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Fabrication of Low Cost Pneumatic Vice

Mr. Sunil Kumar Jena
Assistant Professor,
Department of Mechanical Engineering,
VITS College of Engineering,
Sontyam, Anandapuram, Vizag.

Mr.P.Suresh
Student,
Department of Mechanical Engineering,
VITS College of Engineering,
Sontyam, Anandapuram, Vizag.

Mr.P.T.K.Ravi Teja
Student,
Department of Mechanical Engineering,
VITS College of Engineering,
Sontyam, Anandapuram, Vizag.

Abstract:

Work holding and releasing is the most essential act to carry out machining to hold the job in proper position. To release the job quickly and hold the job rigidly. To prevent the vibrations of the job while the machining is carried out We are using mechanical work holding devices. In this project we are dealing with pneumatic vice used in drilling machineIn pneumatic type vice one end of piston rod is connected to the movable jaw and the piston slides in the cylinder. Here the air actuates the movement of piston, this in turn actuates the movable jaw. Here the principle movement is only a reciprocating movement.

.INTRODUCTION:

Pneumatics is that branch of technology, which deals with the study and application of use of pressurized air to affect mechanical motion. "Pneumos" means "Air" and "Tics" means "TechnologyPneumatics is using air to push/pull things or suck them up. The pistons and tubing are light and powerful, lighter than equivalent motors, however, the compressor is itself a motor and is heavy. Once the big decision to add the compressor is made, adding extra pistons is much easier and lighter than adding extra motors (and gearing).The air compressor keeps air storage tanks filled and the storage tanks provide the reserve air to quickly fill the actuators or pistons. Storage tanks are at least twice the pressure of the actuators so one tank of storage air will quickly fill an actuator the same size, but after that the air compressor cannot replenish the used air very quickly. It adds roughly half a cubic foot of air per minute depending on the pressure already in the system that it's striving to shove more air into. Less air is moved near full pressure (.24cfm) and more at zero (.79cfm) pressure, so in an entire 2 minute match expect the air compressor to add ~.8 cubic feet of air. Plan on doing a test while watching the main high-pressure gauge to see how low it gets during what you expect to be normal operation.

To understand how compressed air is able to do things, let's think of a ball. If we blow up the ball so that it is full, it will contain a lot of compressed air. If we bounce the ball, it will bounce very high. However, if the ball is burst then the compressed air will escape and the ball will not bounce as high. Quite simply, the ball bounces because it is using the energy stored in the compressed air.

HOW IT WORKS:

Compressor The compressor works best when there is no air pressure in the system to resist the pump. As the pressure increases the compressor labors longer to get more pressurized air into the system. The table shows that when at first the system is empty, the compressor can move a lot of air, but as pressure builds up the compressor takes longer and longer to stuff more air in.

ADVANTAGES OF PNEUMATICS:

Simplicity of Design and Control:

- Machines are designed using standard cylinders and other components. Control is as easy as ON-OFF type. Reliability .

- Pneumatic systems tend to have long operating lives and require very little maintenance.

- Because gas is compressible, the equipment is less likely to be damaged by o Storage.

- Compressed Gas can be stored, allowing the use of machines when electrical power is lost.
Safety.

- Very low chance of fire (compared to hydraulic oil). - Machines can be designed to be overload safe.

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AIR STORAGE:

The storage tank volume x its pressure. Since the storage is at 120psi and the highest working pressure will be 60psi, each storage tank holds a reserve of 18.85 in3. However, if your robot starts a match with zero pressure then it will take some time to build working pressure before your pneumatics can be used.

REGULATOR:

High pressure input -> low pressure output Relieving regulator releases excess pressure from the low pressure side to maintain pressure setting, for instance, when an extended cylinder is driven into a wall it drives up the local pressure, but the upstream regulator will release any pressure over its 30-60psi setting.

