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Automatic Lubrication System

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1. INTRODUCTION

When two or more surfaces are in moving contact with each other friction is created between them. Lubricants are used to reduce this friction. In the process they also reduce the wear which the friction causes. Lubrication also counters corrosion by providing a protective film on the concerned surface.

In the early years of industrial revolution lubrication of machinery was anything but systematic. Lubricants were used haphazardly chiefly when friction began to wear out machinery rather than to prevent it from happening. But as more and more sophisticated machinery were developed a whole range of lubricants were delivered to the concerned surfaces in the quantities and at speeds appropriate to the situation.

Lubrication systems and equipment are essential components of manufacturing and industrial machinery and technology. They are used to provide and apply controlled or metered amounts of lubricant to a part or piece of equipment. Companies that provide lubrication equipment are often capable of creating, and may specialize in, custom units of lubrication technology. Lubrication systems are useful in many industries, including packaging, printing, water and sewage pumping, textiles, food processing, chemical processing, mining, brewing and bottling, pellet mills and machinery production. Some of the equipment for which lubrication systems are used includes dies, chains, cables, rails, gears, pumps and any other moving and rotating parts commonly found on conveyer or assembly machinery. To ensure reliable and efficient operation of such equipment, these moving parts often need a constant supply of lubricating fluids, and the lubrication system is able to provide this at the proper temperature, viscosity, flow rate and pressure. Other, more specific examples of machinery that uses lubricants include rock crushers, gearboxes, large blowers and fans, turbines and industrial centrifuges. The most important components of a lubricating system are the reservoir, pump and filter. The reservoir is the area in which the lubricant is stored after coming back from the area it lubricates. The pump is used to move the lubricant through the system and into areas that need to be lubricated. The filter is used to ensure that the lubricant stays clean and free from contaminants so that the system is not disrupted. These systems often have instrumentation to provide readings of the flow rate, temperature and level of the lubricant. More elaborate systems contain alarm points to warn of improper balances. Both manual and automatic lubrication equipment is available. [2]

The lubrication can be defined as a procedure by which introduces a layer of lubricant to reduce friction and detrition of materials between the two surfaces, which are in relative motion. This process includes the following activities:

- The permanently cleaning of lubricants,
- The checking the amount of lubricants,
- Refilling lubricants if is necessary,
- Replacement of lubricants, and others.

Choosing the proper lubricant, in the first place, depends on load, speed, temperature, and conditions in the work environment. The appropriate lubricant with the automatic lubrication system ensures consistency and dispensing lubricants are best for a particular use. The demission of machines will be avoided and the cost of system maintenance will be drastically reduced.

1.1 NEED OF AUTO LUBRICATION

In the early 70's due to liberalization and globalization no. of products available in the market has revolutionary increased .Therefore, high competition in the market so the manufacturers have to reduce the market value of the product. A single product of no. of qualities at different prices are available, this decreases the individual sale of the companies,because every customer is to have best of the best quality at the lowest price. But with the old technology it was not for manufacturer to satisfy such a need of the customer. That is there direct relation in quality of the product and price of it. The nature of tribology processes is natural and inevitable is that mechanical elements hackney out during operation. In some cases, the problem of increasing resistance to abrasion was solved by selecting the higher hardness of steel. For a long time steel is considered, by analogy, resistance to hackney out, and was later replaced by lubricant materials, thus reducing hackney out and tear problems long solved by selecting the appropriate lubricant. From the aspect of improving lubrication in recent years more and more emphasis is on the constant increase in materials and lubricants performance.

1.2 OBJECTIVES

In the Occupation Safety and Health Act protested the workers from working under harmful condition. Therefore employing workers for working in hazardous conditions like heat treatment, spray painting is stopped. Also with the use of old technology during manufacturing like in this project, oiling is done around the piston manually on assembly line by means of brush and spray oiling. And because of brush oiling the body parts like thumbs and fingers affected. The physical problem created like pain at the base of the thumbs and difficulty in moving finger, snapping etc. this causes problem while twisting and gripping. Because of this problem worker cannot work efficiently and it is not able to work more than eight hour a day. The automatic lubrication systems meet the highest standards, both in terms of safety and health at work of employees and in terms of environmental protection. The advantages of automatic lubrication systems to the manual are:

- A constant dose over time a certain amount of fresh lubricant,
- The reduction of maintenance costs of machinery and mechanisms,
- The efficient and safe work of machines and mechanisms
- Avoidness of sudden delay and cancellation,
- The increase of the safety of all employees in the maintenance,
- Savings in time and energy and so on.

The centralized automatic lubricating system is used for easy and economical lubrication of multiple points from one centrally located distributor. It is designed to deliver the right amount of lubricant at right time to every point by means of distributors connected by hoses.

Frequent delays in production caused by inadequate lubrication can be largely prevented by applying some of the units for the automatic

lubrication system. The lubrication systems are constantly reliable in doing appropriate lubricant and quantity to the required system components. At the same time, it protects against corrosion and external contamination, and with the selection of proper lubricants extend service life of machinery and equipment. Lifetime lubricated components, which will be extended and maintenance costs reduced. On systems such as fans, motors, pumps, compressors, blowers conveyors and other hard to reach places, these systems ensure continuous, without maintenance, longtime lubrication for the period from 1 to 24 months. The most common are now in: steel making, mining, energy, petrochemical industry, automobile industry, food industry and so on.

