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A workpiece turnover device based on aerodynamic system

Zhenqian Zheng[1]*, Tianlong Wang[2], Gang Wang[1], Xing Li[1]

[1]College of Mechanical & Power Engineering, China Three Gorges University, Yichang, 443002, China.
[2]College of Civil Engineering & Architecture, China Three Gorges University, Yichang, 443002, China.

ABSTRACT

In view of the problem of workpiece turnover on the assembly line of the factory, a machine for automatic workpiece turnover is designed, whose design directly affects the work level of the whole automatic production line. This paper discusses the mechanical structure of the workpiece turnover device in the automatic production line. The turnover of the workpiece can be realized by using the rotary cylinder drive system. The aerodynamic system of the workpiece is designed. The working principle of the aerodynamic system and the design of PLC circuit are analyzed. The results show that the turning of the workpiece can be realized by using the pneumatic system to control the movement of the mechanical device. The aerodynamic device has the advantages of simple structure, easy operation and strong practicability.

Keywords: Pneumatic system; PLC workpiece turning device; Development trend

***Correspondence to Author:**
Zhenqian Zheng
College of Mechanical & Power Engineering, China Three Gorges University, Yichang, 443002, China.

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1. Introduction

In the industrial field, the workpieces transmitted on the flow line constantly enter the nodes, and the workpieces are processed at each node, such as assembly, changing the placement status, setting parameters, etc. The change of the spatial position or the spatial state of the workpiece is often accompanied by a large amount of handling, turning, vibration and other actions. For example, in the production line of electric bicycle, the hub motor needs to be turned over to meet the assembly requirements on the assembly line. In the prior art, the turning work of the hub motor is completed manually, and the weight of the hub motor is large.[1] Therefore, there are obvious problems of high labor intensity and low production efficiency in the manual work. The use of automation device can combine each link more closely, in which the turnover of workpiece can be completed by machine, greatly reducing the production cost, reducing the labor intensity of workers, improving the production efficiency, improving the pipeline environment, and improving the quality of workpiece. The workpiece turnover device is an important part of the automatic production line, and its design directly affects the work level of the whole automatic production line, so it is very important to design the workpiece turnover device reasonably.[2]

2. Design purpose

Turn the workpieces on the assembly line, turn the tightening mechanism 180 degrees, that is to say, turn the workpieces. The working sequence is as follows: clamp down - clamp workpieces - clamp up, 180 degrees clamp rotation - clamp down - loosen workpieces - clamp up.

3. Mechanical structure design

3.1 General layout

According to the characteristics of the assembly line, the overall mechanical device adopts the column type, and the overall structure is shown in Figure 1. First, the lifting cylinder lowers the overall fixture to the predetermined position, then the clamping cylinder drives the clamping workpiece, then the lifting cylinder drives the fixture to rise to a certain height, then the rotating cylinder drives the overall fixture to rotate 180 degrees against the positioning bolt, and finally the lifting cylinder lowers to the predetermined position , put down the workpiece, that is, complete the whole process of workpiece turning.

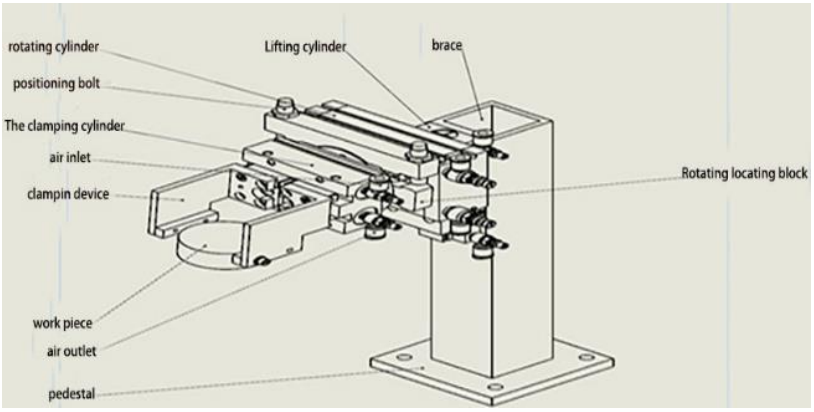

Fig. 1: overall layout

3.2 Realization of flip function

The turning of workpiece is realized by rotation. The explosion view of rotating cylinder and clamp is shown in Fig. 2. The rotating cylinder is to fix the cylinder body on the rotating body and rotate with the rotating load. The air supply

component is fixed. This kind of structure is different from that of ordinary cylinder. If a bearing is used between a rotating cylinder and a non-rotating air supply valve, the rotating cylinder can rotate flexibly.

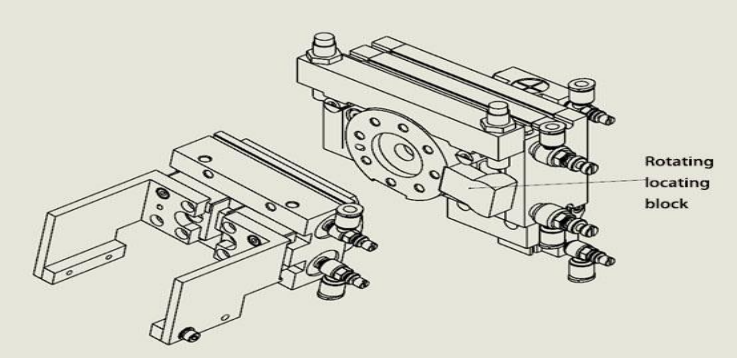

Fig. 2 rotation diagram

4. Case study (Aerodynamic cylinder)

Calculation process of main parts: Choose slide table and pneumatic fixture that can bear workpiece load, torque and clamping force.

