中科电气
ZHONGKE ELECTRIC

Comprehensive Solution
for Electromagnetic Metallurgy

Zhongke Electric

The leading provider of
comprehensive solution for electromagnetic metallurgy.

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HUNAN ZHONGKE ELECTRIC CO., LTD.



Company Profile

Hunan Zhongke Electric Co., Ltd., the leading provider of comprehensive electromagnetic metallurgical solution, was established in 2004, and listed on Shenzhen Stock Exchange in 2009(Stock Code: 300035).

Zhongke Electric is committed to R&D and providing service of overall solution for electromagnetic metallurgy, as well as on-line heating system for continuous rolling. The main performance and technical specifications of complete of electromagnetic metallurgy equipment have reached or exceeded those of similar products abroad. And the market share in China is over 80%.

We believe in technology is the key to production efficiency. We have established technology research and development centers, such as Academician Workstation, Postdoctoral Programme, Engineering Technology Research Center of Metallurgy and Electromagnetism of Hunan Province, Hunan Province Engineering Laboratory for Metallurgical Electromagnetic Energy Conversion Technology, which have provided strong technical support for the sustainable development of the company. Zhongke Electric has more than 100 patents and "know-how", more than 20 software copyrights. In addition, Zhongke Electric has obtained the National Patent Gold Award, the National Science and Technology Progress Award, Hunan Province Science and Technology Progress Award, Hunan Province Science and Technology Innovation Award, etc.

Our main products of the comprehensive solution for electromagnetic metallurgy include: complete set of electromagnetic stirring system, channel type induction heating and refining system for tundish, on-line induction heating system for hot rolled plates and bars, complete set of industrial magnetic equipment (e.g. electromagnet, iron separator, cable drum, etc.), large-power high-low voltage frequency converter, high power medium-high frequency power supply, remote terminal services, etc. The products are widely applied in steel, non-ferrous metallurgy, rail transportation, scientific research institutions, mines, ports and docks, marine military industry, etc. The complete set of EMS system for continuous casting include the supporting special variable frequency power supply, and electromagnetic stirrers which meet various metallurgical process requirements and can be applied at different installation locations.

We have supplied over 4000 strands electromagnetic metallurgy products to more than 300 steelmaking plants. The main customers in China include Baosteel Group, Shougang Group, Hebei Iron & Steel, Jiangsu Shagang Group, Angang Group, Benxi Steel Group, Jinan China Steel Group. Moreover, the products have been exported to many countries and regions, such as Canada, Brazil, Turkey, Russia, India, Thailand, Indonesia, Iran, etc.

We are committed to our clients' performance and embrace their targets as our own. Based on our leading technologies for electromagnetic metallurgy, we will bring steel producers around the world the highest operational as well as economic benefits at maximum sustainability.









ZHONGKE ELECTRIC

Contents

1-Comprehensive solution for electromagnetic metallurgy -01-

2-Complete set of electromagnetic stirring system for continuous casting -02-

Electromagnetic stirring for slab -04-

■Multi-mode meniscus electromagnetic stirring and flow control system (M-MEMS) for slab

■Electromagnetic brake(EMBR) of mould for slab

■In-roll electromagnetic stirrer with high thrust force for the secondary cooling zone of slab

■Box - type electromagnetic stirrer for the secondary cooling zone of slab

Electromagnetic stirrer for billets and rounds -10-

■Submerged nozzle electromagnetic stirrer

■Mold meniscus electromagnetic stirrer for billet

■Mold electromagnetic stirrer for billet

■Strand electromagnetic stirrer for billet

■Final electromagnetic stirrer for billet

Auxiliary system for electromagnetic stirring system -15-

■Dedicated variable frequency power supply for electromagnetic stirring

■Remote monitoring and operation system for electromagnetic stirring

■Cooling water system for electromagnetic stirring

3-Channel type induction heating and refining system for tundish -20-

■Channel type induction heater for tundish

■Special variable frequency power supply for channel type induction heating of tundish

■Remote dynamic monitoring and operation system for channel type induction heating of tundish

4-Online heating system for continuous rolling bars -28-

■Induction heater for continuous rolling bars

■Medium-frequency induction heating power supply

■Electric control system of induction heating for continuous rolling bar

5-Online heating system for continuous rolling plate -32-

■Induction heater for continuous rolling plate

■High power medium frequency induction heating power supply

■Electrical control system of induction heating for continuous rolling plates

6-Industrial magnetic handling system -38-

Lifting electromagnet -38-

Electromagnetic iron separator -42-

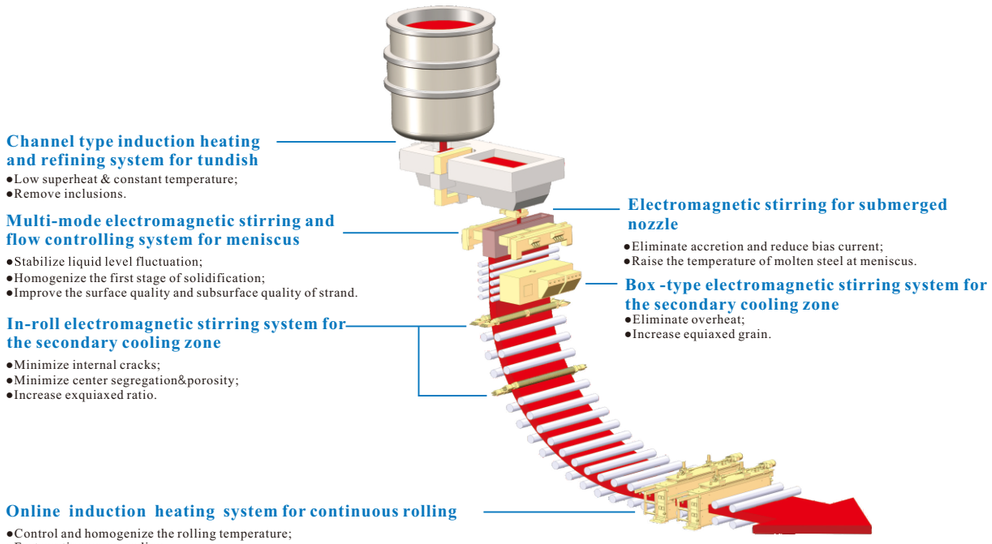
Cable reel -43-

7-Successful cases -44-

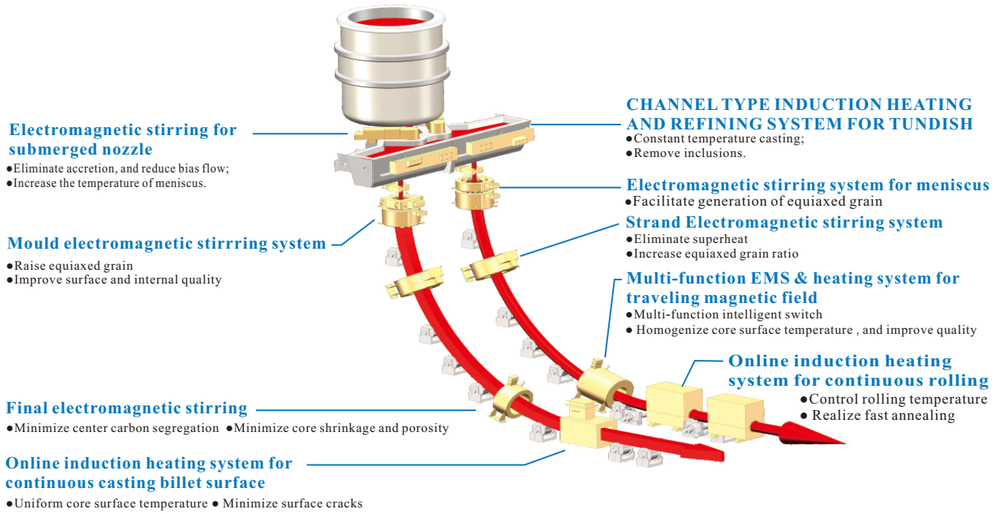
8-References -46-

9-Achievements & Intellectual Property -48-

1 Comprehensive solution for electromagnetic metallurgy



Comprehensive electromagnetic metallurgic solution for continuous casting and rolling of slab



Comprehensive electromagnetic metallurgic solution for billet

2 Complete set of electromagnetic stirring system for continuous casting

Overall description

The mechanism of continuous casting electromagnetic strring is to strengthen the movement of residual molten steel in the slab by means of the electromagnetic force generated by the electromagnetic stirrer, which can change the flow, heat transfer and material migration process during the solidification process of the molten steel, so as to improve the quality of the slab.

A large number of metallurgical and industrial operation practices have proved that the reasonable use of electromagnetic stirring can effectively improve the internal structure of the slab as well as surface quality. Besides, center segregation and center porosity can be decreased, the center shrinkage and cracks can be eliminated, the ratio of equiaxed grain can be increased. In addition, the casting speed and the output will be

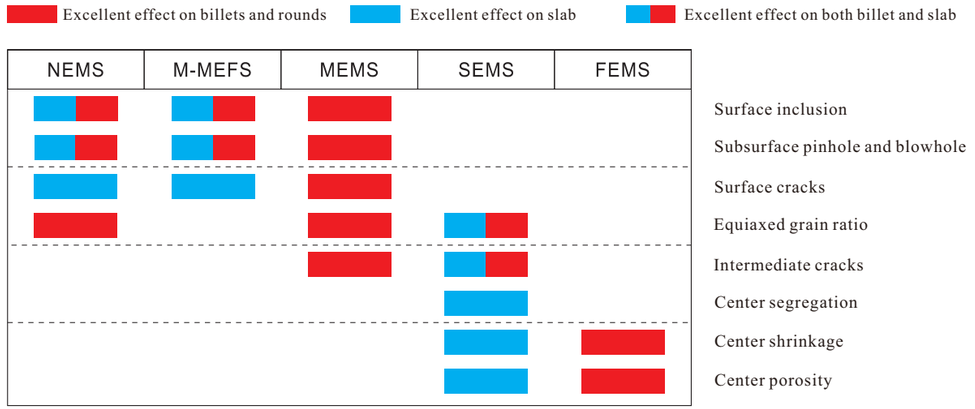
The metallurgical effect of electromagnetic stirring is closely related to the continuous casting process conditions. Therefore, the control of metallurgical quality needs to combine with metallurgical process and metallurgical theory. However, with the application of electromagnetic stirring, the range for metallurgical process can be improved.

A complete set of electromagnetic stirring system for continuous casting consists of five parts

- Power supply part (including transformer and high and low voltage distribution) (sharing one set)
- Special variable frequency power supply for electromagnetic stiring (one set per strand)
- Electromagnetic stirrer (stiring coil) (one set per strand)
- Remote operating system (IPC) (sharing one set)
- Cooling water system (sharing one set)

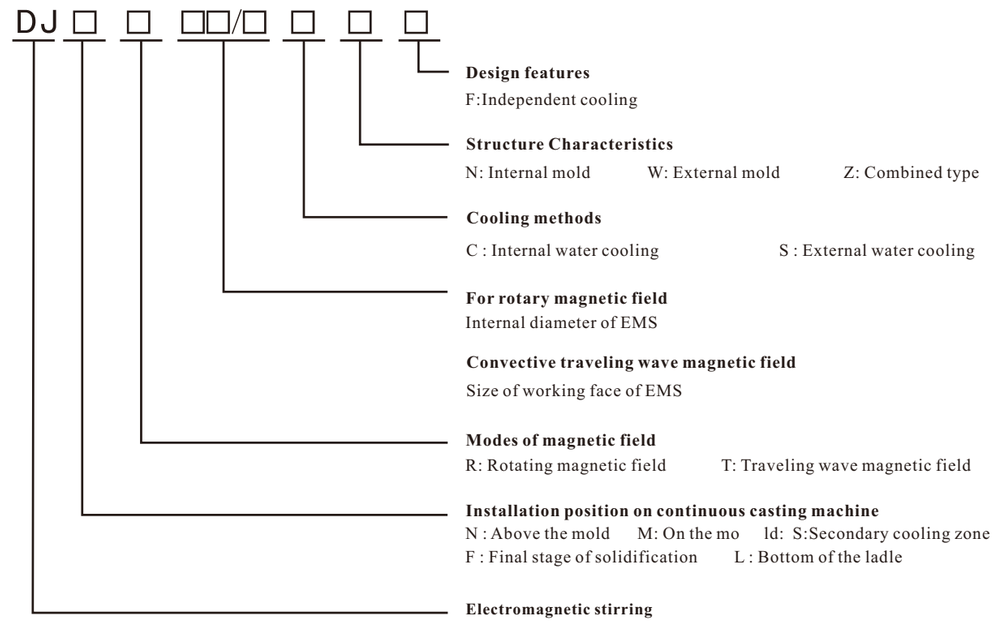
Metallurgical effect

The electromagnetic stirrer at different installation positions has different metallurgical effects for different blank strand.



N-EMS: Submerged nozzle electromagnetic stirrer
M-MEFS: Multi-model meniscus electromagnetic stirring and flow controlling system
M-EMS: Mold electromagnetic stirrer
S-EMS: Strand electromagnetic stirrer
F-EMS: Strand electromagnetic stirrer

Models Description of electromagnetic stirrer



Electromagnetic stirring for slab

Multi-mode meniscus electromagnetic stirring and flow control system (M-MEMS) for slab

Overall description

Multi-mode meniscus electromagnetic stirring and flow controlling system is the advanced product with intellectual property rights, which is researched, developed and manufactured independently by Zhongke Electric.

