

螺旋焊管递送机设计探讨

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摘要 简单介绍了递送机在螺旋焊管机组中的作用,对目前采用的几种结构形式特点进行对比分析,并对其功率选用进行了实例分析,最后推荐了 SMS 公司焊接箱体的一些尺寸规范。

主题词 螺旋焊管机组 轧辊 轧制功率 齿轮传动 工艺设计

1 递送机的作用

递送机(又称夹送机)是螺旋焊管机组的主要设备之一,主要作用是承担螺旋焊管机组成型钢管的递送力,其次是圆盘剪剪边所需动力、消除毛刺、边缘坡口的移动力、成品钢管在支撑托辊上的传动输送力,以及通过入口导板的输送力和活套拖出力,有的机组中开卷、矫直也用此力拖动。

递送机的输出功率较大,递送辊辊径较粗。如日本新日铁公司 $\varnothing 500\sim 1200$ 螺旋焊管机组电机功率为 55kW,辊径 $\varnothing 550\text{mm}$,宝鸡石油钢管厂套筒成型的螺旋焊管机组电机功率现用 100kW,辊径 $\varnothing 500\text{mm}$ 。递送机为满足焊接工艺及质量要求,转速为一定范围内的无级调速;其递送力由于较大,压下装置一般多采用液压方式。

而每增加一对辊子,齿轮箱需要增加一对齿轮和一个中介轮,外部增加一对万向联轴器,结构复杂,制造成本大大提高,而效果不变。故现在设计中,只选用一对辊子,加大结构强度,达到了同样的效果。

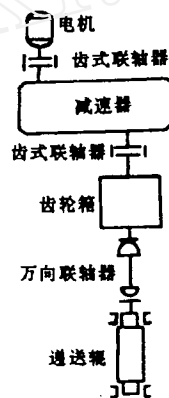


图1 分立式结构示意图

2 结构形式

递送机的结构形式一般有以下几种:

a. 分立式(图1示) 该结构形式具有单独的减速箱和齿轮箱,电机通过齿式联轴器、减速箱、齿式联轴器、齿轮箱、万向联轴器将动力传递到递送辊。其优点是各分立部件体积小,结构紧凑,便于系列化、标准化,也便于部件整体更换或维修,易实现大传动比,大扭矩传递。其缺点是占地面积较大,制造成本较高,功率传递中机械效率损失也较大。

在 70 年代以前的递送机设计中,曾借助齿轮箱实现两对甚至三对辊子的动力传递,

b. 联合式(图2示) 减速箱和齿轮箱做成一个整体部件,电机通过齿式联轴器、联合齿轮箱、万向联轴器将动力传给递送辊。

该结构便于实现齿轮、轴承集中润滑,结构更加紧凑,制造成本相对减少,占地面积也相应减小;其缺点是联合齿轮箱体积较大,维修时拆装、更换零件麻烦。目前,大中口径的螺旋埋弧焊管机组使用较多。

c. 直连式 这种结构国外采用较多。如原西德霍希公司制造的大中口径螺旋焊管机

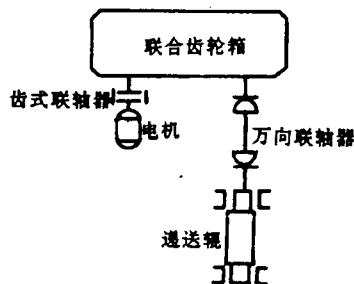


图2 联合式结构示意图

组,两个递送辊上下各自单独使用一个恒力液压马达(功率 22kW,力矩 $5.88 \times 10^4 \text{Nm}$,转速 7.95~35.75rpm),它们又各自通过一个行星摆线减速机(速比 25,力矩 $14.7 \times 10^4 \text{Nm}$ 转速 0.32~1.4rpm)来传递动力到递送辊。

这种结构形式十分简单、紧凑。传递扭矩也大,占地面积相对最小;但液压电气控制过程复杂,制造精度要求较高。

3 功率选用

递送机的递送力设计时按理论计算确定结果十分复杂。计算时要把螺旋焊管机组中的成型力 P_1 、圆盘剪的剪边动力 P_2 、消除毛刺的阻力 P_3 等一系列所需动力列式计算出来,才能确定总的递送力 P , $P = \sum_{i=1}^n P_i$ 。

