Induction Heat Treating Developments

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New developments in the Technology of Induction Heating for Industrial Processes

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Induction-heating technology is widely used in the automotive sector, and the benefits manufacturers are well known. Hardening specifications (depth, profile, cycle times, etc.) are mandatory requirements that any induction-system provider must meet. Especially in the current economic climate, all companies involved in the supply chain should be looking for unique solutions that directly impact the customer’s business strategy.

Solutions could be oriented to increase the production with the same investment, to save operating and maintenance expenses or to improve the quality. GH Induction Group has been working in partnership with automotive and other sectors for many years to arrive at the best solution for their needs. Its offerings include standard, customized and, in some cases, new and unique systems. Some of the developed solutions are highlighted here.

Rotating Inductors are used for hardening bores of large parts that cannot be easily rotated (Fig. 1). This patented system avoids the need for parts to be mechanically handled and turned. Parts are fixed while inductor rotates along the Z axis, and the hardening quality and process speed increase dramatically. Other benefits are that the machine design becomes lighter, less floor is consumed and the operation is safer.

A multi-axis CNC machine combined with special twin-centered inductors (Fig. 2) is designed to efficiently harden small and large diameters on the same part. Using a single inductor with different diameters (twin-centered inductor) is a convenient solution when the part has different cross sections (e.g. camshafts). The design permits improved relationship between part and inductor with just one heat station/inductor for the heat treatment of the whole part. The direct benefit is to produce a complete part (no batches), simplifying the process. In addition, because the inductor fits the part, the consumed energy is much lower and the quality is improved.
Edge tracking inductors – Edge Track system – are used for precise pattern hardening of camshaft lobes (Fig. 3). In vertical-hardening machines the inductor follows the surface of each cam during the heating cycle. This technique allows an even heating around the cam, improving the hardening profile, and it reduces the energy consumption.

Parts such as CV joint components are induction tempered in a tunnel installation. This represents an advantageous alternative to conventional furnaces mainly because of the reduction of the intermediate stock of parts, integration in the automatic production line and the reduced footprint.

The automatic, high-production Starter Rings machine (Fig. 4 – lead photo) shows the capacity to develop challenging solutions. Hardening, tempering, marking and drying are carried out in a 7 second cycle time. The short cycle time, the different type of parts, the quick changeover time and the input ring stack buffer maximize the production.

In Europe, GH is offering a curing system that provides complete and spot heating on structural-adhesive material on automotive panels – door, hood, lift gate; trunk lid, fender and roof. The main customer benefit is to obtain a high-quality finish via fixation of inner and outer panels in the hem flange borderline, corrosion protection (sealing) and polymerization of the adhesive. All German car manufacturers like Audi, VW, Mercedes, BMW and Porsche are employing this application.

The power systems portfolio covers wide frequency-range power solutions, Transithermic® Generators. With a large frequency and power range, 6 kW – 2400 kW and 500 Hz – 400 kHz, these generators offer different combinations of parallel or series circuits. With the same supply, different power outputs provide for treating a variety of parts, or multifrequency gives process flexibility for hardening and tempering).

The configuration flexibility, high power factor, energy efficiency and modularity contribute to a reduction in operating expenses.

Solutions exist using multi-axis CNC machines for hardening large gears and raceways – GTH and GTV. In addition to the automotive sector, GH Group has been working with other industrial sectors with contributions in wind energy, cranes or handling vehicles using large slewing bearings (Fig. 5).

Other versatile installations have been developed to harden any combination of raceways and gears - inner or outer - adjusted to the customer volumes and type of production (Fig. 6).

**Detailed description of unique solutions**

**GH Tempering Tunnel.**

Tempering by induction represents an advantageous alternative to conventional furnaces:

- Small dimension (surface lower than 6 m²) instead of big furnaces
- Reduction of the intermediate stock of parts, with a maximum of 15 parts in process at the same time
- Ease of incorporation in an automatic production line
- Immediate availability of parts
- Part-by-part control

Induction treatment allows perfect control of the process - better than conventional furnaces - achieving homogeneity of heating, with differences in temperature of less than 10ºC. Tempering-tunnel installation is divided into two parts: the heating tunnel and cooling tunnel.

**GH History and Experience**

GH Induction Group is young in North America. However, the GH tradition of service to the different industries using low, medium- and high-frequency induction goes back for decades. Over 4,000 systems supplied since 1961 to over 50 countries form a well-established experience base.

Automotive manufacturers and suppliers are among GH’s customer base: Audi, Mahle, GKN, Mercedes, Chrysler, BMW, Citroen, Nissan, DANA, Delphi, Peugeot, Eaton, Faw, Ford, Tenneco, Gamesa, TRW, Visteon, Valeo, Honda, Iveco, John Deer, ZF, Kia, VW, etc.

GH’s philosophy involves working closely with customers to find customized solutions for their needs. Special focus is given to complete solutions and turnkey projects...

Constantly increasing the local presence, it has sales representation and technical service in almost every country in Europe, U.S., South America and Asia. Its production facilities are located in Germany, Spain, China, India, Korea and Brazil.
The parts pass on a chain conveyor through the tunnel. At the exit, a pyrometer controls the output temperature and selects acceptable parts to pass through the cooling tunnel. A configuration based on a 50 kW generator can achieve a production greater than 300 parts per hour. Tempering-tunnel installation main process characteristics:

- Power: 50 KW
- Frequency: 2-5 kHz
- Production: 300 parts/h (12 seconds/part)
- Max. part length: 275 mm
- Max. part diameter: 150 mm

**Edge-Tracking Inductors – Edge Track System**

The machine equipped with this system is composed of four servo-controlled axes - X, Y and Z for the inductor table and the rotation of the vertically positioned camshaft.

The inductor is designed to ensure a close distance between the part surface and inductor and at the same time allow both cams and bearings/supports to be treated in one station.

By synchronizing movement of the inductor with the rotation of the camshaft, hardening profiles are achieved that are not possible with traditional machines. This method also avoids the problem of overheating the cam top while trying to harden the whole perimeter of the cam.

Combining the Edge Track System and Twin-centered inductor systems incorporates the benefits of both.

**Large Gear/Raceway Machines**

GTH (horizontal) and GTV (vertical) machines are commonly used in industries with low production and short series but with a wide range of part sizes.

Parts are slewing bearings and large rings composed of a combination of inner or outer gears (teeth) and inner or outer raceways (single or double).

Teeth hardening is by scanning, tooth-by-tooth (some machines are able to treat two teeth at same time), and raceway hardening is performed by scanning or single shot in some cases (Fig. 6).

The two basic formulas used in these treatments are:

- **GTH-type**, manual loading machine where the part is treated in horizontal position. Depending on the diameter and the section of the part, the table is composed of three arms or six arms.
- **GTV type**, manual loading machine where the part is treated in vertical position.

The same installation is able to harden different -size pieces, and coils are designed for the desired hardening profile of each customer.

These systems include mostly two inverters to perform multiple heating (pre-heating and heating) of large raceways and sometimes the treatment of teeth two by two. The GTH and GTV machines use one or two inverters at 150-200 KW and single or multiple frequencies depending on the treatment specifications.

**For more information:**

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