Design and Fabrication of PVC Pipe Feeding and Cutting Machine

K. Vaibhav[1], M. Krishna Prasad[2], D. Durga Prasad[3], K. Gowthami[4]

[1,2,3]student, Department of Mechanical Engineering, Department of Mechanical Engineering, Godavari Institute of Engineering & Technology (A), Rajahmundry, Andhra Pradesh, India.
[4]Assistant Professor, Department of Mechanical Engineering, Godavari Institute of Engineering & Technology (A), Rajahmundry, Andhra Pradesh, India.

Abstract –*The motto of PVC pipe feeding and cutting machine Is to slit the pipe pneumatically for the desired length and also cut the pipe in less time with least wastage generated around the pipe to make it cost-effective and ease of use the machine ,we designed and fabrication is used for cutting any pattern of an object like circular. This project works under the applications of pneumatic based systems .According to the type of material to be cut, the cutting tool can be changed, This Machine can be widely applied in almost all type of industries in which the pipe cutting process is a main operation in all industries. Normally the cutting Machine is manually hand operated one for medium and small-scale industries. In our project small and large size pipe cutting can be done. The design of PVC pipe feeding and cutting machine is done by using CATIA V5 software.*

Key Words: pneumatic systems, efficiency, guide ways, cost effective, CATIAV5 software

1. INTRODUCTION

In present day scenario, products have to be manufactured within less production time with having high accuracy dimensions that too on a bulky matter . So as to meet that requirement upgrade of machinery, methods for production are necessary. The main operation that held in the pipe industry is of three major operations i.e. feeding, clamping & cutting. These operations are either limited with time gap between their respective operations by means of either mechanisms or programmed type. When coming to mechanical type, usage of cams – followers, Geneva mechanism and other mechanisms. When comes to program type there will be usage of timers, sensors, plc circuits, counters. Here in this paper material made up of poly vinyl chloride commonly call as PVC is used for experimentation. The material for cutting operation is selected based on the stress calculated considering the pipe or rod material. But various cutters materials specifications used for mild steel rods and pipes. Torque produced by the cutter used in the machine system has been considered for cutting PVC object by help of the design data available. With the help of this system the time required to slice the objects like the pipe or rod will be less the accuracy of slicing or cutting of the material will also be improved. The system can be handled by semi-skilled operators with ease.

2. LITERATURE REVIEW

Pandit Mandar Bipinchandra et al. [1] have proposed that automatic pipe cutting machine has been used for mass production and aims decreasing the mortal involvement in order to improve the productivity and accuracy of the product. Automatic pneumatic pipe cutting machine uses a pneumatic circuit for cutting of PVC pipes which, finally decrease the cumulative time required for the complete cutting operation and increases the production rate.

P.Balashanmugam and G.Balasubramanian [2] proposed a technique in which growth of the cutter is carried out in the upward and downward direction using pneumatic double acting piston and cylinder unit arrangement, along with the foot operated direction control valve (DCV). In this type of machine high pressure air is used as working fluid for the transfer of power and the motion. The invention compressed air from the compressor is used as the force medium for this operation. There are pneumatic double acting cylinders, direction control valve and flow control valve. The arm from the compressor enters to the flow control valve. The controlled air from the flow control valve enters to the DCV. The function of DCV is to enter the air into the pneumatic cylinder. The present work involves the use of 5/2 DCV. In the first position air enters into the cylinder and pushes the piston, so that the cutting stroke is obtained. In the next position air enters into the other side of cylinder and pushes the piston return back, so that the releasing stroke is obtained.

Shital K. Sharma et.al [3] have provided an alternative to the existing automatic PVC pipe cutting machine, in terms of automating the pipe entry into the cutting apparatus, This method eliminates power fluctuation and lesser initial investment. There are many industrial applications where round bar or square bars are required to be operated on different machines to make machine components such as shafts, bolts, screws, etc. The clamping arrangement can be varied according to need of operations suitable. The overall system is compact in size, light weight, modular and flexible to be used in small work jobs which need batch production. The system even has the potential to add up a PLC system to control its overall working with ease and with

less effort. This system has the potential to adopt higher level of automation if desired in future

Nimbalkar Shripad, Velanje Sagar, Patil Abhay and Varpe Pooja [4] have conducted invention related to pneumatically operated automatic pipe-cutting machine. The arrangement of the pneumatic valves deployed in this system is accordance to the circuit was planned. The choice of cutter is based on the stress calculated keeping in mind the pipe or rod material. The material favored in this system is a PVC (Polyvinyl Chloride) pipe for demo. But mild steel rods and pipes can also be worked out by using diverse cutter-provision

Working principle:

"PVC pipe feeding and cutting machine "works on the principle of pneumatic cylinders movement when the compressed air from the compressor enters into the cylinders, there will be change in the piston movement Which are attached to clamps and cutter and the relative motion is acquired by operating the pneumatic valves when needed.

