AUTO INDEXING GEAR CUTTING ATTACHMENT FOR SHAPING MACHINE

M.V.N Srujan Manohar[1], S.Hari krishna[2]

[1]PG student, Institute of science and technology, University College of engineering, JNTU Kakinada, A.P, INDIA.

[2]PG student, Department of mechanical engineering, University College of engineering, JNTU Kakinada, A.P, INDIA.

Abstract

A shaper is used to machine a single job by using a single point cutting tool and hence it can not be used for high production rates. This project intends to use pneumatic shaper for high production of automatic gear cutting with auto indexing work piece. A small ratchet gear structure has been thus devised to demonstrate the gear cutting attachment in shaping machines.

The pneumatic source of power with control accessories is used to drive the ram or the cylinder piston to obtain the forward and return strokes. By this arrangement the forward/reverse stroke of the pneumatic cylinder is adjustable type when compared with the conventional machines.We desired a shaping machine which will automatically index the job and gives automatic tool feed to the pneumatic cylinder.

Key words: *Shaping machine, solenoid valve, Pnematics, lamies equation, design& Drawings.*

1. Introduction:

This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

Degrees of automation are of two types, viz.

Full automation.

Semi automation.

In semi automation a combination of manual effort and mechanical power is required whereas in full automation human participation is very negligible.

1.1 Needs for pneumatic power :

Pneumatic system use pressurized gases to transmit and control power, as the name implies, pneumatic systems typically use air as fluid medium, because air is a safe, low cost and readily available fluid. It is particularly safe environments where an electrical spark could ignite leaks from the system components.

There are several reasons for considering the use of pneumatic system instead of hydraulic system Liquid exhibit greater inertia than gases. Therefore, in hydraulic system the weight of the oil is a potential problem. To design and development a material handling system for automation /semi automation of industries by using pneumatic control system, which is used for low cost automation.

2. Literature survey:

2.1 Pneumatics:

The word ‘pneuma’ comes from Greek and means breather wind. The word pneumatics is the study of air movement and its phenomena is derived from the word pneuma. Today pneumatics is mainly understood to means the application of air as a working medium in industry especially the driving and controlling of machines and equipment.

Pneumatics has for some considerable time between used for carrying out the simplest mechanical tasks in more recent times has played a more important role in the development of pneumatic technology for automation.

Pneumatic systems operate on a supply of compressed air which must be made available in sufficient quantity and at a pressure to suit the capacity of the system. When the pneumatic system is being adopted for the first time, however it wills indeed the necessary to deal with the question of compressed air supply.

The key part of any facility for supply of compressed air is by means using reciprocating compressor. A compressor is a machine that takes in air, gas at a certain pressure and delivered the air at a high pressure.

Compressor capacity is the actual quantity of air compressed and delivered and the volume expressed is that of the air at intake conditions namely at atmosphere pressure and normal ambient temperature.

The compressibility of the air was first investigated by Robert Boyle in 1962 and that found that the product of pressure and volume of a particular quantity of gas.

The usual written as

$PV = C$ (or) $P_1V_1 = P_2V_2$

In this equation the pressure is the absolute pressured which for free is about 14.7 Psi and is of courage capable of maintaining a column of mercury, nearly 30 inches high in an ordinary barometer. Any gas can be used in pneumatic system but air is the mostly used system now a days.

2.2 SELECTION OF PNEUMATICS

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatic is an attractive medium for low cost mechanization particularly for sequential (or) repetitive operations. Many factories and plants already have a compressed air system, which is capable of providing the power (or) energy requirements and the control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power).

The main advantage of an all pneumatic system are usually economic and simplicity the latter reducing maintenance to a low level. It can also have out standing advantages in terms of safety.

3.COMPONENTS AND DESCRIPTION :

3.1 PNEUMATIC CONTROL COMPONENT:

3.1.1. Pnematic cylinder :

An air cylinder is an operative device in which the state input energy of compressed air i.e. pneumatic power is converted in to mechanical output power, by reducing the pressure of the air to that of the atmosphere.

