A focus on former and future staff
Dear Reader!

On the occasion of this latest release of our company journal I would like to recount our basic strategy, taking into account the personnel changes already announced in the press and at our website.

Let me point out that, on a general note, it is our declared intention to continue and expand further along the path we have been following in the past few years. The recent consolidation of our company and our concentration on its core business, in conjunction with the strengthening of our Lammersdorf headquarters site, have turned out to be the right choices and led to success. Thus, we can proudly state that we have managed to expand our market position further – a fact that is clearly reflected in increased new orders and sales growth. Due to the totality of measures taken in recent times, it has proven possible to improve the company’s economic position yet again.

I would like to express my gratitude at this point for the dedicated and skilled work put in by all colleagues – without their efforts, this success would not have been achievable.

Since we are not a mere engineering company, the quality of our products is determined not just by the achievements of our engineers. It also depends on the competence of our professional staff and the craftsman’s skills that go into the manufacture of equipment and castings. We consider our in-house production of core components and the high product quality attained as one of our company's main strengths; it is our aim, therefore, to expand these capabilities further through selective investment and employee training.

Ever since its foundation, our company’s history has been shaped and determined by ongoing innovation and continuous new process and technology development. Continuing this tradition while keeping a close eye on customer benefits shall remain one of our key guiding principles.

Moving ahead, we shall continue our cooperation with the academic world, quite particularly, of course, RWTH and the Aachen University of Applied Sciences. On the other hand, it is the dialogue with our customers – as practiced successfully on our Innovation Day in July – which matters when it comes to focusing our development on areas which are of relevance to the user. With the appointment of the three Heads of Division into our company’s Managing Team, a clear signal has been given that we value and recognize the achievements of the divisions given that their work is so decisive for the company’s success.

Indeed, the different product/business areas of these divisions and the associated diversification represent an essential advantage of our enterprise.

This implies that the cooperation between the divisions is to be intensified and exploited, also as a source of ideas and inspiration.

It is with optimism and commitment that we move ahead on this chosen path.

Yours sincerely,

Markus D. Werner
President and CEO

---

**Contents**

- NEWS 2/3
  - Statement of the Management
  - OTTO JUNKER Innovation Day
  - successfully highlights new induction furnace technology – Industry professionals are given insights into development projects

- TECHNOLOGY 4/5
  - IGBT converter technology facilitates new circuit engineering

- CAST IRON & STEEL 6/7
  - Variable solutions for the casting process
  - Interesting new orders

- LIGHT METAL 8
  - KombiGAS – Innovative equipment design for heating aluminium logs and billets

- HEAVY METAL 9/10
  - Newly developed strip joining system
  - Melting equipment for brass scrap and chips

- HIGH GRADE STEEL FOUNDRY 11
  - Development and application of the INDULADLE induction-heated ladle system

---

**Imprint**

Publisher: OTTO JUNKER GmbH
Jägerhaussstraße 22, D-52152 Simmerath
Editor: Dr. Dietmar Trauzeddel,
Phone: +49 2473 601 342
Photography: OTTO JUNKER Archiv, INDUGA
Layout: Atelier Beißel, Brandstraße 3, 52159 Roetgen, Phone: +49 2471 20 99 83
Public interval: six-monthly

Reproduction of this publication, in whole or in part, is subject to the explicit prior permission of the editors.

**Title:**

A focus on former and future staff

Dedicated and competent employees are a company’s most important asset, no doubt. Teaching young people good occupational skills is a high-priority task, for without young specialists we will not be able to produce high-quality products in the future.

Therefore, we attach increasing importance to our in-house apprentice training. In the new occupational training year alone, another 11 young colleagues joined OTTO JUNKER to learn a trade.

At the same time, our thanks are due to all former employees whose work, over many years, has contributed in a major way to our company's success. Periodic reunions of retirees, in conjunction with ongoing information about company affairs, ensure that this contact will not be severed.

The last such meeting in Lammersdorf on September 25, 2012, brought together more than 50 people!
More than 70 industry experts had followed OTTO JUNKER's invitation to attend this event on June 22 – 23, 2012 and participated actively in the discussions, thus contributing to the success of the Innovation Day.

