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A

PROJECT REPORT

ON

"HYDRAULIC SYSTEM FOR KIKOFF PLATFORM 2 MTON

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YEAR 2023-2024

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I hereby declare that this project report entitled "**HYDRAULIC SYSTEM FOR KIKOFF PLATFORM 2 MTON** " bonafide record of the project work carried out by me during the academic year **2023-2024**, in fulfillment of the requirements for the award of "**PGDM IN OPERATION MANAGEMENT**" of MIT School of Distance Education.

This work has not been undertaken or submitted elsewhere in connection with any other academic course.

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ACKNOWLEDGEMENT

I would like to take this opportunity to express my sincere thanks and gratitude to **"MIT PUNE"**, Faculty of MIT School of Distance Education, for allowing me to do my project work in your esteemed organization. It has been a great learning and enjoyable experience.

I would like to express my deep sense of gratitude and profound thanks to all staff members of MIT School of Distance Education for their kind support and cooperation which helped me in gaining lots of knowledge and experience to do my project work successfully.

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Sign:- ---------

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ABSTRACT

This is the study on Hydraulic system at Nagpur . Hydraulic systems are popular for use in heavy-duty machinery. It might seem odd that the original Greek word hydraulikós from which hydraulic comes referred to water (hydra) and also to a musical instrument made from a hollow tube (aulos).

The previous Pneumatics system are using in our industry (sspl Nagpur) .for lifting one platform of weight 2 mt. . since the system gets old need to change in new system .After study we find that instesd pneumatic system we can use hydraulic system .

Cont..page2 ---I

So I have study for hydraulic system and successfully implement

Means removed old 30 hp pneumatic system and installed 5 hp power pack

Hydraulic system .

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CHAPTER 1: INTRODUCTION

With a variety of applications, hydraulic systems are used in all kinds of large and small industrial settings, as well as buildings, construction equipment, and vehicles. Paper mills, logging, manufacturing, robotics, and steel processing are leading users of hydraulic equipment.

As an efficient and cost-effective way to create movement or repetition, hydraulic system-based equipment is hard to top. It's likely your company has hydraulics in use in one or more applications for these reasons. We'll provide more information about hydraulic systems in this article, including covering the definition and basic designs and components.

An Overview of Hydraulic Systems

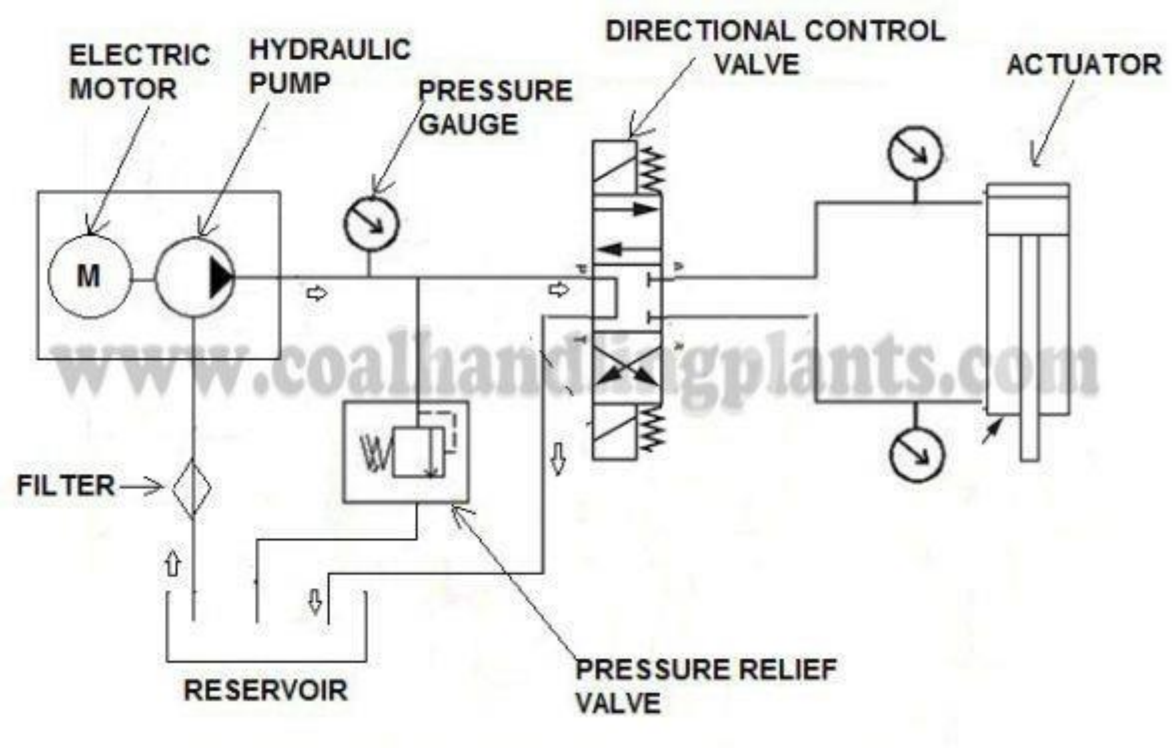
The purpose of a specific hydraulic system may vary, but all hydraulic systems work through the same basic concept. Defined simply, hydraulic systems function and perform tasks through using a fluid that is pressurized. Another way to put this is the pressurized fluid makes things work.

The power of liquid fuel in hydraulics is significant and as a result, hydraulic are commonly used in heavy equipment. In a hydraulic system, pressure, applied to a contained fluid at any point, is transmitted undiminished. That pressurized fluid acts upon every part of the section of a containing vessel and creates force or power. Due to the use of this force, and depending on how it's applied, operators can lift heavy loads, and precise repetitive tasks can be easily done.

Hydraulic Circuits

Transporting liquid through a set of interconnected discrete components, a hydraulic circuit is a system that can control where fluid flows (such as thermodynamic systems), as well as control fluid pressure (such as hydraulic amplifiers).

The system of a hydraulic circuit works similar to electric circuit theory, using linear and discrete elements. Hydraulic circuits are often applied in chemical processing (flow systems).



1. Reservoir / Oil Tank

They are used to hold the hydraulic oil.

2. Hydraulic Pump

They are used to pressurized the hydraulic fluid and force the fluid through the system.There are three types of hydraulic pump:

I. Fixed Displacement Pump – These pump has a set flow rate means every stroke of the motor moves same amount of fluid. Fixed displacement pumps are perfect for single jobs that to be repeated indefinitely over long periods of time. There are three types of fixed displacement pump : Gear Pump, Gerotor Pump, Screw Pump.

II. Variable Displacement Pump – In Variable displacement pumps flow rate and outlet pressure can be changed as the pump operates. They are used to power a wider variety of tool, but require more expense and more attention. There are four types of variable displacement pump: Bent Axis Pump, Axial Piston Pump, Radial Piston Pump, Rotary Vane Pump.

III. Hand /Manual Hydraulic pump – These pump are operated by hand and foot.

3. Hydraulic Motor

A hydraulic motor is a mechanical hydraulic actuator that converts hydraulic energy or hydraulic pressure into torque and angular displacement / rotation.

4. Hydraulic Cylinder

Hydraulic cylinder is a mechanical hydraulic actuator that converts hydraulic energy or hydraulic pressure into linear displacement. It consists of cylindrical barrel, piston and piston rod.

5. Pressure Control Valve

Pressure control valves limit the system pressure to protect the system components. There are four types of pressure control valve:

I. Pressure Relief Valve – They are designed to protect hydraulic system when pressure in the system increases beyond the specified design pressure or maximum working pressure. They are normally closed and it opens when the pressure exceeds a specified maximum value and diverts the pump flow back to reservoir or tank internally. They are located near hydraulic pump.

- **Working of pressure relief valve**

II. Pressure Reducing Valve – They are design to limit and maintain outlet pressure. They are normally open and closed if the pressure exceed beyond specified design pressure at outlet. They are located near hydraulic actuator.

III. Sequence Valve – The sequence valve is used to ensure that a certain pressure level is achieved in one branch of the circuit before a second branch is activated.

IV. Counterbalance Valve – Counterbalance valves are used in hydraulic systems working with running-away or suspended load. They are designed to create backpressure at the return line of the actuator to prevent losing control over the load.

6. Flow Control Valve

A flow control valve is used for adjusting the flow rate of a fluid in a pipeline. The valve contains a flow passage or a port whose area can be varied.

7. Directional control valve

Types of directional control valve.

I. Check Valve – check valve or non return valve are simplest type of directional control valve used to allow free flow offluid in only one direction.

II. Spool Type Directional Control Valve – These valve are used to control the direction of fluid flow.

8. Proportional Valve

They are used in a hydraulic system that need to vary either flow or pressure to reduce lunge and shock.

9. Cheque Q Meter

They control the returning flow in relation to the flow being directed into opposite side of the actuator. It is used in hydraulic system to influence the speed of hydraulic motor and hydraulic cylinder independent to the load (preventrunning away).

10. Solenoid Valve

It is a electro mechanically operated valve. The valve is control by electric current through a **solenoid**. The function ofsolenoid valve in hydraulic system is to shut off, distribute and release fluid.

Nowadays hydraulic systems are of high importance in the industrial as well as in the automotive, aeronautic and naval areas. The purpose of the present thesis is to introduce the reader to the function and analysis of hydraulic systems.

The thesis is based on a variety of bibliography sources aiming to provide a basic but complete spherical view of hydraulic systems. Thus, the structure is established by presenting the major designs of the different components that compose the hydraulic systems, introducing several efficient hydraulics subassemblies that correspond to different objectives and furthermore, analyzing and focusing the scientific areas of Fluid Mechanics, Transport Phenomena and Thermodynamics to better describe common met situations.

Hydraulic systems are unsurpassed in terms of speed and power in relation to other systems. The wide variety of components and their possible assemblies makes them very flexible. Furthermore, the fact that power is transferred through oil, minimizes and lubricates the moving parts providing high reliability and accuracy proving their strong position in today's engineering.

Hydraulics is a very ancient science. It traces back to the Egyptians and Babylonians, who constructed canals. Later the Roman and Egyptians, who –like the previous- had been more interested in the practical and constructional aspects of hydraulics than in theorizing. The first ones that tried to rationalize the nature of pressure and flow patterns were the Greeks, with the laws of hydrostatics and buoyancy. Although, development had been made it was very slow. This was the case until the Renaissance, when men such as Leonardo Da Vinci began to publish the results of their observations. Ideas which emerged then, respecting conservation of mass (continuity of flow), frictional resistance and the velocity of surface waves, are still in use, though sometimes in a more refined form.

In the 17th century, several brilliant men emerged. Descartes, Pascal, Newton, Boyle, Hooke and Leibnitz laid the foundations of modern mathematics and physics. This enabled researchers to perceive a logical pattern in the various aspects of mechanics. On this basis, four great pioneers - Bernoulli, Euler, Clairaut and D'Alembert- developed the academic discipline of hydrodynamics. The 19th century was a period of further advance. Hagen constructed experiments to investigate the effects of temperature on pipe flow. At almost the same time, Poiseuille developed equations for laminar flow in pipes. Further contributions were made by Weisbach, Bresse and Henri Darcy, who developed equations for frictional resistance in pipe and channel flows.

The rapid growth of industry in the 19th and 20th centuries was by now producing a demand for a better understanding of fluid flow phenomena. Navier, Stokes, Schwarz, Christoffel and other hydrodynamicists all contributed to the development of a formidable array of mathematical equations and methods. However, the real breakthrough came with the work of Prandtl. He proposed that flow was "divided into two interdependent parts.

There is on the one hand the free fluid which can be treated as inviscid and on the other hand the transition layer at the fixed boundaries". With this brilliant insight, Prandtl effectively fused together the two disparate schools of thought and laid the foundation for the development of the unified science of Fluid Mechanics.

The 20th century has, in consequence, seen tremendous advances in the understanding and application of fluid mechanics in almost every branch of engineering. Since 1945, the advent of the electronic computer, and advances in sensing and data logging equipment have revolutionized many aspects of hydraulics. Our understanding of the nature of turbulence, steady and unsteady flows in channels, sediment transport and maritime phenomena have developed rapidly. This has been matched by developments in software (Manring, 2005).