CYLINDER:

Force = Pressure x Area:
A cylinder will react as a function of time, working pressure, flow rate, and resistance
Layout Options
Outside a few must-have critical items called-out by the rules for safety, teams have a lot of leeway in how the pneumatics can be laid out. The pneumatics system is divided into at least two circuits:

1. A high pressure (120psi) side for air compression and storage only .

2. One or more low pressure sides (60psi or less) for operating stuff

HIGH PRESSURE SIDE (120psi)

Used for air compression and storage only. ~120psi maximum, the air compressor won't produce much beyond that anyway, but running it constantly can overheat it. This side begins with the air compressor and includes any number of storage tanks, a manual exhaust valve, and a pressure gauge. The air compressor itself has an automatic emergency release valve that prevents the pressure from getting much above 120psi. A pressure regulator is the last stop for the air on it's way to the low-pressure side where the actuators get used. Must Haves:

- Manual exhaust valve
- Pressure gauge
- Regulator for the low side w/ pressure gauge
- Automatic emergency pressure release (on the compressor) You don't actually have to have an air compressor. Storage tanks can be pre-charged from an off-board compressor before a game starts, but you'd better not have any leaks.

LOW PRESSURE SIDE (60psi or less)

Used for doing the work operating actuators/pistons/cylinders/vacuum pumps. This side begins with a regulator output from the high pressure side that cuts the operating pressure down to 60psi or less. It doesn't have to be right at 60psi, but must not be greater. You'll sometimes want to use a lower pressure to, for instance, grab a ball with a little less crushing force. Also, in general using the lowest pressure you need to get the job done will preserve your stored air and means your compressor will have to work less to keep up.

Must Haves:

Regulator from the high pressure side w/ pressure gaugeEven Lower Pressure side (50 to ~25psi) Add another regulator taking input from the 60psi side and outputting an even lower maximum pressure. This is used to save on air and reduce the force pistons exert. Very low pressure sub-systems such as the Venturi vacuum needs a constant flow of pretty low pressure air, so typically it would be setup on it's own isolated circuit so as not to waste is an excess air. Must Haves: Regulator from the low pressure side w/ pressure gauge

CYLINDERS:

Cylinders are linear actuators which convert fluid power into mechanical power. They are also known as JACKS or RAMS .

Hydarulic cylinders are used at high pressures and produce large forces and precise movement. For this reason they are constructed of strong materials such as steel and designed to withstand large forces. Because gas is an expansive substance, it is dangerous to use pneumatic cylinders at high pressures so they are limited to about 10 bar pressure.

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Consequently they are constructed from lighter materials such as aluminium and brass. Because gas is a compressible substance, the motion of a pneumatic cylinder is hard to control precisely.The basic theory for hydraulic and pneumatic cylinders us otherwise the same.

THEORY
FORCE

The fluid pushes against the face of the piston and produces a force. The force produce is given by the formula.

$$F = PA$$

P is the pressure in N/m2 and A is the area the pressure acts on in m2.

This assumes that the pressure on the other side of the piston is negligible. The diagram shows a double acting cylinder. In this case the pressure on the other side is usually atmospheric so if p is a gauge pressure we need not worry about the atmospheric pressure.

Let A be the full area of the piston and a be the cross sectional area of the rod.If the pressure is acting on the rod side, then the area on which the pressure acts is (A-a).

F= P A on the full area of piston.
F= P (A-a) on the rod side.

This force acting on the load is often less because of friction between the seals and both the piston and piston rod.

SPEED

The speed of the piston and rod depends upon the flow rate of fluid. The volume per second entering the cylinder inside. It follows then that .

Q m3/ s =Area * distance moved per second
Q m3/s=A*velocity (full side)
Q m3/s=(A-a)* velocity (rod side)

Note in calculus form velocity is given by v= A dx/dt this is useful in control appilications.

In this case of air cylinders, it must be remembered that Q is the volume of the volume of compressed air and this changes with pressure so any variation in pressure will cause a variation in the velocity.

POWER

Mechanical power is defined as Force * velocity. This makes it easy to calculate the power of a cylinder. The fluid power supplied is more than the mechanical power output because of friction between the sliding parts.

SINGLE ACTING CYLINDERS

A simple single acting cylinders is shown below. The cylinder is only powered in one direction and needs another force to return it such an external load (e.g in a car hoist or jack) or a spring. No hydraulic fluid is present on the low pressure side.

