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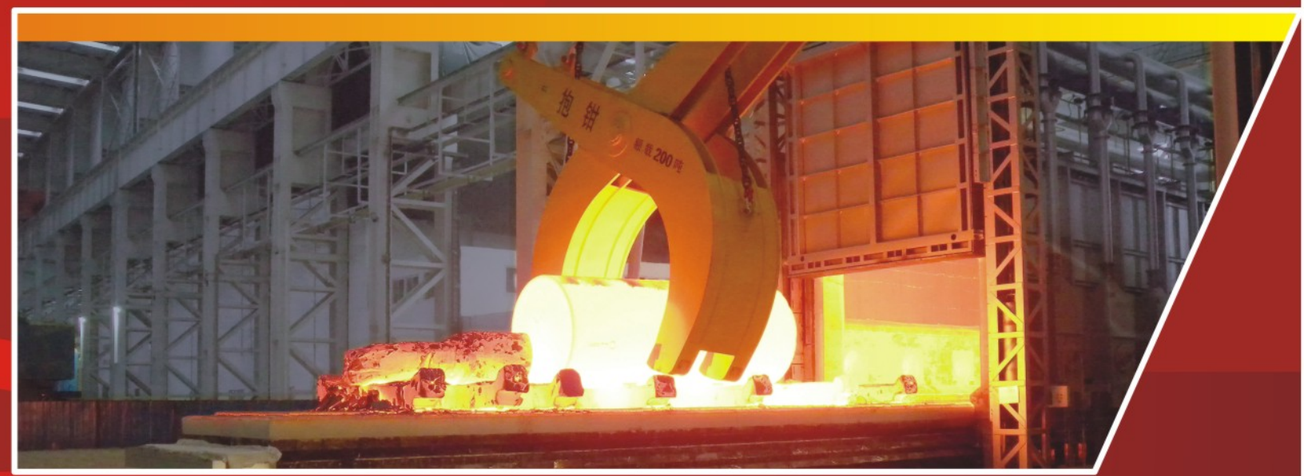
沃克斯工业炉®

独特的蓄热式燃烧及控制技术
UNIQUE REGENERATIVE COMBUSTION AND CONTROL TECHNOLOGY

卓越的蓄热式工业炉品质
OUTSTANDING REGENERATIVE INDUSTRIAL FURNACE



works

- 专业精神
- 专业制造
- 专业服务

Professional manufacture and service

重庆沃克斯科技股份有限公司
Chongqing Works Technology Co., Ltd.

全国中小企业股份转让系统 股票代码:430550
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沃克斯工业炉®
重庆沃克斯科技股份有限公司
办公地址：重庆市九龙坡区渝州路18号高创锦业大厦20-2 邮编：400039
电话：023 68884176 023 61591998 传真：023 68693257
网址：www.cqworks.cn www.workstherm.com www.沃克斯.com
邮箱：cqworks@vip.163.com

中国·重庆
CHONGQING·CHINA

HISTORY OF CHONGQING WORKS TECHNOLOGY CO., LTD.

2014~

Researching and developing low NOx emission and gas regenerative industrial furnaces conforming to international emission standards

2012~2013 Designing and experimenting on regenerative heat treatment furnace with precise temperature control (reaching GB/T9452-2012 and AMS2750D/E temperature uniformity standards)

- Researched and developed high-precision regenerative furnaces (AMS2750D/E standard)
- Continuously developing more stable and precise auto control technology for regenerative combustion furnaces
- Several regenerative products acquiring high-tech products certificates
- Listing on NEEQ (National Equities Exchange and Quotations)

2010~2011Cooperating with Chongqing University of Science and Technology, Worksthern developed and established CFD simulation mathematical model experimental platform for regenerative combustion

- Research platform combining CFD simulation and laboratory testing
- Acquiring hundreds cases of designing and constructing experience
- Achieving 16 national patents for regenerative combustion technology, among which 5 were invention patents
- Awarded the Chongqing high-tech enterprises certificate

2008~2010 Worksthern's regenerative heat treatment furnace passed the GB/T9452-2003 standard test

- Pioneering in the industry, Worksthern independently developed regenerative burners with various types of flame shapes
- Supported by the innovation fund from the State Scientific and Technological Commission

2006~2008 Worksthern constructed the first general contracting of industrial furnaces (foreign investment) with altogether 11 forging industrial furnaces

- Using ceramic beehive regenerator
- Using the unique Worksthern self-developed automatic temperature control program
- Supported by the innovation fund from the State Scientific and Technological Commission

2004~2006 Worksthern's first gas regenerative car-bottom heat treatment furnace(still in service) was built in Chongqing Forging Factory

- Using ceramic beehive regenerator
- Using the independent decentralized regenerative technology and two-way reversing valve
- Using automatic electronic ignition, starting to regenerate heat at room temperature
- No auxiliary high temperature flue
- Using the PID temperature control method
- Achieved the first national invention patent for regenerative combustion technology

2002~2004 Worksthern's first gas regenerative forging furnace (still in service) was built in Chongqing Wangjiang machinery Factory

- Using ceramic beehive regenerator
- Centralized regeneration with reciprocating selector valve
- Using artificial ignition, starting to regenerate heat at room temperature
- Eliminating auxiliary high temperature flue

2001~2002 The laboratory stage of regenerative combustion technology: the birth of Worksthern's first experimental gas forging furnace

- Using ceramic ball as the regenerator
- Centralized regeneration with reciprocating selector valve
- Using artificial ignition, starting to regenerate heat at room temperature
- Using auxiliary high temperature flue

WORKSTHERM AIMS TO PROVIDE WITH THE BEST SERVICE

WITH SOPHISTICATED DESIGN, BRIEF CONSTRUCTION PERIOD, EXCELLENT CUSTOMER SERVICE, AND OVER A THOUSAND OF SUCCESSFUL CASES OF REGENERATIVE FURNACES, WORKSTHERM OFFERS THE BEST SERVICE

Focusing on the research, development and application of the regenerative combustion technology, Worksthem is the leading figure of the regenerative industrial furnace technology.

◇High efficiency waste heat recovery systems with low-temperature distribution regenerates heat at a relatively low temperature
◇Regenerative combustion technology that fulfill the complicated requirement of the heating process of batch type furnaces
◇Comprehensive safety monitoring system
◇Simplified operation, low running costs, and easy maintenance

With a wealth of practical experience, Worksthem focuses on the industrial furnace manufacturing technology in forging industry.

◇Worksthem designs layout scheme according to our clients' factory construction.
◇Worksthem offers industrial furnace configuration scheme according to our clients' process requirements.
◇Worksthem provides the best energy-saving scheme according to the type of fuel our clients adopt.
◇Worksthem offers fuel pipeline calculation according to our clients' industrial furnace configuration requirements.

Each Worksthem furnace is tailored to meet clients' needs

The actual energy consumption of Worksthem Regenerative Combustion Technology applied in different types of furnaces:

Furnace types	Typical process	Natural gas consumption per ton steel (m^3/t)
Regenerative chamber heating furnaces	Free forging	60～120
	Ring forging	50～80
Regenerative car-bottom heating furnaces	Free forging	55～100
	Speed forging	50～80
Regenerative car-bottom heat treatment furnaces	Post-forge heat treatment (annealing, normalizing)	30～45

RESEARCH AND SOLUTIONS ON REGENERATIVE COMBUSTION TECHNOLOGY

ELIMINATING HIGH TEMPERATURE CHIMNEY – A REVOLUTION OF THE TRADITIONAL REGENERATIVE TECHNOLOGIES

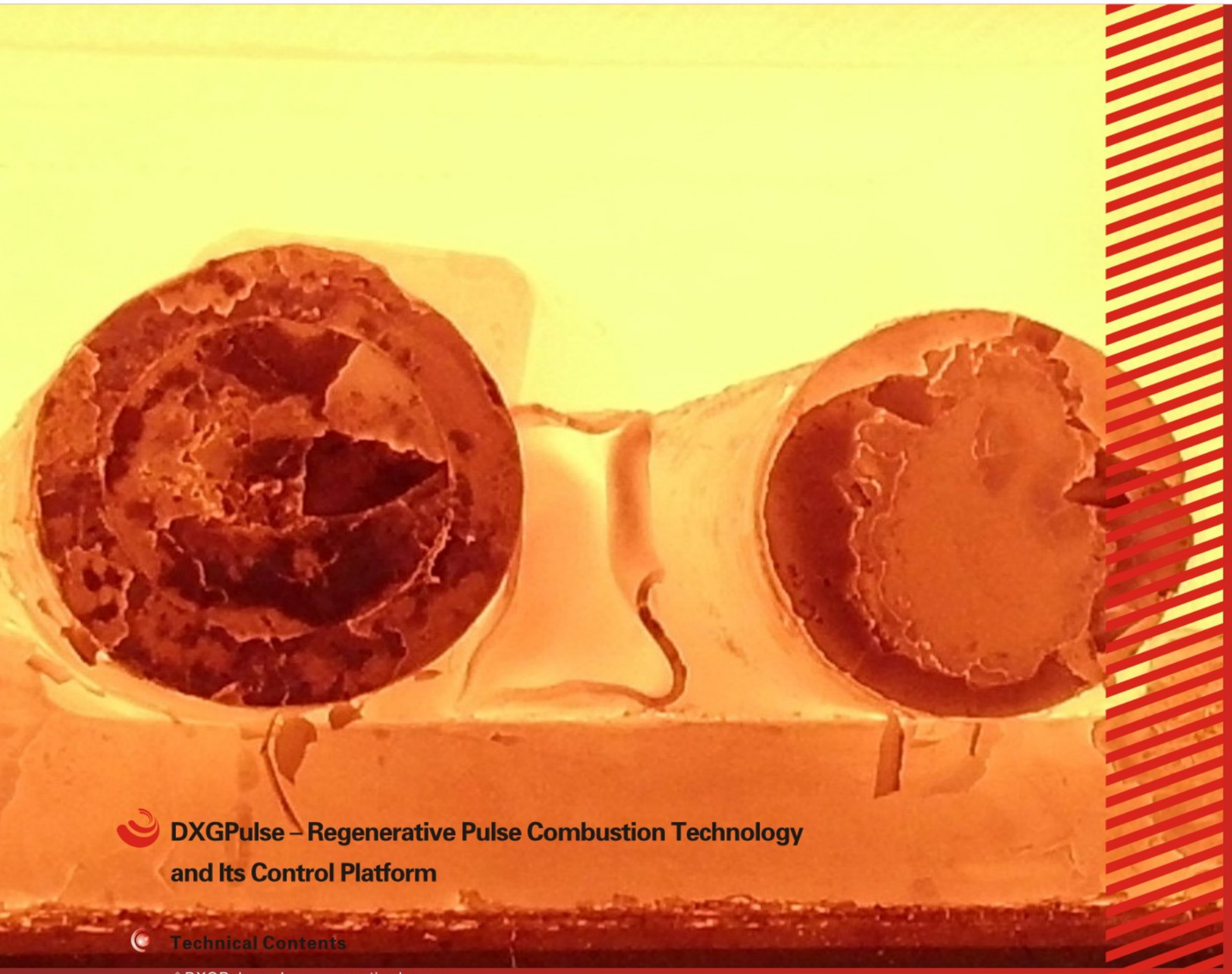
A comparison with the furnaces using conventional combustion methods and metal recuperators:

