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FABRICATION OF PNEUMATIC WATER PUMPING SYSTEM

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Abstract

The technology of pneumatics has gained tremendous importance in the field of automation from old fashioned timber works, machine shops and space robots .Certain characterizes of air have made this medium quite suitable for used in modern manufacturing and production industries. It is therefore important that technicians and engineers should have knowledge on pneumatic systems air operated valves accessories. Pneumatic system consists of a compressor plant, pipe lines control valves and drive members. The air is compressed in an air compressor and from the compressor plant the flow media is transmitted to the pneumatic cylinder through a well laid pipe line system. So keeping in mind about the importance of pneumatic system are introducing a project called Automatic pneumatic water pumping system. Here all need is a compressor pneumatic cylinder, connecting links and a control system. The aim of the project is pneumatic operated water pumping system, radial plunger pneumatic water pumping system are reciprocating pump is provided for the pumping action. The piston is reciprocated with the help of a pneumatic cylinder solenoid valve. There are two cylinders are used in this project, one for pneumatic cylinder and another one for hydraulic cylinder. The output quantity of the water is varied by the timing control unit. This pumping system also used in pumping of petroleum based products, water supply in agriculture lands, Industrial pumping and also in domestical applications.

INTRODUCTION

PNEUMATIC WATER PUMPING SYSTEM:

The aim of the project is pneumatic operated water pumping system. Radial plunger Pneumatic Water pumping system are reciprocating pump in which the piston is provided for the pumping action. The piston is reciprocated with the help of a pneumatic cylinder and solenoid valve.

Fig: Pneumatic Water Pumping System

There are two cylinders are used in this project, one for pneumatic cylinder and another one for hydraulic cylinder. The output quantity of the water is varied by the timing control unit. A pump is a Mechanical device which converts mechanical energy into hydraulic energy. This pump is classified into two types

i. Positive Displacement pump
ii. Non Positive Displacement pump

Positive Displacement Pump:

In positive displacement pump is the liquid is transferred positively from one stage to another stage by the to and fro motion of the plunger or piston of the pump.

Non-Positive Displacement Pump:

In non-positive displacement pump the liquid is transferred by the centrifugal force. This force is cause due to the rotary movement of an impeller in this, our project, pneumatic water pump is of positive displacement pump. The salient features of a pneumatic water pump have been retained in our project model and this has been achieved with great care. Due to high precision work involved in producing pneumatic water pump besides higher cost these pumps are not widely manufactured by most of the industries. The very name itself indicates that it works with the help of a piston. This piston is reciprocated with the help of a solenoid valve and electronic timing control unit.

HYDRAULIC CYLINDER:

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom (also called the cap) and the other end by the cylinder head (also called the gland) where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end / head end).

Fig. Hydraulic Cylinder

Flanges, trunnions, clevises, Lugs are common cylinder mounting options. The piston rod also mounting attachments to connect the cylinder to the object or machine component that it is pushing / pulling.

A hydraulic cylinder is the actuator or "motor" side of this system. The "generator" side of the hydraulic system is the hydraulic pump which brings in a fixed or regulated flow of oil to the hydraulic cylinder, to move the piston. The piston pushes the oil in the other chamber back to the reservoir. If we assume that the oil enters from cap end, during extension stroke, and the oil pressure in the rod end / head end is approximately zero, the force *F* on the piston rod equals the pressure *P* in the cylinder times the piston area *A*:

For double-acting single-rod cylinders, when the input and output pressures are reversed, there is a force difference between the two sides of the piston due to one side of the piston being covered by the rod attached to it. The cylinder rod reduces the surface area of the piston and reduces the force that can be applied for the retraction stroke.

During the retraction stroke, if oil is pumped into the head (or gland) at the rod end and the oil from the cap end flows back to the reservoir without pressure, the fluid pressure in the rod end is Pull Force piston area - piston rod area

Where

P is the fluid pressure

Fp is the pulling force

Ap is the piston face area and

Ar is the rod cross-section area.

For double-acting, double-rod cylinders, when the piston surface area is equally covered by a rod of equal size on both sides of the head, there is no force difference. Such cylinders typically have their cylinder body affixed to a stationary mount.

