"THE GIANT"

ELO-RING XXL induction hardening including for segmented large bearings made by SMS Elotherm GmbH

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Die Firma SMS Elotherm verfügt über langjährige Erfahrungen in der Herstellung von Induktionshärtemaschinen für Großringe und Zahnkränze bis zu einem Durchmesser von 7,5 Metern. Für besondere Einsatzfälle, z.B. für Krane im maritimen Bereich, werden allerdings Ringlager benötigt, deren Durchmesser noch einmal deutlich größer sind. Bis zu einem Durchmesser von ca. 10 m können Ringe aus einem Stück produziert werden. Darüber hinaus erfolgt die Fertigung in Segmenten. Entsprechend hat SMS Elotherm ihr Produktprogramm um die ELO-RING XXL erweitert. Mit dieser Maschine können Vollringe bis zu einem Durchmesser von 10 m induktiv gehärtet werden. Zusätzlich besteht die Möglichkeit, Segmente aus Ringen bis 20 m Durchmesser zu härten.

SMS Elotherm has many years of experience in manufacturing of induction hardening machines for large rings and ring gears up to a diameter of 7.5 meters. However, for special applications, e.g. for cranes in the maritime sector, ring bearings are required whose diameters are once again significantly larger. Up to a diameter of approx. 10 meters, rings can be produced in one piece. Beyond that, ring are made out of segments. Accordingly, SMS Elotherm has extended its product range by the ELO-RING XXL. With this machine, rings up to a diameter of 10 m can be induction hardened. In addition, it is possible to harden segments of rings up to 20 m in diameter.

Figure 1: Example ring with 17 m diameter

Up to now, ring segments of this size have generally been hardened on machines with area gantries, where an inductor traverses the respective circular arc. Especially for particularly large segments, however, a high

hardening depth is often required. This is achieved primarily by working with two inductors, where a significantly higher heat input is achieved by preheating and reheating without overheating the surface. For applications like this, a double area gantry would be necessary, which is technically complicated and cost intensive.

A completely new approach was therefore chosen for the ELO-RING XXL.

The basis is a "standard" ring hardening machine for 10-metre rings in crane gantry design with two induction heads. Each head can be moved independently of the other head in three spatial directions and pivoted around its vertical axis. The workpiece holder rotates the workpiece. It has also been supplemented with another NC axis for linear movement in the direction of the crane gantry.