Conventional combustion methods + metal recuperators	Worksthern regenerative combustion solution	Our advantages
Metal recuperators do not suit transient heat transfer furnaces, i.e., batch type furnace	High efficiency waste heat recovery systems regenerates heat at a relatively low temperature, which especially suit batch type furnaces	Temperature efficiency reaches above 80% with high efficiency waste heat recovery
Metal recuperators are easy to burn and the maintenance is difficult and costly. The common solution to protect the recuperator is to blend in cold air at the cost of heat recovery efficiency	High efficiency waste heat recovery without cold–air blend	Abiding regenerator at a low cost of maintenance and repair
Low efficiency waste heat recovery and high energy consumption. E.g., with an operating temperature of 1200℃, the air preheating temperature of a heating furnace ranges from only 300 to 400℃	High efficiency waste heat recovery and low energy consumption. E.g., with an operating temperature of 1200℃, the air preheating temperature of a heating furnace reaches 1000~1100℃	Heat treatment furnace energy saving rate: 30%~40% Heating furnace energy saving rate: 40%~60%
Requiring high–temperature chimney and underground flue Exhaust gas temperature 400~700℃	Eliminating high–temperature chimney and underground flue Exhaust gas temperature ~150℃	Reducing the construction investment in underground flue & chimney. Revolutionarily eliminating high temperature chimney
Applying burners with different flame shapes to meet the process requirements	Applying burners with different flame shape to meet the process requirements	Substituting various kinds of conventional combustion burners, completely meeting the process requirements
Using temperature meter (PID control method) or PLC program to control temperature. The parameters drift may occur, and regular self–tuning is required	Originating the fully intelligent nonlinear PID controller, breaking the traditional PID theory, achieving comprehensive intellectualization, with no need of manual intervention or self–tuning, and significantly increasing the stability of the control system	Realizing the accurate auto control of various heating process curves. Clients will not be concerned for the decreasing accuracy of the control system due to the parameters drift of PID. The temperature control accuracy can reaches ±1~2℃

A comparison with traditional regenerative combustion technology:

Traditional regenerative combustion technology	Worksthern regenerative combustion technology	Our advantages
Regular combustion below 600℃; starting to regenerate since 600℃	Regenerating heat at room temperature	Higher waste heat recovery efficiency and energy–saving rate
Waste heat emit through regenerator: ~85% Waste heat emit through auxiliary high temperature flue: ~15%	All waste heat emission is completed by regenerator instead of auxiliary high temperature flue	Higher waste heat recovery efficiency and energy–saving rate
The pit regenerative chamber has relatively larger volume. The ceramic ball as regenerator tends to block, thus it needs regular cleaning, which causes higher maintenance and repair costs	Using independent small volume regenerative chamber and ceramic beehive regenerator. The regenerator is not easy to block and does not need regular cleansing	Long service life of the regenerator with low–cost maintenance and repair
The reversing mechanism is large, and reversing and combustion system use clustered–control. When malfunctions occur, the overall furnace system must be shut down immediately for repairing, causing negative impacts on production and the waste of fuel	Each burner has its own independent reversing and combustion system, which is flexible and easy for maintenance	During the working process, malfunctioned burners can be isolated individually without affecting the whole system. The system is fault tolerant that repairing can be conducted after finishing this heat
Regular combustion has poor temperature control accuracy and furnace temperature uniformity. Temperatures of thermocouple and furnace have large difference	Different furnace types and various flame shapes provide high temperature control accuracy and furnace temperature uniformity	Burners with different flame shapes can be configured according to different furnace types and heating process curves. Temperature control accuracy: ±1~2℃ Heat treatment furnaces' temperature uniformity: ±5~10℃

PARTICULAR REGENERATIVE INDUSTRIAL FURNACE EXPERT SYSTEM & UNIQUE REGENERATIVE BURNER



DXGPulse – Regenerative Pulse Combustion Technology and Its Control Platform

Technical Contents

◇DXGPulse pulse regenerative burner
◇DXGPulse regenerative burner controller
◇DXGPulse regenerative combustion control module
◇Highly–efficient, abiding regenerator with inverse gravity installation structure
◇Fine adjustment system of regenerative pulse combustion
◇Air/flue gas ratio control technology
◇Complete combustion security monitoring system and preventive measures (the flame of regenerative burners is monitored by both electric ion and ultraviolet)
◇Fine and abiding technology that controls the furnace pressure (slightly positive) at the flue' s cold–end

Patent

◇Patent number: ZL 2007 1 0078178.8
◇Patent number: ZL 2009 1 0104758.9
◇Patent number: ZL 2006 2 0110071.8
◇Patent number: ZL 2006 2 0110072.2
◇Patent number: ZL 2006 2 0110073.7
◇Patent number: ZL 2009 2 0128702.2
◇Patent number: ZL 2009 2 0128703.7
◇Patent number: ZL 2011 1 0051270.1
◇Patent number: ZL 2011 1 0051272.0

Characteristics

◇Eliminating high–temperature chimney & flue, without auxiliary waste heat emission (high calorific value gas)
◇The efficiency of low–temperature combustion improves by 30%~50% compared with traditional regenerative technology. The energy–saving rate boosts by 15%
◇The energy–saving rate is 30% ~ 60% compared with conventional combustion technology
◇Exhaust gas temperature: ~150℃
◇Flame shape: High–speed cone flame
◇Flame speed: 80~100m/s
◇Temperature control accuracy: ±1 ~ 2℃
◇The temperature uniformity of the active area: ±5 ~ 10℃
◇The automatic control of heating process curve (heating and cooling rate& high–mid–low temperature control platform)
◇The automatic control of the furnace pressure
◇Regeneration starting from room temperature ignition
◇The service life of regenerators: 2 years for the heating furnace, 4 years for the heat treatment furnace
◇The unique flue gas refluxing structure lowers the flame temperature, avoiding local high temperature
◇High–speed forced airstream stir is conducive to furnace temperature uniformity
◇Standardized design of combustion and control systems ensures easy maintenance and repair
◇Substituting for high velocity burners, high speed thermostat burners, self–recuperative burners and metal recuperators

Applications

◇Forging car–bottom furnace
◇Car–bottom heat treatment furnace: Quenching & tempering furnace
◇Car–bottom normalizing & annealing furnace
◇Chamber heating furnace
◇Chamber heat treatment furnace
◇Metallurgical continuous heating furnace and heat treatment furnace
◇Various batch type furnaces

Especially

◇DXGPulse pulse regenerative burners also applies to continuous air/gas ratio control system

PARTICULAR REGENERATIVE INDUSTRIAL FURNACE EXPERT SYSTEM & UNIQUE REGENERATIVE BURNER

LXPulse – Stratified Combustion Regenerative Pulse Combustion Technology and Its Control Platform

Technical Contents

◇LXPulse stratified combustion burner
◇LXPulse burner controller
◇LXPulse regenerative combustion control module
◇Embedded regenerator installation technology
◇Fine–regulating regenerative pulse combustion system
◇Air/gas ratio control technology
◇Enduring and user–friendly on/off selector valve with easy maintenance (lasting more than 3 years)
◇Complete combustion security monitoring system and preventive measures (the flame of regenerative burners is monitored by both electric ion and ultraviolet)

Patent

◇Patent number：ZL 2007 1 0078178.8
◇Patent number：ZL 2007 1 0078215.5
◇Patent number：ZL 2006 2 0110071.8
◇Patent number：ZL 2006 2 0110072.2
◇Patent number：ZL 2007 2 0123604.0

Characteristics

◇Eliminating high–temperature chimney & flue, without auxiliary waste heat emission (high calorific value gas)
◇Compared with traditional regenerative technology, the efficiency of low–temperature combustion improves by 30%~50%. The energy–saving rate boosts by 10%
◇The energy–saving rate is 30% ~ 60% compared with conventional combustion technology
◇Exhaust gas temperature: ~150℃
◇Flame shape: Spiral flame
◇Temperature control accuracy: ± 1.5～2℃
◇Stratified combustion technology lowers the oxidation rate of the workpiece by about 1%
◇Regeneration starts from room temperature ignition
◇The installation of regenerator saves space
◇The automatic control of heating process curve (heating rate & high–mid–low temperature control platform)
◇Standardized design of combustion and control systems ensures easy maintenance and repair
◇Substituting for high velocity burners, high speed thermostat burners, self–recuperative burners and metal recuperator

Applications

◇Chamber forge heating furnace
◇Less–oxidation heating furnace
◇Through type furnace
◇Aluminum melting furnace
◇Continuous furnace
◇Various batch type furnaces

Especially

◇LXPulse stratified combustion self–regenerative burners also applies to pulse control and continuous air/gas ratio control system

PARTICULAR REGENERATIVE INDUSTRIAL FURNACE EXPERT SYSTEM & UNIQUE REGENERATIVE BURNER

PXBurner/DBurner – Flat Flame Combustion Technology and Its Control Platform

Technical Contents

◇PXBurner regenerative flat flame burner/DBurner regenerative stratified burner
◇PXBurner/DBurner burner controller
◇PXBurner/DBurner Regenerative Combustion Control Module
◇Enduring and user–friendly on/off selector valve with easy maintenance (lasting more than 3 years)
◇Fine adjustment system of regenerative pulse combustion
◇Air/flue gas ratio control technology
◇Complete combustion Security monitoring system and preventive measures (the flame of regenerative burners is monitored by both electric ion and ultraviolet)
◇Fine and abiding technology that controls the furnace pressure (slightly positive) at the flue' s cold–end

Patent

◇Patent number：ZL 2007 1 0078178.8
◇Patent number：ZL 2009 1 0104757.4
◇Patent number：ZL 2006 2 0110071.8
◇Patent number：ZL 2006 2 0110072.2
◇Patent number：ZL 2009 2 0128700.3
◇Patent number：ZL 2009 2 0128701.8
◇Patent number：ZL 2011 1 0051270.1
◇Patent number：ZL 2011 1 0051272.0

