International Journal of Mechanical Engineering Research and Development (IJMERD)

ISSN Print: 2248-9347
ISSN Online: 2248-9355

Volume 6 Issue 1, January-April (2017), pp 84-92

IJMERD

© PRJ PUBLICATION

DESIGN AND FABRICATION OF PNEUMATIC CONTROL MECHANICAL ARM

K.RAJAN

Lecturer Senior Grade, Department of Mechanical Engineering,
Murugappa Polytechnic College, S.M.Nagar, Chennai 600062

ABSTRACT

We made a manually controlled mechanical arm to pick and place the components as a prototype for assisting in the material handling system. It demonstrates how a pneumatic power can be utilized to achieve pick and place mechanism. The system makes use of 4 pneumatic actuators to achieve the purpose. The mechanical arm contains 3 flow control valves. These valves control the air flow to the pneumatic actuators in order to control the movement of the cylinder stroke. The valves give a manual control to control over the entire arm movement. The system uses a gripper arm operated by a small cylinder to operate the grip. It is controlled by pneumatic valve to control air flow to the gripper actuator and thus the grasp. There three pneumatic cylinders which are controlled manually by 5/2 way lever operated directional control valves. The inclined up and down movement obtained by pneumatic cylinders. The rack and pinion mechanism is used for converting the reciprocating movement into rotational transverse. In this mechanical arm project, the objects are gripped using pneumatic gripper.

Keywords: Robotic arm, Pneumatic Cylinder, Air compressor, Gripper

1. INTRODUCTION

This is a self – assessment test on the part of the ourself to assess our competency in creativity. During the course of study, we put on a second theoretical foundation of various mechanical engineering subjects and principle of pneumatic systems, to a satisfactory extent. Opportunities are made available for us to work on different kinds of machines, designing model, fabricating , purchasing materials , assembling, so that we exposed to various kinds of manufacturing process. We made pneumatic control mechanical arm for transferring materials by picking and placing in production line . we chose pneumatic system for the project because the main source for pneumatic is air which is practically available everywhere unlimited and easy to transfer air for long distance with simple pipes , speed and easy to control the arm. As students we learn more and more so our hold on production technology becomes stronger. We learned that how we can able to design and fabricate a machine. This is the project work. That is the testimony for the strenuous training, which we had in the institute. This report discuses the necessity of

the project and various aspects of planning , design, , fabrication, erection, estimation and testing.

2. WORKING PRINCIPLE

In our project, we made a manually controlled mechanical arm to pick and place the components as a prototype for assisting in the material handling system. The air is available at the environment which is sucked by the air compressor and it is compressed to the particular pressure by controlling the pressure regulator. The compressed air stored in the reservoir of the compressor next it passes through the FRL unit (filter, regulator, lubricator). The dirt and impurities contained in the air is filtered and removed by using filter. The regulators adjust and control the air pressure of the system to ensure that downline components do not exceed their maximum operating pressures, lubricators reduce the internal friction of components which are used in this system can be prevent it from the damage.

The air is passed to the manifold by connecting the flexible hoses and connectors. From the manifold the air can be taken through the number of ports contained in it. The air should then reach the 5/2way lever operated directional control valve for the execution or working of the pneumatic cylinders and pneumatic gripper. The air then moves to the air cylinder from DCV ports. Then air is passed to pneumatic cylinders through hoses and connectors. The flow control valves are in build inside the pneumatic cylinders. If needed we can adjust speed of the piston. Final connection leads to the pneumatic gripper which is used to grasp the object. The three air cylinders are used for three movement. first cylinder used for the inclined up and down movement of lifting the object, the second cylinder is attached with the gripper for grasping the object, the third cylinder is equipped with rack and pinion gear set for rotational transverse with angle of 180 degree by converting the linear movement of the piston into rotational movement. The entire arm action of picking and placing of object will be done by functioning the directional control valves manually.

Main objective of our project is to Design and Fabricate a pneumatic Mechanical Arm to improve transferring of materials at a high speed and safety in production line by using pneumatic system.

