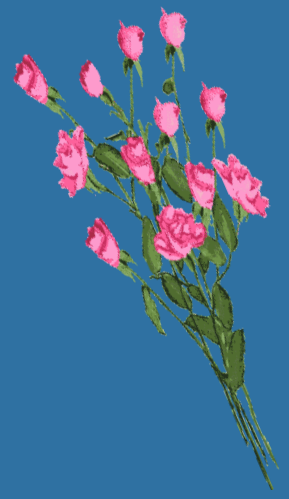
DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEM

B.TECH. V SEMESTER

MECHANICAL ENGINEERING



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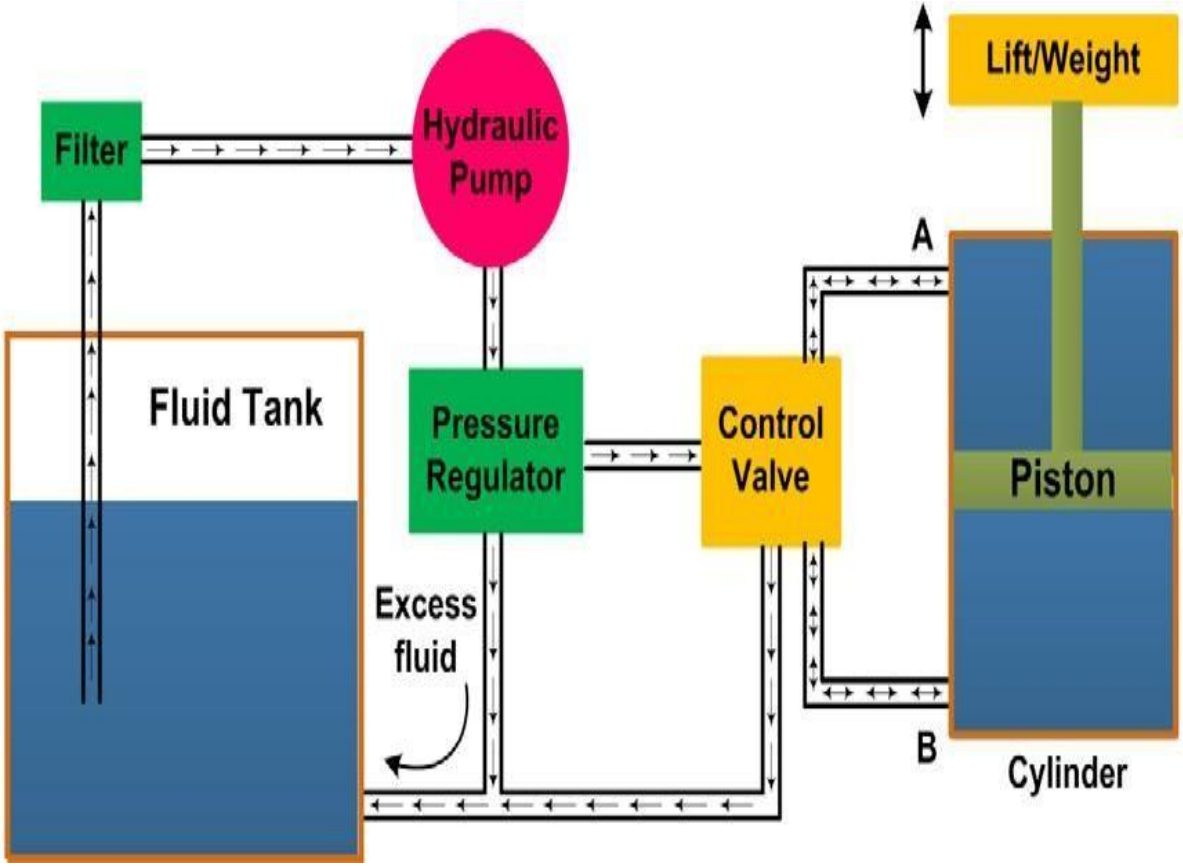
(Autonomous)

UNIT – I

OIL AND HYDRAULIC SYSTEMS

Introduction to Hydraulic System

- Hydraulic systems are used for transmission of power through the medium of hydraulic oil. The hydraulic system works on the principle of Pascal's law which says that "the pressure in a fluid at rest is transmitted uniformly in all directions".
- The fluid medium used is hydraulic oil, which may be mineral oil or water or combinations. This area is also known as oil hydraulics.
- The power transferred is
- Power = Pressure x flow rate in the tubes or hoses.


Lift/Weight
Filter
Hydraulic Pump
A
Fluid Tank
Pressure Regulator
Control Valve
Piston
Excess fluid
B
Cylinder

Applications of Hydraulic Systems

1. Industrial: Plastic processing machineries, steel making and primary metal extraction applications, automated production lines, machine tool industries, paper industries, loaders, crushes, textile machineries, R & D equipment and robotic systems etc.
2. Mobile hydraulics: Tractors, irrigation system, earthmoving equipment, material handling equipment, commercial vehicles, tunnel boring equipment, rail equipment, building and construction machineries and drilling rigs etc.
3. Automobiles: brakes, shock absorbers, steering system, wind shield, lift and cleaning etc.
4. Marine applications: Controls in ocean going vessels, fishing boats and navel equipment.
5. Aerospace equipment: Rudder control, landing gear, breaks, flight control and transmission, rocket motor movement

Advantages of Hydraulic systems

- High power to weight ratio compared to electrical systems
- Allows easy control of speed and position, and direction
- Facilitates stepless power control
- Allows combination with electric controls
- Delivers consistent power output which is difficult in pneumatic or mechanical drive systems
- Performs well in hot environment conditions
- Compared to Pneumatics:
- Much stiffer (or rigid) due to incompressible fluid
- Better speed of response
- Better lubricity (less friction) and rust resistance
- Low maintenance cost.

Disadvantages of Hydraulic system

- **Material of storage tank, piping, cylinder and piston can be corroded with the hydraulic fluid. Therefore one must be careful while selecting materials and hydraulic fluid.**
- **Structural weight and size of the system is more which makes it unsuitable for the smaller instruments.**
- **Small impurities in the hydraulic fluid can permanently damage the complete system. Therefore suitable filter must be installed.**
- **Leakage of hydraulic fluid is also a critical issue and suitable prevention method and seals must be adopted.**
- **Hydraulic fluids, if not disposed properly, can be harmful to the environment.**

Important Properties:

- Shapelessness:
- Liquids have no neutral form
- Conform to shape of container
- Easily transferred through piping from one location to another
- Incompressibility:
- Liquids are essentially incompressible
- Once force is removed, liquid returns to original volume (no permanent distortion)
- Transmission of Force:
- Force is transmitted equally & undiminished
- In every direction -> vessel filled with pressure.