PARTS OF HYDRAULIC CYLINDER

A hydraulic cylinder consists of the following parts

Cylinder barrel

The main function of cylinder body is to hold cylinder pressure. The cylinder barrel is mostly made from a seamless tube. The cylinder barrel is ground and/or honed internally with a typical surface finish of 4 to 16 micro inch. Normally hoop stress is calculated to optimize the barrel size. The piston reciprocates in the cylinder.

Cylinder base or cap

The main function of the cap is to enclose the pressure chamber at one end. The cap is connected to the body by means of welding, threading, bolts, or tie rod. Caps also perform as cylinder mounting components [cap flange, cap trunnion, cap clevis]. Cap size is determined based on the bending stress. A static seal / O-ring is used in between cap and barrel (except welded construction).

Cylinder head

The main function of the head is to enclose the pressure chamber from the other end. The head contains an integrated rod sealing arrangement or the option to accept a seal gland.

The head is connected to the body by means of threading, bolts, or tie rod. A static seal / O-ring is used in between head and barrel.

Piston

The main function of the piston is to separate the pressure zones inside the barrel. The piston is machined with grooves to fit or metal seals and bearing elements. These seals can be single acting or double acting. The difference in pressure between the two sides of the piston causes the cylinder to extend and retract. The piston is attached with the piston rod by means of threads, bolts, or nuts to transfer the linear motion.

Piston rod

The piston rod is a hard chrome-plated piece of cold-rolled steel which attaches to the piston and extends from the cylinder through the rod-end head. In double rod-end cylinders, the actuator has a rod extending from both sides of the piston and out both ends of the barrel. The piston rod connects the hydraulic actuator to the machine component doing the work. This connection can be in the form of a machine thread or a mounting attachment.

Seal gland

The cylinder head is fitted with seals to prevent the pressurized oil from leaking past the interface between the rod and the head. This area is called the seal gland. The advantage of a seal gland is easy removal and seal replacement. The seal gland contains a primary seal, a secondary seal, and buffer seal, bearing elements, wiper, scraper and static seal. In some cases, especially in small hydraulic cylinders, the rod gland and the bearing elements are made from a single integral machined part.

Seals

The seals are considered designed as per the cylinder working pressure, cylinder speed, operating temperature, working medium and application. Piston seals are dynamic seals, and they can be single acting or double acting. Metal seals made from nitrile rubber, Polyurethane or other materials are best in lower temperature environments, while seals made of Fluorocarbon Viton are better for higher temperatures. Metallic seals are also available and commonly use cast iron for the seal material.

LITERATURE SURVEY 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 to 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 it is playing 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 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 delivers 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 he found that the product of pressure and volume of a particular quantity of gas is inversely proportional. It is written as PV =C or P1V1=P2V2

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.

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

POSITIVEDISPLACEMENT 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.

RECIPROCATING COMPRESSORS:

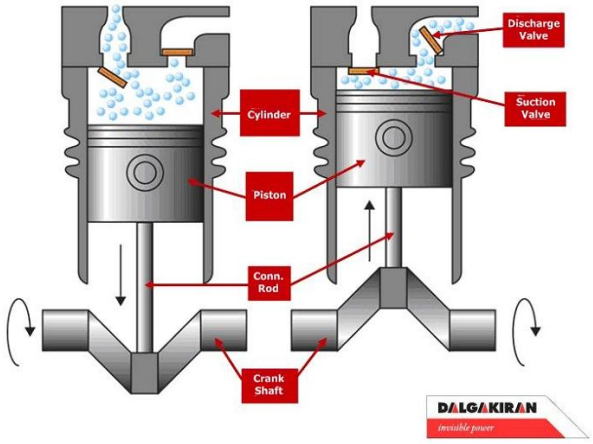

Fig- Working of reciprocating air compressor

In this type of compressor a cylinder bore encloses a moving piston. As the crankshaft of the compressor rotate, the piston moves within the cylinder, similar to the piston in a car engine. As the piston is pulled down, the volume increases, creating a lower atmospheric pressure in the piston chamber. This difference in pressure causes air to enter via the inlet valve. As the piston is forced upwards the volume of air reduces. The air pressure therefore increases. Eventually the pressure forces the outlet valve to open. To avoid an excessive rise in temperature, Multi-stage compressors with Inter coolers have been developed. These compressors can generate higher pressures than single stage compressors. The most common type is the Two-Stage compressor.