It had been OTTO JUNKER's idea to subject upcoming development projects to the critical review of experienced professionals before embarking on their practical implementation, thereby encouraging a debate that would stimulate new subjects and improvements. The viability of this approach was thoroughly confirmed by the event. It was also helpful that some new developments could be demonstrated under field conditions in the company's own foundry.

Apart from a review of key innovations achieved in recent years, the lectures and presentations addressed the following main developments:

- Low-loss induction coil technology
- Melting down / recycling of small-sized charge material
- Optical crucible scanning
- INDULADLE – induction-heated ladle
- IGBT frequency converter technology 2.0

This was followed by workshops in the foundry, which included a "live" demonstration of the induction-heated ladle as well as a presentation of two alternative optical crucible scanning techniques. In a further workshop, various new opportunities offered by upgraded IGBT frequency converter technology were explained and submitted for discussion.

First of all, the induction-heated INDULADLE was shown in the heating stand where the two-tonne ladle was held at the specified temperature for an extended period after having been filled with molten steel. It was demonstrated that heating stand and ladle are entirely separate, without any electrical or mechanical interconnection, and that the ladle can therefore be used in normal molten metal handling and transfer operations.

Optical scanning of the refractory crucible lining contours was carried out using OTTO JUNKER's lining periscope on the one hand and a 3D laser scanner on the other.

Whereas OTTO JUNKER's laser periscope is introduced into the furnace interior with the aid of an appropriate device and moves over the entire crucible wall to plot its contours via distance measurements, the 3D laser scanner takes measurements from various points outside the furnace to produce a three-dimensional image, even rendering undercuts wherever possible.

A technical comparison of these two methods formed the subject of the following talks.

The IGBT workshop focused on recent developments in the following areas:

- Converter control technology
- Circuit arrangement options
- JUNKER visualization systems

For frequency converter control, the newly developed "ZEUS" (central converter control) and "MERKUR" (measured data acquisition and communication module for converter control systems) are now available. Both afford substantial benefits thanks to the use of advanced digital signal processor technology, apart from being straightforward to install and offering enhanced ease of maintenance.

At the circuit engineering level, established solutions such as multi-frequency technology, DUOMELT and DUOCONTROL systems were reviewed and contrasted with more recent alternatives such as twin-melt and phase-shift inverter technologies. Thus, for instance, the phase-shift inverter technique allows higher interior melt flow velocities to be achieved at the centre of the crucible through application of a phase shift between the upper and lower section of a split coil.

Videos of melting trials were shown to illustrate the selective metallurgical control options that can be exercised in induction melting by means of special circuit arrangements.

Depending on furnace operating and monitoring needs, different visualization systems may be used. These differ in terms of the scope and contents of their graphic rendering and operator control functionalities. Ideas for a future "pocket-sized" JOKS furnace control system were likewise presented.

The Innovation Day ended on a lively note, with an intense professional exchange of views taking place on the sidelines of the various workshops.

Dietmar Trauzeddel (+49 2473 601 342)
From a metallurgical point of view, the ideal induction melting process is one in which both the input of thermal power and the melt flow can be controlled in accordance with given technological needs. In addition, the power input and bath movement should be mutually decoupled, i.e., the desired melt movement in the furnace should be adjustable independently of the respective power input. While it is no problem technologically to control the electrical power and hence, the input of thermal energy into the melt, it takes very special circuit engineering to achieve control of the bath movement independently of this energy input.

Moreover, when discussing intense bath movement, it is necessary to distinguish between deep intermixing of the entire melt and mere surface flows, as shall be explained later.

Based on R&D advances achieved over the last few years, OTTO JUNKER has established its Power-Focus and Multi-Frequency technologies – two special circuit systems meeting the above requirements which have by now proven their merits in numerous installed furnace systems.

The Power-Focus technology permits an automatic or freely selectable concentration of power in that coil section (top or bottom) in which it is needed most. Thus, if the furnace is only half full, the power input can be focused in the lower crucible area so that more energy will be put to use there.

On the other hand, when the furnace is full one can direct more power into the top coil section so as to intensify the bath movement and hence, facilitate stir-down of the charge (e.g., metal chips).

The Multi-Frequency technology enables switching between different operating frequencies during the melting process. For example, an appropriate frequency of 250 Hz will be used for melting the charge material down. For the input of carburizing agents and alloying additives, the system is automatically switched to a lower frequency, e.g., 125 Hz. Practice has shown that this changeover to a reduced frequency can greatly accelerate the carbon pick-up in cast iron analysis adjustment.

