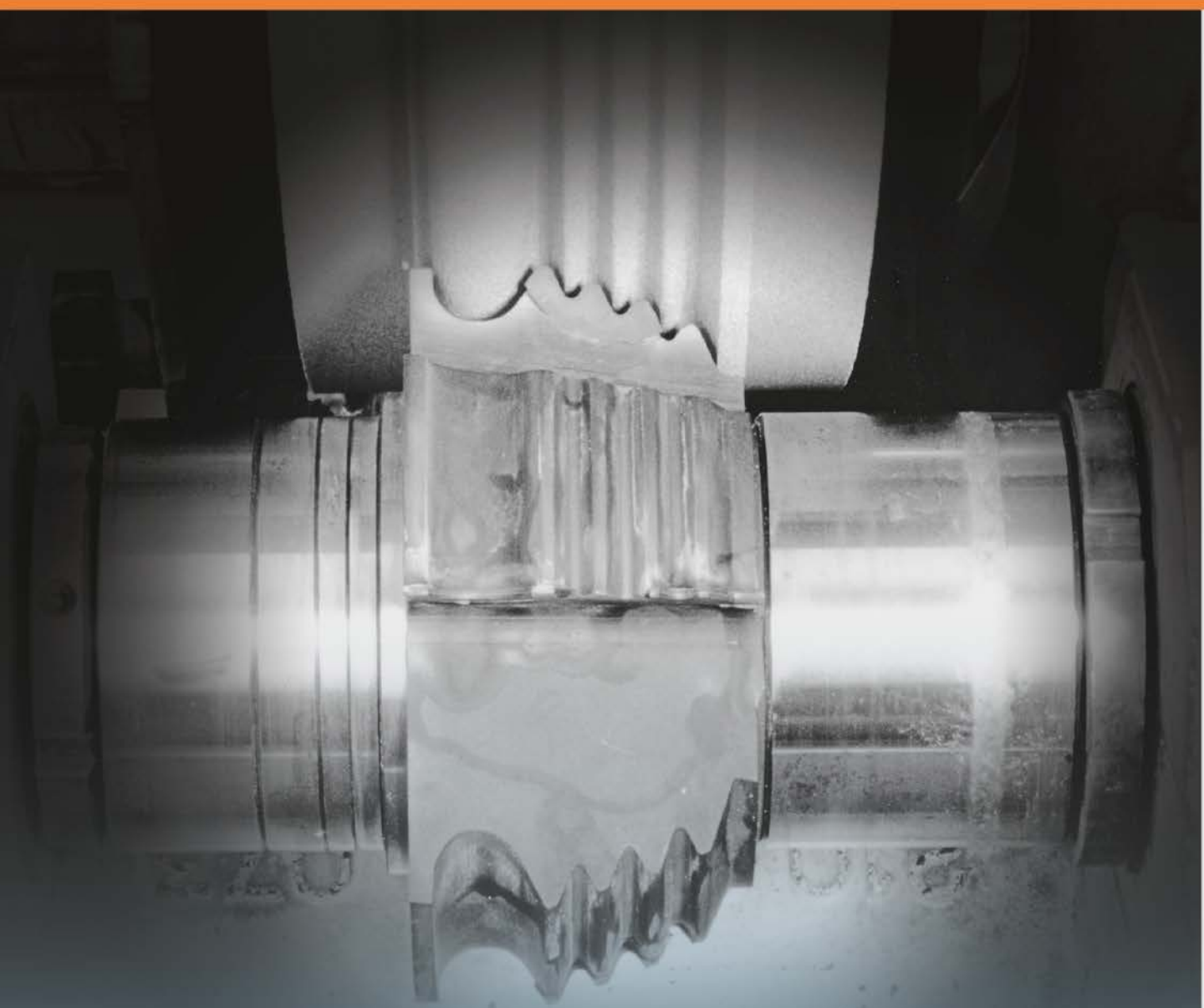
CUTTING TOOL ENGINEERING®



"Poly - Poly - or what?"

Part 8

How the "issue with the comma" turned into a success story after all…

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Part 8: How the “issue with the comma” turned into a success story after all…

Horst Lach, managing director and CEO of LACH DIAMANT, agreed to write an ongoing series of articles about the development of diamond and CBN tools and grinding wheels in modern industries.

Horst Lach is known as a true industry veteran, and we are excited to have this pioneer of technology share some insights from his 59 years of professional experience in the diamond tool business.

True to the motto “Quo vadis – where are you going…?”, you can accompany him to the beginnings of forming and rotating PCD tools and back to the birth hour of mill dressing.