Hydraulic Theory;

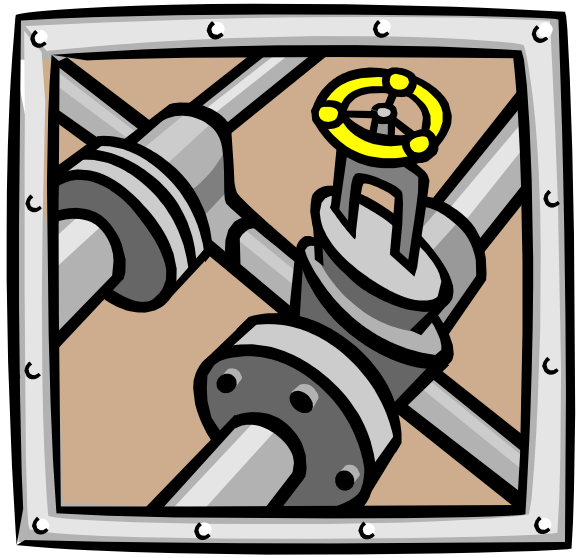
- **Pascal's Law:**
- **Magnitude of force transferred is in direct proportion to the surface area**
- **(F = P*A)**
- **Pressure = Force/Area**
- **Liquid properties enable large objects (rudder, planes, etc) to be moved smoothly**

- **Hydraulic Fluid**
  -Usually oil (2190 TEP)

- **Pressure Source**
  -Hydraulic pump (A-end of system)

- **Pressure user**
  -Hydraulic motor (B-end of system)

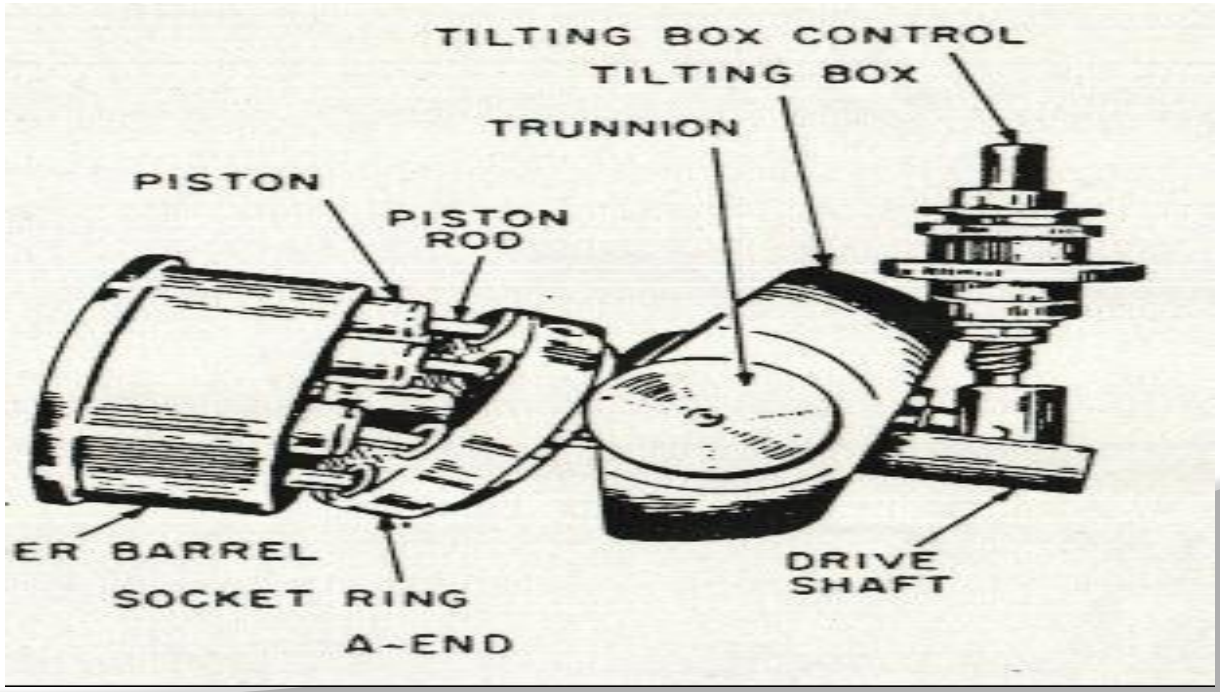
- **Piping system (w/ valves, tanks, etc)**
  -Get fluid from A-end to B-end



Hydraulic Pump (A-End);

Pumps can be positive displacement or centrifugal

- **Waterbury pump**
- **Variable-stroke piston pump**
- **Tilting box can tilt fwd/aft while pump rotates**
- **Angle of tilting box determines capacity and direction of oil flow.**

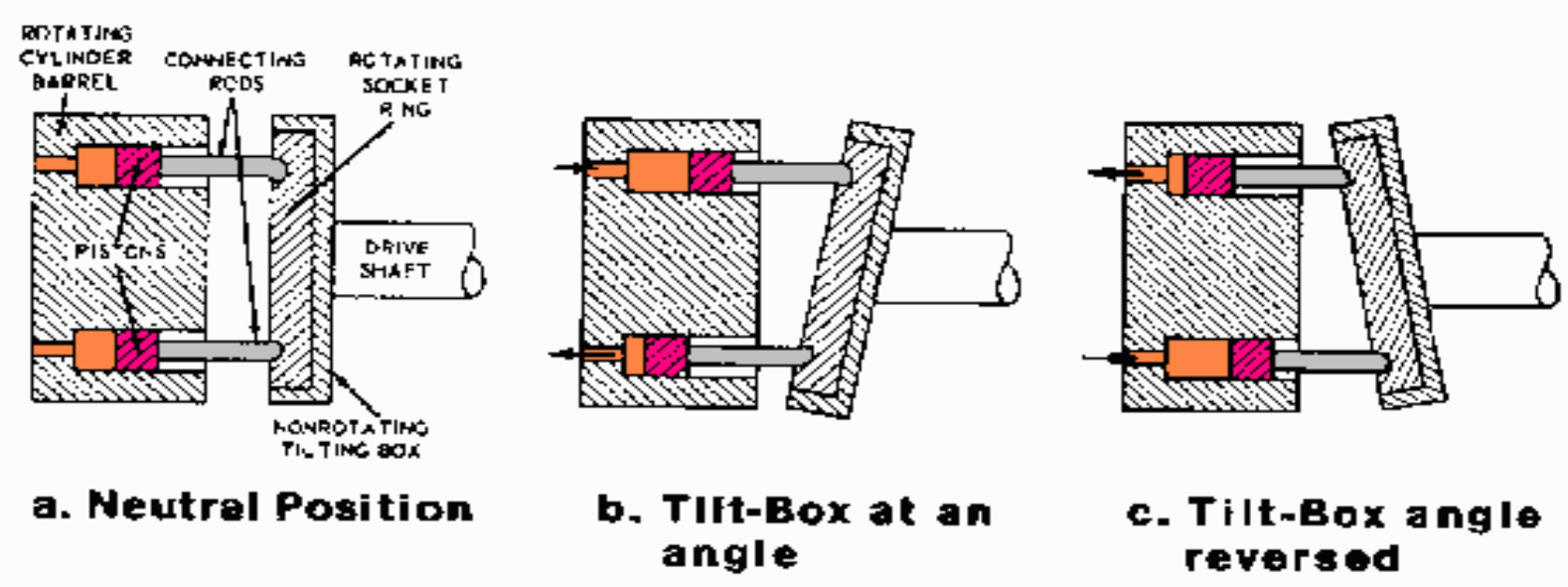


Hydraulic Pump (A-End);

Variable-stroke piston pump

Tilting box can tilt forward/after while pump rotates

Angle of tilting box determines capacity and dir. of flow



Cylinder/Motor (B-end)

Piston/cylinder used if desired motion is linear.