Hydraulics is applied in a wide range of industries: from construction machinery, automobiles, and airplanes (outdoor) to machine tools and press machines (indoor). Typical applications in each industrial field are listed below. Figure 1-4 shows photos of some of the applications.

- Construction machinery: earthmoving equipment (e.g. excavators, bulldozers, wheel loaders), cranes, tunnel boring equipment, rail equipment, building and construction machineries and drilling rigs
- Agricultural/forestry machinery: tractors, combines, rice planting machines, lawn mowers, and logging machines
- Industrial processing/forming machinery: steel mill, machine tools, and plastic processing, die casting, press, and sheet metal processing machines, automated production lines, loaders, textile machineries, R&D equipment and robotic systems
- Automobiles: power steering, transmissions, brake systems, shock absorbers and accessories for transport vehicles
- Industrial and special-purpose vehicles: fork lifts, platform vehicles, garbage trucks, concrete mixer trucks, concrete pump trucks, and accessories for transport vehicles (wing roofs and tail lifts)
- Ships/fishing machinery: steering, propulsion machinery, and deck cranes
- Aerospace machinery: steering, brake systems, and landing gear
- Testing machinery/simulator: vibration testers, flight simulators, and amusement machines

Special equipment: hydraulic lifts, vibration control systems for high-story buildings and trains, sluice gates, crushers, and compactors (Basic Hydraulics)

Basic components to be used in hydraulic systems are categorized as follows.

- Energy converters (hydraulic pumps, motors, and cylinders)
- Energy controllers (directional, pressure, and flow control valves)
- Accessories (reservoirs, filters, tubing, accumulators, sensors, etc.)

A power source (hydraulic package or unit) for practical systems consists of a hydraulic pump, a motor, and a reservoir. Depending on the required accuracy and operability, control valves are also incorporated in the systems. Recently, systems have become available that drive hydraulic pumps with servo motors and adjust the pump speed to control the flow and pressure. Figure 1-5 and Figure 1-6 show a circuit example of the most basic hydraulic systems (Basic Hydraulics .

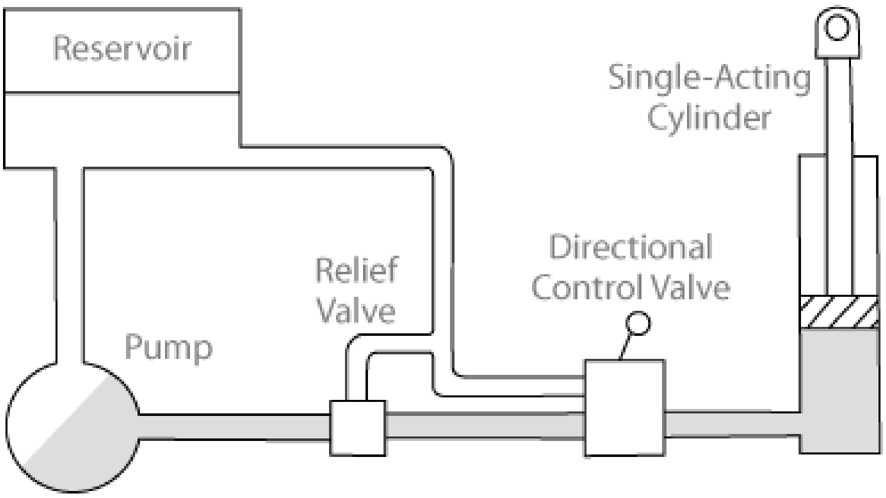


Figure 1-5 - Hydraulic Circuit Example.
(isccompanies.com)

Basic operation process:

1. The reservoir contains the appropriate quantity of oil in order for the system to operate properly.
2. The pump driven by an electric motor produces a flow of oil through the system.
3. The pressure regulator controls the maximum pressure in the system. If the pressure exceeds a set limit, the regulator directs the flow back to the tank and this way relieving the system from the pressure rise.

4. For normal operating pressures the regulator allows flow to the direction valve which can control whether the oil is going to flow from the upper to the lower or from the lower to the upper chamber of the hydraulic cylinder.
5. The hydraulic cylinder is the component through which the hydraulic power is transformed to work with the movement of the shaft.
6. The oil exiting the respective chamber of the cylinder returns to the tank after passing through a filter.

Analyzing the system dynamics of fluid power means using differential equations and simulations to examine the pressures and flows in components of a fluid power circuit, and the forces and motions of the mechanisms driven by the fluid power. Because fluid power systems change with time and because fluid power systems have energy storage elements, a dynamic system analysis approach must be taken which means the use of linear and nonlinear differential equations, linear and nonlinear simulations, time responses, transfer functions and frequency analysis.
Fluid power is one domain within the field of system dynamics, just as mechanical translational, mechanical rotational and electronic networks are system dynamic domains. Fluid power systems can be analyzed with the same mathematical tools used to describe spring-mass damper or inductor-capacitor-resistor systems. Like the other domains, fluid power has fundamental power variables and system elements connected in networks.
Unlike other domains many its elements are nonlinear which makes closed-form analysis somewhat more challenging, but not difficult to simulate. Many concepts from transfer functions and basic closed loop control systems are used to analyze fluid power circuits. Like all system dynamics domains, fluid power is characterized by two power variables that when multiplied form power, and ideal lumped elements including two energy storing elements, one energy dissipating element, a flow source element and a pressure source element. the analogies between fluid power elements and elements in other domains. Lumping fluid power systems into elements is useful when analyzing complex circuits

Hydraulic Components

Every hydraulic system consists of some integral parts, such as pumps, motors and valves. The purpose of this chapter is to introduce the most significant designs of each individual part and analyze their function. The included parts apart from the above mentioned are: reservoirs, filters, hoses, accumulators, heat exchangers and shock absorbers.

Fundamentals of Fluid Power

Three main objectives are analyzed in this chapter.

- The first refers to the properties of fluids. Except for the pneumatic systems which use air, the hydraulic systems use oil as a mean to transfer power, thus it is of high importance to understand the parameters that characterize a fluid like viscosity or bulk modulus.
- The second part refers to the mathematical scope of hydraulic systems. A combination of Transport Phenomena, Liquid Mechanics and Thermodynamics principles is used to describe such a system.
- Finally, the third object is to focus on specific situations found in hydraulic systems, where the general equations are specialized and simplified.

Hydraulic Systems

Having read about the components that assembly a hydraulic system and the mathematical approach that describes it, the main objective of the third chapter is to present different types of systems. Since there are many combinations of components that can lead to the same output, some efficient patterns have been established through the years depending on the type of task the hydraulic system is going to face. Furthermore, the schematics used for circuit design are presented as well as some examples of how to perform calculations on a hydraulic circuit.

Mechanical components perform a basic function in a hydraulic power or control system and must satisfy numerous requirements to perform adequately in a given circuit.
Furthermore, the hydraulic fluid influences the operation of the system components and they, in turn, affect the performance of the hydraulic fluid. The hydraulic fluid and most of the mechanical components that compose the hydraulic circuit are discussed in the current chapter (U.S. Army Material Command, 1971).

Pumps

Hydraulic pumps supply energy to the system, converting the torque and velocity of an input shaft to pressure and flow of the output fluid. Thereby convert mechanical energy to hydraulic energy. It provides the force required to transmit power. Pumps are rated in terms of flow and pressure. The flow rating (volumetric output) is the amount of liquid which can be delivered by the pump per time unit at a specified speed. A pump does not produce pressure. The pressure developed at the outlet depends on the resistance to flow in the circuit. Pumps are classified according to configuration or operating characteristics. They can also be classified as fixed or variable displacement devices (U.S. Army Material Command, 1971).

- ***Variable Displacement Pumps***

These pumps are also known as hydro-dynamic pumps. In these pumps the fluid is pressurized by the rotation of the propeller and the fluid pressure is proportional to the rotor speed. These pumps cannot withstand high pressures and generally used for low- pressure and high-volume flow applications. The fluid motion is generated due to rotating propeller. These pumps provide a smooth and continuous flow but the flow output decreases with an increase in system resistance (load). Therefore, the flow rate not only depends on the rotational speed but also on the resistance provided by the system. The important advantages of non-positive displacement pumps are lower initial cost, less operating maintenance because of less moving parts, simplicity of operation, higher reliability and suitability with wide range of fluid etc. These pumps are primarily used for transporting fluids and find little use in the hydraulic or fluid power industries.

- ***Fixed displacement pump***

These pumps deliver a constant volume of fluid in a cycle. The discharge quantity per revolution is fixed and they produce fluid flow proportional to their displacement and rotor speed. They are used in most of the industrial fluid power applications. The output fluid flow is constant and is independent of the system pressure (load). The important advantage associated with these pumps is that the high-pressure and low-pressure areas (means input and output region) are separated and hence the fluid cannot leak back due to higher pressure at the outlets. These features make the positive displacement pump most suited and universally accepted for hydraulic systems. The important advantages of positive displacement pumps over non-positive displacement pumps include capability to generate high pressures, high volumetric efficiency, high power to weight ratio (Joshi, 2010).

Gear Pumps

Gear pump is a sturdy and simple fixed displacement pump. It has two meshed gears revolving about their respective axes. These pumps operate with two gears engaged with each other and rotating to feed a hydraulic fluid from the suction area to the discharge area. These gears are the only moving parts in the pump. They are compact, relatively inexpensive and have few moving parts. The rigid design of the gears and houses allow for very high pressures and the ability to pump highly viscous fluids. The gear pumps are relatively resistant to working fluid contamination (Basic Hydraulics and Components, 2006), (Joshi, 2010).

External Gear Pumps

The external gear pump consists of two externally meshed gears housed in a pump case as shown in Figure 2-3. One of the gears is coupled with a prime mover and is called as driving gear and another is called as driven gear. The rotating gear carries the fluid from the tank to the outlet pipe. When the gears rotate, volume of the chamber expands leading to pressure drop below atmospheric value. Therefore, vacuum is created and the fluid is pushed into the void due to atmospheric pressure. The fluid is trapped between housing and rotating teeth of the gears.

The amount of fluid discharge is determined by the number of gear teeth, the volume of fluid between each pair of teeth and the speed of rotation. The important drawback of external gear pump is the unbalanced side load on its bearings. It is caused due to high pressure at the outlet and low pressure at the inlet which results in slower speeds and lower pressure ratings in addition to reducing the bearing life. Gear pumps are most commonly used for the hydraulic fluid power applications and are widely used in chemical installations to pump fluid with a certain viscosity (Joshi, 2010).

Types of external gear pumps (U.S. Army Material Command, 1971):

i. ***Spur gear pumps:*** A spur gear rotary hydraulic pump is illustrated in Figure 2-5. The two gears rotate in opposite directions and transfer liquid from the inlet to the outlet through the volume between the teeth and the housing. The output depends on tooth width and depth, and is largest for a minimum number of teeth. The spur gear pump is a fixed displacement pump.

ii. ***Helical gear pumps:*** A variation of the external spur gear pump is the helical gear pump. The fact that several teeth are engaged simultaneously allows the helical gear pump to carry larger loads at high speeds than can the spur gear pump. Operation is similar to that of the spur gear pump, but with less noise and usually smaller flow pulsations.

iii. ***Herringbone gear pumps:*** Another variation of the external gear pump incorporates herringbone gears. Like all gear pumps, the herringbone device is a constant displacement pump.

iv. ***Lobe pumps:*** Lobe pumps work on the similar principle of working as that of external gear pumps. However, the lobes do not make any contact like external gear pump (Figure 2-4). Similar to the external gear pump, the lobes rotate to create expanding volume at the inlet.