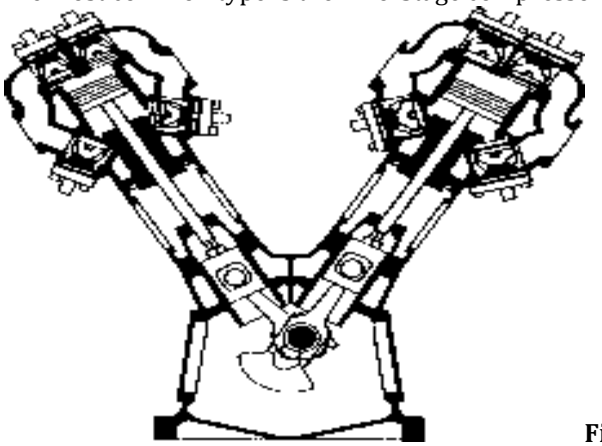

Fig: Compressor work of two stage reciprocating compressor

Built for either stationary (or) portable service the reciprocating compressor is by far the most common type. Reciprocating compressors has its sizes from the smallest capacities to deliver more than 500 m^3/min. In single stage compressor, the air pressure may be of 6 bar machines discharge of pressure is up to 15 bars. Discharge pressure in the range of 250 bars can be obtained with high pressure reciprocating compressors that of three & four stages. Single stage and two stage models are suitable for pneumatic applications, with preference going to the two stage design as soon as the discharge pressure exceeds 6 bar , because it in capable of matching the performance of single stage machine at lower costs per driving powers in the range .

SELECTION OF COMPRESSOR:

It is vital for the effective and efficient running of a compressed air plant that the appropriate compressor is selected to meet the system needs. Large compressor installation can be expensive and complex.

The following points should be considered:

SYSTEM FLOWRATE DEMAND: This should include both the estimated initial loading and near mean loading.

STAND BY CAPACITY FOR EMERGINSIS:

This could be a second compressor that is connected to the main line.

FUTURE AIR REQURIMENT: This issue should be considered in the selection of the compressor due to the cost of replacement of the compressor.

SIZING OF AIR COMPRESSOR

The sizing of air reservoirs requires taking into account parameters such as system pressure and flow-rate requirements, compressor output capability, and the type of duty of operation. It also serves to pressure pulses either coming from the compressor or the pneumatic system during valve shifting and component operation. The reservoirs are equipped with a safety relief valve in order to prevent the explosion of tank.

The equation can be used to determine the proper size of the reservoir as

Vr = $14.7(Qr-QC)-Pmin$

Where t = time that reservoir can supply required amount of air (min)

Q**r**= consumption rate of pneumatic system (SCFM, m3/min)

Qc= output flow-rate of compressor (SCFM, m3/min)

Pmax=maximum pressure level in reservoir (psi, kPa)

Pmin= minimum pressure level in reservoir (psi, kPa)

Vr= reservoir size (ft3, m3)

Air capacity rating of compressors

Air compressors are generally rated in terms of SCFM of free defined as air at actual atmospheric conditions. The equation that allows for this calculation is

Power required to drive the compressor

The following equation can be used to determine the theoretical power required to drive an air compressor.

Theoretical power (in terms of HP) is given by the formula

Theoretical power (in terms of kW) is given by the formula

Pin = inlet atmospheric pressure (psia, kPa abs)

Pout = outlet atmospheric pressure (psia, kPa abs)

Q = flow-rate (standard m3/min)

COMPONENTS AND SPECIFICATIONS

The pneumatic sheet metal shearing machine consists of the following components to full fill the requirements of complete operation of the machine.

1. Pneumatic Control Components.
2. Solenoid Valve.
3. Connectors.
4. Hoses.

PNEUMATIC CONTROL COMPONENTS

Pneumatic cylinder

Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion.

Like hydraulic cylinders, pneumatic cylinders use the stored potential energy of a fluid, in this case compressed air, and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers prefer to use pneumatics sometime because they are quieter, cleaner, and do not require large amounts or space for fluid storage.

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.

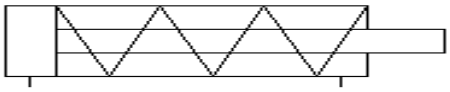

Fig. Single acting cylinder

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

Double acting cylinders

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. This can be done by providing two openings at the ends position.

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.