Let’s look back. Could it be that the world’s first presentation of a dia-compact® monoblock milling cutter for aluminium machining at FAMETA in 1980 already laid the foundation for large-scale use within the automobile industry in the 80s? Actually yes, if the aforementioned “stumbling blocks” were not there (see part 7 of this article series “Poly – poly – or what?”).

As we know, the wood and plastic manufacturing industries were already several steps ahead in this regard – especially when focussing on manufacturers of furniture/kitchen furniture, laminate flooring, and door and particle board industries. One obvious advantage for industrial mass production was the diamond cutting edge, soldered tightly to the carrier, creating quasi- monoblock tools. Without the need to re-tip used cutters with carbide plates after each shift, the dia-compact® tool could show its full capacity – 250 to 300 times longer tool times, compared to carbide, became a calculable reality. No wonder that the related machine industry – particularly manufacturers of routing machines and double end tenoners embraced this new technology enthusiastically. In the 1980s and 1990s, European trade shows (in Hanover and Milan) and shows in the United States (IWF in Atlanta in particular) presented, parallel to the developments of NC/CNC technology, amazing performance increases every two years. This was one side of the story.

The company LACH-SPEZIAL-WERKZEUGE GmbH, founded forty years ago, as well as LACH DIAMOND INC. in Grand Rapids/ Michigan, USA, can pride themselves as the worldwide only pioneers when implementing the idea “diamond for all wood and plastic materials”. You may now ask me about LACH DIAMANT, the long-standing company dedicated to metal machining. Analogous to a rising demand for “precision and efficiency”, sales – in other words revenue – steadily increased from one year to the next, more or less evenly divided between the polycrystalline diamond and CBN tool programme, diamond and CBN grinding wheels, diamond dressing tools and more for the demand in the automobile and airplane industries, machine and tool industry etc.

But I often bemoaned the not-yet-existing use and therefore sales potential of diamond monoblock milling machines for the automotive industry. Was this a “toothless tiger”? Did we already miss this chance due to the development of PCD inserts for use on cutter heads which started almost a decade ago?

As so often in life – and when contemplating our “pioneering beginnings” – a lucky coincidence proved to be helpful. Although the core of the solution was so near, even if it would not necessarily be most expedient to “aluminium machining”.

“Yes – almost Aluminium” – “No – Machining”

In any case another topic for “Poly, poly or what?”. I only had to put two and two together. Diamond milling cutters – also with profiled cutting edges and axis angles – already were inevitably starting to be established as superior machining tools in the wood and composite industry. The first presentation of a profiled PCD monoblock milling cutter at FAMETA 1980 put a “dot on the i” and created the basis for future use in the automotive industry. However, the PCD material could do even more: For example, it could be used for dressing conventional grinding wheels.

The combination of two PCD tools, both first presented at this trade show, caused a stir. One was the dia-compact® monoblock milling cutter for machining aluminium with high silicon content, the other trade fair novelty drebodress® with the slogan “the beginning of a new technology for dressing grinding wheels”.

The already available PCD material could do even more, for example “Dressing of (conventional) grinding wheels”.

All in all, this was the birth hour of "mill dressing" for dressing conventional grinding wheels; an international patent was pending and promoted under the proprietary name drebojet®.

By the way, the European patent No_0038929, registered on April 30th, 1980, did not only protect the dressing roll drebojet® but also drebobloc®, the PCD dressing block which was named at the same time.

LACH DIAMANT first presented this new technology for dressing and profiling conventional grinding wheels at EMO 1981 in Hanover. A video about milling dressing with drebojet® also premiered at this trade show. You can watch it at https://vimeo.com/207282861.

Out of many press publications from that time, two excerpts should be mentioned: "The area 'Research and Technology' in hall 7 at Hanover Trade Show 1982, featured the best inventions submitted for the Inventor's Prize 1982.

drebojet®, technologically world-wide an absolute novelty tool based on synthetic diamonds for serial dressing of grinding wheels, particularly for use in the automotive and automotive accessories industry, submitted by innovator Horst Lach, CEO and co-owner of the Hanau enterprise Lach Diamant – Jakob Lach GmbH & Co. KG, was one of them. The drebojet® diamond mill dressing roll, first presented during the international machine tool exhibition EMO in Hanover in the autumn of 1981, provides a new technology for serial dressing of grinding wheels in serial production. So far, with diamond dressing rolls, the profile of e.g. a crankshaft had to be tediously worked into a grinding wheel in 20 minutes or more; now this takes a maximum of 120 seconds." (see *Hanauer Anzeiger* of May 5th, 1981).