Internal Gear Pumps

Internal gear pumps are exceptionally adaptable. It comprises of an internal gear, a regular spur gear, a crescent-shaped seal and an external housing. The schematic of internal gear pump is shown in Figure 2-6. Liquid enters the suction port between the rotor (large exterior gear) and idler (small interior gear) teeth. Liquid travels through the pump between the teeth and crescent. Crescent divides the liquid and acts as a seal between the suction and discharge ports. When the teeth mesh on the side opposite to the crescent seal, the fluid is forced out through the discharge port of the pump. This clearance between gears can be adjusted to accommodate high temperature, to handle high viscosity fluids and to accommodate the wear. However, they are not suitable for high speed and high-pressure applications (Bolton, 2003).

Types of internal gear pumps (Department of the Army, 1997):

i. ***Crescent seal pumps:*** The crescent seal pump consists of an inner and outer gear separated by a crescent shaped seal (Figure 2-7). The gears rotate the same direction, with the inner gear rotating at a higher speed. The liquid is drawn into the pump at the point where the gear teeth begin to separate and is carried to the outlet in the space between the crescent and the teeth of both gears. The contact point of the gear teeth forms a seal, as does the small tip clearance at the crescent. This pump is generally used for low output applications.

ii. ***Gerotor pumps:*** Gerotor is a fixed displacement pump (Figure 2-8). The name Gerotor is derived from Generated Rotor. Gerotor pump is an internal gear pump without the crescent. It consists of two rotors, the inner and the outer rotor. The inner rotor has N teeth, and the outer rotor has $N + 1$ teeth. The inner rotor is located off-center and both rotors rotate. The geometry of the two rotors partitions the volume between them into N different dynamically changing volumes. During the rotation, volume of each partition changes continuously. Therefore, any given volume first increases, and then decreases. An increase in volume creates vacuum. This vacuum creates suction, and thus, this part of the cycle sucks the fluid. As the volume decreases, compression occurs. During this compression period, fluids can be pumped, or compressed (if they are gaseous fluids). The flow output is uniform and constant at the outlets.

Vane Pumps

Vane pumps generate a pumping action by tracking of vanes along the casing wall. They generally consist of a rotor, vanes, ring and a port plate with inlet and outlet ports. The rotor in a vane pump is connected to the prime mover through a shaft. The vanes are located on the slotted rotor. The rotor is eccentrically placed inside a cam ring as shown in the Figure 2-9. When the prime mover rotates the rotor, the vanes are thrown outward due to centrifugal force. The vanes track along the ring. This produces a suction cavity in the ring as the rotor rotates and therefore, the fluid is pushed into the pump through the inlet. The fluid is carried around to the outlet by the vanes whose retraction causes the fluid to be expelled. The capacity of the pump depends upon the eccentricity, expansion of vanes, width of vanes and speed of the rotor.

Their simple construction results in a high degree of reliability and easy maintenance. They are relatively low in cost and exhibit long operating life. They have comparatively high volumetric and overall efficiencies and are available in a wide range of output ratings. These pumps are quieter because of their structure and are less susceptible to working fluid contamination than piston pumps. Therefore, they are conveniently used in a wide range of applications. Capacity and pressure ratings of a vane pump are generally

lower than the gear pumps, but reduced leakage gives an improved volumetric efficiency of around 95%.
They provide the following advantages: minimized discharge pressure pulsation, compactness and light weight for high output, less efficiency degradation due to vane wear, and reliability and ease of maintenance.
The schematic of vane pump working principle is shown in Figure 2-9. These pumps can handle thin liquids (low viscosity) at relatively higher pressure. However, they are not suitable for high speed applications and for the high viscosity fluids or fluids carrying some abrasive particles. The maintenance cost is also higher due to many moving parts (U.S. Army Material Command, 1971), (Basic Hydraulics and Components, 2006).

Unbalanced Vane Pumps

In the unbalanced vane pump, the rotor and cam housing are eccentric (Figure 2-10). The pump suction is generated in the region where the vanes begin to move outward. The liquid is carried around the rotor by the vanes, which form a seal with the housing and the end plates, and it is discharged as the vanes are forced back into the rotor slots by the eccentric housing. Unbalanced vane pumps can be either fixed or variable displacement pumps. In the fixed displacement pump the rotor-housing eccentricity is constant and, hence, the displacement volume is fixed. A constant volume of fluid is discharged during each revolution of the rotor. Variable displacement can be provided if the housing can be moved with respect to the rotor. This movement changes the eccentricity and, therefore, the displacement. In addition to sliding vanes, rolling vanes and swinging vanes are also available in unbalanced vane pumps.

Balanced Vane Pumps

Hydraulic balance is achieved in the balanced vane pump in which the rotor is in an elliptic housing (Figure 2-11). This configuration creates two diametrically opposed displacement volumes. Pressure loading still occurs in the vanes, but the two identical pump halves create equal but opposite forces on the rotor. It leads to the zero-net force on the shaft and bearings. Thus, lives of pump and bearing increase significantly. Also, the sounds and vibrations decrease in the running mode of the pump. Balanced vane pumps are necessarily fixed displacement machines (U.S. Army Material Command, 1971), (Basic Hydraulics and Components, 2006).

1.1.1 Piston Pumps

The applications for which the piston pump is well suited are determined by its two principal advantages high-pressure capability and high volumetric efficiency. They are easy to convert to the variable displacement type. Thus, they can operate with various control types. In addition, the piston pump can operate at speeds over 2,000 rpm, is available in a wide range of output ratings, and provides a compact, lightweight unit for high power applications, low noise level when flow path is linear, and better system economy in the higher power ranges. The piston pumps provide advantages including: high efficiency, ease of operation at high pressure, ease of conversion to the variable displacement type, and various applicable control types. Piston pumps are classified by the motion of the piston relative to the drive shaft. There are three categories-axial, radial, or rotating (U.S. Army Material Command, 1971), (Basic Hydraulics and Components, 2006).

Axial piston Pumps

Axial piston pumps are fixed displacement pumps which converts rotary motion of the input shaft into an axial reciprocating motion of the pistons. These pumps have a number of pistons (usually an odd number) in a circular array within a housing which is commonly referred to as a cylinder block, rotor or barrel. Output can be controlled by manual, mechanical, or pressure-compensated controls. An axial-piston pump is shown in Figure 2-13. Rotary motion is converted to axial piston motion by means of the thrust cam, or wobble plate, mounted on the drive shaft. Variable displacement volume is provided by the internal valve arrangement (Department of the Army, 1997).

a. Bent Axis Piston Pumps

Figure 2-14 shows the schematic of bent axis piston pump. In these pumps, the reciprocating action of the pistons is obtained by bending the axis of the cylinder block. The cylinder block rotates at an angle which is inclined to the drive shaft. Then it is turned by the drive shaft through a universal link. It is set at an offset angle with the drive shaft. Also, it contains a number of pistons along its perimeter. These pistons are forced in and out of their bores as the distance between the drive shaft flange and the cylinder block changes.

a. Swash Plate Axial Piston Pump

A swash plate is a device that translates the rotary motion of a shaft into the reciprocating motion. It consists of a disk attached to a shaft as shown in Figure 2-15. If the disk is aligned perpendicular to the shaft, the disk will turn along with the rotating shaft without any reciprocating effect. Similarly, the edge of the inclined shaft will appear to oscillate along the shaft's length. This apparent linear motion increases with increase in the angle between disk and the shaft (offset angle).
In swash plate axial piston pump a series of pistons are aligned coaxially with a shaft through a swash plate to pump a fluid. The axial reciprocating motion of pistons is obtained by a swash plate that is either fixed or has variable degree of angle. As the piston barrel assembly rotates, the piston rotates around the shaft with the piston shoes in contact with the swash plate. The piston shoes follow the angled surface of the swash plate and the rotational motion of the shaft is converted into the reciprocating motion of the pistons. When the swash plate is perpendicular to the shaft, the reciprocating motion to the piston does not occur. As the swash plate angle increases, the piston follows the angle of the swash plate surface and hence it moves in and out of the barrel. The piston moves out of the cylinder barrel during one half of the cycle of rotation thereby generating an increasing volume, while during other half of the rotating cycle, the pistons move into the cylinder barrel generating a decreasing volume. This reciprocating motion of the piston results in the drawing in and pumping out of the fluid. Pump capacity can be controlled by varying the swash plate angle with the help of a separate hydraulic cylinder.

Radial Piston Pumps

The typical construction of radial piston pump is shown in Figure 2-16. The piston pump has pistons aligned radially in a cylindrical block. It consists of a shaft, a cylinder barrel with pistons and a rotor containing a reaction ring. The shaft directs the fluid in and out of the cylinder. Pistons are placed in radial bores around the rotor. The piston shoes ride on an eccentric ring which causes them to reciprocate as they rotate. The eccentricity determines the stroke of the pumping piston. Each piston is connected to inlet port when it starts extending while it is connected to the outlet port when start retracting. For

1.1.1.1 **Rotating Piston Pumps**

The rotating piston pump (sometimes called the rotary abutment pump) has three parallel synchronous shafts. Piston rotors are mounted on the outside shafts and seal dynamically against the cylindrical housing. The rotor mounted on the centre shaft forms an abutment valve. The rims of the piston rotors pass through a bucket cut in the centre rotor. Except when the rim is meshed with the abutment valve, a rolling contact seal is maintained between the rotors. Liquid is drawn into the right cylinder, pumped through to the left cylinder, and discharged by the left piston (Joshi, 2010).

1.1.2 **Screw Pumps**

A screw pump is an axial-flow gear pump and operates by rotating two or three screw shafts, which are aligned and engaged in parallel, to continuously convey a volume structured with screw leads. Figure 2-17 shows a two-rotor screw pump with helical gears. Liquid is introduced at the two ends and discharged at the center. The seal is formed by the contact of the two gears at the intersection of their addenda and by the small clearance between the gears and the pump housing. In pumps employing double helical gears, the thrust loads are balanced. This design is frequently employed in large pumps. Screw pumps are especially applicable where quiet operation is essential. In screw pumps, the gears must be in contact at the intersection of their addenda. This contact plus the minimum clearance at the outside diameter of the gears, provides a series of sealed chambers along the length of the screws. Screw pumps can also be arranged with three rotors. The center gear is the driver, and no timing gears are necessary. Because of the low noise level and reduced pulsation, they are used as hydraulic pressure sources for hydraulic lifts and submarines. Because gear pumps are less susceptible to working fluid contamination, they are also used for pumping cutting oils and lubricants (Basic Hydraulics and Components, 2006).

CHAPTER 2: ORGANIZATIONAL PROFILE

We (SSPL- NAGPUR)Roll Mill Industries Ltd is considered as a leading manufacturer and exporter of HotSteel Rolling Plants.

COMPANY PROFILE

Rollmill Industries Ltd. introduces itself as a reputed manufacturer and exporter of Hot Steel Rolling Plants. The company today enjoys a leading position and also manufactures and experts a complete rage of Rolling mill plants and various allied equipments, created using latest technology and techniques.

The range of different equipments the company produces includes all types of Gear Boxes, Pinion Stands, Speed Increasers, Roller Tables, Tilting Tables, Ejectors, Automation of Cooling Bed, Vertical Stands, Hot Saw, Coilers, Billet Handling Equipments and various types of Shears.

Each of our products retains some of the most advanced attributes thus has acquired wide recognition in both national and international markets. All our products come with best quality and innovative features thus we have never experienced rejection even for a single part of our plants and equipments.

We have been satisfying our worldwide customers who continuously forward their feedbacks as well as refer us to other organisations. Such positive state simply means that we are in position where our customers have turned into permanent clients as they also maintain trust, confidence, respects and above all an everlasting relationship with us.

OUR TEAM

We at Rollmill industries are completely backed by an expert team including designers, developers, engineers and other manpower which help us in creating a technologically advanced range of Rollmill plants and other equipments. Each member in the team holds thorough expertise of the domain and work with dedication in order to render every product to be called distinct among others, which are available for same applications. The team also provides required support for installation of these plants and equipments.

