Gear Shaping Attachment in a Shaper Machine

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Abstract – The objectives of the project to design and fabrication of gear shifting system for shaper machine. It can be designed by attached with shaper machine. A shaping machine is used to machine surfaces. It can cut curves, angles and many other shapes. It is a popular machine in a workshop because its movement is very simple although it can produce a variety of work. A shaper is used to machine a single job by using a single point cutting tool and hence it cannot 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.

Index Terms – Gear Shaping, Shaper Machine, Cylinder psiton.

1. INTRODUCTION

This is an arera 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. Shaping machine

A photographic view of general configuration of shaping machine is shown in Fig.1.1. The main functions of shaping machines are to produce flat surfaces in different planes. Fig.1.2 shows the basic principle of generation of flat surface by shaping machine. The cutting motion provided by the linear forward motion of the reciprocating tool and the intermittent feed motion provided by the slow transverse motion of the job along with the bed result in producing a flat surface by gradual removal of excess material layer by layer in the form of chips.

The vertical infeed is given either by descending the tool holder or raising the bed or both. Straight grooves of various curved sections are also made in shaping machines by using specific form tools. The single point straight or form tool is clamped in the vertical slide which is mounted at the front face of the reciprocating ram whereas the work piece is directly or indirectly through a vice is mounted on the bed.

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

$$PV = C \text{ (or) } P_1V_1 = P2V2$$

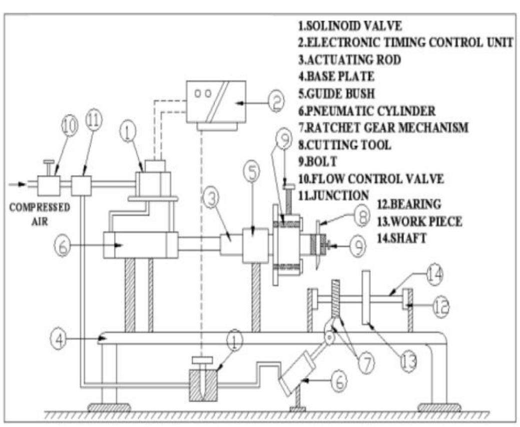
In this equation the pressure is the absolute pressured which for free is about 14.7 Psi and is of courage capable of maintaining a column of mercury, nearly 30 inches high in an ordinary barometer. Any gas can be used in pneumatic system but air is the mostly used system now a days.

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 outstanding advantages in terms of safety.

3. DESIGN OF THE PROJECT



3.1. 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 3/2 solenoid valve. The 3/2 solenoid valve is having one input port, two output port and two exhaust port.

The 3/2 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.

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 3/2 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.

4. PNEUMATIC FITTINGS

There are no nuts to tighten the tube to the fittings as in the conventional type of metallic fittings. The tube is connected to the fitting by a simple push ensuring leak proof connection and can be released by pressing the cap and does not require any special tooling like spanner to connect (or) disconnect the tube from the fitting

SPECIFICATION OF THE FITTING:

➢ Body Material	-	Plastic
➢ Collect/Thread Nipple	-	Brass
➢ Seal	-	Nitrate Rubber
➢ Fluid Used	-	Air
➢ Max. Operating Pressure	-	7 Bar
➢ Tolerance on OD of the tubes	-	± 1 mm
➢ Min.Wall thickness of tubes	-	1 mm.

4.1. FLEXIBLE HOSES:

The Pneumatic hoses, which is used when pneumaticcompone nts such as actuators are subjected to movement. Hose isfabric ated in layer of elastomeric or synthetic rubber, which permits operation at high pressure. The standard outside diameter of tubing is 1/16 inch. If the hose is subjected to rubbing, it should be encased in a protective sleeve.

4.2. COMPRESSOR

An air compressor is a device that converts power (usually from an electric motor, a diesel engine or a gasoline engine) into kinetic energy by compressing and pressurizing air, which, on command, can be released in quick bursts. There are numerous methods of air compression, divided into either positive-displacement or negative-displacement types.

5. TYPES OF AIR COMPRESSOR

1. According to the design and principle of operation
    1. Reciprocating compressor
    2. Rotary screw compressor
2. According to the number of stages
    1. Single stage compressor
    2. Multi stage compressor
3. According to the pressure limits
    1. Low pressure compressors
    2. Medium pressure compressors
    3. High pressure compressors
    4. Super high pressure compressors
4. According to the capacity
    1. Low capacity compressors
    2. Medium capacity compressors
    3. High capacity compressors
5. According to the method of cooling
    1. Air cooled compressor
    2. Water cooled compressor

5.1. APPLICATIONS

- To supply high-pressure clean air to fill gas cylinders
- To supply moderate-pressure clean air to a submerged surface supplied diver
- To supply moderate-pressure clean air for driving some office and school building pneumatic HVAC control system valves
- To supply a large amount of moderate-pressure air to power pneumatic tools
- For filling tires
- To produce large volumes of moderate-pressure air for large-scale industrial processes (such as oxidation for petroleum coking or cement plant bag house purge systems).

