高精度自动送料系统设计

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摘要：本设计从实际出发，通过使用压针和导向张紧轮，将矫平机、送料机构等独立体形成了一个有机的整体，纠正了带料跑偏现象，有效地保证了送料精度，减小了系统设备占用空间，提出了几个计算公式。

关键词：系统；冲压机；送料

中图分类号：TH-39　　文献标识码：A　　文章编号：1009-9492 (2004) 11-0062-02

1 引言

根据 165 厂生产需要，对一种航天用继电器的可膨胀合金材料进行多工步冲压，板宽 b 为 28~110mm，板厚 h 为 0.3~0.8mm，每次送料长 20~60mm,四工步，其要求矫平精度和送料精度都比较高，但设备附近空间较小，有关文献[1][2][3]就此类似问题也进行了一些研究，目前市场上各类冲压辅助机构也比较多，如：材料架、矫正机、空气自动送料机等，但均是分开的，其占地空间大，结构松散。为了解决上述问题，本设计提出了一种新的解决方案，并付诸实施。

2 系统设计

如图 1 所示，本系统设计包括收料器 1，送料机构 3，导向张紧轮 4，盛料架 5，矫平机构 6 等部件构成。收料器 1 的一对咬入轮以一定速度转动将被冲压带料咬入，带料经导向轮进入矫平机构 6 矫平，矫平后的带料经导向张紧轮 4 和送料机构 3，再通过冲压设备被冲剪，回收料器回收。

3 矫平机设计

辊式矫平机设计的关键参数是辊径 D、辊距 t。矫平机关键参数的正确选择对带料的矫正质量、设备的结构尺寸和功率消耗等都有重要的影响。

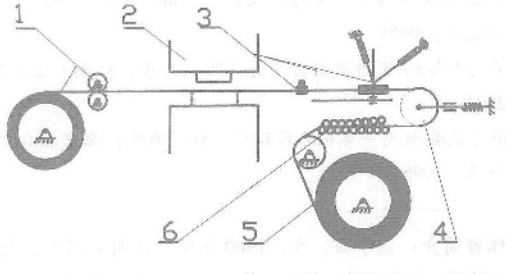

图 1 自动送料系统示意图

1.收料器　2.冲压设备　3.送料机构

4.张紧轮　5.盛料架　6.矫平机构

（1）辊距 t 的确定

考虑满足最小厚度轧件的矫正质量要求，又考虑满足矫正最大断面轧件的矫正辊的强度要求，为此应分别计算最大允许辊距 t_{max} 和最小允许辊距 t_{min}，最后确定的辊距 t 应是 $t_{min}<t<t_{max}$（尽量取小值），而且应圆整至矫平机参数系列中的相应数值[6]。

在板厚 h 为 0.3~0.8mm 时，最大[7]允许辊距 t_{max} 和最小允许辊距 t_{min} 为：

$$t_{max}=0.35\frac{h_{min}E}{\sigma_s}=0.35\times\frac{0.3\times200\times10^9}{235\times10^6}=89.36(mm)$$

$$t_{min}=0.43h_{max}\sqrt{\frac{E}{\sigma_s}}=0.43\times0.8\times\sqrt{\frac{200\times10^9}{235\times10^6}}=10.8(mm)$$

所选辊距 t 应满足 $t_{min}<t<t_{max}$，在满足要求的情况下，辊距尽可能选小值，取 t=42mm。

（2）辊径 D 的确定

由 $\beta=\frac{D}{t}=0.95$[8]，可求得 D=39.9mm，取 D=40mm。

4 送料机构的设计

（1）送料机构

送料机构每步送料精度要求很高，且表面无划痕；从冲压一个零件到完成一次送料，工作循环周期很短。在此，我们选用了气动送料机构。如图 2(a)所示，

由于要求每次送料一致性较高，按级进模要求，保证冲剪刀口不出现崩刃，并且无论送料长短，每次送料一致性精度高达 5μm；虽然市场上已有气动压板送料机构，也有相关文献论述[4][5]，然而当送料速度较大时，常常仍出现微量打滑现象，故在上压板上使用压针，如图 2 (b) 所示。