VISION & MISSION

Total Customer Satisfaction

Continous Improvement

Dedication to quality

Rollmill has the mission of providing quality services related to the Hot Rolling Mill and Machining of Metals according to the standards / specifications of our customers. Working towards our missions, we follow the axion of total quality assurance and continous improvement in product features and processes. We will strive to do this better to achive world class manufacturing systems and continually improve, so that all customers and members of the Rollmill Industries can share prosperity in long term growth.

OUR CAPABILITIES

Following are the capabilities, setting the company apart in the entire industry:

- Finding unique solutions to new problems
- Executing new rolling Mill Project on turn-key basis
- Also providing services for modernisation of existing mill
- Solving out particular condition and special needs of global clients
- Enhancement in the production capacity & diversification of product range

CHAPTER 3: PROJECT OBJECTIVES AND SCOPE

OBJECTIVE OF STUDY

Aim of Hydraulic system

is using an incompressible fluid to perform work by displacing areas, which will create either linear or rotary movement of actuators.

it works by

A positive displacement pump (gear, vane or piston pump) is driven by a prime mover (Electrical Motor or Engine) it sucs fluid from reservior and delivers oil to system.

During loading a resistance to flow creates the pressure which is utilised to do the work through cylinder for linear motion or through hydraulic motor for rotary motion, Direction of flow is changed with help of direction control valve & system pressure is regulated by pressure control valve & flow is regulated by flow control valve.

Hydraulics are a rather expensive but effective way of transferring power from one source to another on the same vehicle. This principle applies whether it is a garbage truck or a combat vehicle. Hydraulics on these vehicles translate power from the engine to to the dump bed hydraulics or the recovery winch or hydraulically powered ac compressor or hydraulically driven cooling fans. Hydraulics work when mechanical drives cannot because of location and electrical motors are impractical. So essentially just about every combat vehicle that has a winch that is driven by hydraulics. Dump trucks have dump beds that are driven by hydraulics. Farm tractors have implements run by hydraulics.

Hydraulics have the ability to exert extreme pressure in movement. Pumping fluid into a cavity or tube, if done properly can exert tremendous force. In a press to form steel panels, hydraulic pumps can move the forms or presses to easily bend & shape metal. In some cases, several hundred tons of pressure.

Hydraulic systems are used in a wide range of applications today, from small assembly processes to integrated steel and paper mills. The reservoir, pump, valve(s), and actuator(s) are the main components of a hydraulic system (motor, cylinder, etc.).

1. The hydraulic reservoir's purpose is to hold a volume of fluid, transfer heat from the system, allow solid contaminants to settle, and aid in the release of air and moisture from the fluid.

2. The hydraulic pump transmits mechanical energy into hydraulic energy. This is done by the movement of fluid which is the transmission medium. There are several types of hydraulic pumps including gear, vane, and piston.

3. Hydraulic valves start, stop, and direct fluid flow in a system. Hydraulic valves are composed of poppets or spools and can be actuated pneumatically, hydraulically, electrically, manually, or mechanically.

4. Actuators are the point at which hydraulic energy is converted back to mechanical energy.

5. This can be accomplished by using a hydraulic cylinder to convert hydraulic energy into linear motion and work, or a hydraulic motor to convert hydraulic energy into rotary motion and work.

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The Logic Behind Hydraulics

Hydrostatic Pressure

Hydrostatic pressure is the pressure which rises above a certain level in a liquid owing to the weight of the liquid mass an example of which is the atmospheric pressure (Smits, 2017):

$$Ps = h \, \rho \, g \qquad (3.1)$$

$Ps :$ *hydrostatic pressure (gravitational pressure) in (psi)* $h :$ *level of the column of liquid in (in)*
$\rho :$ *density of the liquid in* $(lb - sec^2/in^4)$
$g :$ *acceleration due to gravity in* (in/sec^2)

The hydrostatic pressure, or simply “pressure” as it is known for short, does not depend on the type of vessel used. It is purely dependent on the height and density of the column of liquid

Pascal's Law – Pressure Transmission

Pascal's law states that when there is an increase in pressure at any point in a confined fluid, there is an equal increase at every other point in the container (Fairman, 1996). For this reason, the shape of the container has no significance.

Valves

Control valves are essential and appear in all fluid power systems. Valves are sometimes categorized by function, which includes directional control valves for directing fluid flow to one or the other side of a cylinder or motor, pressure control valves for controlling the fluid pressure at a point and flow control valves for limiting the fluid flow rate in a line, which in turn limits the extension or retraction velocities of a piston. Valves are also characterized by the number of ports on the valve for connecting input and output lines and by the number of operating positions that the valve can assume. For example, a 3- way, 2-position valve commonly found in pneumatic systems has three ports for connecting supply line, exhaust or reservoir line and output line to the cylinder and two positions. In one position the supply line connects to the cylinder line extending the piston. In the other position the exhaust line connects to the cylinder retracting the piston, assuming the piston has a spring return. On/off valves can only be in the states defined by their positions while proportional valves are continuously variable and can take on any position in their working range. A servo valve is a proportional valve with an internal closed-loop feedback mechanism to maintain precise control over the valve behavior.

Valve Types

Valves are classified according to their function in the hydraulic system. These basic types are pressure control valves, directional control valves, and flow control valves. Most valves can be regarded as some combination of these basic types.

1.1.1 Pressure Control Valves

A pressure control valve either limits the pressure in various circuit components or changes the direction of all or part of the flow when the pressure at a certain point reaches a specified level. Such controls are directly or indirectly actuated by some system-pressure level (U.S. Army Material Command, 1971).

1.1.1.1 Relief Valves

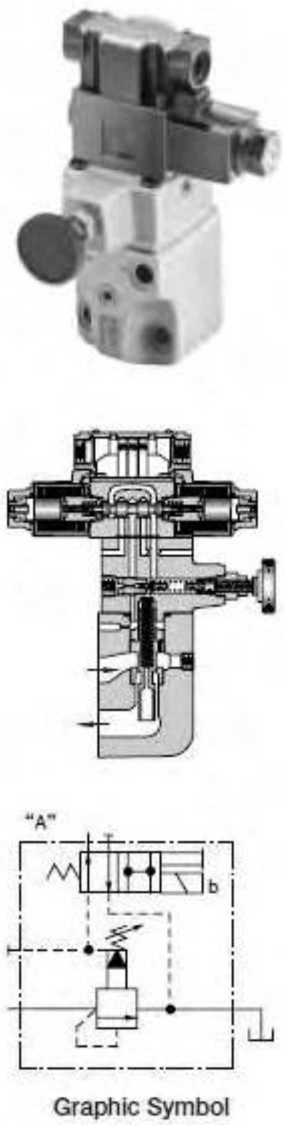
A relief valve limits the maximum pressure that can be applied to the part of the system to which it is connected. It acts as an orifice between the pressurized region and a secondary region at a lower pressure. In most applications, the relief valve is closed until the pressure attains a specified value. Then the flow through the valve increases as the system pressure rises until the entire system flow is vented to the low-pressure region. As the system pressure decreases, the valve closes (Basic Hydraulics and Components, 2006).

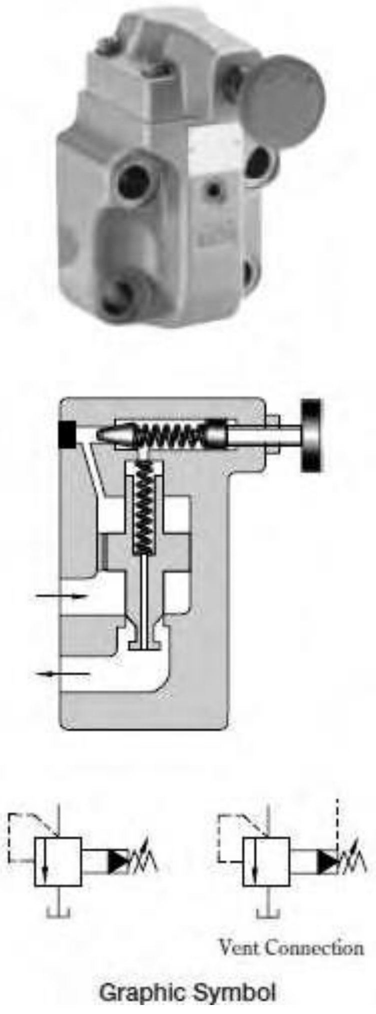
a. In the direct-acting pressure relief valve, the system pressure acts directly on the spring (Figure 2-25). These valves are small and have a simple structure for their capacity. However, they are likely to exhibit high-pressure override (a pressure characteristic observed when a fluid starts flowing from a valve and reaches the rated flow rate) and chattering. Therefore, they are used to control the pressure of relatively small flows and low-pressure systems or when relief valve conditions are expected only rarely. Valves of the size 1/8, in particular, are very popular for pilot pressure controls.

b. The differential relief valve can be constructed with a much lighter spring than the direct-acting type because the system pressure acts over only a differential area.

c. In the pilot operated relief valve, pressurized liquid is used to assist the spring (Figure 2-24). The liquid passes from the supply line through a restricted passage to a control chamber where it acts on a plunger to add to the spring force. The force is limited by a small capacity, direct-acting pilot relief valve. The pilot-operated relief valve is usually specified for systems which require frequent relieving. Placed in a vent circuit, they can perform remote control, unloading, or two-pressure control.

d. The solenoid controlled relief valve is a combination of a pilot operated relief valve and a small solenoid operated directional valve (Figure 2-23). Sending electrical signals to the directional valve can remotely unload pump pressure or conduct the two- or three- pressure control in hydraulic circuits.





1.1.1.2 **Unloading Valves**

An unloading valve provides a vent to a low pressure area when a specified pilot pressure is applied (Figure 2-26). They are used to operate pumps at the minimum load in an accumulator circuit or in a high-low pump circuit. A typical application is in a double pump system where a high volume, low pressure pump is completely loaded at maximum pressure, while a low volume, high pressure pump continues to develop higher pressure (Basic Hydraulics and Components, 2006).

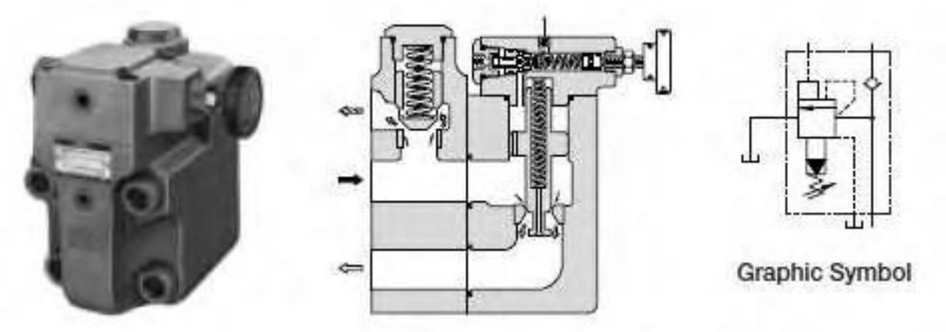


Figure 2-26 - Unloading Valve
(Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.1.3 **Load Dividing Valves**

In a circuit with two pumps operating in series, the load can be equally divided between the pumps by a load dividing valve. The low pressure pump discharge is connected to a larger piston area. The low pressure flow tends to open the valve and relieve the pump discharge to the reservoir. The high pressure pump discharge is connected to the small area and, assisted by the spring, tends to close the valve. The ratio of the pressure produced at the low pressure pump to the discharge pressure of the high pressure pump is the same as the valve area ratio (U.S. Army Material Command, 1971).

1.1.1.4 **Brake Valves**

These valves smoothly stop actuators that have a large inertia force (Figure 2-27). When a directional control valve is closed, a relief valve at the outlet side releases the accumulating pressure while maintaining the circuit pressure at the preset level. At the inlet side, a check valve feeds the flow, supply of which has been blocked by the directional control valve, to reduce a risk of cavitation (Department of the Army, 1997).