DOUBLE ROD CYLINDERS

The basic design of a double rod cylinder is shown below. The design allows equal force and speed in both directions. It is useful in robotic mechanisms were the rod is clamped at both ends and the body moves instead.

TELESCOPIC CYLINDERS

These cylinders produce long strokes from an initial short length. Each section slides inside a larger section.
These cylinders have from 2 to 5 stages. They are typically used in refuse lorries for ejecting the compactedrefuse. They are also used for lifts, tipping, platforms, lifting platforms, and other commercial vehicle applications.

3.SEALS AND BEARINGS

The detailed diagram shows a double acting cylinder. The main seals used are:

1.Piston seals to prevent leakage from one side to the other

2.Rod seal to prevent leakage from the rod end.

3.Static seals to prevent leakage from joints between the barrel and end caps

4.Wiper seal to prevent The bearings are

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1.The rod end bearing made of brass or bronze. This takes the side loads on the rod and ensures lubricating and reduced wear. It also prevents the seal distorting and leaking.

2.The pistons bearing to take the sideways forces and reduce wear.

5. BUCKLING

Buckling occurs when the rod bends or bows out sideways under load. The longer and thinner the rod, the more likely it is for buckling to occur. When selecting from a catalogue, the manufacture will show information to enable you to determine the buckling load.

Sizes:

Air cylinders are available in a variety of sizes and can typically range from a small 2.5 mm air cylinder, which might be used for picking up a small transistor or other electronic component, to 400 mm diameter air cylinders which would impart enough force to lift a car. Some pneumatic cylinders reach 1000 mm in diameter, and are used in place of hydraulic cylinders for special circumstances where leaking hydraulic oil could impose an extreme hazard.

Materials:

The pneumatic cylinders designed for educational use typically have transparent outer sleeves (often plexi glass), so students can see the piston moving inside. The pneumatic cylinders designed for cleanroom applications often use lubricant-free Pyrex Glass pistons sliding inside graphite sleeves.

VALVES:

Valves control the flow of compressed air to a cylinder. They can be used to turn the air on or off, change the direction in which the air is flowing or even slow down the airflow.

COMPRESSORS:
THEORY:

We know already that pneumatic systems need compressed air to make them work.

A bicycle pump can produce compressed air. This is all right for inflating the tires of the bicycle, but can you imagine trying to blow up all the tires on a lorry using this? You would soon become tired, exhausted even. In order to supply pneumatic systems with compressed air we use a machine called a compressor. Compressors come in lots of different shapes and sizes but they all work in the same way.A pump that is driven by a motor, sucks-in air from the room and stores it in a tank called the receiver. We will be able to hear the compressor when it is running. Sometimes though, it will stop because the receiver is full.

An air compressor is a machine which takes in air at a certain pressure and delivers the air at a higher pressure. Everything on earth is subjected to the absolute atmospheric pressure(pa), this pressure cannot be felt. The prevailing atmospheric pressure is therefore regarded as the base and any deviation is termed "gauge pressure". Absolute pressure = Atmospheric pressure + gauge pressure Absolute pressure is approximately one bar greater than the gauge pressure. Characteristics of interest on a compressor are, Delivery volume or capacity of the compressor, Compression ratio. Compressor capacity is usually expressed as air volume at ambient conditions at the compressor intake, namely in units of meter cube per minute or litres per minute.

Compression ratio is expressed by the discharge pressure measured in the generally accepted unit of bars. Compressors should be installed in a separate room. Special care is required to ensure that the compressors will be able to take in air that is preferably cool but above all dry and substantially dust-free. At locations where clean suction air is not available, the installation of a separate intake filter can answer this requirement. Piping leading from the filter to the compressor intake should be amply dimensioned. In this way it is also possible for clean suction air to be supplied to a multiple number of compressors via a common intake duct.