"Dressing becomes a milling procedure. Conventional diamond dressing rolls will be manufactured in different procedures and in multiple precision stages. They all have one thing in common: Their shape, no matter which geometry, is a closed shape. The diamond mill dressing roll in the picture is different in this regard. As during milling, the 'chip space', placed intermittently between the cutting teeth, allow for maximum insertion into the grinding wheel […]. Afterwards, the milled grinding tools are – unlike in previously known dressing methods – completely stable and available for the next grinding operation. […] By changing the cutting speed of the diamond milling roll, it is also possible to influence the subsequent surface roughness of a grinding wheel dressed in this way. […]" (see *Der Betriebsleiter* of November 1981).

"Milling instead of conventional dressing of grinding wheels!"

This was the slogan which caught on like wildfire after the first presentations of drebojet® at EMO 1981. A milling cutter tipped with polycrystalline diamonds (PCD) in competition to traditional diamond dressing rolls? A challenge – especially for the world-wide very few diamond tool manufacturers who had been involved in design and production of diamond dressing rolls.

The implementation of the milling technique could possibly multiply the number of roll

Diamond milling rolls were first introduced under the name »drebojet®« at EMO 1981 in Hanover.

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VDI-ZEITSCHRIFT, Band 120, Nr. 24, Dezember 1978, Düsseldorf, H.R. MEYER "Diamant- und CBN-Werkzeuge für Bearbeitungsaufgaben im Maschinenbau"

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Dressing tool for machining abrasives with a rotating dressing roll or a linearly moved dressing block as well as a number of subsequently, in cutting direction arranged protrusions on the circumference of the dressing roll or the edge of the dressing block; with inserts preferably made from polycrystalline synthetic diamond, cubic crystalline boron nitride, carbide or ceramics, which partially overlap to form the profile of the dressing tool, characterized in that cutting inserts of at least two subsequent, in cutting direction arranged protrusions differ in shape.

manufacturers, particularly in an industry which had up to this date nothing to do with dressing grinding wheels: Namely all carbide tool manufacturers and sharpening companies, all of which were just beginning to profit from the success of diamond tools in the wood industry.

At that time also, the leading manufacturer of super abrasives, General Electric, took notice of the demonstrated success of polycrystalline cutting materials in the wood and plastic industries. So it was not surprising at all that, even before EMO 1981, I received a personal invitation from Louis Kapernaros, general manager at GE Superabrasives, and was asked to present all our special activities in the United States of America.

The start of a long friendship

There were a lot of wishes from our side. For example, the provision of larger PCD circular blanks. Up to this point, we had to be content with blade lengths of max. 10-13 mm, for tool production, and cut from 13 mm blanks with EDM wire (keyword: overlapping cutting edges). Even in retrospect, I can say that this meeting with Louis Kapernaros was very successful. For General Electric and the subsequent development of further PCD sizes and types, as well as regarding the following decade-long, intensive cooperation with LACH DIAMANT. Ultimately, these conversations were the start of a long friendship with an always pleasant and cultivated conversation partner.

After the presentation, I was promised full support by the entire General Electric staff for research and development for the drebojet® mill dressing project. I will later get back to other results from this visit.

Support for research and development – knowledgeable readers will have guessed this already – there was something else! The previously mentioned article in the magazine "*Der Betriebsleiter*" suggested this already. And here it comes: "The issue with the comma".

"Chip spaces" between individual teeth – or the distance from tooth to tooth – cause an unwelcome and unacceptable "comma" during plunging when machining/milling a grinding wheel. This is independent of the milling direction (see comparative illustration on page 4).

What now – what to do?

As chance would have it, I met Dr.-Ing. Günter Warnecke in early 1982. At that time, he was preparing for a new position as professor at University of Kaiserslautern (Chair of Production Technology and Business Organization). It goes without saying that we started discussing dressing of grinding wheels with rolls and we also talked about my new, patent-pending idea of mill dressing. First tests at Elb-Schliff in Babenhausen, at that time a leading manufacturer of surface grinding machines, had already provided advantageous insights. For example, that up-cut milling had an advantage over synchronous dressing. And the undeniable "comma issue". Consequently, we commissioned the university of Kaiserslautern or rather Professor Dr.-Ing Günter Warnecke to conduct research regarding the "optimization of operating conditions during dressing of grinding wheels with patent-pending diamond milling tools".