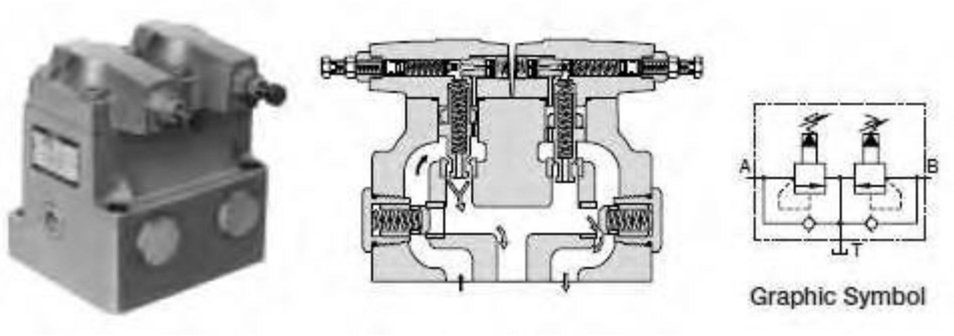


Figure 2-27 - Brake Valve
(Yuken Kogyo Co. - Basic Hydraulics and Components)

Sequence Valves

The order of flow to different parts of a hydraulic system can be controlled by sequence valves. These valves control the sequential operation of two or more actuators. If the inlet pressure exceeds a preset level, they deliver effective pressure to the outlet side. This is accomplished by controlling minimum pressure. Either an internal or external pilot pressure can be applied. The valves can serve as pressure holding valves to maintain hydraulic pressure in a circuit. Figure 2-28 shows an externally piloted, externally drained sequence valve. The inlet pressure must reach a prescribed value before the flow is allowed to pass through the valve (Basic Hydraulics and Components, 2006).

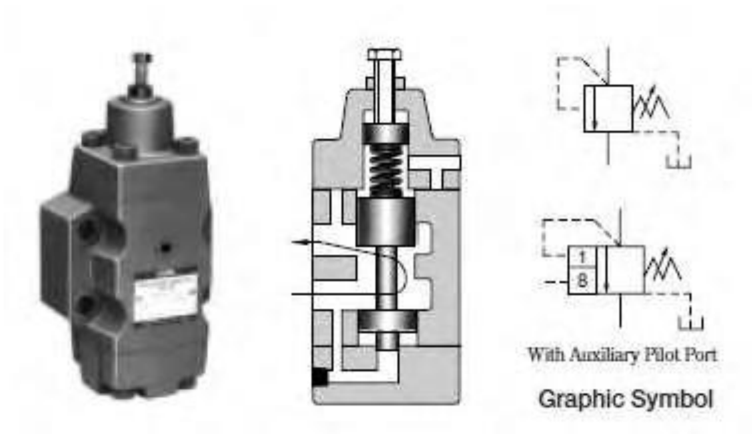
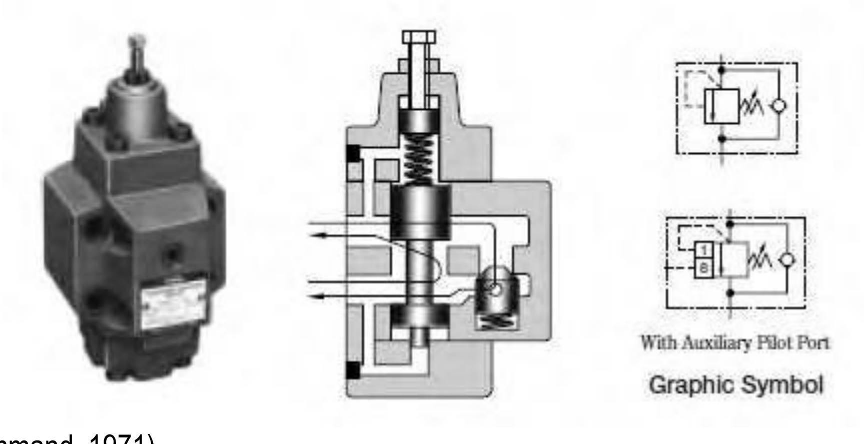


Figure 2-28 - Sequence Valve
(Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.1.5 **Counterbalance Valves**

The counterbalance back pressure valve can be used to allow free flow in one direction but restricted flow in the opposite direction (Figure 2-29). These valves maintain hydraulic pressure in a hydraulic system or load backpressure on a cylinder. If the inlet pressure exceeds a preset level, flow is released to keep the pressure constant. They are accompanied with a check valve that allows the flow for lifting a cylinder up to freely pass. This valve can be used, for example, to prevent the weight of a vertically mounted piston from causing the piston to descend. The spring setting produces a back pressure on the piston which counterbalances the force of gravity (U.S. Army



Material Command, 1971).

Figure 2-29 - Counterbalance Valve
(Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.1.6 **Pressure Reducing Valves**

Pressure regulator or pressure reducing valves set hydraulic circuit pressure equal to or below a pressure in the main circuit. When the outlet pressure reaches a preset level, the valve opens, and the balanced piston moves to throttle a passage to keep the outlet pressure constant. The outlet pressure is maintained constant, regardless of the inlet pressure. In the type shown in Figure 2-30, the outlet pressure is balanced against a spring (Basic Hydraulics and Components, 2006).

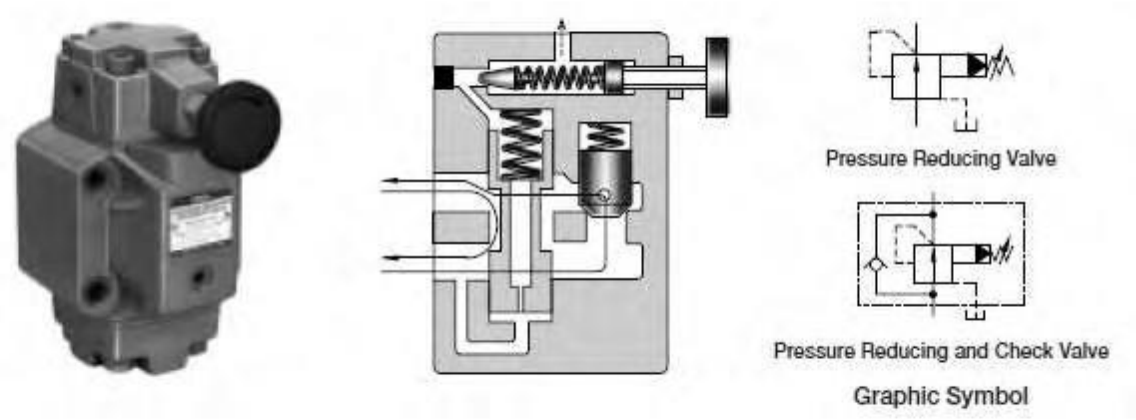


Figure 2-30 - Pressure Reducing and Check Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.1.7 **Pressure Switch**

Pressure switches are used in hydraulic systems to make or break an electrical circuit at a preset hydraulic pressure (Figure 2-31). The system pressure acts against an adjustable spring used to preset the switch. A sensing component made of semi- conducting materials detects the pressure. When the pressure reaches the specified value, the sensor is activated. The signal can be used to actuate a variety of control elements. Although the pressure switch is not a valve, it is a valuable control element in valve systems (Basic Hydraulics and Components, 2006).

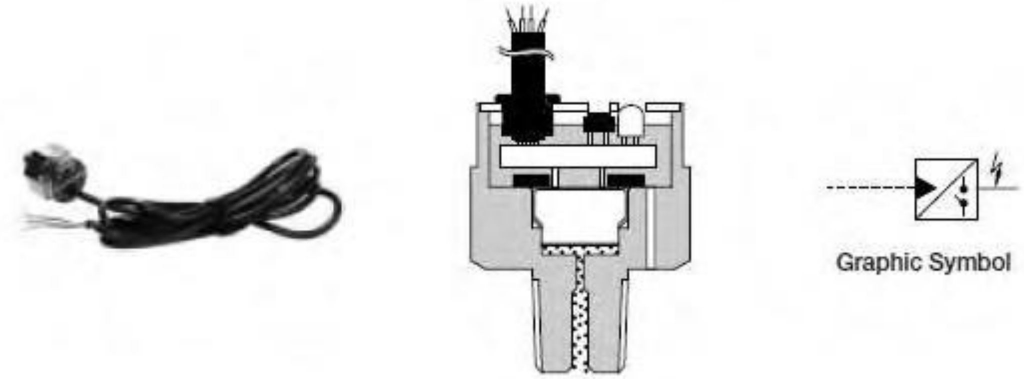


Figure 2-31 - Pressure Switch (Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.1.8 **Balancing Valves**

These valves are combination valves that have pressure reducing and counterbalancing functions developed for applications such as a hydraulic balance circuit in a vertical machining center. When the pressure reducing function is employed, the outlet pressure is maintained at the preset level for pressure reduction, regardless of the inlet pressure. If the counterbalancing function is employed, the outlet pressure is maintained at the preset

level for pressure relief, which is higher than the pressure reducing (U.S. Army Material Command, 1993).

1.1.1.9 Hydraulic Fuses

A hydraulic fuse employs a fragile diaphragm or similar device which fractures at a preset pressure. It can thus be used as a substitute for, or in conjunction with, a pressure control valve. Hydraulic fuses can be used with safety valves to prevent hydraulic fluid loss under normal operating conditions. They usually do not have automatic reset capabilities. It is necessary to manually replace the diaphragm if the hydraulic fuse is actuated (U.S. Army Material Command, 1971).

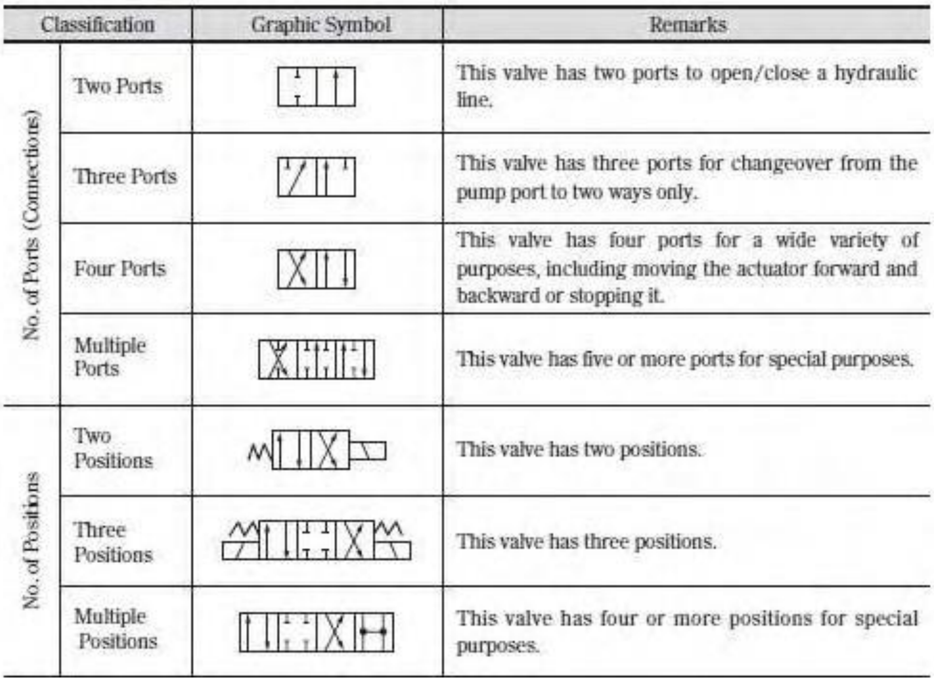
1.1.2 Direction Control Valves

Directional control valves control start/stop, directions, and acceleration/deceleration of hydraulic cylinders and motors. They can be used in a various applications, and a wide range of products is available. They are often used to control the operation of actuators. They can be categorized into three types: spool, poppet, and ball. The spool type can be either a sliding type or a rotary type. The former is the most popular for pressure balancing and high capacity. The poppet type offers excellent leak-tight capability (zero leak) for its poppet-seat contact. The ball type is an alternative for the poppet: a ball is used instead of a poppet (Basic Hydraulics and Components, 2006).