3. COMPONENT USED:

3.1 Base frame:

Base frame of this machine is made up of aluminum and manufactured in the shape of "L". Dimensioned lengths of 35 cm, 28cm,18cm(*2),15cm rectangular aluminum shafts with 20cm heighted rectangular aluminum shafts helps to stable the machine while in working .

This base frame is attached to guide ways which holds the primary objects like PVC pipe , material cutter.

- Arc welding is used in manufacturing the base frame

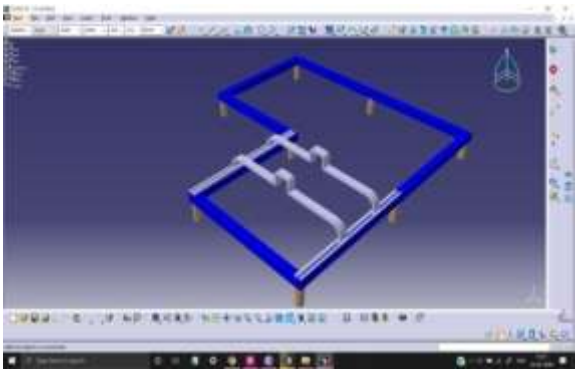

Fig 1: Catia base frame

3.2 Pneumatic system:

Pneumatic system consists of two major components, that are compressor, cylinders.

3.2.1 Compressor:

The compressor plays a crucial role in machine in supplying of pressurized working fluid i.e. air. In this project we used the centrally located and electrically powered compressor

Fig 2: compressor

3.2.2 Cylinders:

Pneumatic cylinders can be defined as the cylinders which will work under the action of compressor air .the cylinders contains inlet and outlet valves which connects with pneumatic valves for the change of pressure of air to get change in the piston movements .

Size of the bore 25 mm
Stroke of the cylinder 80 mm
Pressure capacity up to 10bar
Cylinder model: SC32*100

Fig 3: cylinder

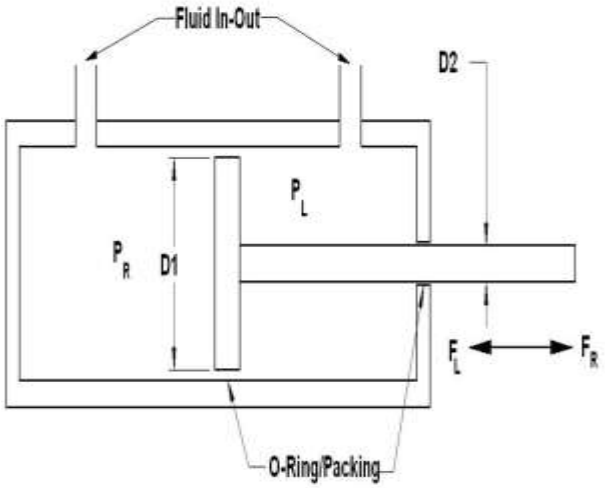

Fig 4: cylinder working model

3.3 GUIDE WAYS:

Guide ways helps to get the desired motion in the pre-determined path in-order to get required output

Fig 5: guide ways

3.4 Cutting machine:

This cutter helps in cutting the material provided
To a specific determined dimensioned length

Specifications:
Voltage -220v
Frequency-50Hz
Power-710w
Speed-11000rpm
Diameter-100 mm

Fig 6: cutter

3.5 Pressure regulators:

Presure regulator is a mechanical device , which helps in getting the constant output in the regulatory flow .even though there will be many disturbances given as an input but there is a constant output flow.

Fig 7: pressure regulator

3.6 Bolts and nuts:

Fig 8: bolts and nuts

4. CALCULATION:-

4.1 Pressure produced due to load:-

Area of trolley (A) = 609.6 381 = 232257.6mm² = 0.2322 m²

Volume of the Trailer Box (V) = 609.6 381 19.05 = 4424507.28mm³=0.004424 m³

Actual load =10 kg = 100 N

Factor of safety = 2

Max load = 20 kg = 200 N

Load of wooden trolley = 3 kg = 30 N

Pressure = load / area

P= 230/ 0.2322

P =990.525 N/m2

4.2 Pressure required lifting the load in the pneumatic cylinder:-

Diameter of the cylinder (d) = 25 mm =0.025 m

Area of the cylinder (A) = 0.0125^2 =0.0004908 m2

Pressure = load / area of the cylinder

P2 = 200/0.0004908

P2 =4.07 bar

Pressure produced by the load is less the Pressure produced by the cylinder.