2. LITRATURE REVIEW

The Literature review gives some background into the engines worked out in various industries. In the following literature review, a discussion of lubrication provided around the piston cylinder assembly in which the some of the important criteria must have to study such that the Tribological aspects and the lubrication technique with the help of various journals and papers. This information is supported by experimental setups found by other researchers whose work is summarized. The literature review concludes with the descriptions of lubrication.

As per **Mr. Gowtham Tamilselvan**, "Proximity Sensors in Obstacle Evasion" Proximity sensors can detect objects without any physical contact, this property allows for robotic navigation without collisions. Multiple types of proximity sensors currently exist with each specializing on certain types of surface, metal or concrete, it interacts with to gain accurate readings. This paper focuses on the use of proximity sensors in obstacle evasion for autonomous robotic systems; discusses commercially available products, identifies the functionality of different sensors, and implementation of proximity sensors in autonomous robots.. The article then teaches key inductive proximity sensor specifications followed by a discussion of mounting restrictions for the sensor's implementation. Together, this information will supply a designer with the knowledge required for a successful inductive proximity sensor to object detection design.

As per **Bharat Bhushan** on "Principles And Applications Of Tribology". Tribology is the science and technology of interacting surfaces in relative motion and of related subjects and practices. Its popular English language equivalent is friction, wear, and lubrication or lubrication science. The nature and consequence of the interactions that take place at the interface control its friction, wear and lubrication behavior. During these interactions, forces are transmitted, mechanical energy is converted, physical and chemical natures including surface topography of the interacting materials are altered. In this paper Understanding the nature of these interactions and solving the technological problems associated with the interfacial phenomena constitute the essence of tribology. Sliding and rolling surfaces represent the key to much of our technological society. Understanding of tribological principles is essential for the successful design of machine elements. Friction is the resistance to motion that is experienced whenever one solid body moves over another. Wear is thesurface damage or removal of material from one or both of two solid surfaces in a moving contact. Materials, coatings and surface treatments are used to control friction and wear.

The task of every well-organized function in the maintenance of lubrication is to achieve lower costs to workers in the maintenance

and lubricants and spare parts. Manual lubrication system components tribomechanical persisted, despite the great efforts and poor ergonomic conditions for acting of lubrication, but in recent years is much more marked appreciable progress of improving lubrication by introducing of automatic lubrication systems in almost all industries throughout the world. Inadequate lubrication are now the most common reasons for early termination tribomechanical components, which can certainly cause further damage to the machines themselves. Much of the damage can be avoided by choosing an appropriate method of automatic lubrication systems, choosing the appropriate dosage and method of lubricants for specific conditions of exploitation. This strategy was explained by **Aleksandar Ašonja, Živoslav Adamović** in the paper, "The Economic Justification of the Automatic Lubrication", in 2010.

It is about a quarter of a century since the energy crisis of the 1970s. This led to an enhanced awareness of the need to use scarce natural resources more efficiently and precipitated an intense study of the efficiency of the internal combustion engine: the piston assembly, valve train and engine bearings. Such studies have remained vibrant and have been further driven by the increasing recognition of the fragility of our environment and the need to accommodate growth in the automobile sector in a sustainable manner. **M. Priest, C.M.Taylor** gives the paper,"Automobile Engine Tribology-Approaching The Surface".Thispaper has reviewed the current position regarding the tribological design and friction associated with the tribological components of the engine with a specific focus upon surface topography and surface interaction considerations. Much remains to be achieved in this important field and significant areas for future attention have been identified.

This keynote address will provide a comprehensive overview of various lubrication aspects of a typical power train system including the engine, transmission, driveline, and other components, as well as the integration of these lubrication and surface engineering concepts into a unified automotive power train system. In addition, this presentation will focus on the current status and future trends in automotive lubricants including discussion of current and anticipated future requirements of automotive engine oils. This presentation will also review the current standard ASTM (American Society for Testing and Materials) test methods for engine lubricants and other compilations of automotive standards. In addition to engine oil test development, industrial researchers are developing light-weight materials suchas non-ferrous materials (Al, Mg) for engine and drive train materials to replace the current heavy-weight cast iron blocks. Recent industrial developments include high strength and high density of composite materials, high volume liquid moulding and hydro forming technology, structural adhesive boding, and the ability to mold large structural components. Industrial researchers have also developed processing improvements for forming more complex stamped aluminium parts or panels, more robust stamping, and improved casting techniques. **Simon C. Tung, Michael L. McMillan** gives the paper,"Automotive Tribology Overview ofCurrent Advances And Challenges For The Future", in this paper, our insights and perspectives on future trends in light-weight tribological material and non-tribology will also be reviewed.

