any industrial growth had to be financed solely by bank credits. All expenses were there subjected to the principles of utmost scrutiny and thrift, and the owners were consequently forced to act with nearly complete restraint with regard to withdrawals.

In view of the additional expansion plans for Falkensteinstrasse, however, as well as in response to pressures exerted on by part of the banks, the company's capital resources had to be strengthened. Naturally, the first person of choice to be consulted in this situation would be MR's long-standing business partner and licensor, *Dr. Jansen*, who recommended his daughter, Magdalena, as co-investor. On January 1st, 1954, the company was thus changed over into *Maschinenfabrik Reinhausen Gebrüder Scheubeck KG*.

Upon completion of the most urgent reconstruction works following the Second World War, the company's growth rates were beginning to normalise accordingly. The fiscal year 1957 saw a first-time reduction in annual turnover, further exacerbated by a prolonged interruption of operations due to the transfer of the component production facility from Holzgartenstrasse to Falkensteinstrasse. The lifebuoy which came to the company's rescue was the rapidly growing export business which accounted for 50% of the overall turnover even in those days.



Building Site Falkensteinstrasse

On October 15th, 1958, *Dr. Jansen*, who was only 59 years old at that time, passed away unexpectedly as a result of a car accident. A total of 49 German patents can be traced back to him, concerning a most diverse range of problems, improvements and further developments in connection with the on-load tap-changer and the regulating transformer, many of which had also been applied for abroad. The last German patent attributed to *Bernhard Jansen* was published on July 7th, 1966 under Patent no. 1 207 490.

5 MILESTONES ON THE WAY TO BECOMING WORLD MARKET LEADER

After *Dr. Jansen*'s death, *Maschinenfabrik Reinhäusen* was forced to resume the task of continuing the development of the high-speed resistor-type tap-changer. In identically worded letters previously agreed with the Jansen family, all of *Dr. Jansens*' licensees were reassured that MR would henceforth assume the duty of ensuring the maintenance of the patents, the continuation of the research and development works, and the advisory service to the licensees in the same manner as it had earlier been performed by the inventor himself. Assumption of responsibility for research and development inaugurated a fundamental restructuring and modernisation of the on-load tap-changer program, since the products yielding the highest turnover rates were after all still based on pre-war designs. The powerful extent of the development projects, but equally the confidence in one's own abilities are not in the least attested to by the fact that a patent attorney had been hired back in 1961, and commissioned with the establishment of a patent system. Throughout the following years, up to 14 patent applications per year were submitted in Germany, and several times that number abroad. The objective was to protect new in-house developments to the greatest extent possible against uncontrolled plagiarism, and to create sufficient leeway for future development steps through establishment of fundamental stockpiling patents. Taken into account were countries with a history of renowned transformer industries, i.e. France, Italy, Great Britain, Sweden, Norway, Austria, Spain, Australia, Japan, also the US and Hungary.

In December of 1961 *Richard Scheubeck* passed away at the age of 64. When it rains, but it pours – in addition to going through a time of upheaval on the technical sector, the highly indebted company also had to come to terms with changes within its circle of partners.

Maschinenfabrik Reinhäusen's progress in development culminating in the position it now enjoys in the field of high-voltage technology was determined to a major extent by the fact that MR succeeded in concluding additional license agreements with renowned companies during this period of time, e.g. in 1961 in Japan with *Mitsubishi*, *Toshiba* and *Nissin*. These agreements provided not only access to new markets with considerable sales potential, but also highly welcome license fees badly needed for covering the immense costs associated with research and development.

While national sales were stagnating, even reverting drastically in 1966 and 1967 due to weak market conditions, exports kept increasing at a steady rate, growing from an overall turnover percentage of 67 % in 1963 all the way to a whopping 82 % by 1968 – whereof 55 % for Western Europe, 25 % for overseas countries and 2 % for the East Bloc countries. This continuously increasing dependence on exports was a logical consequence of German market conditions: the companies *AEG* and *Siemens* were producing all the on-load tap-changers they required to meet their own requirements, whereas all of the other German transformer manufacturers were already having their demands covered nearly exclusively by *Maschinenfabrik Reinhäusen*. Roughly 40 % of the total sales figures were divided over a mere four exporting countries each, among them with great regularity Italy, France and Spain, in certain years also Japan, Australia, and Canada. Other countries with noteworthy sales shares included Switzerland, Austria, Finland, and lately Brazil and Argentina. By 1968, the number of employees had risen to 840.

The great breakthrough came with the 1973 market introduction of the Type M on-load tap-changer resulting from large-scale research and development efforts – a major technological leap on the „Mechanics“ sector. Thus had the conditions been prepared for replacing the type D on-load tap-changer developed so long ago by *Dr. Jansen*, which had first been manufactured by *Maschinenfabrik Reinhhausen* in 1938. In the end, however, a few more years were to pass until the manufacture of this most robust of on-load tap-changers was finally stopped in Regensburg – all in all, more than 11,000 on-load tap-changers type D were produced by *MR*.

In July of 1978, *Oskar Scheubeck*, who had for decades been one of the company's most treasured source of new impulses and had at all times been an uncompromising advocate of excellence in quality and entrepreneurial courage, passed away at the age of 83. For many of *Maschinenfabrik Reinhhausen*'s older employees he continues to remain a figure of identification, certainly not least for those reasons. His succession had been taken care of in due time – his son *Egon Scheubeck* had already worked his way up into management.

