INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 6.078
(Volume 6, Issue 2)
Available online at: www.ijariit.com

Automated Pneumatic Fixture

Ninad Male
ninadmale130@gmail.com
Rajiv Gandhi Institute of Technology, Mumbai, Maharashtra

Prerit Shah
preritshah1997@gmail.com
Rajiv Gandhi Institute of Technology, Mumbai, Maharashtra

Tanveet Marucha
tanveetmarucha@gmail.com
Rajiv Gandhi Institute of Technology, Mumbai, Maharashtra

Parth Mullaji
parth123mullaji@gmail.com
Rajiv Gandhi Institute of Technology, Mumbai, Maharashtra

ABSTRACT

Smart Clamping System can fix the workpiece with the required force without deforming the workpiece. This paper presents a review of an intelligent clamping system for rubber printing on a plastic bottle surface in which sensors are used to detect the workpiece presence and clamping/declamping is achieved by pneumatic cylinder, which is operated by a directional control valve. In many Industries as of now, bottle printing is done using bench wise. The process of bench wise is non-accurate and time-consuming. This system can help impart flexibility to a conventional clamping system and also helps in achieving increased productivity and better quality. This paper presents the methodologies for rapid reconfiguration and part-to-fixture positioning in an intelligent fixturing system. Both methods are based on a modular fixturing system consisting of movable actuators and sensors. The reconfiguration methodology utilizes an object-oriented approach to make sure that the fixture can work with various setups without the need of compromising the control software.

Keywords— *Automated Fixture, Pneumatic Fixture, Clamping System, Bottle Clamping*

1. INTRODUCTION

Fixtures can enhance the production quality if they are accurately designed. Fixture serves both purposes i.e. Work holding mechanism and positioning mechanism. Workpiece detection is achieved by using proximity sensors and clamping/ unclamping is achieved by applying sufficient forces to hold the workpiece at the desired location. A pneumatic or hydraulic actuation system can be provided to hold the workpiece against the forces developed during the rubber printing operation. A pneumatic fixture is a special process device which is assembled and fixed in the process of machining. Its performance directly affects the quality of the products. The rationality of the fixture design is to ensure that the workpiece quality, improve labor productivity, reduce labor intensity and repeatability, the basic way to reduce the manufacturing cost. Therefore, the continuous development of pneumatic clamp is a great power, to push forward manufacturing current fixture research is widespread attention from the domestic and international manufacturing industry.

2. LITERATURE REVIEW

Bench Vice is a holding mechanism that holds the product for machining operations. Abrasive chop saws have a unique type of bench vices built for the respective operations. Many people use a machine vise as a bench vise because of the less cost and reduced space. Dr. S K Patel has designed and built a work-holding Vice for the machining purpose. This project gave the idea about the machining vice for drilling purposes as well as several other machining purposes. In large scale production of different products, there is a wastage of time in setting up the product and clamping the product. The trial and error method are usually practiced until the body is properly aligned with the machining clamps. this leads to more time wastage to maintain the accuracy of the operation. Eventually, it increases production time. Thus, pneumatic fixtures increase productivity by eliminating individual positioning. The main advantage of the fixtures is interchangeability as the clamps can be changed according to the required operation.

3. DESIGN CRITERIA

A fixture is a device used to clamp and support the bottle during machining. The most important criteria for a fixture are workpiece stability, position accuracy, and workpiece deformation. Efficient fixture design is one that reduces geometric errors during the machining process. Workpiece location principles are defined in terms of 3-2-1 fixture which is a widely used workpiece location method for prismatic parts. Force analysis is concerned with checking whether the forces applied by the fixture are proper to maintain equilibrium. The job of the Fixtures is that it must correctly locate a workpiece in a given orientation concerning a given device, during assembly or welding.