The coefficient of friction, may impact solid mechanics problems and tangential tractions

are essentially free parameters in many cases. Active issues of research in tribology where solid mechanics is applied include: friction and wear in dynamic loading of bearings to extend bearing life; models for contact and thermal stresses of sliding surface asperities; design criteria for magnetic recording heads, and behavior of human artifcial joints to extend service life. Countless other applications exist, requiring the development of essential theories of conforming and non- conforming surface behavior. Information such as the frictional response of surfaces in relative motion, and modes of stress and deformation emerges from the fusion of solid mechanics and tribology. This is given by **John A. Tichy,Donna M. Meyer** in the paper, and "Review of solid mechanics in tribology".

The study of solid mechanics is essential to the field of tribology, (friction, lubrication and wear). Tribology is of immense economic importance. The potential savings, were tribological principles better understood and applied to friction and wear reduction) may be several percent of the gross national product. Solutions to tribology problems often enable current technologies in a broad spectrum of applications from friction contact in the turbine shrouds of aircraft engines, to bearing contact in motor vehicle gear assemblies, to the sliding contact of magnetic storage disk drives. Conversely, tribology issues. This is given by **KojiKato**, in the paper,"Wear in relation to friction — a review".

3. TRIBOLOGICAL CONSTRAINTS

In this project, selection of the different instruments are depends upon number of things like tribological constraints (Friction, wear, surface tension etc), functions of lubrication, advantages and limitations. [12]

3.1 FRICTION AND WEAR

Friction and wear arise from the relative motion of solid surface in contact. Friction is the force of resistance to the relative motion of two contacting surface. Wear results when this resistance is overcome by applied force. Lubrication causes reduction of friction between two relative moving surfaces by the interposition of some other substance (lubricant) between the surfaces. [12]

3.1.1. Friction

When two surfaces are placed over each other and moved, a force is developed, which opposes the motion. This force is called friction force or frictional resistance and the phenomenon is called **"friction".**

The molecular attraction between two surfaces is responsible for the origin of this friction force. When two surfaces are placed or rubbed over each other, a considerable amount of heat is being continuously produced called friction heat. This heat is not distributed uniformly because of very small real area of contact. Therefore, the intense local heating occurs and temperature rises continuously. When this temperature exceeds the melting point of material, fusion of asperities occurs. These fused asperities are called welded junctions and the phenomenon is called "cold welding". These junctions have the intermolecular attraction of quite high extent, which opposes the movements of surface over each other.

1. Frictional force (F) is proportional to normal load (W)

   $F \alpha W$

2. Frictional force (F) depends upon real contact area (A)

   $F \alpha A$

Real area: Apparent area

1:10,000

It is independent of apparent contact area

3.1.2 Types of friction

A) Static friction (potential friction)
B) Kinematic friction (dynamic friction)

A) Static friction: -

When two surfaces are placed over each other, a real contact between them occurs only at a limited number of asperities, under such conditions, a very small load develops a very high Static frictional force = Real area × Strength.

$F = A \times S$

Real area = applied load

Mean pressure

$$A = W/P$$

$$F = (W/P)\, S$$

But, S/P= coefficient of static friction = f

$$F = W \times f$$

$$F = F/W$$

Coefficient of static friction force is higher than those of other frictional forces. Therefore, the static frictional force is always greater than the other frictional force.

B) Kinetic friction: -

This type of force is developed when one surface moves over the other or both surfaces move over each other. It is of two types:

a) Sliding friction
b) Rolling friction

a) Sliding friction

This type of force is developed when one metal surface is made to slide over the other. Sliding, welded joints get shared off (worn out), resulting in wear of the material. Theforce required for sliding is called frictional force (shear force). It depends upon the area of junction and shear stress i.e. the strength of adhesive of the welded junction. Shearing frictional force = real area × Shear strength

$Fs = A \times S$

pressure (few tones/$cm^{2)}$ at the real contact. Therefore, asperities get crushed and deformed permanently till the area of real contact become large enough to support the load. Due to increase in temperature, the crushed asperities get firmly united together. Therefore, sufficient force is required to slide one surface over the other. This force is called static frictional force.

But, real area of contact depends upon the applied load and means pressure A = W/P

$$Fs = (W/P)\, S$$

But S/P= coefficient of sliding friction = f

$$Fs = W \times f$$

$$F = Fs / W$$

Coefficient of sliding friction is smaller than of static friction. Therefore, the sliding frictional force is always smaller than static frictional force.

b) Rolling friction:

When a cylinder rolls over a flat surface, it makes a line contact parallels to the axis of cylinder and when sphere rolls over a flat surface it makes a point contact makes the rolling friction (pure rolling).

In this case load of body passes through line or point contact under their circumstance practically there is always resistance. This is due to the fact of deformation of roller or a surface on

which it is rolling. Therefore there is no line of point contact.

3.1.3 Consequences of friction:

1. Loss of material due to the deformation of asperities.
2. Decrease in speed – more the friction, less the speed of moving body.
3. Change in shape due to expansion caused by frictional heat.
4. Decrease in efficiency due to dissipation of energy (unavailable for work)
5. Decrease in life of material due to intense local heating.

