

200 t/h D 型锅炉设计技术特点

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摘 要: 介绍锅炉本体结构布置, 系统流程, 重力传递等系统特点。D 型锅炉节省钢材, 热效率高。

关 键 词: 锅炉设计; 结构; 系统; 重力传递

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1 引言

D 型锅炉的重要特点是结构紧凑, 占地面积小; 系统简单、金属耗量少; 安全可靠、热效率高、初投资少、建设周期短。目前安装在宁夏化肥厂的 HG—200/10.3—Y1 锅炉, 是哈尔滨锅炉有限责任公司设计和制造的国内首台 200 t/h 燃油 D 型炉。

2 锅炉本体部分

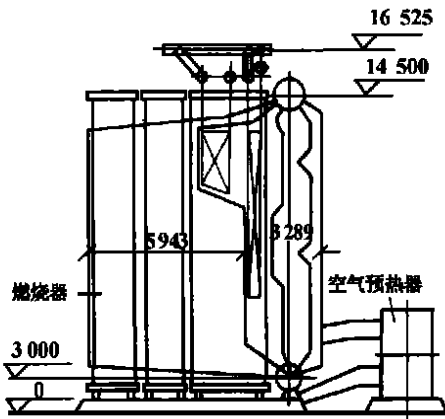


图 1

如图 1 所示, 按沿烟气流方向, 布置了高温过热器、低温过热器。上下锅筒之间, 布置了对流管束一及对流管束二, 作为下降管和蒸发受热面, 因为锅炉没有经济器, 并且采用了卧式回转式空气预热器, 从而使锅炉高度与同等容量的燃油锅炉相比, 降低了大约 15 m 左右, 燃烧器布置在前墙, 炉膛采用全焊封的膜式水冷壁, 呈正方形。本锅炉不设用于专门支撑受压元件的构架。图 1 中的柱子仅用于支撑平台和楼梯。前后水冷壁上、下两端分别与上锅筒和下锅筒胀接

连接, 侧水冷壁上集箱和侧水冷壁下集箱, 通过连接管分别与上、下锅筒焊接连接, 各部件之间相互连接, 使锅炉成为一个整体, 仅是同种容量 II 型燃油锅炉占地面积的 1/4。

3 系统简单、金属耗量少

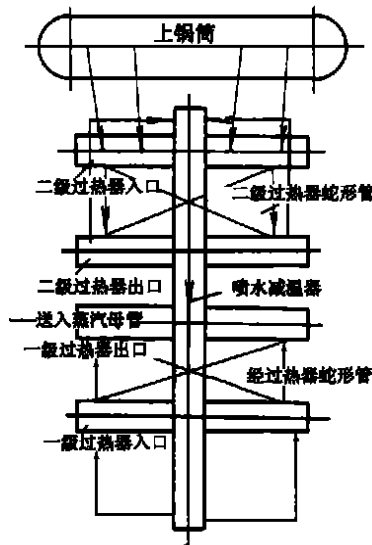


图 2 过热器系统简图(图中箭头表示工质流向)

如图 2、图 3 所示, 过热器系统由具有对流特性的第一级蛇形管过热器和第二级蛇形管过热器组成, 从锅筒出来的饱和蒸汽, 经连接管引入二级过热器入口集箱, 蒸汽通过二级过热器逆向进入其出口集箱, 从出口集箱出来经 2 根 $\Phi 168 \times 16$ 连接管对称引入纵向布置在炉膛中心线上的喷水减温器, 减温后, 蒸汽进入第一级蛇形管入口集箱, 通过过热器蛇形管, 顺流进入其出口集箱, 蒸汽从出口集箱右端引出, 送入高压蒸汽母管。

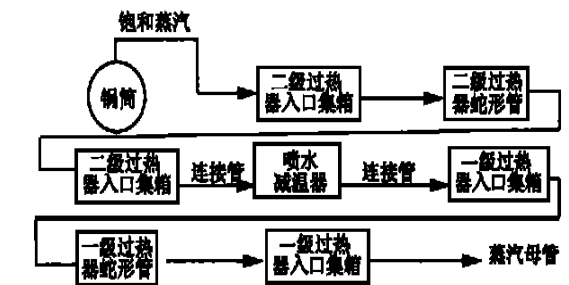


图 3 蒸汽流程图

汽水系统因锅炉没有经济器,由一根给水管,直接送入锅筒,然后按:上锅筒→对流管束→下锅筒→膜式水冷壁→上锅筒的规律进行循环,产生的蒸汽进入过热系统。本锅炉无构架,200 t/h D型炉金属耗量为512 t,200 t/h II型锅炉金属耗量为687 t,可见,D型炉可节约钢材175 t。