3.1.2 Single acting cylinder:

Single acting cylinder is only capable of performing an operating medium in only one direction. Single acting cylinders equipped with one inlet for the operating air pressure, can be production in several fundamentally different designs.

Single cylinders develop power in one direction only. Therefore no heavy control equipment should be attached to them, which requires to be moved on the piston return stoke single action cylinder requires only about half the air volume consumed by a double acting for one operating cycle.

3.1.3 Double acting cylinder:

A double acting cylinder is employed in control systems with the full pneumatic cushioning and it is essential when the cylinder itself is required to retard heavy messes. This can only be done at the end positions of the piston stock. In all intermediate position a separate externally mounted cushioning derive most be provided with the damping feature.

The normal escape of air is out off by a cushioning piston before the end of the stock is required. As a result the sit in the cushioning chamber is again compressed since it cannot escape but slowly according to the setting made on reverses. The air freely enters the cylinder and the piston stokes in the other direction at full force and velocity.

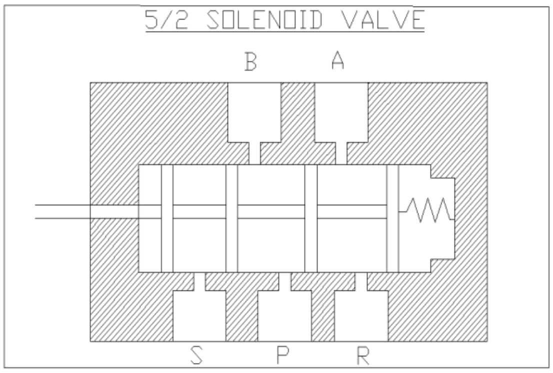
3.1.4 Solenoid valve:

5/2 Double Acting Solenoid Valve:

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

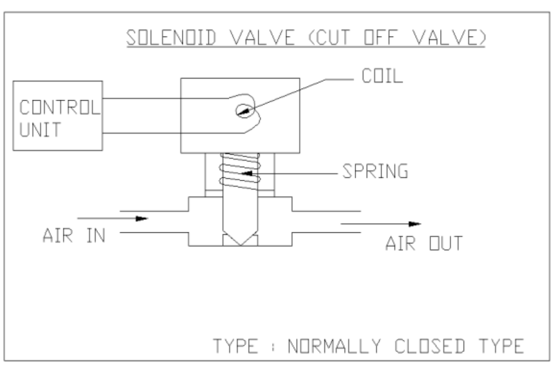
This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve.

A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism. Solenoids may be push type or pull type. The push type solenoid is one in which the plunger is pushed when the solenoid is energized electrically. The pull type solenoid is one is which the plunger is pulled when the solenoid is energized. The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, to do service work or to install them.



Solenoid valve or cut of valve

The control valve is used to control the flow direction is called cut off valve or solenoid valve. This solenoid cut off valve is controlled by the electronic control unit.



In our Work separate solenoid valve is used for flow direction of vice cylinder. It is used to flow the air from compressor to the single acting cylinder.

4. DESIGN AND DRAWING:

Pneumatic components and its specification

The pneumatic auto feed drilling machine consists of the following components to full fill the requirements of complete operation of the machine.

Double acting pneumatic cylinder,Single acting Cylinder , 5/2 Solenoid Valve, 3/2 Solenoid Valve, Flow control Valve, Connectors, Hoses

4.1 Double acting pneumatic cylinder :
Technical Data

Stroke length: Cylinder stoker length 170 mm = 0.17 m
Piston rod : 15 mm = 15 x 10^{-3} m
Quantity : 1
Seals : Nitride (Buna-N) Elastomer
End cones : Cast iron
Piston : EN – 8
Media : Air
Temperature : 0-80 º C
Pressure Range : 0- 8 N/m²

4.2. Single acting pneumatic cylinder
Technical Data

Stroke length : Cylinder stoker length 100 mm
Quantity : 1
Seals : Nitride (Buna-N) Elastomer
End cones : Cast iron
Piston : EN – 8
Media : Air
Temperature : 0-80 º C
Pressure Range : 8 N/m²

