●工艺与设备

螺旋焊管内焊双丝焊装置的设计与应用

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摘 要: 根据螺旋焊管内焊双丝焊工艺的特殊性,研制了一套内焊双丝焊装置,该装置由焊丝对缝跟踪机构、焊臂支撑导向机构、送丝系统、调节机构及导电焊炬等组成。装置结构紧凑,调整方便,工作稳定可靠,可应用于直径大于 559 mm厚壁钢管内焊双丝焊接。

关键词: 螺旋焊管; 双丝焊; 内焊装置
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0 引 言

近年来,随着国内对石油天然气需求的日益增长,油气管道建设进入了高速发展期。高钢级、大直径、大壁厚焊接钢管正在成为干线管道设计选用的主流管材。

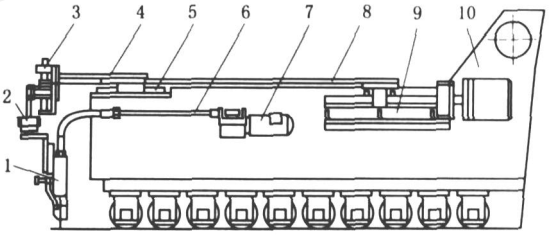
生产高钢级、大壁厚、大直径螺旋焊管时,内外焊普遍采用双丝埋弧自动焊工艺。螺旋焊管的内焊在管坯内进行,不便于观察,且受管内空间位置的限制,因而内焊装置具有其特殊性。内焊焊丝形位参数是通过调整焊接装置实现的,内焊质量的控制在很大程度上取决于内焊装置的可调性、稳定性和可靠性[1],特别是内焊应用双丝焊工艺时,焊丝的形位参数调整更加复杂,要求内焊装置必须满足工艺调整的需要,才能保证内焊质量。为此,设计了一套结构紧凑、调整方便、稳定性好的内焊双丝焊装置。

1 内焊双丝焊装置的结构设计

内焊双丝焊装置结构如图 1所示。该套装置由对缝跟踪机构,焊臂支撑导向机构,升降、偏移调节机构,导电焊炬及送丝系统等组成。

1.1 对缝跟踪机构

如图 1所示,跟踪驱动机构 9采用低速永磁同步电机驱动,滚珠丝杠副传动,直线导轨副导向。直线导轨安装在三角支座上,用螺栓连接在成型器机臂 10 (2#梁)侧面。焊臂 8采用板状构



1—导电焊炬 2—旋转机构 3—升降调节机构
4—偏移调节机构 5—支撑导向机构 6—导丝管
7—送丝马达 8—焊臂 9—跟踪驱动机构 10—成型器机臂

图 1 内焊双丝焊装置结构示意图

件,分别与驱动机构 9和支撑导向机构 5的滑块连接。

焊臂支撑导向机构 5安装在成型器机臂 10前端顶部,对焊臂 8起支撑和导向作用。导向机构仍采用直线导轨副,其结构简图如图 2所示。直线导轨用螺栓固定在连接板上,焊臂与滑块用螺钉连接,推动焊臂可使滑块作往复直线移动。

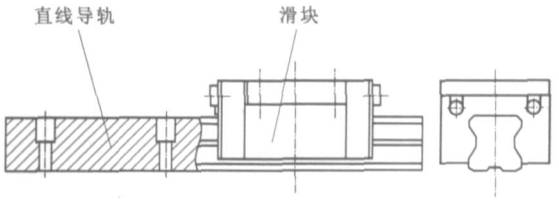
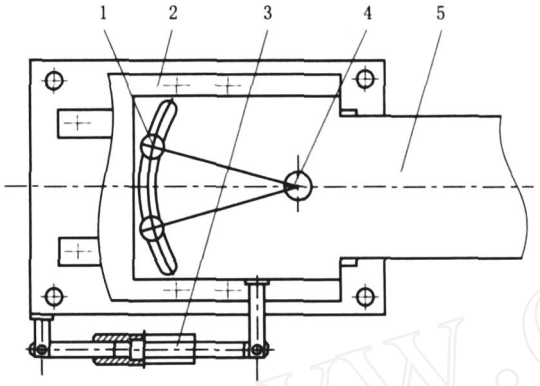


