DESIGN AND FABRICATION OF AUTOMATED PNEUMATIC WELDING MACHINE

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Abstract: The technology of pneumatic (air) has gained tremendous importance within the field of work rationalization and automation from old style timber works and coal mines to trendy machine retailers and space robots. Certain characteristics of compressed air have created this medium quite suitable for used in trendy manufacturing and production industries. It is therefore crucial that technicians and engineers ought to have an honest information of air system, air operated valves and accessories. A air system consists of a mechanical device, pipe lines, directional control valves, drive and connected auxiliary appliances. The air is compressed in an air compressor and from the compressor, the flow medium is transmitted to the pneumatic cylinder through a well arranged pipe line system. Pneumatic welding is the most preferred welding technique once it comes to construction in varied diameters. Pneumatic welding permits creating and maintaining a high quality welding advancement, ensuring flexibility, high potency. The bottom metal used for welding is mild-steel. Through this report our effort can eliminate human contact throughout welding which can little question be safer however also will be a lot of economical. The machine is employed to weld work pieces in flat position since higher deposition rates area unit achieved during this position and may be a convenient approach. This machine will use pneumatic systems that facilitate to weld quicker likewise as low value. Pneumatic welding is employed in the method so as to attain correct trade-off between quality of welding and therefore the value. The report provides step wise development of the complete designing method for pneumatic welding equipment.

In our project "DESIGN AND FABRICATION OF AUTOMATED PNEUMATIC WELDING MACHINE" with an introduction to weld the varied elements semi-automatically. Two Double acting pneumatic cylinders and two directional control valve are provided. One cylinder for arm lifting and another one for the rotation. During this project we tend to created 3D model by SOLIDWORKS software system and finally the fabrication has been administrated.

Index Terms **- Automation, Pneumatic System, Cylinder, Welding, Machine.**

1. INTRODUCTION

"Welding is the method of joining together two pieces of metal. So, that the bonding takes place at their surfaces". When two elements to be joined are liquefied together, heat or pressure or both is applied and with or without added metal for formation of metallic bond.

Figure 1 Welding Process

Welding is a fabrication method that joins materials, sometimes metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques like brazing and soldering, which don't melt the base metal. In addition to melting the base metal, a filler material is often added to the joint to create a pool of molten material (the weld pool) that cools to make a joint that's usually stronger than the base material. Pressure might also be utilized in conjunction with heat, or by itself, to produce a weld. Welding additionally needs a form of shield to protect the filler metals or melted metals from being contaminated or oxidized. Though less common, there are also solid state welding processes such as friction welding in which metal doesn't melt.

1.1 PROBLEM IDENTIFICATION

Now days with use of recent technologies, new machines or instruments area unit being mechanically operated or controlled.

Throughout survey (Survey of native factories) we tend to found that some factories area unit using manual welding and machining strategies because of lack of economic resources and infrastructure. Therefore the uniformity and quality of welding method isn't maintained. There's a persistent risk of inflicting welding injuries to operator through fumes, fires, spatter flying off those machines. Sometimes, because of manual method, correct welding at some elements isn't excellent.

As we took project title as "DESIGN AND FABRICATION OF AUTOMATED PNEUMATIC WELDING MACHINE" we are going to attempt to create a mechanism which is capable for pneumatic welding in specific motion.

1.2 WORKING

In our project "DESIGN AND FABRICATION OF AUTOMATED PNEUMATIC WELDING MACHINE" is beings with introduction to welding the varied elements automatically. Two double acting pneumatic cylinders and two directional control valve are provided. Cylinder is employed for the forward and backward movement. This welding machine makes use of properly formed MS alloy electrodes so as to use air pressure and carry electrical current through the work items. Heat is generated mainly at the merging purpose between two sheets. This causes the fabric being welded to melt bit by bit, thereby forming a molten bath, called the weld mass. The liquefied bath is control through the pressure applied by the electrode tip and therefore the encircling solid metal. If the compressed gas goes to directional control valve to pneumatic cylinder, welding holder connected to pneumatic cylinder that motivated by directional control valve at the time automatic welded for metal.

1.3 OBJEVTIVE OF THE RESEARCH

- To achieve high safety
- To reduce man power
- To increase the efficiency.
- To reduce the work load
- To reduce the accident
- Less Maintenance cost.

1.4 ADVANTAGES

- It saves labor cost
- Small in size.
- Cost is less compared to other welding machine.
- Due to the nature of portable it can be easily handled.
- Due to portable ability it is easily handled.

1.5 APPLICATION

- Automobile industry
- Automotive manufacturing
- Metal working
- Shipbuilding
- Fabrication
- Casting

2. COMPONENTS USED IN MODEL

1) Frame:

This is made of mild steel material. The entire elements are mounted on this frame structure with the appropriate arrangement.