4.3. 5/2 Solenoid Valve
Technical data

Size : 0.635 x 10^{-2} m
Part size : G 0.635 x 10^{-2} m
Max pressure range: 0-10 x 10^{5} N/m²
Quantity : 1
Voltage : 230 V A.C supply
Frequency : 50 Hz

4.4. 3/2 solenoid valve:-
Technical Data:

Size : ¼"
Pressure : 0 to 7 kg / cm2
Media : Air
Type : 3/2
Applied Voltage : 230V A.C
Frequency : 50 Hz

4.5. Flow control Valve
Technical Data

Port size : 0.635 x 10^{-2} m
Pressure : 0-8 x 10^{5} N/m²
Media : Air
Quantity : 1

4.6. Connectors
Technical data

Max working pressure: 10 x 10^{5} N/m²
Temperature : 0-100 º C
Fluid media : Air
Material : Brass

4.7. Hoses
Technical date

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 1 Issue 6, August - 2012

Max pressure :10×10^5 N/m²
Outer diameter : 6 mm = 6×10^{-3}m
Inner diameter :3.5 mm = 3.5×10^{-3}m

5.DESIGN CALCULATION

5.1. PNEUMATIC DOUBLE ACTING CYLINDER

Design of Piston rod:-
Load due to air Pressure.

Diameter of the Piston (d) = 40 mm
Pressure acting (p) = 6 kgf/cm²
Material used for rod = C 45
Yield stress (σ_y) = 36 kgf/mm²
Assuming factor of safety = 2

Force acting on the rod (P) = Pressure x Area
= p x (Πd^2 / 4)
= 6 x {($\Pi \times 4^2$) / 4 }
P = 73.36 Kgf

Design Stress(σ_y) = σy / F0 S
= 36 / 2 = 18 Kgf/mm²
= P / (Π d² / 4)

$$\therefore d = \sqrt{4P/\pi[\sigma y]}$$
$$= \sqrt{4 \times 75.36/\{\pi \times 18\}}$$
$$= 2.3\text{mm.}$$

∴ Minimum diameter of rod required for the load
= 2.3 mm

We assume diameter of the rod
= 15 mm

5.2 Design of cylinder thickness:

Material used =Cast iron
Assuming internal diameter of the cylinder= 40 mm
Ultimate tensile stress= 250 N/mm² = 2500 gf/mm²
Working Stress=Ultimate tensile stress / factor of Safety.
Assuming factor of safety = 4
Working stress (f_t)=2500 / 4 = 625 Kgf/cm²

According to 'LAMES EQUATION'

Minimum thickness of cylinder (t)

$$= ri\{\sqrt{\frac{f_t+P}{f_t-P}} - 1\}$$

Where,
ri=inner radius of cylinder in cm, f_t=Working stress (Kgf/cm²), p=Working pressure in Kgf/cm².

∴ Substituting values we get,
t = 0.19mm.

We assume thickness of cylinder = 2.5 mm
Inner diameter of barrel = 40 mm
Outer diameter of barrel = 40 + 2t
= 40 + (2 x 2.5)
= 45 mm.

5.3 Design of Piston rod:

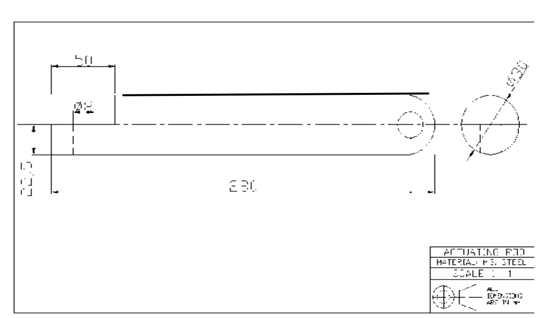
Diameter of Piston Rod:

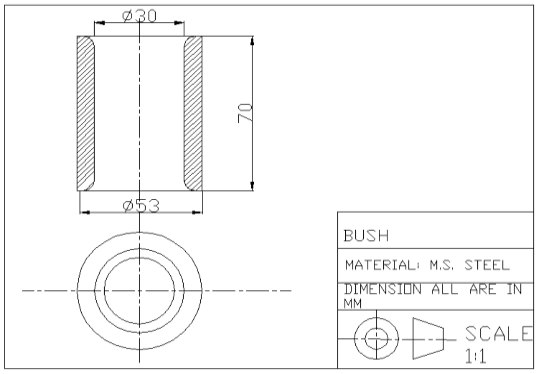
Force of piston Rod (P) = Pressure x area
= p x Π/4 (d²)
= 6 x (Π / 4) x (4)²
= 73.36 Kgf

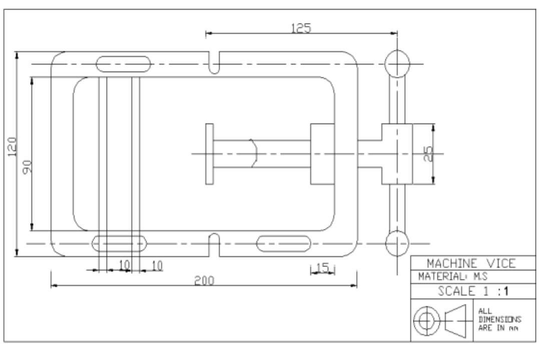
Also, force on piston rod (P)= (Π/4) (d_p)² x f_t
P= (Π/4) x (dp)² x 625
73.36= (Π/4) x (dp)² x 625
∴ dp²= 73.36 x (4/Π) x (1/625)
= 0.15
dp=0.38 cm=3.8 mm
By standardizing dp=15 mm.

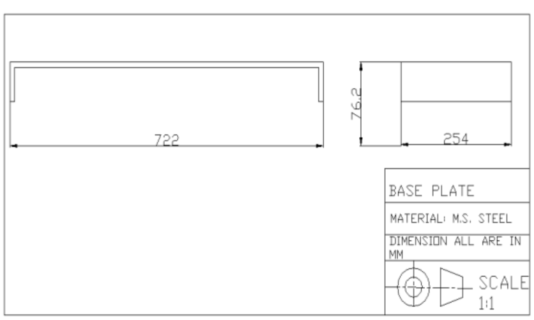
Length of piston rod:

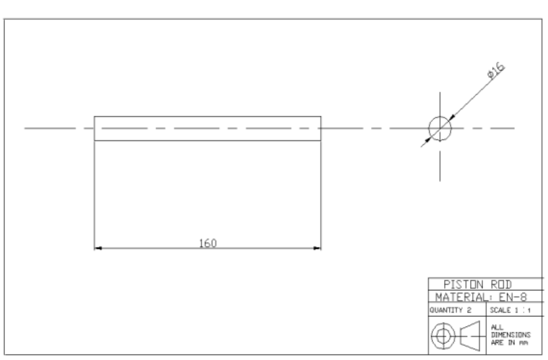
Approach stroke =160 mm
Length of threads =2 x 20=40mm
Extra length due to front cover =12 mm
Extra length of accommodate head=20 mm
Total length of the piston rod =160 + 40 + 12 + 20
=232 mm
By standardizing, length of the piston rod=230 mm