SPECIFICATIONS:

Stroke length	Cylinder stoker length 160 mm =0.16 m
Piston diameter	60 mm
Piston rod	25 mm = 2.5 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	10 N/m

VALVES

5/2 Double Acting Solenoid Valve

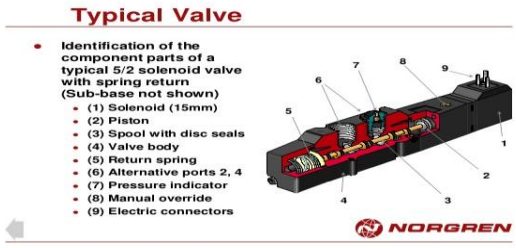

Fig: 5/2 solenoid valve

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.

Working of 5/2 Solenoid Valve

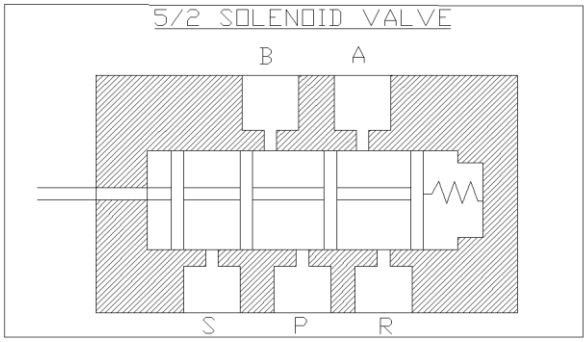

Fig -line diagram of Solenoid valve

Position-1

When the spool is actuated towards outer direction port 'P' gets connected to 'B' and 'S' remains closed while 'A' gets connected to 'R'

Poisition-2

When the spool is pushed in the inner direction port 'P' and 'A' gets connected to each other and 'B' to 'S' while port 'R' remains closed.

Parts of Solenoid Valve

Coil (Electromagnetic) : The solenoid coil is made of copper wire. The layers of wire are separated by insulating layer. The entire solenoid coil is covered with an varnish that is not affected by solvents, moisture, cutting oil or often fluids. Coils are rated in various voltages such as 115 volts AC, 230 volts AC, 460 volts AC, 575 Volts AC, 6 Volts DC, 12 Volts DC, 24 Volts DC, 115 Volts DC & 230 Volts DC. They are designed for such frequencies as 50 Hz to 60 Hz.

Frame

The solenoid frame serves several purposes. It is made of laminated sheets, it is magnetized when the current passes through the coil. The magnetized coil attracts the metal plunger to move. The frame has provisions for attaching the mounting. They are usually bolted or welded to the frame. The frame has provisions for receivers, the plunger. The wear strips are mounted to the solenoid frame, and are made of materials such as metal or impregnated less fiber cloth.

Solenoid Plunger

The Solenoid plunger is the mover mechanism of the solenoid. The plunger is made of steel laminations which are riveted together under high pressure, so that there will be no movement of the lamination with respect to one another. At the top of the plunger a pin hole is placed for making a connection to some device. The solenoid plunger is moved by a magnetic force in one direction and is usually returned by spring action. Solenoid operated valves are usually provided with cover over either the solenoid or the entire valve. This protects the solenoid from dirt and other foreign matter, and protects the actuator.

Size	0.635×10^{-2} m
Part size	G 0.635×10^{-2} m
Max pressure range	$0\text{-}10 \times 10^{5}$ N/m^2

TIMER:

A **timer** is a specialized type of clock for measuring time intervals. By function timers can be categorized to two main types. A timer which counts upwards from zero for measuring elapsed time is often called a stopwatch; a device which counts down from a specified time interval is more usually called a timer or a countdown timer. A simple example for this type is an hourglass. By working method timers have two main groups: Hardware and Software timers.

Fig:Timer

The timer may switch equipment on, off, or both, at a preset time or times, after a preset interval, or cyclically. A countdown time switch switches power, usually off, after a preset time. A cyclical timer switches equipment both on and off at preset times over a period, then repeats the cycle.

CONNECTORS:

Fig -connector

In this system there are two type of connectors used. One is the hose connector and the other is the reducer. Hose connectors normally comprise an adoptee hose nipple and cap nut. These types of connectors are made up of brass (or) Aluminum (or) hardened pneumatic steel.

FLEXIBLE HOSES:

Hose is fabricated in layer of elastomer or synthetic rubber and braided fabric, which permits operation at higher pressure. The standard tubing outside diameter is 1/16 inch. If the hose is subject to rubbing, it should be encased in a protective sleeve.