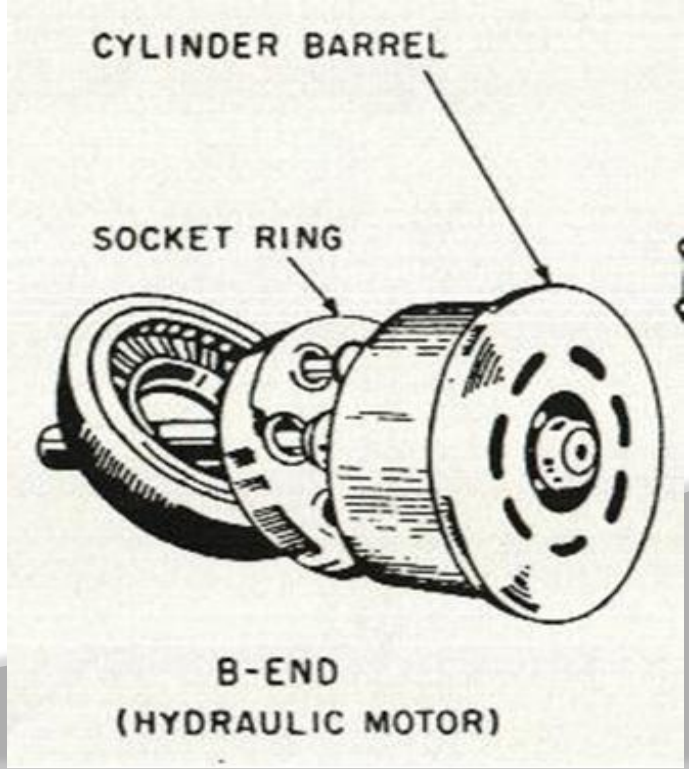
Hydraulic pressure moves piston & ram.

Load is connected to ram (rudder, planes, masts, periscopes).

Motor used if desired motion is rotary

Essentially a variable-stroke pump in reverse

Used for capstan, anchor windlass, etc

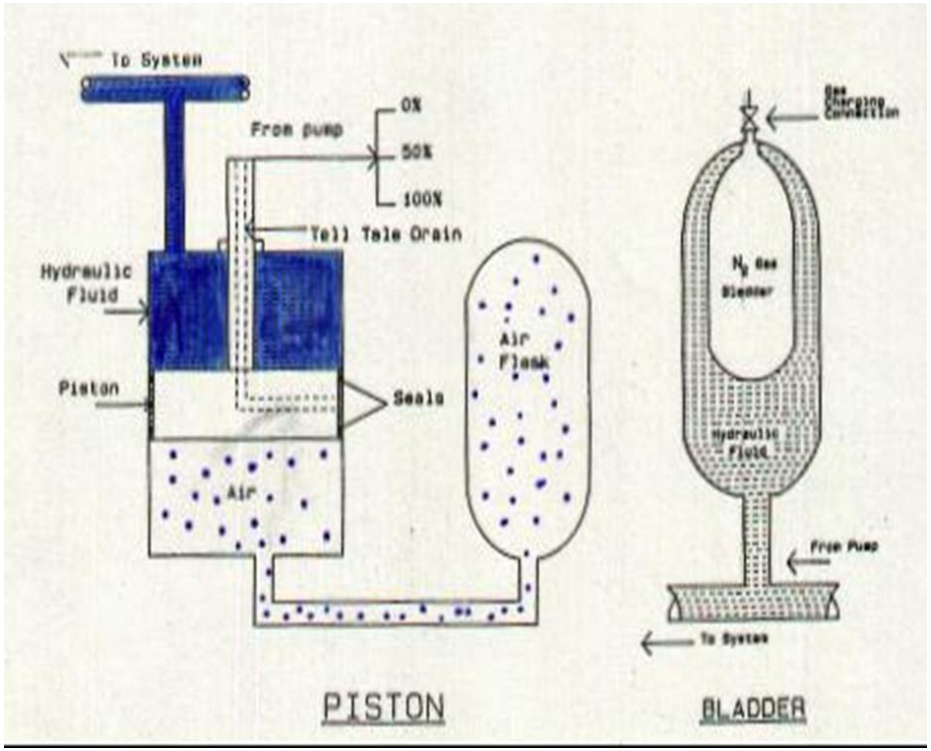


Piping System

- Has to withstand excessive pressure
- Valves, filters, & HX's all necessary
- Accumulators
- Holds system under pressure (w/out contin. pump)
- Provides hydraulics when pump off/lost
- Compensates for leakage/makeup volume
- Types:
- piston, bladder, & direct contact.

Accumulator Types

- Piston
  - -Most common
- Bladder
  - -Gun mounts
  - -Steering systems
- Direct contact
  - -Least common



Basic principle

- Liquids:
  - Have no Shape
  - Are incompressible
  - Transmit force in all Directions, Equally
  - Multiply Force

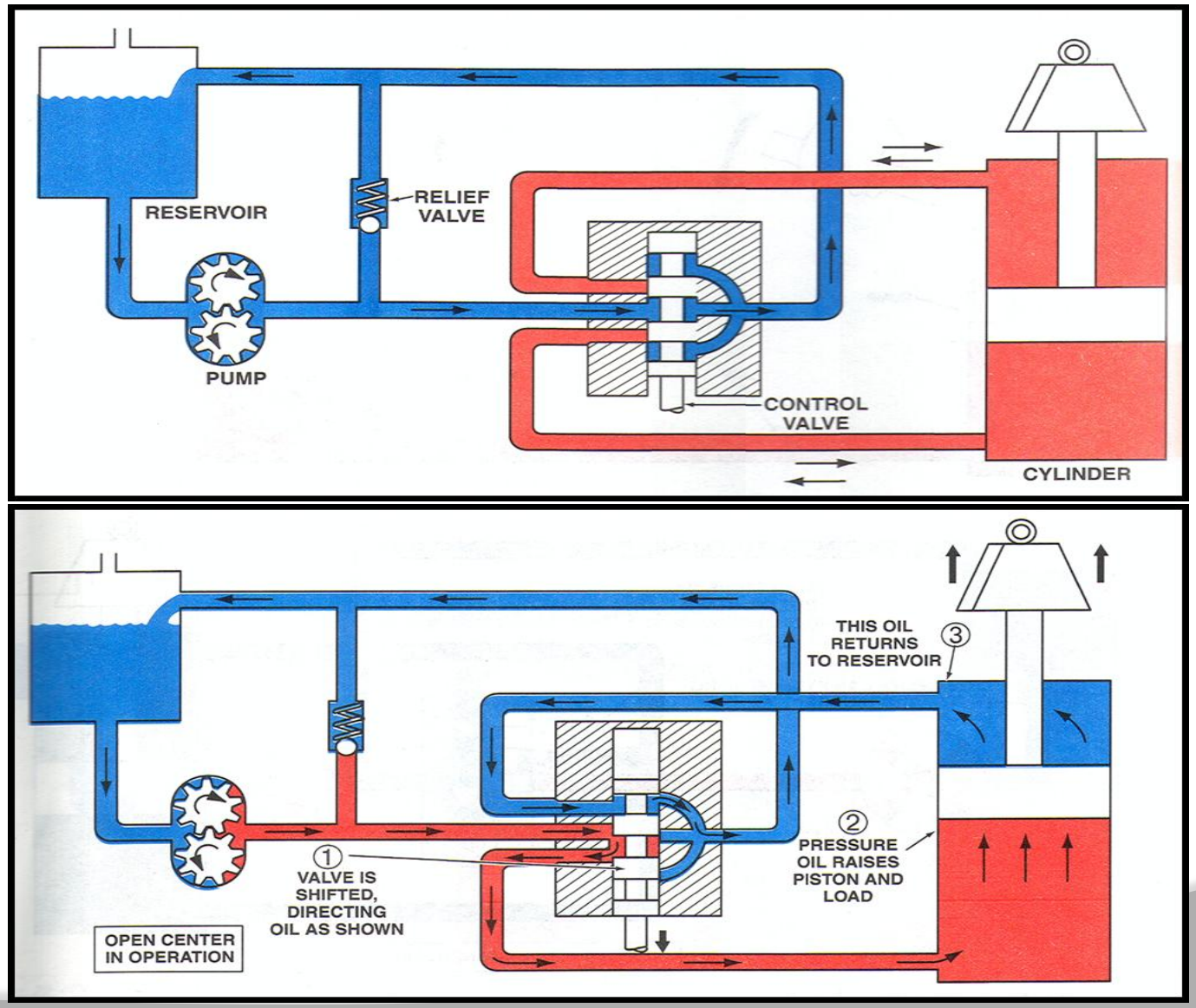
Primary Hydraulic Systems

- **Open-Center Systems:**
- **Oil is pumped constantly, excess oil is returned to the reservoir.**
- **Closed-Center Systems:**
- **Oil is pumped on demand, control valve stops oil flow.**