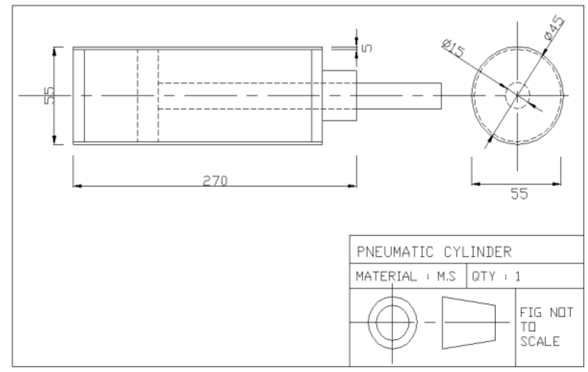


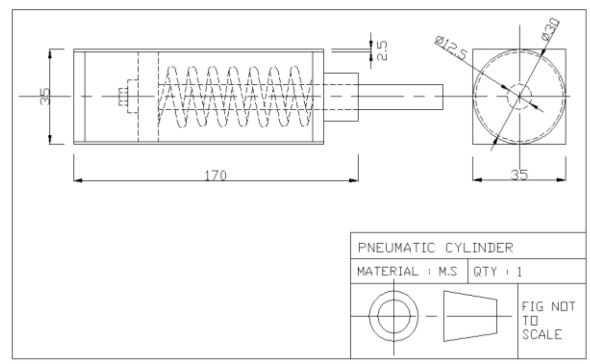

Ø30
70
Ø53
BUSH
MATERIAL: M.S. STEEL
DIMENSION ALL ARE IN MM
SCALE 1:1

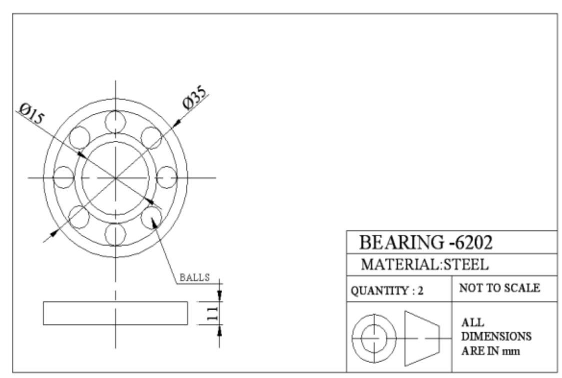

125
120
90
25
10
10
15
200
MACHINE VICE
MATERIAL: M.S
SCALE 1 :1
ALL DIMENSIONS ARE IN mm

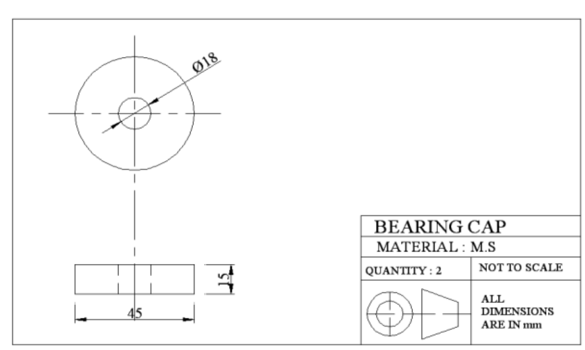

76.2
722
254
BASE PLATE
MATERIAL: M.S. STEEL
DIMENSION ALL ARE IN MM
SCALE 1:1

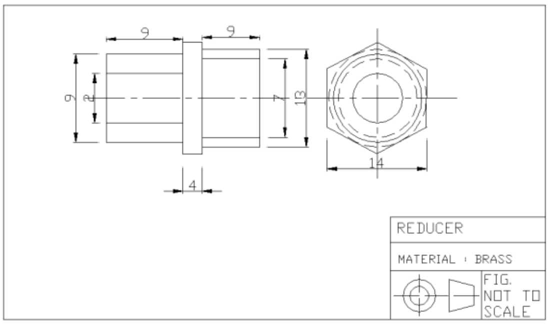

Ø16
160
PISTON ROD
MATERIAL: EN-8

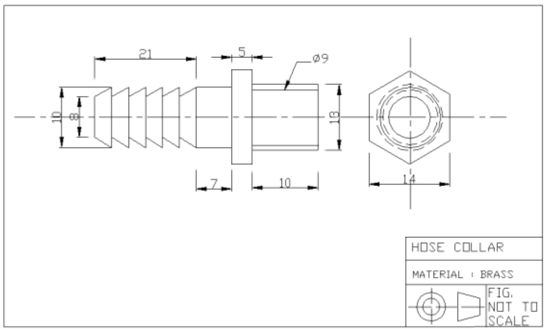

55
5
Ø15
Ø45
270
55
PNEUMATIC CYLINDER
MATERIAL : M.S
QTY : 1
FIG NOT TO SCALE

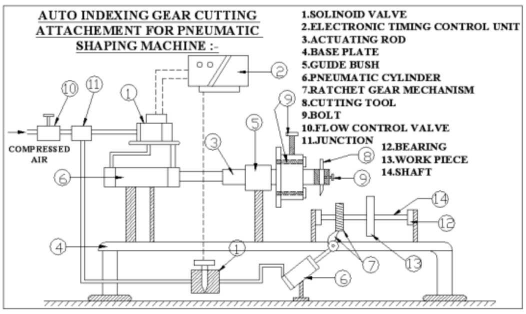

35
2.5
Ø12.5
Ø30
170
35
PNEUMATIC CYLINDER
MATERIAL : M.S
QTY : 1
FIG NOT TO SCALE


Ø15
Ø35
BALLS
11
BEARING -6202
MATERIAL:STEEL
QUANTITY : 2
NOT TO SCALE
ALL DIMENSIONS ARE IN mm


Ø18
15
45
BEARING CAP
MATERIAL : M.S
QUANTITY : 2
NOT TO SCALE
ALL DIMENSIONS ARE IN mm







WORKING PRINCIPLE:

Initially starting with air compresses, its function is to compress air from a low inlet pressure (usually atmospheric) to a higher pressure level. This is an accomplished by reducing the volume of the air.

Air compressors are generally positive displacement units and are either of the reciprocating piston type or the rotary screw or rotary vane types. The air compressor used here is a typically small sized, two-stage compressor unit. It also consists of a compressed air tank, electric rotor and pulley drive, pressure controls and instruments for quick hook up and use. The pressure exceeds the designed pressure of the receiver a release value provided releases the excesses air and thus stays a head of any hazards to take place.

The compressed air goes to the solenoid valve through flow control valve. The flow control valve is used to control the amount air flow to the cylinder. This flow is adjusted by manually by the nap is fixed above the flow control valve. Then this air goes to the 5/2 solenoid valve. The 5/2 solenoid valve is having one input port, two output port and two exhaust port.