Much to my regret, Dipl.-Ing. Franz-Josef Grün, assigned to this project by Professor Dr.-Ing. Warnecke, focussed his initial research on extensive wear tests of existing polycrystalline diamond types (General Electric and deBeers) – incomprehensible to me because my focus was to find a solution to the annoying comma issue and to see sales revenues as fast as possible. I do not intend to discuss the pros and cons of this research project, which was eventually evaluated as Dipl.-Ing. Franz Josef Grün's dissertation. I shall limit myself to some basic assessments taken from his publication "Kinematic and technological foundations of mill dressing" (published in 1988 by VDI, volume 152:

The drebojet® system. The new technology for dressing of grinding wheels in serial production.

The drebobloc® system. The new technology for dressing of grinding wheels in serial production.

"4.1 Process Principle of Mill Dressing. During mill dressing, the dressing procedure is done with a dressing roll which, unlike traditional diamond dressing profile rolls, is tipped with one or more geometrically defined polycrystalline diamond blades (PCD). The dressing roll has a larger effective width than the grinding wheel, and it is possible to work in synchronous or up-cut mode."

Furthermore, an excerpt from summary and outlook on page 120:

"Evenly arranged blade inserts over the entire circumferential surface of the grinding wheel, resulting from an appropriate choice of speed ratio and dressing time, produce a completely dressed grinding wheel with a wavelike circumference profile".

When this research did not provide any practical solution to avoid "commas", even after the third progress report, we discontinued financial support from LACH DIAMANT. At the same time, it became apparent that Professor Saljé, together with grinding machine manufacturer Blohm in Hamburg, was also investigating the new technology of "mill dressing". From the start, his work was meant to find the ideal relative velocity for specially developed drive systems during synchronous milling and up-cut milling in order to avoid "commas" altogether.

Comma or no Comma

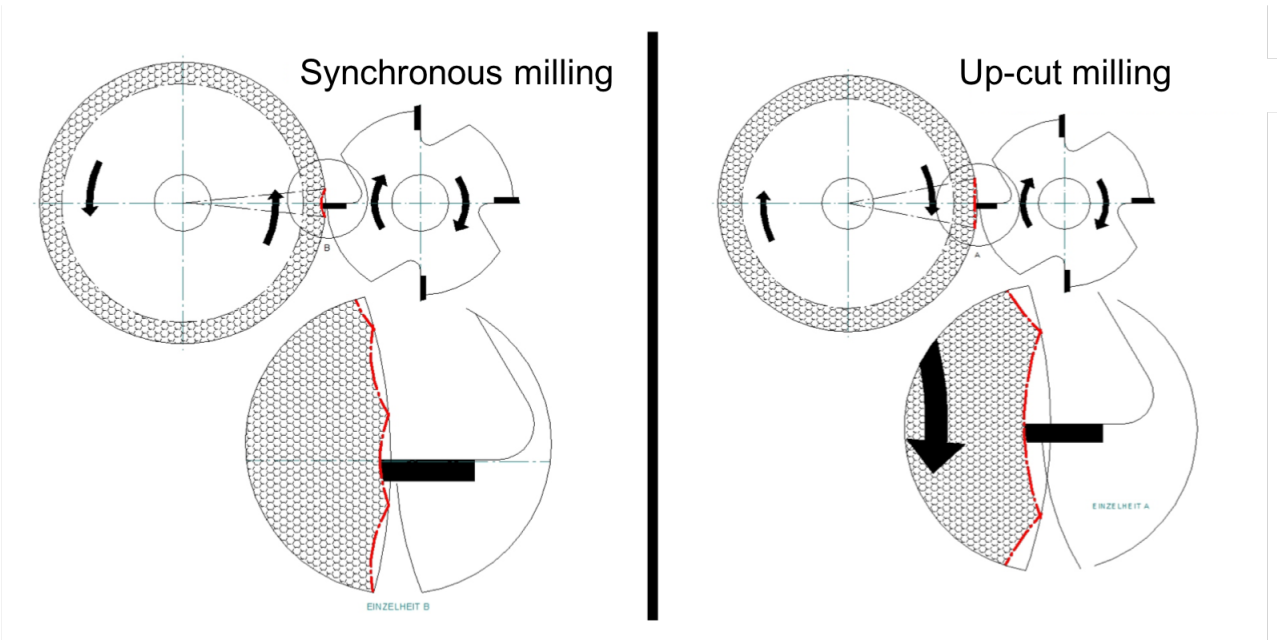
In my opinion, this approach was absolutely right. If only we would already have had today's computer power and programming abilities in the mid 1980s. Of course, I kept pondering the issue. Comma or no comma, simply put, the real "issue" originated from the nature of milling: There was a chip space between each pair of successive teeth; after this type of mill dressing this space imprint would more or less show on the grinding wheel. Why not fill the gap between the individual PCD teeth with diamond, and in this case, tightly attached to the body?