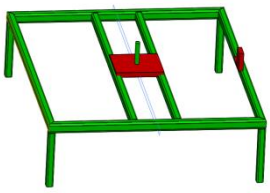

Figure 2 Frame

2) Rack and Pinion:

A rack and pinion is a kind of linear actuator that contains a pair of gears which convert rotary motion into linear motion and vica versa. A circular gear is referred to as "the pinion" engages teeth on a linear "gear" bar is referred to as "the rack"; rotary motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotary motion of the pinion into linear motion of the rack and vica versa.

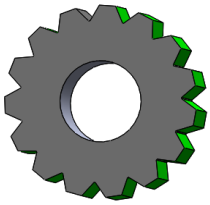

Figure 3 Pinion

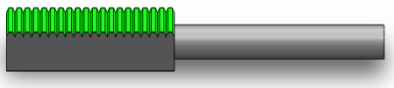

Figure 4 Rack

3) Air Compressor:

An air compressor is a mechanical device that wills increase the pressure of an air. Once tank pressure reaches its higher limit the air compressor shuts off. Then the compressed air is held in the tank until called into use. Compressors are same as pumps: both are increases the pressure on a fluid and both can transport the fluid through a pipe. In other words an air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in compressed air. This compressor works on the D.C. 12volt battery and regulates the ON/OFF switch.

Figure 5 Air Compressor

4) Double Acting Pneumatic Cylinder:

Schematic diagram of double acting pneumatic cylinder is shown in Fig -6. Double Acting Pneumatic Cylinders are equipped with two working ports- one on the piston side and the other on the rod side. To attain forward motion of the cylinder, compressed air is admitted on the piston side and the rod side is connected to exhaust. During return motion compressed air is admitted at the rod side where as the piston side is connected to the exhaust. Force is exerted by the piston during both forward and return motion of cylinder. Double acting cylinders are available in diameters from few millimetres to around 300 millimetre and stroke lengths of few millimetres up to 2 meters.

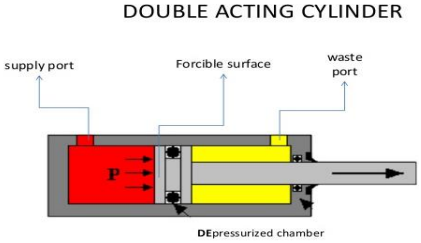

Figure 6 Double Acting Pneumatic Cylinder

The construction features of double acting pneumatic cylinder are shown in Fig -7. The construction of double acting cylinder is similar to that of a single acting pneumatic cylinder. However, there is no return spring in double acting pneumatic cylinder; air pressure can be applied to either side (supply and exhaust) of the piston, thereby providing a pneumatic force in both directions. The double acting pneumatic cylinders are mostly commonly utilized in the application where ever larger stroke length is needed.

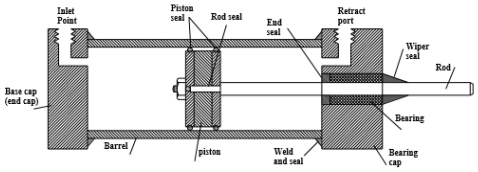

Figure 7 Construction features of double acting cylinder

5) Directional Control Valve:

The directional control valve is one of the important element of a pneumatic system. Commonly known as DCV, this valve is used to regulate the direction of air flow in the pneumatic system. The directional control valve does this by changing the position of its internal movable elements.

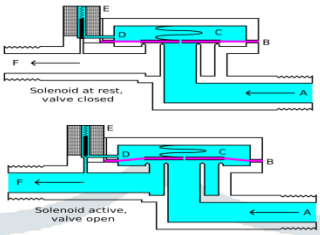

Figure 8 Directional Control Valve

This valve was selected for quick operation and to reduce the manual effort and additionally for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that converts electrical energy into straight line motion and force.

3. DESIGN CALCULTION

3.1 Design Calculation for Frame:

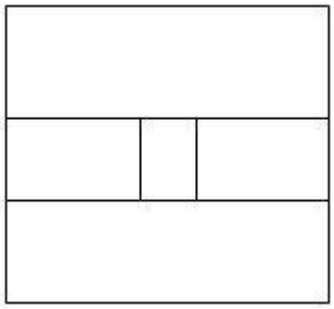

Figure 9 Frame Structure

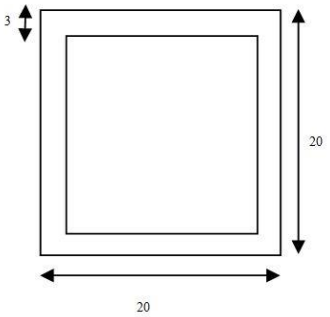

Figure 10 Cross-section of tube

- Now, take pressure generated inside the compressor

p = 300 psi = 2.06843 MPa

- The diameter of the Pneumatic Cylinder is d = 20.32 mm

- Therefore, F = p×a
  = p. $(\frac{\pi}{4})$ d^2
  = (2.06843) $(\frac{\pi}{4})$ $(20.32)^2$
  = 670.77 N
- Here considering force acting at middle of the frame as shown in Figure 4.1
- Bending Moment, M = $\frac{F}{2} * \frac{L}{2}$