这些力 P_i 用公式计算考虑因素较多,有些系数也难以确定。如前苏联 60 年代曾对半套式 $\phi 1020$ 螺旋焊管成型过程进行实验和理论分析,推导出该机组的递送力计算公式和计算结果,然后进行复杂的实测试验,结果两者差距很大;又如原西德的霍希公司对螺旋焊管机组递送力研究出专门的计算公式,然后对几个机组进行理论公式计算和实测数据比较,结果两者误差最大的达 62.7%,最小的 11.5%,平均 29.1%。这说明设计中用理论计算办法预先确定准确的递送力是十分困难的。我国在这方面研究甚少,新设计时多

是参照已使用的机组技术参数进行修定。

对已使用的螺旋焊管机组递送机的递送力由主传电机输出功率很容易确定。由基本公式功率 $N = VI$ 和 $N = Pv$,考虑系数和单位换算等,可推出递送力公式:

$$P = 60 \cdot \eta \frac{VI}{v} (\text{N})$$

式中: η ——总机械效率,等于各传动部件效率之和,即 $\eta = \eta_1 + \eta_2 + \eta_3 \dots$ 。

V ——电机工作电压,单位 V。

I ——电机工作电流,单位 A。

v ——辊子转动线速度,即带钢移动速度或焊接速度,单位 m/min。

根据以上公式,很容易计算出递送机的递送力 P 。以宝鸡石油钢管厂 $\phi 168 \sim 426$ 高频螺旋焊管机组为例,正常工作电压为 190~230V,电流 100~130A,故输出功率在 20~30kW 之间,其递送力大约为 $18.5 \sim 27.8 \times 10^4 \text{N}$ (η 取 0.85)。在实际使用中,由于各种意外情况,如递送辊带进板条等异物,会造成负荷突然增大。为防止设备损坏,设计时电机一般选用计算功率的 2~3 倍,其它部件也应与此匹配,并应考虑机械电气安全保护装置,如过流继电器等。

4 箱体尺寸规范

为了降低单件小批量生产成本,缩短生产周期,递送机的齿轮箱或联合齿轮箱多采用钢板焊接结构。宝鸡石油钢管厂引进的 16 英寸电阻焊钢管机组齿轮箱体全部采用焊接结构,目前国内新上的机组也均已采用。笔者在螺旋焊管机组递送机改造中,选用原西德 SMS 公司减速器焊接箱体尺寸规范进行齿轮箱设计,效果很好,现部分整理介绍如下:图 3 是焊接箱体示意图,根据表 1 即可确定壁厚和焊缝尺寸,也可确定上下箱体连接板尺寸和螺栓边距等尺寸。

另外,轴承座紧固螺栓尺寸规范,箱体机械加工技术要求等,都可以参考原西德 SMS

公司圆柱齿轮减速器设计资料技术标准,这里不再重述。

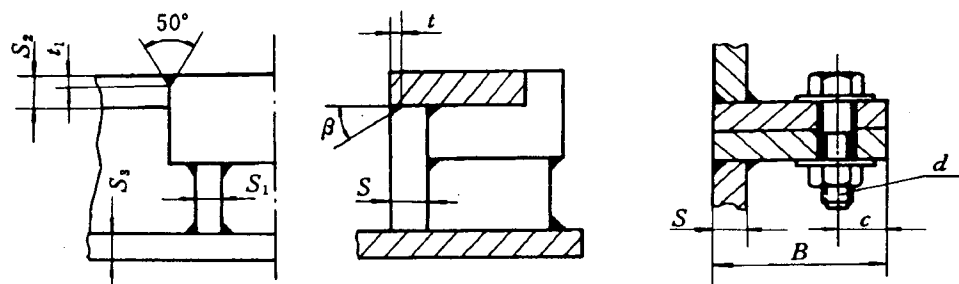


图 3 焊接箱体示意图

表 1 焊接箱体尺寸规范

输出扭矩 kNm 尺寸值 项目	<25	25~60	60~100	100~150	150~300	300~600	>600**
S	10	12	15	20	25	30	35
S ₁	10	12	15	20	20	25	30
S ₂	15	20	25	30	35	40	50
S ₂	15	20	20	25	30	40	45
β	45°						35°
t*	3	4	5	6	7	8	10
t ₁	10	12	15	20	20	25	30
d	M12	M12	M16	M16	M20	M20	M24
B	85	90	105	110	125	130	145
C	35	35	40	40	45	45	50

注: * t 值仅供设计参考

** 该扭矩范围有待进一步研究确定。

(收稿日期:1994—02—22)

制造超厚壁电阻焊管工艺技术的发展

日本 NKK 公司现今开发了一种新的制造超厚壁电阻焊管的技术,其目的是为了满足不同市场对超厚壁和更高质量电阻焊管日益增长的需求。新技术的先进性在于它总结了普通电阻焊接方式所遇到的某些难题,在于它把一些新的工艺技术应用到了成型、焊接、质量保证以及其它有关工序上,从而使得生产多种规格超厚壁的高质量电阻焊管成为可能。

《金属成型文摘》(英)1991. 11. Vol. 20, No. 11.