Characteristics

◇Eliminating high–temperature chimney & flue, without auxiliary waste heat emission (high calorific value gas)
◇The efficiency of low–temperature combustion improves by 30%~50% compared with traditional regenerative technology. The energy–saving rate boosts by 15%.
◇The energy–saving rate is 30% ~ 60% compared with conventional combustion technology
◇Exhaust gas temperature: ~150℃
◇Flame shape : Strong radiation plate disc type flame/high–kinetic energy
◇Temperature control accuracy: ±1.5～2℃
◇The automatic control of heating process curve (heating rate & high–mid–low temperature control platform)
◇The automatic control of the furnace pressure
◇Regeneration starting from room temperature ignition
◇The service life of the heating furnace's regenerator: 2 years
◇Enhancing high temperature radiation capabilities, improving heating efficiency, and avoiding the direct contact between the flame and the steel ingot, which avoids melting
◇The unique flue gas refluxing structure lowers the flame temperature, avoiding local high temperature
◇Standardized design of combustion and control systems ensures easy maintenance and repair
◇Completely substituting for flat flame burners and metal recuperators

Applications

◇Car–bottom heating furnace for large forgings
◇Car–bottom heating furnace for free forgings
◇Continuous heating furnace

Especially

◇PXBurner /DXBurner pulse regenerative burners also apply to pulse combustion control and continuous air/gas ratio control system

HIGH-PRECISION REGENERATIVE INDUSTRIAL FURNACES

High-precision forging furnaces for special materials forging

Technical Features		
Burner	Regenerative parallel high-speed burner	
Control	Original highly precise, stable and smart control module	
Temperature control accuracy	±1.5℃	
Temperature uniformity	Precision	±10～14℃
	Testing standard reference	GB/T9452-2012 AMS2750D（E）-2005
Furnace atmosphere control	Weak oxidizing atmosphere, preventing hydrogen contamination	
Energy consumption index	90～100kgce/t	

Applications	
Forging material	Titanium alloy, high temperature alloy, high-speed steel, etc.
Furnace type	Chamber furnace, car-bottom furnace, etc.
Applicable industry	Aviation, nuclear power, etc.

High-precision heat treatment furnaces for forging heat treatment

Technical Features			
Burner	Regenerative high-speed burner		
Control	Original highly precise, stable and smart control module		
Temperature control accuracy	±1℃		
Temperature uniformity	Highest temperature ≤900℃	Precision	±6℃
		Testing standard	GB/T9452-2012 AMS2750D（E）-2005
	Highest temperature ≤1100℃	Precision	±8℃
		Testing standard	GB/T9452-2012 AMS2750D（E）-2005
Furnace atmosphere control	Weak oxidizing atmosphere, preventing hydrogen contamination		
Energy consumption index	35～75kgce/t		

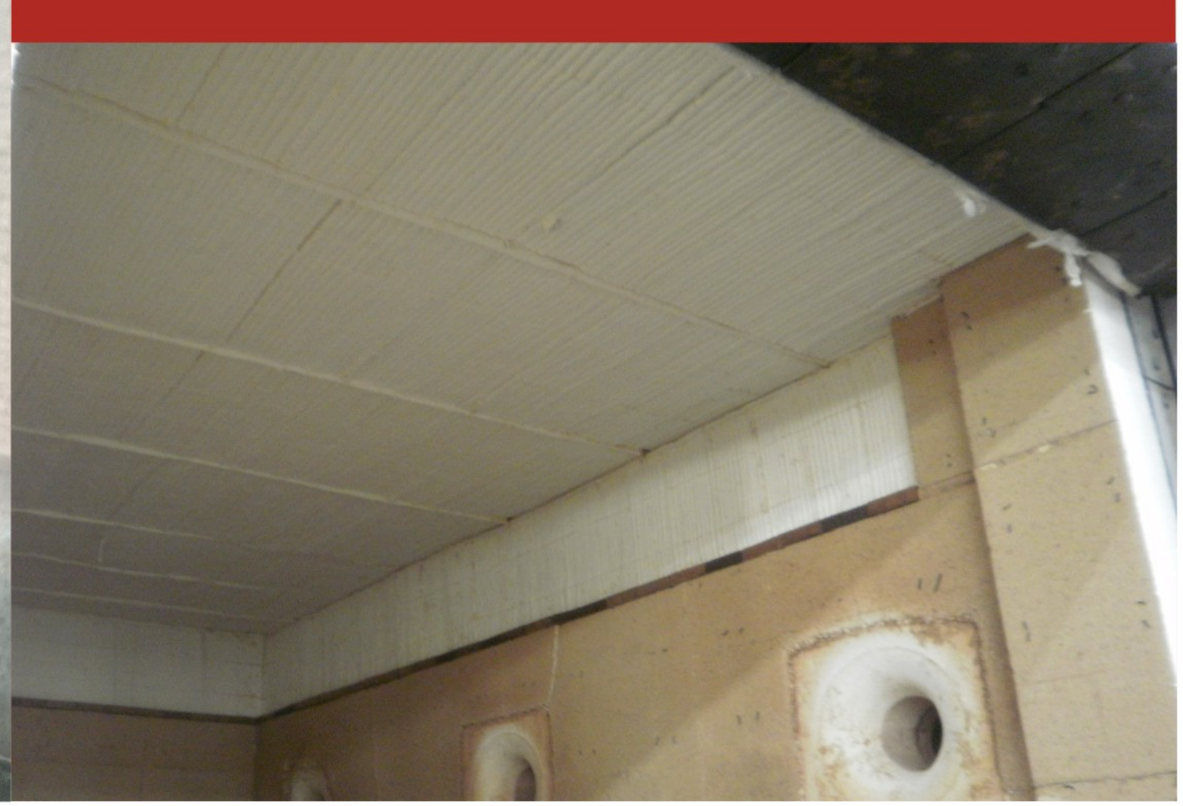
Applications	
Forging material	Titanium alloy, high temperature alloy, high-speed steel, etc.
Furnace type	Chamber heat treatment furnaces, car-bottom heat treatment furnaces, square (round) cover type heat treatment furnaces
Applicable industry	Quenching, normalizing, and annealing of large forgings

HIGH-PRECISION REGENERATIVE INDUSTRIAL FURNACES

Unique fiber furnace roof structure

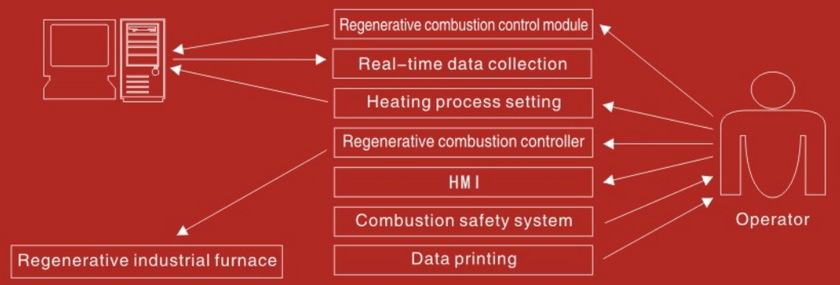
Patent number: ZL 2011 1 0051272.0

This invention has solved the unstableness and the maintaining problems of the fiber furnace roof of heating furnaces (working temperature 1250℃), greatly reducing maintaining and repairing costs.



COMPLETE RESEARCH AND DEVELOPMENT, EXPERIMENT AND DESIGN OF THE SYSTEM FOR REGENERATIVE FURNACES

WORKSTHERM FULFILLS THE REQUIREMENT OF THE HEATING PROCESS AND UTILIZE DIFFERENT FLAME SHAPES IN ORDER TO BE ENVIRONMENT FRIENDLY AND TO SAVE AS MUCH ENERGY AS POSSIBLE



Regenerative Combustion Control:

- ◇DXGPulse digital regenerative high speed pulse combustion and its control platform
- ◇LXPulse stratified combustion self-regenerative pulse combustion and its control platform
- ◇PXBurner regenerative flat flame combustion and its control platform
- ◇DBurner regenerative top-loading diffusion combustion and its control platform
- ◇Fulfilling clients' requirements of heating processes
- ◇Low operation costs
- ◇Simple operation
- ◇Easy maintenance
- ◇Accurate auto-control of the furnace temperature
- ◇Achieving the highest energy efficiency

Worksthern can:

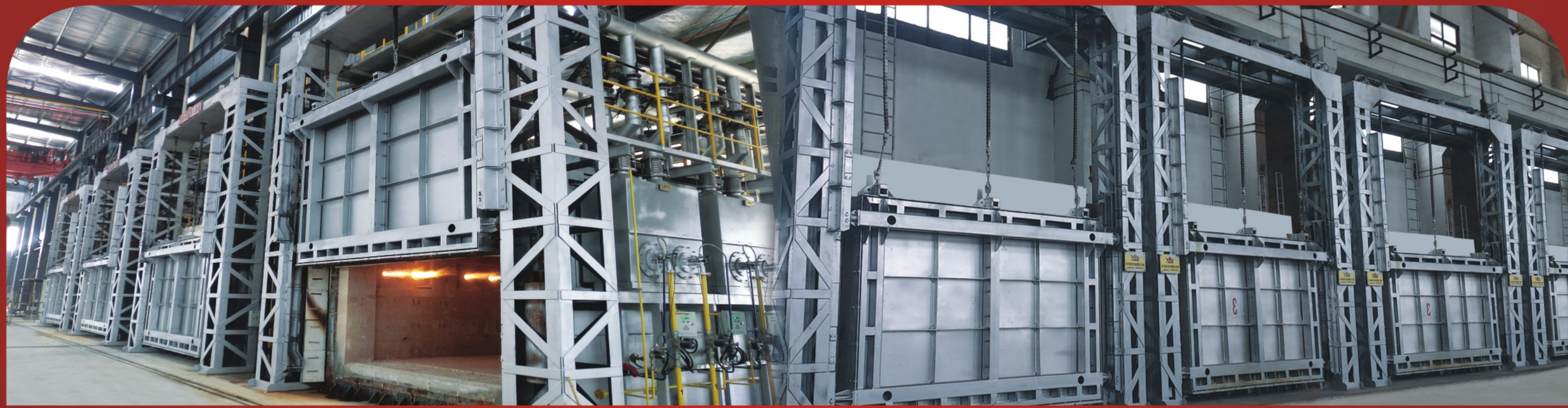
- ◇Compared with regular combustion methods using metal recuperators, our technology saves 30%~60% of energy
- ◇Eliminating high-temperature chimneys & flues and auxiliary flues
- ◇Regenerating heat at a relatively low temperature, improving the low-temperature thermal efficiency by 30%~50%
- ◇Realizing the automatic control of heating process curve and accurate temperature control
- ◇Substituting traditional high-speed, flat flame, and self-recuperative burners as well as metal recuperators
- ◇Changing and improving the traditional regenerative combustion and temperature control technology

Worksthern has:

- ◇Seven National Invention Patents and ten Utility Model Patents on our regenerative combustion technology
- ◇2009 and 2011 innovation funds supported by State Scientific and Technological Commission
- ◇Over a thousand of successful cases

R&D and Design:

- ◇Experienced in the design and construction of regenerative industrial furnaces
- ◇World-leading furnace structural design technology
- ◇The research platform combining the CFD simulation and experiments
- ◇Structural analysis of regenerative industrial furnaces
- ◇Combustion and temperature control technologies



WORKSTHERM HAS OVER A THOUSAND OF SUCCESSFUL CASES IN DESIGNING AND CONSTRUCTING REGENERATIVE INDUSTRIAL FURNACES

The Process configuration of industrial furnaces for forging equipment

Based on clients' forging equipment and product structures, Worksthermoffers professional advice and help on the configuration and selection of industrial furnaces, including the selection of the furnace type, determination of the combustion and control parameters, accurate calculation, CFD simulation, etc. Each industrial furnace is tailored to meet clients' needs.