图 2 直线导轨副结构简图

此结构形式既增强了焊臂的刚性,又减少了焊臂进退阻力,能很好地保持焊接过程中焊丝形位参数的稳定性,从而保证焊接电弧的稳定燃烧。

1.2　偏移调节机构

偏移调节机构如图 3所示,一端与支撑导向机构滑块连接,另一端与升降调节机构连接。该机构可作水平方向 ±20 旋转调节,调节时与跟踪调节机构配合使用,以改变焊点横向位置,从而最终实现焊点"偏移量"这一重要形位参数的调整。



1—锁紧螺钉　2—焊臂　3—调节杆
4—转轴　5—联结面板

图 3　偏移调节机构结构简图

1.3　升降调节机构

图 1中升降调节机构 3设计成手动丝杠、双柱导向结构,通过旋转机构与导电焊炬连接。通过手动调节丝杠,可使导电焊炬沿垂直方向上下移动,从而实现对焊丝伸出长度的调整。该调节机构只负责对焊丝伸长量一个形位参数的调整。

1.4　旋转机构

图 1中旋转机构 2是升降调节机构与焊炬的连接件。为满足内焊双丝焊工艺的需要,直流焊丝和交流焊丝必须同时对准螺旋焊缝,因此,将此连接件设计成可绕连接轴旋转的机构。该机构可作水平方向 360 旋转,保证了两根焊丝能同时对准螺旋焊缝。旋转到位后,能可靠锁紧。

1.5　导电焊炬

导电焊炬由直流焊炬与交流焊炬组成,其结构简图如图 4所示。导电焊炬采用分体式设计,分为导电主体与夹块式导电嘴两部分。

前后丝导电嘴分别通过导丝管 (图 1中 6)与送丝马达 (图 1中 7)连接。前丝导电嘴与后丝导电嘴同时用螺栓连接在绝缘胶木板上,并形成合适的夹角,从而满足双丝焊工艺对交直流焊丝的倾角及间距等形位参数的调整要求。

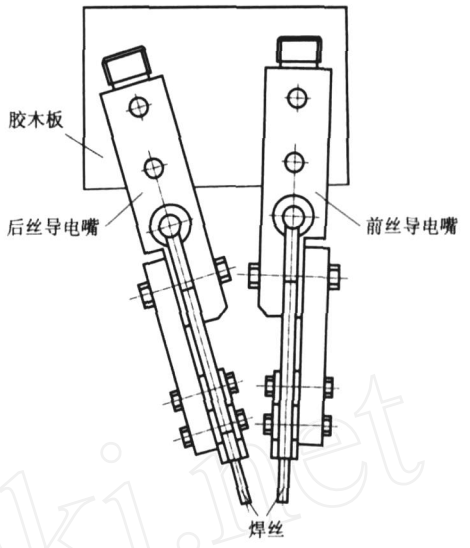


图 4　导电焊炬结构简图

1.6　送丝系统

送丝系统由导丝管 (图 1中 6)与送丝马达 (图 1中 7)等组成。导丝管采用如图 5所示的组合结构,由钢丝弹簧管 (φ8 mm ×1 mm)外套钢丝编织胶管 (内径 8mm)组成,两端活接头采用了液压胶管的接头技术,既拆卸方便,又能牢固锁紧[2]。这种结构形式的导丝管既具有合适的刚度,又具有良好的柔性,能很好地满足焊丝以推丝式顺畅输送。导丝管通过活接头与导电焊炬连接,能始终保证焊丝平稳连续地导入导电嘴。

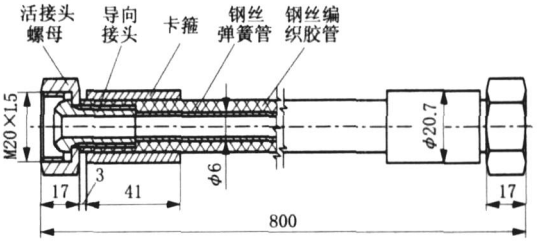


图 5　导丝管结构图

2　技术参数和调整原理

2.1　主要技术参数

该套内焊双丝焊装置的主要技术参数如下:

适应管径范围 ≥559 mm;

适应壁厚范围 10～20 mm;

焊接速度 ≤2.0 m/min;

轴向 (*x*)调整量 ±75 mm;

垂直方向 (*z*)调整量 ±30 mm;

水平旋转 360°;

焊点偏移调整量 ±35 mm;

焊丝倾角调整量 ±15°;

