Intelligent Manufacturing Research Based on Sheet Metal Modularization of Elevator

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Abstract. It is an inevitable trend to using general elevator processing equipment, elevator sheet metal modular design and intelligent manufacturing to in order to improve the intelligent manufacturing level of elevator sheet metal production line, improve the work efficiency and reduce the operation workers intensity. The adoption of a general elevator processing equipment plus robot technology production line has a reasonable structure, improves the processing quality, high efficiency, and saves labor, and can meet the automation requirements of elevator sheet metal production.

1 DEMAND FOR AUTOMATIC PRODUCTION LINE OF ELEVATOR SHEET METAL PROCESSING

The elevator is an important means of transportation for vertical transport. The safe, comfortable, efficient and energy-saving operation of the elevator is a strict requirement for the elevator itself. China's elevator production, elevator ownership, and annual growth are the best and world number one in the world. The elevator manufacturing performance is further enhanced in the industrial concentration, the development trend is good, and the industrial structure has undergone significant changes. It shows the situation that the stronger performers getting stronger and the local companies progressing faster and faster. However, small business＇s growth slows down and even declines. At the same time, industrial concentration has further increased.

With the continuous economic development, people's demand for elevator products is also rapidly developing. An obvious change is that now elevator-manufacturing companies have become increasingly diverse range of products, such as passenger elevator, medical elevator, freight elevator, escalator and moving walkways elevator. According to the technical points, it is divided into rooms, no rooms, small rooms etc. Multiple varieties, large batches, individualized customizations and errors in the construction of elevator shafts, mass customization have become the mainstream production mode for the development of modern elevator manufacturing. With the increasing demand for personalized products, the market is increasingly competitive. Fiercely, it is decided that elevator companies need to solve the production transformation according to the order. Enterprises urgently need practical product configuration design and manufacturing methods.

At present, elevator industrial strong countries such as Europe, USA, Japan and other countries have generally adopted the automatic production line for elevator sheet metal processing that integrates high-end machine tool equipment and logistics automation as the manufacturing mode for elevator cars and car doors; for example, the flexibility of Italy's Salvagnini Company. Sheet metal processing system is a model of flexible sheet metal processing system technology and is widely used in various industries. However, the production of most elevator cars and car doors in China is still dominated by labor-intensive manual production. The transfer of work pieces and the control of production cycles between processes are mainly realized manually. The gap between key equipment and production lines and the international advanced level is relatively large. The import dependence is strong. With the change of the age structure of the population in our country, there is a shortage of skilled workers. In short, the demographic dividend disappears and the cost advantage of China's manufacturing industry is losing. It can be foreseen that the intelligent manufacturing based on modular elevator sheet metal processing will be the first choice for the transformation and

upgrading of China's elevator parts processing enterprises, and it will also be the main research topic of elevator sheet metal processing machine manufacturing enterprises in China.

2 CONSTRUCTION OF SELF-DEVELOPED INTELLIGENT ELEVATOR SHEET METAL PROCESSING PRODUCTION LINE

The production of elevator products has its own particularity, and it is necessary to have a predictive judgment on the market, because the elevator size, power, lifting height and so on required for each different building are different, and need to be based on customized order data parameters. Can quickly form the products needed by users through modularization. The basic method used in the production of elevators is to transform the manufacturing problems of customized products into or into partial batch production problems through product reorganization and process reorganization, that is, new and customized personalized products are provided to users, and actual products are mainly composed of different modules. Then elevator development needs to develop a common platform first, and then carry out a rapid customer-oriented deformation design on this platform. When the elevator load capacity, the structure of the hoistway, the effective area of the elevator room and the use situation and other requirements are different, the mechanical structure of the elevator. The structure and size of the medium-sized room vary greatly. Therefore, the key to the structural design of the elevator is the design of the room.

When the requirements for lift load, well structure, room effective area and use occasion are different, the elevator structure and size must be adjusted accordingly. Therefore, parametric design technology is applied in the elevator room structure system. By modifying the design parameters, the 3D CAD model can be modified, which can greatly improve the repeat design efficiency and can quickly establish the overall product appearance CAD model.