Fig :Flexible hoses

NON-RETURN VALVE:

Non-Return Valve is a valve that normally allows fluid (liquid or gas) to flow through it in only one direction. Check valves are two-port valves, meaning they have two openings in the body, one for fluid to enter and the other for fluid to leave. There are various types of check valves used in a wide variety of applications. Check valves are often part of common household items. Although they are available in a wide range of sizes and costs, check valves generally are very small, simple, or inexpensive. Check valves work automatically and most are not controlled by a person or any external control; accordingly, most do not have any valve handle or stem. The bodies (external shells) of most check valves are made of plastic or metal.

Fig non-return valve

FABRICATION AND WORKING

COMPONENTS

- Piston
- Base
- Timer
- Solenoid valve
- Flexible horses
- Cylinder block

PISTON

The piston is fitted in the cylinder block and reciprocates inside. When the solenoid valve supplies the air in the front end of the piston, the piston is pushed forward. This moves the hacksaw and the cutting stroke takes place. Then the solenoid valve supplies air to the rear end of the piston. The pressure is same but the contact area is less due to the presence of the piston rod and pushes the piston at a greater pressure thus resulting in a fast return stroke. The material for the piston is Aluminum.

BASE

All the components of the machine are mounted on the base. It withstands the vibrations encountered during machining. It is mounted on the bench.

TIMER

Time switch is also called as timer switch or simply timer is a timer that operates an electric switch controlled by the timing mechanism.

The switch may be connected to a circuit operating from mains power, or for lower-voltage circuits, including battery-operated equipment in vehicles. It may be built into power circuits (as with a central heating timer), plugged into a power point with equipment plugged into the timer instead of directly into the power point, or built into equipment as, for example, a sleep timer that turns off a television receiver after an interval.

Solenoid Valve

It is a 2x3 positional control valve. It receives the compressed air from the compressor and supplies to the cylinder block according to the signal, given by the timing device. During one position it supplies air to the front end of the cylinder block. During the next position it supplies air to the rear end of the cylinder block.

Flexible Hoses

The flexible hoses connect the solenoid valve and the cylinder block. Hoses are made of in layer of elastomer (or) synthetic rubber and braided fabric which takes up the higher pressure. If the hose is subjected to rubbing, it should be enclosed in a protective sleeve.

Cylinder block

The cylinder block has two opening for admitting air inside the block for achieving the reciprocation motion of the piston. The material for cylinder block is aluminum.

PRINCIPLE OF WORKING

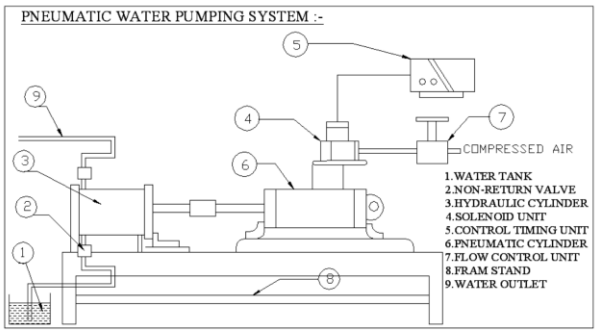

Fig: Pneumatic Water Pumping System

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 compressor is driver by a 10HP motor and designed to operate in 145 – 175 PSI range. If 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 stored air from compressor is passed through an air fitter where the compressed air is filtered from the fine dust particles. However, before the suction of air into compressor a filter process take place, but not sufficient to operate in the circuit here the filter is used. Then having a pressure regulator where the desired pressure

to the operated is set. Here a variable pressure regulator is adopted. Through a variety of direction control value are available, a hand operated solenoid Valve with control unit is applied. The solenoid valve used here is 5 ports, 3 positions. There are two exhaust ports, two outlet ports and one inlet port. In two extreme positions only the directions can be changed while the Center is a neutral position and no physical changes are incurred. 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 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 non-return valve is fixed to the hydraulic cylinders two side (Four numbers). The stroke length of the piston can be changed by making suitable adjustment in the timer

Pneumatic Transmission of Energy

The reason for using pneumatics, or any other type of energy transmission on a machine, is to perform work. The accomplishment of work requires the application of kinetic energy to a resisting object resulting in the object moving through a distance. In a pneumatic system, energy is stored in a potential state under the form of compressed air. Working energy (kinetic energy and pressure) results in a pneumatic system when the compressed air is allowed to expand. For example, a tank is charged to 100 with compressed air. When the valve at the tank outlet is opened, the air inside the tank expands until the pressure inside the tank equals the atmospheric pressure. Air expansion takes the form of airflow.

