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# DESIGN OF MECHANICALLY OPERATED PNEUMATIC ARM

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***ABSTRACT***

*In our Paper Basically the Pneumatic Arm is specially designed for conversion of energy sources into mechanical moments. The main purpose of the pneumatic arm is handling materials and operating various task at the less time. The main advancement of pneumatic arm to minimize the human efforts and to increase the productivity. In today's industrial automation the principle components are programmable controller & robots. The pneumatic arm of joints are driven by electric and pneumatic actuators. The Mild steel, Aluminium, Chromium, Gun metals etc such type of materials are used for the design of pneumatic arm because of better tensile & compressive strength. By using the pneumatics in industrial automation is more economical as compared to the hydraulics. In present day's as the need of automation the pneumatic arm is very applicable and improving the life of human being.*

***KEYWORDS:*** *Automation, Pneumatic Arm.*

## I. INTRODUCTION

In the present day's industry is increasingly shifting towards automation. The actual result of automation is increased productivity, decreased cost of production & improved quality of manufacturing. The industrial pneumatic arm is actually mechanical handling devices that can be manipulate under computer controlled system. The pneumatic arm worked like a human being i.e shoulder, elbow & wrist. A pneumatic arm is a multi-functional manipulator designed to move material parts, specialized devices for the performance of a variety of tasks through variable preselected motion. This pneumatic arm is working in a compressed air. In this simulation includes the properties of manipulator payload, drive elements and control system etc. In general the structure of manipulator is composed of a mainframe. The main parts of the pneumatic arm is number of cylinder, ms angle, motor, controlling device, gripper etc. The motion is generated by controlling the position and velocity of the pneumatic arm axes of motion. The axis of motion means the degree of freedom in which pneumatic arm can move. Typically the wrist section contents three rotary or linear motion. The combination of these six motion will orient the arm end effectors & position with increase in the number of DOF, The complexity of the machine increased and so also the cost. In most of the industrial operations may be completed with only 3 to 6 DOF. The pneumatic actuator includes cylinder or electric motor. The pneumatic cylinder are cheap and need little maintenance. These application is suited for high speed operation with light payloads as compared to hydraulic actuators are more costly and need more maintenance. In this paper the single rod double-acting cylinder are studied. By using the pneumatic arm is fully automated then its gives the high productivity and less human efforts.

## Advantages of Industrial pneumatic Arm

- It gives more Flexibility.
- To improve better quality of products.
- It gives high productivity.
- Improved quality of human life.

## II. MATERIAL SELECTION

The main objective in the fabrication of machine is the proper selection of materials. A design engineer it is must that familier with the effect which the manufacturing process and heat treatment have on the properties of materials. The mechanical properties of the metals are associated with the ability of the material to resist mechanical forces and loads. The mechanical properties are strength, elasticity, plasticity, ductility, brittleness, toughness, hardness etc these are very much important properties of the material selection. The hardness is the important property of the metal and has a wide variety of meaning. The systematic selection of the good material for various application begins with properties and cost of the materials.

The choice of material for engineering purpose depends upon the following factors:

- Availability of the materials.
- Cost of materials.
- Physical and Chemical properties of materials.
- Mechanical properties of materials.
- Suitability of materials for the working condition.

### Materials used For Pneumatic Arm

**Table 1: Selection of material for particular parts**

| SR NO. | COMPONENTS | MATERIAL |
|---|---|---|
| 1 | Frame | M.S. angle |
| 2 | Vertical shaft | Mild steel |
| 3 | Base Plate | Mild steel |
| 4 | Bearing | Chromium steel |
| 5 | Pneumatic Cylinder 1 | Aluminium |
| 6 | Pneumatic Cylinder 2 | Aluminium |
| 7 | Motor | 75N-M/S 250VA.C.5Amp 24rpm |
| 8 | Nut bolt & washer | Mild steel |
| 9 | Bushes | Gun metal |
| 10 | Pin | Bright steel |
| 11 | Sheet | M.S. |

## III. CALCULATIONS

### Design of Pneumatic Arm

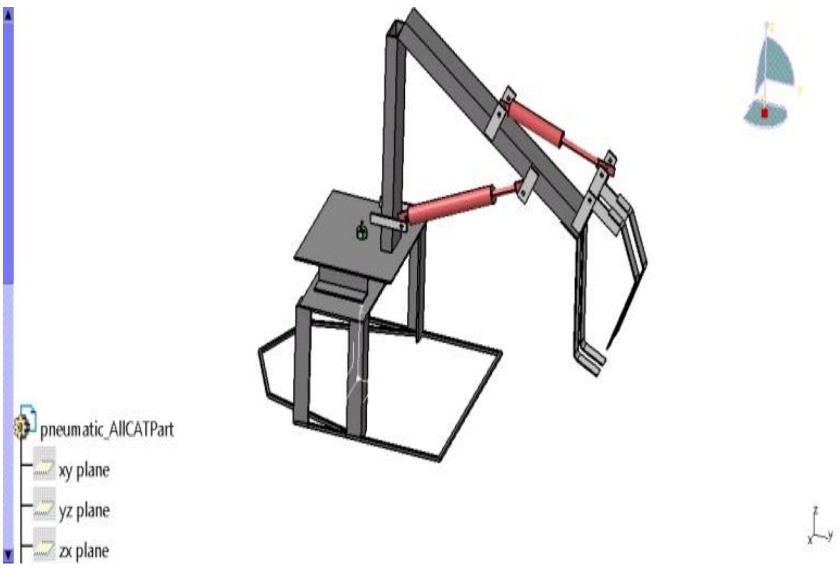


**Fig.** 3D Structure of Pneumatic Arm

## Design of Cylinder

Consider, the Internal diameter ($D_i$) of cylinder is 2cm.