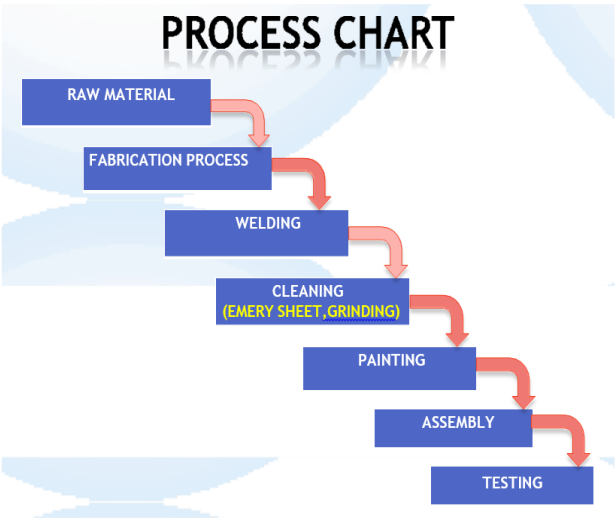

Figure 1 Process chart

3. BLOCK DIAGRAM

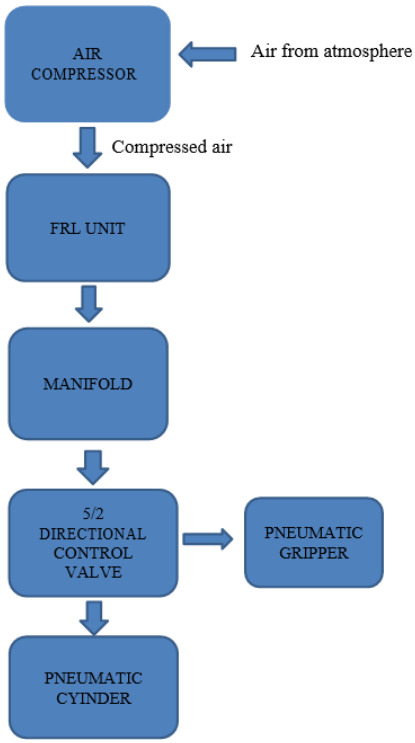

Figure 2 Block Diagram

4. AIR COMPRESSOR

An air compressor is a pneumatic device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure.

Figure 3 Air Compressor

5. PNEUMATIC CYLINDER

Pneumatic cylinder(s) (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Pneumatics system are quieter, cleaner, and do not require large amounts of space for fluid storage. Double-acting cylinders (DAC) use the force of air to move in both extend and retract strokes. They have two ports to allow air in, one for outstroke and one for instroke. Stroke length for this design is 400mm X 150mm.The Cushioning Seals are used to obtain the smooth piston movement into its dead end position. The pneumatic cushions deccelarate piston and rod assembly at the end of the cylinders travel, reducing internal impact force and enabling faster piston velocity.

Figure 4 Pneumatic cylinder

6. PNEUMATIC GRIPPER

A pneumatic gripper is a specific type of pneumatic actuator that typically involves either parallel or angular motion of surfaces “tooling jaws or fingers” that will grip an object. It is shown in fig 3.2.7, When it is connected with pneumatic circuit this gripper can be used as part of a "pick and place" system that will allow a component to be picked up and placed elsewhere during the manufacturing process.

these grippers act directly on the object they are gripping based on the force of the air pressure supplied to the gripper, Grippers can also vary in terms of the opening size, the amount of force that can be applied, and the shape of the gripping surfaces or objects frequently called "tooling jaws or fingers". They can be used to pick up everything from very small items.

7. 5/2 DIRECTION CONTROL VALVE

Various types of control valves are used to regulate, control and monitor the air energy for control of direction pressure, flow, etc. Pneumatic energy is regulated and controlled by pneumatic valves. It is shown in fig 3.2.8. Functionally valves are divided into four major groups.

- Direction Control
- Flow Control

In our project 5/2 DC valves are used.

- A directional control valve with five ways, five ports, and two positions.It ensures

- Quick and sure action
- Long life.
- Easy maintenance.

Figure 5 5/2 Direction Control Valve

8. SEALS AND CONNECTORS

Seal is an important component of a pneumatic system and is used to prevent the air leakage through the joint. This project passes the static seal which are used to prevent the leakage through the stationary surface.Material of the seal is Teflon tape. Teflon has the following properties

- Withstand the system pressure and temperature without any damage.
- Resist the wear and abrasion.
- Recover from deformation.

Resists the adverse effects such as deterioration and shrinking caused by the system air. Connectors are used for connecting the hoses to the components.