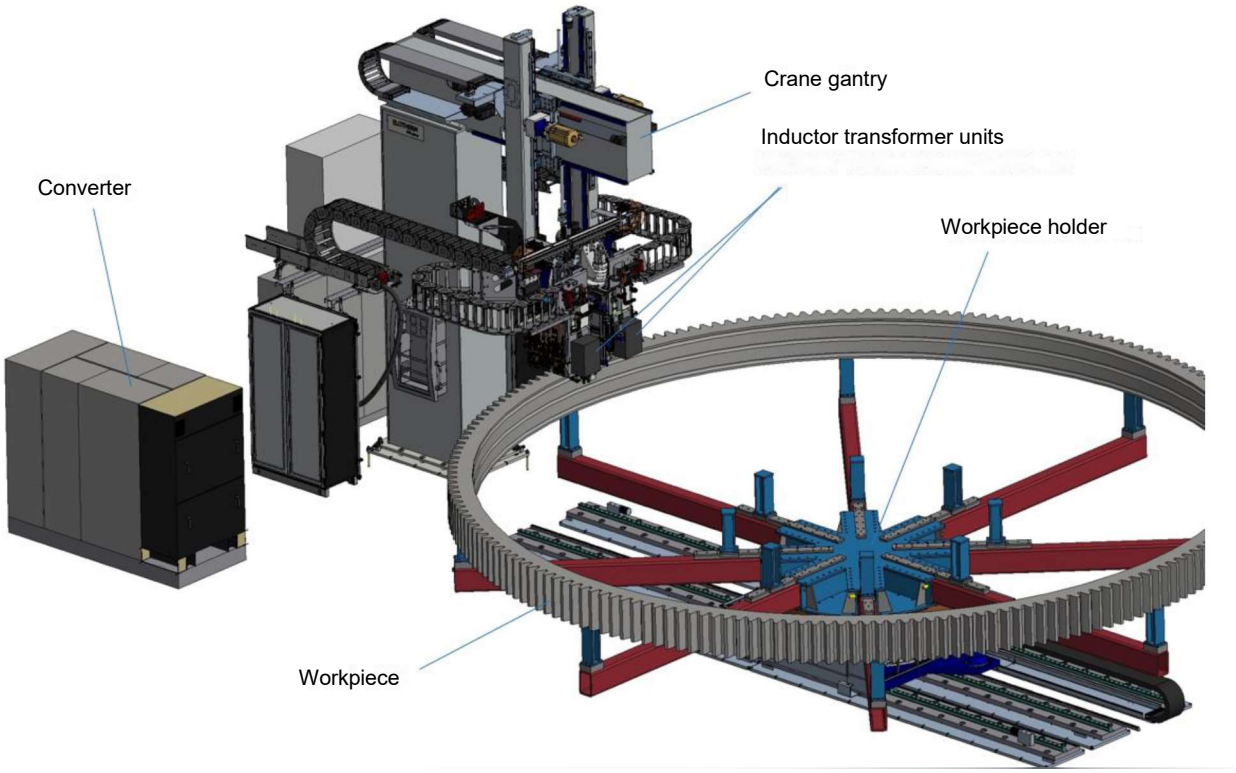

Figure 2: ELO-Ring XXL with ring

This setup enables the machine to harden two single or double teeth or two tracks at the same time, or it can be used in tandem operation to preheat and harden a track.

The basic idea for segment hardening is to guide the oversized ring segment past the inductors by synchronized movement of all NC axes so that a homogeneous two-stage machining takes place.

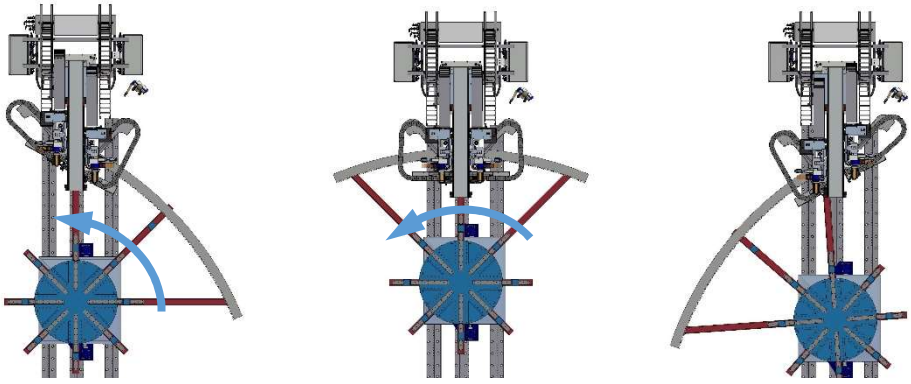

Figure 3: Movement sequence during segment hardening (inlet area, middle, outlet area)

Various requirements must be complied with during implementation:

- Both inductors must move over the workpiece in a continuous curve.
- The conveyor speed of the inductors over the workpiece must be constant.
- The radial coupling distance of the inductors to the workpiece must be constant.
- The axial coupling distance of the inductors to the workpiece must be constant.
- The inductors must always be perpendicular to the surface of the workpiece.
- The distance between the two inductors must be the same throughout the entire process.
- The inevitable thermal expansion of the workpiece in axial and radial direction resulting from the process must be detected and compensated without violating the previous points.

These requirements can only be met if all ten NC axes move simultaneously and in a synchronised manner, during which the predicted paths are adjusted "live" by current measured values. It is easy to see that the interdependencies are highly non-linear.

The control possibilities of a "normal" machine tool are usually limited to 5-axis interpolation. As already mentioned, non-linear interpolation of 10 axes is necessary here.

A software function module was therefore developed for the control system, which calculates the tracks in advance, monitors the current coupling distances and carries out the track control of all axes.

There are two immediate questions for the subsequent operator:

- How long does it take to set up such a complex machine for a new workpiece?
- What special requirements are placed on the machine setter/operator?

The engineers at SMS Elotherm have taken this into account and implemented a "self-programming function" in the function module. A high-quality radio measurement sensor has been integrated into the machine. This gives it the functionality of a 3D coordinate measuring machine.

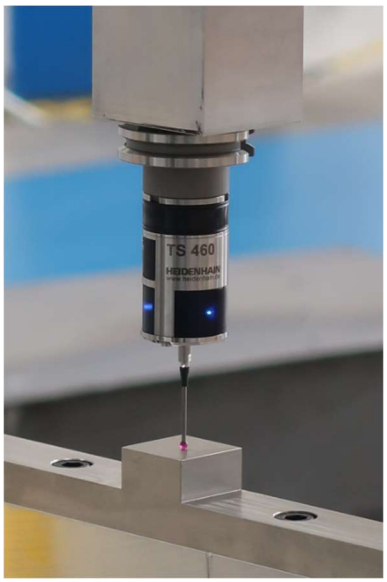

Figure 4: Radio measurement sensor

A new workpiece is measured within five minutes and the inductor positions and all track curves for the process are calculated on this basis. Immediately before the hardening process begins, the inductors then automatically touch the workpiece to check that the coupling distances are precisely set to 0.1 mm.