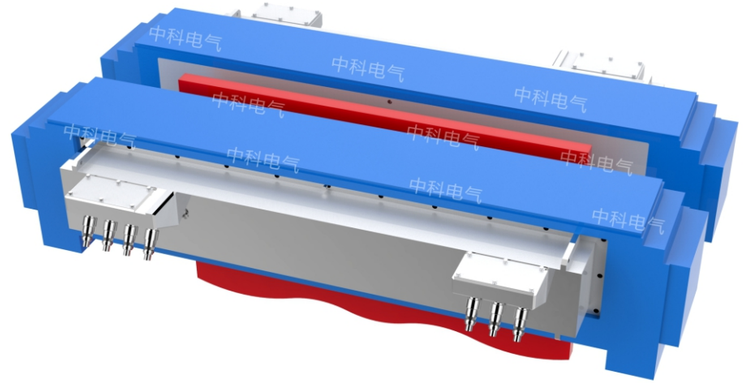
With the unique magnetic circuit design and control technology, the product can automatically realize many stirring modes: single rotation mode, acceleration mode, deceleration mode, two-zone rotation mode, double-D acceleration mode and so on. By using the metallurgical data packet, the required stirring position, modes and parameters can be switched according to the steel grades, the strand section and the quality requirements.

The electromagnetic stirrer for meniscus is installed at the mold of the continuous caster. The electromagnetic action zone covers the meniscus. It is mainly used to improve surface and subsurface quality of the slab. It is one of the key metallurgical equipments for continuous casting of special steel with high surface quality requirements, such as cars and household appliances.

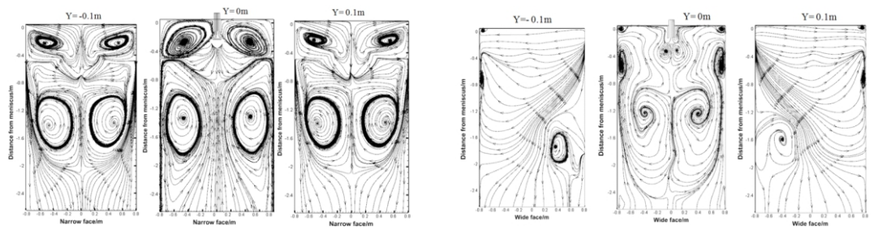
Modes selection and the metallurgical effects

Comparison of metallurgical effects of different modes

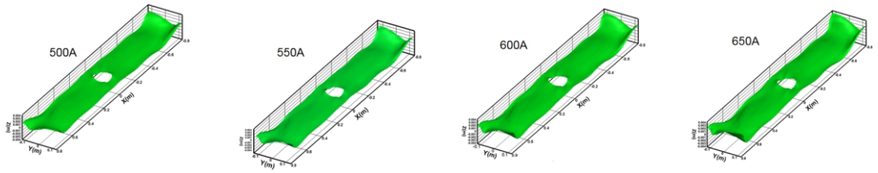
Mode	Main application scope	Metallurgical mechanism	Meallugical effect
Single rotation mode	High casting speed and high throughput	Reduce the excessive height of liquid level of narrow face; Reduce excessive flowing speed of the meniscus; Reduce the excessive high flux of the meniscus; Prevent mold powder from being thinner or sheared;	Reduce the slag; Improve the lubrication at the narrow side; Reduce steel break-out.
Accleration mode	Low casting speed and low throughput (especially at the beginning of casting , at the period exchange of ladle and tundish, and final casting)	Improve heat transfer to meniscus. Improve melting of mold fluxes. Increase the velocity of meniscus	Reduce alumina-based defects; Reduce meniscus freezing; Reduce longitudinal cracks in the middle of the wide face; Reduce segregating of subsurface bubbles and inclusions.
Deceleration mode	Some special steels grades for conventional casting speed: ultra-low carbon, Medium-carbon,aluminum-killed steel and other steel grades of high oxygen content.	Remove pinholes and blowholes from surface and subsurface mechanically; Homogenize the temperature and flow speed round the periphery of the mould. Improve the consistency growth of the slab shell; Improve heat transfer to the surface of the mold.	Reduce alumina-based inclusions; Reduce argon-based pinholes in killed steel; Reduce co- based porosity in pseudo rimmed seel; Reduce longitudinal cracks in peritectic steel.



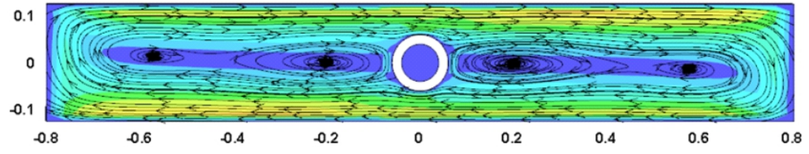
Multi-mode meniscus electromagnetic stirring and flow controlling system



Without electromagenetic stirring　　With electromagnetic stirring



Analysis of fluctuation on liquid surface



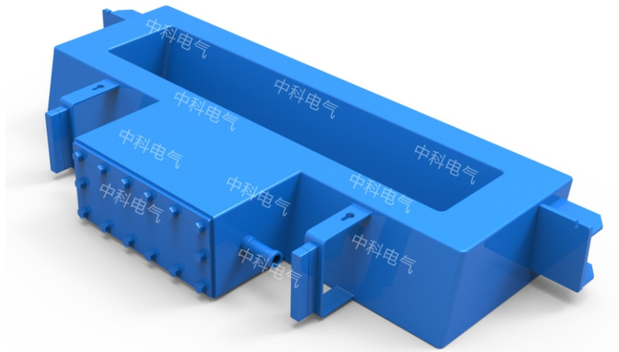
Flow field distribution of cross section in the mold

Typical references

Clients	Section	Main steel grades
Slab CCM #2 of BOF workshop 2 at Zhangjiagang Rockcheck Steel Group	170/200×850-1600	Pipeline steel, ship plate steel, container plate steel
Slab CCM #2 at steelmaking workshop 1 of Qian'an Iron and Steel of Shougang Group	230/250×1100-2150	Galvanized steel, deep drawing steel, automotive steel,boiler and pressure vessel steel, ship plate steel, pipeline steel,weathering steel, bridge steel
Slab CCM #2 at plant 3 of Baosteel	210/230/250×900-1600	High-quality carbon steel, bridge steel, weathering steel, high-strength structural steel
Slab CCM #1 at Baosteel Zhanjiang Iron&Steel Co., Ltd.	230×900-2150	Low carbon steel, structural steel, hull steel,pipeline steel, machinery steel , deep drawing steel
Slab CCM #2 at Baosteel Zhanjiang Iron&Steel Co., Ltd.	230×900-2150	Low carbon steel, structural steel, hull steel,pipeline steel, machinery steel , deep drawing steel
Slab CCM #6 at steelmaking plant 2 of Baosteel	230×900-1450	Tin plate, cold rolled plate, hot rolled coil, oriented silicon steel, non-oriented silicon steel
Slab CCM #1 at steelmaking plant 1 of Baosteel	250×900-1930	Carbon structure steel, deep drawing steel, spiral welded pipe steel, structural steel, low alloy steel, ship plate steel
Slab CCM #5 at steelmaking plant 2 of Baosteel	230×900-1450	Tin plate, cold rolled plate, hot rolled coil, oriented silicon steel, non-oriented silicon steel
Slab CCM #2 at steelmaking plant 1 of Baosteel	250×900-1930	Carbon structure steel, deep drawing steel, spiral welded pipe steel structural steel, low alloy steel, ship plate steel

Electromagnetic brake(EMBR) of mold for slab

- Electromagnetic brake(EMBR) of mold for slab is to use the electromagnetic force opposite to the direction of molten steel flow, which is generated by the downward flow of molten steel through a strong DC static magnetic field, to retard the speed of downward flow of molten steel.
- Electromagnetic brake of mold for slab is a necessary equipment for high-speed continuous casting of conventional thick slab, continuous casting and rolling of thin slab (CSP) and endless rolling (ESP)production. It can decrease the penetration depth of molten steel flow in the mold, stabilize molten steel flow at meniscus, uniform temperature, and eventually reduce inclusions on the surface of slab, as well as increase the productivity of caster.pro pri productivity of the caster.
- Clients: Masteel, Shougang Jingtang Iron & Steel Co.,Ltd.



Electromagnetic brake(EMBR) of mold

In-roll electromagnetic stirrer with high thrust force for the secondary cooling zone of slab

- The in-roll electromagnetic stirrer with high thrust force for the secondary cooling zone of slab has passed the scientific and technological achievements appraisal of China Metal Society, as the technology of it is advanced. The product has been applied on more than one hundred strand of continuous casting line for slab, and its domestic market share is over 90%.
- It is easy to install. The in-roll electromagnetic stirrer is installed on the segment of the continuous casting machine, replacing free supporting roller, without affecting the structure of the existing continuous casting machine. The installation dimensions are exactly the same as that of the ordinary roller, and can be exchanged. The position is easy to be adjusted.



In-roll electromagnetic stirrer with high thrust force for the secondary cooling zone of slab (complete roller type)

- It adopts special magnetism shielding technology, non-cogging structure technology, numerical simulation optimization of winding and iron core structure technology, the electromagnetic force is above twice that of similar products (patented invention).
- The roller sleeve is made of non-magnetic, high-Cr-Ni heat-resistant stainless steel, which has excellent wear resistance and heat resistance; And its reasonable water circuit design provides high cooling efficiency.
- The auxiliary supporting structure is adopted to be applied on continuous caster with plate width of 1800 mm to 2600 mm; and the splitting design is adopted, so as to make it applied on continuous caster with plate width of 2600 mm or more.
- Clients: Wuhan Iron & Steel, Bao steel, Shougang Qian'an Iron & Steel, Guangxi Liuzhou Iron & Steel, Hebei Iron & Steel, Baotou Iron & Steel, Xingcheng Special Steel, Henan Puyang Steel, Jiangxi Xinyu Iron & Steel, Hunan Lianyuan Steel, etc.



In-roll electromagnetic stirrer with high thrust (Splitting roller)

Low-magnification pictures



Without electromagnetic stirring
(Medium carbon alloy steel)



With in-roll electromagnetic stirring
(Medium carbon alloy steel)



Without electromagnetic stirring(Silicon steel)



With in-roll electromagnetic stirring for the secondary zone(silicon steel)



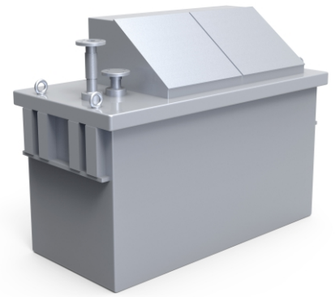
Without electromagnetic stirring(stainless steel)



With in-roll electromagnetic stirring for the secondary zone for 430

Box - type electromagnetic stirrer for the secondary cooling zone of slab

- Box-type electromagnetic stirrer for the secondary cooling zone, also called as rear roller of electromagnetic stirrer. It is usually installed behind the supporting roller at the inner arc side (or) in the zero section, about 2m away from the meniscus arc. When installed on the continuous caster for stainless steel slab, the equiaxed grain ratio reaches more than 55%.
- The product adopts numerical simulation to optimize the design, which can save energy and reduce consumption, and minimize the defect of large power consumption. Equipped with a hydraulic push device, the electromagnetic stirrer is pushed to the vicinity of the casting slab. The maintenance is easy, and the service life is long.
- Clients: Taiyuan iron & Steel, Angang Lianzhong Stainless Steel ,etc.