在送料系统工作时，经过导向张紧轮的带料始终处张紧状态，即有 F_2 拉力。收料器的一对咬入辊在系统工作过程中，始终处于咬入状态，当气缸 C 压下时，收料器的咬

收稿日期：2004－08－12

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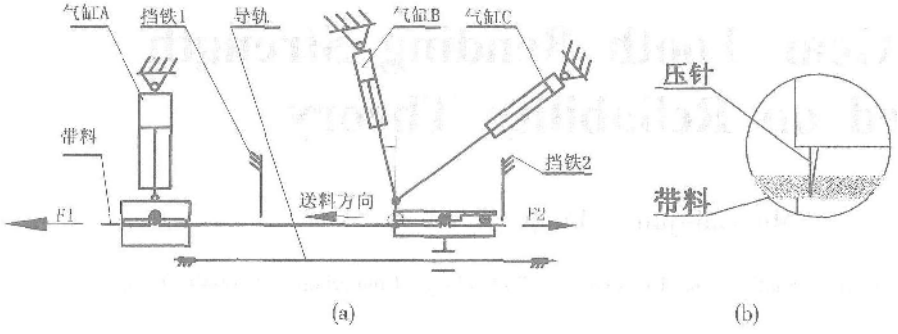

图 2 气动送料机构示意图

入辊与被冲压后的材料之间打滑，但仍有张紧力 F_1。

送料时，气缸 B 伸杆，使压针压入带料中，同时使送料压板与挡铁 2 接触；气缸 C 伸出，带动带料同步沿送料方向运动，同时使压针进一步压入带料。当送料压板碰到挡铁 1 时，气缸 A 压下，送料过程完毕；气缸 B、气缸 C 复位送料压板退回，至挡铁 1 处，回位过程完毕。当冲剪完成后，气缸 A 复位，允许送料；气缸 B 伸杆，重复上述过程。

(2) 送料缸动力分析

如图 3 所示,在气缸 B 伸出与挡铁 2 接触后,气缸 B 与中线夹角为 α ,气缸 C 与中线夹角的余角为 β, 且使 $CD>>X$，则 β 可认为是常数。各种摩擦力阻力忽略不计。

在气缸 C 的伸出过程中,气缸 B 中的气体压缩, 压缩量为

$$\zeta=100\%*\Delta/L_B \qquad (1)$$

其中, $\Delta=BD\ (1-\sin\alpha)$, L_B 为气缸 B 的伸出量，忽略气管的影响。

在垂直方向的压入力为

$$F_{垂}=F_C\sin\beta+F_B\ (\zeta+1)\ \cos\alpha \qquad (2)$$

其中, F_B 为气缸 B 的最大输出压力, F_C 为气缸 C 的最大输出压力。

水平方向推力

$$F_{水}=F_C\cos\beta-F_B\ (1+\zeta)\ \sin\alpha \qquad (3)$$

将 $\Delta=BD\ (1-\sin\alpha)$ 带入 (3) 整理得：

$$F_{水}=F_B\frac{BD}{L_B}\sin^2\alpha-F_B\ (1+\frac{BD}{L_B})\ \sin\alpha+F_C\cos\beta \qquad (4)$$

为了保证水平推力 $F_{水}>0$,在设计时必须保证

$$4F_B\frac{BD}{L_B}(F_C\cos\beta+F_2)\ -F_B^2\ (1+\frac{BD}{L_B})\ >0 \qquad (5)$$

若气路压力 0.7MPa, β 取 30°, ζ=30%,气缸 B 选用 MDBB80,气缸 C 也选用 MDBB80 时，气缸 B 过中线时,压针压入金属带料的力可达 520kgf,足以压入金属带料中，有效防止了打滑现象的出现。

5 张紧轮的设计

导向张紧轮设计的目的主要是解决两个问题。一方面解决送料机构和矫平机构的速度匹配；因为送料机构的送料过程是间歇的，矫平机构的矫平过程是连续的，保证两者的速度匹配，可防止因速度不匹配而产生被冲剪材料的折损。另一方面由于导向张紧轮的存在，带料始终处于张紧状态，可保证带料不横向跑偏。

张紧轮的直径 Φ 和弹簧系数 K 的确定如下：

根据设计要求经矫平后的钢带通过导向张紧轮时，只能发生弹性变形，不能发生塑性变形；由 $t_{max}=0.35\frac{h_{min}E}{\sigma_s}$ 式可知

$$\Phi\geqslant 0.35\times\frac{0.8\times200\times10^9}{235\times10^6}=238.3\ (mm)$$