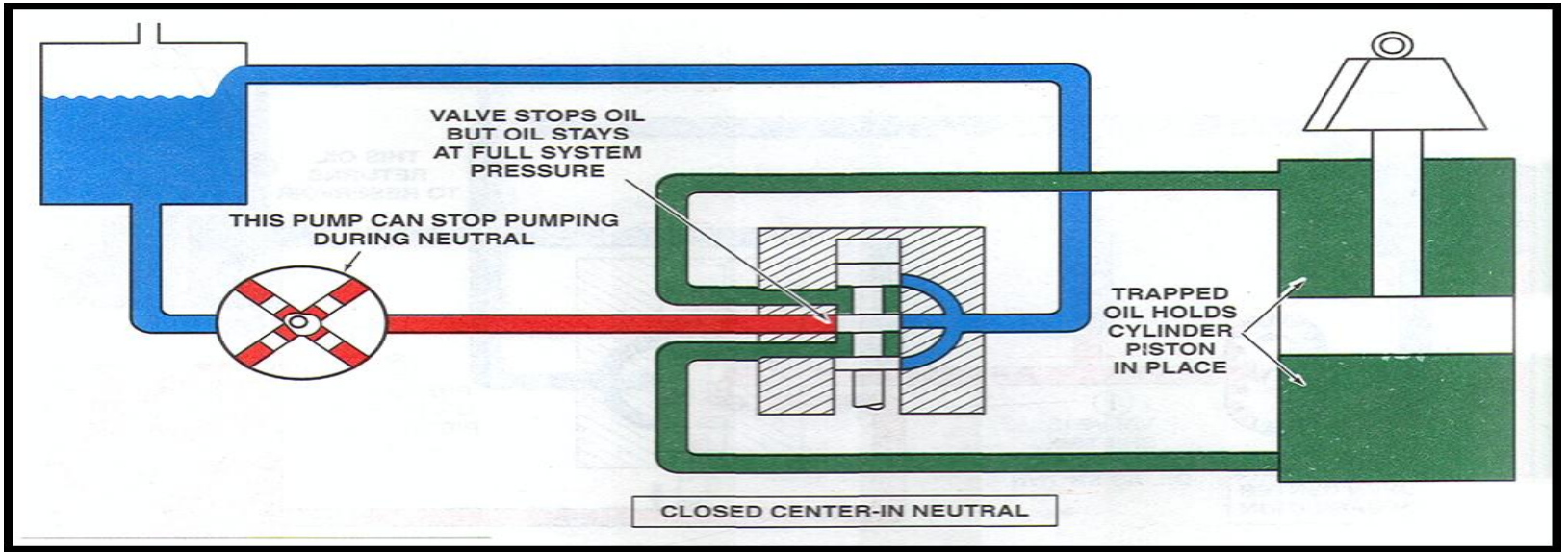
Open-Center Systems

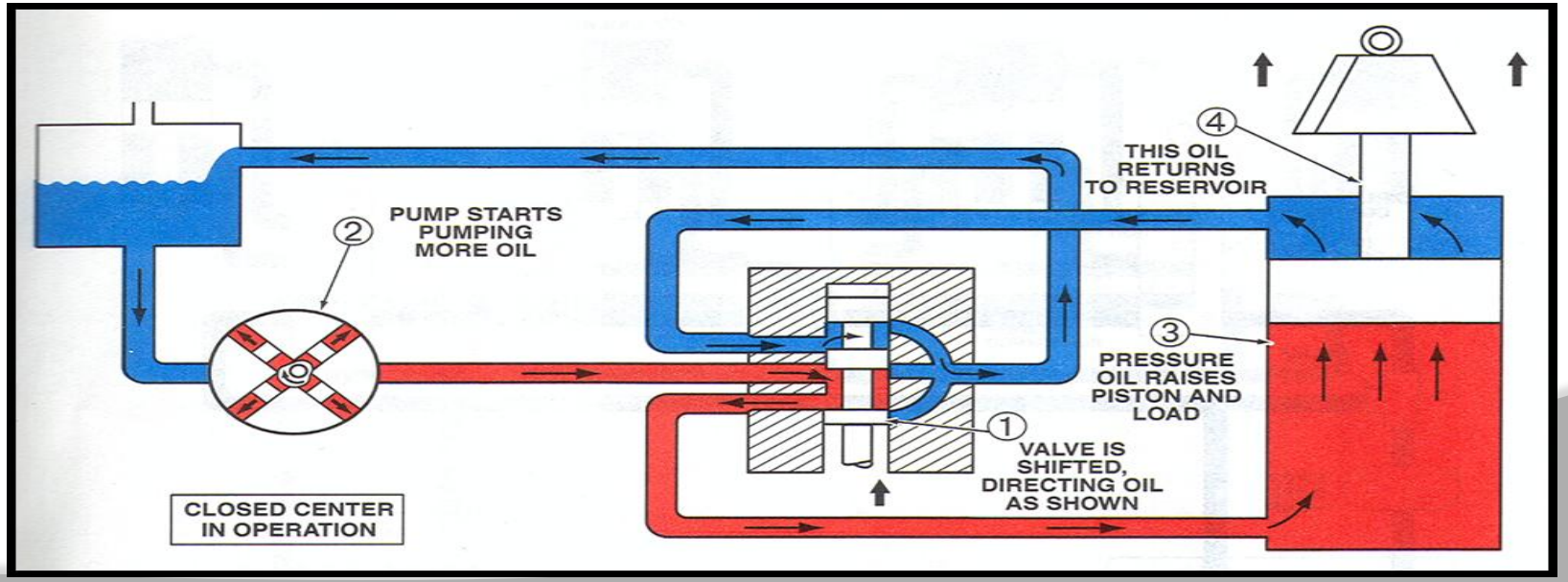
- **Simplistic**
- **Inexpensive**
- **Ineffective with Multiple Applications**
- **Variations of Open-Center Systems:**
  - **-Open-Center with a Series Connection**
  - **-Open-Center with a Series Parallel Connection**
  - **-Open-Center with a Flow Divider**

Open-Center Systems



Closed-Center Systems





Hydraulic Facts

- **Mechanical-Hydraulic-Mechanical**

  -Inputs and Outputs

- **Three types of Hydraulic Energy:**

  -Potential, Kinetic, & Heat

  -None are created or destroyed, only converted

  -All energy input is converted into an output, gain (work) or loss (heat)