In view of the considerable volume of the export share, coupled with promising growth perspectives for some of the markets abroad, the foundation of subsidiary companies became a major active strategic element. The first subsidiary was *MR do Brasil*, founded in 1980, which produces on-load tap-changers for the Brazilian market and provides support services for *MR* products all over Latin America. Eight years later Australia's long-standing sales and services agency was taken over and renamed into *Reinhhausen Australia*. A major leap forward came in the 1989 takeover of *Westinghouse*'s on-load tap-changer production and renaming of the company as *Reinhhausen Manufacturing*: this step involved both the completion of built-in resistor-type tap-changers from Reinhhausen with the competing technology of bolt-on reactor tap-changers, and paved the way for final entry into the US market. 1993 saw the takeover of the sales and service agency in the important European market in Italy, since renamed as *Reinhhausen Italia*. A further milestone on the way to becoming a player in the global market was the foundation of two joint venture companies in China (*Guangdong MR*) and in India (*Easun-MR*) in 1996. The last in this series so far was *Reinhhausen Asia-Pacific*, founded in 1997 in Malaysia and responsible for providing sales and support services to the smaller countries of Southeast Asia. The objective behind the above measures, in view of an increased transfer of the transformer business away from Europe and into Asia and North and South America, was to keep the spatial, temporal, language-related and cultural distances between *Maschinenfabrik Reinhhausen* and its customers to an all-time minimum.



Type M On-Load Tap-Changer

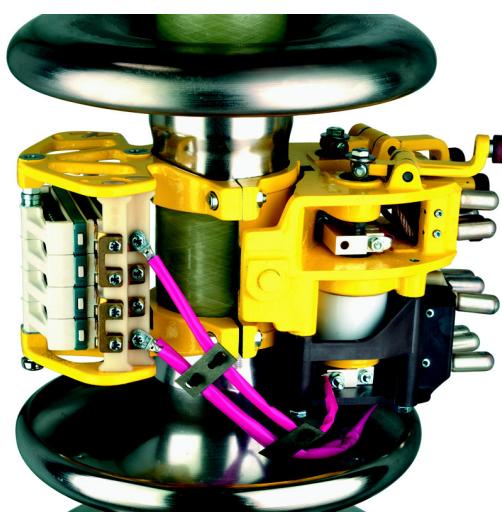
The company's continuous growth, coupled with the foreseeable withdrawal, for reasons of age-related retirement, of the last one of the partners actively involved in the company, *Egon Scheubeck*, gave rise in 1988 to the idea of a separation of capital and management. The interests of the family owners, the descendants of the *Gebrüder Scheubeck* as well as the daughter of *Dr. Jansen*, were focused on the *Scheubeck GmbH & Co*, whereas the industrial activities were focused on *Maschinenfabrik Reinhausen GmbH*.

1989 presented the possibility for takeover of the on-load tap-changer production from Siemens, one of the major and historically most important competitors, against the granting of a minimum participation. This step represented another significant spurt of growth for the company which would soon afterward cause the factories in Falkensteinstrasse and Holzgartenstrasse to appear too small once again. Correspondingly, the operations were transferred to Works no. II in Haslbach in 1993, and the original site in Holzgartenstrasse, the company's homestead of more than 125 years, was abandoned.

The death of *Magdalena Woschek* (née *Jansen*) in 1998 marked the passing away of the very last of the second-generation family partners. The decisions in regard to law of partnership and company law which were passed early on and were updated continuously in keeping with the ongoing developments, have passed the test of time and proven to be in the best interest of *Maschinenfabrik Reinhausen* throughout the decades.

The unknown territory conquered in 2000 with the market introduction of the Type VACUTAP® VV was new in more sense than one: not only was it the first time ever that a technological leap was made for a high-speed resistor-type tap-changer with a wide range of applications in switching technology from the original „switching in oil“ to „switching in a vacuum“; this step was taken even further by the continuous development of the selector switch design, culminating in a full and adequate on-load tap-changer.

The market introduction of other vacuum tap changers within the VACUTAP® series, has been scheduled for 2002 and was intended to convey even more advantages to the user.



VV VACUTAP®

Dr. Jansen, with his fundamental and ground-breaking inventions, has made an impact on the construction of on-load tap-changers – and has thus indirectly influenced the construction of regulating transformers – in a way that has never been duplicated by anyone else so far. *Maschinenfabrik Reinhausen*, with its new inventions, has managed a virtually seamless follow-up to the extraordinary technical achievements of this consummate technician and visionary. To this date, *MR* has registered more than 470 inventions in Germany alone – whether as patent applications or as utility model applications. The majority of these inventions have in addition been registered abroad, quite a significant proof of the innovative forces at work in this company. Apart from state-of-the-art control technology, the company has for the past few years been successfully marketing innovative monitoring systems. The number of employees has over the years been increased at a steady pace, with a staff of 1,050 currently employed in Regensburg, and a total staff of 1,350 including the subsidiaries worldwide.

In summary, *Maschinenfabrik Reinhausen* by serving its customers with quality work, has succeeded in becoming a highly-specialised, globally active and outstandingly successful company in the field of high-voltage technology. The one trait which has remained essentially unchanged since the time the company was first founded is its character of a family-owned business, combined with the equally unchanged rooting of the net product at the Regensburg site, especially the Reinhausen city district. As luck would have it, 2001 will see the delivery of the 100,000th on-load/off-circuit tap-changers „Made in Reinhausen“, a worthy conclusion of the 100th anniversary as well as convincing proof of *MR*’s decades of performance of efficiency as the world market leader of on-load tap-changers.



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