It should also be mentioned that these two circuit configurations can be combined to amplify their respective effects. These options are substantially expanded further by the latest developments utilizing the technical advantages of IGBT converter technology.

Apart from the proven frequency converter solutions based on thyristors, the successful development of special IGBT converters has come to play an increasingly important role in electothermal processes. These systems involve the use of insulated gate bipolar transistors (IGBTs) instead of thyristors in the inverter. IGBT converters made by OTTO JUNKER distinguish themselves by a standardized modular design. The inverters and d. c. link circuit capacitors form one integral unit. This unit is suitable for use in a variety of circuit configurations.

Typical examples are:

- independent inverters serving several furnaces
- multiple inverters for the coil sections of one furnace
- parallel connection for increased power
- series connection for increased voltage

To explain the technological capabilities of a process-oriented IGBT converter system, let us examine a melting furnace delivered early this year.

The process specification for melting and treating a special aluminium material called for the capability of providing an increased power input in the melt-down phase while ensuring an adjustable...
new circuit engineering

intense bath movement with low power in the subsequent metallurgical treatment cycle. This high bath movement was to be achieved simultaneously both inside the melt and on the bath surface.

The metallurgical process is characterized essentially by mass transfer at the bath surface, so the amount of thermal energy supplied in this phase should be low.

The technical prerequisites for controlling the bath movement within a wide range were met by installing an IGBT converter with two separate inverters and a controller ensuring a phase-shifted operation of the furnace coil sections. The furnace is run at a nominal frequency of 250 Hz in the charge melt-down phase. For the increased bath agitation at low power, the frequency can be steplessly controlled between 33 and 100 Hz. The amount of phase offset between the two coil sections is likewise adjustable to provide a selective control of the flow pattern (i.e., direction of rotation and velocity) in the central coil area of the furnace. This way, the region of maximum flow velocity can be moved into the interior of the molten metal bath and more effective intermixing of the entire melt will occur.

The correctness of these deliberations is confirmed by the numeric flow simulations performed (see illustration).

Before the adopted technical solution was finally executed on the industrial-scale system, its effectiveness was successfully validated in our in-house test foundry. By now this furnace system has proven its performance in day-to-day production practice.

The technical options available for influencing bath movement in a coreless induction furnace can be implemented and combined in manifold ways to address specific metallurgical tasks, as is summarized in the following table.

Dietmar Trauzeddel (+49 2473 601 342)

CEA, Grenoble

The CEA research centre in Grenoble (France) placed an order with OTTO JUNKER GmbH for delivery of a pilot furnace for melting silicon with a capacity of 20 kg and a converter power of 50 kW.

In order to cover a wide experimental spectrum, a high flexibility of the melting bath condition is required.

This requirement is met by the split coil and the phase-shifted inverter operation of the IGBT converter plant allowing for an independent and stepless adjustment of power, frequency and phase angle.

Numerical flow simulation for a split (two-section) coil, with normal (left) and phase-offset power supply (right).
Our versatility in providing custom equipment solutions for specific tasks and applications is illustrated by some current contracts.

Pouring furnace with increased power rating

Short and strong superheating of the molten metal fed into the pouring furnace is a key process requirement of a German foundry for the production of special castings. This is why the five-tonne pouring furnace to be used in this application has a power rating of 1,000 kW as distinct from the 300 kW rating of a standard furnace of this type. This makes it possible to superheat a molten metal charge of 1,800 kg from 1,420 °C to 1,510 °C in less than 4 minutes. In order to obtain rapid metal temperature equalization between filling gate siphon and furnace vessel the pressurization control system is designed such that the furnace pressure is relieved and then applied again. This creates a pumping effect for rapid metal exchange. A furnace processor and weighing system are mandatory features to meet these specific user requirements.

Further plant characteristics include the following:

- The pouring ladles are filled via a pouring lip on the discharge siphon by pressurization of the furnace vessel. Close tolerances are met thanks to laser monitoring of the metal level in the ladle.
- Electric power supply is based on an IGBT frequency converter which also compensates for parameter changes occurring over the furnace campaign.
- Filling of pouring ladles via a docking station which carries an attached laser sensor to control and monitor the filling cycle.