  -A restricted flowing liquid creates heat

  -This also causes a pressure drop

- **Hydraulic systems must be sealed to work**

Hydraulic Facts

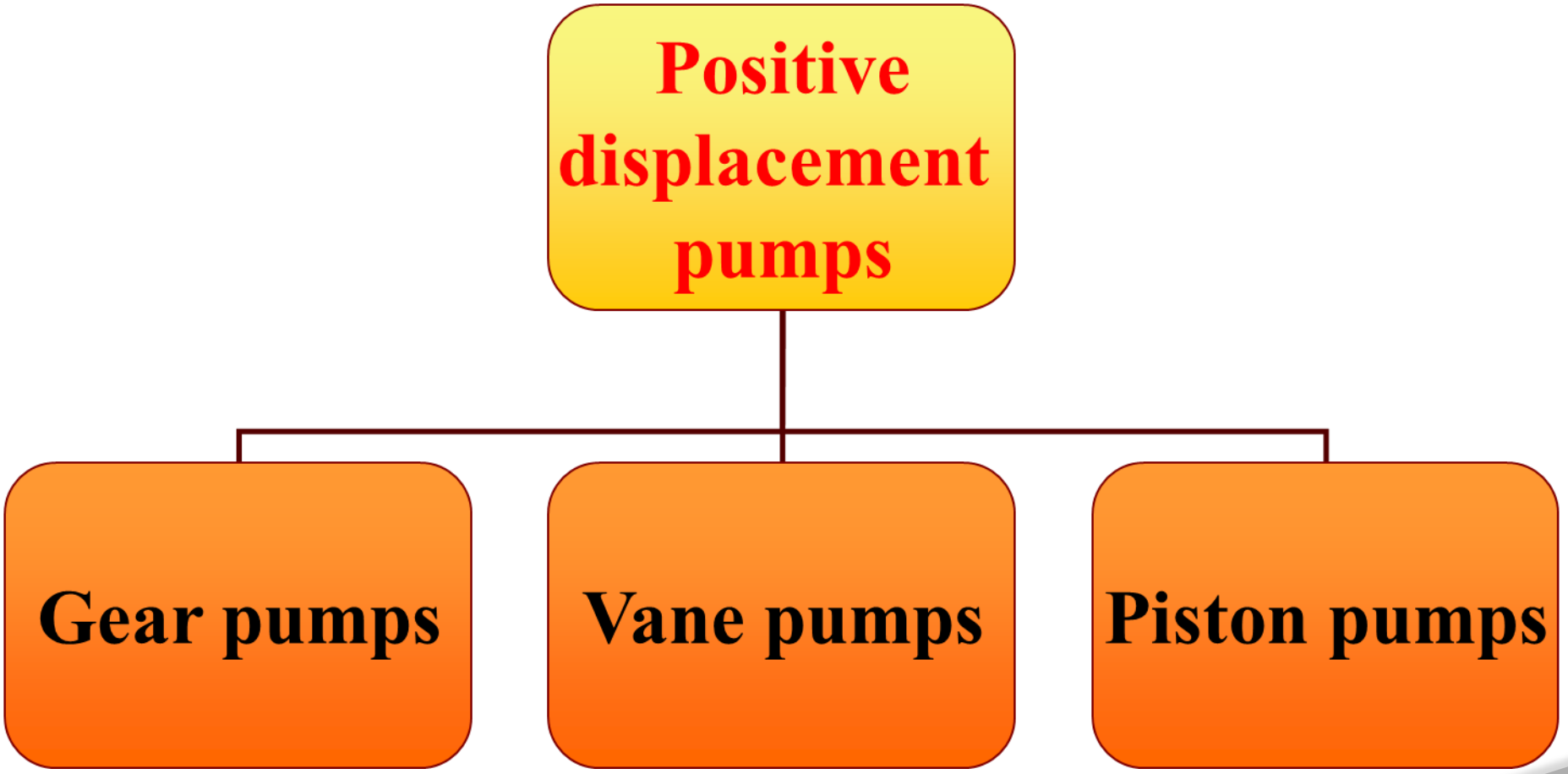
- Oil takes the path of least resistance
- Oil is pushed into a pump, not drawn
- A pump does not create pressure, it creates flow. Pressure is caused by resistance to flow.
- These can produce the same power:
- High pressure & low flow
- Low pressure & high flow
- Two basic types of hydraulics:
- Hydrodynamics
- Hydrostatics.

UNIT – II

HYDRAULIC PUMPS

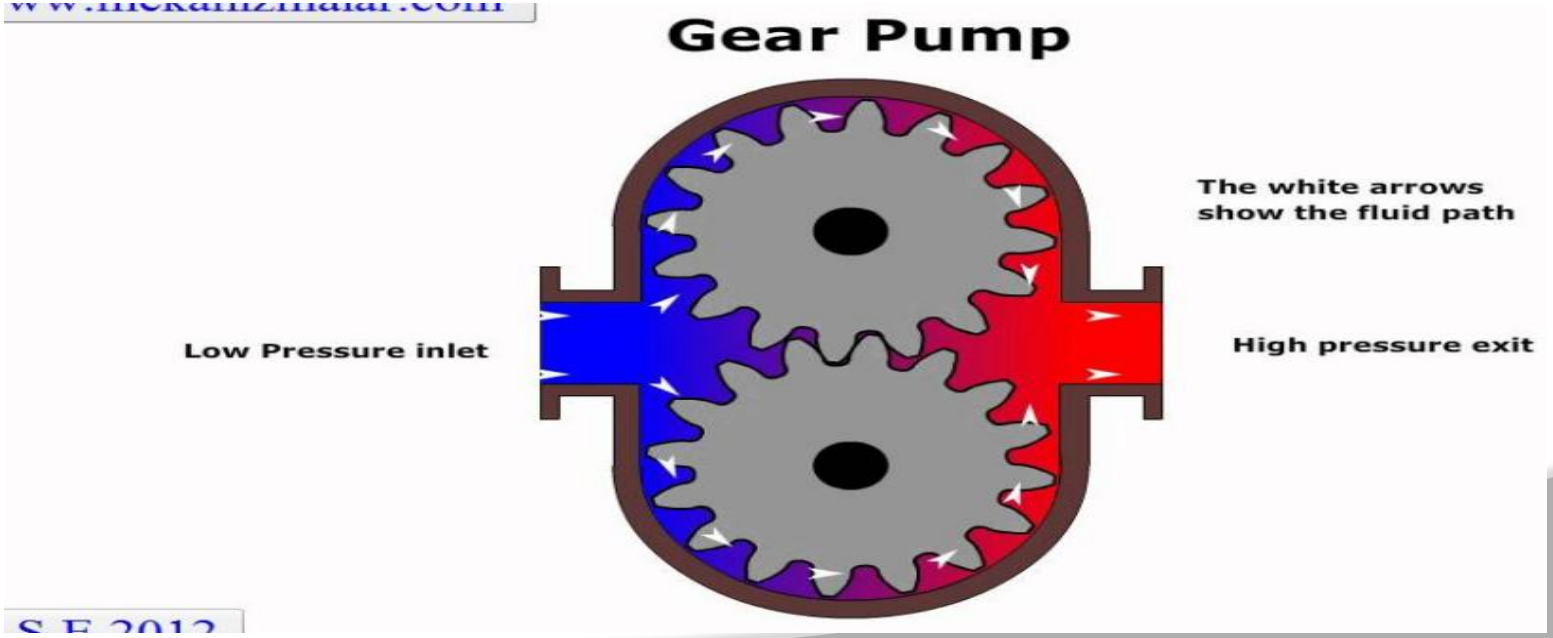
- The function of a pump is to convert mechanical energy into hydraulic energy.
- It is the heart of any hydraulic system because it generates the force necessary to move the load.
- Mechanical energy is delivered to the pump using a prime mover such as an electric motor.
- Partial vacuum is created at the inlet due to the mechanical rotation of pump shaft.
- Vacuum permits atmospheric pressure to force the fluid through the inlet line and into the pump.
- The pump then pushes the fluid mechanically into the fluid power actuated devices such as a motor or a cylinder.

HYDRAULIC PUMPS



Gear Pumps

- Gear pumps are less expensive but limited to pressures below 140 bar.
- It is noisy in operation than either vane or piston pumps. Gear pumps are invariably of fixed displacement type, which means that the amount of fluid displaced for each revolution of the drive shaft is theoretically constant.