Increase in maintenance cost.

3.2 WEAR:

Wear occurs in lubricated system by three mechanisms;

a. Abrasion
b. Corrosion
c. Metal to metal contact

The lubricants play important role in combating each type of wear.

Abrasive wear is caused by solid particles entering the area between lubricatedsurfaces and physically eroding the surface. The solid particles may be contaminating or wear fragments. To cause wear, the particle must be larger than the oil film thickness in size and harder than the surface with which it comes in contact. Abrasive wear usually appears as scratching or scrolling of the surface and may be catastrophic it served enough. Seals and filters are most important accessories in a lubrication system exposed to abrasive contaminants.

The product of oxidation of lubricates generally causes **corrosive wear**. A certain amount of corrosive wear may be substitute for catastrophic abrasive or metal to metal contact wear when extreme pressure (EP) lubricants combustion engine. Products of combustion are highly acidic and contaminated the lubricating oil.

The observed wear of the piston rings and cylinder walls in the above examples has a significant effect on the performance of the piston assembly. Yet traditionally, no wear modeling has been included in piston ring tribological analyses. This is because incorporating a consideration of wear in the analysis adds a further layer of complexity to an already sophisticated model. It is further compounded by the fact that wear is the least understood of the three main processes in tribology; friction, lubrication and wear.

Lubricated functions to minimize corrosive wear in two ways. Proper refinement plus the use of oxidation inhibitors reduces lubricants deterioration, thus keeping the level of corrosive oxidation products low. In addition, corrosion prevention may be added to protect metal surface from those acidic oxidation product that may form.

Wear caused by metal to metal contact result from break down of lubricant film-under normal hydrodynamic conditions, this can occur on starting and stopping before full fluid film lubrications established. It can also be a result of excessive surface roughness or interruption of lubricant supply. This type of wear is usually severe. A plentiful supply of lubricating oil of proper viscosity is often the best way to avoid this condition.

3.3 LUBRICATION:

The process of reducing friction resistance between the two moving surfaces by the introduction of a suitable lubricant between them is called lubrication.

Function of lubrication:

The important functions of lubrication are:

a. To reduce friction between moving parts to its minimum value so that loss is minimized.

b. To reduce wear and tear between the rubbing and bearing surface.
c. To provide cooling effect by carrying away heat generated by friction between moving parts.
d. To carry away the particle of worm metal and carbon i.e. to provided cleaning action.
e. To seal a space adjoin the surface such as piston moving in a cylinder.
f. To reduce expansion of metal by local friction heat.
g. To reduce maintenance and running cost of the machine.
h. To reduce he engine noise and to increase he engine life

4. DESIGN

4.1 DESIGN OF PNEUMATIC CYLINDER

Force to be exerted is 40N
Force = pressure □ area
Pressure in the cylinder = 0.4 x10^5 N/m^2

Where, P = Pressure in the cylinder (N/m^2)
A = Area of the piston (m^2)
a = Cross sectional area of the piston rod (m^2)

Therefore,

Area of the piston (A-a) = {(π□ d^2)/4}-{(π□ d_1^2)/4}

= {(π□ 40^2)/4}-{π (□16^2)/4}
= 1256.6-201
= 1055mm^2

Force to be converted
On the reverse direction = pressure □ area
= 0.4□ 10^5 □1055
= 42.2 N
For working pressure = 0.4□10^5 N/m^2
Extending force = 50.3 N

Area of the piston, (πd^2)/4 = Force/pressure
= 40/ 40000
= 0.001m^2
Bore diameter = 0.0356m = 35.6 mm

From Jana tics pneumatic products catalogue we have selected 40mm bore diameter cylinder.

For forward stroke:

For 40mm bore diameter
Corresponding rod diameter = 16mm
Area of the piston = (πd^2)/4
= (πx40^2)/4
= 1256.8mm^2
Force (modified) to be exerted = pressure □area
= 0.4 x10^5 x1256.8
= 50N

For return stroke:

On the return stroke, when the pressure is applied to the reverse direction, the force on the piston due to the pressure is = P □(A-a)

Retracting force = 42.2 N

Pneumatic cylinder

Design of Piston rod:
Load due to air Pressure.
Diameter of the Piston (d) = 20 mm
Pressure acting (p) = 1.5 kgf/cm²
Material used for rod = C 45
Yield stress (σ_y) = 36 kgf/mm²
Assuming factor of safety = 2
Force acting on the rod (P) = Pressure x Area
= p x (Πd^2 / 4)
= 6 x {(Π x 4^2) / 4 }

P = 73.36 Kgf
Design Stress (σ_y) = σy / F0 S

∴ Minimum diameter of rod required for the load = 2.3 mm We assume diameter of the rod =15 mm

4.2 DESIGN OF CYLINDER THICKNESS:

Material used = Cast iron

Assuming internal diameter of the cylinder = 40 mm

Ultimate tensile stress = 250 N/mm² = 2500 gf/mm²

Working Stress = Ultimate tensile stress / factor of safety

Assuming factor of safety = 4

Working stress (f_t) = 2500 / 4 = 625 Kgf/cm²

According to 'LAMES EQUATION'