The design and construction of the furnace body

Modular and standardized design concept ensures the controllability and the efficiency of the producing process. Worksthermuses the world-leading steel structure for the furnace body and the fine treatment to the details.
Worksthermmoves forward every day.

Installation, construction and adjustment

Well-prepared factory production, assembled framework, pre-assembled equipment components, and excellent on-site management enable Worksthermto complete the construction with high efficiency.

After service

Efficient and comprehensive service system ensures the normal operation of our clients' equipment.

FREE FORGING

CASE 1

◇ Main forging equipment: A 2000t hydraulic press
◇ Main product: Shafts
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car-bottom heating furnace	2	6500 × 2800 × 2500	120	PXBurner
Regenerative car-bottom heat treatment furnace	2	10000 × 2320 × 2000	120	DXGPulse
Regenerative car-bottom heat treatment furnace	1	8700 × 2320 × 2000	100	DXGPulse
Regenerative car-bottom heat treatment furnace	1	7300 × 2320 × 2000	100	DXGPulse
Chamber quenching furnace	3	7500 × 2500 × 1200	20	DXGPulse

WORKSTHERM INDUSTRIAL FURNACES CASES




CASE 2

◇Main forging equipment: A 40000t hydraulic machine, a 2000t hydraulic machine; and a 5m ring rolling machine
◇Main product: Shafts, ring pieces
◇Main supporting regenerative industrial furnaces

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car–bottom heating furnace	2	8000 × 3240 × 3450	150	PXBurner
Regenerative car–bottom heating furnace	1	6000 × 3200 × 2500	120	PXBurner
Regenerative car–bottom heating furnace	1	6000 × 3000 × 2770	120	PXBurner
Regenerative car–bottom heat treatment furnace	3	9800 × 3580 × 3250	180	DXGPulse
Regenerative car–bottom heat treatment furnace	1	8000 × 4500 × 3050	150	DXGPulse
Regenerative car–bottom heat treatment furnace	1	12000 × 3580 × 3050	200	DXGPulse

CASE 3

◇Main forging equipment: A 7000t hydraulic machine
◇Main product: Shafts, free forgings
◇Main supporting regenerative industrial furnaces for post–forge heat treatment:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car–bottom heat treatment furnace	1	10000 × 3500 × 3250	250	DXGPulse
Regenerative car–bottom heat treatment furnace	1	15000 × 3500 × 3250	300	DXGPulse

CASE 4

◇Main forging equipment: A GFM1800t precision forging machine
◇Main product: Shafts, pie pieces
◇Main supporting regenerative industrial furnaces for post–forge heat treatment:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car–bottom heat treatment furnace	1	7000 × 3600 × 2300	120	DXGPulse
Regenerative car–bottom heat treatment furnace	1	15000 × 4200 × 2300	200	DXGPulse
Regenerative car–bottom heat treatment furnace	1	9000 × 3700 × 2290	150	DXGPulse
Regenerative car–bottom heat treatment furnace	1	9000 × 3700 × 2290	150	DXGPulse
Regenerative square–hood heat treatment furnace	1	18500 × 2000 × 1200	120	DXGPulse

CASE 5

◇Main forging equipment: A 4000t hydraulic machine
◇Main product: Rollers, shafts, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car–bottom heating furnace	2	7000 × 3000 × 2400	100	PXBurner
Regenerative car–bottom heating furnace	1	8000 × 3500 × 2500	120	PXBurner
Regenerative car–bottom heat treatment furnace	1	6000 × 4000 × 2500	100	DXGPulse
Regenerative car–bottom heat treatment furnace	2	8000 × 3500 × 2500	150	DXGPulse

CASE 6

◇Main forging equipment: A 6000t hydraulic machine
◇Main product: Shafts, cube types, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car–bottom heating furnace	1	8000 × 4000 × 3200	160	PXBurner
Regenerative car–bottom heating furnace	1	5000 × 3000 × 2400	100	PXBurner
Regenerative car–bottom heat treatment furnace	1	8000 × 4000 × 3200	150	DXGPulse

CASE 7

◇Main forging equipment: A 4500t hydraulic machine
◇Main product: Long shafts
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car–bottom heating furnace	1	6000 × 4000 × 3000	100	PXBurner
Regenerative car–bottom heating furnace	1	8000 × 4000 × 3000	120	PXBurner
Regenerative car–bottom heat treatment furnace	1	8000 × 4000 × 3150	150	DXGPulse
Regenerative car–bottom heat treatment furnace	1	10000 × 4000 × 3150	180	DXGPulse
Regenerative car–bottom heat treatment furnace	3	15000 × 4000 × 3150	200	DXGPulse

WORKSTHERM INDUSTRIAL FURNACES CASES

CASE 8

◇Main forging equipment: A 2500t hydraulic press
◇Main product: Rollers, shafts, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car-bottom heating furnace	1	6500 × 2800 × 2400	100	PXBurner
Regenerative car-bottom heating furnace	1	8000 × 3000 × 2400	120	PXBurner
Regenerative car-bottom heat treatment furnace	1	7000 × 4000 × 2400	100	DXGPulse
Regenerative car-bottom heat treatment furnace	1	12000 × 3500 × 2400	180	DXGPulse

CASE 9

◇Main forging equipment: A 2000t hydraulic machine
◇Main product: Shafts, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective length (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car-bottom heating furnace	1	6550 × 2500 × 2000	80	PXBurner
Regenerative car-bottom heating furnace	1	7000 × 2500 × 2000	80	PXBurner
Regenerative car-bottom heat treatment furnace	1	8000 × 2500 × 2000	120	DXGPulse

◇Main forging equipment: A 3t electro-hydraulic hammer
◇Main product: Shafts, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace (double chambers)	2	1856 × 1858 × 1694	8	LXPulse
Regenerative chamber heating furnace	1	2600 × 2000 × 1684	5	LXPulse
Regenerative car-bottom heat treatment furnace	1	4000 × 1500 × 1500 (length × width × height)	15	DXGPulse

RING FORGING

CASE 10

◇Main forging equipment: A 4500t hydraulic press
◇Main product: Ring forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	2	3500 × 3700 × 3400	80	LXPulse
Regenerative chamber heating furnace	2	3500 × 3900 × 3400	80	LXPulse
Regenerative chamber heating furnace	1	4500 × 5500 × 3000	100	LXPulse

CASE 11

◇Main forging equipments: A 4500t hydraulic machine, a 5m ring rolling machine， and a 1.3m ring rolling machine
◇Main product: Ring forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	2	4000 × 3700 × 2650	45	LXPulse
Regenerative chamber heating furnace	2	3000 × 2500 × 2000	25	LXPulse
Regenerative chamber heating furnace	1	2500 × 2000 × 2000	20	LXPulse

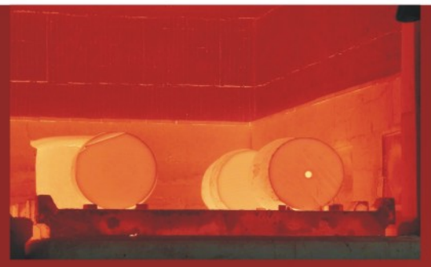
CASE 12

◇Main forging equipments: A 4500t hydraulic machine and a 5m ring rolling machine
◇Main product: Ring forging, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	1	4000 × 3500 × 2400	50	LXPulse
Regenerative chamber heating furnace	1	4000 × 4500 × 2000	60	LXPulse
Regenerative chamber heating furnace	1	4500 × 4500 × 2000	80	LXPulse







CASE 13

◇Main forging equipments: A 4500t hydraulic machine and a 6.3m ring rolling machine
◇Main product: Ring forgings, flange
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	2	3500 × 3016 × 2500	50	LXPulse
Regenerative chamber heating furnace	2	3500 × 3016 × 2500	60	LXPulse
Regenerative chamber heating furnace	1	2900 × 3150 × 3000	40	LXPulse
Regenerative square hood heat treatment furnace	1	5000 × 5000 × 2000 (length × width × height)	100	DXGPulse

CASE 14

◇Main forging equipments: A 6000t hydraulic machine, a 3600t hydraulic machine, and a 6.8m ring rolling machine
◇Main product: Wind power flange, shafts, large gear blanks
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative car-bottom heating furnace	2	8700 × 4000 × 2800 (length × width × height)	160	PXBurner
Regenerative chamber heating furnace (double chambers)	1	3500 × 3000 × 2900	40	LXPulse
Regenerative chamber heating furnace (double chambers)	4	3500 × 3500 × 2900	40	LXPulse
Regenerative car-bottom heat treatment furnace	1	12000 × 4000 × 3300 (length × width × height)	200	DXGPulse
Regenerative car-bottom heat treatment furnace	1	8000 × 5000 × 3100 (length × width × height)	160	DXGPulse
Regenerative square hood heat treatment furnace	1	7200 × 7200 × 2500 (length × width × height)	150	DXGPulse

HOT FORGING

CASE 15

◇Main forging equipments: A 4t electro-hydraulic hammer, a 3t electro-hydraulic hammer, a 1t electro-hydraulic hammer, and a 8000t friction press
◇Main product: Die forging, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	1	3280 × 2204 × 1836	25	LXPulse
Regenerative chamber heating furnace	1	2780 × 1508 × 1632	15	LXPulse
Regenerative through type heating furnace	1	2508 × 980 × 935	1.3 t/h	PXBurner
Regenerative through type heating furnace	1	5500 × 1100 × 900	2.5 t/h	LXPulse
Regenerative chamber heating furnace	1	3500 × 2500 × 1400	25	LXPulse
Regenerative car-bottom heat treatment furnace	1	6000 × 2000 × 2004 (length × width × height)	50	DXGPulse