The 5/2 solenoid valve is controlled by the electronic timing control unit. The speed of the on/off the solenoid valve is controlled by this timing control unit. The 2 outlet ports are connected to an actuator (Cylinder). The pneumatic activates is a double acting, single rod cylinder. The cylinder output is coupled to further purpose. The piston end has an air horning effect to prevent sudden thrust at extreme ends.

PRINCIPLES OF WORKING:

The compressed air from the compressor reaches the solenoid valve. The solenoid valve changes the direction of flow according to the signals from the timing device.

The compressed air pass through the 5/2 solenoid valve and it is admitted into the front end of the cylinder block. The air pushes the piston for the cutting stroke. At the end of the cutting stroke air from the solenoid valve reaches the rear end of the cylinder block. The pressure remains the same but the area is less due to the presence of piston rod. This exerts greater pressure on the piston, pushing it at a faster rate thus enabling faster return stroke.

The compressed air pass through the 3/2 solenoid valve and it is admitted into the front end of the cylinder block. The air pushes the piston for the gear changer. At the end of the cutting stroke air from the solenoid valve reaches the rear end of the cylinder block.

The pressure remains the same but the area is less due to the presence of piston rod. This exerts greater pressure on the piston, pushing it at a faster rate thus enabling faster return stroke.

The screw attached is fixed to the clapper box frame gives constant loads which lower the sapper to enable continuous cutting of the work.

The stroke length of the piston can be changed by making suitable adjustment in the timer.

6.CONCLUSION :

In the gear cutting attachment for sapping machine variable speeds can be obtained by adjusting the timer device and pressure of the compressed air. Since the mechanism is so simple and versatile it can be handled by any operator, constriction of the unit is very simple. Handling the machine is easy and smooth operation is achieved.

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