

The Shining Finish

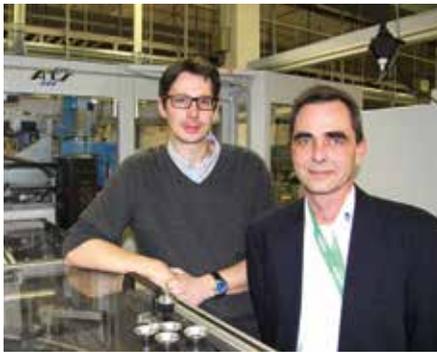
BAUBLIES[®]
SURFACE TECHNOLOGY

Forming process fastens cutting parts:
The mixing blade in Vorwerk's Thermomix combines the support disc and the grinding blades with the screwed-on and tumble-mounted M6 nut. The sheet metal cap has been flanged in two seconds which conforms the construction for use with foodstuff and is also dishwasher safe.

This article was published
in NC-Fertigung, 03/2017

NC FERTIGUNG
Werkzeuge • Maschinen • Anlagenbau





Good cooperation:

Dirk Höhne and Thomas Kappel (r.) are more than satisfied with the service life of the flanging tool. More than 2 million blending blades have so far been fastened, using this simple forming process.



Low forces are sufficient for crimping:

Theoretically, roller speeds of up to 50 m/min and feed rates of up to 0.5 mm per revolution are possible with oil or emulsion lubrication. However Vorwerk beads dry at 300 min⁻¹.



No deburring, no reworking:

The crimping process creates a 100% form closure - with perfect surface quality

By HARALD KLIEBER **What do flanging tools have to do with cutting? "Relatively a lot," says Thomas Kappel, the development manager at Baublies AG in Reningen near Stuttgart. Mr. Kappel has already seen many product developments from concept through to series production. "The majority of our roller and flanging tools run on turning and milling machines. Set in as a changing tool, surface qualities up to $Rz < 1 \mu m$ can be achieved or parts can be shaped energy efficiently and yet very precisely in the lathe." Dirk Höhne, product manager, underlines how well this works particularly for the mixing blade in the Thermomix, the "flagship" of the Wuppertaler household appliance manufacturer, Vorwerk.**

Everyone knows Vorwerk, especially the app controlled Kobold robot vacuum cleaner. The Kobold can wet-mop and, at the same time, vacuum. No fewer electronics are plugged into the battery powered window cleaner or the battery tool set, Twercs, which was launched in 2015 and aimed especially at women. Vorwerk has not, however, stopped at fully digitizing and reinventing its housekeeping products range. Vorwerk's highest turnover product is the Thermomix. This is the legendary kitchen machine with which any hobby cook can prepare the finest meals. To this end, Vorwerk has upgraded the current model, the TM5 launched in 2014, with modern electronics. Via touch screen, WLAN and recipe chip, laymen and the now million-strong Thermomix fan community can follow the daily mixing, grinding, kneading, cooking, steam, weighing, and emulsifying. Each step, every ingredient becomes digitally stipulated and acknowledged.

How good the Thermomix is, particularly the quality and performance of its driving elements, is shown by the blade speed of around 10,000 revolutions per minute or the torque of 3 Nm, decisive during kneading. "The TM5 is the only device, as far as we know, that can produce very fine powdered sugar from granulated sugar in just a few second."

Material forming, burnishing, strengthening

Just as operating the machine is easy without any necessity of modification, so is the cleaning of the TM5. "Most parts are dishwasher safe, just like the heart piece, the mixing blade", emphasizes the product manager responsible for the engineering, Dirk Höhne, as he points out the practical intricacies of the kitchen machine. Having already been sold over 2 million times since 2014, the Thermomix is now in its fifth generation. "The predecessor model had a mixing blade that was not mounted around the ball bearing from individual plastic parts. The ball bearing was still completely moulded with plastic, which caused a little more noise and was also more elaborate to produce. This was the motivation for seeking a new assembly," related Dirk Höhne. Quality and cost were the focus. A decisive detail was the necessity of a stainless steel sheet cap, which would neutralizes the contact of the mixing blades with food and protects the innerworkings while in the dishwasher. How could a stainless steel cap be fastened? "Ultimately, in December 2012, we came across the crimping process from Baublies which allowed us to form the sheet metal while at the same time produce the necessary surface quality," explains Dirk Höhne.



