Design and Fabrication of Pneumatic Vice

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***Abstract*— A vice is a mechanical screw apparatus used for holding or clamping a work piece to allow work to be performed on it with tools such as saws, planes, drills, mills, screwdrivers, sandpaper, etc. Vices usually have one fixed jaw and another parallel jaw which is moved towards or away from the fixed jaw by the screw. Vice is used to drill a wood, metal, etc. by holding your workpiece tightly, it gives you all stability you need so you can make precise cuts. Even it is used for sawing a job with constant force applied by hand, or automatically, in order to cut desired shapes. A pneumatic system is controlled through manual or automatic process. In this Automatic pneumatic vice project for metal working is provided with widely and quick movable clamping jaw and fixed jaw where the vertical clamping surface of the fixed jaw and the horizontal surface of the fastening plane for the working piece confirm an accurate and unchangeable. Using automatically operated pneumatic vice will help you to get the work down easily and save energy.**

***Index Terms*— Pneumatic, Actuators, Compressor, Bench Vice, Pneumatic Vice**

I. INTRODUCTION

Vise is a mechanical screw apparatus used for holding or clamping a work piece to allow work to be performed on it with tools such as saws, planes, mills, drills, screwdrivers sandpaper, etc. Vises usually have one fixed jaw and another, parallel jaw which is moved towards or away from the fixed jaw by the screw. Vises are used as holding devise on machines like lathes, milling machine, drilling machine etc. and also by tool makers for holding jobs. Design wise three types of vises are very common in use namely plain vise, swivel vise and tool maker's vise which is commonly known as bench vise. Vise is usually refers to a bench vise with flat, parallel jaws, attached to a workbench. There are two main types: a woodworking vise and engineer's vise. The woodworker's bench vise main characteristic is its integration into the bench. An engineer's bench vise is usually clamped or bolted onto the top of the bench. The handle is usually adjustable so that it can be tightened in small places. There are four main types of bench vises these are machinist vise, mechanics vise, post vise and woodworkers vise. The machinist's vise is considered as "cream of the crop". They are stoutly made and are finely machined. The jaws should match up perfectly, and they will be made of very high grade (60,000psi or greater) cast iron. The mechanic's vises are made of lower grade iron. They usually have an integrated anvil area. The post vise is a blacksmith's tool, these vises are made of forged wrought iron, not cast iron, allowing them to have ductility. The woodworker's vise is an undermount vise, usually with a retractable dog for clamping work upon the workbench. There are two main types of jaws used on vises: hard and soft. Hard jaws are available with either a coarse gripping surface or are ground flat and smooth to increase accuracy. The latter relies on pressure for gripping, instead of a rough surface. An unskilled operator has the tendency to over tighten jaws, leading to part deformation and error in the finished work piece. Soft jaws are usually made from a soft metal (usually aluminum), plastic, or wood. They are used to either hold delicate work pieces. These specifically cut jaws are often used in place of fixtures and most commonly used in gang operations. They are also used for rapid change-over type set-ups since they can be easily engraved with the part number, the job number, or other information relevant to the job being run. Soft jaws are considered a consumable item, because they are discarded or recycled after multiple uses. Pneumatics is all about using compressed air to make a process happens. Compressed air is simply the air we breathe squeezed into a small space under pressure. You might remember that air under pressure possesses potential energy which can be released to do useful work. Their principle of operation is similar to that of the hydraulic power systems. An air compressor converts the mechanical energy of the prime mover into, mainly, pressure energy of the compressed air. This transformation facilitates the transmission, storage,

and control of energy. After compression, the compressed air should be prepared for use.

II. SYSTEM & COMPONENTS PNEUMATIC

Pneumatic components can be divided into two categories:

1. Components that produce and transport compressed air.
2. Components that consume compressed air.

All main pneumatic components can be represented by simple pneumatic symbols. Each symbol shows only the function of the component it represents, but not its structure. Pneumatic symbols can be combined to form pneumatic diagrams. A pneumatic diagram describes the relations between each pneumatic component, that is, the design of the system.

(a) Compressor :

A compressor can compress air to the required pressures. It can convert the mechanical energy from motors and engines into the potential energy in compressed. A single central compressor can supply various pneumatic components with compressed air, which is transported through pipes from the cylinder to the pneumatic components. Compressors can be divided into two classes: reciprocator and rotary.

(b) Pressure regulating component :

Pressure regulating components are formed by various components, each of which has its own pneumatic symbol:

(i) Filter – can remove impurities from compressed air before it is fed to the pneumatic components.

(ii) Pressure regulator – to stabilize the pressure and regulate the operation of pneumatic components.

(iii) Lubricator – To provide lubrication for pneumatic components.

III. ELEMENTS OF A BASIC COMPRESSED AIR PNEUMATIC SYSTEM

A. AIR COMPRESSOR :

Driven with the help of an electric motor, it compresses the air raising air pressure to above ambient pressure for use in pneumatic system. Commonly used air compressors are the ones in which successive volumes of air are isolated & then compressed. These are:

1. SINGLE ACTING, SINGLE STAGE, VERTICAL RECIPROCATING COMPRESSOR

on the air intake stroke the descending piston causes air to be sucked into the chamber through the spring loaded inlet valve & when the piston starts to rise again, the trapped air forces the inlet valve to close & so becomes compressed. When the air pressure has risen sufficiently, the spring loaded outlet valve opens & the trapped air flows into the compressed air system. After the piston has reached the top dead centre it then begins to descend & the cycle repeats itself.