Minimum thickness of cylinder (t) = ri $\{\sqrt{(f_t + p) / (f_t - p)} - 1\}$

Where, ri = inner radius of cylinder in cm.

f_t = Working stress (Kgf/cm²)

p = Working pressure in Kgf/cm²

∴ Substituting values we get,

$t = 2.0 \{\sqrt{(625 + 6) / (625 - 6)} - 1\}$

t = 0.019 cm = 0.19 mm

We assume thickness of cylinder = 2.5 mm

Inner diameter of barrel = 40 mm

rod = 160 + 40 + 12 + 20 = 232 mm

By standardizing, length of the piston rod = 230 mm

Outer diameter of barrel = 40 + 2t

= 40 + (2 x 2.5) = 45 mm [11]

4.3 DESIGN OF PISTON ROD:

Diameter of Piston Rod:

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

= 6 x (Π / 4) x (4)²

= 73.36 Kgf

Also, force on piston rod (P) = (Π/4) $(d_p)^2$ x f_t

P = (Π/4) x $(dp)^2$ x 625

73.36 = (Π/4) x $(dp)^2$ x 625

∴ dp^2 = 73.36 x (4/Π) x (1/625)

= 0.15

dp = 0.38 cm = 3.8 mm

By standardizing dp = 15 mm

Length of piston rod:

Approach stroke = 160 mm

Length of threads = 2 x 20 = 40mm

Extra length due to front cover = 12 mm

Extra length of accommodate head = 20 mm

Total length of the piston

4.4 SPECIFICATION

4.4.1 Double acting pneumatic cylinder [11]

Technical Data

Stroke length	:	Cylinder stoker length 160 mm = 0.16 m
Quantity	:	1
Seals	:	Nitride (Buna-N) Elastomer
End cones	:	Cast iron
Piston	:	EN – 8
Media	:	Air
Temperature	:	0-80 ° C
Pressure Range	:	8 N/m²

Media	: Air
Temperature	: 0-80 ° C
Pressure Range	: 8 N/m² [11]

4.4.2 Solenoid Valve:

Technical data

Max pressure range:	0-10 x 10^5 N/m²
Quantity :	3

4.4.3 Flow control Valve

Technical Data

Port size : 0.635 x 10 ⁻² m

Pressure : 0-8 x 10 ⁵ N/m²

Media : Air

Quantity : 1

4.4.4 Connectors

Technical data

Max working pressure: 10 x 10 ⁵ N/m²

Temperature : 0-100 ° C

Fluid media : Air

Material : Brass

4.4.5 Hoses

Technical date

Max pressure : 10 x 10 ⁵ N/m²

Outer diameter : 6 mm = 6 x 10 ⁻³m

Inner diameter : 3.5 mm = 3.5 x 10 ⁻³m

4.4.6 Double Acting Pneumatic Cylinder [11]

Technical Data

Stroke length : Cylinder stoker length 160 mm = 0.16 m

Piston Diameter : 45

Shaft Diameter : 15

Quantity : 1

Seals : Nitride (Buna-N) Elastomer

End cones : Cast iron

Piston : EN – 8

Media : Air

Temperature : 0-80 ° C

Pressure Range : 2- 8 N/m²

4.4.7 Solenoid Valve

Technical data

Max pressure range: 0-10 x 10 ⁵ N/m²

Type : 5/2 (5 Ports – 2 Position Valv

Quantity : 1

Voltage : 230V A.C

Frequency : 50 Hz

Size : 1/8”

4.4.8 Flow control Valve

Technical Data

Port size : 0.635 x 10 ⁻² m

Pressure : 0-8 x 10 ⁵ N/m²

Media : Air

Quantity : 1

4.4.9 Hose connectors

Technical data

Max working pressure: 10 x 10 ⁵ N/m²

Temperature : 0-100 ° C

Fluid media : Air

Material : Brass

Thread : 1/8”

4.4.10 IC 555

Supply Voltage (Vcc) = 4.5 to 15V

Supply Current (Vcc=5V/2) = 3 to 6mA

Supply Current (Vcc=25V/2) = 10 to 15mA

Output Current = 200mA (maxin

Power dissipation = 600mw

Flow rate calculations

1) $P = \varrho h$

Where,

h = head in m.

$2\times10^5 = 825 \times 9810\times h$

h = 0.0247

m

2) $V = \sqrt{2gh}$

Where,

V = velocity of oil in m/s

Where,

Q= discharge of oil in

m^3/s A=area of pipe in m^2.

$Q = A /4) \times (0.003)^2\times0.6963$

$= 4.921\times10^{-6}\ m^3/s$

Q = 4. 92 ml/s

P = air pressure in bar.

ϱ = density of oil in kg/m^3

g = acceleration due to gravity m/s^2

$V = 2\times9.81\times0.0247$

V = 0.6963 m/s

3) $Q = V\times A$

5. PART DESCRIPTION

5.1 DIFFERENT TYPES OF VALVES:

Although many different types of valves are used to control the flow of fluids, the basic valve types can be divided into two general groups: stop valves and check valves.