A Cross-sectional view of Thermomix:

Vorwerk only uses the highest quality components. The components decisive for the life-span and operation are produced in the Wuppertal main plant. The mixing blade is the heart, bringing torque and speed to the foodstuffs.

Defining form and force locking moving parts

In the meantime, Baublies AG has developed a large range of tools for the optimization of metallic surfaces: from single and multi-roller tools to diamond burnishing tools to forming and special tools.

"Baublies has nearly always done flanging, the roller technology-so for almost fifty years now. We have actively shown the border crimping in the catalog and on our homepage for around ten years. And it has been worth it," says Development Manager, Thomas Kappel. The roller and crimping tools would be used above all on machine tools. "The vast majority of our roller and flanging tools run on turning and milling machines. When tools are inserted from the tool magazine, surface finishes up to $R_z < 1 \mu\text{m}$ or even tubular workpieces can be shaped quickly and precisely using this energy-saving process." Thomas Kappel assures that it is really quite easy. What is needed is merely a drill press which moves the flanging tool on the sheet metal or tube, and then shapes the desired circumference. Alternatively, along with flanging, Baublies AG also offers flaring, as well as external and internal fluting, which allows the rotary part and components to be not only profiled, but can also be connected in a 100% form-fitting and force-fit manner.

Original rolls running for 2 years

Everything other than „standard“ was Vorwerk's specifications. Dirk Höhne outlines the basic conditions: "The small stainless steel cap has to be

sophisticated. The task was to reduce the circumference from about 45 to 43 mm in diameter without leaving any significant traces. The process should run in our assembly line at a cycle time of about 8 seconds. Additionally the tool should be able to run without maintenance for a considerable time, so not merely 1,000 parts, but rather more than one million parts need to be produced." "These were large piece requirements and very fine forming processes, which were to be carried out on relatively compliant material with relatively large tolerances," recalls Thomas Kappel. Moreover, no lubricant could be used. "It was clear to us, of course, that we had to use good quality material for this dry shaping. For such cases, we take heat-treated tool steel for our forming rolls, which in the end result has fully met our expectations," says Thomas Kappel. Baublies AG developed the tool and the process in just three months, put it into practice and delivered it to the special machine builder. The mechanism was put into operation in January 2014. "The Baublies tool has fully met our requirements. Although we have a second set of tools, the system has been running for more than two years with the original rollers - which still leave no marks on the sheet metal caps but only a beautiful, burr-free roundness - perfect for a high-quality household appliance," grins Dirk Höhne.

Pressing process would require 10 times higher forces

The flanging tool is driven by a Suhner milling spindle (type Powermaster with 500 min-1) via a VDI40 tool fixture in the approximately 10 m long assembly line of ATS. "You can theoretically drive the flanging tool at up to 600 rpm and deliver 5/10 per revolution. Here at Vorwerk, 300 revolutions are enough. And yet the actual forming process takes just two seconds," says Thomas Kappel, emphasizing the efficiency of his tool. The rollers are only used in a point-by-point manner on the sheet metal, thus allowing low rotational speeds and low axial forces. "If you wanted to implement this process with a press, you would need a force 10 times higher for the stamping," which, according to Thomas Kappel's experience, would of course lead the design of the system into a completely different dimension. "The solution with the sheet metal cap is as simple as it is ingenious: we do not need to clip or glue, and with the Baublies solution, the critical construction and application specifications for the Thermomix were fulfilled."

"The sheet metal cap takes a lot of work off of our hands". Dirk Höhne praises the simple and efficient solution to solve form and force closure with a tiny sheet metal form. "It is actually the brilliant conclusion for a complete assembly," emphasizes Thomas Kappel. According to the development manager, the secret of the process efficiency and stability is primarily the radius profile of the three forming rolls, which are specially adapted to the rotating part. "In order to reconcile material and roll geometry, of course, you need some previous experience - and a customer who has confidence and does not only require the lowest priced possible process. Together, such a perfect solution can emerge," concludes Thomas Kappel, emphasizing the good, very goal-oriented cooperation with Vorwerk.

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