Pneumatic linear slide. Assuming the weight of the workpiece is 0.3KG, the inner diameter of the cylinder is $\Phi 20$. Cylinder driving force = load rate * service pressure * inner diameter cross section of cylinder = 0.5*0.4π*162/4=40 N>30N (Total load including workpiece 3*9.8).

Rotary slide table. Required torque = load *10=0.0044*10=0.044N*m<2.2N*m.

Pneumatic fixture. Supporting force=10*m*g (When the friction is 0.2, set the safety factor to 10) =10*0.3*9.8=29.4N>3N (Workpiece weight)

5. Working principle of aerodynamic system

When the workpiece on the assembly line is in the lower area of the device, press the start switch, YV1 is powered on and the lifting sliding table descends, YV2 is powered off when it touches the limit switch SQ3, YV5 is powered on, the pressure relay acts when the fixture clamps the workpiece, YV1 is powered on, and it loses power when it rises to SQ4, YV3 and YV2 are powered on at the same time, the workpiece turns over and descends, and YV6 is powered on when the rotation touches SQ1, When the workpiece is released, the SP contact of the pressure relay is reset. The workpiece continues along the assembly line and completes a cycle.

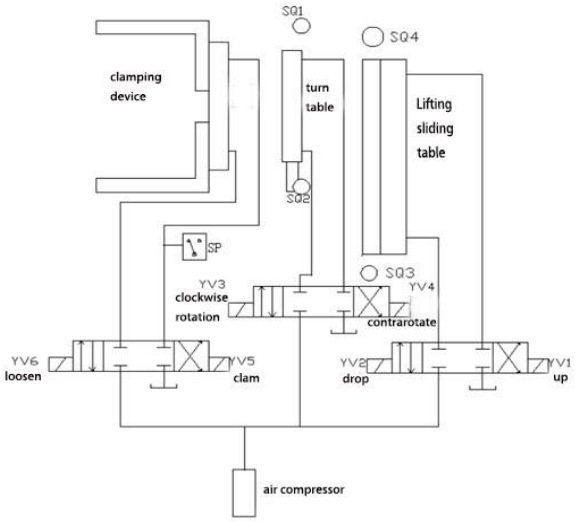

Fig. 3 The schematic diagram of aerodynamic platform

6. Control scheme design and circuit design

Table 1 input / output elements and control functions

	PLC soft components	Component text symbol	Component name	control function
Input	X0	SB	Start button	control
	X1	SQ1	Limit switch	Control the clockwise limit of rotary table
	X2	SQ2	Limit switch	Reverse limit of rotary table
	X3	SQ3	Limit switch	Lower limit of lifting slide
	X4	SQ4	Limit switch	Upper limit of lifting slide
	X5	SP	Pressure relay	Workpiece clamping
output	Y0	YV1	Solenoid valve	Lifting slide rising
	Y1	YV2	Solenoid valve	Lifting slide down
	Y2	YV3	Solenoid valve	Rotating table clockwise
	Y3	YV4	Solenoid valve	Counter clockwise rotation
	Y4	YV5	Solenoid valve	Clamp transpose clamp
	Y5	YV6	Solenoid valve	Clamp rotation release

PLC wiring diagram of pneumatic power station is as shown in Fig. 4.

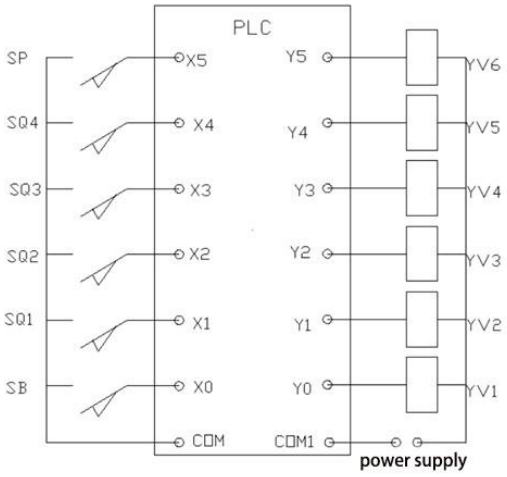

Fig. 4 PLC wiring diagram of pneumatic power station

7. Conclusion

The pneumatic workpiece turning device realizes the function of turning the workpiece automatically. Compared with manual turning, it saves labor cost, reduces labor intensity, improves the quality of working environment, and improves the efficiency and reliability of aerodynamic system. The inner diameter of the cylinder and the material selection of the fixture can be configured according to the size of the

workpiece to meet the turnover of workpiece with different quality and size. The aerodynamic system function can be further developed, such as increasing the detection function of workpiece quality, automatically removing unqualified workpiece, and so on.

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