故导向张紧轮的直径通常取值为 240mm。

弹簧系数 K 大小的取值可根据式 (5) 可得

$$K<\frac{1}{6}\ (4F_C\cos\beta-F_B\ (\frac{L_B+BD}{4BD}) \qquad (6)$$

6 结论

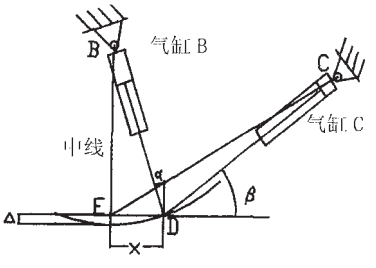

图 3 送料机构动力分析原理图

实践证明，带料从盛料架出来后，经过一个导向张紧轮进入气动送料机构，使整体设备占用空间减小；有效地将矫平机、送料机构等部件组成一个有机整体。在送料板上使用压针，使之在送料过程中压入金属带料，有效地防止了打滑现象的出现，保证了送料的准确性。

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(编辑：梁　玉)

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WEB data mining with Virtual database information retrieval fields is discussed to improve efficiency and quality of WEB information retrieval.
Keywords: Virtual database; WEB data mining; Intelligent search

004-11-54 Analysis of Pile Driver Extractor Dynamic Characteristics Based on Virtual Prototype
Zhang Xiaowei, Yao Hongliang, Li Xiaopeng, Wen Bangchun(Northeastern University, Shenyang, 110004, China)
Abstract: Aided with dynamic simulation software-ADAMS, vibrating pile driver and extractor model is built and the system dynamic characteristics are studied. The results indicate that when the vibrating machine is designed by virtual prototype technology approach, the work status of the system can be observed simply and the parameter of the system can be chose easily. Virtual prototype technology approach provides a short cut for us in product design and by using it the periods of the product is shortened, the cost of the product is reduced and the whole synthesis quality of the machine and market competition of the product is improved.
Keywords: Virtual prototype; Vibrating pile driver extractor; Dynamic characteristic

004-11-56 Modularize Design of the Competition robot
Li Lin, Zhang Tie, Xie Cunxi (South China University of technology, Guangzhou, 510640, China)
Abstract: Robot design is a creative work relating to many subjects, and that the competition robot is the special type robot, it is requested to accomplish the set act or function at short time, so the robot design is differ to the generic.In this paper we first analyze the robot design to modularization. Then it makes the design according to the module function and there interrelation.
Keywords: Modularize design; Competition; Robot

004-11-58 The DSP Control and Simulation of Alternating Server Motor
Ao Yinghui (Guangdong Industry University, Guangzhou, 510090, China)
Abstract: This paper analyzed the model of permanent magnetic synchronized motor (PMSM), conducted the whole control simulation for the PMSM. Further, we present the scheme of PMSM speed tuning system based on TMS320LF2407 produced by Texas instruments. The design and results of the experiment are also showed.
Keywords: PMSM; DSP;Simulating Model

004-11-60 Design of Automatic Coiling System for Metal Wire
Liu Xiaomei, Liu Zuoshi, Xie Xuhong, Xu Guanghong(Jiangxi University of Science & Technology, Ganzhou, 341000, China)
Abstract: The design, manufacture and application of the automatic coiling system for metal wire are presented in this paper. The system is mainly applied to coil formed metal wire. The function of arraying and coiling in the system is realized by step-motor, mechanical system, PLC, VVVF keeping constant rate for coiling wire and good order and compact for arraying wire, to achieve the goal of automatic production.
Keywords: Coiling system; Arraying wire; Constant rate; PLC; Frequency control

004-11-62 The Design of the System on Auto Loading Material at High Precision
Liu Xiaogang[1], Liu Zhiyong[1], Wang Bin[2] (1.Guilin College of Aerospace Technology, Guilin, 541001, China; 2.165 Factory, Guilin, 541001, China)
Abstract: With the help of pressing-pricker and ensuring wheel, the design makes the separate part such as rectification machine, loading machine and so on into a whole unit. So it can avoid strap material departure, assures the precision of the loading material and reduces the volume of the machine system.
Keywords: System; Punching machine; Loading Material