To perform any applicable amount of work then, a device is needed which can supply an air tank with a sufficient amount of air at a desired pressure. This device is positive displacement compressor. A positive displacement compressor consists of a movable member inside housing. The compressor has a piston for a movable member. The piston is connected to a crankshaft, which is in turn connected to a prime mover (electric motor, internal combustion engine). At inlet and outlet ports, valves allow air to enter and exit the chamber.

Control of Pneumatic Energy Working energy transmitted pneumatically must be directed and under complete control at all times. If not under control, useful work will not be done and machinery or machine operators might be harmed. One of the advantages of transmitting energy pneumatically is that energy can be controlled relatively easily by using valves.

Control of Pressure

Pressure in a pneumatic system must be controlled at two points - after the compressor and after the air receiver tank. Control of pressure is required after the compressor as a safety for the system. Control of pressure after an air receiver tank is necessary so that an actuator receives a steady pressure source

Table : Cylinder Tube Materials:-

without wasting energy.

Control of Pressure after a Compressor

In a pneumatic system, energy delivered by a compressor is not generally used immediately, but is stored as potential energy in air receiver tank in the form of compressed air.

In most instances, a compressor is designed into a system so that it operates intermittently. A compressor usually delivers compressed air to a receiver tank until high pressure is reached, and then it is shut down . When air pressure in the tank decreases, the compressor cuts in and recharges the tank. Intermittent compressor operation in this manner is a power saving benefit for the system. A common way of sensing tank pressure and controlling actuation and de-actuation of relatively small (2-15 HP) compressors, is with a pressure switch.

OVER VIEW OF AUTOMATION

Now a days almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. The manufacturing operation is being atomized for the following reasons.

To achieve mass production
To reduce man power
To increase the efficiency of the plant
To reduce the work load
To reduce the production cost
To reduce the production time
To reduce the material handling
To reduce the fatigue of workers
To achieve good product quality
Less Maintenance

Comparison of pneumatics and hydraulics

Both pneumatics and hydraulics are applications of fluid power. Pneumatics uses an easily compressible gas such as air or a suitable pure gas, while hydraulics uses relatively incompressible liquid media such as oil. Most industrial pneumatic applications use pressures range of about 550 to 690 kPa. Hydraulics applications commonly use from 6.9 to 34 MPa, but specialized applications may exceed even 69 MPa.

Advantages of pneumatics

Simplicity of Design and Control Machines are easily designed using standard cylinders & other components. Control is as easy, High Reliability. Pneumatic systems tend to have long operating lives and require very little maintenance.

Advantages of hydraulics

Liquid (oil) does not absorb any of the supplied energy, i.e. maximum power transmission is possible. Capable of carrying much higher loads and providing much higher forces due to the incompressibility.

The hydraulic working fluid is basically incompressible, leading to a minimum of vibrations.

Disadvantages of pneumatics

Initial higher cost. May be a choice of air leakage. Cylinder stroke length is constant.

Disadvantages of hydraulics

Fluid Leakage is one of the serious problems in hydraulics, High maintenance cost. The chances of fire accidents are more.

RESULTS AND CALCULATIONS

RESULTS

By applying different pressures can obtain different heads of water as shown in the tabular column:

CALCULATIONS

Maximum pressure applied in cylinder (P)=10 bar

PNEUMATIC CYLINDER

Diameter of pneumatic cylinder = 80mm = 8 cm Applied pressure = 5 bar = 50 N /cm2

Stroke length(L) = 160mm

Piston rod dia (d) = 25mm = 2.5 cm **FORWARD STROKE FOR DOUBLE ACTING CYLINDER**

Force (F) = π4×D2×P = π4× (8)2×50 = 2513.27 N

RETURN STROKE FOR DOUBLE ACTING CYLINDER

Force (F) = π4× (D2-d2) ×P = π4× (82-2.52) ×50

= 2267.83 N

HYDRAULIC CYLINDER

Diameter of hydraulic cylinder (D) =56mm

=5.6cm

Stroke length =160mm

Piston rod dia (d) =25mm =2.5 cm

Here the force acting on hydraulic cylinder is same as force acting on pneumatic cylinder.