Besides the basic types of valves, many special valves, which cannot really be classified as either stop valves or check valves, are found in the engineering spaces. Many of these valves serve to control the pressure of fluids and are known as pressure-control valves. Other valves are identified by names that indicate their general function, such as thermostatic reticulating valves. The following sections deal first with the basic types of stop valves and check valves, then with some of the more complicated special valves.

5.1.1 STOP VALVE

Stop valves are used to shut off or, in some cases, partially shut off the flow of fluid. Stop valves are controlled by the movement of the valve stem. Stop valves can be divided into four general categories: globe, gate, butterfly, and ball valves. Plug valves and needle valves may also be considered stop valves.

5.1.2 GATE VALVES

Gate valves are used when a straight-line flow of fluid and minimum restriction is desired. Gate valves are so named because the part that either stops or allows flow through the valve acts somewhat like the opening or closing of a gate and is called, appropriately, the gate. The gate is usually wedge shaped. When the valve is wide open, the gate is fully drawn up into the valve, leaving an opening for flow through the valve the same size as the pipe in which the valve is installed. Therefore, there is little pressure drop or flow restriction through the valve. Gate valves are not suitable for throttling purposes since the control of flow would be difficult due to valve design and since the flow of fluid slapping against

a partially open gate can cause extensive damage to the valve. Except as specifically authorized, gate valves should not be used for throttling.

Gate valves are classified as either RISINGSTEM or NONRISING-STEM valves. On the nourishing-stem gate valve the stem is threaded on the lower end into the gate. As the hand wheel on the stem is rotated, the gate travels up or down the stem on the threads, while the stem remains vertically stationary. This type of valve almost always
has a pointer-type indicator, threaded onto the upper end of the stem to indicate valve position.

The rising-stem gate valve, shown in figure has the stem attached to the gate; the gate and stem rise and lower together as the valve is operated. Gate valves used in steam systems have flexible gates. The reason for using a flexible gate is to prevent binding of the gate within the valve when the valve is in the closed position. When steam lines are heated, they will expand, causing some distortion of valve bodies. If a solid gate fits snugly between the seat of a valve in a cold steam system, when the system is heated and pipes elongate, the seats will compress against the gate, wedging the gate between them and clamping the valve shut. This problem is overcome by use of a flexible gate (two circular plates attached to each other with a flexible hub in the middle).

5.1.3 SOLENOID VALVES

A solenoid valve is a combination of two functional units:

1) A solenoid operator essentially consisting of a coil, core, core tube, shading coil and spring(s).
2) A valve body containing orifices in which a disc, diaphragm or piston etc. is positioned according to the type of technology used.

The valve is opened or closed by movement of the magnetic core which is drawn into a solenoid when the coil is energized.

5.2 SOLENOID VALVE TERMINOLOGY

Coil:

Electrical part of the valve consisting of a spool wound with insulated copper wire creating a magnetic flux when energized. The coil is held in place on the tube with a retaining clip.

Core:

Soft magnetic plug nut moved by magnetic forces (flux generated by the coil).

Core spring:

Spring which keeps the core in fixed position when the coil is de-energized.

Core tube:

Stainless steel tube closed at one end, installed to improve the magnetic flux of the solenoid coil upon energisation.

Cover:

Cover mounted on the valve body and incorporating a number of orifice.

Dead volume:

Volume of fluid in the non-flushable areas within the solenoid valve.

Diaphragm:

Seal-tight diaphragm isolating the fluid from the control system.

Disc, valve disc:

Sealing material on the core or disc-holder which shuts off the seat orifice.

Solenoid enclosure:

Metal housing around the coil for electrical and mechanical protection, as well as protection against ingress of water or dust.

5.3 GENERAL DESCRIPTION

5.3.1 COMPONENT DESCRIPTION:

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. [9]

The usual written as

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

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. 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. 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).

5.3.2 PRODUCTION OF COMPRESSED AIR

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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.

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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 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.

6. CONSTRUCTION & WORKING

6.1 PNEUMATIC CONTROL COMPONENT

Pneumatic control in fixed installation such as factories use compress air because of sustainable supple can be made by refreshed atmospheric air. The air usually has moisture remove and a small quantity of oil added compressor to avoid corrosion of component and to lubricate them.

Pneumatic control contain following component:-

6.1.1 Pneumatic cylinder:

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

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 messes. This can only be done at the end positions of the piston stock. In all intermediate position a separate externally mounted cushioning derive most be provided with the damping feature.

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

6.1.2 Valves

5/2 Double Acting Solenoid Valve:

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

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

A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turnoperates 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.

6.2 IC 555 TIMER:

The IC SE / NE 555 monolithic circuit is a highly stable controller capable of producing accurate time delays or oscillations. Additional terminals are provided for triggering or resetting if desired.

In the timing operations, the time is precisely controlled by one external resistor and a capacitor, by the operation as an oscillator, the free running frequency and the duty cycle are both accurately contributed with the external RC constants.

Pin 1: It is ground terminal.

