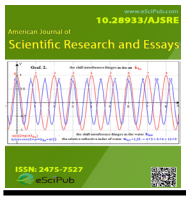
Research Article **AJSRE (2020) 5:27**



American Journal of Scientific Research and Essays (ISSN:2475-7527)

Development of a workpiece transfer machine based on a gas-electric hybrid system

Qiang Gu[1]*, Wenxing Wang[2], Yu Cao[3]

[1]College of Mechanical and Power Engineering, China Three Gorges University, Yichang, 443002, China.

[2]College of Materials and Chemical Engineering, China Three Gorges University, Yichang, 443002, China.

[3]College of Science, China Three Gorges University, Yichang 443002, China.

ABSTRACT

To solve the problem of transferring the workpiece to the next process, design a gas-electric hybrid workpiece transfer machine. The mechanical structure of workpiece transfer in automatic production line is discussed. The transfer of workpiece can be realized by pulse motor, pneumatic system is used to clamp and lift the workpiece,and design this system, analyze the principle of pneumatic system and design the PLC circuit. The results show that the designed device has the characteristics of simple structure, operability and practicability.

Keywords: Gas-electric hybrid power system; PLC workpiece transfer device

***Correspondence to Author:**
Qiang Gu
College of Mechanical and Power Engineering, China Three Gorges University, Yichang, 443002, China.

How to cite this article:
Qiang Gu, Wenxing Wang, Yu Cao. Development of a workpiece transfer machine based on a gas-electric hybrid system. American Journal of Scientific Research and Essays, 2020; 5:27

eSciPub LLC, Houston, TX USA.
Website: http://escipub.com/

1. Introduction

In industry, the workpieces transferred on the assembly line continuously enter the nodes，artifacts are processed at each node [1]. For example, assembly changes placement state setting parameters and so on. The change of the workpiece's spatial position or spatial state is usually accompanied by the movement of carrying, turning and vibration with a large workload. Moving from one process to the next on the assembly line， need man to complete it. This makes the labor intensity of workers high production, low efficiency and labor cost high. using of automation can make every link docking closely, Mechanical transfer, can reduce the labor intensity of workers to reduce labor costs to improve production efficiency, the assembly line environment and the quality of the workpiece. Workpiece transfer device plays an important role in the process of process transfer, its design directly affects the quality of the workpiece, so it is extremely important to set up the device reasonably [2].

2. Design purpose

Rotate the workpiece on the conveyor belt and transfer it to the next step. The order of work is as follows：Clamp down → Holding workpiece → Clamp rise → 90°rotary 、180°rotary Clamp → Clamp down→ Loose workpiece→ Clamp rise.

3. Mechanical structure design

3.1 General layout

As a result of the characteristics of the work, the overall mechanical device using column type，the overall results are shown in figure 1，The lifting cylinder lowers the clamp to the specified position，then clamped by pneumatic fixture，the lifting cylinder drives the fixture up to a certain height，then the pulsed motor drives the overall rotation 90 degrees，larger wheel turns the smaller wheel by 180 degrees，Finally, the fixture drops to the designated position and releases the workpiece, which completes the process of transferring the whole workpiece.

1：clamping device 2：clamping cylinder 3：lifting cylinder 4：bracket 5：small belt 6：belt 7：big belt 8：base

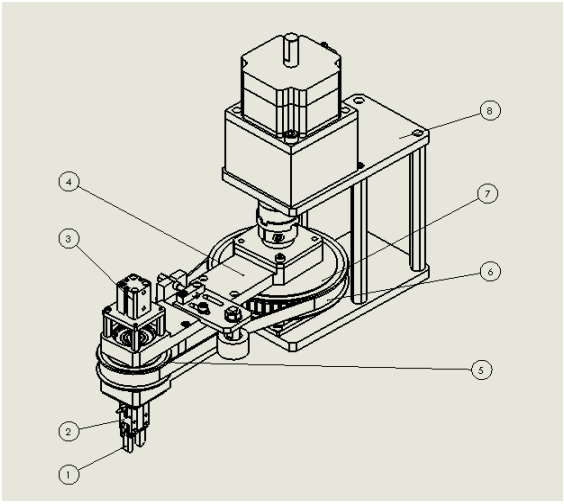


Fig. 1: overall layout

3.2 Mechanical features specifications, dimensions

Transfer degree：90°

Rotation degree：180°

Lifting cylinder stroke：10mm

close stroke：one side 3mm

outline dimension： W136(before turn) x D403 x H398

3.3 The implementation of the transfer

function

The workpiece transfer is realized by the rotation of the pulse motor, the large wheel drives the small wheel, the synchronous belt wheel ratio is 2:1, the large wheel rotates 90 and the small wheel rotates 180 to drive the fixture to rotate 90.

Inertia torque borne by the pulse motor is more important. The selection calculation of the motor is shown below.