F= 2513.27 N (forward stroke for double acting cylinder)

F=2267.83 N(return stroke for double acting cylinder)

Therefore need to find out the pressure acting in double acting hydraulic cylinder for both forward and backward strokes

We know that F= A×P

P=F/A = (4×2513.27)×5.62 = 102.04 N/cm2

=10.2 Bars (forward stroke)

We know that F= A×P

P=F/A = (4×2267.83)×(5.62−2.52)

=114.99 N/cm2 =11.4 bars (return stroke)

Velocity of water flow from hydraulic cylinder

Pressure developed in hydraulic cylinder (p) = 10×104 kg/m2

Radius of hose pipe = 4mm = 4×10-3 m

We know that force (F) =p ×A

= 10×104 × π × (4×10-3)2 = 5.026 kg

We know that force (F) =M×A

Here M=mass of the piston = 0.3 kg ;

a = acceleration

There Fore Acceleration (a) =F/M = (5.026)/ (0.3) =16.753 m/sec2

We know that V2 -U2 =2aL

Here U= initial velocity =0

V=final velocity

Therefore final velocity (V) =$\sqrt{2}(2aL)$

=$\sqrt{}$(2×16.753×160×10-3) =2.315m/sec

HEAD OF WATER RAISED

Pressure (P) =ρgh

Here (h) =head of water raised

Therefore (h) =P/ρg = (**10×104**)(**103×10**)= 10mts

DISCHARGE OF WATER FROM HYDRAULIC CYLINDER

We know that velocity (V) =L×N

Where L=stroke length =160×10-3mts

N= number of strokes per minute

Therefore N=VL =2.315160×10−3 =14.468 strokes/sec

=868.12 strokes/minute

We know that for double acting hydraulic cylinder

Discharge (Q)=A×L×N60

= π/4×(56×10−3)2 × 160×10−3×(868.12)60

=0.0057m3/sec

WORKDONE BY HYDRAULIC CYLINDER

Work done (W) =ρg×ALN 60×(hs+hd)

Here hs=suction head **= 0**

hd= discharge head = 10 m

Q=103×10×π4× (56×10-3)2 × 160×10-3× (868.12)/60× (0+10) = 570.18 watt

POWER REQUIRED

Power required **(P) =*work done per second* 1000**=570.18/1000 = 0.57KW

LABOUR COST

DRILLING, WELDING COST = 500

OVERHEAD CHARGES

The overhead charges are referred by “Manufacturing cost”

Manufacturing cost = material cost + Labor cost

Here material cost = 11000

Labor cost = 500

TOTAL COST

Total cost = Material cost + labor cost

= 11000+500

= 11500
Total cost of this project = 11500

ADVANTAGESAND LIMITATIONS

ADVANTAGES

Even if all the other pumps are similar in use the pneumatic water pump is more advantages than the pumps.

- This is compact in size.
- Less maintenance is enough.
- The oil or water is of high pressure.
- Quite running and smooth operation is achieved. Higher efficiency.

Full efficient positive displacement pump.

- Effective working principle.
- It does not have any prime mover, like electric motor related to the unit.
- As the air is freely available, we can utilize the air to pumping the water and hence it is economical. Less maintenance.

DISADVANTAGES

- It is costlier than the other types of pump because of compressor unit.
- Less efficiency when compressed to other device.
- Leakage of air affects the working of the unit.

APPLICATIONS

- It is used in agriculture for water pumping.
- It is used in petroleum industries for pumping petrol with less energy.
- This type of pumping system is mainly used in the areas where the electrical energy is less.
- It is applicable in small and large scale industries for lubrication.

CONCLUSION

It is concluded that, this system is very useful in the area where there is less amount of electricity is available. By using less amount of electricity we can able to suck the water from the ground by this system. This system is also useful in petrol industries to suck petrol from ground to the required height by using less amount of electricity than the motors.

By increasing the pressure can able to raise the head of water with less amount of electricity than the motors which use for sucking of water from ground.

In this system the discharge of water increases with increase in pressure but takes less amount of electricity as compared to electric motors which depends upon electricity for increase in discharge of water i.e. discharge of water increases by increasing of electricity consumed. But only things take care in this system is about the leakages.

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