B-Vane pumps

- The operation of the vane pump is based on , the rotor which contain radial slots rotate by a shaft and rotate in cam ring (housing), each slot contain a vane design as to comes out from the slot as the rotor turns.
- During one half of the rotation the oil inters between the vane and the housing then this area starts to decrease in the second half which permit the pressure to be produced , then the oil comes out pressurizes to the output port.

- Types of vane pump

  1- Fixed Displacement vane pump

  2- Variable Displacement vane pump

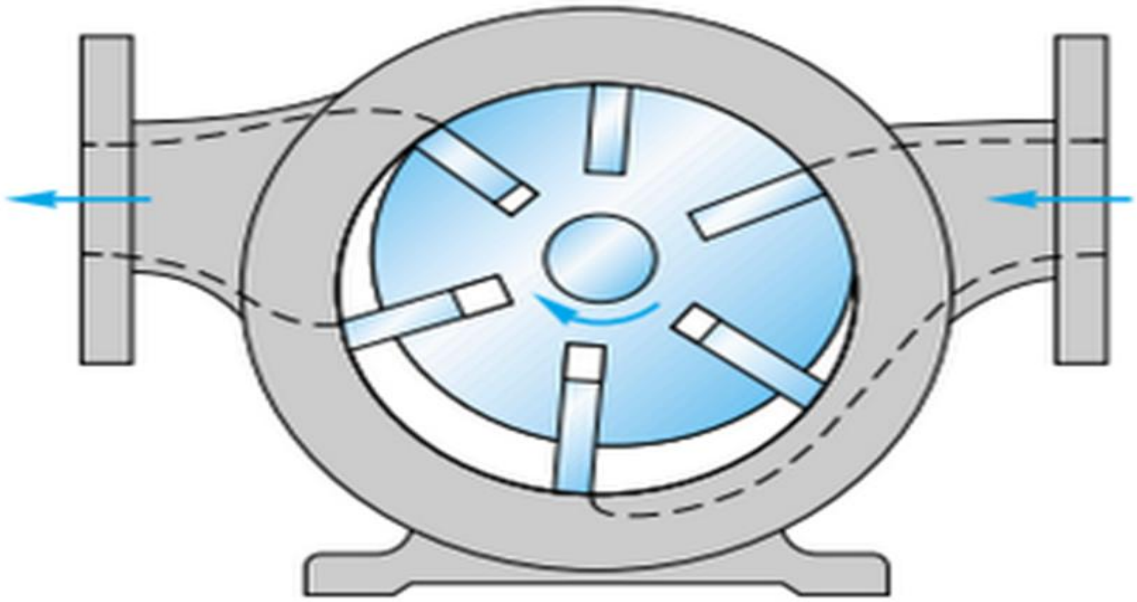
Unbalanced vane pump

- In this type of pump the eccentricity between pump cam-ring and rotor is fixed and pump discharge always remain same at a particular pressure.

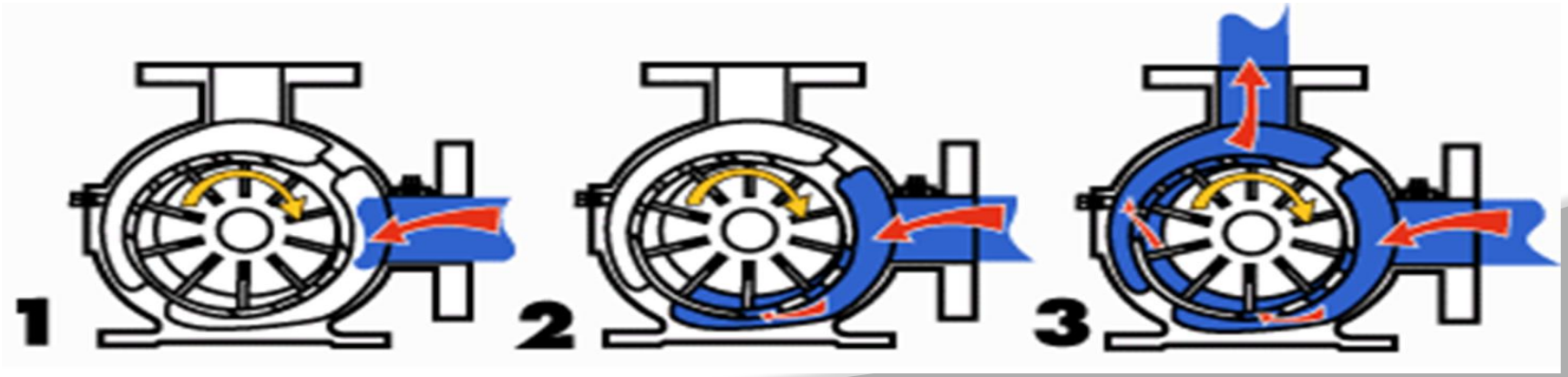
- There are two types of fixed displacement Vane Pump:-
  1- Unbalanced Vane Pump
  2- Balanced Vane Pump

Unbalanced vane pump

- A slotted rotor is eccentrically supported in a cycloidal cam.
- The rotor is located close to the wall of the cam so
- a crescent-shaped cavity is formed.
- The rotor is sealed into the cam by two side plates.
- Vanes or blades fit within the slots of the impeller.

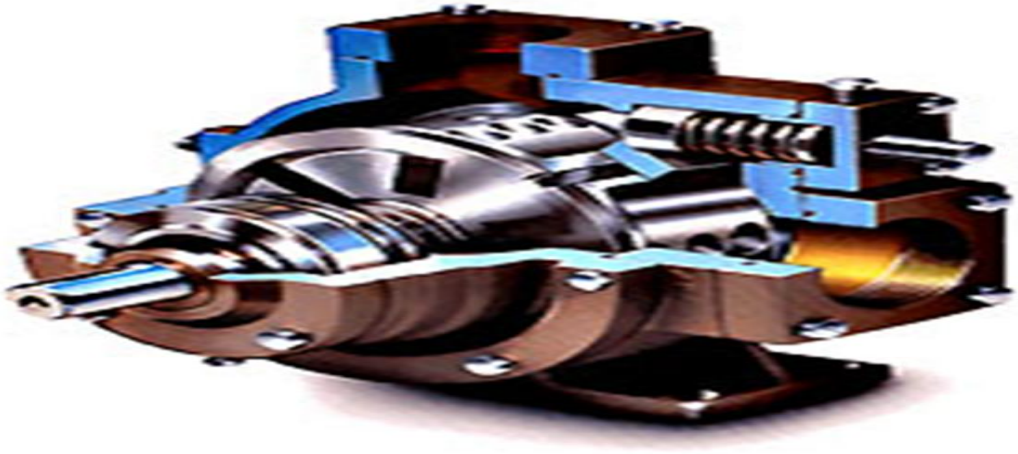


- As the rotor rotates (yellow arrow) and fluid enters the pump,
- centrifugal force, hydraulic pressure, and/or pushrods push the
- vanes to the walls of the housing. The tight seal among the vanes,
- rotor, cam, and side plate is the key to the good suction characteristics common to the vane pumping principle.