$$= \frac{670.77}{2} * \frac{L}{2} \text{ N.mm}$$

- From Figure 6.2

$$I = \frac{20^4 - 14^4}{12} = 10132 \text{ mm}^4$$

- Yield stress of the mild steel, σ_{yield} = 247 MPa

$$\sigma_{yield} = \frac{M.y}{I}$$
$$247 = \frac{670.77 \times L \times 20 \times 1}{4 \times 2 \times 10132}$$
$$L = 1492 \text{ mm}$$

- Length of frame is 1492 mm. So, in design we will take,

L = 590 mm = 23.22 inch (approx)

- As we take L= 590 mm, the stress would be

$$\sigma = \frac{M.y}{I}$$
$$\sigma = \frac{670.77 \times 590 \times 20 \times 1}{4 \times 2 \times 10132}$$
$$= \frac{7915086}{81056}$$
$$= 97.64 \text{ MPA}$$

Here $\sigma < \sigma_{yield}$, Therefore design is safe.

3.2 Design Calculation for Vertical Beam:

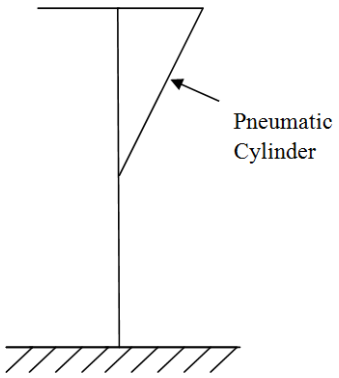

Figure 11 Side view of model

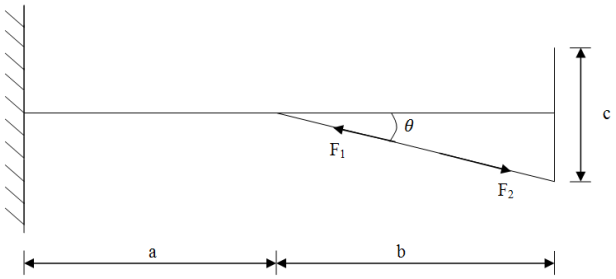

Figure 12 Forces acting on beam

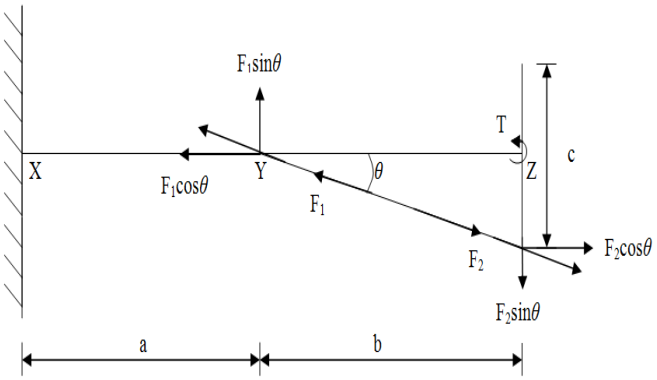

Figure 13 Resolution of forces on beam

- Nomenclature,

  a = Height of beam from base to cylinder
  b = Height of beam from cylinder to top of the beam
  c = Length of the mounted plate
  $F_1=F2=F=$ Force exerted by cylinder=670.77 N

- Assuming, a =300 mm
  b =335 mm
  c =250 mm
  θ =35°
- Now, balancing horizontal and vertical forces

  $\sum H=0$
  $F_1\times\cos\theta = F_2\times\cos\theta$
  $\sum V=0$
  $F_1\times\sin\theta = F_2\times\sin\theta$
- Torque, $T = F_2\times\cos\theta\times(c/2)$

  $=670.77\times \cos35 \times(250/2)$
  =68683 Nmm
- Now,

  $M@X = [F_1\times\sin\theta\times a] - [F_2\times\sin\theta\ (a+b)] +T$
  $= [670.77\times\sin35\times300]-[670.77\times\sin35\times635]+68683$
  = -60250 Nmm

  $M@Y = - [F_2\times\sin\theta\ (a+b)]+T$
  $= [670.77\times\sin35\times635]+68683$
  = -175626 Nmm

  M@Z =0

➢ Now,

y =20/2
=10 mm

$\sigma = \frac{M.y}{I}$

$= \frac{175626 \times 10}{10132}$

=173 Nmm

Here $\sigma < \sigma_{yield}$, Therefore design is safe.

