



The KAPP Group has recently introduced a combined process for the hard finishing of transmission gears for the automotive industry that involves two machines—one for grinding and the other for Coroning™ (honing)—that are designed specifically to work in tandem with one another.

The conventional process for mass producing gears needed to be improved. The need to improve the process of hard finishing automotive gears has increased as the noise and power density requirements have increased. The conventional

process for mass producing gears has been either to grind them or to hone them, or it has been to use two separate machines—often from two different manufacturers—set side by side for a grind/hone combined process.

While using grinding as a single process produces excellent geometrical quality gears, the surface structure produced is less than optimal for noise considerations. Honing as a stand-alone process produces the desired surface structure, but the process itself is not capable of either material removal or the geometrical process control necessary without

INNOVATION IS A MUST IN TODAY'S COMPETITIVE MANUFACTURING ENVIRONMENT, SO KAPP HAS DESIGNED MACHINES THAT ARE COUPLED TO PROVIDE GRINDING AND CORONING IN A SINGLE AUTOMATED PROCESS.

KAPP'S

KOMBINED FOR PROCESS

AUTOMOTIVE APPLICATIONS

By Tom Lang

extreme care taken in the pre-honed blank. Using two non-compatible machines can be expensive, time consuming, it requires two separate inventories of spare parts, and it invites conflicts with automation.

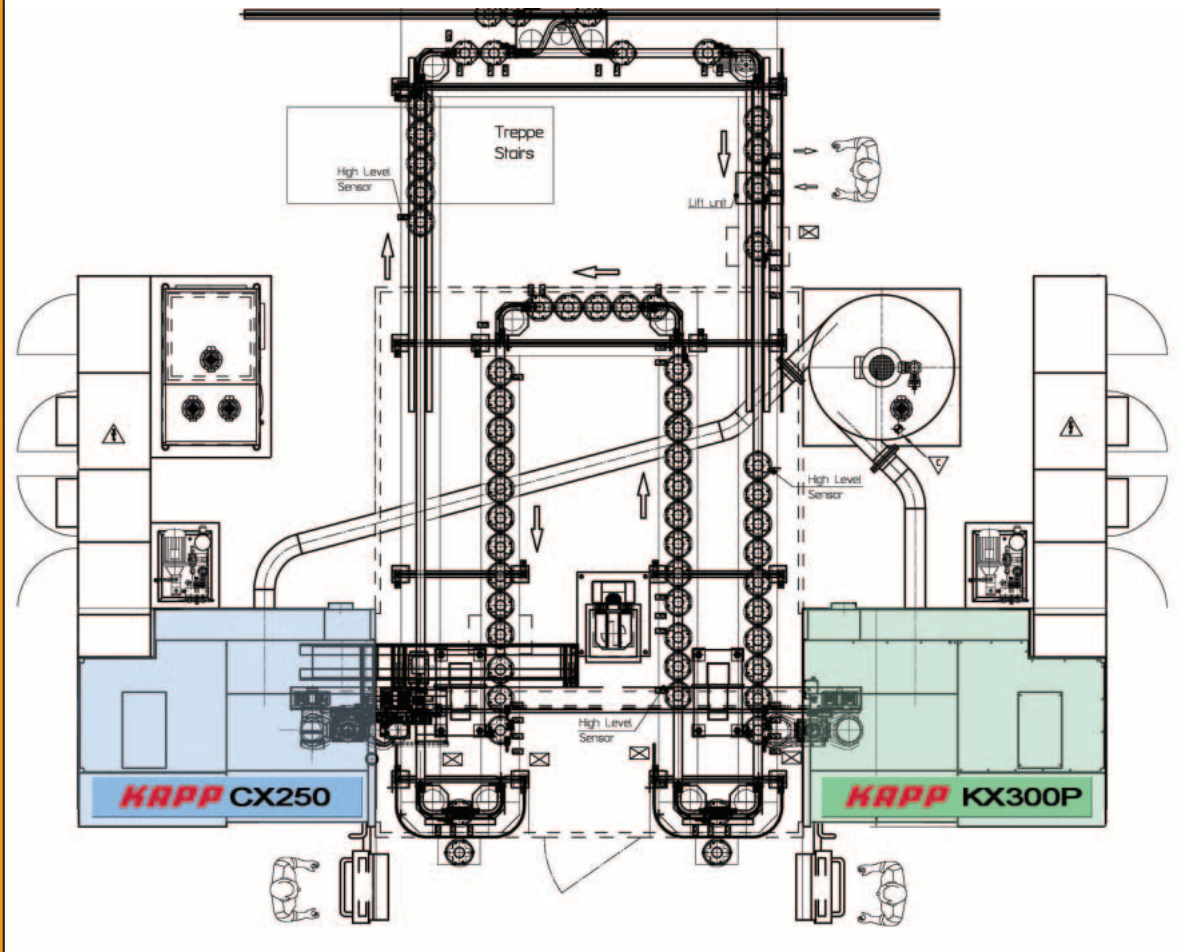
Multiple Approaches

KAPP went through a number of machine concepts before it settled on the design for coupling two machines in a mirror image of each other. We first explored the possibility of put-

ting both the grinding process and the honing process on a common machine base. This idea, while interesting, proved not to be the most economical or practical solution because of the complexity required for a single machine to do both processes at the same time. In addition, the single machine concept would require both processes to stop completely for set-ups and tool changes.