CASE 16

◇Main forging equipment: A 5t electro-hydraulic hammer, a 3t forging hammer, and a 8000t friction press
◇Main product: Forgings, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	1	2784 × 1856 × 1500	20	LXPulse
Regenerative chamber heating furnace	2	2700 × 1600 × 1500	20	LXPulse
Regenerative through type heating furnace	1	3600 × 920 × 1000	1.5t/h	PXBurner
Regenerative through type heating furnace	1	4000 × 900 × 900	1.8t/h	PXBurner
Regenerative car-bottom heat treatment furnace	1	5500 × 3200 × 1800 (length × width × height)	80	DXGPulse

CASE 17

◇Main forging equipments: A 16t forging hammer, a 10t forging hammer, and a 3t electro-hydraulic hammer
◇Main product: Forgings, free forgings
◇Main supporting regenerative industrial furnaces:

Furnace type	Number	Effective depth (mm) × width (mm) × height (mm)	Loading (t)	Combustion system type
Regenerative chamber heating furnace	1	2088 × 2088 × 2000	20	LXPulse
Regenerative Through type heating furnace	1	6600 × 1800 × 1200	3t/h	LXPulse
Regenerative Through type heating furnace	1	6028 × 2540 × 1200	3t/h	DXGPulse
Regenerative car-bottom heat treatment furnace	1	6600 × 2500 × 1700 (length × width × height)	70	DXGPulse

CONVENTIONAL COMBUSTION TECHNOLOGY AND BURNERS CONFIGURATION

Conventional combustion technology

If clients use conventional burners (with metal recuperators), Worksthern also offers all kinds of products for clients to choose from.

According to flame shapes, Worksthern has:

G series: high speed, sub-high speed, high speed thermostat burners
Applicable fuel types: LPG, fuel oil, natural gas, COG, LDG, mixed gas, producer gas, and blast furnace gas
Performance indicator:
Flame speed: 60 ~ 120m/s (adjust according to our clients)

P series: flat flame burners
Applicable fuel type: LPG, fuel oil, natural gas, COG, LDG, mixed gas, producer gas, and blast furnace gas
Performance indicator:
Flame diameter: see manuals and related instructions
Flame thickness: 80~100 mm

T series: long flame adjustable burners
Applicable fuel type: LPG, fuel oil, natural gas, COG, LDG, mixed gas, producer gas, and blast furnace gas
Performance indicator:
The Adjustable range of long flames: see manuals and related instructions

S series: burners with three flame shapes (short flame, spherical flame, and flat fame)
Applicable fuel type: LPG, natural gas, COG, LDG, mixed gas, and producer gas

According to fuel types, Worksthern has:

◇LPG: G, P, T, S series burners
◇Fuel oil: G, P, T, series burners
◇Natural gas: G, P, T, S series burners
◇COG: G, P, T, S series burners
◇LDG: G, P, T, S series burners
◇Mixed gas: G, P, T, S series burners
◇Producer gas: G, P, T, S series burners
◇Blast furnace gas: G, P, T series burners

Special burners:

◇Self-recuperative burners
◇H_2S burners: H_2S combustion
◇Ignition burners: LPG, natural gas, COG, mixed gas
◇Point guns: LPG, natural gas, COG
◇Pellet igniter burners: COG, blast furnace gas
◇Rotary kiln burners: natural gas (2000 ~ 6000m3/h), COG, blast furnace gas

Especially: Non-standard design can be conducted according to clients' needs

Different burners according to furnace types:

Serial number	Furnace type	Vertical installation	Furnace wall installation	Furnace roof installation	Hot-blast chamber
1	Rolling heating furnace	T	G, T	P	
2	Car-bottom heating furnace		G, P		
3	Car-bottom heat treatment furnace		G		
4	Car-bottom normalizing/tempering furnace		G		
5	Bell type annealing furnace		P(furnace enclosure), G(coil base)		
6	Aluminum heat treatment furnace				G
7	Aluminum melting furnace		G		
8	Chamber/double-chamber heating furnace			P, G	

重庆沃克斯科技股份有限公司发展历程

2001年——2002年 蓄热式燃烧技术的实验室阶段，试制第一台实验性天然气锻造加热炉

- 蓄热体采用陶瓷小球
- 采用集中换向，换向阀为往复式
- 采用人工点火，室温开始换向蓄热
- 采用辅助高温烟道

2002年——2004年 在重庆望江机器厂建造第一台天然气蓄热式锻造加热炉（至今仍在使用）

- 蓄热体采用陶瓷蜂窝体
- 采用集中换向，换向阀为往复式
- 采用人工点火，室温开始换向蓄热
- 取消辅助高温烟道

2004年——2006年 在重庆锻造厂建造第一台天然气蓄热式台车热处理炉（至今仍在使用）

- 蓄热体采用陶瓷蜂窝体
- 采用独立的分散换向技术，采用2通式换向阀
- 采用自动电子点火，室温开始换向蓄热
- 无辅助高温烟道
- 采用PID方式控温
- 取得首项蓄热式燃烧技术方面的国家发明专利

2006年——2008年 承建第一个新建锻造项目的工业炉总包（全外资）共11台锻造工业炉

- 蓄热体采用陶瓷蜂窝体
- 自主研发沃克斯独有的控温自动化程序
- 蓄热式燃烧技术取得国家科委创新基金支持

2008年——2010年 沃克斯公司建造的蓄热式热处理炉（调质），通过GB/T9452-2003标准的炉温均匀性检测

- 领先于同行业，自主研发了各类火焰形式的蓄热式烧嘴以适应不同的加热工艺需要
- 蓄热式燃烧技术再次取得国家科委创新基金支持

2010年——2011年 与重庆科技学院联合开发建立蓄热式燃烧的CFD仿真模拟数学模型实验平台

- CFD仿真模拟与实验室的测试相结合的研究平台
- 取得数百台的蓄热式工业炉的设计建造经验
- 累计取得有关蓄热式技术的16项国家专利，其中6项发明专利
- 获颁重庆市“高新技术企业”证书

2012年——2013年 设计、建造高精度控温的蓄热式热处理炉（达到GB/T9452-2012；AMS2750D/E炉温均匀性相关标准）

- 研发制造了高精度蓄热式加热炉（达到AMS2750D/E相关标准）
- 继续开发更为稳定、精准的蓄热式燃烧及炉温自动控制技术
- 多项蓄热式技术产品获“高新技术产品”证书
- 全国中小企业股份转让系统（新三板）首批挂牌企业

2014年——

- 研发新一代低NO_x氧化物排放，符合国际环保排放标准的天然气蓄热式工业炉
- 根据您的需要我们还在不断的改进、提高

重庆沃克斯的目标—为客户提供最大的帮助

设计经验丰富 施工周期短 售后服务完善

专注于蓄热式燃烧技术的研发和应用，拥有领先的蓄热式工业炉技术

◇全温段换向，无高温辅助烟道，热回收效率高
◇满足周期工作制炉子的复杂的加热工艺要求
◇完备的系统安全监测防范措施
◇系统操作简单、运行费用低廉、维修方便

专注于锻造、重型机械行业的工业炉制造技术，积累了丰富的实践经验

◇按厂房结构为客户提供合理的工业炉布局方案
◇按工艺要求为客户提供工业炉炉型配置方案
◇按燃料种类为客户提供最佳节能方案
◇按工业炉配置要求为客户提供燃料管线计算

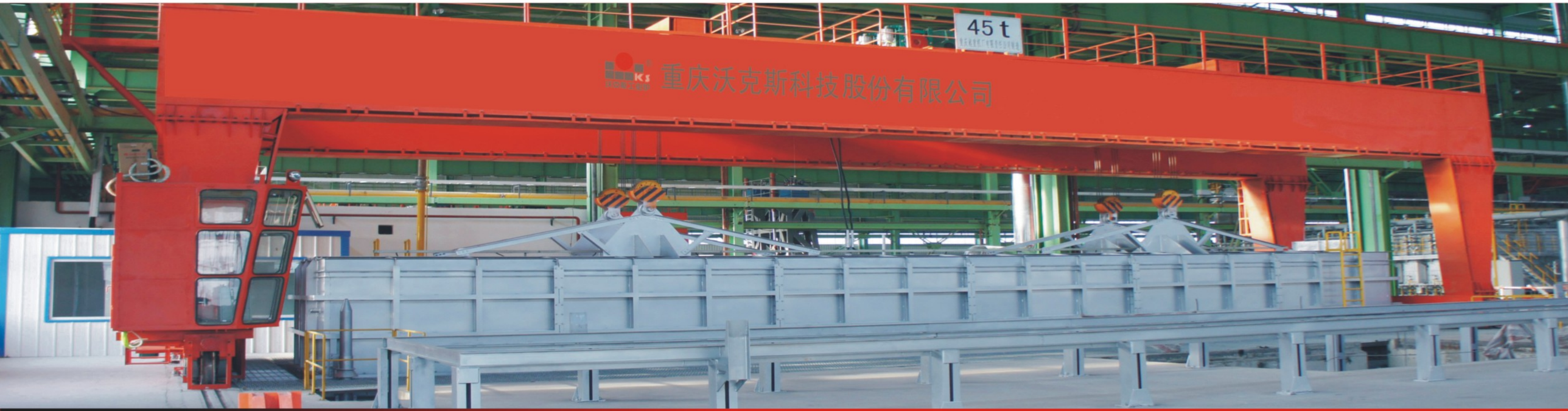
为客户量身定做每一台工业炉

拥有上千台蓄热式工业炉的成功案例

重庆沃克斯蓄热式燃烧技术在不同炉型应用的实际能耗

炉型	典型工艺	吨钢天然气能耗（m^3/t）
蓄热式室式加热炉	自由锻	60～120
	环锻	50～80
蓄热式台车式加热炉	自由锻	55～100
	快锻	50～80
蓄热式台车式热处理炉	锻后热处理（退火、正火）	30～45