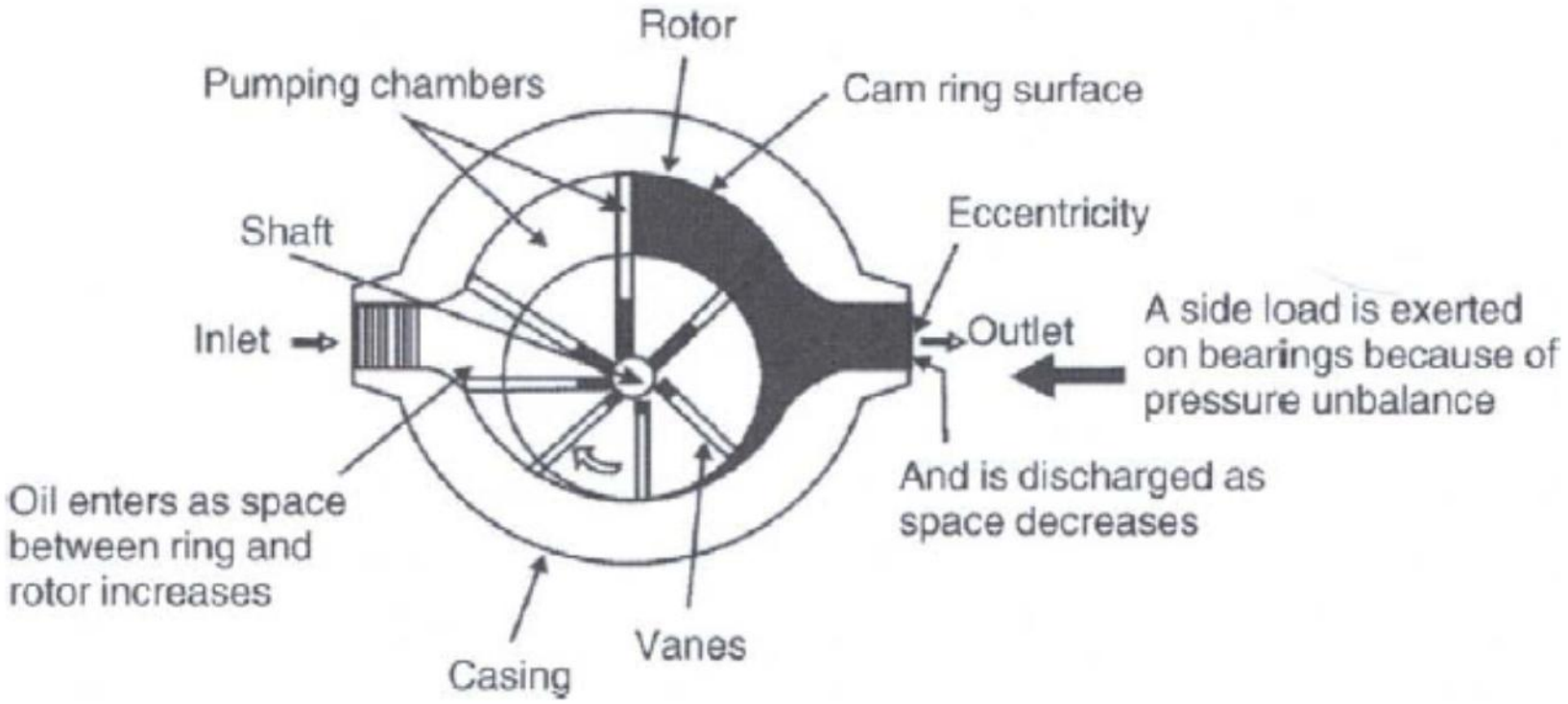


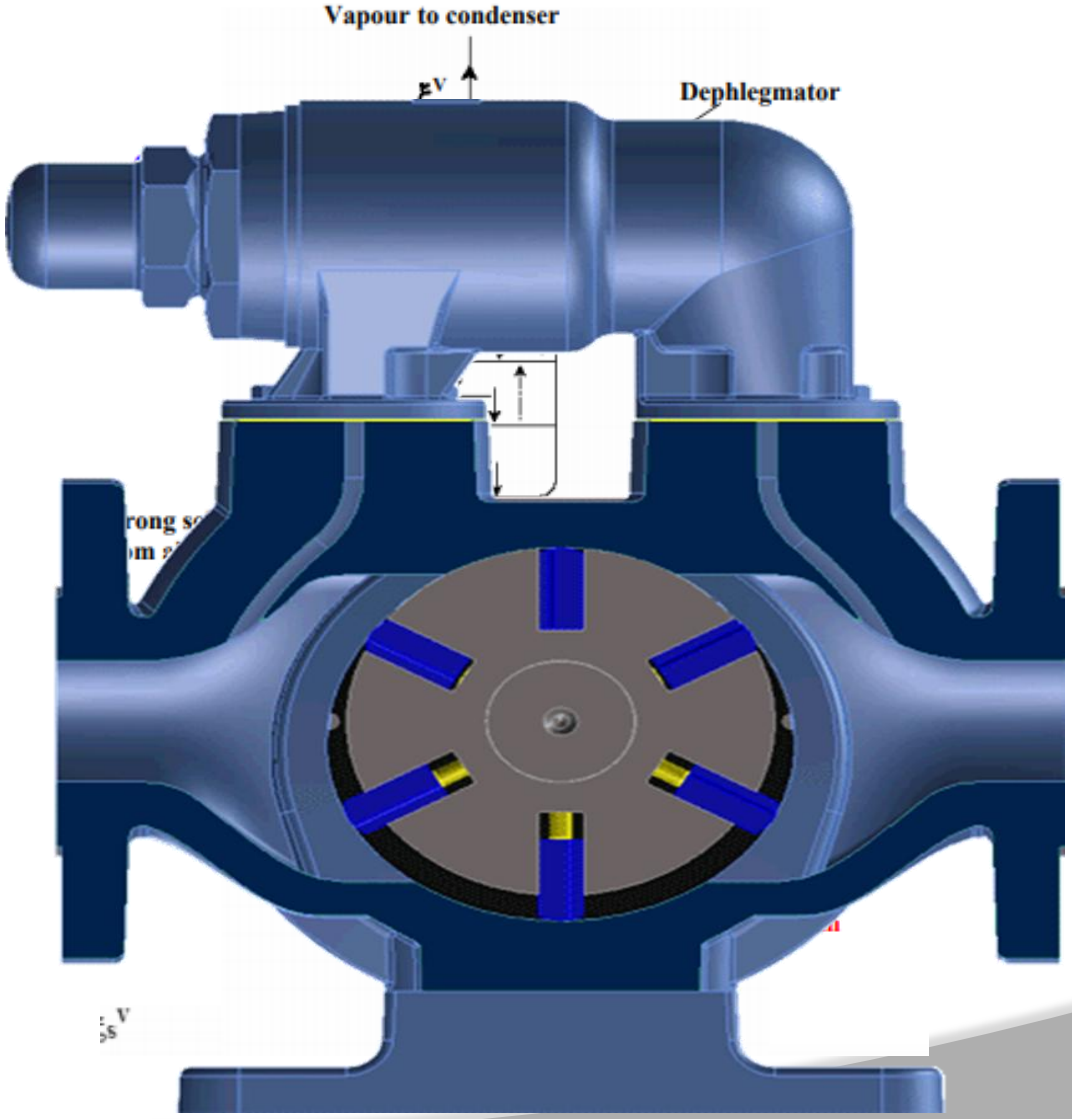
Unbalanced vane pump

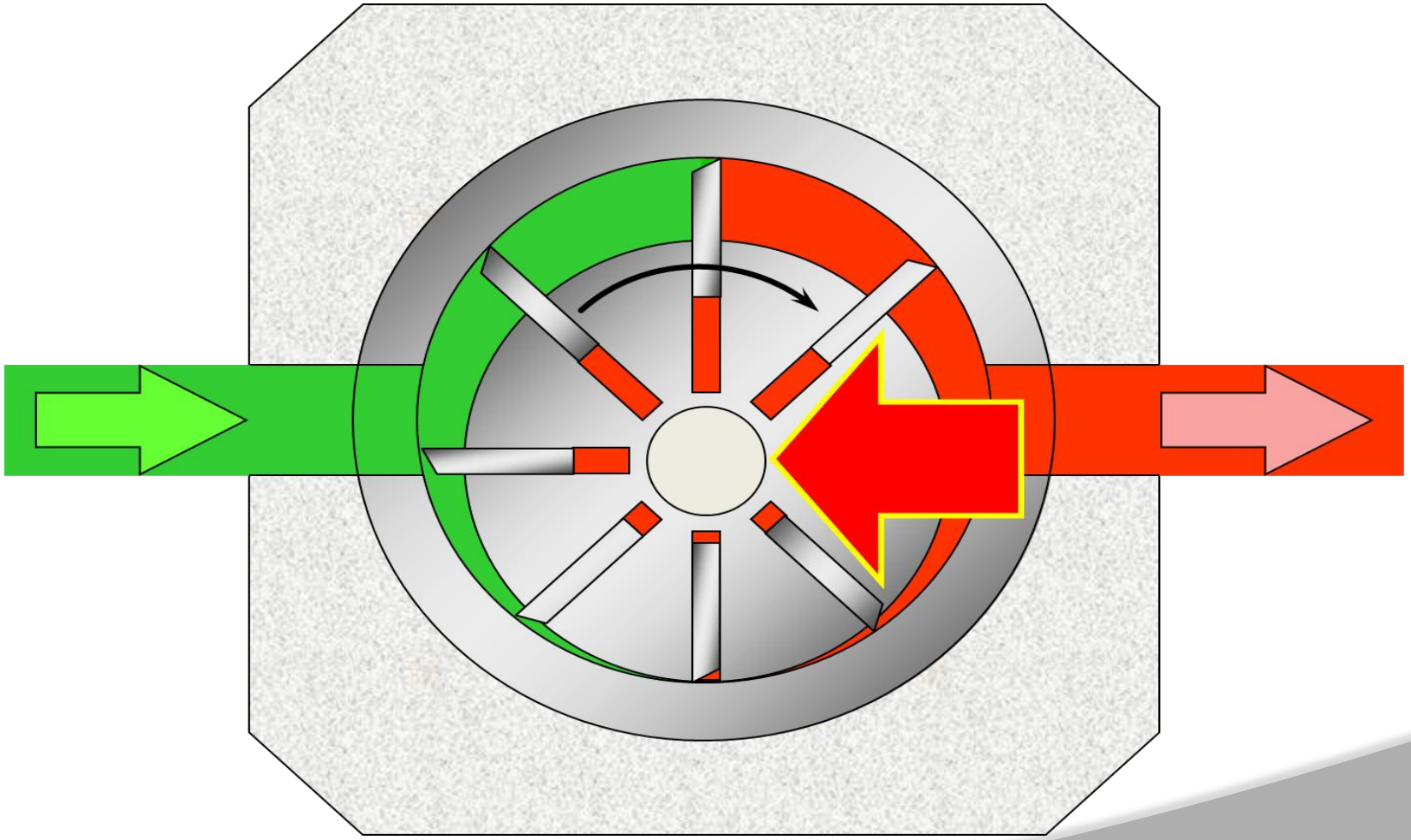
- **2. The housing and cam force fluid into the pumping chamber through holes in the cam (small red arrow on the bottom of the pump). Fluid enters the pockets created by the vanes, rotor, cam, and side plate.**
