

Review Paper Based Demonstration of PLC Controlled Electro-Pneumatic Stamping Machine

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Abstract- The proposed work describes the design and fabrication of prototype of electro pneumatic stamping machine controlled by PLC and shedding light on the working principle and the hardware structure of the system. In this pneumatic system we replace traditional hand stamping method by automatic stamping. By automating this process one can have a greater control over the process. Programmable Logic Controllers are used for the control of the system. This system can replace existing manual feed and operated punching and pressing machines. By interfacing PLC controls with the conventional machines, it is possible to achieve good results in the form of reduced manual efforts, time and reduced cost. Now this automatic paper stamping machine consists of conveyor belt mechanism on which we place any paper to be stamped. We interfaced IR proximity sensor to detect

the object. We also used DC motor to run the conveyor belt and when the conveyor starts IR proximity sensor will detect the object. When object is detected it will indicate a signal to the PLC and the PLC will stop the conveyor motor, the second motor will start to print the stamp on the page. After specified time the conveyor will start again and process will continue to stamp next object.

INTRODUCTION

The pneumatic stamping system is controlled by PLC and the control program is written by software. There are five types of PLC programming languages but here we need only two types, ladder diagram and instruction list. Between these two, ladder diagram program is used to control the system. Photoelectric sensor and two push buttons are used as inputs and the outputs are 12V DC gear motor, solenoid valve and

two pilot lights. Programmable Logic Controller (PLC), 24V DC power supply, eight pin relays and connectors are placed in the control panel and push buttons and pilot lamps are placed at the front cover of panel. All product automation processes require labelling or stamping as a last step to brand the finished product. Different types of products require different types of stamping mechanisms. Here we will demonstrate a complete stamping system that stamps the logo on a square product as it moves on a conveyor. The system will consist of a conveyor belt driven by a motor. The conveyor would be used to lead the product to the stamping base. Once the product reaches the stamping base, the stamping assembly will become active which is a combination of 2 pneumatic pistons integrated with a stamp. The stamping assembly will then press the stamp on an inkpad and then moved to stamp the ink label onto the product. After this the product will be push on towards the second conveyor belt and separated out of the system into a tray. The system would be powered by a PLC and integrated with proximity sensor to detect product as we already know that PLC is used to detect product at each stage, move the product through the system by operating the conveyors accordingly, and operate stamping mechanism and then move the product to the final tray. There are two main parts in this system, pneumatic system and motor conveyor drive. Compressor is used to get air supply for pneumatic system and solenoid valve is used to control single acting cylinder. A stamp

is joined with single acting cylinder for stamping. In motor conveyor drive section, the conveyor is driven by 12V DC gear motor.

1.1. Problem Statement -

- We are going to make this project for the purpose of student learning i.e. for the demonstration of PLC control in the subject Mechatronics.

- 3 • Also, in industries we see that continuous printing and counting leads to hand and eye fatigue and requires lots of efforts and also affects the accuracy to results

1.2. Objective-

- In terms of lab use, to demonstrate working and show PLC control, studied in subject of Mechatronics to students on the topic “PLC controlled Automatic Stamping Machine based on electro-pneumatic circuit”

- To stamp of any name on the object with an accuracy.

- To reduce time and manual efforts of humans. • To reduce manpower in industrial sector.

II LITERATURE REVIEW

T Sheela. S .Shivraman et al [1] in the paper titled “Low Cost Automation for Sorting of Objects on Conveyor Belt”, proposed the system which describes that uses Raspberry pi 3 making the model generally

sensing the colour of the object is a big challenge as there is a chance of high uncertainty due to the external lighting conditions and each nose. Similarly, while collecting objects from conveyor belt by a linear actuator, there are variations in weight and size of object. Further approaches to this system can be made to increase the capability to segregate large and heavy objects and sort them effectively. The objects once kept on the conveyor belt, the further assembly makes the work of sorting the objects very efficiently. In the paper, the author have revealed that they have proposed a system which sorts the objects based on their colour which can future be enhanced to sort them based on their size and shape with the help of IR sensor of near about short range communication requirements. Ekta Tripathi, [14], A sorting and stamping machine have main task of sorting letters according to the pin codes. This method is highly efficient in sorting printed letters occupies very little space and is a one-time investment that provides invaluable future returns.