A= $\pi/4\ (2)^2$ =3.14 $cm^2$
For unit length of link say force acting =4kg
Then,
Load = F/A
= 4/3.14
=1.27 kgf
Consider, Factor of safety for the jerk load is '4'
So,
P = 4(1.27) = 5.09 kgf
For unit area 1 $cm^2$
Then,
P = 5.09/1 = 5.09 kg/$cm^2$
And Operating Pressure is 5.09 kg/$cm^2$
For, Aluminium max ft = 210 kg/$cm^2$
fb= 280 kg/$cm^2$

Then Outer Diameter ($D_o$) of cylinder is
Do = Di + 2t
Do = 2 + 2(0.222)
Do = 2 + 0.445
Do = 2.445 = 2.5 cm.
Hence, Do = 25 mm.

## Design of Piston Rod

The piston rod is subjected to compressive load is 30 kg/$cm^2$ For mild steel.
Taking the factor of safety = 3
P = 30/3 = 10 kg/$cm^2$
and
p = 5 kg (compressive)

A = P/p = 10/5 = 2 $cm^2$

$$A = \frac{\pi}{4} d^2$$

d = 1.5cm
Diameter of piston rod is 15mm.

## Design or Selection of DC Motor

Power of motor = 75N-m/s
Rpm of motor = 1800 rpm
Output rpm required = 2400rpm
Load on the motor = 25(9.81) = 245N
Max. load of job = 30(9.81) = 294N
Power of motor = P = 75watt

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

Then, Torque Transmitted (T)

$$75 = \frac{2\pi \times 1800 \times T}{60}$$

T = 0.39 N-m

T = 398N-mm

**Calculation of torque obtained by gear box**

Torque input of gear box =398 N-mm

Input rpm of gear box = 1800 rpm

The reduction ratio of gear box is 1:22

Then,

Output rpm of gear box is,

$$N_2 = N_1 / 22$$
$$N_2 = 1800/22$$
$$N_2 = 81.8 \text{ rpm}$$
$$N_2 = 82 \text{ rpm}$$

Output torque of gear box,

$$N_1/N_2 = T_2/T_1$$
$$1800/82 = x/398$$
$$x = (1800*398)/82$$
$$x = 8736 \text{ N-mm}$$

T2 = 8736N-mm

# IV. AUTOMATION

The automation system is widely used in the industrial area For the automatic operation. The industrial automation is usually for high initial investment but they save manufactures amount of money in the long time.The industrial robot are made from materials that from easy to find and easy to fix. Itis available to produce good 24 hrs a day accept sheduled maintennce. While industrial robots have replace human workers for so many repititive task,and they can also perform task in the dangerous condition to improve safety in work place as well there will be less accidents and more safety.The repititive tasks in factories will be dominated bby the industrial robots,but the tasks that requires creativity will be enjoyed more by the humans.

**Pneumatic Arm**

The pneumatic arm is the type of mechanical arm. The main purpose of pneumatic arm is to reduce the operator efforts and to handle the job in its working area. The pneumatic links of manipulator can be considered to form a kinematic chain. The terminals of the kinematics chain of the manipulator is called end effector and it is analogous to the human hand.

**Classification of Robot**

Industrial robots may be classified in the following 4 ways:

- According to order of technology :
    - Low technology
    - Medium technology
    - High technology
- According to the type of controlled group:
    - Non servo robots
    - Servo controlled robots
- According to axes of movement:
    - Rectangular robots
    - Cylindrical robots
    - Spherical robots
    - Jointed spherical robots
- According to the provision of intelligence:
    - Intelligent robots

- Non intelligent robot

### Pneumatic Cylinder:

In pneumatics various types of cyklinders are use for specilized operations. The pneumatic power is converted into straight line reciprocating motion by the pneumatic cylinders. It is mechanical device workung in typically compressed air. These cylinders are available in varietyof styles including tie rod , compact round body , rotory and rodless cylinder etc.

### Piston rod :

The force exerted by the compressed air then move the piston in two direction called the double acting cylinder. In cylinders the piston rod is specially designed for various types of operations.

### DC Motor :

We are gouing to select DC motor or install this motor at the base of the central main post, which holds all the arms frimly. This post is rotated about its vertical axis to move the arm in horizontal plane. Hence it is requred to rotate the motor shaft in clock and anticloc directon as per the destinations need.

## V. CONCLUSION

The pneumatic arm gives more flexibility and high productivity. It also improves the quality of human life.As campare to hydroulic the pneumatic arm is economically good and it is used for heavy loads to pick and place opreraion.

## VI. FUTURE SCOPE

- The Pneumatic Arm are very useful for material transfer application and machine loading / unloading.
- It reduce the time consumed in lifting the heavy loads and works very effectively.
- It will reduce the danger for the human life and physical problems.
- It is more efficient, reliable and improved productivity.
- To increase the utility of pneumatic arm i.e various types of modifications are involved, then it is better working on the heavy loads.

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