We can apply the pressure 4.07 to lift the 230 N.

4.3 Pneumatic Cylinder Design piston rod:

Diameter of the Piston (d) = 25 mm

Pressure acting (p) = 10 bar

Material used for rod = C 45

Yield stress (by) = 350 N/mm

Assuming factor of safety = 2

Force acting on the rod (P) = Pressure x Area=p x (Πd^2 / 4)

=10 x {(Π x 25^2) / 4}

P=4908 bar.

Design Stress (by) = by / F0 S=350/2=175 N/mm

= P / (Π d^2 / 4)

$\therefore$ d = $\sqrt{}$ 4 p / Π[σy]

=$\sqrt{}$ 4 x 4908 / {Π x 175} = 8.9272

= 17.85 mm

$\therefore$ Minimum diameter of rod required for the load = 17.85 mm

$\therefore$ We assume diameter of the rod = 20 mm

4.4 Design of Cylinder Thickness:

Material used = Cast iron

Internal diameter of the cylinder = 25 mm

Ultimate tensile stress = 250 N/mm

Working Stress = Ultimate tensile stress / factor of safety

Assuming Factor of safety = 4

Working stress (ft) = 250 / 4

= 62.5 N/mm

According to 'LAMES EQUATION' Minimum thickness of cylinder (t) = ri {$\sqrt{}$ (ft + p) / (ft – p) -1 }

Where, r_i = inner radius of cylinder in cm.

ft = Working stress (N/mm)

p = Working pressure in bar

∴ Substituting values we get,

$t = 20\{ \sqrt{(62.5 + 10) / (62.5 - 10)} - 1\} = 3.502$mm

We assume thickness of cylinder = 19.05 mm

Inner diameter of barrel = 25mm

=25+ (2 x 19.05)

=63 mm

Table -1: Component's Material

SR.NO.	COMPONENT NAMES	MATERIAL
1.	Frame	Aluminum
2.	Cylinder	Alloy steel
3.	Piston rod	Carbon steel
4.	Bolts &nuts	Cast iron
5.	Compressor	Cast iron
6.	Guide ways	Aluminum

5. APPLICATIONS:

- Suitable for small industries
- Work shop use

6. ADVANTAGES

- Particularly used for medium batch production
- Working process is simple
- Low maintenance cost
- Easily portable
- Low weight
- High accuracy
- No corrosive agent
- Skill operator is not required
- Production time is less