4 安全可靠、热效率高

为了保证锅炉的安全运行,D型炉装有炉膛安全保护系统;吹灰程控系统,在上锅筒的封头上,装有电子水位表,电感应水位表各一套。水位自动保护装置一套。在锅筒和过热蒸汽出口管道上,装有直接作用的安全阀,在过热器出口管道上还装有避免安全阀频繁起动的动力控制阀。安全阀的总排放量,大于锅炉额定蒸发量。

锅炉的热效率是锅炉运行最主要的经济指标。500 MW 高压燃油锅炉的热效率在90%~91%之间,实际运行时,受各种因素的影响,锅炉的实际效率还要低。年连续运行时数在7 000 h左右。而D型炉则不然。本D型炉设计效率为92%,年连续运行时数大于8 000 h。表1为运行时间已达3年的200 t/h D型炉锅炉主要经济技术指标设计值与实测值的对比情况。从表中可以看出锅炉各项经济指标,完全达到了设计要求。

表1 锅炉主要经济技术指标对照表(100%负荷)

	额定蒸发量	额定压力	过热蒸汽温度	给水温度	排烟温度	效率	年连续运行小时数
设计值	200 t/h	10.3 MPa	495 °C	262 °C	164 °C	92%	> 8 000
实测值	200 t/h	10.31 MPa	495 °C	260 °C	158 °C	92.1%	8 100

5 锅炉的先进性

5.1 重力传递系统

本锅炉无构架,即D型锅炉没有专门设置支撑锅炉本体的钢构架,锅炉全部受压元件及其中的汽水质和锅炉绝热保温材料的全部重量,都通过受压元件自身传递到锅炉基础上。因而,建立重力传递系统,正确处理受压元件之间的重力传递,成为保障锅炉安全运行的关键。

重力传递系统:过热器、减温器、水冷壁、顶棚管、顶部各连接管、炉顶密封小室等重量,通过炉顶若干纵向和横向钢梁及桁架,作用到上锅筒和侧水冷壁上集箱上;上锅筒及其承受的荷载,通过上、下

锅筒间的对流管束传递到下锅筒上;侧水冷壁上集箱及其承受的荷载,通过左、右两侧水冷壁管屏,传递到侧水冷壁下集箱上;燃烧器及大风箱的重量,通过风箱和桁架及三道刚性梁作用到前水冷壁上;下锅筒、侧水冷壁下集箱、前水冷壁管屏、炉底管屏以及各自承受的荷载,都通过相应的支座将力传递到锅炉基础上,至此整个重力传递全部完成。

5.2 膨胀系统

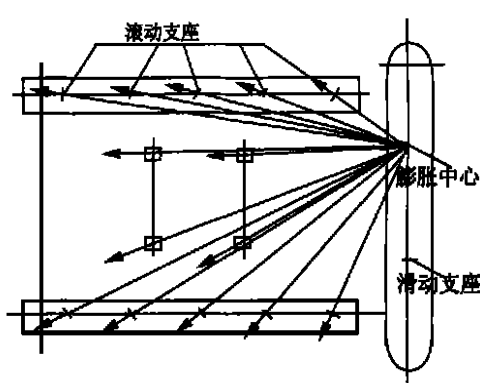


图4 膨胀系统图

锅炉运行后,受压元件由于受热,将产生热膨胀。膨胀问题处理不好,直接影响锅炉安全运行。D型

炉设置了优于其它炉型的膨胀系统,对保证锅炉高效、安全运行起到了非常重要的作用,如图4所示。

整个锅炉的膨胀中心,设在下锅筒右支座,其它所有支座都是滚动支座。每个滚动支座、滚柱的滚动方向,均按膨胀中心与该支座连线所指的热膨胀方向安装。锅炉运行时,各滚动支座都以膨胀中心为零点,呈辐射状向离开中心的方向自由膨胀。在垂直方向因为各受压件自身均支撑在炉底各支座上,所以总体上是自下向上自由膨胀,不受任何限制。