蓄热式燃烧技术的研究及其解决方案



实现甩掉高温烟囱的革命，对传统蓄热式技术的一次重大提升

与采用常规燃烧方式+金属换热器工业炉的比较

常规燃烧方式 +金属换热器	沃克斯蓄热式燃烧解决方案	沃克斯蓄热式燃烧技术的优势
金属换热器不适应非稳态传热的工业炉（周期工作制的工业炉）	沃克斯蓄热式燃烧采用全温段换向，全温段热量回收。特别适合于周期工作制的工业炉	温度效率可达80%以上 烟气余热极限回收
金属换热器容易被烧坏，维护维修难度大、成本高，目前通常采用烟气兑冷保护换热器，但会大大降低热回收效率	烟气余热极限回收，无需进行烟气兑冷	蓄热体寿命长，维护、维修成本低
采用金属换热器余热回收效率低。以工作温度在1200℃的加热炉为例，空气预热温度只有300~400℃，能耗较高	采用沃克斯蓄热式燃烧技术热回收效率高，以工作温度在1200℃的加热炉为例，空气预热温度在1000~1100℃，能耗低	热处理炉可节能30%~40% 加热炉可节能40%~60%
需要高温烟囱及地下烟道 排烟温度400℃～700℃	无需高温烟囱及地下烟道 排烟温度~150℃	减少地下烟道和烟囱的土建投资，实现无烟囱的革命
采用不同火焰形态的烧嘴以满足工艺要求	采用不同火焰形态的烧嘴以满足工艺要求	等效替代常规燃烧的各型烧嘴，完全满足工艺要求
温度控制采用控温仪表（PID控制方式）或PLC程序控制。会发生参数漂移，需要定期自整定	首创全智能化非线性PID控制器。打破了传统的PID理论，实现全智能化，无需人工干预或自整定，极限提高了控制系统的稳定性	实现各种加热工艺曲线的精确自动控制，用户完全不必担心由于PID参数漂移造成的控制系统精度下降。控温精度同样可以达到±1～2℃

与传统的蓄热式燃烧方式的比较

传统蓄热式燃烧方式	沃克斯蓄热式燃烧解决方案	沃克斯蓄热式燃烧技术的优势
600℃以下常规燃烧，600℃以上开始换向	从室温开始进行全温段换向	热回收效率更高，节能率更高
烟气经由蓄热体排出～85% 高温辅助烟道直排～15%	无需高温辅助烟道，余热烟气100%全部经由蓄热体排出	热回收效率更高，节能率更高
采用地坑式蓄热室，蓄热体采用陶瓷小球，蓄热室体积较大蓄热体易堵塞，需定期清洗，维护、维修成本高	沃克斯采用独立的蓄热箱设计，蓄热体采用蜂窝陶瓷，蓄热箱体积小，蓄热体不易堵塞，无需定期清洗	蓄热体寿命长，维护、维修成本低
换向和燃烧系统采用集群控制，换向机构庞大，出现故障时必须即刻整体停炉检修。影响生产，浪费燃料	每个烧嘴均配置自成体系的独立的换向和燃烧系统，轻巧灵活，便于维修	使用中单个烧嘴的故障可单独隔离，不影响燃烧系统整体工作，待本炉次工作完成后再进行检修。具有容错功能
采用弥散燃烧，控温精度差，炉温均匀性差，偶温与炉温温差大	烧嘴形式和火焰形态多样，控温精度高，炉温均匀性好	根据不同的炉型和工艺曲线配置不同火焰形态的烧嘴，控温精度±1~2℃，热处理炉炉温均匀性±5~10℃

DXGPulse蓄热式高速脉冲燃烧技术及其控制平台

技术内容

◇DXGPulse蓄热式脉冲燃烧器
◇DXGPulse蓄热式烧嘴控制器
◇DXGPulse蓄热式燃烧控制模块
◇高效、长寿命的蓄热体逆重力安装结构
◇蓄热式脉冲燃烧精细调节系统
◇空气/烟气比例控制技术
◇完备的燃烧安全监测防范措施（蓄热式烧嘴火焰实行电离子、紫外双重监测）
◇精密、长寿命的冷端式炉压控制技术（微正压）

涉及专利

◇专利号：ZL 2007 1 0078178.8
◇专利号：ZL 2009 1 0104758.9
◇专利号：ZL 2006 2 0110071.8
◇专利号：ZL 2006 2 0110072.2
◇专利号：ZL 2006 2 0110073.7
◇专利号：ZL 2009 2 0128702.2
◇专利号：ZL 2009 2 0128703.7
◇专利号：ZL 2011 1 0051270.1
◇专利号：ZL 2011 1 0051272.0

技术特点

◇无高温烟道、烟囱，无辅助高温排烟（高热值煤气）
◇与传统蓄热式比较，提高低温段燃烧效率30~50%，节能率提高15%
◇与常规燃烧技术相比，节能30～60%
◇排烟温度：~150℃
◇火焰形式：高速锥形火焰
◇火焰速度：80~100m/s
◇控温精度：±1～2℃
◇有效工作区温度均匀性：±5～10℃
◇加热工艺曲线自动控制（升、降温速度和高、中、低温度控制平台）
◇炉压的自动控制
◇从室温点火开始的全温段蓄热换向
◇蓄热体寿命加热炉2年、热处理炉4年
◇特殊的烟气回流冷却结构，降低了火焰温度，避免了局部高温
◇高速的强制气流搅拌有利于提高炉温均匀性
◇燃烧和控制系统的标准化设计保证用户的维护、维修简单
◇完全取代高速烧嘴、高速调温烧嘴、自身预热烧嘴和金属空气换热器

适用范围

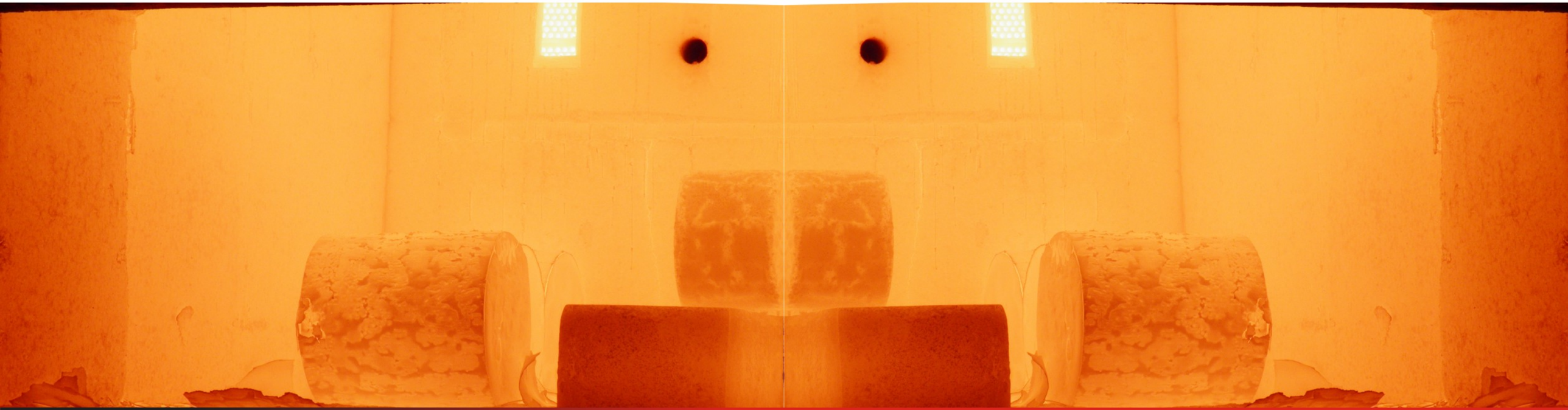
◇锻造台车式加热炉
◇台车式热处理炉：调质炉、回火炉
◇台车式正火、退火炉
◇室式加热炉
◇室式热处理炉
◇冶金行业连续式加热炉和热处理炉
◇特别适用于各类周期性工作制工业炉

特别说明

◇DXGPulse蓄热式脉冲燃烧器同样适用于连续空/燃比例控制方式

独有的蓄热式工业炉专家系统

独特的蓄热式燃烧器



LXPulse分层燃烧自身蓄热式脉冲燃烧技术及其控制平台

技术内容

◇LXPulse分层燃烧自身蓄热式燃烧器
◇LXPulse烧嘴控制器
◇LXPulse蓄热式燃烧控制模块
◇嵌入式蓄热体安装技术
◇蓄热式脉冲燃烧精细调节系统
◇空气/烟气比例控制技术
◇长寿命、控制灵活和维护简单的通/断式换向阀（寿命3年以上）
◇完备的燃烧安全监测防范措施（蓄热式烧嘴火焰实行电离子、紫外双重监测）

涉及专利

◇专利号：ZL 2007 1 0078178.8
◇专利号：ZL 2007 1 0078215.5
◇专利号：ZL 2006 2 0110071.8
◇专利号：ZL 2006 2 0110072.2
◇专利号：ZL 2007 2 0123604.0

技术特点

◇无高温烟道、烟囱，无辅助高温排烟（高热值煤气）
◇与传统蓄热式比较，提高低温段燃烧效率30~50%，节能率提高10%
◇与常规燃烧技术相比，节能30～60%
◇排烟温度：~150℃
◇火焰形式：炉内弥散分层燃烧的螺旋状火焰
◇控温精度：±1.5～2℃
◇分层燃烧技术减少加热件氧化率1%
◇从室温点火开始的全温段蓄热换向
◇蓄热体安装节省空间
◇加热工艺曲线自动控制（升温速度、温度平台）
◇燃烧和控制系统的标准化设计保证用户的维护、维修简单
◇完全取代常规高速烧嘴、高速调温烧嘴、自身预热烧嘴和金属空气换热器