1.1.2.1 Classification of Directional Control Valves

- ***Classification by Port/Position Count***

The port count indicates the number of connectable lines, and the position count indicates the number of changeovers in the directional control valves. Figure 2-32 lists the classifications. The valves with four ports and three positions are very popular. The four ports include: pump port (P), tank port (T), and cylinder ports (A and B). The symbols are often appended with graphic symbols of the directional control valves (Basic Hydraulics and Components, 2006).



Classification		Graphic Symbol	Remarks
No. of Ports (Connections)	Two Ports		This valve has two ports to open/close a hydraulic line.
	Three Ports		This valve has three ports for changeover from the pump port to two ways only.
	Four Ports		This valve has four ports for a wide variety of purposes, including moving the actuator forward and backward or stopping it.
	Multiple Ports		This valve has five or more ports for special purposes.
No. of Positions	Two Positions		This valve has two positions.
	Three Positions		This valve has three positions.
	Multiple Positions		This valve has four or more positions for special purposes.

Figure 2-32 - Classification by Port/Position Count (Yuken Kogyo Co. - Basic Hydraulics and Components

1.1.2.2 **Structure and Characteristics of Directional Control Valves**

i. Solenoid Operated Directional Valves

These valves control the flow direction in hydraulic circuits, electrically operated with manual switches, limit switches, or pressure switches. They are the most popular for use in practical hydraulic systems. Three types of solenoids are available: for direct current (DC), for alternating current (AC), and with a rectifier. The solenoids can be grouped into wet and dry types in respect to the structure. The solenoid operated directional valves are commercially available in the many sizes, among them, the 1/8 size is most often selected for practical hydraulic systems. Figure 2-35 shows the 1/8 solenoid operated directional valve. Aside from the maximum working pressure, flow, tank-line back pressure, and changeover frequency, performance characteristics of the solenoid operated directional valves include power consumption.

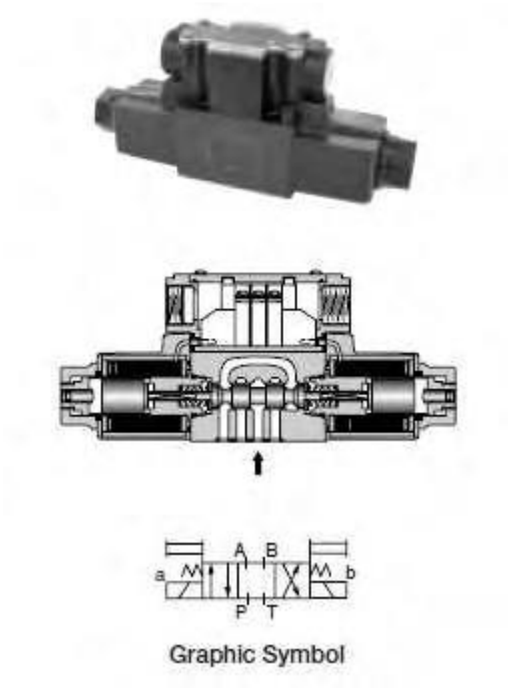


Figure 2-35 - Solenoid Operated Directional Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

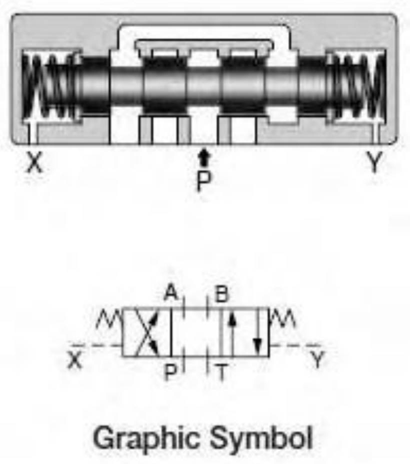


Figure 2-34 - Pilot Operated Directional Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

ii. Solenoid Controlled Pilot Operated Directional Valves

These valves are a combination of a small solenoid operated directional valve and a large pilot operated directional valve. The small four-way solenoid valve is used for directional control of the pilot line. The main valve (main spool) provides directional control of the main line. The pilot operated directional valve includes the spring offset, spring-centered and no-spring types. Figure 2-36 shows a solenoid controlled pilot operated directional valve of the 3/4 size.

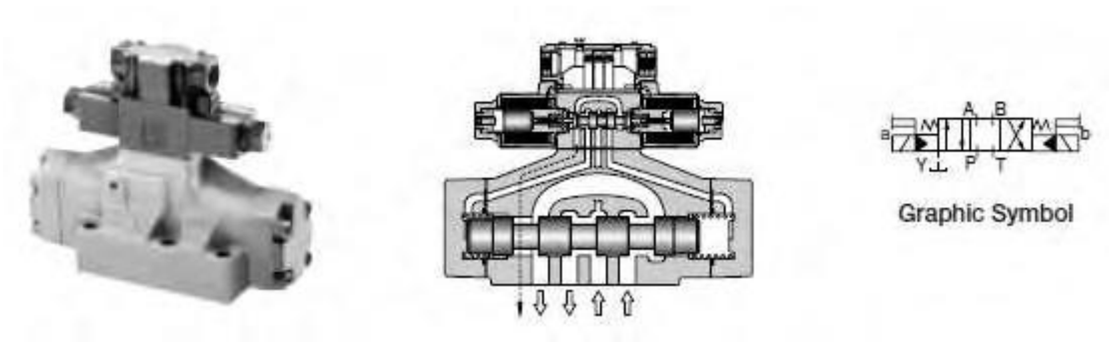


Figure 2-36 - Solenoid Controlled Pilot Operated Directional Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

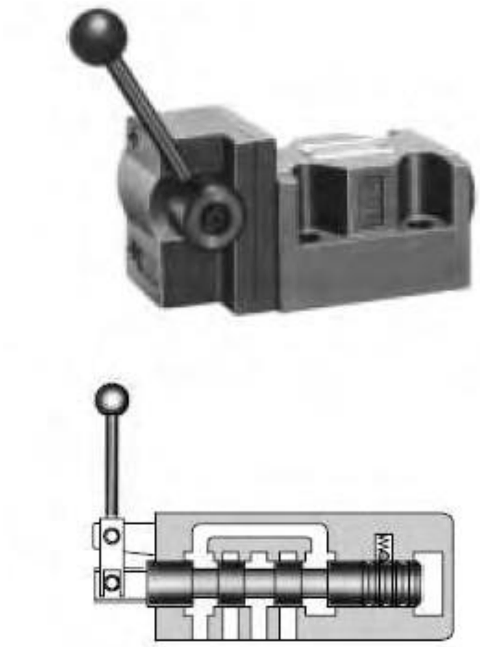
iii. Poppet Type Solenoid Controlled Pilot Operated Directional Control Valves These valves are solenoid controlled pilot operated directional valves, which are made multi-functional by granting individual poppet functions, such as directional control, flow control, and pressure control. They consist of a main valve with four poppets, a solenoid operated directional valve for the pilot line, and a pilot selector valve. These valves are used in large-scale hydraulic systems including press and compressing machines.

iv. Pilot Operated Directional Valves

These valves perform spool changeover by the hydraulic pilot. They are useful when the pilot directional control valve and the main directional control valve should be installed distant to each other. Figure 2-34 shows the pilot operated directional valve.

v. Manually Operated Directional Valves

These valves are manually operated to change the direction of hydraulic flow. They are available in the spool-operated and rotary types. These valves are structured in two types, detent and spring. The detent type maintains the spool position at the time the lever is operated, and the spool is returned to the center by the spring force. The spring type springs back the spool to either position of changeover, as is in the two-position valve. Figure 2-38 shows the spool-operated type and rotary type directional valves, respectively.



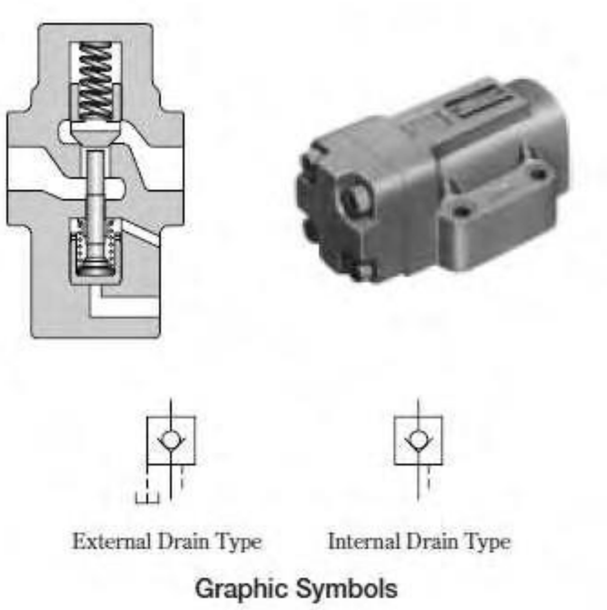


Figure 2-37 - Pilot Operated Check Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

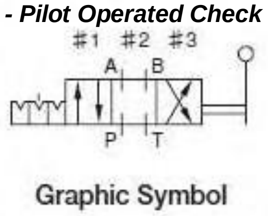


Figure 2-38 - Manually Operated Directional Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

vi. Check Valves

These valves allow free flow in one direction, while preventing flow in the reverse direction. When flow is in the normal direction, the liquid pressure acts against the spring tension to hold the poppet off the seat. When flow stops, the spring seats the poppet and liquid cannot pass in the reverse direction. Check valves are often incorporated in sequence valves or pressure reducing valves to let them open in one direction and bypass the free flow in the reverse direction.

vii. Pilot Operated Check Valves

These check valves have a pilot piston, which works with remote pressure to open the closed check valve, allowing reversed flow. Two types are available, standard and decompression. The decompression type has a main poppet valve combined with a decompression valve. When the pilot pressure increases to lift the pilot piston, the decompression poppet valve opens first, and then the main poppet after the pressure is reduced. These valves are used to moderate shock caused by a sudden pressure release, which often occurs during the return stroke of a press process. They maintain the actuator position and system pressure, opening/closing the seat, therefore, internal leakage can be kept at minimum. When they are used with a restrictor or a counterbalance valve that produces back pressure on the outlet side of reversed free flow, a counter force may work on the piston, which opens/closes the poppet continuously and vibrates the valves as a result. If the valves are in such a hydraulic circuit, the external drain type should be used. Figure 2-37 shows the pilot operated check valve.

viii. Multiple Control Valves

These valves have multiple functions, including direction, relief, and check control in one body and are mainly used for vehicles. Whether the functions are to be activated individually or simultaneously determines the circuit type: parallel, tandem, or series.
When the directional control function is not working, the pump output flow goes through the valve into the tank. For this reason, power loss and heat generation are minimum. The mono block construction, which houses multiple spools in one body, and the sectional construction, which is modular by valve function, are available. For directional control, manual, solenoid, and proportional control valves are offered. (Basic Hydraulics and Components, 2006)

1.1.3 **Flow Control Valves**

Flow control valves are used to regulate the rate of liquid flow to different parts of a hydraulic system. Control of flow rate is a means by which the speed of hydraulic machine elements is controlled. The rate of flow to a particular system component is varied by throttling or by diverting the flow (U.S. Army Material Command, 1971).

1.1.3.1 **Restrictors/One Way Restrictors**

These valves regulate flow rates in hydraulic circuits (Figure 2-39). They have the advantages of plain structure, simple operation, and wide range of adjustment. On the other hand, they cannot accurately control the flow, even though the fixed restriction, the flow varies with the inlet-outlet differential pressure and the fluid viscosity. Therefore, these valves are placed where the pressure difference varies little, and high control accuracy is not required. The one-way restrictors regulate flow in one way, while allowing reversed flow to freely pass through (Basic Hydraulics and Components, 2006).