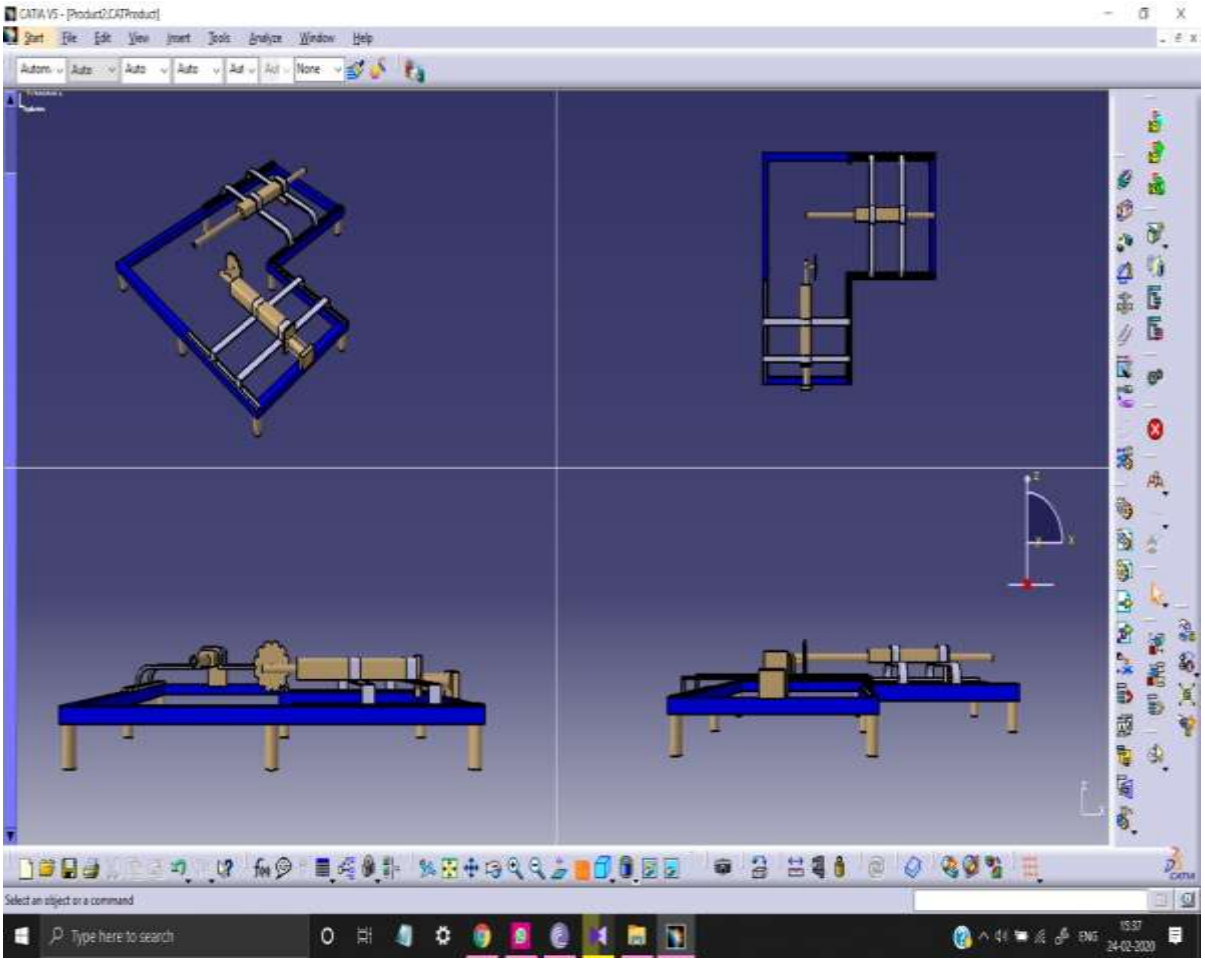

Fig -9: Catia model Of PVC Pipe Feeding and Cutting Machine

Fig-10: Actual Model Of PVC Pipe Feeding And Cutting Machine

7. CONCLUSIONS

Here finally we concluded that our machine helps in production which is bulky natured processed in less production time with high accuracy. The problem that mostly occurred in pipe manufacturing industry can be solved by employing this machine in manufacturing process.

8. REFERENCES

1. Handbook of pneumatic system. Mr. S.R. Mujumdar
2. Handbook of component of pneumatic control system.
3. Kshirsagar prashant r,rathodnayan, rahateprashantp, halayeprashant p, survesachins, international journal for innovative research in science and engineering volumeno 1, issue 2, march 2016
4. Shital ksharma Prasad , the model of automatic bar feeding mechanism for pipe cutting machine ,
5. Harshit bk, sunil h, shashidhar h, vinayak b, navvenb,Design of automatic lack and pvc pipe cutting machine
6. Mahesh aher , Prasad raut , kishorvya vahare , omlar nilkanth, pallavigade, automatic pneumatic pipe cutting machine
7. Black and Ronald a kosher ,pneumatic systems principles and maintainance the mc graw hill by s.r
8. Mohan m, sathish m, prakash r, kali rahiman m, design and fabrication of automatic pvc pipe feeding and cutting machine.
9. Handbook of guidelines for the use of pneumatic system,Mr. H.Adelman
10. P.M.Pradhan, "Experimental Investigation and Fabrication of Pneumatic Cutting tool", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 6, June 2013.
11. Pneumatic Systems (principles and maintenance) wriiten by S.R. Majumdar.

9. BIOGRAPHIES:

1) Mr. K. Vaibhav
Engineering bachelor student
Mechanical engineering department
Godavari institute of engineering and technology, Rajahmundry
Andhra Pradesh , INDIA

2) Mr. M. Krishna Prasad
Engineering bachelor student
Mechanical engineering department
Godavari institute of engineering and technology, Rajahmundry
Andhra Pradesh , INDIA

3) Mr. D. Durga Prasad
Engineering bachelor student
Mechanical engineering department
Godavari institute of engineering and technology, Rajahmundry
Andhra Pradesh , INDIA

4) Mrs. K .Gowthami
Assistant professor
Mechanical engineering department
Godavari institute of engineering and technology, Rajahmundry
Andhra Pradesh , INDIA