适用范围

◇室式锻造加热炉
◇少氧化加热炉
◇贯通式加热炉
◇铝合金熔化炉
◇连续式加热炉
◇特别适用于各类周期工作制工业炉

特别说明

◇LXPulse分层燃烧自身蓄热式燃烧器适用于脉冲燃烧控制方式和连续空/燃比例控制方式

PXBurner/DBurner蓄热式平焰燃烧技术及其控制平台

技术内容

◇PXBurner蓄热式平焰燃烧器/DBurner蓄热式顶装弥散燃烧器

◇PXBurner/DBurner烧嘴控制器

◇PXBurner/DBurner蓄热式燃烧控制模块

◇长寿命、控制灵活和维护简单的通/断式换向阀（寿命3年以上）

◇蓄热式脉冲燃烧精细调节系统

◇空气/烟气比例控制技术

◇完备的燃烧安全监测防范措施（蓄热式烧嘴火焰实行电离子、紫外双重监测）

◇精密、长寿命的冷端式炉压控制技术（微正压）

涉及专利

◇专利号：ZL 2007 1 0078178.8

◇专利号：ZL 2009 1 0104757.4

◇专利号：ZL 2006 2 0110071.8

◇专利号：ZL 2006 2 0110072.2

◇专利号：ZL 2009 2 0128700.3

◇专利号：ZL 2009 2 0128701.8

◇专利号：ZL 2011 1 0051270.1

◇专利号：ZL 2011 1 0051272.0

技术特点

◇无高温烟道、烟囱，无辅助高温排烟 （高热值煤气）

◇与传统蓄热式比较，提高低温段燃烧效率30~50%，节能率提高15%

◇与常规燃烧技术相比，节能30～60%

◇排烟温度：~150℃

◇火焰形状：强辐射盘型平面火焰/高动能强辐射弥散火焰

◇控温精度：±1.5～2℃

◇加热工艺曲线自动控制（升温速度和高、中、低温度控制平台）

◇炉压的自动控制

◇从室温点火开始的全温段蓄热换向

◇蓄热体寿命加热炉2年

◇增强了高温辐射能力，提高了加热效率；避免了火焰直接接触钢锭，杜绝了化钢现象

◇特殊的烟气回流冷却结构，降低了火焰温度，避免了局部高温

◇燃烧和控制系统的标准化设计保证用户的维护、维修简单

◇完全取代常规平焰烧嘴和金属空气换热器

适用范围

◇大型锻件台车式加热炉

◇自由锻件台车式加热炉

◇连续式加热炉

特别说明

◇PXBurner/DBurner蓄热式脉冲燃烧器适用于脉冲燃烧控制方式和连续空/燃比例控制方式

高精度蓄热式工业炉

用于特殊材料锻造的蓄热式高精度锻造加热炉

技术特点		
烧嘴	蓄热式并联式高速烧嘴	
控制方式	独立研发的高精度、全智能、超稳定炉温控制模块	
控温精度	±1.5℃	
炉温均匀性	满足精度	±10～14℃
	参照检测标准	GB/T9452-2012　AMS2750D（E）-2005
炉内气氛的控制	弱氧化气氛，有效避免氢污染	
能耗指标	90～100kgce/t	

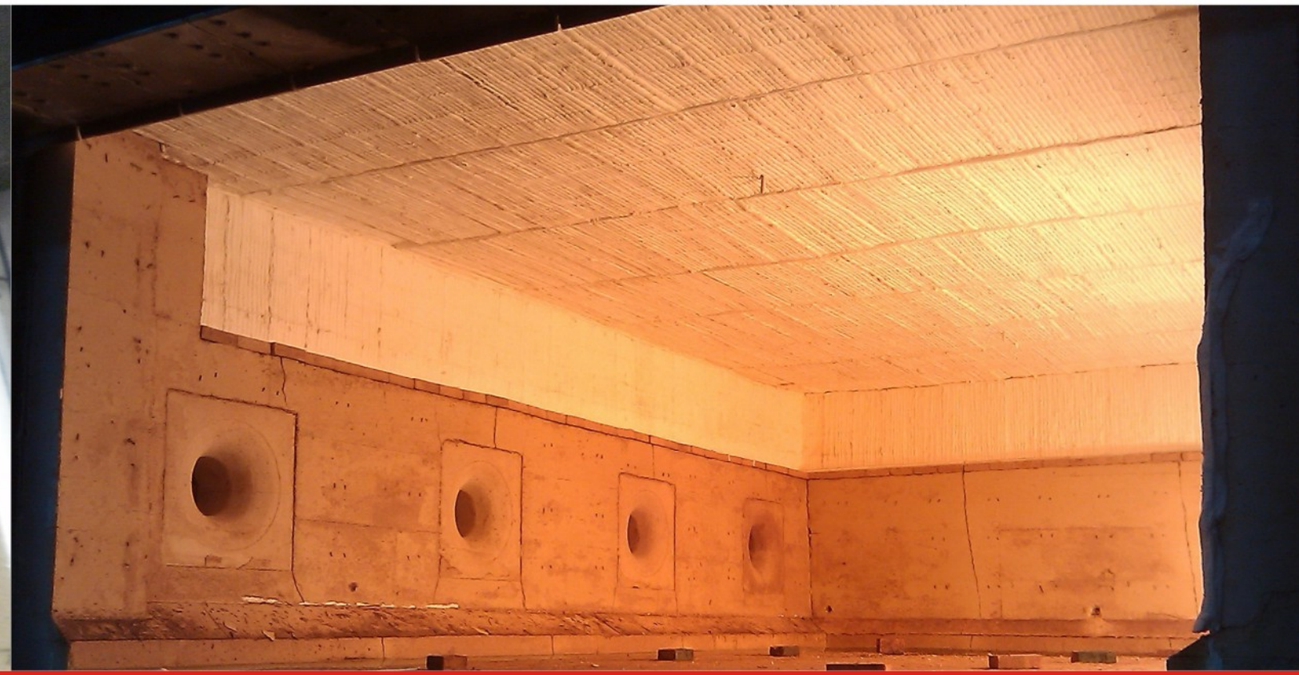
适用范围	
锻件材料	钛合金、高温合金、高速钢等
适用炉型	室式炉、台车式炉等
适用行业	航空、核电等

用于锻件热处理的蓄热式高精度热处理炉

技术特点			
烧嘴	蓄热式高速烧嘴		
控制方式	独立研发的高精度、全智能、超稳定炉温控制模块		
控温精度	±1℃		
炉温均匀性	最高炉温≤900℃	满足精度	±6℃
		检测标准	GB/T9452-2012　AMS2750D（E）-2005
	最高炉温≤1100℃	满足精度	±8℃
		检测标准	GB/T9452-2012　AMS2750D（E）-2005
炉内气氛的控制	弱氧化气氛，有效避免氢污染		
能耗指标	35～75kgce/t		

适用范围	
锻件材料	钛合金、高温合金、高速钢等
适用炉型	室式热处理炉、台车式热处理炉、方（圆）罩式热处理炉
适用行业	大型锻件、铸件的调质、淬火、退火、正火等

高精度蓄热式工业炉



免维护、长寿命、独特的纤维炉顶结构

专利号：ZL 2011 1 0051272.0

本发明解决了长期以来加热炉（工作温度1250℃）纤维炉顶的纤维模块容易掉落，维护维修难度大等问题。

本发明大幅度降低了维护维修成本，即使在不停炉的情况下都可以对炉顶纤维进行修复，大大提高了加热炉纤维炉顶的使用寿命。

含Zr纤维的主要性能

性能指标		含Zr纤维毯
体积密度/kg•m^{-3}		122
导热系数/W•(m•K)-1(平均500℃)		0.120
加热线收缩/%	1300℃×24h	2.0
	1350℃×24h	2.2
	1400℃×24h	2.4

含Zr纤维的性能参数

温度等级	1430℃
建议使用温度	1343℃
熔点	1760℃
纤维直径	3.5μm
1093℃下的比热	1130 J/kg℃
比重	2.73 g/cm3
平均抗拉强度	70KPa•128kg/m3
导热系数	
平均温度	160 kg/m^3
600℃	0.11
800℃	0.18
1000℃	0.21
1200℃	0.33
化学成分	
AL_2O_3	29.31%
SiO_2	53.55%
ZrO_2	15—17%
可沥滤氧化物	＜10ppm

以上数据来源于英国Morgan公司

完整的蓄热式工业炉研发、实验、设计体系

以满足加热工艺为前提 以组织火焰形态为手段

蓄热式燃烧控制：

◇DXGPulse数字化蓄热式高速脉冲燃烧与控制平台
◇LXPulse分层燃烧自身蓄热式脉冲燃烧与控制平台
◇PXBurner蓄热式平焰燃烧与控制平台
◇DBurner蓄热式顶装弥散燃烧与控制平台
◇满足顾客对加热工艺的要求
◇设备运行成本低
◇操作简单
◇维修方便
◇精确的炉内温度自动控制
◇实现最高的节能效率

实现最大节能效率 完全达到环保要求

我们拥有：

◇蓄热式燃烧技术的7项国家发明专利，10项实用新型专利
◇国家科委2009、2011年度创新基金支持
◇上千台蓄热式工业炉的成功经验

研发与设计：

◇丰富的蓄热式工业炉设计和制造经验
◇世界先进的工业炉结构设计技术
◇CFD仿真模拟与实验的测试相结合的研究平台
◇蓄热式工业炉的构造分析
◇独特的燃烧控制及温度控制技术

我们能够：

◇比采用金属换热器的常规燃烧方式节能30%~60%
◇甩掉高温烟道、烟囱及辅助高温烟道
◇全温段的换向蓄热，提高低温段热效率30%~50%
◇实现加热工艺曲线自动控制和精密控温
◇取代常规高速、平焰、自身预热烧嘴及金属换热器
◇改变和提升传统蓄热式燃烧及温度控制技术

重庆沃克斯蓄热式工业炉案例

我们已经拥有上千台蓄热式工业炉设计、制造的成功案例和经验

锻造设备的工业炉工艺配置

我们将根据您的锻造设备和产品结构，在工业炉配置选型上为您提供专业的意见和帮助。炉型的选择，燃烧及控制参数的确定，精准的计算，CFD仿真模拟，结合丰富的经验，我们为您量身定做每一台工业炉。

炉体的设计、制造

模块化、标准化的设计理念给生产制造过程的可控和效率提供了保证。采用国际先进的炉体钢结构和注重对细节的精细化处理，我们每一天都在进步。

安装施工、调试

充分的工厂制作准备，拼装式的框架结构，预组合的设备部件，出色的现场管理使我们有高效的施工效率，用最短的时间完成现场的设备安装。

售后服务

完善的售后服务体系，及时、有效确保客户设备的正常运行。

自由锻

案例一

◇主要锻造设备：2000t水压机
◇主要产品：轴类件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	2	6500×2800×2500	120	PXBurner
蓄热式台车热处理炉	2	10000×2320×2000	120	DXGPulse
蓄热式台车热处理炉	1	8700×2320×2000	100	DXGPulse
蓄热式台车热处理炉	1	7300×2320×2000	100	DXGPulse
室式调质炉	3	7500×2500×1200	20	DXGPulse

重庆沃克斯蓄热式工业炉案例

案例二

◇主要锻造设备：40000t油压机一台、2000t一台，5m碾环机一台
◇主要产品：轴类件，环类件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	2	8000×3240×3450	150	PXBurner
蓄热式台车加热炉	1	6000×3200×2500	120	PXBurner
蓄热式台车加热炉	1	6000×3000×2770	120	PXBurner
蓄热式台车热处理炉	3	9800×3580×3250	180	DXGPulse
蓄热式台车热处理炉	1	8000×4500×3050	150	DXGPulse
蓄热式台车热处理炉	1	12000×3580×3050	200	DXGPulse

案例三

◇主要锻造设备：7000t油压机
◇主要产品：轴类件，自由锻件
◇主要配套的锻后热处理用蓄热式炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车热处理炉	1	10000×3500×3250	250	DXGPulse
蓄热式台车热处理炉	1	15000×3500×3250	300	DXGPulse