Box-type electromagnetic stirrer for the secondary cooling zone of slab

Typical references

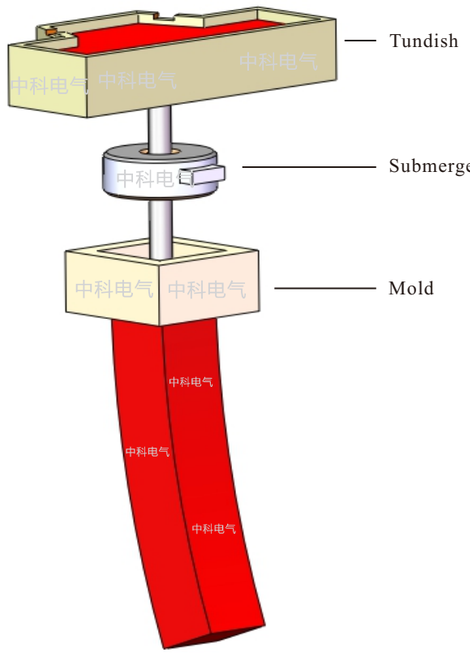
Clients	Section	Main steel grades
Slab CCM #2 at steelmaking plant 1 of Baosteel	250×900-1930	Carbon structure steel, deep drawing steel, spiral welded pipe steel structural steel, low alloy steel, ship plate steel
CCM #5 at steelmaking plant 2 of Baosteel	230×900-1450	Tin plate, cold rolled plate, hot rolled coil,oriented silicon steel, non-oriented silicon steel
Slab CCM #1 at steelmaking plant 1 of Baosteel	250×900-1930	Carbon structure steel, deep drawing steel, spiral welded pipe steel,structural steel, low alloy steel, ship plate steel
Slab CCM #6 at steelmaking plant 2 of Baosteel	230×900-1450	Tin plate, cold rolled plate, hot rolled coil, oriented silicon steel, non-oriented silicon steel
Slab CCM #1 at Baosteel Zhanjiang Iron&Steel Co., Ltd.	230×900-2150	Low carbon steel, structural steel, hull steel,pipeline steel, machinery Steel , deep drawing steel
Slab CCM #2 at Baosteel Zhanjiang Iron&Steel Co., Ltd.	230×900-2150	Low carbon steel, structural steel, hull steel,pipeline steel, machinery Steel , deep drawing steel
Slab CCM #2 at plant 3 of Baosteel	210/230/250×900-1600	High quality carbon steel, bridge steel, weathering steel, high strength structural steel
Slab CCM #2 at steelmaking workshop 1 of Qian'an Iron and Steel of Shougang Group	230/250×1100-2150	Galvanized steel, deep drawing steel, automotive steel,boiler and pressure vessel steel, ship plate steel , pipeline steel, weathering steel, bridge steel
Slab CCM #2 of BOF workshop 2 at Zhangjiagang Rockcheck Steel Group	170/200×850-1600	Pipeline steel, ship plate steel, container plate steel

Electromagnetic stirrer for billets and rounds

Submerged nozzle electromagnetic stirrer

Install the electromagnetic stirrer on both sides of the submerged nozzle, and the electromagnetic force generated by the stirrer makes the molten steel in the nozzle spirally rotate, thereby optimizing the temperature and speed of the molten steel in the nozzle and the molten steel entering into mold from the outlet of the nozzle, which will reduce the nozzle accretion and bias flow and increase the equiaxial grain ratio in slab significantly.

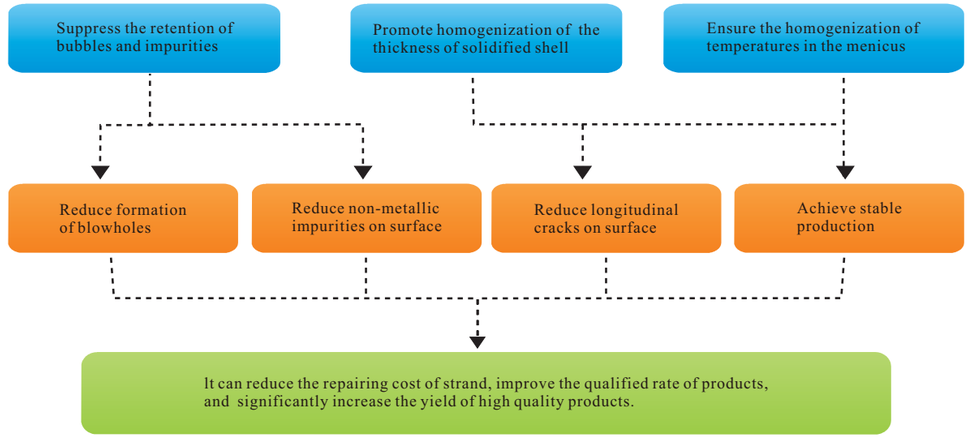
It is convenient to install the submerged nozzle EMS. Install the driving device on both sides of the beam, so as to make the electromagnetic stirrer automatically work from the standby position to the online position.



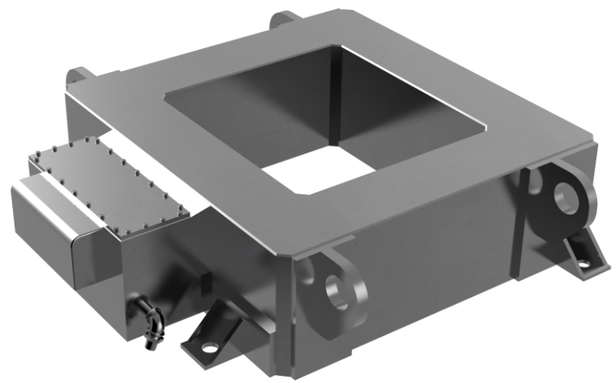
Schematic diagram of installation position of the nozzle EMS

Mold meniscus electromagnetic stirrer for billet

- The mold meniscus electromagnetic stirrer for billet adopts the advanced electromagnetic design concept so that the electromagnetic force mainly acts on the meniscus of the molten steel in the mold, so as to minimize quality defects on the surface of the casting strand.
- The electromagnetic stirrer for meniscus is installed on the upper position of the mold to form homogeneous stirring flow at the meniscus. It can scour the front of the solidification, minimize the accretion, homogenize temperature field, and improve the surface and subsurface quality of the continuous casting strand. And it is suitable for rectangular billet and large rounds for special steel grades(such as gearing steel and bearing steel)with high surface quality requirements.



Mechanism of effect

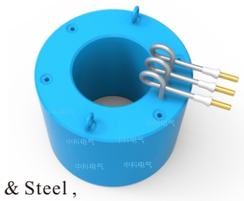


Mold meniscus electromagnetic stirrer

Mold Electromagnetic stirrer for billets

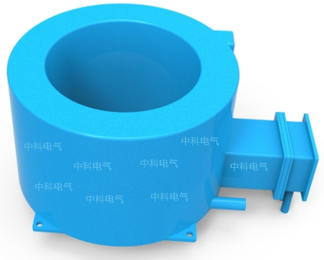
Internal mold, annular core, copper tube winding
(Highly recommended-patented products)

- The consistency efficiency of magnetic field is high.
- The stirring zone is long, which is suitable for short copper tube of mold.
- With good insulation structure and long service life.
- With high cooling efficiency, small water volume; high voltage and low current.
- Typical customers: Xining Special Steel, Huaigang, Zenith Steel, Lingyuan Iron & Steel , Weifang Special Steel,Longteng Special Steel, etc.



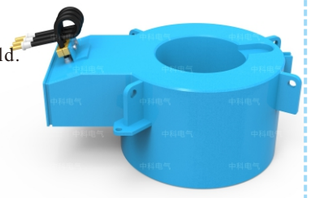
External mold, E-shape iron core, flat wire winding

- The structure is simple and the price is relatively low.
- It's convenient to install and maintenance.
- Less spare parts are required.
- Typical Customers: Xinyu Special Steel, Tianjin Steel Tube, Bao Steel, Beitai Steel Plant, Shougang, Anshan Steel, Ma Steel, Taiyuan Iron & Steel, Nanjing Steel,Hengyang Steel Tube, Chengdu Steel Tube, Xingtai Jitai, Tianjin Rockcheck Steel Group, Guangxi Liuzhou Iron & Steel.Tianjin Rongcheng and dozens of steelcompanies.



External mold, annular core, copper tube winding
(highly recommended - patented product)

- Metallurgical effect is good, especially suitable for bloom.
- The consistency efficiency of magnetic field is high.
- The stirring zone is long, which is suitable for the short cooper tube of mold.
- The insulation structure is good and the service life is long.
- The volume of cooling water and current are small, and the operation is economical.
- It’s convenient to install and maintenance; Less spare parts are required.
- Typical Customers: Baosteel, Ma Steel, Wuhan Steel, Xingtai Iron & Steel, Baotou lron & Steel,Chengde Steel, Weifang Special Steel, Jiyuan Steel, Hubei Xinye Special Steel, Wuhu Xinxing Pipes,etc.



Internal mold (independent cooling), E-shape iron core, flat wire winding
(recommended patented product)



- Metallurgical effect is good.
- The structure is simple and the price is low.
- Independent cooling water is adopted; The service life is long.
- SmalI size, suitable for small mould.
- The volume of cooling water is small, the current is low, and the operation is relatively economical.
- Typical Customers: Shougang, Jiyuan steel, SGIS Songshan co.,ltd, Beitai Iron & Steel Group, Lingyuan Iron & steel, Zenith steel, Chengde Iron & Xuanhua Steel, Chenggang, Shandong Shiheng special Steel, Jiangsu Suzhou Steel, CSN in Brazil etc.

Internal mold (with external water cooling) (traditional type), E-shape iron core, flat wire winding.



- Coil of cooling water for mold in common. The structure of the system is simple and it is unnecessary to equip with water system.
- Typical Customers: Xinyu iron and steel, Baosteel, Shijiazhuang Iron & Steel, Gansu Jiuquan Iron & Steel, etc.

Low-magnification pictures



Without electromagnetic stirring(stainless steel)



With electromagnetic stirring(stainless steel)



Without electromagnetic stirring(Round)



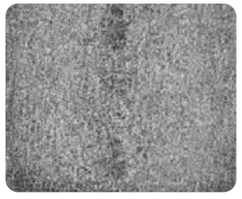
With electromagnetic stirring(Round)



Without electromagnetic stirring (billet)



With electromagnetic stirring (billet)



Without electromagnetic stirring (bloom)



With electromagnetic stirring at the final stage of solidification (bloom)

Strand electromagnetic stirrer for billet

Annular iron core and copper tube winding with internal water cooling.



- Effective stirring zone is long and metallurgical effect is good;
- With Continuous stirring and alternative stirring;
- The operation is economical.

E-shape iron core and flat wire winding with external water cooling.



- The structure is simple;
- The installation and maintenance is convenient;
- The price is relatively low.

Final electromagnetic stirrer for billet

Annular iron core and copper tube winding with internal water cooling (highly recommended) ;



- The consistency efficiency of cooling is high, and the metallurgical effect is good.
- With good insulation structure, high insulation level, and long service life.
- The stirring zone is long and the consistency efficiency of magnetic field is high.
- It is suitable for stirring stainless steel and high alloy steel.
- Typical client: Baosteel Tianjin Pipes, Jiyuan Steel, Shandong Fukai, Pangang Group Chengdu Iron & Steel. Huaigang, Tianjin Rockcheck Steel Group, Hubei Xinye steel, etc.

E-shape iron core and flat wire winding with external water cooling;



- The structure is simple;
- The installation and maintenance is convenient;
- The price is relatively low.
- Typical clients: Jiangsu Shagang Group, etc.

Auxiliary system for electromagnetic stirring system

Dedicated variable frequency power supply for electromagnetic stirring

- The power supply of electromagnetic stirrer is one of the key equipments of electromagnetic stirring system, which directly affects the effect of electromagnetic stirring. ZKNBF series dedicated variable frequency of power supply for electromagnetic stirring is developed by Zhongke Electric in cooperation with Hunan University. It has been upgraded from the first generation frequency converter system with single chip microcomputer as the control core to the fourth generation frequency conversion system based on DSP. It uses high-performance DSP as the control core, and adopts the three-loop control method of load current inner loop, output voltage instantaneous value outer loop and voltage RMS outer loop, so that the inverter power supply can obtain better dynamic performance and steady-state performance in the harsh environment.
- ZKNBF series of electromagnetic stirring inverter power has obtained a number of patented technology, software copyrights, and won the China Patent Gold Award in 2014 , the second prize of National Technology Invention Award . ZKNBF series power supply has very high performance-price ratio. Up to now, thousands of strands systems have been running on-line in steel plants worldwide. The system runs steadily and reliably.



Dedicated special variable frequency power supply for electromagnetic stirring

Technical characteristics

Two-phase / three-phase multiplexed SPWM modulation(patented technology), three-phase 120 ° phase deviation, two-phase orthogonal.

The continuous, quick alternative and intermittent stirring mode is available, and the scope of application for process requirements is wide. The current switching time can be continuously set in clockwise&counter clockwise under alternative stirring mode.

Multi-frequency power fiber synchronization (patented technology), the main cabinet and affiliated cabinet can be independently controlled, and the output can also be synchronous, the waveform synchronization rate > 99%.

Monitoring on leakage current real-time on-line monitoring (patented technology): on-line detection on electromagnetic stirrer leakage current size, and the value of leakage current can be transmitted to the upper IPC, for the analysis and evaluation on the use of electromagnetic stirrer status and life.

Low-frequency parameter microprocessor can measure and process low-frequency parameters, which can be easily and intuitively compared with the given parameters by users .

Performance of the product

Comprehensive protection function: over-current, over-voltage, bridge arm through short-circuit, protection from instantaneous power failure, radiator overheating, peak voltage protection, imbalance of output three-phase current, over-high leakage current, high temperature of backwater protection of electromagnetic stirrer, low flow of backwater protection, etc.

PID precise closed-loop control of stirring current: high current stability, error less than 3%, waveform distortion rate less than 5%, frequency error less than 0.1Hz,and overshoot less than (+5%).

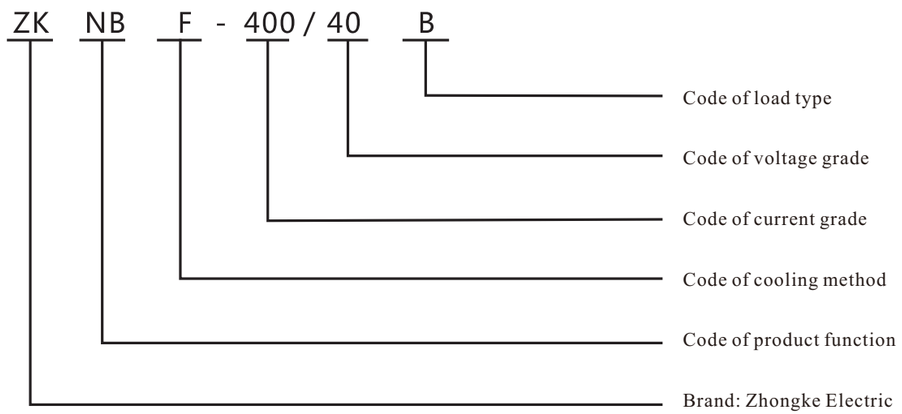
Double power supply of the system is available; and the control program is reasonable, which can effectively prevent from system failure or data loss caused by sudden power failure.