We also explored the idea of building two machines on separate bases and making one control system and one electrical system to run both. While this solution may have been

Figure 1 — Engineering drawing shows KAPP's solution for hard finishing that involves a grinding machine coupled in mirror image with a Coroning machine.



the most economical from a capital investment point of view, once again both machines would be down for tool changes and set-up due to the automotive industry's lockout requirements.

The ultimate KAPP solution for this combined process uses a similar machine base for two independent machines. We built one to be a grinding machine, and a mirror image of that machine to be a honing, or a "Coroning" machine, which is KAPP's trademarked honing process that uses a single layer diamond-plated tool instead of a vitrified stone. Each machine has its own control and electrical system. KAPP's solution has the machines facing each other, which makes the automation relatively simple. One gantry services both machines with a conveyor band that runs between them. By making the control systems identical, along with identical human machine interfaces (HMIs), a single operator can walk from one machine to the other to perform the

set-ups and operations of both machines. This design simplified training significantly.

Another advantage of this combined process is that the control systems, motors, and the pumps are all compatible from machine to machine. This cuts plant engineers' stock of replacement parts by half. Figure 1 shows KAPP's solution to couple two independent machines in a mirror image of each other.

A critical economical feature to KAPP's design is that one coolant system services both machines. This could save customers more than \$1 million in upfront expenses for medium size installations, and hundreds of dollars in additional oil costs, since only one type of oil is needed.

KX300P for Grinding

KAPP's combined process for hard finishing in the automotive industry uses two viable and proven machines coupled together.

The KX300P—the newest model in KAPP's external-grinding machine line—has dressing for worms, dressing for form wheels, can use either CBN-plated worms or CBN-plated form wheels, and also features on-board inspection and integrated balancing. For the automotive industry—and as a pre-process for Coroning—we recommend using dressable, continuous-generating grinding technology.

The dresser on the KX300P, which is full form, dresses both flanks and the outside diameter of the wheel. It runs anywhere between 30 and 80 parts between dress. With this feature, we can precisely control the quality and the stock that goes to the Coroning machine, which is an enormous advantage over what was done in the past. Figure 2 is a photo of KAPP's KX300P, an external-generating grinding machine.

CX250 for Coroning

KAPP's CX250 is a Coroning machine designed as a mirror image of the KX300P machine. CX250 uses the single layer plated diamond-coated Coroning rings, which makes the set-up time on this machine relatively short. There is no dressing in the process, so it is very stable. It is a simple process and has the same control system, the same software, and the same HMIs as the continuous-generating KX300P. The biggest difference from other honing machines is that the CX250 is vertical in orientation, which makes automation much simpler. Figure 3 is a photo of the KAPP's CX250 Coroning machine.

A major technical advantage for coupling these two machines in this arrangement is that the operator—or KAPP, as the provider—has the capability to fine tune the stock conditions. Honing historically is a fine-finishing process and doesn't remove much material. It doesn't make big corrections in profile errors or lead errors, and it can't effectively remove more than 15 to 30 microns of stock. Problems arise when the process before the honing isn't done well enough, or accurately enough.

Consequently, by putting a grinder in front of a honing machine, we can carefully control the quality of the gear going into the honing machine, and in

the end get a much higher quality gear. Further, the stock removal of both processes can be tuned to balance cycle times and therefore achieve maximum throughput. Compared to either a single grinding machine or a single honing machine, the throughput achieved by the combined process is generally greater than two times the throughput of the individual processes.

Automotive Evolution

KAPP's combined process for hard finishing gears for new automobiles is evolutionary in the automotive industry. This is the first time one manufacturer has designed two compact machines in a mirror image of each other in an automated system.

Using only one coolant system for both machines saves an enormous

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Figure 2 — For automotive industry, KAPP's KX300P uses dressable, continuous generating grinding technology.



Figure 3 — KAPP's CX250 Coroning machine uses single layer plated diamond-coated rings.

amount of money in upfront purchasing costs. Using the same control systems, HMIs, and compatible parts saves an enormous amount of time and money in training and inventory, and the coupled system works as one machine to grind and hone gears in the most efficient and economical solution available in the automotive industry. 📄

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