Pin 2: The trigger voltage to the lower comparator is applied. It has constant voltage thatis at least one third of the supply voltage, when trigger voltage falls below this level the flip-flop changes its state and output becomes high.

Pin 3: It is the output terminal, in low state output is equal to zero and when at higher stateoutput is equal to Vcc.

Pin 4: It controls the flip flop directly. It turns the device to its original position whenreset pin is connected to ground the output is approximately equal to zero. When reset is not used it is connected to Vcc.

Pin 5: It is the control voltage terminal. It is connected to ground through a capacitor of0.01 μF. Any external voltage at pin: 5 will change both the threshold voltage and the trigger voltage reference level.

Pin 6: Threshold voltage of upper comparator is applied from this terminal. The resistorRt connected to Vcc and pin: 6 is grounded by an external capacitor. The output is high capacitor charges by resistor Rt. When the capacitor changes to the threshold level, the output becomes low.

Pin 7: It is the discharge pin for external capacitor. Usually pin: 7 is connected with pin: 6directly to by a resistor. When the output becomes low then the external capacitor discharges by internal discharge transistor remains at

cut-off and the external capacitor charges to Vcc.

Pin 8: It is the positive supply terminal. A dc voltage from +5 to + 15 can be applied.

The important features of IC555 can be summarized as follows.

1. Timing range from microseconds to hours.
2. Mono-stable and A stable operation is possible through IC555.
3. The duty cycle can be adjusted according to our necessity.

It has the ability to operate from a wide range of supply Voltage.

6.3 PARTS OF SOLENOID VALVE

6.3.1 Coil:

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.

6.3.2 Frame:

The solenoid frame serves several purposes. Since 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.

6.3.3 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. In many applications it is necessary to use explosion proof solenoids.

6.3.4 Flow control valve:

In any fluid power circuit, flow control valve is used to control the speed of the actuator. The flow control can be achieved. By varying the area of flow through which the air is passing.

When area is increased, more quantity of air will be sent to actuator as a result its speed will increase. If the quantity of air entering into the actuator is reduced, the speed of the actuator is reduced.

6.3.5 Punch Tool:

The tool is device which penetrates in to sheet metal .it is made in high tensile carbon steel.

6.4 ELECTRONIC CONTROL UNIT:-

Here the 555 IC has been used as a multi vibrator. The output of IC 555 is fed to the input pin (pin no 14) of CD 4017 continues counting. The output of the IC becomes available at pin Nos. 3, 2 and 4. The output pulse of any one of output pin triggers (Puts ON) the Triac and current starts flowing across the load connected.

This process continues on other pins at different time intervals and the cycle continues. The frequency interval (Time) of the cycle can be adjusted by the pre-set look connected to pin 6 of 555 Timer IC.

6.5 WORKING OF 5/2 SOLENOID VALVE

The solenoid valve has 5 openings. This ensure easy exhausting of 5/2 valve. The spool of the 5/2 valve slide inside the main bore according to spool position; the ports get connected and disconnected. The working principle is as follows.

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.

6.6 WORKING OF SYSTEM

The working of the lubricating system is as follows. The air from atmosphere is drawn into the air compressor and is compressed. The air compressor is driven by the motor. The high pressure air is stored in the air tank. Our system incorporates a solenoid valve and an electronic timer. Timer may be made to operate at periodic interval of time. Whenever the timer is on, the solenoid valve gets opened. The air from the air tank is now admitted to the rear end of the double acting cylinder. Now the compressed air pushed the piston of the pneumatic cylinder forward. This makes the plunger in the distributor to push the oil towards the outlet of the distributor. So the oil is supplied to various parts where the hoses are connected. The valve is 5/2 solenoid valve which makes the piston of the pneumatic cylinder to its position (left end) after one stroke. During the return stroke a partial vacuum is created at the front end of the oil cylinder. To compensate the vacuum, the oil from the container enters the chamber.

During the forward stroke of piston the oil contained in the chamber is pushed out with pressure. The pressurized lubricating oil is then taken to required points through distributors. Flow control valves are provided in each hose so as to vary the flow of oil to different parts.

Sequence (i):

When the solenoid valve actuates, the air from the compressor enters the air cylinder and pushes the piston forward. This in turn pushes the piston in the oil cylinder.

Sequence (ii):

When the solenoid valve closes, the air from the compressor to the air cylinder is exhausted through the exhaust port of solenoid valve. Since the air cylinder is double acting, the piston retraces its path which in turn pulls the piston in the oil cylinder, there by creating vacuum in oil cylinder. Then the oil from the reservoir is sucked into cylinder to compensate the partial vacuum.

Sequence (iii):

Again when the valve open, air from the compressor enters the cylinder and pushes the piston which in turn pushes the piston in oil cylinder. The oil is pumped to the distributor from where it is taken to various parts to be lubricated.