The high power factor and small harmonic disturbance are beneficial for the effective utilization and operation of the power grid of users.

It has strong anti-interference ability that it can run steadily and reliably under harsh environment in steel factory.

Comprehensive status screen, real-time curve, fault alarm, and history query functions which can be easily accessed in the human-machine interface. The interface is intuitive and comprehensive, and the parameters can be set quickly and conveniently.

Model description



Specifications of variable frequency power supply for electromagnetic stirrer

Load	Voltage of main power supply	Model	Output current (A)	Output frequency (Hz)	External dimmension(mm)
2 phase	400VAC 50/60Hz	ZKNBF-400/40B	0~400	1~16	800x800x2200
		ZKNBF-500/40B	0~500		
		ZKNBF-600/40B	0~600		
2 phase	500VAC 50/60Hz	ZKNBF-400/50B	0~400	1~16	800x800x2200
		ZKNBF-500/50B	0~500		
		ZKNBF-600/50B	0~600		
3 phase	400VAC 50/60Hz	ZKNBF-400/40	0~400	1~16	800x800x2200
		ZKNBF-500/40	0~500		
		ZKNBF-600/40	0~600		
		ZKNBF-700/40	0~700		
		ZKNBF-800/40	0~800		
		ZKNBF-1000/40	0~1000		1000x800x2200
		ZKNBF-1200/40	0~1200		
		ZKNBF-1600/40	0~1600		
		ZKNBF-2000/40	0~2000		1200x800x2200
3 phase	500VAC 50/60Hz	ZKNBF-400/50	0~400	1~16	800x800x2200
		ZKNBF-500/50	0~500		
		ZKNBF-600/50	0~600		
		ZKNBF-700/50	0~700		
		ZKNBF-800/50	0~800		
		ZKNBF-1000/50	0~1000		1000x800x2200
		ZKNBF-1200/50	0~1200		
		ZKNBF-1600/50	0~1600		
		ZKNBF-2000/50	0~2000		1200x800x2200

Remote monitoring and operation system for electromagnetic stirring

Remote monitoring and operation system for electromagnetic stirring is used for monitoring, parameters setting and remote control of the electromagnetic stirring equipment.

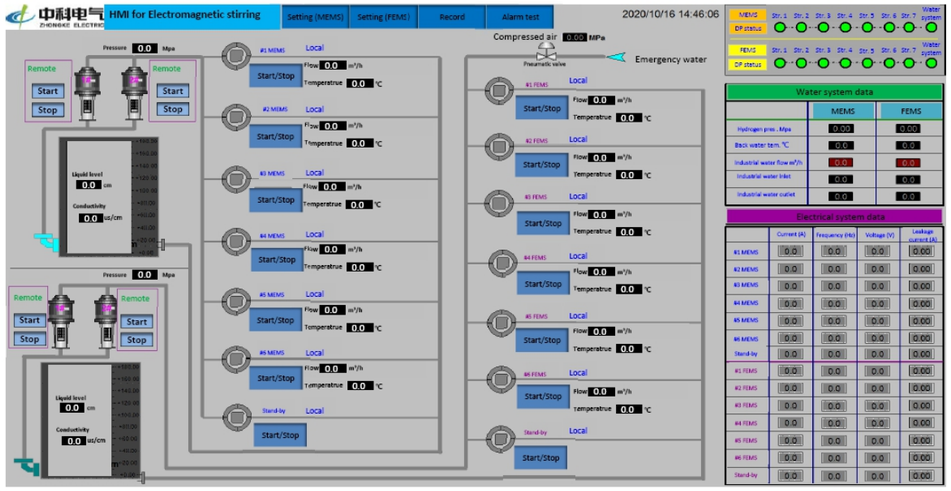
The configuration software of IPC is used to configure friendly HMI. lt has various of functions, including process parameters(such as current and frequency) display, process parameter setting, history record storing, printing, inquiring, status(operation and fault) indication.

The stirring parameters can be set, and the parameters of the variable frequency power supply can be automatically set according to the parameters formula.

The expansion interface of process parameter for users is reserved, and the users can directly set the stirring process parameters.

The IPC can display the working condition of the electromagnetic stirrer in real-time, and analyze and evaluate the operating condition of the electromagnetic stirrer in real time. With the friendly HMI , it is easy to master and operate.

The stirring process parameters (including process parameters such as current value, frequency value and the digital control signal parameters such as start and stop) can be set or modified online, and the parameter setting and control on variable frequency power supply for each strand can be automatically completed according to the formula via network, so as to achieve remote control.



Remote monitoring and operation system interface for electromagnetic stirring

Cooling water system for electromagnetic stirring

- Cooling water system for electromagnetic stirring consists of pure water manufacturing equipment, ion exchanger, pure water pump, magnetic filter, heat exchanger, flow regulation, flow detection, pressure detection, temperature detection and water quality detection.
- The flow regulation device is installed in front of electromagnetic stirrer, and the water consumption of each electromagnetic stirrer can be distributed according to the requirements.
- Flow detection is used for the remote control of water consumption of each electromagnetic stirrer. It has the function of on-line alarm to prevent the electromagnetic stirrer from water shortage.
- The temperature detection is used to detect the temperature of the effluent of the electromagnetic stirrer, so as to provide basis for the flow regulation.
- Water quality detection is used to observe the conductivity of circulating cooling water and has on-line alarm function.
- The pure water manufacturing equipment adopts reverse osmosis technology to provide high quality cooling water for the electromagnetic stirrer.



Cooling water system

Table for model selection of cooling water system

Model	Main pipe diameter	Flow rate (m^3/h)	External dimension (mm)	Pure water machine	Water production (m^3/h)
ZKSX-20	DN50	15~20	3500×2200×1900	ZKZS-5	0.5
ZKSX-60	DN80	30~60	4300×2200×1900	ZKZS-10	1
ZKSX-90	DN100	70~90	4700×2200×1900		
ZKSX-150	DN125	100~150	5000×2800×1900		
ZKSX-200	DN150	160~200	5300×2800×1900		
ZKSX-300	DN200	200~300	6800×3300×1900		

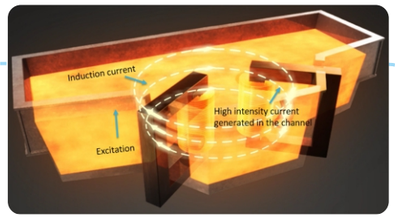
3 Channel type induction heating and refining system for tundish

The channel type induction heating and refining technology for tundish is the technology that uses the principle of electromagnetic induction to form current circuit inside the molten steel and generate Joule heat in the channel of flow steel, thereby realizing heating and heat preservation of the molten steel.

In addition, the electromagnetic pinching force in the channel enables the inclusions to be adsorbed and removed by the channel wall. On the other hand, the hot molten steel is sprayed out of the channel from the outlet , and an upflow formed under the effect of the temperature difference, so that the inclusions float up to the surface of the molten steel and be absorbed and removed by the covering agent.

Heating principle

The excitation coil is the primary circuit, and the molten steel is the secondary circuit. By inputting variable frequency current to the excitation coil, high-intensity magnetic field is generated in the iron core, so that the connected molten steel generates induced current, thereby achieving continuous heating on the molten steel.



Principle of induction heating

Technical advantage

Non-contact heating: the reheat of molten steel reaches 3°C/ min ;

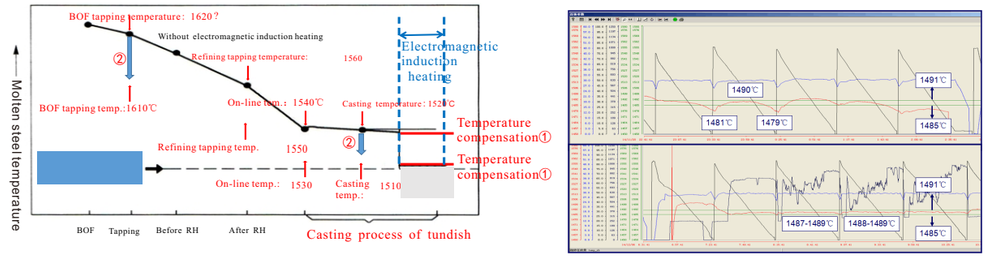
Achieve constant temperature casting with optimum overheat , and the accuracy of temperature control is up to±3°C;

Decrease the on-line temperature of the ladle (10~15°C) ; Save energy ;

It can effectively reduce total oxygen content in molten steel and remove small inclusions.

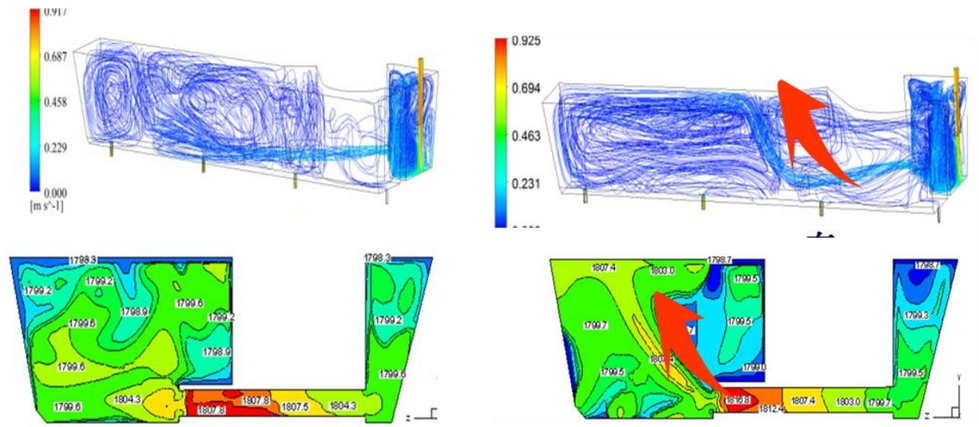
Metallurgical mechanism

Parameters of initiative temperature control: Decrease the on-line temperature of the ladle(10-15°C);
Heating rate:(1-3)°C/min;
Target temperature of overheating control: target temperature (±3°C).



Curve of on-line temperature of ladle and actual temperature control of tundish

Heating in the channel enables the heated molten steel form an upflow from the outlet of the channel, which causes the inclusions float up to the free surface to be absorbed by the covering agent, and the upflow also promotes mixing of the molten steel in the tundish, homogenizing the temperature distribution.

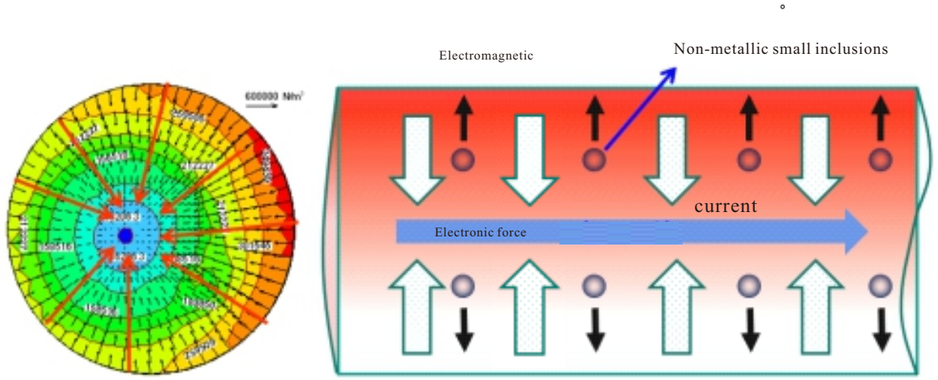


Without heating

With heating

Simulation diagram of temperature field and flow field

A pinch force directed toward the center is generated in the channel to cause non-metallic inclusions to surge toward the wall and then be absorbed by the channel wall.

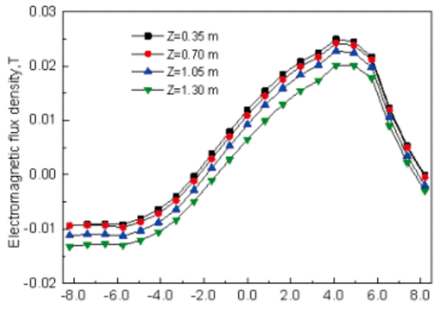


Mechanism of inclusions removal

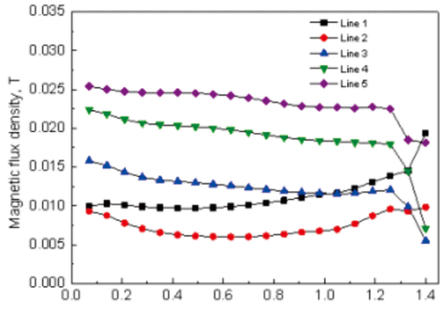
Optimization of numerical and water simulation

Zhongke Electric has professional experiment platform for numerical simulation and water simulation. In addition, we cooperate with major universities in China. We are committed to the numerical and water simulation analysis of tundish induction heating. We have reasonable database of flow field and temperature field of molten steel in tundish, as well as the ability to optimize design of the channel diameter, length and installation forms of various types of tundish to achieve the best metallurgical effect of induction heating technology.