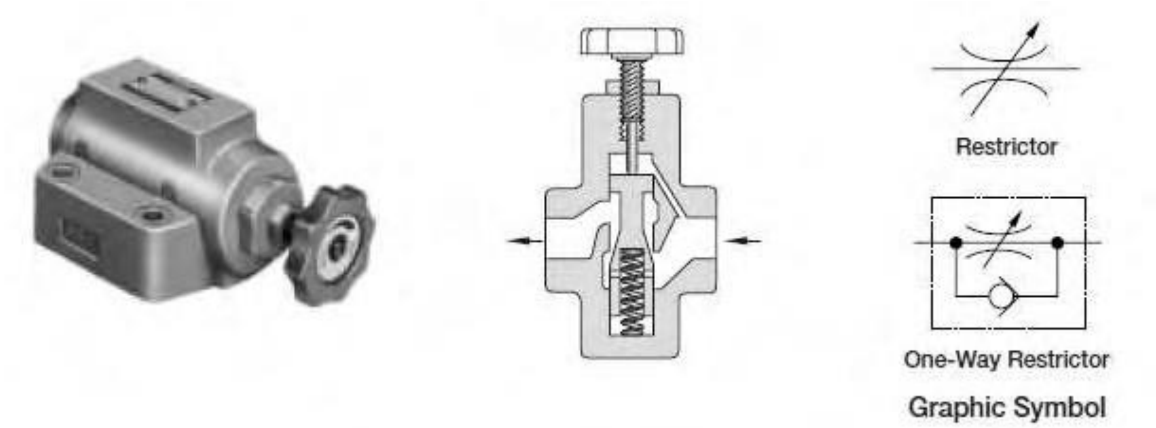


Figure 2-39 - Restrictor
(Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.3.2 **Flow Control Valves/Flow Control and Check Valves**

These valves consist of a pressure compensator (pressure reducing valve that keeps the pressure difference constant) and a restrictor (Figure 2-40). They maintain a constant flow rate, independent of the inlet-outlet differential pressure. Provided with a sharp-edge orifice, they can also work regardless of fluid temperature or viscosity. In a circuit where the flow rate is regulated to a low level, the control flow may be momentarily exceeded, leading to jumping of the actuator. This phenomenon is related to a time lag until the pressure compensating piston is properly positioned for flow control. To prevent the phenomenon, the piston stroke should be adjusted according to the inlet-outlet differential pressure. Flow control valves are basically used as follows (Basic Hydraulics and Components, 2006).

- ***Meter-In Control***

The control valve is connected in series with the cylinder inlet to directly control the input flow. Prior to the control valve, a relief valve is applied to excess flow, which escapes through a relief valve. In a circuit where load is applied in the direction of piston travel, the control valve may lose cylinder speed control.

- ***Meter-Out Control***

The control valve is connected in series with the cylinder outlet to directly control the output flow. Prior to the control valve, excess flow escapes through a relief valve to a tank. This circuit design is used for applications where the piston could move down faster than a control speed, as in the case of vertical drilling machines, or where there should always be a back pressure in the cylinder. Careful attention should be paid to the fact that the cylinder outlet pressure may rise above the relief pressure produced in the circuit.

- ***Bleed-Off Control***

The control valve is installed on a by-pass line to regulate flow to the tank and control the actuator speed. Compared to the other control circuits, this circuit works with small power consumption because discharge pressure of the pump is fully delivered to the load resistance. Given that the bleed flow is constant, the fluctuation of pump flow determines the actuator speed. In other words, the pump discharge flow directly influences the load and the pump's volumetric efficiency. This circuit does not allow for control of multiple actuators.

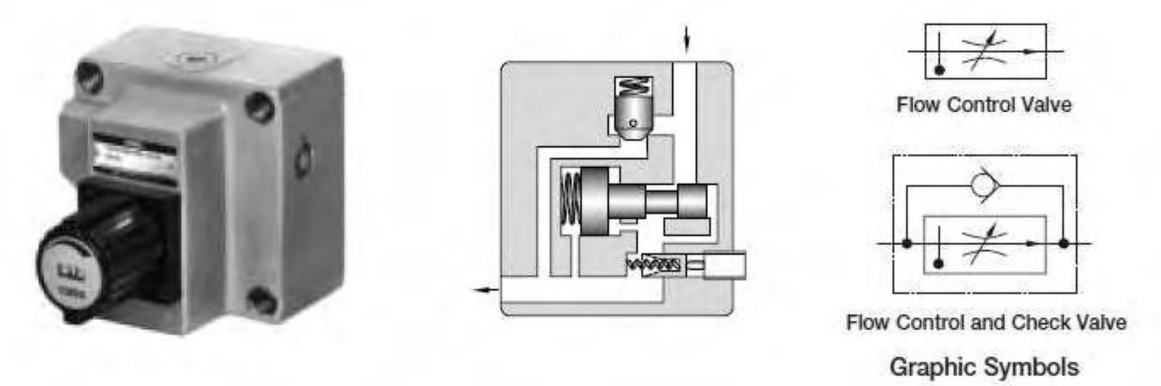


Figure 2-40 - Flow Control and Check Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.3.3 **Deceleration Valves/Deceleration and Check Valves**

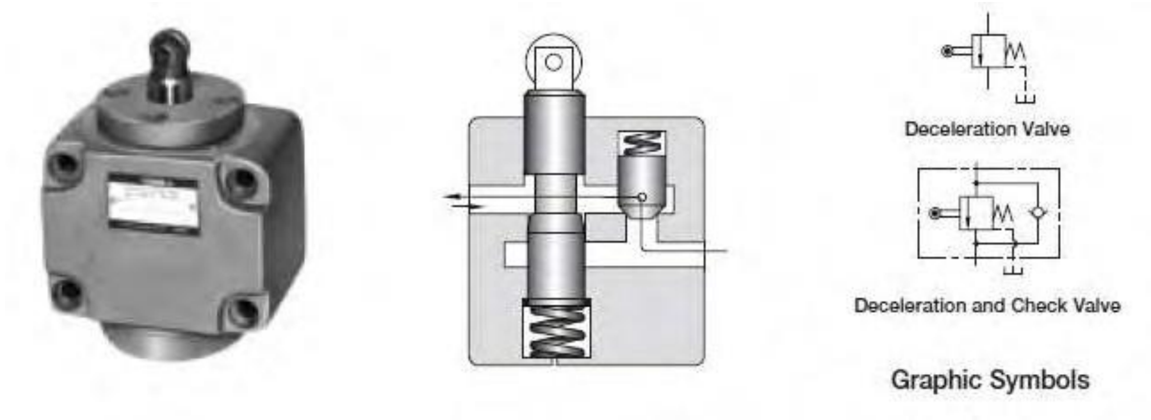


Figure 2-41 - Deceleration and Check Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

These valves continuously regulate flow rates, using a cam mechanism (Figure 2-41). Pushing the spool down decreases the flow rate for the normal open type and increases it for the normal close type. When the normal open type is installed to cushion the cylinder piston, accurate stroke end control is difficult. In this case, the restrictor and directional control valve should be adjusted so that the piston slowly returns to an intended position and then stops (Basic Hydraulics and Components, 2006).

1.1.3.4 **Feed Control Valves**

These valves are a combination of a flow control and check valve and a deceleration valve: they are used mainly for feed control of machine tools (Figure 2-42). Switching from rapid traverse to feed is made by a cam operation, and the feed speed is controlled with a flow control valve. Rapid return is free of cam actuation. Two-speed mode with two flow control valves is also available (Basic Hydraulics and Components, 2006).

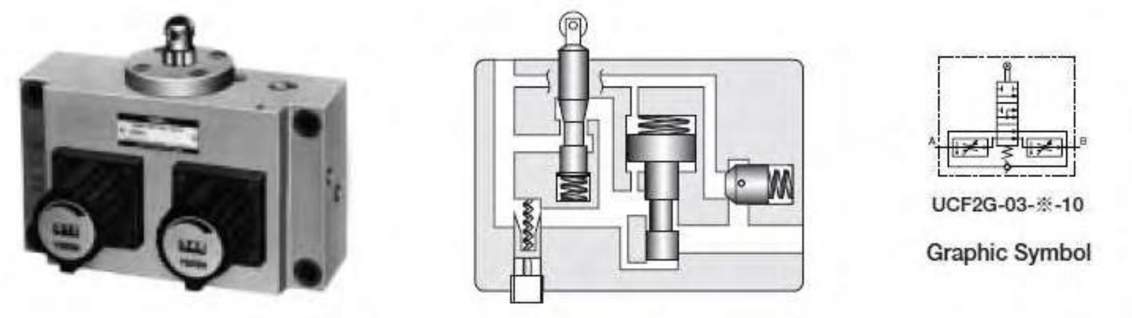


Figure 2-42 - Feed Control Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.3.5 **Flow divider valves**

Flow-divider valves utilize sliding elements to change the orifice area. They distribute the flow to multiple lines, each of which then has the same flow rate downstream of the valve. They are generally pressure-compensating valves and are frequently used to synchronize the motion of several linear actuators (U.S. Army Material Command, 1971).

1.1.4 **Modular Valves**

These valves, including the pressure control, flow control, and directional control types, have standardized mounting surfaces that conform to the ISO standards for solenoid operated directional valves. They are stacked on a base plate and referred to as sandwich valves or stack valves. They are available in nominal sizes of less than 1/8" and 1/8" to 1¼". These modular valves provide the following advantages.

- Compact stacking. They require very small mounting space.
- Easy circuit building. They eliminate the necessity for a large part of piping and assembly work, allowing easy and quick circuit building.
- Improved reliability. They are stacked together without piping: therefore, they are almost free from problems such as oil leakage, vibration, and noise.
- Easy maintenance due to integrated functions.

Note that the number of stacking layers is subject to the bolt strength. Also, due caution should be paid to the maximum flow and the pressure loss (Basic Hydraulics and Components, 2006).

1.1.5 **Logic Valves**

These valves consist of cartridge type elements and covers with pilot passages. Although they are two-port valves designed to simply open/close the poppets according to pressure signals from the pilot line, various types may be combined for direction, flow rate, and pressure control. Standard covers, which have several pressure signal ports and control valves, including pilot operated relief valves, are available for control purposes.

Logic valves provide fast-response, high-pressure, and high-flow control. They are typically applied to machines that involve high-speed actuator operation, such as die-cast machines, injection molding machines, and press machines. The logic valves have the following features (Basic Hydraulics and Components, 2006).

- Multifunction performance in terms of direction, flow, and pressure can be obtained by combining elements and covers.
- Various functions can be achieved, depending on the pilot line connection.
- Poppet-type elements virtually eliminate internal leakage and hydraulic locking. Because there are no overlaps, the response time is very short, permitting high- speed shifting.
- For high pressure, large capacity systems, optimum performance is achieved with low pressure losses.
- Since the logic valves are directly incorporated in cavities provided in blocks, the system faces fewer problems related to piping such as oil leakage, vibration, and noise, and higher reliability is achieved.
- Multi-function logic valves permit compact integrated hydraulic systems that reduce manifold dimensions and mass and achieve lower cost than that of the conventional types.

1.1.6 **Proportional Electro-Hydraulic Control Valves**

These valves and related devices work with electrical settings to provide continuous remote control of the pressure and flow in hydraulic circuits. For multi-stage pressure or flow control, various combinations of control valves have been used, however, proportional electro-hydraulic control valves and devices eliminate the necessity for those valves and greatly simplify the circuit architectures. These valves and devices, which permit remote control, allow hydraulic systems and their control rooms to be separately located. In other words, they are well suited for applications in large plants. Proportional electro-hydraulic control valves and devices, based on general-purpose hydraulic products, are easy to maintain and manage, highly resistant to contamination by fluids, and cost-effective for applications where very quick response and high accuracy are not required (Basic Hydraulics and Components, 2006).