Most air compressors either are reciprocating piston type, rotary vane or rotary screw. Centrifugal compressors are common in very large applications. There are two main types of air compressor's pumps: oil-lubed and oil-less. The oil-less system has more technical development, but is more expensive, louder and lasts for less time than oil-lubed pumps. The oil-less system also delivers air of better quality.

5.2. PRESSURE GAUGE

The construction of a bourdon tube gauge. Construction elements are made of brass

Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure pressure are called **pressure gauges** or **vacuum gauges**.

A **manometer** could also refer to a pressuremeasuring instrument, usually limited to measuring pressures near to atmospheric. The term manometer is often used to refer specifically to liquid column hydrostatic instruments.

A **vacuum gauge** is used to measure the pressure in a vacuum—which is further divided into two subcategories, high and low vacuum (and sometimes ultra-high vacuum). The applicable pressure range of many of the techniques used to measure vacuums have an overlap. Hence, by combining several different types of gauge, it is possible to measure system pressure continuously from 10 mbar down to 10^{-11} mbar.

Absolute, gauge and differential pressures - zero reference

Everyday pressure measurements, such as for tire pressure, are usually made to ambient air pressure. In other cases measurements are made relative to a vacuum or to some other ad hoc reference. When distinguishing between these zero references, the following terms are used:

Absolute pressure is zero-referenced against a perfect vacuum, so it is equal to gauge pressure plus atmospheric pressure.

Gauge pressure is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure. Negative signs are usually omitted.

Differential pressure is the difference in pressure between two points.

The zero reference in use is usually implied by context, and these words are added only when clarification is needed. Tire pressure and blood pressure are gauge pressures by convention, while atmospheric pressures, deep vacuum pressures, and altimeter pressures must be absolute. Differential pressures are commonly used in industrial process systems. Differential pressure gauges have two inlet ports, each connected to one of the volumes whose pressure is to be monitored. In effect, such a gauge performs the mathematical operation of subtraction through mechanical means, obviating the need for an operator or control system to watch two separate gauges and determine the difference in readings.

Moderate vacuum pressures are often ambiguous, as they may represent absolute pressure or gauge pressure without a negative sign. Thus a vacuum of 26 inHg gauge is equivalent to an absolute pressure of 30 in Hg (typical atmospheric pressure) − 26 inHg = 4 inHg.

Atmospheric pressure is typically about 100 kPa at sea level, but is variable with altitude and weather. If the absolute pressure of a fluid stays constant, the gauge pressure of the same fluid will vary as atmospheric pressure changes. For example, when a car drives up a mountain (atmospheric air pressure decreases), the (gauge) tire pressure goes up. Some standard values of atmospheric pressure such as 101.325 kPa or 100 kPa have been defined, and some instruments use one of these standard values as a constant zero reference instead of the actual variable ambient air pressure. This impairs the accuracy of these instruments, especially when used at high altitudes.

Use of the atmosphere as reference is usually signified by a (g) after the pressure unit e.g. 30 psi g, which means that the pressure measured is the total pressure minus atmospheric pressure. There are two types of gauge reference pressure: vented gauge (vg) and sealed gauge (sg).

A vented gauge pressure transmitter for example allows the outside air pressure to be exposed to the negative side of the pressure sensing diaphragm, via a vented cable or a hole on the side of the device, so that it always measures the pressure referred to ambient barometric pressure. Thus a vented gauge reference pressure sensor should always read zero pressure when the process pressure connection is held open to the air.

A sealed gauge reference is very similar except that atmospheric pressure is sealed on the negative side of the diaphragm. This is usually adopted on high pressure ranges such as hydraulics where atmospheric pressure changes will have a negligible effect on the accuracy of the reading, so venting is not necessary.

This also allows some manufacturers to provide secondary pressure containment as an extra precaution for pressure equipment safety if the burst pressure of the primary sensing diaphragm is exceeded.

There is another way of creating a sealed gauge reference and this is to seal a high vacuum on the reverse side of the sensing diaphragm. Then the output signal is offset so the pressure sensor reads close to zero when measuring atmospheric pressure.