SPECIFICATIONS :

Medium: Compressed air
Mounting position: Vertical ± 5°
Pressure range max.: 10 Bar
Temperature nominal: -10 to + 60

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SAFETY RULES:

Safety rules help to keep us safe. They highlight dangers and this helps to prevent accidents. When we are using pneumatics we must follow these rules.
1. Never blow compressed air at anyone, not even yourself.
2. Never let compressed air come into contact with your skin, as this can be very dangerous.
3. Always wear safety goggles when you are connecting and operating circuits.
4. Check that all airlines are connected before turning on the main air supply.
5. Always turn off the main air supply before changing a circuit.
6. Keep your hands away from moving parts.
7. Avoid having airlines trailing across the floor or where someone could trip or become entangled.

MODIFICATION

Pneumatic pump comprises of pressure valve for the checking pressure .So the valve will only send compressed air, but will not oppose (pass through it in opposite direction).So we need to open the cylinder and the pressure valve will be removed. Then the cylinder will be assembled.All the fittings must be air tight. Thread lockers are used for the air tightness of the cylinder.

DESIGN OF VICE

TYPEOF MATERIAL: ms steel
TYPE OF FABRICATION: welding

WELDING

Arc welding is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is usually protected by some type of shielding gas, vapor, or slag. Arc welding processes may be manual, semi-automatic, or fully automated. First developed in the late part of the 19th century, arc welding became commercially important in shipbuilding during the Second World War. Today it remains an important process for the fabrication of steel structures and vehicles.

Electrode Arc welding is used for joining of the MS steel plates. The electrode will act as both electrode and filler material for the fabrication purpose.

WORKING:

The apparatus is fixed is shown in the fig.Make sure that the all the joints are air leak proof start the compressor for the running condition after the pressure reached between the 2 & 3 kgf/cm2 release the compressor valve slowly to maximum position.

After that release the regulating valve of the pneumatic cylinder the high pressured compressed air will enters into the cylinder moving the piston to lock the work piece.

When the machining operation is completed the hose pipe is removed and the valves are opened to the atmosphere then the work piece will be removed.

CALCULATION

Perimeter of the Cylinder = $2*\pi*R=23cm$

$R=23/(2*\pi)$
$R=3.66cm$

Diameter of the cylinder $D=2R$
$D=2*3.66$
$D=7.32$

Connecting rod Perimeter = $2*\pi*r = 2.5cm$

$r = 2.5/(2*\pi)$
$r = 0.3978$ cm

Diameter of the connecting rod = $d= 2r$

$d =2*0.3978$
$d = 0.7956$

Total stroke length of the cylinder = 15.5 cm

Effective stroke length = 6cm
F =Force exerted on work piece
F = P*A
F = (Pcomp – Patm) * A
F= (Pcomp – Patm) * $\pi/4(D^2 -d^2)$

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SNO	Pcomp	Patm	P=(Pcomp – Patm)	A=π/4(D^ 2 –d^2)	F=P*A
1	2	1.03297	0.96703	41.3	39.931
2	3	1.03297	1.96704	41.3	81.23
3	4	1.03297	2.96704	41.3	122.53
4	5	1.03297	3.96704	41.3	163.83
5	6	1.03297	4.96704	41.3	205.13
6	7	1.03297	5.96704	41.3	246.43
7	8	1.03297	6.96704	41.3	287.73
8	9	1.03297	7.96704	41.3	329.03 7

ADVANTAGES:

1. Idle time of the machining is reduced
2. When compared with the mechanical vices it consumes less time for clamping and unclamping the job
3. It reduces the manual labour
4. hence, the production rate is higher
5. In this mechanism there is no backlash

DISADVANTAGES:

1. Initial cost is high
2. May be chance of air leakage
3. Cylinder stroke length is constant

CONCLUSION:

The project is meant to produce a low cost pneumatic vice as a work holding devices for machining operations like filing, grinding, drilling..e.t.cWe designed a pneumatic vice which costs less than that available in the market. We are very good at what we have done and had fun doing it. Our pneumatic vice is useful to do machining operations operation and 10 kgf/cm2 max pressure withstanding. We can do simple operations which is very useful and helpful to do small works at our college.We tested our project on holding the work pieces.

FUTURE EXTENSION:

1. Two cylinders side by side placed in the arrangement leads to hold a greater size work piece for grinding operations also for higher thickness metals.

2. Two adjustable cylinders placed in opposite side results in the holding of all sizes work piece.

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