6.7 ADVANTAGES

1. All points are lubricated simultaneously
2. Timer can also be used to lubricate the points at regular intervals
3. Requirement of man power for this system is not necessary

4. Wastage of lubricant is eliminated
5. Uniform flow of lubricant to all parts
6. Grease nipples are replaced by small adapters
7. Wear and tear lubricating components due to improper maintenance is eliminated
8. As the wastage of lubricant is avoided, lubrication cost is less
9. Equipment such of lubricant is avoided, lubrication cost is less.

The components can be lubricated even when the vehicle is in operation.

1) Reduced time

Due to atomization technique the time taken to complete the work is less as compared to conventional method.

2) Reduced human fatigue

The factor which affected human effort/ effect in conventional method are reduces in this technique.

3) Less amount of oil required

The limited but, calculated oil used in this process due to high specifiedtechnique.

4) Increased productivity as well as performance

Due to increase in work ratio increases the productivity which improves the industrial portfolio.

5) Reduce friction between piston and cylinder.

Due to minimizingthe conventional method the dust, sand particles, etc.situated on the piston or cylinder is totally escapes.

6.8 DISADVANTAGES

1) **Initial cost is high**
   The cost to build this assembly requires high, but it is only an initial investment.
2) **It depends upon external source i.e. electricity, compressor.**
   It depends upon the electronics instruments like sensor and microcontroller which isdifficult to repair.

6.9 APPLICATION

1. Recent application-In automobile industries, generally during assembly.
2. Future application-Used in reciprocating pump, compressor plant etc.

Applications

1) When any machine runs moving parts make contact with each other giving rise to what is known as friction which acts as a parasite sucking or consuming most parts of the available power. So in order to avoid or in actual terms reduce friction, a suitable medium should be applied between them which minimize this metal to metal contact. So this medium, aptly called the lubricant should be supplied between the movingparts. Besides reducing friction, this lubricant has also the function of heat discipline and cleaning the parts so the lubricant is actually called the life blood of the machinery.
2) When machinery is operated on a longer time basis a need arises for the lubricant namely a lubricating oil of the correct viscosity as the application dictates to be supplied continuously. This need is taken up by an auxiliary system to any machinery called the lubricant system. In order to lubricate the machinery they have to be kept off from working which reduces precious working hours this leads to production losses. Our lubrication system namely the automatic centralized lubrication was designed with an outlook of removing the hassles of periodic manual lubrication, stopping the machinery for lubrication etc. It has an added advantage of serving multiple service points at a single time this system can be adopted for any

machinery like lathes, milling machines which need a constant supply of lubricant.

3) A miniature version of our system can be also used in heavy duty automobiles like earth movers trucks etc., Which till now needs manual lubrication for its suspension etc. Our system can work on the pneumatic compressor available on the heavy duty automobiles. A bigger version of our system can be used in industries where machinery needs a constant supply of lubricant. This reduces constant manual supervision and reduces this need for shutting off the machinery for lubrication.

4) The service time for particular machinery can be preset on a timer and the system automatically fills up the service points on the machinery. Also the system can be attached to heavy vehicle which required lubrication in regular intervals of mileage. In this case, the timer may be attached to the odometer such that if gets actuated when the meter readings coincide with the preset intervals. The system can be easily attached to available compressor in heavy vehicle.

7. COST ESTIMATION

1. Material cost

SR. No.	PART NAME	MATERIAL	Quantity	Costing
01.	Pneumatic Double Acting Cylinder	Aluminium	1	2600
02.	Solenoid Valve	Aluminium	1	1800
03.	Flow Control Valve	Aluminium	1	450
04.	Electronic timing control unit	Electronic	1	1560
05.	Relay unit	Electronic	1	450
06.	Frame Stand	M.S.	1	2000
07.	Hose Collar and Hose Connector	Brass	6	650
08.	PU tube	Polyurethane	5 Meter	750

2. Labour Cost:

Lathe, Drilling, Welding, Grinding, Power Hacksaw, Gas Cutting:

Cost = 1500

3. Overhead Charges:

The overhead charges are arrived by "Manufacturing cost"

Manufacturing Cost = Material Cost + Labour cost

= 10260 + 1500

= 11760

Overhead Charges = Rs. 3000

4. Total Cost

Total cost = Material Cost + Labour cost + Overhead Charges

= 10260+1500+3000

= 14760

Total cost for this project = Rs. 15000

CONCLUSION

By this project we conclude that, in earlier days the lubrications are provided manually i.e. by brush and spray, due to which the body parts like thumbs and fingers gets affected and the physical problem are created like pain at the base of the thumbs and difficulty in moving finger, snapping etc. this causes problem while twisting and gripping, because of this problem worker cannot work efficiently and that indirectly affects the production rate. To overcome these problems the automatic lubrication system has played a very important role, as it is designed to deliver the right amount of lubricant at right time to every point by means of distributors connected by hoses and it has completely removed the manual work.

FUTURE SCOPE

Miniature version of our system can be used in heavy duty automobiles like earth movers trucks etc., Which till now needs manual lubrication for its suspension etc. Our system can work on the pneumatic compressor available on the heavy duty automobiles. A bigger version of our system can be used in industries where machinery needs a constant supply of lubricant. This reduces constant manual supervision and reduces this need for shutting off the machinery for lubrication.

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