No sooner said than done

The result was a patent application on February 6th, 1985 with the simple title "dressing tool" – short description: "The invention relates to a profiled dressing tool, a dressing roll in particular, for rotating grinding tools with an effective, surface consisting of seattered hard grains."

Many other development steps preceded the final result which was first introduced in 2015 under the name of drebojet-plus®. Today's drebojet-plus® diamond rolls incorporate all of them.
Today, the actual PCD milling tooth of the original drebojet® roll, serves as stabilizer in the current dressing roll, coated with diamond grain. Usually, its modern design makes re-profiling (service), for example during path-controlled dressing of grinding wheels, unnecessary.

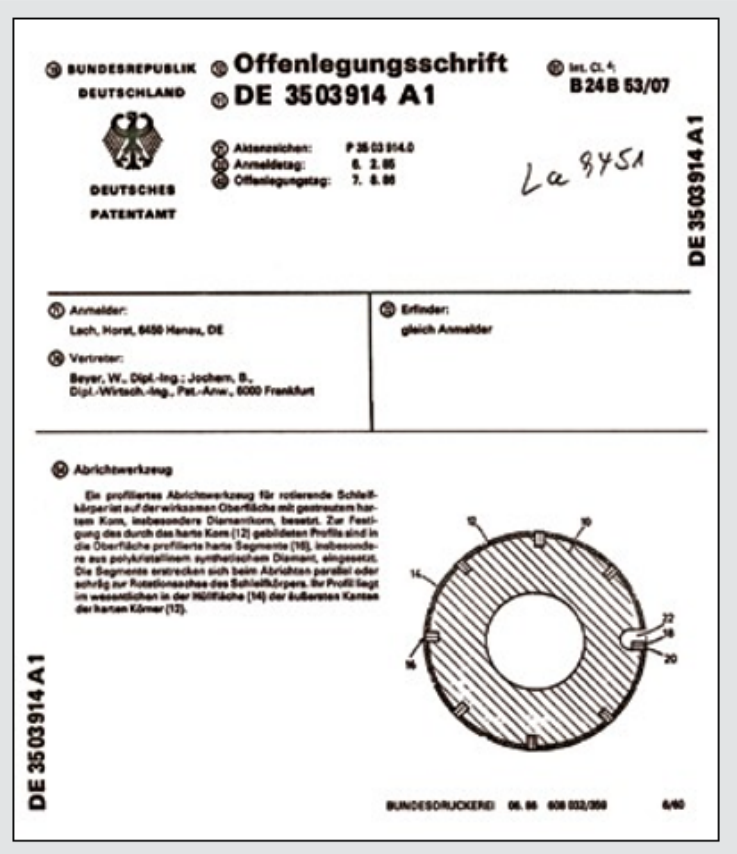
Now, finally, the aforementioned additional success story relating to mill dressing. In any case an economic success story for LACH DIAMANT.



With the support of former manufacturers of polycrystalline diamonds (PCD), LACH DIAMANT's innovations (patent applications) and pioneering achievements had become a topic of interest, such as the development of spark erosion EDM/EDG for machining PCD and the new technology of "mill dressing of grinding wheels".

Thus, in March 1982, the Japanese diamond tool manufacturer Asahi Diamond Industrial Co, Ltd. under president Arihisa Tanaka signed a license agreement for both technologies. This provided the base investment for the new company headquarters building in Donaustrasse in Hanau where we moved in 1984.

Horst Lach



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(54) Abrichtewerkzeug

(57) Ein profiliertes Abrichtewerkzeug für rotierende Schleifkörper ist auf der wirksamen Oberfläche mit gestreutem harten Korn, insbesondere Diamantkorn, besetzt. Zur Festigung des durch das harte Korn (12) gebildeten Profils sind in die Oberfläche profilierte harte Segmente (16), insbesondere aus polykristallinem synthetischem Diamant, eingesetzt. Die Segmente erstrecken sich beim Abrichten parallel oder schräg zur Rotationsachse des Schleifkörpers. Ihr Profil liegt im wesentlichen in der Hüllfläche (14) der äußersten Kanten der harten Körner (12).

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