Analysis and presentation of numerical simulation



(a)Curve of channel radial electromagnetic force distribution



(b) Curve of channel axial electromagnetic force distribution

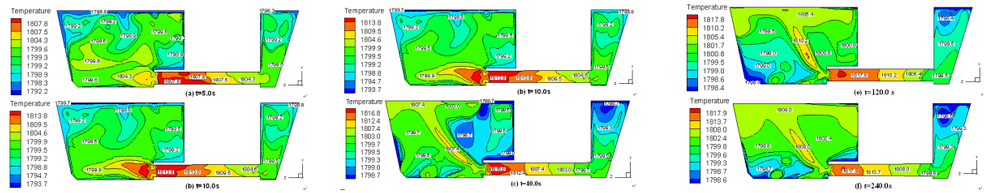
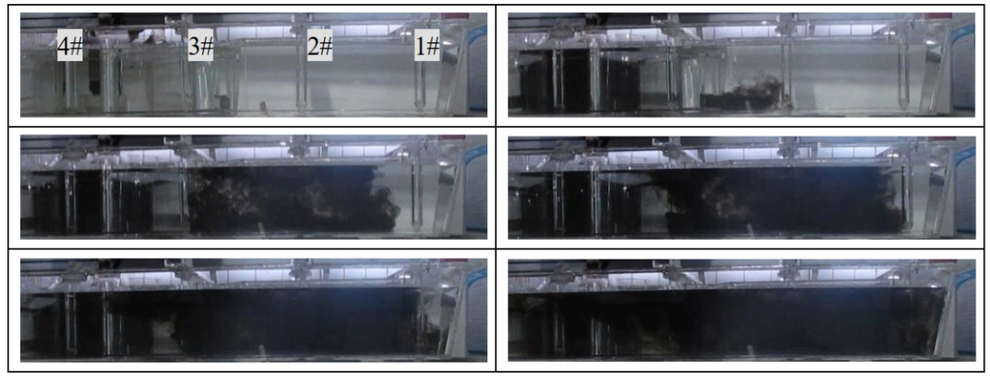
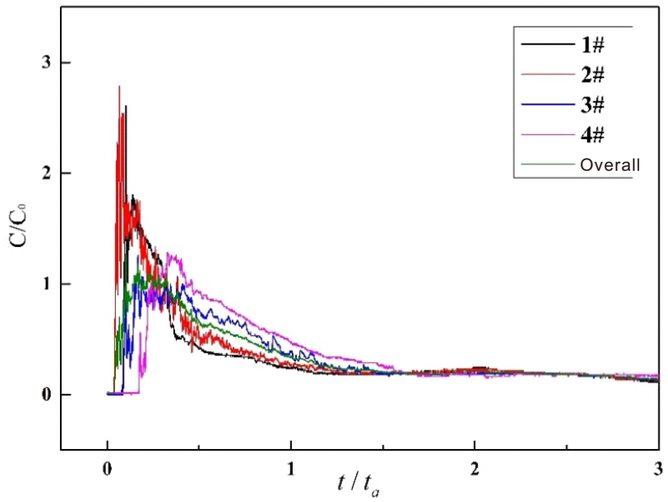


Diagram of flow field and temperature field distribution in the tundish at different time

Analysis of water simulation



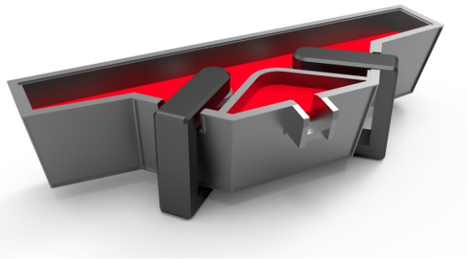
Flow forms in the tundish at different time



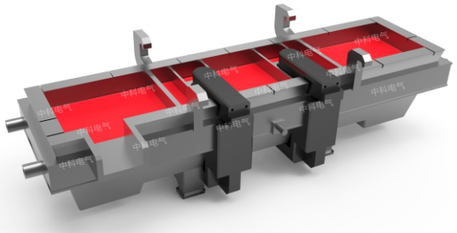
RTD curve of the tundish

Product structure

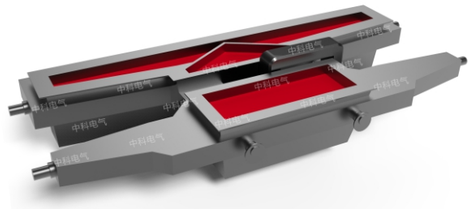
The layout of channel of the tundish is inverted V shaped, which breaks through the restriction of the position of the ladle shroud can not be changed and the distance between the ladle turret and the tundish is short. The tundish channel has various structures, which can be applied to different types of tundish..



Tundish structure with short strand distance(a)



Tundish structure with short strand distance(b)



Tundish structure with long strand distance

System compositon

- The channel type induction heating and refining system for tundish consists of induction heater, dedicated variable frequency power supply, remote dynamic monitoring and operation system, and compound cooling system.
- The system was assessed by China Machinery Industry Federation that the overall technology has reached international advanced level.



Cooling water system



Aerosol cooling system



Tundish and induction heater



Variable frequency power supply and electric control system

Channel type induction heater for tundish

The induction heater is composed of iron core, coil and air duct. The iron core is composed of movable door frame type upper iron core and lower iron core fixed at the bottom of the tundish. Special insulation treatment process is applied for the coil.



Induction heater

Structure characteristics of products

- Small size: it is suitable for adding induction device on tundish with short strand distance.
- The air duct can be automatically docked, and the iron core self-locking can be quickly located: it is convenient to disassemble and assemble, and it is suitable for fast-paced industrial production of the continuous casting production.
- Unique inductor insulation treatment process: long service life, and it's suitable for high temperature steel making environment.

Special variable frequency power supply for channel type induction heating of tundish

CSMF series variable frequency power supply is the dedicated power supply of channel induction heating for tundish developed independently by Zhongke Electric. It is green and energy-saving variable frequency technology. It has obtained many patented technology, software copyrights, and has been awarded the Chinese Mechanical Industry Award for Science and Technology Progress and National Award for Science and Technology Progress. It is high-tech and energy-saving product integrated with high-power electronic technology, microelectronics technology, high-voltage optical fiber communication technology, automation control technology and high-voltage technology. Local control and remote control of the system are available, which can realize precise parameter setting and real-time monitoring, remote fault diagnosis and alarm, record preservation and inquiry. It can achieve automatic control, and it is safe, high efficiency and energy saving.

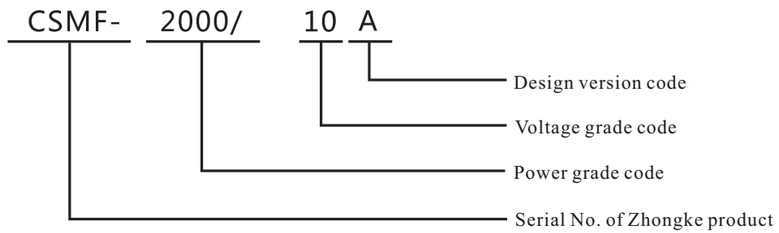


Dedicated variable frequency power supply for induction heating

Technical characteristics

- Power unit module redundancy cascade technology(patented technology), hot and cold standby of redundancy module improve the stability and reliability of the converter.
- Units cascaded multilevel technology: the output PWM waveform is good, and the Du/Dt is small, which can reduce insulation damage of cable and harmonic loss of induction coil.
- Multi module-cascaded(patented technology):the range of voltage and power is wide. The output voltage can satisfy various requirements of customers by adjusting quantity of power units box or input voltage or output voltage of power unit.
- Power factor resonance Compensation Technology (patented technology)is used to improve the power factor of the power supply system.
- Dynamic insulation detection technology (i.e.current leakage protection technology), real-time on-line detection of inductor current leakage ensures the stable operation of equipment, and extends the service life of equipment.
- High-voltage optical fiber communication technology is used to achieve the isolation of strong electric and weak electric signals. The shielding terminals and grounding facilities are installed inside the variable frequency cabinet. The system has high security and good anti-electromagnetic interference.
- Comprehensive protection functions: including protection from overload, over-current, over-voltage,under-voltage,overheating,current leakage, water pressure and temperature exceed limit. limit limit.
- Automatic bypass function of unit: When a certain power module fails, automatic bypass works, redundant power unit start running, and frequency conversion device will not power off.
- Modularization designing concept of power unit: structure of power units is completely same. It is very convenient to withdraw, move and replace each unit box from the rack, so it is easy to maintain.

Model description



Model description of CSMF series variable-frequency power supply

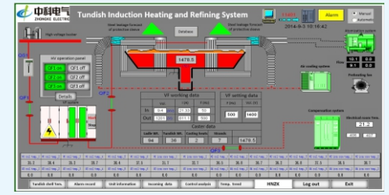
Model	Rated capacity (kVA)	Input voltage (kV)	Output frequency (Hz)
CSMF-500/10A	500	10	50-2000A continuous adjustable
CSMF-1000/10A	1000	10	50-2000A continuous adjustable
CSMF-1500/10A	1500	10	50-2000A continuous adjustable
CSMF-2000/10A	2000	10	50-2000A continuous adjustable
CSMF-2500/10A	2500	10	50-2000A continuous adjustable
CSMF-3000/10A	3000	10	50-2000A continuous adjustable
CSMF-3500/10A	3500	10	50-2000A continuous adjustable

Remote dynamic monitoring and operation system for channel type induction heating of tundish

Remote monitoring and operation system undertakes overall monitoring, parameter setting, remote electric auxiliary control and logic control of variable-frequency power supply, induction heater and water system. The design of this system is advanced, and characterized with innovative design, high reliability, low cost, convenience, short development cycle.

Technical characteristics

- It has various functions, including process parameters(such as power, frequency, current and voltage) display, process parameters setting, historical records storing, printing, inquiring, and status (operation and fault) indication. The output power of the variable frequency power supply can be automatically adjusted according to the heating temperature so as to meet the requirements of heating process.
- The upper IPC can display the working condition of induction heating, and analyze and evaluate the operating condition of induction heater in real time.
- The alarm function of steel break-out is available to monitor the break-out condition through break-out prediction system and temperature detection means, and distinguish light break-out and serious break-out, so as to improve the system security. With friendly HMI, it is convenient to operate.
- Detailed technical documents and guidance for operation, as well as flexible online support, provide good interface for users to redevelop.



Interface of channel type induction heating and refining system for tundish

References

Clients	Section	Steel grades	Tundish capacity
Shandong Iron&Steel Co.,Ltd., Laiwu Branch	Φ500mm Φ650mm Φ800mm	Bearing steel, alloy structural steel, etc	40t
Inner Mongolia Baotou Steel Union Co., Ltd.	380mm×280mm	Heavy rail steel, U71Mn U75V, etc	40t
Shijiazhuang Iron & Steel	300mm×340mm	Alloy structural steel, gear steel、bearing steel, spring steel, etc	45-50t
Weifang Special Steel	150mm×150mm 200mm×240mm	Bearing steel, cord steel, etc	50t
Hebei Jingye	1350mm×2mm ultra-thin strip	High quality special steel	25t
Zhangjiagang Rockcheck Steel Group	300mm×390mm	Medium-high carbon steel, alloy steel, etc	40t
Xingtai Iron and Steel Co.,Ltd.	280mmx325mm	Cold heading steel, cord steel, bearing steel, spring steel, stainless steel, etc	30t
Jiangyin Xingcheng Special Steel Co., Ltd.	Round：Φ600 Billet：210×240etc	Medium-high carbon steel, cord steel	50t

4 Online heating system for continuous rolling bars

The product is mainly applied in billet before medium rolling or rough rolling. Induction heating technology can be used to heat the continuous casting billet on-line. It can compensate temperature before the temperature of the continuous casting billet has been greatly reduced, decrease the temperature difference of core and surface, as well as the decrease temperature difference of first strand and the last strand, and reduce the thickness of the oxidized surface of continuous casting billet so as to meet the rolling requirements.

Technical characteristics

High temperature control accuracy: Through online temperature control, the temperature of the front, end parts, core surface can be kept consistent with that of the entire strand, so that the soft and hard deviation of the strand is small, and the quality problems such as cracks and inconsistence of rolling thickness can be avoided.