Time to move at a 90-degree Angle t0: 0.5sec

Acceleration time t1: 0.1sec

Swing components moment of inertia：$JL=4.16\times10^{-2}$ Kg•m^2

Action angle: θ=90°、minimum step Angle of the pulse moto: θ_s＝0.072°

Action pulse number：A=θ/ θs=1250

Running pulse speed：f2=A/(t0-t1) =3125Hz

Running speed： NM= θs /360×f2×60 ＝ 37.5r/min

Inertia moment of the rotor of the selected motor：$J0 = 1.1\times10^{-4}$

Gear ratio of motor：i = 1/10

Calculated acceleration torque：Ta = (J0・i²+JL)/9.55×NM/t1 = 2.065N・m

Calculate the required torque：TM = Ta× safety factor = 4.13N・m (safety factor :2)

Select the motor according to the torque characteristics of the motor. Confirm the inertia ratio：JL / (J0 × i²) = 3.78 ≦ 10

Friction coefficient and workpiece weight should be considered when selecting clamping force of pneumatic fixture. Blessing force = 10 x mg (When the friction force is 0.2, the safety factor is set to 10, and m is the mass of the workpiece)

4. Working principle of aerodynamic system

When the workpiece on the assembly line is under the fixture, press the start button SB,YV1 get power, move the fixture down until the limit switch SQ1 is touched and YV3 get power, clamping workpiece, pressure relay SP action to power YV2, make the clamping device move up, touch SQ2, the pulse voltage makes the motor rotate while the synchronous belt wheel makes the workpiece rotate 180. When it touches SQ4, the power of YV1 causes the clamping device to move down while the pressure relay SP is reset. When SQ1 is touched again, YV4 releases the workpiece and continues along the pipeline to complete a cycle.

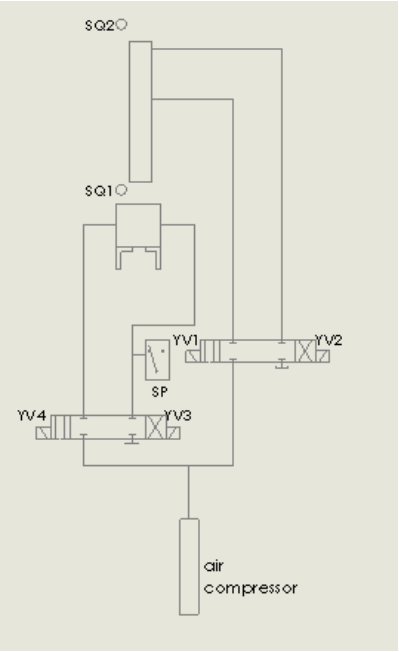


Fig. 2 The schematic diagram of pneumatic part control

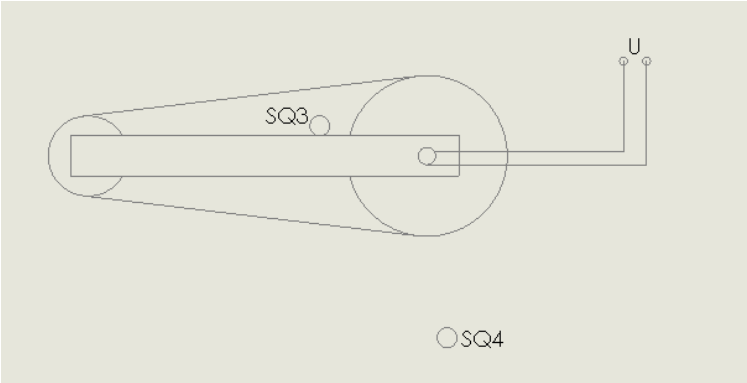


Fig. 3 The motor control part

5. Control scheme design and circuit design

Table 1 input / output elements and control functions

	PLC soft components	Component text symbol	Component name	control function
In put	X0	SB	Start button	control
	X1	SQ1	Limit switch	Lower limit of lifting cylinder
	X2	SQ2	Limit switch	Upper limit of lifting cylinder
	X3	SQ3	Limit switch	Suitable limit
	X4	SQ4	Limit switch	Inverse limit
	X5	SP	Pressure relay	Work holding
Out put	Y1	YV1	Solenoid valve	Drop of lifting cylinder
	Y2	YV2	Solenoid valve	Rise lifting cylinder
	Y3	YV3	Solenoid valve	Clamping device clamping
	Y4	YV4	Solenoid valve	Releasing device clamping

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

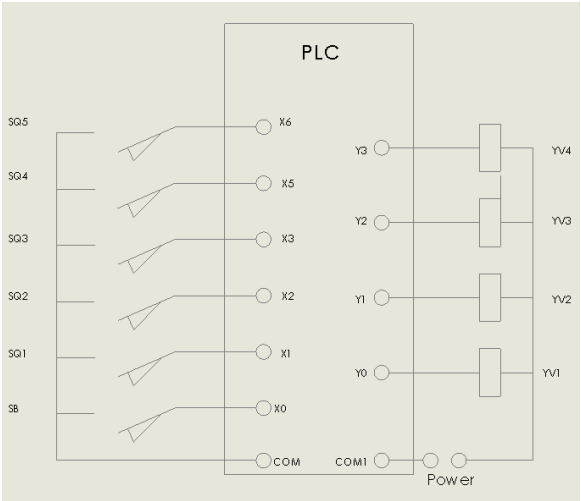


Fig. 4 PLC wiring diagram

6. Conclusion

Gas-electric hybrid transfer device implements the artifact quickly moved to the next working procedure function, has many advantages: reducing the workers, save the labor cost, reduce the labor intensity, the reliability of a significant

boost can also according to the different choice of different pneumatic clamping workpiece, good commonality can reduce machining line length, reduce factory building covers, and so on.

References

1. Zhao Yaping, Yang Guilin, Yang Wei, et al. Research on Force-Controlled End-effectors of Gas-electric Hybrid Robot [J]. Modular Machine Tool & Automatic Manufacturing Technology (12).
2. Guo Hong, Wang Wei, Xing Wei, et al. Design of Electric / Mechanical Hybrid Four Redundant Brushless DC Torque Motors (English) [J]. Chinese Journal of Aeronautics, 2010, 23 (2): 72-76.