The installation is currently under design. It is scheduled for delivery to the customer in early 2013.

Unheated pouring system boosts flexibility

In this application the user has opted for an unheated pouring system to supplement an existing pouring furnace on a moulding machine. The specific advantages of the unheated pouring system lie mainly in the unproblematic change of alloys and in its flexibility in use. The new system is intended for pouring diverse cast-iron grades, especially alloys of nodular cast iron.

It has a capacity of 4 tonnes and is equipped with an electromechanical stopper device. The pouring process is controlled by teach-in programming. The optimized pouring curve for each casting is retrieved from memory or, in the case of new castings, will be taught-in by manual control. Load cells determine the weight and thus the current molten metal level. With the moulding machine output of 200 boxes per hour, the time available for each pouring cycle is 18 seconds.

The system is to be shipped to the customer by the end of this year.

Use for heavy castings

A customer in Sweden entrusted us with an order for a pouring furnace intended for the production of heavy castings. In line with their needs, a furnace having a useful capacity of 15 tonnes and a 500 kW power rating will be supplied. This installed power rating enables the
furnace to superheat 9 tonnes of metal by 100 K in one hour with pouring temperatures ranging from 1,315 to 1,455 °C. The filling and pouring siphons are arranged at a 90° angle to each other. The bath level on the pouring side is controlled and monitored by laser system with additional safety electrodes.

The furnace position and approach to the mould sprue cup are likewise controlled by a laser system. The furnace will be prepared for installation of a pouring level controller and of an inoculation system. Moreover, it will feature two central PLC systems of which one will be in charge of overall furnace control functions while the other takes care of the pouring process.

The plant is scheduled to be shipped to Sweden in the early summer of 2013.

Dietmar Trauzeddel (+49 2473 601 342)

Below is an outline of some new melting furnace systems for cast iron and steel which we are currently working on.

Under a contract from Emirates Aluminium Ltd. in Abu Dhabi we are building a melting plant consisting of three medium-frequency coreless furnaces. Their purpose will be to cast iron mounting supports into anodes used in aluminium electrolysis.

Each furnace with a capacity of 1.5 tonnes will have its own IGBT converter system designed for an operating frequency of 250 Hz and a rated power of 1,250 kW. The melting rate will be 2.4 tonnes/h per furnace based on a melt temperature of 1,450 °C.

The furnaces are to be charged via buckets and will have a swing-type lid with a ring exhaust system.

Plant control functions will be executed using Allen Bradley technology throughout. Each furnace will be equipped with its own water re-cooling system based on water-to-water heat exchangers. At the time of writing, the equipment was being prepared for shipment to the customer.

Orders booked for customers in Russia/Ukraine via the Guss-EX Sp.z o.o. trading company

The "New Machines Technologies" company based in Lutugino / Ukraine is to receive a melting installation for cast iron and steel that will feature two 16-tonne coreless furnaces as well as a DUOMELT frequency converter system rated for 4,600 kW. Both furnaces will be equipped with a stepless back-tilting device allowing each unit to be inclined by up to 20°. A JOKS melt processor and a water re-cooling system based on a glycol-free air-to-water heat exchanger complete the package.

The furnace installation can melt up to 7.9 tonnes/h of cast iron at a melting temperature of 1,500 °C and will consume 500 kWh/t in this mode. Delivery to the Ukrainian customer is scheduled for this autumn.

ZAO "TERMOTRON-ZAVOD", a Russian company headquartered in Bryansk, has opted for a Monomelt medium-frequency melting system of standard compact design. The equipment will consist of a 2-tonne coreless furnace as well as the associated 800 kW frequency converter system. It is rated for a melt output of 1.4 tonnes of cast iron per hour. The water re-cooling circuit incorporates an air-to-water heat exchanger. For controlling and operating the installation, a "Basic Control" system will be employed. It is intended to complete this equipment for shipment to the customer by late October of this year.