Pawan Koppa [15] the idea behind this project is to develop atomize sequence of stamping using PLC in electro pneumatic stamping machine. An automatic stamping machine working on the principle of electro-pneumatics and PLC was successfully designed and developed

III DESIGN CONSIDERATION

3.1 Motor selection:

Thus selecting a motor of the following specifications:

- 12V DC Motor
- Power = 24 watt
- Speed = 60 rpm

Motor Torque

$$P = \frac{2 \pi N T}{60}$$

$$T = 3.819 \text{ N-m}$$

$$T = (60 \times 24) / (2 \pi \times 60) T = 3.819 \text{ N-m}$$

3.3 Shaft design

To find shaft diameter by ASME code,

For mild steel, actual shear stress,

$$\tau_{act} = 185$$

$$T = (\pi/16) \times (\tau_{act} \times d^3) \quad 3.819 \times 10^3 = (3.14/16) \times (185 \times d^3) \quad d = 17.12 \text{ mm (approx. 20mm)}$$

3.4 Cylinder

Single-acting cylinders use less air as compared to double acting cylinder (as air is used for extension and retraction is done automatically with the help of spring). They are well suited for low loads that requires both pushing of piston and retracting is done with the

help of spring. The single acting cylinder has single ports to connect with solenoid valve to get air supply.

Make: Festo DNC

Bore diameter: 32 mm

Stroke Length: 100 mm

Pressure=4 bar

Flow rate (V_a)=5.16L/m-0.834L/s

Diameter of Bore=32mm=320cm

Stroke length=100mm=10cm

Area=0.000804m²

Volume = 0.804L

To Calculate Q,

$Q = \text{Volume of Cylinder} / \text{stroke length}$

=0.08042/10

=0.00804 L/cm

Find the volume from the air consumption,

$V = Q * d$

$V = 0.0084 * 8$

$V = 0.06432 \text{ L}$

3.5 Cycle Time

$t = V / V_a$

=0.06432/0.0834

=0.7712

3.6 Force exerted by pneumatic cylinder on product

$P = 4 \text{ bar}$

= 0.4 N/mm²

$d = 32 \text{ mm}$

$F = P \pi d^2 / 4$

= (0.4 x 3.14 x 32 x 32)/4

= 321.69 N ~ 322 N

SR. NO.	COMPONENTS	QUANTITY
1.	PLC Make: Selec Voltage: 230 V AC Frequency:50-60 Hz	1
2.	PNEUMATIC CYLINDER	1
3.	SHAFT	2
4.	SOLENOID OPERATED VALVE	1
5.	NUT AND BOLT	16
6.	FRAME STRUCTURE	1
7.	AIR COMPRESSOR	1
8.	IR PROXIMITY SENSOR	2
9.	RELAY MODULE	4
10.	DC MOTOR	1
11.	CONVEYOR	1
12.	PUSH BUTTONS	4

Component Used

Fig.no.1 Relay Module

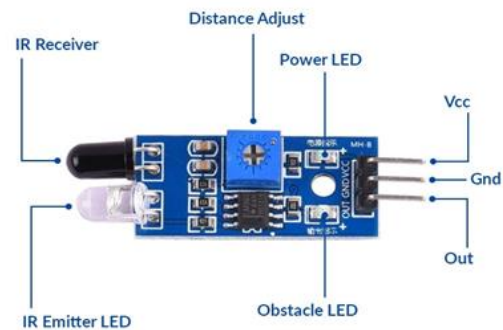
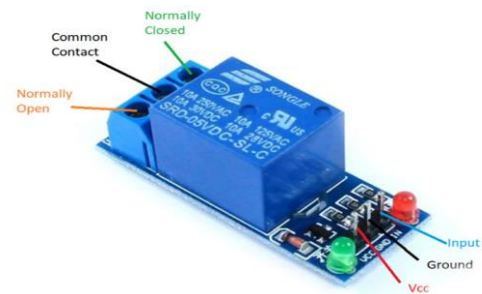