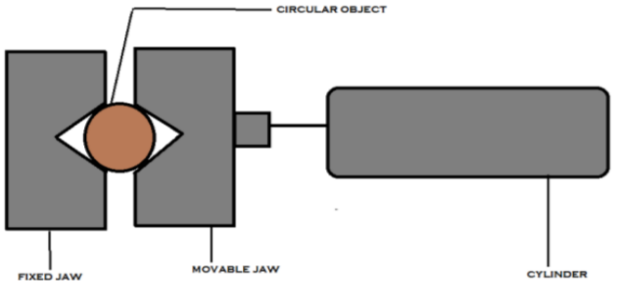

Fig. 1: Holding Cylindrical Object

The devices must clamp and secure the product in that location for the particular processing operation. There are many standard works holding devices such as jaw chucks, machine vises, drill chucks, etc. Fixtures are widely used in workshops and are usually kept in stock for general purpose applications. Fixtures are designed for a unique operation to machine a specific product and are manufactured separately.

4. ASSEMBLY ARRANGEMENT

The jaws are made up of mild steel. The mild Steel has the flexibility to hold so strong as well as able to fix the job rigidly. The base of the project is also made of mild steel, the whole project is assembled and fastened on this surface. Whereas the material of the base plate of the fixture is Aluminum. Since the force generated by a stamp on the fixture is not very high hence the material should not be very tough or brittle. Aluminum is chosen over other materials because it is rigid and resilient in absorbing sudden loads and vibrations on the fixture plate. The pneumatics is connected with the DCV by the polyurethane tube. 5/2 direction control valve is connected with the compressor and the output of the DCV is connected with the Pneumatics. The DCV is controlled with the 8-bit microcontroller. Other components like safety switch, flow regulators and pressure regulators are mounted on the Aluminum frame. The assembly of all the components is provided in the CAD model.

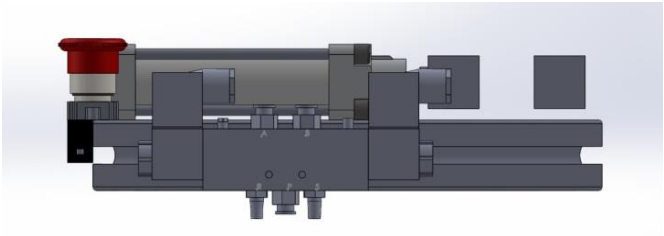

Fig. 2: Front view of CAD Model.

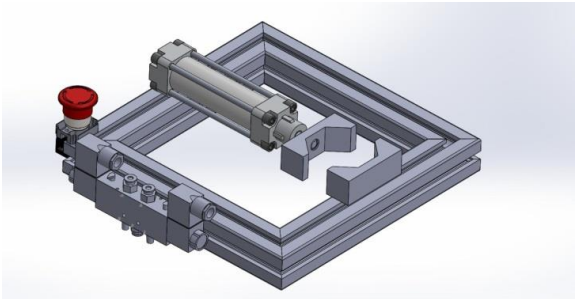

Fig. 3: Isometric view CAD Model.

Table 1: Components and Specifications

Pneumatic Cylinder	• Diameter-32 • Stroke length- 100mm • Maximum Pressure- 0.1- 0.7 Mpa
5/2 DCV (Direction Control Valve)	• 12 V- DC support • 400 mA Current • 4.8 watts
Microcontroller	• Type- 8 Bit • Model- PIC 16F877A • +5V Voltage
Polyurethane Tube	• 6mm diameter • 200mm long

5. WORKING

The Automatic Clamping system is operated with the pneumatics. The process starts by actuating the compressor using the start switch. The machine vice is controlled with the DCV at a constant rate of the compressed air from the compressor. The extent of pressure is been controlled by the pressure regulator. The DCV is controlled either manually i.e. using a foot pedal or Automatically using the microcontroller. The operation is made to follow a sequence of timed control by the cocked timed programmed with the PC microcontroller. There is an IR sensor that will continuously monitor the presence of the object during the machining operation. There is a safety switch that is operated manually or by using a microcontroller which will stop the process during improper functioning. The operation begins with the presence of object detection by the IR sensor and the signal is fed to the microcontroller as shown in the figure.