004-11-64 基于可靠性理论的齿轮强度设计
莫海军，李杞仪 (华南理工大学机械工程学院，广东广州，510641)
摘要：在齿轮传统的设计方法中，安全系数法常常导致齿轮的设计尺寸偏大，齿轮重量偏重。而基于可靠性理论的齿轮弯曲强度的设计方法，可使齿轮满足一定可靠度的前提下，使得齿轮设计更科学、更符合实际。论文给出齿轮齿根弯曲强度的可靠性设计公式，并给出相应的设计实例。
关键词：齿轮；弯曲强度；可靠性理论

004-11-66 Design and Application of Shape Memory Alloy in Intelligent Structures
Wang Lihong,Wang Jinfeng (Zhengzhou Institute of Aeronautical Industry Management, Zhengzhou, 450015,China)
Abstract: In the paper, design and application of shape memory alloy in smart material and intelligent structures are summarized. Firstly, properties of SMA material and apply principle in intelligent structures are analyzed. Then, adult application fields using SMA elements as sensor and actuator in intelligent structures are introduced. Finally, the key technology, existent question and futurity development of intelligent structures with shape memory alloy are discussed.
Keywords: Shape memory alloy; Smart material; Intelligent structures

004-11-69 Wafer Manufacturing Technology
Xie Zhenhua, Huang Ruiwei (Guangdong Industry University, Guangzhou, 510090, China)
Abstract: Wafer manufacture has become the key factor in the economic development of a country. The wafer manufacture industry in our country has shown the complexion that design, manufacture and encapsulation are developing all together. IC technology has come into the domain of the international artery of technology. The international communion and cooperation has shortened the gap between us and the outer land. But we should realize that there are lot of gaps between us and the advanced countries. In this paper, it introduced the primary techniques from crystal manufacturing to the wafers encapsulation.
Keywords: IC; Wafer; Crystal; Encapsulation; Techniques

004-11-73 The Research on Filling Method of Patternless Casting Manufacturing Technique
Yang Weidong[1,2], Yan Yongnian[3], Chen Jianrong[4], Yang Ruyu[1], Tan Yuzheng[1](1. Foshan Pump Factory Co. Ltd. Foshan 528000 2. Hebei University of Technology, Tianjin 300130 3. Qsinghua University, Beijing 100084 4.Foshan Quality Check Bureau 528000)
Abstract: In this paper the filling method of patternless casting manufacturing technique is innovated under the guidance of forming theory, in order to decrease the binder content of casting mold. The concept of selective filling method is presented.
Keywords: Patternless casting manufacturing; Filling method; Framed casting mold

004-11-75 The Technique Analysis of Welding Dissimilar Small-diameter Thin-wall Steel Pipes
Yang yunlan (Maoming Vocation Technology Institute, Maoming, 525000, China)
Abstract: The welding of small-diameter thin-wall steel pipe is one of the hard nuts in installing engineering. This paper introduces the welding technique including the method, the material, the equipments, the decision of parameter and so on. It also studies out and analyses the welding process.
Keywords: Small-diameter thin-wall steel pipe; Welding technique; Technique analysis

004-11-77 Integrated BIW Production Line Planning Environment
Zheng Yongqian (Tongji University, Shanghai 200092, China)
Abstract: This paper presents the implementation of an integrated planning envelopment (IPE) for designing car's body in white (BIW) welding and assembly production line in SVW. The relating modeling methods for manufacturing resources and process information are introduced (which is especially complicated in a joint venture for car production in China). Details in the development of the toolkit involved are discussed.
Keywords: BIW; Integrated planning; IPE; Information modeling; Process modeling

004-11-80 Clean Manufacturing Technologies in the Surface Treatment Processes of Aluminium Alloy
Yan Xiu (Dongguan Gaobao Aluminium Manufactory Co. Ltd., Dongguan, 523268,China)
Abstract: The European Union has issued regulations that from July 1, 2006,all imported mechanical and electric products into Europe must be up to the RoHS. Many European and USA customers have decided to do away with all the parts that do not accord with RoHS before July, 2005. At present, during the surface treatment of aluminum alloy, Cr+6 and other hazardous substances always exist. This article provides some practical clean manufacturing methods used in the surface treatment of aluminum alloy, which could be countermeasures against the RoHS, and give two samples named "passivation without chromium" and "harmless treatment of chromium dregs" for further explanation.
Keywords: Aluminum alloy; Surface treatment; Clean manufacturing; Passivation without chromium

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