定径和矫直挤压管的方法

把钢管挤压成精确的内径和线性弯曲度的方法,是把钢管先挤压成为近似尺寸,然后用芯棒定径和矫直实现的。芯棒呈锥状,以便小端能够插入钢管。芯棒插入为的是使钢管不致于产生弹性变形。芯棒以 2. 2ft/min—1in/s 的缓慢速度插入到所需位置时,再增加插入速度,其速度可达 48ft/min。芯棒的拔出也像插入一样先缓慢地拔到所需位置时,这时增加速度快速拔出。

专利编号:US4926667(USA)

杨志锋译自《金属成型文摘》(英)1991. 11, Vol. 20, No. 11.

ABSTRACTS

WELDED PIPE AND TUBE

Vol. 17 No. 5 Sept. 1994

Yu Enlin, Lai Mingdao, Cai Songqing(1)

Elastic—plastic Finite Element Large Displacement Analysis of Thin Plates

Elastic—plastic large displacement bending of thin plates involves material and geometrically nonlinear analysis. In this, the finite element models are obtained by means of translations of coordinate systems and small displacement formulas of thin plates. Analysis of straight seam tube forming process are carried out. The results demonstrate that this method is effective to analyze elastic—plastic, large displacement bending of thin plates.

Subject terms: mechanics of materials mechanical model stress state

Huang Shuju, Deng Zengjie, Jin Shilin(5)

CO₂ Corrosion of X70 Transportation Pipes and J55 Casing Tubes

The corrosion behaviors of the parent metal and the weld of two types of X70 and J55 specimens in CO₂—containing salt solution have been studied. The result shows that CO₂ makes the rate of corrosion, the tendency of pit and crevice corrosion increase, while the increased margin is influenced by the metallurgical parameters, including chemical composition, microstructure and so on.

Subject terms: transportation pipe casing tube CO₂ corrosion

Ding Qingru(10)

The Experiment on Materials Selection of Argon—Arc Welding Wire for F—Grade Pipe of Alkanisation Refining Equipment

A study on mechanical behaviour, weldability, corrosion properties and microstructure of welding wire H08Mn2Si and H10MnSi at home is made. The substitution possibility of welding wire at home for wilding wire TGS—50 from Japan is discussed.

Subject terms: argon—shielded arc welding pipeline mechanical property corrosion resistance weldability

Lu Guofeng(14)

The Development of High Lampcolumn made of Longitudinally Welded Taper Pipe

Taper pipe lampcolumn with 6—20m height are developed in Hongli lamp and lampstand factory. The lighting area of the high—column lamp is 10m², and straightness deviation of lampcolumn is not larger than 1/1000 of lampcolumn height. The manufacture process of the lampcolumn are: cutting of plate; forming of taper pipe; submerged arc welding; straightening; polishing; galvanizing and inspecting etc..

Subject terms: special shape welded steel tube exciter lamp luminaire marking machinery

Chen Shaojie, Cheng Yongxiao, Wang Jizhong(16)

The Improvement of Extruding Installation and Friction Analysis in Spiral Welded Pipe

In the production of H. F. butt spiral welded pipe, the vertical roll extruding installation with fixed position are changed into horizontal roll installation with fixed pressure. The friction parameters of both installation are analysed. The results of calculation and experiment show that friction force of vertical installation is 1.3 times as large as that of horizontal one. A stable butt weld could be obtained in horizontal roll installation

as both edge of steel belt colse easily.

Subject terms: spiral weld—pipe mill high frequency welding extrusion—forming roll forming pressure

Fu Zhengrong, Lu Zhijian, Yu Xuewen etc. (19)

Design of $\varnothing 219$ Longitudinally Welded Pipe Mill

$\varnothing 219$ longitudinally welding pipe mill has been designed on the basis of analysis to properties and parameters of same kind of the mill abroad and at home. The principal contents of the paper are as follows: basic parameters of the mill; technological process; the determination of shaping zone length; design of transmission system of shaper; the diameter determination of vertical and horizontal rolls; the pass selection of directive roll, exrtuctive roll and shaping roll; the structure characteristics of inner—wall burr toll, looper, coil—opener and straghtener, shearing—welder and fly—saw. Finally, some design shortages are also pointed out.