For the Kamsky Motor Plant Ltd. at Naberezhnye Chelny we are working on a DUOMELT system comprising two 3-tonne furnaces. Both are to be of standard compact design and will be powered via a 24-pulse IGBT frequency converter system providing a nominal 2,400 kW. With a power consumption of 500 kWh/tonne, the installation will thus deliver 4.5 tonnes of melt per hour. In addition to a JOKS melt processor, a JOKS GATT system will be used for controlling the charge make-up and charging process. One particularity of this project is that the basic power supply for the furnaces is to come from the gas turbines installed on the customer's factory premises.

The scheduled delivery date for this equipment is January 2013.
The new OTTO JUNKER heating concept is characterized by the efficient combination of two proven types of furnaces.

While basic heating of the aluminium logs or billets is performed in a convection heater with a thermal efficiency of more than 80%, final heating and flexibilisation is achieved in a downstream heater section of minimum length in which heating is effected by direct flame application. This way the energetic advantages of the convection heater are combined with the rapid temperature change capability. This is of particular benefit when running at so-called regular throughput rates.

The key benefits of KombiGAS include:

- low energy demand, especially at regular throughput rates
- gentle heating action
- excellent temperature uniformity in the convection heater
- reduced footprint compared to an all-convection heater
- rapid temperature change capability
- low thermal stress on the heater chamber, low wear
- good accessibility
- supports any type of conveyor system
  - driven/idling roller conveyor
  - walking beam conveyor

The first billet heater of the KombiGAS type has been in successful operation at a customer in Germany for several months now. The benefits mentioned above and the low energy consumption figures could thus be confirmed impressively.

Jürgen Stengel  (+49 2473 601 310)
The purpose of this process, on which a patent is pending, is to join the strip ends of two coils, specifically for the purpose of being able to draw the strip through a treatment line or processing plant successively and without interruption.

In plants of this type – e.g., annealing furnaces, cleaning lines, pickling or coating lines, or straightening trains – the metal strip is placed at the entry end in the form of a so-called coil. It is then unwound for passage through the line and, following treatment, rewound into a coil again at the exit end.

Once the coil is unwound at the entry, its trailing end is to be joined to the leading end of a fresh coil so that strip can be drawn through the line continuously.

The main technical challenges lie in ensuring that the joint will withstand
- the forces of strip pull,
- the chemical attack by lye, acids and solvents and
- the high temperatures of up to 1,100 °C.

At the same time, the joint should be as flat as possible and devoid of sharp edges so as to cause no damage to the rollers in the line. Needless to say, the joining device must also be capable of joining non-identical materials or poorly formable ones, e.g., full-hard as-rolled metal strip.

Furthermore, for use in continuous processing lines, it is essential that the joint can be produced in minimum time.

Based on these requirements, OTTO JUNKER developed a device which initially punches holes into the strips in a first stroke and then joins them in a second stroke by means of special eyelets placed in these punched holes.

In the case of very light-gauge materials, the prior punching step may even become dispensable. The joining eyelets themselves are fed to the operating area of the joining device, using a guide rail, between the two strokes.

Compared to known stitching devices with (or even without) fastening hardware, the new joint is appreciably flatter in shape and has less edges. Unlike stitched joints formed without fasteners, it is also suitable for treatment processes involving no or only very low strip tension (e.g., annealing furnaces).

Compared to welded joints, the new process requires no re-assignment of parameters to adjust for material properties and metal combinations before every joining operation.

This will be found particularly beneficial if the coils have thinner-than-nominal ends, e.g., because they come from a reversing mill.

The functionality and reliability of the new strip joining system has been demonstrated in extensive trial runs carried out in OTTO JUNKER GmbH’s technology center. Its suitability for industrial operation has thus been confirmed.

Klaus Schmitz (+49 2473 601 532)
INDUGA has received a contract from the Mexican NACOBRE company for a complete melting and pouring furnace installation which is intended to melt down moist brass chips or scrap and serve the new horizontal-type continuous billet casting operation at the Cobrecel plant in Celaya. Charge material is to be fed to the melting furnaces via two separate conveyor and charging systems for chips or scrap.

The system will consist of two Monomelt coreless furnaces with a capacity of around 6 tonnes. The two IGBT converter systems will be rated for 1,600 kW at a 60-70 Hz operating frequency.