2. ROTARY VANE COMPRESSOR:

This has a rotor mounted eccentrically in a cylindrical chamber. The rotor has blades, the vanes , which are free to slide in radial slots with rotation causing the vanes to be driven outward s against the walls of the cylinder. As the rotor rotates, air is trapped in the pockets formed by vanes & as the rotor rotates so the pockets become smaller & the air gets compressed.

3. ROTARY SCREW COMPRESSOR :

It has two intermeshing rotary screws which rotate in opposite directions. As the screw rotates, air is drawn into the casing through inlet port & into the space b/w the screws. Then, this trapped air is moved along the length of the screws & compressed as the space becomes progr. smaller, emerging from the discharge port. Out of these three discussed above the highest pressurized air is provided by the rotary screw compressor.

B. CHECK VALVE:

It's a one-way valve that allows pressurized air to enter the pneumatic system but prevents the backflow of air towards the compressor when compressor is stopped.

C. ACCUMULATOR :

It stores the compressed air, prevents surges in the pressure & hence prevents constant compressor operation.

D. DIRECTIONAL CONTROL VALVE:

Controls the pressurized air flow from the accumulator. These valves can be actuated manually or electrically. They are not intended to vary the rate flow but are either completely open or completely closed. The symbol used for these valves consists of a square for each of its switching positions.

E. PILOT OPERATED VALVE:
The force required to move the piston can be often too large for normal valve operation. To overcome this problem a pilot operated system is used where one valve is used to control the second valve. The pilot valve is of small capacity & can be operated manually or by a solenoid.

F. ACTUATORS: Converts energy stored in compressed air into mechanical motion.

IV. PRODUCTION OF COMPRESSED AIR

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 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. Clean condition of the suction air is one of the factors, which decides the life of a compressor. Warm and moist suction air will result in increased precipitation of condense from the compressed air.

Compressor may be classified in two general types :
1. Positive displacement compressor
2. Turbo compressor

POSITIVE DISPLACEMENT COMPRESSOR
Positive displacement compressors are most frequently employed for compressed air plant and have proved highly successful and supply air for pneumatic control application.

The types of positive compressor :
1.Reciprocating type compressor
2.Rotary type compressor
Turbo compressors are employed where large capacity of air required at low discharge pressures. They cannot attain pressure necessary for pneumatic control application unless built in multistage designs and are seldom encountered in pneumatic service.

V. WORKING

Examples of components that consume compressed air include execution components (cylinders), directional control valves and assistant valves. 5.1 Execution component Pneumatic execution components provide rectilinear or rotary movement. Examples of pneumatic execution components include cylinder pistons, pneumatic motors, etc. Rectilinear motion is produced by cylinder pistons, while pneumatic motors provide continuous rotations. There are many kinds of cylinders, such as single acting cylinders and double acting cylinders.
(i) Single acting cylinder Therefore, it can only produce thrust in one direction. The piston rod is propelled in the opposite direction by an internal spring, or by the external force provided by mechanical movement or weight of a load.
The thrust from the piston rod is greatly lowered because it has to overcome the force from the spring. Therefore, in order to provide the driving force for machines, the diameter of the cylinder should be increased. In order to match the length of the spring, the length of the cylinder should also be increased, thus limiting the length of the path. Single acting cylinders are used in stamping, printing, moving materials, etc.
(ii) Double acting cylinder In a double acting cylinder, air pressure is applied alternately to the relative surface of the piston, producing a propelling force and a retracting force. As the effective area of the piston is small, the thrust produced during retraction is relatively weak. The impeccable tubes of double acting cylinders are usually made of steel. The working surfaces are also polished and coated with chromium to reduce friction.
Directional control valve Directional control valves ensure the flow of air between air ports by opening, closing and switching their internal connections.
Their classification is determined by the number of ports, the number of switching positions, the normal position of the valve and its method of operation. Common types of directional control valves include 2/2, 3/2, 5/2, etc. The first number represents the number of ports; the second number represents the number of positions. A directional control valve that

has two ports and five positions can be represented by the drawing in, as well as its own unique pneumatic symbol.

VI. CONCLUSION

The designed bench vise is a handy automatic vise that can reduce the human efforts and saves the time. Which is can used for the industrial purpose. So here we propose an automatic bench vise machine that delivers accurate tapping, sawing, planning, and drilling functionality by consuming a small amount of space for accurate work results.

REFERENCE

[1] Gupta J.K and Kurume R.S (1981) "Textbook of machine Design", S. Chand & comp and.
[2] Parr. Andrew (2003) "Hydraulic & Pneumatics" Butterworth Hermann Ltd.
[3] Majumdar S.R "Pneumatic systems", Tata McGraw-hills company Ltd.
[4] S.G. College of Technology. (2000), "Design Data Book", Coimbatore Publication, 4th Edition.
[5] Malachi Somalia, (Jan. 2011), "Design and Manufacture of 30-ton hydraulic press", Mechanical Engineering Department, Federal University of Technology Yola, Armada State Nigeria; A.U.J.T. 14(3): 196-200.
[6] Bhandari, V.B. (2009), "Design of Machine element", Tata McGraw-Hill Education.
[7] Khurmi, R.S. and Gupta, J.K. (2005), "A Textbook of Machine Design", Eurasia Publication House(P.V.T.) Ltd. 14th Edition, 1230pp. ISBN: 81-219- 2537-1.
[8] Fundamentals of Machine Elements, Bernand J. Hamrock, Bo Jacobson, Steven R. Schmid; WCB/McGraw-Hill International Edition; 1999