Setting specific module-related parameters at specific locations forms a digital product. The computer can quickly determine the product's specification and model number by identifying a specific number at a specific location then map the code to a specific encoder and decompose it into production-ready parts. The design is divided into various components, and these factors are divided according to the governing relationship to the corresponding manufacturing production lines, collaboration companies, outsourcing and other departments.

2.1 Elevator sheet metal processing intelligent manufacturing line

It is a system integration innovation project involving a wide range, through the upstream parameterized design, through the optimization of the computer to the manufacturing of the modular production process, involving the upper and lower material feeding system, punching, bending, welding and other online equipment and processes Tooling, as well as integrated innovations such as CNC systems, functional components, and automatic controls. Therefore, we must use the thoughts and methods of system engineering to start from the optimization and innovation of the overall solution for elevator sheet metal processing, explore new intelligent manufacturing process flow and methods, and study and summarize the overall solution for the formation of intelligent manufacturing processing units or automated production lines.

According to the requirements of the overall solution, we will focus on solving the current problems in China's general processing equipment design optimization, dynamic monitoring, the establishment of a knowledge expert database, adaptive intelligent control compensation, networked intelligent monitoring, and reliability enhancement; Research and application of processing technology, design and development of green efficient, supporting robots, comprehensively enhance the technical performance and level of enterprise equipment, and meet the development and application requirements of elevator sheet metal processing related fields in China.

2.2 Current Elevator Sheet Metal Processing Flow

The technological development status of intelligent manufacturing processes and equipment for elevator sheet metal processing, and the overall solutions for typical elevator sheet metal processing automatic production lines have the following technical features and development trends.

At present, the workers do most of the elevator sheet metal processing in China independently. Each machine tool such as blanking machine tool, stamping machine tool, bending machine tool and welding equipment consists of 2-3 artificial feeding, blanking, and indexing operations. The completion of the transfer of the upper and lower processes of the vehicle not only has low production efficiency, but also lags behind in production management. At the same time, the labor intensity in the production process has affected the increase in production.

2.3 The overall technical route and characteristics of elevator sheet metal flexible production line

Due to the volume and size of the elevator sheet metal, the developed elevator sheet metal intelligent manufacturing line (shown in Figure 1) consists of general equipment, open CNC robots, manipulators, and follow-up units and automatic feeding units for auxiliary automatic processes. Under the control of the control system, the robot grabs the plate to be processed from the platform truck and sends it to the conveyor belt.
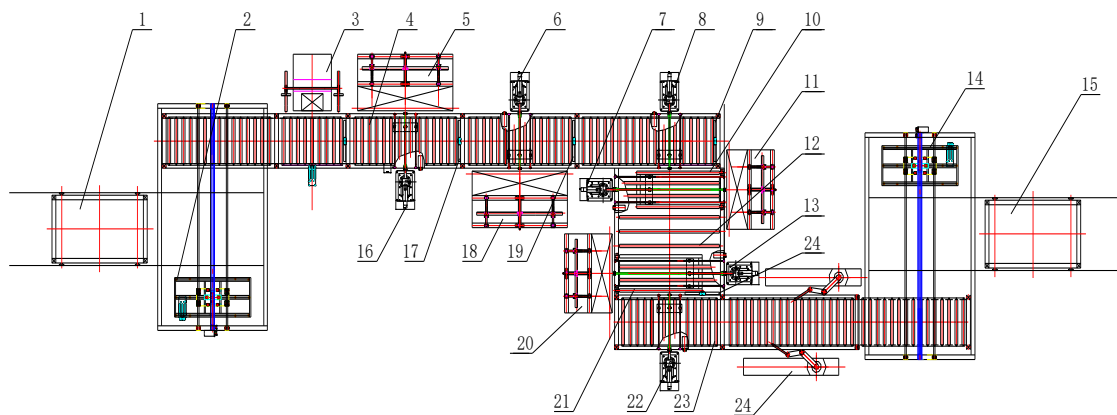

Figure 1 Schematic diagram of elevator sheet metal intelligent manufacturing line

(1) Pick up the robot with sucker 2 to the platform truck 1, lift it, move it to the set position above the conveyor belt 4, and lower it. The conveyor belt 4 transports the work piece to the adjustable stop plate of the punch press 3, and an open CNC robot with a clamp completes work piece positioning, feed, take-out, and plane movement of the work piece. The punching machine completes the punching work, and the robot returns the work piece. On the conveyor belt, the adjustable baffle falls and starts the conveyor belt operation.