伺服电机功率 130 W。

2.2 焊接工艺调整

2.2.1 对缝跟踪调整

如图 1所示,操作伺服电机,通过滚珠丝杆副和直线导轨副传动,驱动焊臂作直线移动,导电焊炬在焊臂带动下沿钢管轴向移动,从而实现对缝跟踪。伺服电机运行时振动小,噪音低,转速稳定,启动转矩大,启动时电流无冲击,负载变化时电流变化极小,具有一定的自锁能力,且能瞬间启动、倒转和停机[1]。滚珠丝杆副和直线导轨副的配合使用保证了机械传动的精度与平稳性,满足了动态焊接条件下焊丝点动对缝的工艺需要。

2.2.2 焊点偏移量调整

一般来说,螺旋焊管自动焊焊点位置与钢管中轴线方向都有一段距离,这个距离称为焊点偏移量[3]。双丝埋弧焊时,焊点偏移量对焊接质量的影响很大。偏移量过小,容易造成焊漏或引发内焊裂纹;偏移量过大,容易造成焊缝内凹,严重时内凹部分甚至低于母材。因此,选择合适的焊点偏移量尤为重要。

如图 3所示,松开锁紧螺钉 1,扳动调节杆 3的螺母,连接面板 5绕转轴 4旋转,再前后驱动焊臂 2作配合调整,从而使焊点偏移量达到双丝焊要求的最佳位置。调整到位后,紧固锁紧螺钉,保证焊接过程中偏移量的恒定。

2.2.3 焊丝伸长量调整

如图 1所示,扳动升降调节机构 3的丝杆,移动滑块沿着导向柱上下移动,可带动整个导电焊炬 1上下垂直移动,从而使焊丝伸出长度达到工艺要求。该装置调整灵活,由于移动部件采用滚珠丝杆副,因此,具有很好的自锁性,调整到位后能保证焊丝伸长量不会发生变化。

2.2.4 双丝间距和焊丝倾角调整

双丝埋弧焊时,双丝间距和前后焊丝的倾角也是影响焊接质量的较重要的形位参数,而保持焊接过程中这两个参数的恒定是内焊双丝焊的技术关键。如图 4所示,对焊炬结构作整体优化设计,将前后丝导电嘴以螺栓连接的方式与胶木板形成一个有机的整体,从而保证双丝间距和焊丝倾角这两个形位参数均能达到工艺要求的最佳值:前后丝间距为 10～12 mm,前丝倾角为 3°～5°,后丝倾角为 12°～15°。

3 结　语

(1) 2006年 10月,该装置在兰银线 X70级管线钢 φ610 mm ×11 mm钢管的生产中,表现出了整体稳定性好、调整灵活、动作可靠性高等优点,并能实现大焊接电流条件下的连续作业,焊接质量稳定。

(2)对焊道形貌有着重大影响的焊丝形位参数组合调整能力充分,取得了良好的效果。钢管内焊道形貌较好,焊道与母材过渡较平滑,较好地解决了以往内焊应用双丝焊工艺时焊道的“拖槽”及过渡差等问题。

(3)有效解决了中小直径的厚壁钢管内焊应用单丝焊工艺时的“咬边”问题。

(4)更换导电嘴或调整焊头形位参数时,需在管坯上割孔。调整时须注意四维调节要综合进行,以保证焊丝形位参数满足工艺需要。

(5)由于交直流夹块式导电嘴外形相互影响,更换导电嘴时拆卸不方便,需要一定的操作技巧。

参考文献:

[1]刘云,彭春明,刘成坤. 新型螺旋焊管内焊装置 [J]. 石油机械, 2006(9): 61 - 62.

[2]王文斌. 机械设计手册 [M]. 北京:机械工业出版社, 2004.

[3]董军,周林. 螺旋埋弧焊管内焊双丝焊工艺参数的优化 [J]. 焊管, 2005(4): 60 - 61.

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Application of Bar Code Technology by Steel Pipe Enterprise

LI Chun-lin

Abstract ID: 1001-3938(2007)04-0047-EA

Abstract: Current situation of pipe marking by China steel pipe enterprise briefly analyzed. The bar code technology has been developed in order to solve problem of pipe No. repeating and wrong pipe number in pipe manufacturing during production. Combining computer information control system of pipe manufacturer, the bar code technology is successfully applied into pipe production process and realizes automatic collection and input of pipe number and other information for whole production process, and increases working efficiency while reduces production cost.