1.1.7 Servomechanism & Servo Valves

A servomechanism is an automatic control system designed to operate in accordance with input control parameters. The mechanism continuously compares the input signal to the feedback signal to adjust the operating conditions for error correction. Commercially available servo systems vary according to their methods for error detection, amplification, communication, and output.
Hydraulic servo systems have been widely applied in general industrial areas, as well as in the airline, maritime, and military industries. Servo systems, capable of automatic position, speed, and force (load) control with high accuracy and quick response, are used for high-speed injection molding, die-casting, rolling mill, press machines, industrial robots, simulators, testing machinery, and table feeders.
A hydraulic servo system consists of an actuator (hydraulic motor/cylinder), servo valves, sensors, and a servo amplifier.
There are two types of electro-hydraulic servo valves: the pilot operated type, which drives a torque motor to amplify the hydraulic power with a nozzle flapper mechanism, and the direct type, which directly drives a spool with a linear motor and electrically provides feedbacks about the spool position. Mechanical servo valves are also available that have a stylus at one side of the spool to control the flow direction by the mechanical motion of the stylus (Basic Hydraulics and Components, 2006).

1.1.7.1 Types

i. Electro-Hydraulic Two-Stage Servo Valves

Nearly all types of servo valves are based on common principles. Electro-hydraulic two- stage servo valves generally operate with force feedback. Given that valve pressure drop is constant, the valves control the output flow in proportion to the input signal. Therefore, they can be used to drive a hydraulic cylinder or motor at a speed proportional to the input current. Figure 2-43 provides illustrations of an electro-hydraulic servo valve.
The valve contains identical torque motors in parallel, which serve as a nozzle flapper amplifier with movable coils and nozzles. Coil displacement always determines the spool position. To ensure reliable pilot operation, the valve is provided with a filter prior to the pilot line, as well as a high-performance line filter prior to the valve inlet.

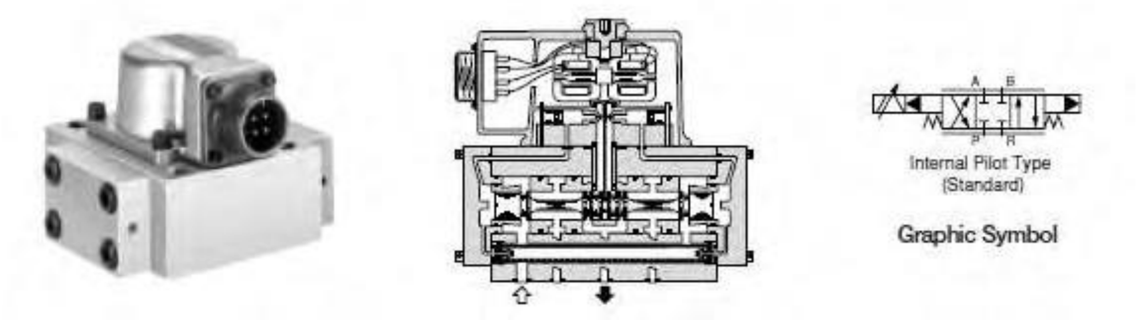
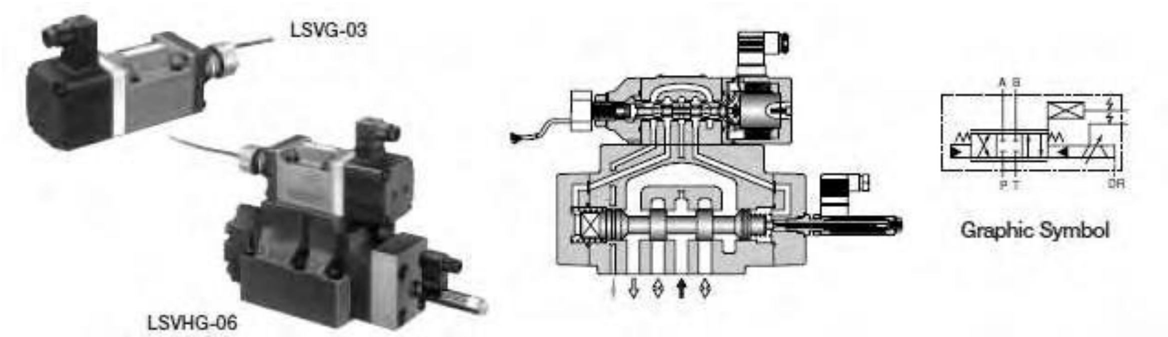


Figure 2-43 - Electro-Hydraulic Servo Valve (Yuken Kogyo Co. - Basic Hydraulics and Components)

ii. Direct Drive Servo Valves

The valves directly drive a spool with a small and high power linear motor. Direct drive servo valves electrically send the spool position data to the controller to provide quick response and high contamination resistance. These valves are available in two types:

direct spool control and pilot operation (a combination of small valves). Figure 2-44 shows illustrations of direct drive servo



valves.

Figure 2-44 - Direct Drive Servo Valve
(Yuken Kogyo Co. - Basic Hydraulics and Components)

1.1.7.2 **Servo Supplementary Components**

a. Servo amplifiers drive servo valves, based on the same principles as the amplifiers for proportional electro-hydraulic control.

Position sensors, including potentiometers, synchronization generators, magnetic scales, and optical equipment (pulse encoder, digital position s

CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

Any foreign matter present in the circuit of the hydraulic system will have an adverse effect on the efficiency of the hydraulic components and the circuit. Contaminating foreign objects may be solid, liquid or gaseous.

Most foreign matter contamination will cause frictional movement between the workpiece and the tight clearance between the workpiece, which will lead to accelerated wear and cracking of the workpiece.

hydraulic performance are particulate or water contamination, clogged filters, high fluid temperature and incorrect hydraulic fluids

Environmental hydraulics is a branch of fluid mechanics that deals with the study of the interactions between water and the environment. It focuses on the behavior of water in natural systems, such as rivers, lakes, oceans, and wetlands, and how it affects the surrounding environment. Environmental hydraulics involves the study of a wide range of topics, including flow dynamics, sediment transport, water quality, erosion and sedimentation, and the interaction between water and vegetation. It is used in a variety of fields, including environmental engineering, hydrology, coastal and marine engineering, and water resources management, to understand and manage the impact of water on the environment.

Environmental hydraulics is an interdisciplinary field that combines principles from fluid mechanics, environmental science, and engineering. It involves the application of mathematical and computational models to study the complex interactions between water and the environment. Some of the specific areas of research in environmental hydraulics include:

1. River and stream hydraulics: This involves the study of the flow dynamics of water in rivers and streams, including the effects of channel geometry, flow velocity, and sediment transport.

2. Coastal and marine hydraulics: This involves the study of the behavior of water in the coastal zone and in the open ocean, including the effects of waves, tides, currents, and sediment transport.

3. Wetland hydraulics: This involves the study of the interactions between water and vegetation in wetlands, including the effects of hydrology, vegetation type, and sediment transport on wetland ecosystems.

4. Water quality and pollution transport: This involves the study of the transport and fate of contaminants in water systems, including the effects of flow dynamics, sediment transport, and chemical reactions on water quality.

Environmental hydraulics has many practical applications, including the design of hydraulic structures such as dams, levees, and water treatment facilities, as well as the management of water resources in natural and engineered systems. It is also used to study the impacts of human activities on the environment, such as the effects of land use changes, urbanization, and climate change on water systems.

In addition to the areas of research mentioned earlier, environmental hydraulics also includes the study of various physical and biological processes that occur in water systems. Some examples of these processes include:

1. Erosion and sedimentation: This involves the study of how water transports and deposits sediment in different environments, such as rivers, estuaries, and coastal zones. The study of erosion and sedimentation is important for understanding the impact of human activities, such as land use changes and construction, on water systems.

2. Aquatic ecosystems: This involves the study of interactions between water and living organisms in aquatic environments, such as fish, plants, and microorganisms. Environmental hydraulics is used to understand the physical and biological processes that affect the health and functioning of aquatic ecosystems.

3. Flood management: This involves the study of the behavior of water during floods, including the effects of floodplain topography, flow velocity, and sediment transport. Environmental hydraulics is used to design flood management structures and to predict the impacts of floods on communities and ecosystems.

4. Water resources management: This involves the study of the availability, quality, and use of water resources, including surface water and groundwater. Environmental hydraulics is used to develop models for managing water resources, such as predicting the impacts of climate change on water availability and designing systems for water storage and distribution.

Overall, environmental hydraulics is an important field for understanding the complex interactions between water and the environment, and for developing sustainable solutions for managing water resources and protecting the environment.

It depends on the hydraulic system, the oil in it, and the components. Many hydraulic systems (most mobile systems) use motor oil as hydraulic fluid since it absorbs the moisture and burns it off instead of leaving it in the bottom of the tank to enter the pump and cavitate the pump.

Hydraulic system itself does not “generate” power. The system does “transfer” or “amplify” the power. Power generated by the power source (electric motor, petrol engine, manpower, etc) transferred through the hydraulic system then often amplified to get greater force. This amplification is explained by theory called Theorem of Bernoulli (a French scientist). You push one end with smaller power for longer distance provides greater power for shorter distance at the other side of hydraulic system. This is based on the fact that liquid would not change its volume by pressurizing it. Maybe this explanation is too much of simplification, but I believe principle of physics is always simple.

It is where the system operates under constant pressure. All directional valves are closed center. That means they only release pressure to the load when activated. as opposed to an open circuit system, which is what a forklift and most mobile hydraulic applications use. In this case the spools on the valving flow freely from pressure to tank. and when a valve gets operated, it shuttles a portion of the oil to the load. Closed circuit systems generally require a pump that can destroke when the system pressure is reached for max efficiency. You can use a constant volume pump with a pressure relief, but it wastes a LOT of energy. You can use a constant volume pump, a check valve, pressure sensing switch, a normally open dump valve along with an accumulator to make a cheap version of a variable volume pump system.

CHAPTER 5: CONCLUSION AND FINDINGS

CONCLUSION

Hydraulic systems can move heavier loads and provide more force than rotary, electrical, or compressor systems can.

Defined simply, hydraulic systems function and perform tasks through using a fluid that is pressurized. Another way to put this is the pressurized fluid makes things work. The power of liquid fuel in hydraulics is significant and as a result, hydraulic are commonly used in heavy equipment.

Based on the experiment we have tabulated our data collection and analyze it. We can conclude that the objective of the experiment is achieved. From this experiment, we experience on how to do the setup and function of each double-acting cylinder and 4/2-way valve and 4/3-way valve. After the assembly part, we measured the travel time. However, before measuring times, the piston rod should be advanced and retracted several times in order to force out any air which might have flowed into the cylinder's piston rod chamber during the last exercises. The time measured we took is compared to the actual measured values by using the formula. Nevertheless, the data collection is not exactly as the actual measured due to some error that occur during the experiment. The error exist could be systematic error and technical error. Thus, the time measured is slightly different with the actual measure value.

FINDINGS

This work has provided a n excellent opportunity and experience, to use limited knowledge. It has gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. The work is a good solution to bridge the gates between institution and industries. The work is completed the work with the limited time successfully. The "HYDRAULIC SYSTEM FOR KIKOFF PLATFORM MACHINE" is working with satisfactory.

SUGGESTION /RECOMMENDATIONS

Hydraulic systems should use hydraulic fluid that has a viscosity of 130 - 225 SSU at 100 degrees F / 38 degrees C. Hydraulic fluids of petroleum base with anitwear properties and high viscosity indexes over -140 will meet recommended hydraulic

fluid requirements over a wide range of operating temperatures.

In the design stage of a power unit and its installation, it is always best to try to minimize and bends in the system as this will allow the hydraulic fluid to flow more freely and efficiently. Pipe sizing is crucial to minimize pressure losses that add to the power requirements.

Hydraulic oils have a significant impact on the system's productivity. Hydraulic systems are often made for high-speed, high-pressure, and high-temperature applications. Premature system failure can be avoided by analyzing and adequately maintaining the oil.

Hydraulic Preventive Maintenance Task List

Check hydraulic fluid levels. ...

Check breather caps, filters, and fill screens.

Check return/pressure/hydraulic filter indicators and pressure gauges for readings.

Sample hydraulic fluid for color, visible signs of contamination, and odor.

CHAPTER 7: ANNEXURE

CHAPTER 8: REFERENCES AND BIBLIOGRAPHY

The hydraulic handbook by T. Hunt and N. Vaughan.

This is book is pretty simple and easy to learn from. Also good for references.

End of Project Report

1. .

End of Project Report