Figure 6 Seals and Connectors

9. RACK AND PINION

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. A rack and pinion drive can use both straight and helical gears. The maximum force that can be transmitted in a rack and pinion mechanism is determined by the tooth pitch and the size of the pinion

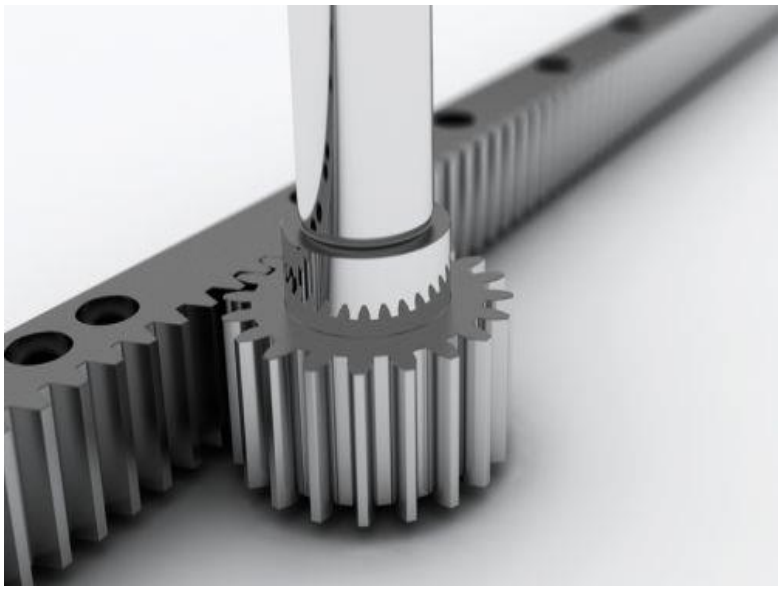

Figure 7 Rack and Pinion

10. WORKING PRINCIPLE

In our project, we made a manually controlled mechanical arm to pick and place the components as a prototype for assisting in the material handling system. The air is available at the environment which is sucked by the air compressor and it is compressed to the particular pressure by controlling the pressure regulator. The compressed air stored in the reservoir of the compressor next it passes through the FRL unit (filter, regulator, lubricator). The dirt and impurities contained in the air is filtered and removed by using filter. The regulators adjust and control the air pressure of the system to ensure that downline components do not exceed their maximum operating pressures, lubricators reduce the internal friction of components which are used in this system can be prevent it from the damage. The air is passed to the manifold by connecting the flexible hoses and connectors. From the manifold the air can be taken through the number of ports contained in it. The air should then reach the 5/2way lever operated directional control valve for the execution or working of the pneumatic cylinders and pneumatic gripper. The air then moves to the air cylinder from DCV ports. Then air is passed to pneumatic cylinders through hoses and connectors. The flow control valves are in build inside the pneumatic cylinders. If needed we can adjust speed of the piston. Final connection leads to the pneumatic gripper which is used to grasp the object. The three air cylinders are used for three movement. first cylinder used for the inclined up and down movement of lifting the object, the second cylinder is attached with the gripper for grasping the object, the third cylinder is equipped with rack and pinion gear set for rotational transverse with angle of 180 degree by converting the linear movement of the piston into rotational movement. The entire arm action of picking and placing of object will be done by functioning the directional control valves manually.