Key words: steel pipe; bar code technology; tracing of pipe number

Manufacture of the Clayed Aluminium Alloy for Automotive Heat Exchanger

HU Rui-ling, LI Zhi-qiang, XIE Jian-ying

Abstract ID: 1001-3938(2007)04-0049-EA

Abstract: Clayed aluminium alloy, with Al-Mn as the core and covered Al-Si brazing filler metal layer outside and Al-Zn anticorrosion layer inside, is welded together using high frequency current, then is brazed by Nocolok brazing method. The radiator has excellent integration performance and wider application foreground.

Key words: automotive heat exchanger; clayed aluminium alloy; Nocolok brazing

Design and Application of Inside Welding Double Wires Welding Unit for Spiral Submerged Arc Welding Pipe

LIU Yun, PENG Chun-ming, LIU De-ying

Abstract ID: 1001-3938(2007)04-0051-EA

Abstract: In accordance with specialty of double wires welding process of inside welding for spiral submerged arc welded pipe, a set of internal welding double wires welding unit is developed. It compose of tracking unit of butter welding with filled wire, guiding mechanism of welding arm, feeding system, elevating mechanism, and conductive welding torch, etc.. It can be applied into inside welding double wires welding for steel pipe of larger wall thickness and outside-diameter in exceeding of 559 mm with solid structure, convenient adjusting, stabilization and reliability in operation.

Key words: spiral submerged arc welded pipe; double wires welding; internal welding unit

New Type Tactile Sensor of Weld Seam Tracking System

ZHU Jia-lei, JIAO Xiang-dong, JIANG Li-pei, XUE Long, ZHOU Chan-feng, YU Jian-rong

Abstract ID: 1001-3938(2007)04-0054-EA

Abstract: A tactile sensor of weld seam tracking system was introduced in this paper. The system collect the weld seam by the durative touch between the sensor and the seam, and transform the movement of the sensor into electricity signal. By using the PLC drive the electromotor of turning control and height control, achieving the adjust of the welding torch and the real time tracking. The practice prove that the system can fulfill the responsibility and can meet the need of engineering welding.

Key words: seam tracking; welding robot; tactile sensor

Pass Design of High-strength Welded Pipe

MA Hai-jun

Abstract ID: 1001-3938(2007)04-0056-EA

Abstract: High-strength welded pipe was designed out by Shanghai Shen Hua Steel Pipe Co., Ltd by breaking through traditional cold-bending forming change on OD 114 mm high frequency welded pipe units. The characteristic and its production process flow of high strength welded pipe are introduced. The pass design method of high strength welded pipe is also explained with examples. It has been proved by actual application that the metal consumption of high-strength welded pipe is lower than that of traditional rectangle tube under the same using condition. High-strength welded pipe has been widely used for many industries, such as mechanical manufacturing, automobile framework, storage shelf and light steel construction etc., with practical patent.

Key words: welded pipe; cold-bending forming; pass design; metal consumption

Application of "VistaWeld" Weld Automatic Tracking System in the Production of Spiral Submerged Arc Welded Pipe

ZONG Bo, LIU xin, YANG Wan-xia

Abstract ID: 1001-3938(2007)04-0058-EA

Abstract: Traditional weld automatic tracking system can not meet requirements of welding process due to low precision, poor sensitivity, longer response time and high skill operation requirements to operator. "VistaWeld" weld automatic tracking system made by British Meta Co. is based on laser stripes as working medium. After the image of laser stripes is collected by video camera and then it is inputted into computer for image processing, finally the executing unit will complete its related action after obtained the results. "VistaWeld" weld automatic tracking system makes welding quality of spiral submerge arc welding pipe greatly improved with advantages such as high system reliability and stability operation, simple structure, and convenient for installation and maintenance etc.

Key words: spiral submerged arc welded pipe; weld; automatic tracking; laser

Matching of Welding Process with Milling Shape of Strip Edges for Spiral Submerged Arc Welded Pipe

LIU Hong-fei

Abstract ID: 1001-3938(2007)04-0061-EA

Abstract: To adopt milling machines to prepare strip edges and groove to give good condition for forming and welding of spiral submerged arc-welded pipe. The article introduces to determine milling shape of strip edges, establish milling process of strip through calculating weld penetration as well as calculating section, width and reinforcement of weld bead by establishing strip milling process and making comparison with ideal section, width and reinforcement of weld bead to adjust welding parameters to achieve matching between milling shape and welding process and ensure welding quality of spiral submerged arc welded pipe.

Key words: spiral submerged welded pipe; milling process; groove type of strip edge; welding process; welding penetration; width of weld bead