All this takes place without manual intervention, so that an operator who has previously set up and operated a ring hardening machine for full rings can also easily process segments: The machine programs the entire geometry control itself!

SMS Elotherm thus provides its customers with an "all-round worry-free package" that is unparalleled on the market.

The geometry of the segments of oversized rings is extremely diverse (ring diameter, pitch number, profile). When asked by a customer, how can an operator of the machine actually check how they can process a segment on their machine and what geometry the inductor required for this must have?

SMS Elotherm provides a CAE tool for this purpose. A function module identical to the geometry control system has been embedded in a PC program (Figure 5). With this tool, the operator of the machine can enter the geometry data of the workpiece and simulate its processing, exactly according to the movement rules as they are also used in the machine control.
As a result, the operator can see how best to position the workpiece on the machine and the optimal design of the inductors.

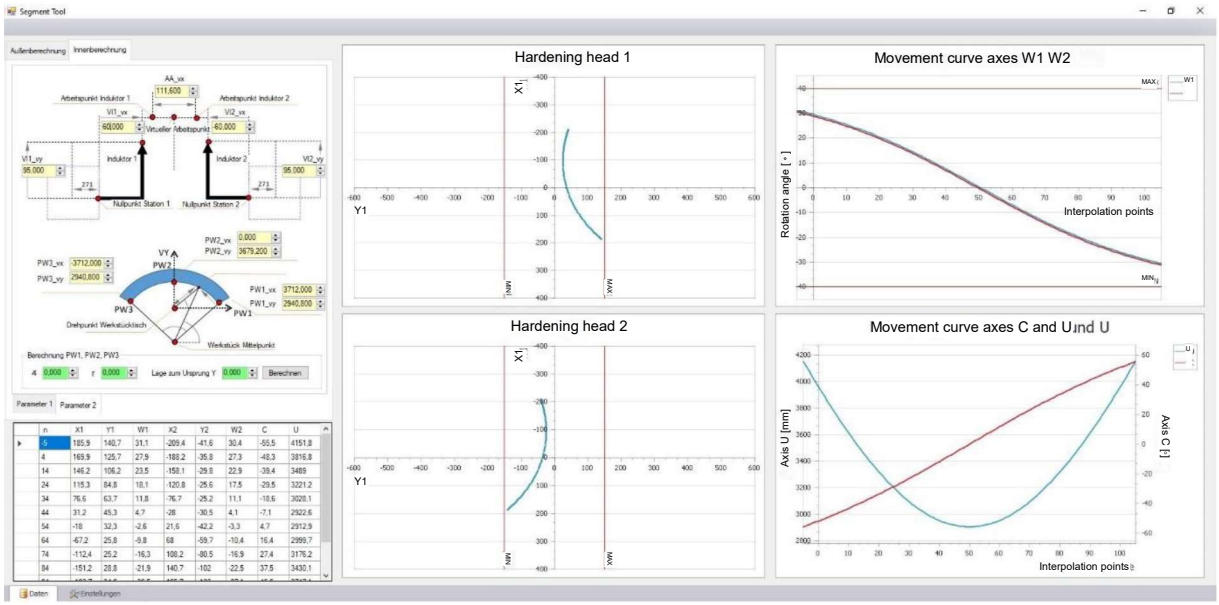

Figure 5: Screenshot of the simulation program

Figure 6: Test phase at SMS Elotherm

Figure 7: Hardening of a segment in the test phase

The ELO-RING XXL machine (Figure 6-8) is not a development project on the engineers' "drawing board", but a real machine that has been running successfully for our long-standing customer Liebherr-Components AG for over a year.