A sealed gauge reference pressure transducer will never read exactly zero because atmospheric pressure is always changing and the reference in this case is fixed at 1 bar.

An absolute pressure measurement is one that is referred to absolute vacuum. The best example of an absolute referenced pressure is atmospheric or barometric pressure.

To produce an absolute pressure sensor the manufacturer will seal a high vacuum behind the sensing diaphragm. If the process pressure connection of an absolute pressure transmitter is open to the air, it will read the actual barometric pressure.

Static and dynamic pressure

Static pressure is uniform in all directions, so pressure measurements are independent of direction in an immovable (static) fluid. Flow, however, applies additional pressure on surfaces perpendicular to the flow direction, while having little impact on surfaces parallel to the flow direction. This directional component of pressure in a moving (dynamic) fluid is called dynamic pressure. An instrument facing the flow direction measures the sum of the static and dynamic pressures; this measurement is called the total pressure or stagnation pressure.

Since dynamic pressure is referenced to static pressure, it is neither gauge nor absolute; it is a differential pressure.

While static gauge pressure is of primary importance to determining net loads on pipe walls, dynamic pressure is used to measure flow rates and airspeed. Dynamic pressure can be measured by taking the differential pressure between instruments parallel and perpendicular to the flow. Pitot-static tubes, for example perform this measurement on airplanes to determine airspeed. The presence of the measuring instrument inevitably acts to divert flow and create turbulence, so its shape is critical to accuracy and the calibration curves are often non-linear.

5.3. Applications

- Altimeter
- Barometer
- MAP sensor
- Pitot tube
- Sphygmomanometer

5.4. Instruments

Many instruments have been invented to measure pressure, with different advantages and disadvantages. Pressure range, sensitivity, dynamic response and cost all vary by several orders of magnitude from one instrument design to the next. The oldest type is the liquid column (a vertical tube filled with mercury) manometer invented by Evangelista Torricelli in 1643. The U-Tube was invented by Christian Huygens in 1661.

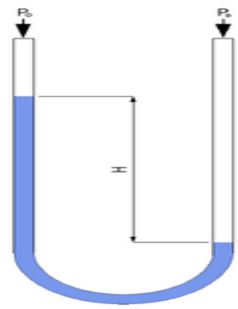
5.5. Hydrostatic

Hydrostatic gauges (such as the mercury column manometer) compare pressure to the hydrostatic force per unit area at the base of a column of fluid. Hydrostatic gauge measurements are independent of the type of gas being measured, and can be designed to have a very linear calibration. They have poor dynamic response.

5.6. Piston

Piston-type gauges counterbalance the pressure of a fluid with a spring (for example tire-pressure gauges of comparatively low accuracy) or a solid weight, in which case it is known as a deadweight tester and may be used for calibration of other gauges.

5.7. Liquid column



The difference in fluid height in a liquid column manometer is proportional to the pressure difference.

$$x = \frac{P_a - P_o}{g\rho}$$

Liquid column gauges consist of a vertical column of liquid in a tube that has ends which are exposed to different pressures. The column will rise or fall until its weight is in equilibrium with the pressure differential between the two ends of the tube. A very simple version is a U-shaped tube half-full of liquid, one side of which is connected to the region of interest while the reference pressure (which might be the atmospheric pressure or a vacuum) is applied to the other. The difference in liquid level represents the applied pressure.

The pressure exerted by a column of fluid of height h and density ρ is given by the hydrostatic pressure equation, $P = hg\rho$. Therefore the pressure difference between the applied pressure Pa and the reference pressure P0 in a U-tube manometer can be found by solving $Pa - P0 = hg\rho$. In other words, the pressure on either end of the liquid (shown in blue in the figure to the right) must be balanced (since the liquid is static) and so $Pa = P0 + hg\rho$.

If the fluid being measured is significantly dense, hydrostatic corrections may have to be made for the height between the moving surface of the manometer working fluid and the location where the pressure measurement is desired except when measuring differential pressure of a fluid (for example across an orifice plate or venturi), in which case the density ρ should be corrected by subtracting the density of the fluid being measured.

Although any fluid can be used, mercury is preferred for its high density (13.534 g/cm3) and low vapour pressure. For low pressure differences well above the vapour pressure of water, water is commonly used (and "inches of water" is a common pressure unit). Liquid-column pressure gauges are independent of the type of gas being measured and have a highly linear calibration.