(2) After the conveyor belt 4 sends the work piece to the SPS numerical control bending machine 5, the baffle plate 17 works, the robot hand 16 sends the metal plate to the specified position with the push plate, the SPS numerical control bending machine 5 works, and the follow-up unit works to ensure the work piece bending Reliable, complete one-sided bending work. After the baffle plate 17 falls, the conveyor belt 4 sends the work piece to the SPS numerical control bending machine 18, and the baffle 19 works. The robot 6 sends the metal plate to the predetermined position with the push plate, the SPS numerical control bending machine 18 works, and the follow-up unit works to ensure the work piece. The bending is performed reliably and the second bending work is completed. The baffle 19 falls, the conveyor belt 4 sends the work piece to the end, the robot 8 and the baffle 12 work, the robot 7 pushes the metal plate to the specified position with the push plate, the SPS CNC bending machine 11 works, and the follow-up unit works to ensure that the work piece is bent Reliable and complete the third side bending work. The baffle 12 falls. After

the conveyor belt 10 sends the work piece to the SPS numerical control bending machine 20, the baffle 21 works, the robot 13 sends the metal plate to the predetermined position with the push plate, the SPS numerical control bending machine 20 works, and the follow-up unit works to ensure the reliable bending of the work piece. Complete the fourth side bending work. The baffle 21 falls and the robot 22 pulls the work piece onto the conveyor belt 24,

(3) After the conveyor 24 has sent the work piece to the welding position, it is positioned and the welding robot 24 is operated. After the completion, the shutter is dropped and the start conveyor 24 is operated to send the work piece to the end.

(4) The conveyor 24 sends the work piece to the retrieving station, and then the work piece is sent to the platform truck 15 by the sucker-disc open type numerically-controlled robot 14 to complete all the work.
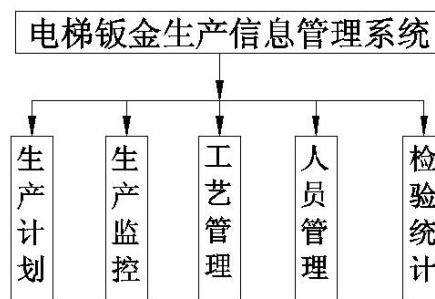
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Figure 2 Functional block diagram of elevator sheet metal production information management system

2.4   Management Structure

The intelligent sheet metal production information management system in the elevator sheet metal production line system (function structure shown in Figure 2) completes elevator sheet metal order management, elevator sheet metal production statistics, elevator sheet metal production monitoring, elevator sheet metal processing Management and elevator sheet metal operator management work.

2.5   Design of the equipment layer

The equipment layer includes purchased robots, mechanical arm, and elevator sheet metal processing equipment. The three sets of equipment complete the automatic production line of elevator sheet metal under the control of the decision-making control system, the robot control system and the robot control system, feeding, feeding, stamping, bending and welding.

The horizontal transfer device is a railcar with its own positioning and lifting device and is positioned by the sensor. The material trolley is equipped with three sensors, two for near deceleration and one for stop. The horizontal transfer trolley is driven by two AC servo motors. One drive rolls along the inside of the I-beam and the other drives the up and down movement of the material rack. The trolley has its own battery and can be charged freely while waiting. During the movement, there is no need to consider the problem of entanglement of the accompanying cable. The track of the trolley can be freely selected along any track of the material warehouse, and the material can be taken and fed conveniently. In combination with the PC intelligent control technology, the path can be optimized and the trolley can be moved laterally. The highest efficiency. In the design of the up and down elevator platform, the motor is used to drive the screw rod, and the ball screw driver ball pair moves on a screw rod with two opposite thread directions. When the screw rod rotates, the two ball bearings are close to or far away at the same time and pass through the four-bar mechanism. The pallet lifting the trolley car overall lifts the pallet. Since the screw can drive the ball, and the drive in turn can achieve self-locking, its principle is equivalent to the jack. Therefore, the device is safe and reliable when it is raised and lowered, and it will not be