案例四

◇主要锻造设备：GFM1800t精锻机
◇主要产品：轴类件，饼类件
◇主要配套的锻后热处理用蓄热式炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车热处理炉	1	7000×3600×2300	120	DXGPulse
蓄热式台车热处理炉	1	15000×4200×2300	200	DXGPulse
蓄热式台车热处理炉	1	9000×3700×2290	150	DXGPulse
蓄热式台车热处理炉	1	9000×3700×2290	150	DXGPulse
蓄热式方罩式热处理炉	1	18500×2000×1200	120	DXGPulse

案例五

◇主要锻造设备：4000t油压机一台
◇主要产品：轧辊、轴类件，自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	2	7000×3000×2400	100	PXBurner
蓄热式台车加热炉	1	8000×3500×2500	120	PXBurner
蓄热式台车热处理炉	1	6000×4000×2500	100	DXGPulse
蓄热式台车热处理炉	2	8000×3500×2500	150	DXGPulse

案例六

◇主要锻造设备：6000t油压机一台
◇主要产品：轴类件，方块类件，自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	1	8000×4000×3200	160	PXBurner
蓄热式台车加热炉	1	5000×3000×2400	100	PXBurner
蓄热式台车热处理炉	1	8000×4000×3200	150	DXGPulse

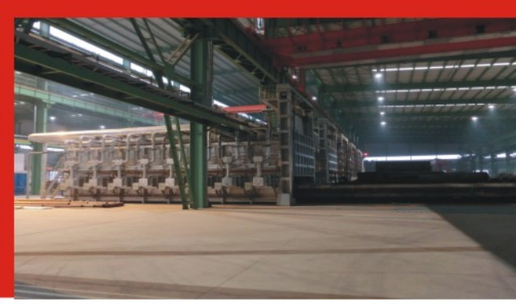
案例七

◇主要锻造设备：4500t油压机
◇主要产品：长轴类件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	1	6000×4000×3000	100	PXBurner
蓄热式台车加热炉	1	8000×4000×3000	120	PXBurner
蓄热式台车热处理炉	1	8000×4000×3150	150	DXGPulse
蓄热式台车热处理炉	1	10000×4000×3150	180	DXGPulse
蓄热式台车热处理炉	3	15000×4000×3150	200	DXGPulse







重庆沃克斯蓄热式工业炉案例

案例八

◇主要锻造设备：2500t水压机一台
◇主要产品：轧辊、轴类件，自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	1	6500×2800×2400	100	PXBurner
蓄热式台车加热炉	1	8000×3000×2400	120	PXBurner
蓄热式台车热处理炉	1	7000×4000×2400	100	DXGPulse
蓄热式台车热处理炉	1	12000×3500×2400	180	DXGPulse

案例九

◇主要锻造设备：2000t油压机一台
◇主要产品：轴类件，自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效长度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	1	6550×2500×2000	80	PXBurner
蓄热式台车加热炉	1	7000×2500×2000	80	PXBurner
蓄热式台车热处理炉	1	8000×2500×2000	120	DXGPulse

◇主要锻造设备：3T电液锤一台
◇主要产品：轴类件，自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉（双室）	2	1856×1858×1694	8	LXPulse
蓄热式室式加热炉	1	2600×2000×1684	5	LXPulse
蓄热式台车热处理炉	1	4000×1500×1500（长×宽×高）	15	DXGPulse

环锻

案例十

◇主要锻造设备：4500t油压机一台
◇主要产品：环锻
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	2	3500×3700×3400	80	LXPulse
蓄热式室式加热炉	2	3500×3900×3400	80	LXPulse
蓄热式室式加热炉	1	4500×5500×3000	100	LXPulse

案例十一

◇主要锻造设备：4500t油压机一台，5m碾环机一台，1.3m碾环机一台
◇主要产品：环锻
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	2	4000×3700×2650	45	LXPulse
蓄热式室式加热炉	2	3000×2500×2000	25	LXPulse
蓄热式室式加热炉	1	2500×2000×2000	20	LXPulse

案例十二

◇主要锻造设备：4500t油压机一台，5m碾环机一台
◇主要产品：环锻、自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	1	4000×3500×2400	50	LXPulse
蓄热式室式加热炉	1	4000×4500×2000	60	LXPulse
蓄热式室式加热炉	1	4500×4500×2000	80	LXPulse





重庆沃克斯蓄热式工业炉案例

案例十三

◇主要锻造设备：4500t油压机一台，6.3m碾环机一台
◇主要产品：环锻、法兰
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	2	3500×3016×2500	50	LXPulse
蓄热式室式加热炉	2	3500×3016×2500	60	LXPulse
蓄热式室式加热炉	1	2900×3150×3000	40	LXPulse
蓄热式方罩式热处理炉	1	5000×5000×2000（长×宽×高）	100	DXGPulse

案例十四

◇主要锻造设备：6000t油压机一台，3600t油压机一台，6.8m碾环机一台
◇主要产品：风电法兰、轴、大型齿轮坯
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式台车加热炉	2	8700×4000×2800（长×宽×高）	160	PXBurner
蓄热式室式加热炉（双室）	1	3500×3000×2900	40	LXPulse
蓄热式室式加热炉（双室）	4	3500×3500×2900	40	LXPulse
蓄热式台车热处理炉	1	12000×4000×3300（长×宽×高）	200	DXGPulse
蓄热式台车热处理炉	1	8000×5000×3100（长×宽×高）	160	DXGPulse
蓄热式方罩式热处理炉	1	7200×7200×2500（长×宽×高）	150	DXGPulse

热模锻

案例十五

◇主要锻造设备：4t电液锤，3t电液锤、1t锤、8000t摩擦压力机
◇主要产品：模锻件、自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	1	3280×2204×1836	25	LXPulse
蓄热式室式加热炉	1	2780×1508×1632	15	LXPulse
蓄热式贯通式加热炉	1	2508×980×935	1.3 t/h	PXBurner
蓄热式贯通式加热炉	1	5500×1100×900	2.5 t/h	LXPulse
蓄热式室式加热炉	1	3500×2500×1400	25	LXPulse
蓄热式台车热处理炉	1	6000×2000×2004（长×宽×高）	50	DXGPulse

案例十六

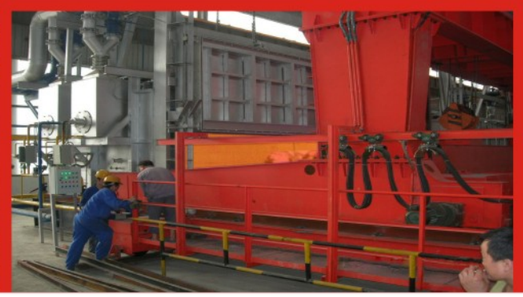
◇主要锻造设备：5t电液锤，3t模锻锤、8000t摩擦压力机
◇主要产品：模锻件、自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	1	2784×1856×1500	20	LXPulse
蓄热式室式加热炉	2	2700×1600×1500	20	LXPulse
蓄热式贯通式加热炉	1	3600×920×1000	1.5t/h	PXBurner
蓄热式贯通式加热炉	1	4000×900×900	1.8t/h	PXBurner
蓄热式台车热处理炉	1	5500×3200×1800（长×宽×高）	80	DXGPulse

案例十七

◇主要锻造设备：16t模锻锤，10t模锻锤、3t电液锤
◇主要产品：模锻件、自由锻件
◇主要配套的蓄热式工业炉

工业炉类型	数量（台）	有效深度（mm）×有效宽度（mm）×有效高度（mm）	装炉重量（t）	燃烧系统类型
蓄热式室式加热炉	1	2088×2088×2000	20	LXPulse
蓄热式贯通式加热炉	1	6600×1800×1200	3t/h	LXPulse
蓄热式贯通式加热炉	1	6028×2540×1200	3t/h	LXPulse
蓄热式台车热处理炉	1	6600×2500×1700（长×宽×高）	70	DXGPulse

常规燃烧技术及燃烧器的配置

常规燃烧技术

鉴于各种原因仍然使用常规燃烧器（采用金属换热器）的用户我们也有完备的产品库供您选择：

按火焰形式：

G系列：高速、亚高速、高速调温烧嘴
适用的燃料种类：液化石油气、燃油、天然气、焦炉煤气、转炉煤气、混合煤气、发生炉煤气、高炉煤气
性能指标：
火焰速度：60～120m/s（根据用户要求）

P系列：平焰烧嘴
适用的燃料种类：液化石油气、燃油、天然气、焦炉煤气、转炉煤气、混合煤气、发生炉煤气、高炉煤气
性能指标：
火盘直径：请参考相关烧嘴说明书
火盘厚度：80～100mm

T系列：长焰可调烧嘴
适用的燃料种类：液化石油气、燃油、天然气、焦炉煤气、转炉煤气、混合煤气、发生炉煤气、高炉煤气
性能指标：
火焰长度可调范围请参考相关烧嘴说明书

S系列：三焰烧嘴
短火焰、球型火焰和平焰可调。
适用的燃料种类：液化石油气、天然气、焦炉煤气、转炉煤气、混合煤气、发生炉煤气

按燃料种类

◇液化石油气：G、P、T、S系列烧嘴
◇燃油：G、P、T系列烧嘴
◇天然气：G、P、T、S系列烧嘴
◇焦炉煤气：G、P、T、S系列烧嘴
◇转炉煤气：G、P、T、S系列烧嘴
◇混合煤气：G、P、T、S系列烧嘴
◇发生炉煤气：G、P、T、S系列烧嘴
◇高炉煤气：G、P、T系列烧嘴

特殊烧嘴

◇自身预热式烧嘴
◇H_2S烧嘴：H_2S燃烧
◇点火烧嘴：液化气、天然气、焦炉煤气、混合煤气
◇点火枪：液化气、天然气、焦炉煤气
◇球团点火器烧嘴：焦炉煤气、高炉煤气
◇回转窑燃烧器：天然气（2000～6000m^3/h）、焦炉煤气、高炉煤气

特别说明：可根据用户要求进行烧嘴非标设计

按炉型配置的烧嘴选型推荐：

序号	工业炉炉型	纵向安装	炉墙安装	炉顶安装	热风室
1	轧钢加热炉	T	G、T	P	
2	台车式加热炉		G、P		
3	台车式热处理炉		G		
4	台车式正火、退火炉		G		
5	罩式退火炉		P(炉罩)、G(炉台)		
6	铝合金热处理炉				G
7	铝合金熔化炉		G		
8	室式、双室式加热炉			P、G	

专利 证书 荣誉 PATENTS & CERTIFICATES