5.3 正压密封系统

锅炉的密封,一直是锅炉设计中的一大难题。50~200 MW 燃煤或燃油锅炉,由于密封不好,锅炉有时出现漏烟现象,炉顶密封是锅炉密封的难中难,锅炉运行后,由于设计、安全等原因,锅炉房内时有烟气和粉尘。D型炉上采用了正压空气密封,完美的解决了密封问题。D型炉需要密封的地方主要有:炉顶、看火孔、吹灰孔和监测孔。将高于炉内压力的压缩空气引至炉顶、看火孔、吹灰孔等需要密封之处,在密封处形成一个高压空气膜,使烟气、灰尘、火焰不能窜出。这种方法,简单易行。现场观察,锅炉非常清洁,无烟气、无灰尘,用户很满意。

(何静芳 编辑)

tube connected in series. An experimental study was conducted with air and water serving as working mediums. The results of the study indicate that the pressure drop characteristics of the vertical descending Venturi tube in a ring-shaped flow zone have been found to be more approximate to the calculation results of the uniform-phase flow model. Under the proposed method the relative error of measurement within the range of dryness given in the paper is smaller than $\pm 10\%$.

Key words: gas-liquid two-phase flow, mass gas-content rate, dryness, measurement

“煤气化—无烟燃烧技术”的原理及其应用 = **Basic Theory of “Gasification—Smoke-free Combustion Technology” and its Application in the Technical Modification of Boilers** [刊, 汉] / SUN Dong-hong (Harbin Institute of Technology, Harbin, China, Post Code: 150001), HAO Zhi-jing, WANG Qing (Northeast Electric Power Institute, Changchun, China, Post Code: 132012) // Journal of Engineering for Thermal Energy & Power. — 2001, 16(3). — 325 ~ 327

An analysis is given of the present status of development of Chinese industrial boilers. On this basis briefly covered in this paper is the topic “gasification— a smoke-free combustion technology” and its application in the technical modification of industrial boilers. The implementation of that technology has opened up a new approach for the technical retrofit of industrial boilers, which can contribute not only to smoke-free and low-ash combustion but also to significant energy savings.

Key words: gasification, smoke-free combustion technology, industrial boiler, technical modification or retrofit

低 NO_x 高温空气燃烧技术 = **Low NO_x Combustion Technology of High-temperature Air** [刊, 汉] / ZHU Tong, LIU Min-fei (Thermal Energy Engineering Department, Tongji University, Shanghai, China, Post Code: 200092), RAO Wen-tao (Equipment Research Institute under the Baoshan Iron and Steel Corporation-affiliated Research Academy, Shanghai, China, Post Code: 201900) // Journal of Engineering for Thermal Energy & Power. — 2001, 16(3). — 328 ~ 330, 321

By organically integrating traditional low NO_x combustion technology of high temperature air with a high-temperature thermal-storage type combustion system, the resulting low NO_x high-temperature air combustion technology features a high thermal efficiency, a uniform distribution of temperature within the furnace, and low NO_x emissions, etc. The present paper deals with the high-temperature air combustion technology with a focus on the analysis of basic principles of low NO_x emissions specific to the high-temperature air combustion technology. In addition, also depicted are two types of low NO_x high-temperature air combustors incorporating respectively gas recirculation and graded combustion technology. **Key words:** low NO_x , high-temperature air combustion, thermal storage type combustor, combustion technology

KA-13D 燃气轮机注水系统的应用 = **The Application of a Model KA-13D Gas Turbine Water Injection System** [刊, 汉] / LONG Xian-lin, JIA Xi-long (Desheng Electric Power Plant Co. Ltd., Shunde, Guangdong Province, China, Post Code: 528300) // Journal of Engineering for Thermal Energy & Power. — 2001, 16(3). — 331 ~ 333

On the basis of the operating experience of a power plant over the years an analysis was conducted of the influence of water injection or no water injection on the heat resistant pad of combustor components as well as on the components of a post-cycle. The water injection has been applied to the combustor of a gas turbine operating under combined cycle power plant conditions. In this context, expounded are the merits and demerits of employing water injection or no injection into the combustor of the above-mentioned gas turbine. **Key words:** gas turbine, combustor, combined cycle power plant, heat resistant pad

200 t/h D 型锅炉设计技术特点 = **Technical Features of the Design of a 200 t/h D-shaped Boiler** [刊, 汉] / YUAN Mei-yan, LI Jing-shi (Harbin Boiler Works Company, Ltd., Harbin, China, Post Code: 150090) // Journal of Engineering for Thermal Energy & Power. — 2001, 16(3). — 334 ~ 335

Presented in this paper is the brief description of a 200 t/h D-shaped boiler, highlighting the structural layout of the boiler proper, the system flow path, low steel consumption, high thermal efficiency and water circulation head of the boiler.

Key words: structural design, boiler system, water circulation head of boiler