Fig.no.2 IR proximity sensor

3.7

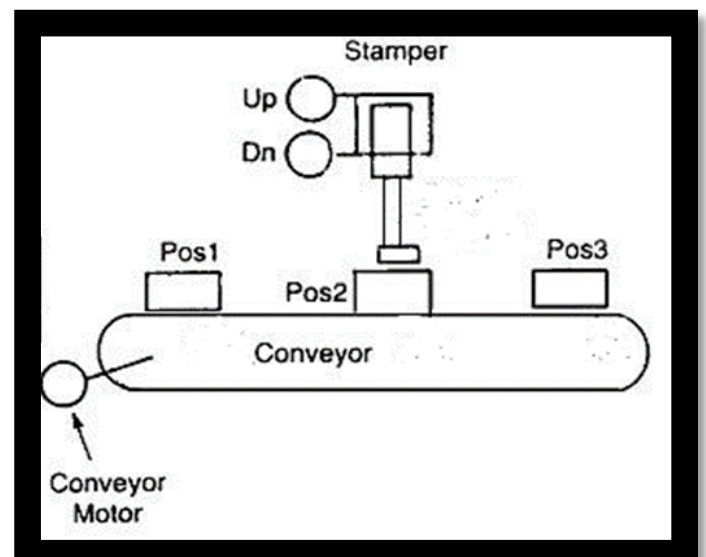


Fig.no.3 project layout



Fig.no.4 PLC

IV WORKING

When the power supply is turned on, the compressor starts compressing the air at desired pressure and this compressed air is stored in receiver tank. After starting power supply a conveyor motor is started as PLC sends signal to the motor, then conveyor is started. As product that is kept on the conveyor comes on stamping position, the IR proximity sensor senses the product and sends a command to the PLC and then the conveyor belt stops at the stamping position. Here, we kept the delay time of few seconds (time required for the product to be

stamped). At the same time PLC operates the solenoid valve and the compressed air which is stored in the receiver is passes to the cylinder through the check valve. Then this compressed air is passed to the cylinder the piston gets extended. As we have attached self-inked stamp at the piston end, so when the piston extends and our task is performed. After stamping on the page, the cylinder retracts automatically due to spring force and the delay period is over and the conveyor belt is turned on and the product is moved to the tray and the cycle repeats.

VI. Advantages

1. Reduce man power and human efforts when used in industry for mass production.
2. Stamping is done accurately.
3. students better understand about PLC when used as demonstration module

VI. Limitations

1. Noise produced by compressor while stamping.
2. A bit expensive.
3. For change in product dimensions, programme has to be changed.

VII. Conclusion

This project of PLC based Electro-Pneumatic Automatic Stamping Machine is the reliable printing mechanism that replaces traditional hand stamping on any object. The general purpose is to provide a portable automatic pneumatic stamping machine which has many advantages of the low power consumption, effective performance and many specified features of the system. The pneumatic stamping system is widely used in industries. The current model is aimed for demonstration purpose. It can be used for stamping their logo/signature onto the files. Compare to hydraulic system, pneumatic system has simplicity of design and control, reliability and very low chance of fire. And, the pressure of pneumatic system is enough for stamping process. The speed of single acting cylinder is easy to control because of the use solenoid valve. As the system is controlled by Programmable Logic Controller, so time and human energy can be saved since human energy can be reduced because of automation. And, this system has high effectiveness and accuracy. But a little noise produced by compressor while stamping and this system has limitations as it is bit expensive

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