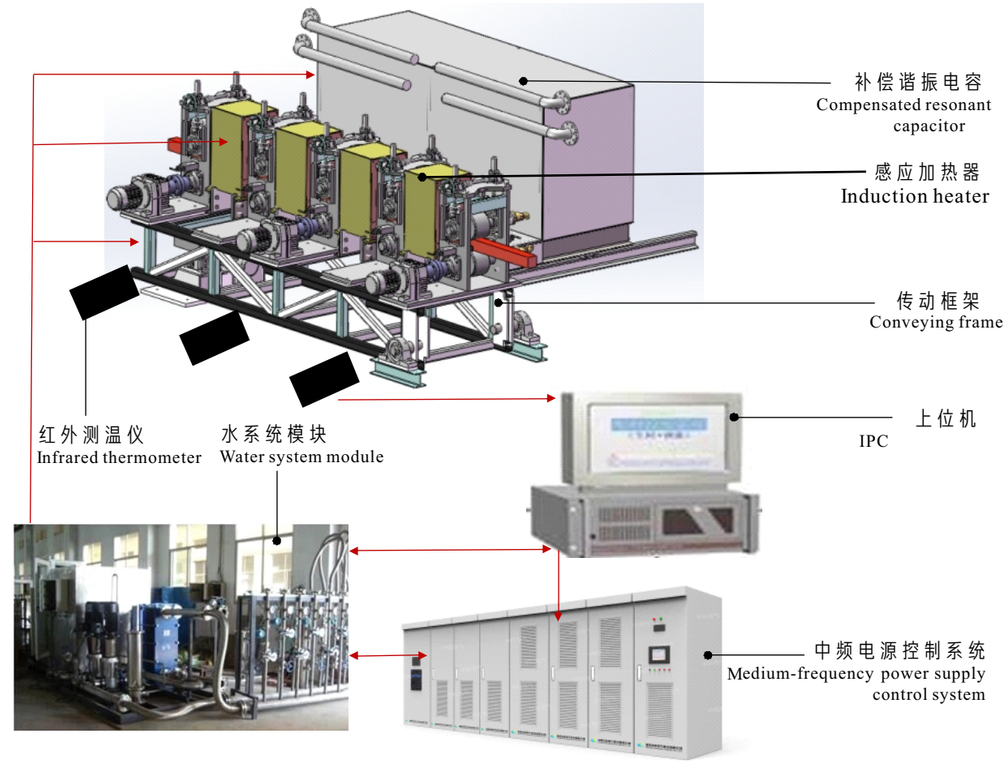
The electromagnetic induction heating is an energy-saving and environmental friendly technology, the energy utilization rate of induction is 70%.

Increase yield: The heating time of strand with electromagnetic induction heating can be obviously shorten, so the oxygen combustion consumption is reduced. Generally speaking, the combustion consumption of traditional heating is about 1%-1.5%,while that of electromagnetic induction heating is only 0.3%~0.5%.

Extend the service life of roller: The use of electromagnetic induction heating can reduce the scale, so as to increase the life of roller by 20%to 30%.

System composition

The on-line heating system of continuous rolling bar is composed of induction heater, high power medium-frequency induction heating power supply, induction heating electric control system and compound cooling system.



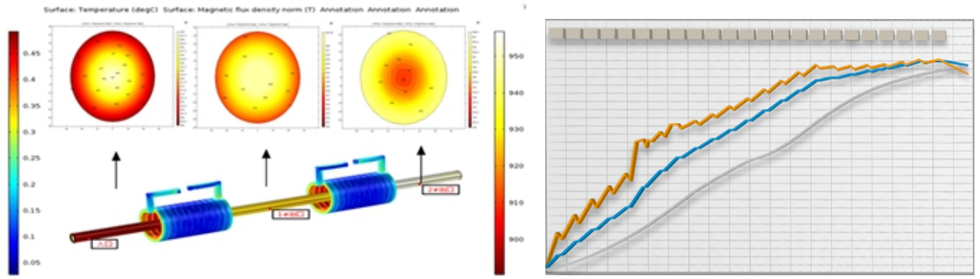
System composition diagram of on-line heating system for continuous rolling bar

References

No.	Projects	Clients	Specifications
1	Induction heating for continuous casting strand of Φ97mm	Yongxing Special Steel	2000KW
2	Induction heating for continuous casting strand of Φ55mm	Yongxing Special Steel	2000KW
3	Induction heating for continuous casting strand of Φ80mm	SWG of Baosteel	2800KW

Induction heater for continuous rolling bars

Induction heater for continuous rolling bar possess advantages of high heating speed, high efficiency, accurate control, homogenization, less contamination, etc. When the casting strand enters the rolling mill, the temperature difference on the cross section of it can be decreased by about 30% compared with that of natural cooling. And the rolling process is more stable at higher absolute and relative temperature. The required rolling force is smaller, so the roller wear is less and the service life of the rolling mill is longer.



Mechanism of induction heating for continuous rolling bars



Diagram of induction heater for continuous rolling bar in operation on-site

Medium-frequency induction heating power supply

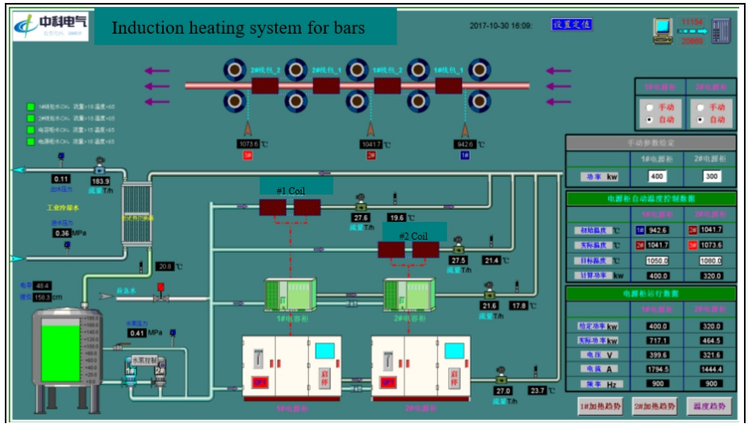
The induction heating power supply for continuous rolling bar is developed independently by Zhongke Electric, which is composed of rectifier cabinet, inverter cabinet and electro-thermal capacitor. The green, environmental, energy-saving variable frequency technology is adopted, which integrates local control, remote control and IPC, realizes automation, safety, high efficiency and energy-saving of system control.



External structure of medium- frequency power supply for induction heating

Electric control system of induction heating for continuous rolling bar

Advanced computer technology and automatic control system technology are adopted for the remote dynamic temperature closed-loop control system. The system performance is excellent: the system is stable and reliable, having characteristics of innovative design, high reliability, low cost, convenience, short development cycle. The interface is clear, intuitive and convenient. Detailed technical document, guidance for operation and flexible online help, provide good secondary development interface to help users to develop and extend the functional program and hardware drivers program.



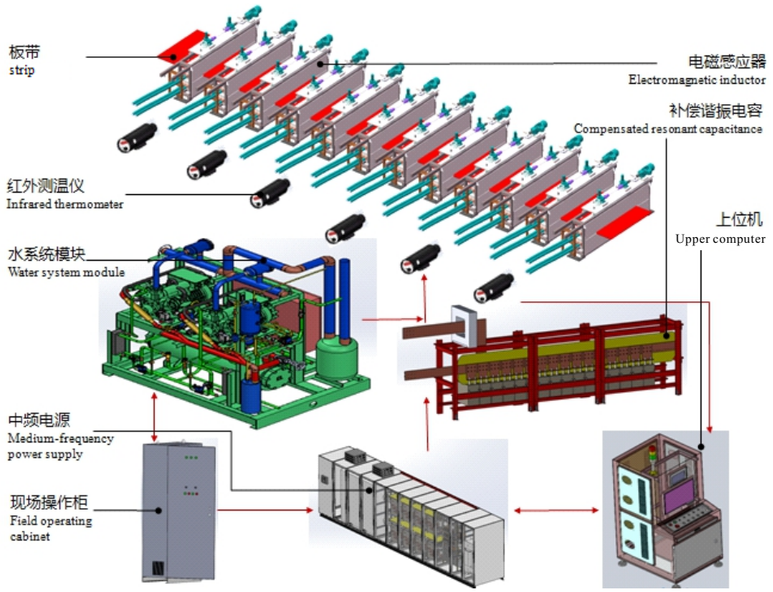
Interface of electric control system of induction heating for continuous rolling bar

5 Online heating system for continuous rolling plate

- By using the energy of the eddy current, the steel plate is heated online continuously, rapidly and uniformly to the required temperature of the rolling process, so that the carbide in the final product is more refined and dispersed, and the performance of the plate product is improved.
- Electric energy is used for heating , which can reduce environmental pollution and power consumption, as well as save electricity.
- The structure of electromagnetic inductor is compact: the same inductor can be used for induction heating plates with different thickness and width. At the same time, the strand temperature in the length direction and cross section can be uniformly distributed, and then reach the optimum rolling temperature, which improves the applicability and utilization of the equipment. The heating speed is fast and the produced oxidized surface can be greatly reduced.
- The heating power factor and heating efficiency are high, The variable frequency heating is adopted, and the heating power factor can be improved by more than 80%compared with that of similar products.

System composition

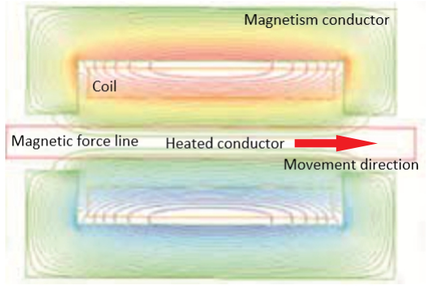
- The on-line heating system of continuous rolling plate is composed of induction heater, high power medium-frequency induction heating power supply, induction heating electrical control system and compound cooling system.



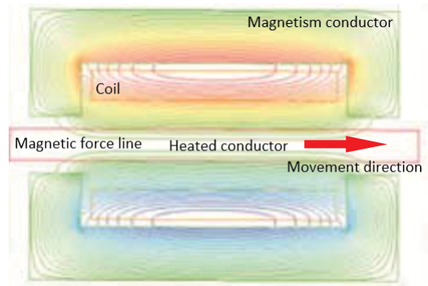
System composition of on-line heating system for continuous rolling plate

Induction heater for continuous rolling plate

According to the different types of the inductor and direction of the magnetic field, there are longitudinal magnetic inductor and transverse magnetic sensor. Longitudinal magnetic induction heater: The magnetic force lines excited by the inductor are parallel to the axis of the heated plate. Transverse magnetic induction heater: The magnetic force lines excited by the inductor are perpendicular to the heated plate.

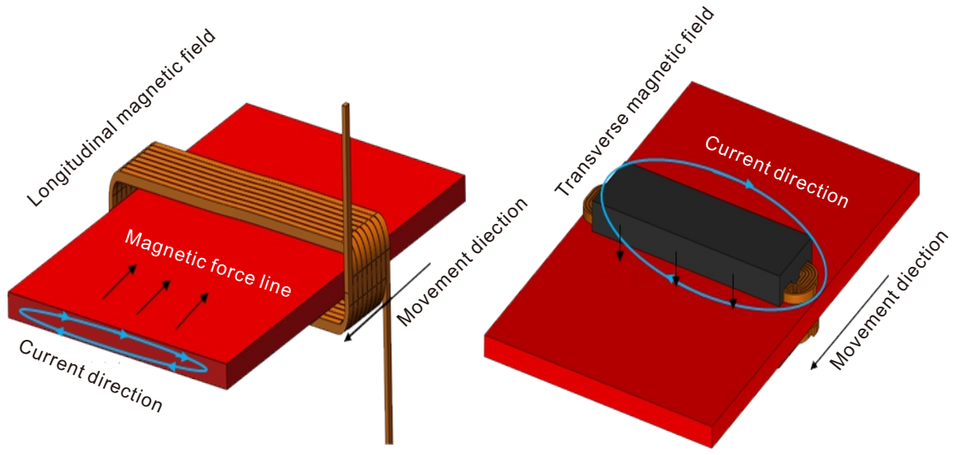


Transverse magnetic field



Longitudinal magnetic field

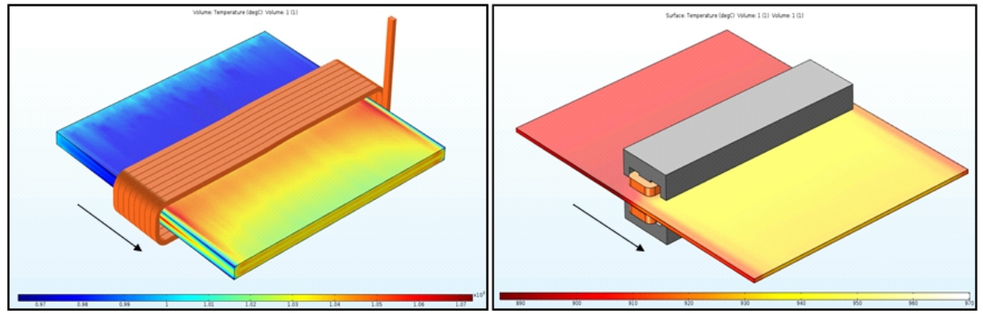
Cross section distribution diagram of magnetic lines for different inductors



Structures of different inductors

Comparison of longitudinal and transverse magnetic heating efficiency

- Longitudinal magnetic heating: heating efficiency increases as the width and thickness of plate increase;
- Transverse heating: heating efficiency decreases as the thickness of the plate increases; increases as the width of the plate increases



Longitudinal heating(thickness of the plate is 70mm)　　Transverse heating(thickness of the plate is 20mm)

Comparison of longitudinal magnetic and transverse magnetic induction heating efficiency

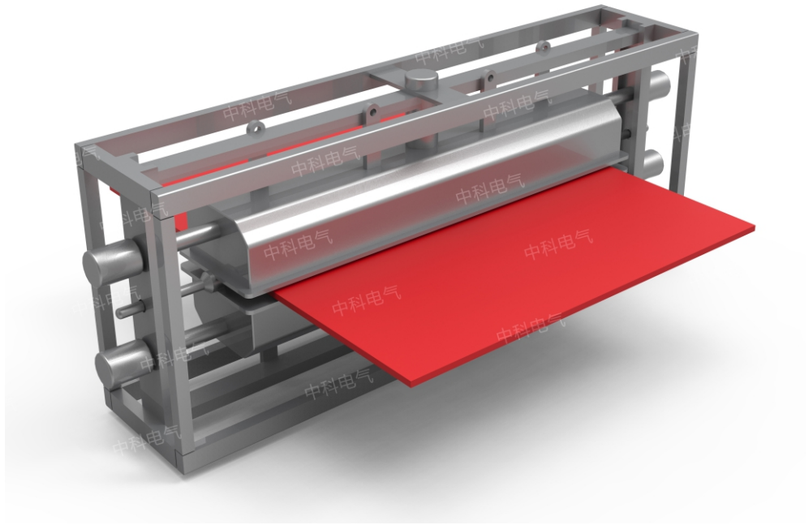
- The requirements of different rolling temperatures can be satisfied by induction heating. For different thickness of plate, the heating efficiency of longitudinal magnetic and transverse magnetic are different. Generally, the longitudinal magnetic field is more suitable for the heating of thick plates, while the transverse magnetic field is more suitable for the heating of medium thick plates and thin plates.