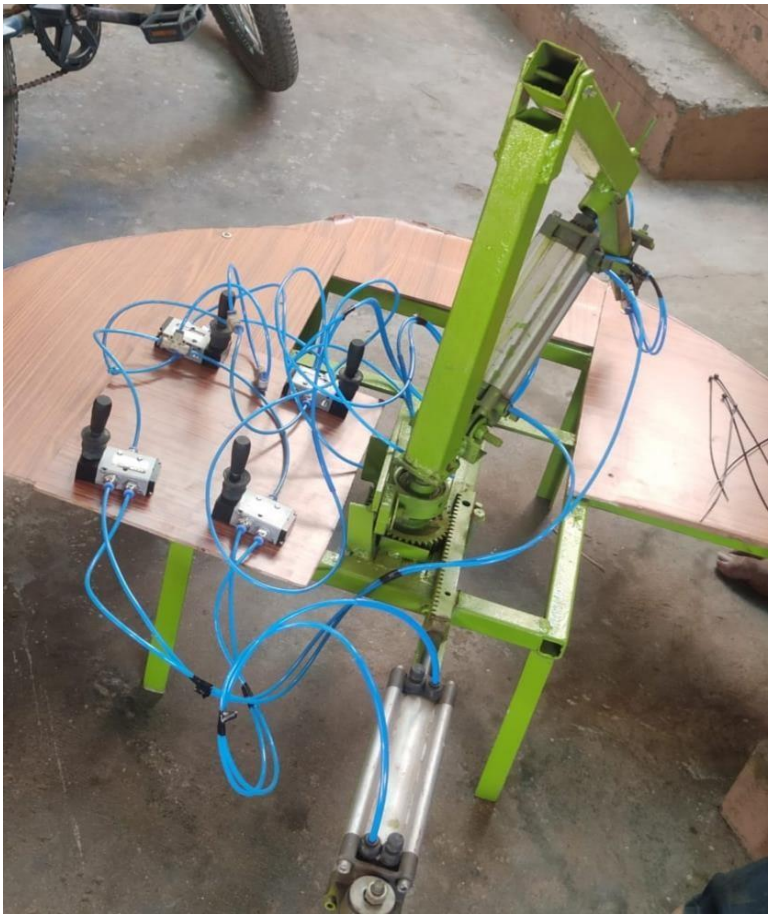

Figure 8 FABRICATION OF PNEUMATIC CONTROL MECHANICAL ARM

MERITS

- The Pneumatic arm is more efficient in the technical field
- Quick response is achieved
- Simple in constructions
- Easy to maintain and repair
- No fire hazard problem due to over loading
- Comparatively the operation cost is less
- The operation of arm is faster because the media to operate is air
- Use of pneumatic components eliminates the mechanical linkages.
- Quick in action due to pneumatic control system
- Simple in design reduces the wear and lubrication system
- Unskilled operator can operate and handle

DEMERITS

- High torque cannot be obtained.
- Load Carrying capacity of this unit is not very high (3 – 5 kg/s).
- Silencer may be used, to reduce the noise of compressed air.

11. APPLICATIONS

11.1. DISCHARGE OF WORKPIECE

The arm fed has wide application in low cost automation. It can be used in automated assembly lines to pick- up the finished product from workstation and place them in the bins. It can also be used to pick-up the raw material and place them on the conveyor belts and vice versa.

11.2. JOB CLAMPING

This unit can also be used in clamping operations in certain areas of mass productions where clamping and unclamping have to be done at high speeds. The application of this unit is limited to operations, which involves moderate clamping forces.

11.3. TRANSFER OF JOBS BETWEEN WORK STATIONS:

The gripping method used in a low cost automation to move the work piece from one workstation to another. The combination of an angular rotary motion is the principle behind this method. The gripper holds the work rigidly. The to and fro motion is achieved by means of the actuating cylinder.

12. CONCLUSION

The design and fabrication of pneumatic control mechanical arm for pick and place is completed with economic and effective considerations. It is controlled by manually flow control and direction control valves. Pneumatic arm movement and rotation is done by pneumatic cylinder using a rack and pinion mechanism. The operation of various arm linkages and the components has been extensively tested and the required corrective measures were taken. Hence the objective of designing and manufacturing of a pick and place robot at low cost was successful and affordable. concepts involved in our project is entirely different which is effectively done with the help of subject which we study. This project which looks very simple

and easy to construct was actually very difficult to concentric and image process nit the forces, which predominate among the schemes of the active tinkers. By doing this project we gained the knowledge of fabrication and working of pneumatic system and We have successfully completed the project work of (Pneumatic Control Mechanical Arm) has been tested using pneumatic components at our Institute.

REFERENCES

We referred the following books,

- S. S. Manian & Raja gopal & G. Balaji singh, machine shop technology,1996.
- R.K. RAJPUT "STRENGTH OF MATERIAL" by S. CHAND publication
- Shripad Shashikant Chopade, M Tech (MachineDesign & Robotics), Research Scholar, India.Vol.3, Issue. 5, Sep - Oct. 2013 "MCKIBBEN'S MUSCLERobots Make Our Work Lighter, But We Have Madethe Robots Lighter."
- K. Ramachandran, manufacturing process, 1998.