subject to free fall. The railcar adopts four-point support and asynchronous two-point drive, which can guarantee the effective driving force of the rail-to-rail transfer to prevent slipping, and also can guarantee the stability of the railcar and prevent the side-turn or lateral tilting moment. The layout of the entire rail car is shown in Figure 3.
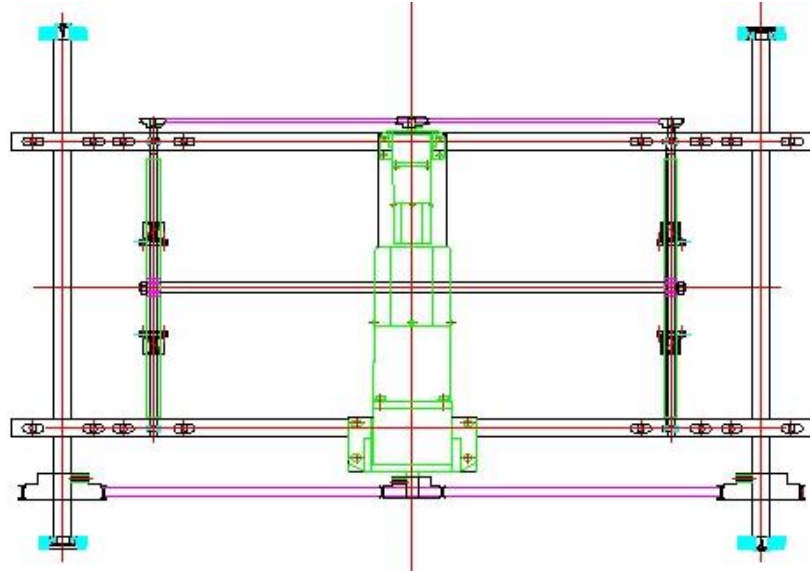

Figure 3 Horizontal transfer trolley car

2.6   Intelligent manufacturing technology elevator sheet metal production line workflow

Intelligent manufacturing technology elevator sheet metal production line workflow, the use of photoelectric sensors, photoelectric switches, in and out of material detection, CCD online detection technology to achieve the entire system of closed control, automatic detection technology can greatly improve the reliability of the equipment and reduce the incidence of accidents probability. After starting the decision system, the robots and robots are started separately to complete the preparation of the robots and robots. By starting the operation of the production line through a touch screen or an open numerical control system, the decision control system waits for the robot, the manipulator to return to zero, and the shaping unit to return to zero. According to the working status, the decision unit notifies the robot to pick up the work piece, send it to the conveyor production line, the production line pneumatically, and the work piece enters the detection part; at the same time, the decision-making control system detects the position of the work piece through the infrared sensor and controls the robot to clamp the work piece. The robot completes the workflow. In the specified position, the robot returns to the waiting position, waits for decision-making control system instructions, punches, bends, and welds the equipment. The robot processes the finished work piece and the mechanical arm places the work piece.

Elevator sheet metal intelligent manufacturing automated production line control is the core of the entire system, complete the control of robots, mechanical arm and equipment. The open CNC system can realize information interaction with touch screens and PCs and improve the openness of the system. The open CNC system control system uses a PC+ control card structure. The open CNC system control system interacts with the decision control system information through the serial port, and controls the mechanical arm actuators of each axis through the control card to realize the robot motion control. The robot control system uses CC-Link and decision control systems for information exchange. According to the instructions of the decision control system, the mechanical arm actuator is controlled to complete the work of feeding the work piece.

3   CONCLUSIONS

To liberate people from heavy, repetitive and cumbersome work and to engage in relatively easy service work is an embodiment of scientific and technological advancement and a development trend of human society.

Automation technology is a solution that partially replaces labor, reduces labor intensity, and improves processing efficiency. Automated machining saves labor costs while improving machining efficiency and machining accuracy, and has good economic benefits. Therefore, for the upgrade needs of China's elevator processing industry, independent research and development of elevator sheet metal modular processing intelligent manufacturing production line, the previous paragraph uses a parametric design, manufacturing uses a modular technology, due to the use of robots to assist the work, not only improved Efficacy, reduced labor, and improved product quality. Without adding bending, stamping machine equipment, etc., it can reduce 2/3 of the staff to complete the same job. By adjusting processing equipment, not only can people be reduced, they can meet the needs of the order market, and they can also significantly increase production. It is the inevitable choice for upgrading and upgrading of elevator manufacturing enterprises in China.

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BIOGRAPHICAL DETAILS

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