Subject terms: pipe welding machine HF welding technological desing technological parameter

Wang Yuhua (25)

The Improvement of Argon—Arc Welding Gun with 3 cathodes

The operation principle and structure characteristics of a key equipment—argon—arc welding gun with 3 cathodes in stainless steel welded pipe mill imported from abroad are analysed. Fortial structures of argon arc welding gun have been improved. For example, the diameter of circulatig water path is changed into 1.0mm from 0.4mm in spray nozzle made of heat—resisting stainless steel. As a result, service life of welding gun increases by 4 times because of unblocking of circulating water.

Subject terms: electric arc welder argon—shielded arc welding welding gun good command of introduced technology

Yang Xianxun (28)

The Application of Shear—Butt Welder

Shear—butt welder for welded pipe below $\varnothing 114\text{mm}$ imported from abroad since 1980's are analysed. The property characteristics of a kind of shrar—butt welder which is composed of two shear—blade and a carbon—dioxide arc welder are introduced. The principal advantages of the welder are compact structure, handy operation, high automation and excellent welding quality. In this paper, srtucture sketch map, hydraulic system map and principal property parameters of the welder are given.

Subject terms: pipe welding machine shear butt welding machanical equipment technological property

Feng Shigong (31)

The Calculation of Forming Force, Rolling Torque and Motor Power of ERW Pipe

The new experience formulae have been deduced on the basis of analysis to previous experience formulae of forming force and rolling torque in longitunally welded pipe. The formulae could be used to get following data: forming force; rolling torque; transmission power; rolling force of horizontal roll; driving force of vertical roll; forming force of directive hoop roll. The application examples in $\varnothing 168 \times 6, 8, 10, 13$ welded pipe production, in this paper, are also given.

Subject terms: pipe welding machine forming roll factors related to rolling process roll force rolling torque desing

Ren Hongcheng (41)

Design of the Conveyer of Spiral Welded Pipe

The function of the conveyer in spiral welded pipe mill is introduced in brief. The structure features of both types of conveyers, i. e. separatted and combined, are analysed, and examples of power selection of con-

vayer are set out. Finally, the dimensions standards of welded box—body of SMS Co. are recommend.

Subject terms: sprial weld—pipe mill roll rolling power gear drive technological design

Wang Liansheng (44)

A Design of Small—Sized Longitudinally Shearer Set

The principal mechanism and parameters of a small—sized longitudinal shearer set are introduced. The set has a shear—width bellow 300mm, shear—thickness bilow 3.7mm and shear—speed 30m/s. In this paper, shear force, the torque and power of disc cutting tool, the transmission ratio of shearer and coiler have been calculated.

Subject terms: steel strip disc shears coiler machanical equipment technological design

Tong Lianxun, Zhao Shanyuan, Bi Jingdong (48)

A Brief Introduction to Normalizing Equipment of Longitudinally Welded Pipe

The structure and property of normalizing heat treatment equipment are introduced. Integrated circuit power source and controller are used in this equipment. Heat—platform with condenser and power transformer is fixed on wheelbarrow, and inductor is orientated relating to pipe. The effective part of the inductor is a rectangle copper pipe with silicon plates. The standard voltage of inductor is 100V and current is 7000A.

Subject terms: straight welded steel pipe weld joint induction heat treatment heat treatment equipment

Wei Changchun (53)

Analyzing and Quality System Certification of the API Spec Q1 5th Edition and ISO9001 Standard

This paper analysed and evaluated, comparing with ISO9001, characteristics of the API Spec. Q1 5th edition Specification for Quality Programs; described 20 elements and its relations of the API Q1 5th edition and ISO9001; deliberated the quality system certification in accordance with these two standards.

Subject terms: quality control quality certification standard

Li Yunjiang etc. (59)

Characteristics of Present Tube and Pipe Technology

— from '93 Tube and Pipe Hong Kong International Exhibition and Congress

This article gives a comprehensive introduction to the '93 Tube and Pipe Hong Kong International Exhibition and Congress, and further summarizes the characteristics of the international tube and pipe technology at present.

Subject terms: welded tube and pipe quantitative forecasting technico—economical assessment

征稿启事

为充实和丰富《焊管》期刊的报道内容,同时也为明年召开的第五届焊管学术年会和第九届焊管(涂镀管)生产技术交流会做好准备,欢迎国内外同行工程技术人员、现场生产人员积极总结单位和个人的实践经验、理论研究成果,努力撰写稿件,论文、消息、产供销信息等,均可投稿。来稿请寄:

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