Technical features

Transverse magnetic induction heating: The principle of inductor heating is transverse magnetic heating, with high heating efficiency, special magnetic circuit design and processing technology, which effectively solves the technical problem of uneven temperature and over-burning of the plate front part, avoiding the cutoff of the over-burnt plate which causes material waste.

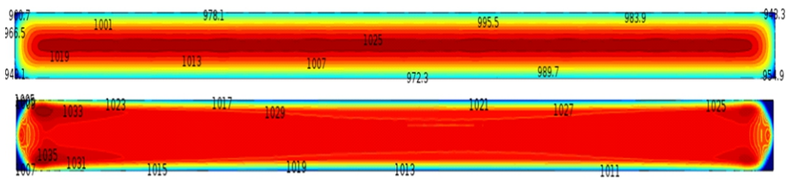
Intermediate frequency heating: transverse magnetic field heating, the adopted frequency is low. Magnetic lines of flux penetrate the heated plate vertically, the magnetic line of flux dissipated in the air gap is very few, so the electrical efficiency is high, which can reach 70%.

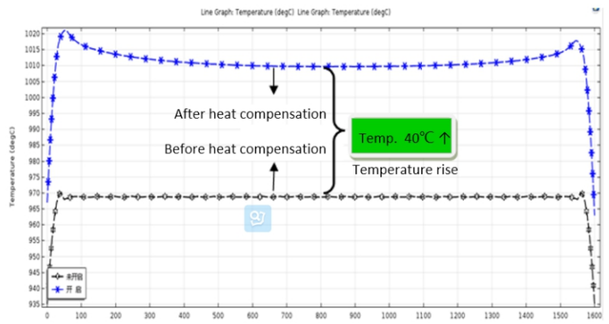
High safety of equipment : The induction heater equipment increases the convenience and safety of the complete set of equipment by increasing longitudinal and transverse mobile drive, the purging device and the cogging iron core. The heating of different plates with minimum air gap can be achieved, which can reduce the excitation power of the device.



External structure of induction heater

Heating effect of transverse magnetic induction





Parameters of single inductor :
Power (P):2500kW
Frequency(F):(600~1000)Hz
Thickness of the plate:70mm
Width of the plate:1600mm

Cloud diagram of temperature distribution at the cross outlet of inductor before and after heating

High power medium frequency induction heating power supply

High-power medium-frequency induction heating power supply is independently developed by Zhongke Electric. It is composed of incoming switch cabinet, transformer cabinet, power unit cabinet, system control cabinet, outgoing cabinet and electric heating capacitor. It is high-tech energy-saving product integrates high-power electronics technology, microelectronics technology, high-voltage optical fiber communication technology, automation control technology and high-voltage technology. The system integrates local control and remote control, can realize functions including parameter setting and real-time monitoring, remote fault diagnosis and alarm, complete record preservation and inquiry. The automatic control can be achieved. It is safe, high efficient and energy-saving.



External structure of high-power medium-frequency induction heating power supply

Reference

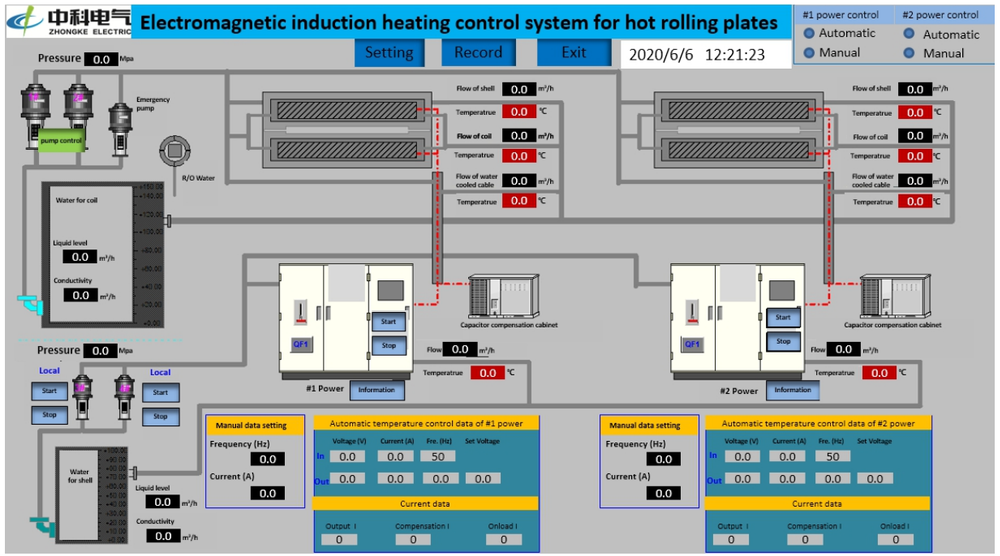
Product	Working condition					Typical customers
	Requirement of temperature control	Temperature range at the inlet	Section width of strand	Section thickness of strand	Steel grades	
Complete set of electromagnetic induction heating system for ESP	The maximum temperature rise on the surface is 300 ℃	(760~960)℃	(900~1600)mm	(9~20)mm	Low-carbon steel, high carbon steel, biphasic steel	Shandong Ri zhao Steel

Electrical control system of induction heating for continuous rolling plates

Remote dynamic control system possesses functions of comprehensive monitoring, parameter setting, remote electrical auxiliary control and logic control for high-power medium-frequency induction heating power supply, induction heater and supporting water system.

Main technical characteristics

- It has functions of process parameters(such as power, frequency, current and voltage) display, process parameters setting, historical records storing, printing, inquiring, and status (operation and fault) indication.
- It can automatically adjust the opening angle of the induction heater according to strip thickness, improve the power factor of the system, reduce the power consumption and save energy.
- The output power of the medium-frequency power can be automatically adjusted according to the heating temperature, so as to meet the heating process requirements.
- The upper IPC can display the working condition of the induction heater, analyze and evaluate the operating status of the induction heater in real time.
- With friendly HMI, it's convenient to operate.



Schematic diagram of electrical control system interface of induction heating for continuous rolling plates

6 Industrial magnetic handling system

Lifting electromagnet

With 30 years' experience on R&D, design and manufacturing, we adopt the professional magnetic field analysis software for simulation, and combine with advanced manufacturing technology, optimizing the structure, weight and attraction force of the electromagnet.

Characteristics of product

- Advanced fully sealed and waterproof design
- The coil adopts special filler to consolidate, which is high temperature-resistant, high humidity -resistant and anti-violent impact.
- The outlet box adopts internal and external double chambers structure , which is water-proof, moisture-proof and has excellent insulation.
- Insulation grade of electromagnetic wire of the electromagnet: Grade C.
- The electromagnet chain has anti-rotation function.

Strict testing standard

Turn to turn insulation test: Power frequency voltage is 550V, without short circuit and flash-over in one minute.
The magnetic-conductive material is made of high-quality carbon steel;

Voltage withstand test: Power frequency voltage is 3000V, without short circuit and flash-over in one minute.

Series MW5 & MW61 for scrap

Application: They are widely used for handling iron ingots, steel balls, steel scrap, etc.
Characteristics: Simple structure and convenient installation. There are three types: rated voltage DC220V, strong excitation DC290/200V, over excitation DC350/ 290/200V. Both strong excitation and over excitation type can improve the lifting capacity by about 5-10%.
Selection: Series MW5 is circular shape; And generally, MW61 is designed to be oval with semicircular structure at both ends,. The dimensions of both the two series electromagnets can be customized based on the actual demand.



Series MW22, MW42 for handling rounds and billets

Application: It is mainly used for handling billets, blooms, rounds, steel ingots, and profiled steel.
Characteristics: With deep magnetic penetration and large magnetic force, it can even lift uneven steel. There are two types: normal temperature type and high temperature type. The applied temperature range is 0-600℃.
Selection: The length of electromagnet depends on the width of the attracted material. Series MW22 are usually used to lift normal temperature materials, which are of temperature ＜300℃ ,while series MW42 are usually used to lift high temperature materials, which are of temperature≥ 300 ℃.



Series MW12 for lifting bundled wires and bars

Application: It is used for loading, unloading and stacking bundled wires and bars.
Characteristics: The special double magnetic poles enables the magnetic circuit to penetrate the multilayer air gap. It's unnecessary to manually hook and unhook. The operation is safe and convenient.
Selection: The quantity and dimension of multi-piece of electromagnets used in combination depend on the length of attracted materials and the number of bundles each time. Generally speaking, the length of the bundled wires lifted by one single piece of magnet is approximately 3 meters.



Series MW19 for handling coiled wires

Application: It is suitable for loading, transporting and stacking coiled wires.
Characteristics: It's unnecessary to use wire rope while lifting. The special magnetic pole is suitable for coiled wires of different diameters. With deep magnetic penetration and large attraction force, the lifting is safe, reliable, convenient and quick.
Selection: The model selection of electromagnet depends on the length of the coiled bar. If the electromagnet is long enough, several coils can be lifted along the length direction of electromagnet at one time, or several coils can be lifted by using multi-piece of electromagnets in combination each time.



Series MW929 for lifting large steel ingots

Application: It is suitable for transporting, loading and unloading large steel ingots.
Characteristics: It is suitable for lifting steel ingots of large diameters with powerful attraction force.
Selection: The dimension of electromagnet depends on the maximum diameter and weight of the lifted ingot.



Series MW73 for turning

Application: Used for lifting and turning slabs, applied for the turning operations when inspecting the front and reverse sides of slabs.
Characteristics: The magnetic pole structure is unique, which is specially designed for turning slabs.
Selection: The dimension of electromagnet depends on the size and weight of the attracted material.



Series MW16/MW26/MW36 for lifting coiled steel strips

Application: It is applied for lifting, stacking, transporting and unloading coiled steel strips, can lift steel coils vertically and horizontally
Characteristics: Vertical lifting type--the electromagnet absorbs the front of the coil, which is suitable for lifting and transporting the bundled or unbound coil;
The horizontal lifting type--the electromagnet absorbs the side of the coil, and the coil must be bundled. The types of lifting depend on the storage forms of coiled strips. the electromagnet has deep magnetic permeability, strong suction, it is safe and reliable.
Selection: The models of electromagnets depend on the diameter of the coiled steel strips during vertical lifting, while depend on the width of coiled steel strip during horizontal lifting.





Series MW92 with movable magnetic poles(conventional type)

Application: Suitable for lifting multiple sectional steel, blooms with uneven heights, and staggered ingots.
Characteristics: The movable magnetic pole blocks are set inside the electromagnet, which is retractable and can automatically adjust the contact area with the sucked material, increase the attraction area and improve the lifting capacity. There are various structures of movable magnetic pole structure, which is suitable for various on-site working conditions.
Selection: The dimension of electromagnet depends on the width of attracted materials, while the quantity of electromagnets used in combination depends on the length of attracted materials.



Series MW13 for lifting heavy rails

Application: It is applied for loading and stacking bundled rebar and small round steel for construction, as well as for lifting heavy rails of over-length and over-weight.
Characteristics: It has deep magnetic permeability and strong force attraction. In addition, during the process of lifting, it's unnecessary to hook and unhook, so that the operation is safe.
Selection: Using many pieces of electromagnets in combination according to the length of the rail. And the length of the electromagnet depend on the width of attracted materials.



MW3/MW84/MW4 series for lifting steel plates

Application: They are used for lifting steel plates of different thickness, and are applied for loading, unloading and transporting plates at factories, warehouses and docks. It can lift one piece or several pieces of steel plates.
Characteristics: The weight of electromagnet is light, the attraction force is strong, and the lifting operation is safe, fast and accurate. Series MW84, MW4 can accurately lift and stack by adjusting the magnetism.
Selection: For series MW3, the optimum magnetic circuit can be designed based on the entire piece of strand. The power consumption is low, the weight is light, and the lifting capacity is large.