4. ANALYSIS

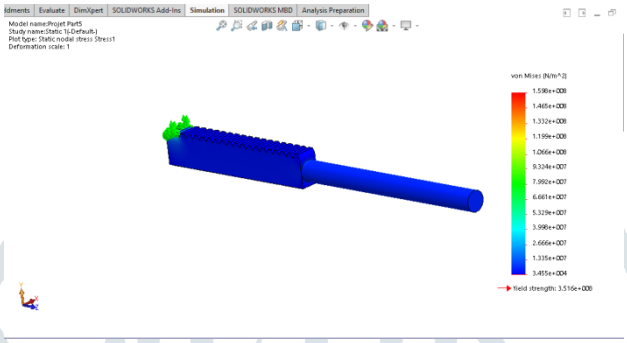

Figure 14 Analysis of Stress for Rack

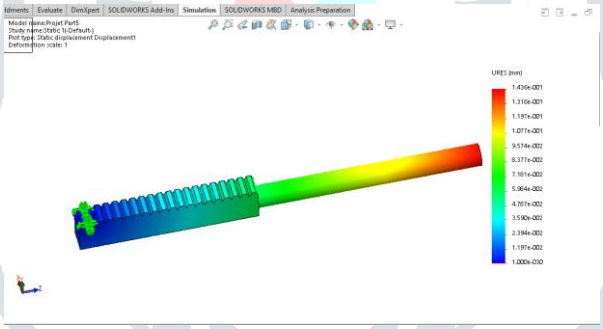

Figure 15 Analysis of Deformation for Rack

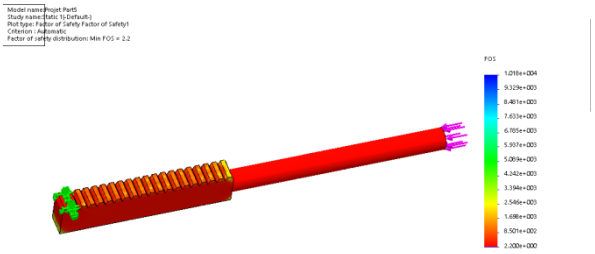

Figure 16 Analysis of Factor of Safety for Rack

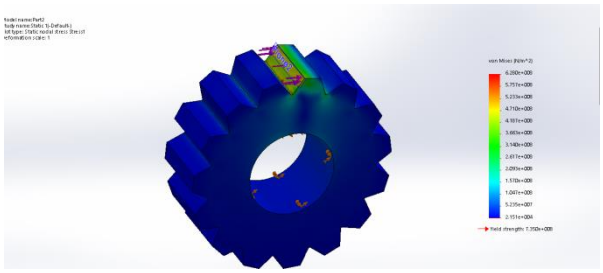

Figure 17 Analysis of Gear

5. CONCLUSION

This project work has provided us a wonderful opportunity and experience, to use our restricted information. We have a tendency to gained a lot of practical knowledge relating to, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the establishment and the industries.

We are proud that we have completed the work with the restricted time successfully. We can able to perceive the difficulties in maintaining the tolerances and also the standard. We have a tendency to utilized maximum of the available facilities as per our ability and talent.

In conclusion remarks of our project work, allow us to add a few more lines regarding the impression of our project work. Therefore we have developed "DESIGN AND FABRICATION OF AUTOMATED PNEUMATIC WELDING MACHINE". By using a lot of techniques, they can be modified and developed according to the applications.

REFERENCES

[1] Seayon S. Dmello, Jebin Biju, Shashank S. Hegde and Anand V. Ganoo, Design and Fabrication of Automated 2-Axis Welding Machine. International Journal of Mechanical Engineering and Technology, 8(3), 2017, pp. 209–218.

[2] Prof.S.N.Teli, Akshay Bhalerao, Sagar Ingole, Mahesh Jagadale, Kiran Kharat "Design and Fabrication of Pneumatic Robotic Arm " from "International Journal of Scientific & Engineering Research" Volume 8, Issue 3, March-2017 ISSN 2229-551, (pp. 126-132)

[3] Mr.Sateesh.R, Sreenithi.R.M, Tamilmani.R, Tamil Selvan.V, Vasanthakumar.A on 2018. ISSN-2395-4396 "FABRICATION OF AUTOMATIC PNEUMATIC DOUBLE AXIS WELDING MACHINE" from "International Journal of Advance Research and Innovative Ideas in Education". Volume 4,(pp. 1201-1206)

[4] Norrish, J. (2009). Process control and automation developments in welding. Trends in Welding Research, Proceedings of the 8th International Conference (pp. 17-24).