A melting rate of around 5 tonnes/h will thus be achieved with Ms58 brass, based on a tapping temperature of 1,030 °C and a 40 % liquid heel. Since the main objective is to melt down moist chips in a continuous process, specially designed fume exhaust hoods with water-cooled duct elbows are to be fitted. Molten metal will be fed to the pressurized pouring furnace alternately from one or the other melting furnace via a swivelling launder. The pouring furnace is purpose-designed for horizontal continuous casting operation and has three furnace chambers (charging chamber, pressure chamber, pouring chamber) and a sandwich-type channel inductor.

The two continuous casting moulds are built into the front plate of the pouring chamber. With its capacity of 10 tonnes, the equipment allows a maximum useful tapping weight of 6 tonnes. Again, heating will rely on an IGBT converter system planned to have a nominal power rating of 350 kW in this application. Diverse measuring, control and monitoring features will round out this advanced installation.

At present, work is proceeding apace on the design of these diverse systems. Shipping has been scheduled for February 2013.

A Dutch company have placed an order with us for the supply of a medium-frequency melting furnace for melting down brass chips and lumpy material.

The 6-tonne coreless unit will have a 1,300 kW power rating and an operating frequency of 33-50 Hz. It is to be powered via an IGBT frequency converter. An M2F Touch control system is to be provided for controlling and monitoring its operation. This furnace achieves a melting rate of 4.9 tonnes/h with lumpy charge material and a slightly lower 4.3 tonnes/h when melting down chips.

Meanwhile, the new smelting plant started operation takes place.

Alejandro Hauck (+49 2473 601 724)
Development and application of the INDULADLE induction-heated ladle system

Cooperation across business units between Induction Melting Furnaces and High-Grade Steel Foundry

The aim of this development project was to design and build a mobile induction heated vessel that might basically serve as a melt transfer and holding vessel but could also be used as a metallurgical extra unit for alloying and other metallurgical processes. As evident from this profile, such a vessel would have to be designed for a power input into the molten metal that exceeds mere holding requirements plus, at the same time, an adequate bath movement. Moreover, the vessel should be capable, on principle, to operate under vacuum.

The basis of OTTO JUNKER’s new design is the induction heating system for molten metal transport ladles developed by INDUGA, which was refined and optimized for the purpose. One design target was that it should be possible to adapt standard transport ladles for the task by appropriate modification, i.e., that it would not be absolutely necessary to use new ladles. This modification mainly involves the provision of a so-called “magnetic window” in the lower ladle region so that power is prevented from going into the ladle shell. This way, the energy transmitted via the alternating electromagnetic field is effectively delivered directly to the molten metal and heating of the ladle shell is minimized.

The transport ladle is placed in the heating stand using a crane or forklift truck. The configuration of this heating stand is such that the induction coil encloses the lower half of the ladle shell. In other words, the arrangement is very similar to that of a short-coil type coreless furnace, except that the ladle and heating stand form two entirely separate units.

Before work was started on modifying the ladle, extensive numerical calculations for diverse design variants were carried out with a view to optimizing the electromagnetic field. The aim was to maximize the input of power into the molten metal while reducing the input of thermal energy into the ladle shell. Based on these findings, one transport ladle was modified accordingly.

In cooperation with specialized colleagues from the steel foundry, this ladle was then tested. To this end, it was placed in the ladle heating stand in the melting shop and subjected to extensive trials. The results were satisfactory. The system’s operating viability was demonstrated, and it emerged that the power input was restricted almost exclusively to the melt.

Relating to holding operation, an efficiency of around 70 % was achieved. The preconditions were thus met for embarking on specific planning to employ the system in our in-house foundry.

The rationale behind the INDULADLE project is to obtain a means of holding larger steel volumes but without risking melt temperature loss in the event of prolonged waiting times. In that sense, the ladle operates as a holding and storage furnace. As such, it can boost a foundry’s flexibility while at the same time providing an improved temperature management, especially in the production of large castings. Another idea is that a vacuum-tight version of this ladle system might be suitable for after-treating molten steel from a conventional coreless furnace, i.e., to improve the steel quality by carrying out partial degassing in this vacuum ladle.

Apart from employing the INDULADLE system in our in-house foundry, an intensive programme of work is now underway to prepare the ladle system for industrial applications at OTTO JUNKER equipment users’ sites.

Elmar Westhoff (Tel. +49 2473 601 400)
Frank Donsbach (Tel. +49 2473 601 207)

High grade steel foundry
Production