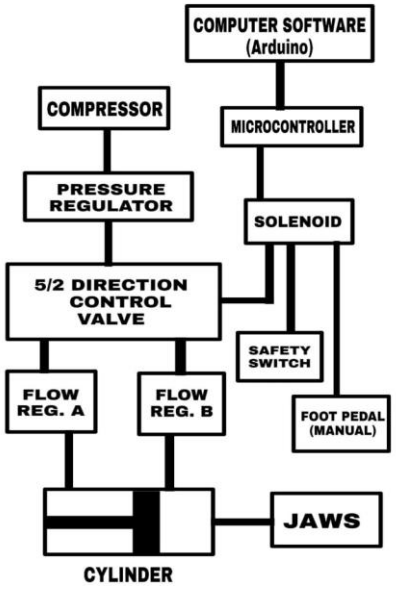

Fig. 4: Block Diagram

When the object is detected the buzzer, alarm produces a sequential sound for the 2-4 seconds. The microcontroller actuates the DCV for the pneumatics and the cylinder is operated. The microcontroller has the advantage of re-write the program as well as electrically erasable and store at any instant. After the operation, the vice is retracted. We follow slow forward extinction and the fast retraction while returning. Depend upon the operation the clocked time can be changed.

6. CALCULATIONS

(a) Force exerted on the work piece

$$F = P*A$$

$$F= (Pcomp – Patm) * \pi/4(D^2 –d^2)$$

Diameter of the cylinder D=2R
Diameter of the connecting rod = d= 2r
Total stroke length of the cylinder = l
Diameter of piston = D
Diameter of piston rod =d
Atmospheric pressure = Patm
Compressive pressure = Pcomp

(b) Time Consumption

Processing time = Machining time + Clamp acting time + Part travel time

(c) Fluid

$$Q = 14.28cv * \sqrt{P/r}$$

Q- Flow (L/min)
P- Pressure Drop
r- Density of Fluid (kg/dm^3)
cv- Flow rating of valve

7. ADVANTAGES

- Reduced Fatigue
- No Man Power Required
- It can hold any type of Object
- Lead time Reduction
- Increased productivity
- Quick operation.
- Stable and rigid design.
- Extremely high clamping force.
- High accuracy and repeatability.
- Reduces production costs.
- Design is compact and very simple to operate requiring almost no maintenance.
- Can be mounted horizontally or vertically

8. CONCLUSION

The unique design of the proposed project automates the otherwise complex task of manually operating the vice and fixture to set the product for machining operations with the help of an automated pneumatic clamp. In industries, our proposed system might have a very crucial application. With an adequate supply of compressed air, this project could serve as a cost-effective vice or fixture. Being highly accurate helps reduce non-productive time by speeding up the setup time of the process. Since there is minimal use of hands to manually operate the bottle, this could help in reducing the accidental cases of a hand getting trapped or injured in the vice. It will also improve error-proofing and the quality of manufactured bottles. Based on the proposed design, an intelligent clamping system can be designed and developed for workpiece detection and automatic clamping for the required force without deforming the workpiece for a bottle printing operation. This clamping can be achieved by using various sensors, actuators, and microcontrollers.

9. ACKNOWLEDGMENT

We are grateful to our Project Guide- Prof. Deepa Pandey for their support and guidance, with which we have been able to complete our project. We respect them for his understanding of the problems faced by the students, and his ability to solve them with ease. We are grateful to our Head of Department, Dr. Rajesh Kale, and Principal Dr. Sanjay Bokade, for his valuable guidance and motivation. We would also like to thanks the Management who directly or indirectly helped us during this project.

10. REFERENCES

[1] Guohua Qin, Weihong, Zhang Min Wan “Analysis and Optimal Design of Fixture Clamping Sequence ASME for publication in the Journal of Manufacturing Science And Engineering, 2006.

[2] Shailesh S Pachbhai1* and Laukik P Raut2 “Design and development of hydraulic fixture for machining hydraulic lift housing” ISSN 2278 –0149 © 2014 IJMERR

[3] Weifang Chen, Lijun Ni & Jianbin Xue “Deformation control through fixture layout design and clamping force optimization of Pneumatic Fixture Based on Automotive Sheet Metal Parts

[4] Siddhant Sharma, “Design of Fixtures and Pneumatics for welding”.