They have poor dynamic response. When measuring vacuum, the working liquid may evaporate and contaminate the vacuum if its vapor pressure is too high. When measuring liquid pressure, a loop filled with gas or a light fluid can isolate the liquids to prevent them from mixing but this can be unnecessary, for example when mercury is used as the manometer fluid to measure differential pressure of a fluid such as water. Simple hydrostatic gauges can measure pressures ranging from a few Torr (a few 100 Pa) to a few atmospheres. (Approximately 1,000,000 Pa)

5.8. Electronic pressure sensors

Piezoresistive Strain Gage

Uses the piezoresistive effect of bonded or formed strain gauges to detect strain due to applied pressure .

Capacitive

Uses a diaphragm and pressure cavity to create a variable capacitor to detect strain due to applied pressure .

Magnetic

Measures the displacement of a diaphragm by means of changes in inductance (reluctance), LVDT, Hall Effect, or by eddy current principal .

Piezoelectric

Uses the piezoelectric effect in certain materials such as quartz to measure the strain upon the sensing mechanism due to pressure .

Optical

Uses the physical change of an optical fiber to detect strain due applied pressure .

Potentiometric

Uses the motion of a wiper along a resistive mechanism to detect the strain caused by applied pressure .

Resonant

Uses the changes in resonant frequency in a sensing mechanism to measure stress, or changes in gas density, caused by applied pressure .

Thermal conductivity

Generally, as a real gas increases in density -which may indicate an increase in pressure- its ability to conduct heat increases. In this type of gauge, a wire filament is heated by running current through it. A thermocouple or Resistance Temperature Detector (RTD) can then be used to measure the temperature of the filament. This temperature is dependent on the rate at which the filament loses heat to the surrounding gas, and therefore on the thermal conductivity. A common variant is the Pirani gauge, which uses a single platinum filament as both the heated element and RTD. These gauges are accurate from 10 Torr to 10^{-3} Torr, but they are sensitive to the chemical composition of the gases being measured.

Two-wire

One wire coil is used as a heater, and the other is used to measure nearby temperature due to convection.

Pirani (one wire)

A Pirani gauge consist of a metal wire open to the pressure being measured. The wire is heated by a current flowing through it and cooled by the gas surrounding it. If the gas pressure is reduced, the cooling effect will decrease, hence the equilibrium temperature of the wire will increase. The resistance of the wire is a function of its temperature: by measuring the voltage across the wire and the current flowing through it, the resistance (and so the gas pressure) can be determined. This type of gauge was invented by Marcello Pirani.

Thermocouple gauges and thermistor gauges work in a similar manner, except a thermocouple or thermistor is used to measure the temperature of the wire.

Useful range: 10-3 - 10 Torr[9] (roughly 10-1 - 1000 Pa)

Ionization gauge

Ionization gauges are the most sensitive gauges for very low pressures (also referred to as hard or high vacuum). They sense pressure indirectly by measuring the electrical ions produced when the gas is bombarded with electrons. Fewer ions will be produced by lower density gases. The calibration of an ion gauge is unstable and dependent on the nature of the gases being measured, which is not always known. They can be calibrated against a McLeod gauge which is much more stable and independent of gas chemistry.

Thermionic emission generate electrons, which collide with gas atoms and generate positive ions. The ions are attracted to a suitably biased electrode known as the collector. The current in the collector is proportional to the rate of ionization, which is a function of the pressure in the system. Hence, measuring the collector current gives the gas pressure. There are several sub-types of ionization gauge.

Useful range: 10-10 - 10-3 torr (roughly 10-8 - 10-1 Pa)

Most ion gauges come in two types: hot cathode and cold cathode. A third type that is more sensitive and expensive known as a spinning rotor gauge exists, but is not discussed here. In the hot cathode version, an electrically heated filament produces an electron beam. The electrons travel through the gauge and ionize gas molecules around them. The resulting ions are collected at a negative electrode. The current depends on the number of ions, which depends on the pressure in the gauge. Hot cathode gauges are accurate from 10−3 Torr to 10−10 Torr. The principle behind cold cathode version is the same, except that electrons are produced in the discharge of a high voltage. Cold Cathode gauges are accurate from 10−2 Torr to 10−9 Torr. Ionization gauge calibration is very sensitive to construction geometry, chemical composition of gases being measured, corrosion and surface deposits. Their calibration can be invalidated by activation at atmospheric pressure or low vacuum. The composition of gases at high vacuums will usually be unpredictable, so a mass spectrometer must be used in conjunction with the ionization gauge for accurate measurement.

6. CONCLUSION

In the gear shifting attachment for shapping 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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