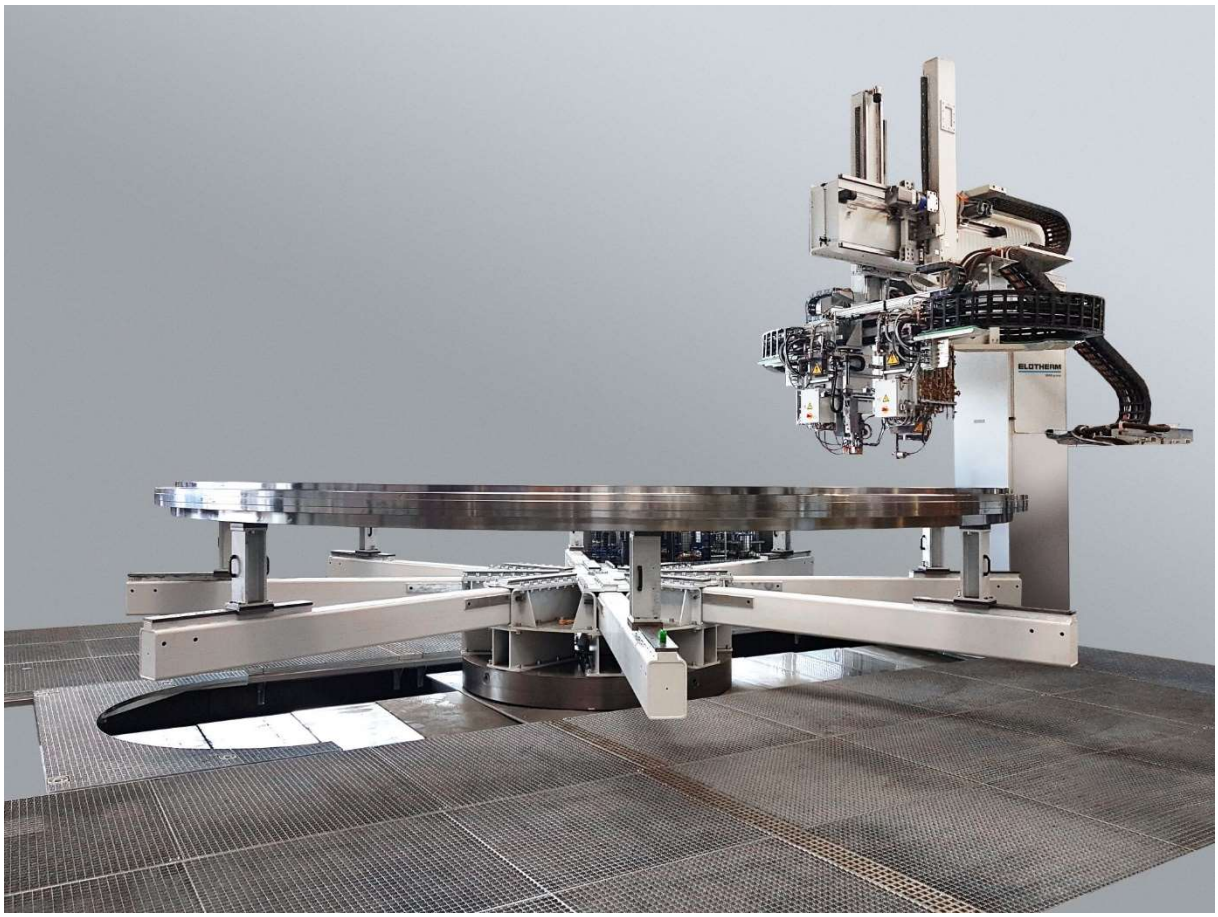

Figure 8: Photo of the whole machine

Oversized rings hardened on the machine are already in use in a gantry crane, for example.

Of course, full rings up to a diameter of 10 m in the familiar quality can also be induction hardened on the ELO-RING XXL. All machining is possible (inside/outside, track/teeth).

The operator benefits from the fact that the machine has two induction heads. During track hardening, higher hardness depths can be achieved or two running tracks can be machined simultaneously, but independently of each another. During tooth hardening, the cycle time can be significantly reduced via the simultaneity factor 2 or 4.

The ELO-RING XXL is therefore a highly productive and versatile machine. Thanks to the option of hardening segments of rings up to a diameter of 20 m in addition to the full rings up to a diameter of 10 m, it covers a wide range of components and is therefore extremely versatile, which ensures high utilization.

The induction hardening process makes a major and decisive contribution to meeting very high quality requirements throughout the entire manufacturing process. The sometimes very demanding component and wear properties of slewing rings for wind turbines or maritime applications can be ensured with the ELO-RING XXL from SMS Elotherm and contribute significantly to extending the service life of large bearings.

The induction hardening process achieves reproducible results and is characterised overall as an energy-efficient machining method for partially and economically hardening even complex components of different sizes and varied hardening requirements.

Individual customer specifications for unsplit slewing rings, as well as for segmented large bearings, can be covered thanks to the expansion of the SMS Elotherm GmbH product portfolio. As offshore applications

become increasingly widespread as a supplier of environmentally friendly electricity, induction hardening will also become increasingly important and face new challenges. This involves, on the one hand, increasing productivity through optimised feed or total area technologies and, on the other hand, greatly reduced downtime through automation and the targeted use of complex software solutions.

Please do not hesitate to contact us for further information or advice for your specific application. We will be happy to assist you.

https://www.sms-elotherm.com/kontakt/kontaktsuche/

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