Application	Series	Characteristics	Instruction
Lift single piece of thick plate	Series MW3 (round)	Can lift single piece of thick plate; Light self weight; Strong attraction; High safety coefficient.	Using many pieces of electromagnets in combination according to the thickness and length of steel plate. Generally, 1 piece of electromagnet can lift thick plate with length of 6 meters, and 2 pieces or more electromagnets will be used in combination when the length of thick plates exceed 6 meters.
Lift many pieces of steel plates	MW84-400series (rectangle)	Can be applied for lifting many pieces of steel plates each time.	Using many pieces of electromagnets in combination according to the length of steel plate. When lifting the medium-thick plate (6 ~ 32mm), the distance between each piece of electromagnet is about 3meters.
Lift few pieces of steel plates	MW84-350series (rectangle)	Can lift a piece or a few pieces of steel plates each time, and the quantity of lifted steel plates of each time can be controlled.	
Lift a piece of steel plate	Series MW4 (round)	Can lift a piece of steel plate, and the bending degree of steel platecan be minimized.	Using many pieces of electromagnets in combination according to the thickness and length of steel plate, as well as to the deformation degree of steel plate which need to be controlled.

CLP magnetic uncoiler

Application: It is installed in the space surrounded by magnetic uncoiler pulley and endless belt. It can ensure continuous operation while uncoiling.
Characteristic: This series of products are specially designed according to the characteristics of uncoiler. Many pieces of uncoilers can be used in combination. It can adapt to different strip speeds. Electromagnetic and permanent magnetic products of different specifications can be customized.



Series MW18 for high temperature furnace cover

Application: It is dedicated to the automatic opening and closing of the furnace cover of the automatic coal charging machine for the coking furnace. It is equipped with signal feedback device.
Characteristics: It's convenient to operate; The attraction is fast; It's reliable and safe; It is heat-resistant, and can work continuously at 600℃ .
Selection: Generally, the dimension of electromagnet depends on the size, temperature and weight of furnace cover.



Electromagnetic iron separator

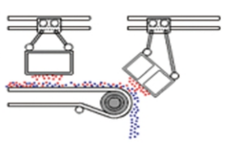
The electromagnetic iron separator produced by Zhongke Electric adopts advanced computer simulation technology to optimize design. There are two classifications of electromagnet and permanent magnet with multiple specifications. It has characteristics of strong magnetic field intensity, deep magnetic penetration, strong attraction force, low energy consumption, strong environmental adaptability, high safety and reliability.

Characteristics

- Fully sealed natural cooling structure can prevent the coil from being damaged and eroded by humid air, dust particles and harmful gases.
- The magnetic circuit is specially designed with deep magnetic penetration, and the geometric shape of the spatial magnetic field is approximately hemispherical, which has stronger attraction.
- Generally, it is installed in the middle or at the head of the conveyor belt, when installed on the head, the iron separating capacity is stronger than when installed in the middle.
- The products have good supporting performance, and the rectifier equipment have comprehensive functions, which can meet the requirements of various occasions, and can be used indoors and outdoors.

Series RCDB(MC03)

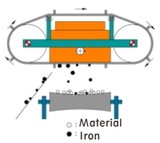
Characteristics:
1. It is applicable for removing iron from different kinds of materials on conveyor belt.
2.Small volume; light weight; no noise; low temperature rise; stable magnetic field.
3. With fully sealed structure, it can adapt to various harsh environment.
4.Local and remote control are available;
5.It is applicable for removing iron from high temperature materials or in high temperature environment.





Series RCDD(MC12)

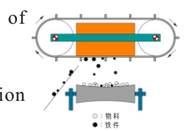
Characteristics:
1. It is applicable for removing iron from different kinds of materials on conveyor belt.
2. It can realize integrated control, automatic iron unloading and can rectify deviation of the belt automatically.
3. Compact structure; large heat dissipation area; low temperature rise ; stable magnetic field.
4. It is applicable for removing iron from high temperature materials or in high temperature environment.





Series RCYD(YC12)

Characteristics:
1. It is applicable for removing iron from different kinds of materials on conveyor belt.
2. The third generation permanent magnetic material made of rare earth is used to generate magnetic field with strong attraction force.
3. It can unload iron and rectify belt deviation automatically.
4. Light weight; Low energy consumption; stable magnetic field.



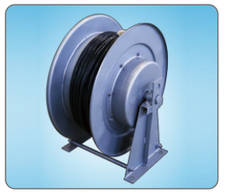


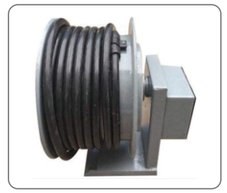
Cable reel

- Cable reel is cable winding device which provides power supply, control power or control signal for large mobile equipment. It is widely used in crane, lifting electromagnet, electric grab, electric flat car, ladle car and other mobile equipments of the same working conditions.
- Structural types： Internal slip ring type, external slip ring type, cantilever type.
- Driving types: Spring type, torque motor type, mechanical external force type, heavy hammer type, magnetic coupling type, hydraulic coupling type, hysteresis type.

Spring cable reel(Series JT)

Characteristics: It self doesn't consume power; It can work reliably. The force on the cable is moderate ; It has good synchronization property. The structure is compact; It is easy to install and maintain.


Internal slip ring structure

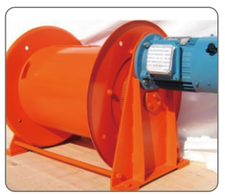

L-shaped bracket structure


Cantilever structure

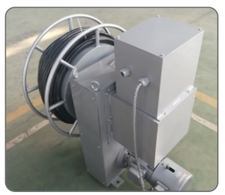

Compact structure

Electric cable reel(Series JD)

Characteristics: Large coiling torque; Long coiling distance; Convenient adjustment of coiling force and speed; Good synchronization performance.


Internal slip ring structure


Horizontal structure


Vertical structure


Vertical structure with limit

Magnetic coupling cable reel

Characteristics:The power is external power; The output torque is constant torque; The synchronization performance is good; It is suitable for winding small-sized cables.


Mechanical external force structure

Hysteresis cable reel

Characteristics: It has large coiling torque which is adjustable and its output torque is constant. It is applicable for coiling large-size cable of long-distance.


Single magnetic head structure

7 Successful cases



12 pieces of electromaget produced by Zhongke in combination successfully lifted heavy rail of 100m in Ansteel
(July 2007)



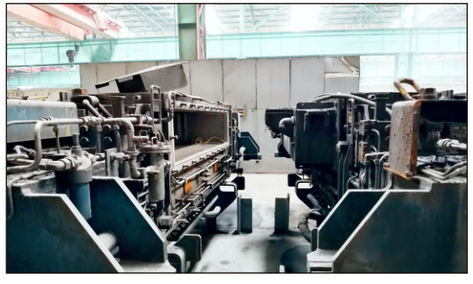
Multi-mode mold electromagnetic flow control system independently designed applied in Hebei Shougang Qi An Iron & Steel
(Sep. 2016)



Electromagnetic induction heating technology of Zhongke applied in rolling line for stainless steel bars and rods at Yongxing Special Materials., realizing accurate temperature control.(Oct.2017)



Tundish induction heating and refining system of Zhongke applied in ESP of Hebei Jingye iron& Steel
(April 2018)



The multi-mode mold electromagnetic flow control system of Zhongke applied in automobile slab production of Shagang Group
(Aug. 2018)



8-caster 8-strand MEMS + FEMS produced by Zhongke installed at Fujian Qingtuo Nickel Industry
(Aug. 2018)



Splitting in-roll EMS system for ultra-thick plates applied in Nanyang Hanye
(Nov. 2018)



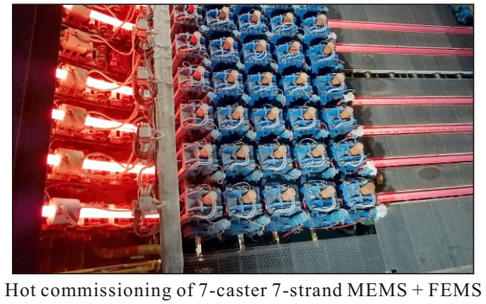
High efficient electromagnetic induction heating & heat compensation system applied in titanium alloy rods production line of Xianyang Tiancheng
(Dec. 2019)



The tundish induction heating and refining system applied in the production of heavy rail steel at Baotou Steel
(May 2020)



Integrated electromagnetic metallurgical technology of MEMS and In-roll EMS at secondary zone has been applied in the production of high-quality steel at Hunan Valin Lianyuan Iron and Steel(June 2020)



Hot commissioning of 7-caster 7-strand MEMS + FEMS produced by Zhongke was successfully finished at Tangshan Wenfeng Special Steel
(July 2020)



Factory test on the large lifting electromagnet of 6000mm × 2000mm designed and produced by Zhongke. The lifting capacity is 17.8T.
(Oct. 2020)

8 References

Hunan Zhongke Electric Co., Ltd. is engaged in design and production of complete set of electromagnetic stirring (EMS) system in China. By 2020, more than 4000 strands complete set of EMS system produced by Zhongke have running on-line, and the quantity of EMS has exceeded 8000 units.

Zhongke's first complete set of EMS system: 3-caster 3-strand complete set of flat wire winding external M-EMS system at Xinyu Special Steel. The water cooling system for mold was adopted in 2001, and a set of independent water system was added in 2003, which greatly extends the service life of EMS. And it has running stably up to now.

Zhongke's first set of external EMS system with separate water supply: 2-caster 2-strand external flat wire winding M-EMS system at Tian Jin Pipe (group) Corporation. It was put into operation in 2003.The metallurgical effect has reached the level of similar imported products and has been running steadily up to now.

Zhongke's first set of internal flat wire winding EMS with independent cooling water system, the patent of Zhongke. It was put on line for 8-strand CCM of No.3 Steelmaking Plant of Shougang Group in Feb. 2005, opening up a new era of internal EMS.

Zhongke's first set of internal copper tube winding F-EMS system, the patent of Zhongke. It was applied for 5-caster 5-strand CCM at Xining Special Steel was put into operation in May 2006. The equiaxed grain ratio reached over 60%. And it has been running steadily up to now.

Complete set of EMS system applied for 12-strand CCM: Internal flat wire winding EMS system with independent water system applied for 12-caster 12-strand CCM at Xuanhua Steel, and internal copper tube winding EMS system applied for 12-caster 12-strand CCM at Weifang Special Steel.

Zhongke's first complete set of copper tube winding F-EMS system: Applied for 6-caster 6-strand CCM at Tian Jin Pipe (group) Corporation, which was put into operation in Dec., 2006. It greatly reduced the center shrinkage and core cracks of the stainless steel.

Research on localization of electromagnetic brake :Development of electromagnetic brake applied at Maanshan Iron & Steel.

Zhongke's first set of in-roll EMS with high thrusting force, the patent of Zhongke. It was applied for slab of 250mm*1700mm at WISCO. The electromagnetic intensity is 2.5 times of the similar imported products.

Zhongke's first complete set of in-roll EMS system with high thrust force was applied for slab of 250mm*1900mm at Guangxi Liuzhou Iron And Steel. It was put into operation in Dec. 2007. It has significantly improved the equiaxed grain rate, and reduced the internal cracks and center segregation.

Zhongke's first complete set of EMS system for stainless steel slab was applied for slab of 220mm*1650mm at Shandong Taishan Steel Group Co.,Ltd. It was put into operation in Aug. 2008. It has significantly improved the internal quality of the stainless steel slab, and the equiaxed grain rate has increased to more than 50%.

Zhongke's first complete set of EMS system for wide thick plates of width above 2000mm for CCM was applied for complete set of in-roll EMS for slab of 300mm*2500mm at Wuyang Steel Co., Ltd. It was put into operation in Oct 2008. It has significantly improved the equiaxed grain rate, and reduced the internal cracks and center segregation.

Zhongke's first set of M-EMS for slab -Applied for slab of width 1930mm of #2 CCM at Baosteel Group.

Zhongke's first complete set of splitting in-roll EMS system was put into operation in Nanjing Iron&Steel. The applied maximum width of section is 150mm*3250mm.

Exported complete set of EMS system to CNS of Brazil: complete set of EMS system for 3-caster 3-strand , it was put into operation in Nov. 2008.

Exported complete set of EMS system to Iran: complete set of EMS system for 6-caster 6-strand , it was put into operation in Nov. 2011.

Exported complete set of EMS system to Turkey: complete set of EMS system for 8-caster 8-strand , it was put into operation in Sep. 2012.

Exported complete set of EMS system to Saudi Arabia: complete set of EMS system for 6-caster 6-strand , it was put into operation in in March 2009.

Exported complete set of EMS system to India: complete set of EMS system for 2-caster 2-strand , it was put into operation in Jan. 2012.

Tundish channel-type induction heating and refining system applied for # 5 CCM of Xingtai Iron & Steel , was put into operation at the end of 2012.The performance of the system has reached and surpassed that of similar foreign products.

Zhongke's first set of multi-mode meniscus EMS and flow control system applied for No.2 slab CCM at Hebei Shougang Qian An Iron&Steel was put into operation in 2016.

Zhongke's first set of on-line induction heating system for hot-rolled bars was put into operation at Yongxing Special Stainless Steel in 2017.

Zhongke's first set of on-line induction heating system for hot-rolled platss was put into operation at Rizhao Steel in 2018.

9 Achievements & Intellectual Property

