- **3. As the rotor continues around, the vanes sweep the fluid to the opposite side of the crescent where it is squeezed through discharge holes of the cam as the vane approaches the point of the crescent (small red arrow on the side of the pump). Fluid then exits the discharge port.**

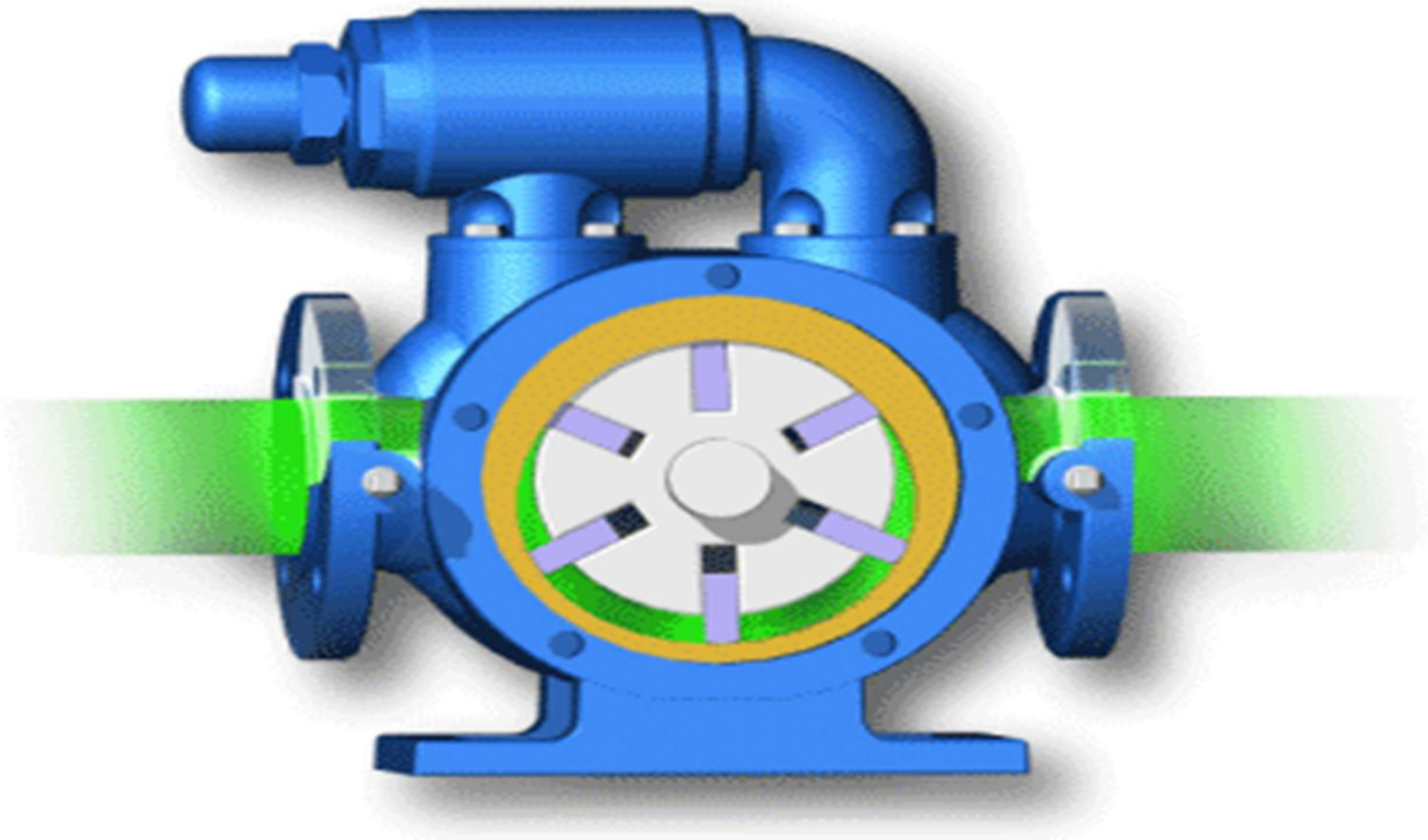


Unbalanced vane pump




Vapour to condenser
Dephlegmator

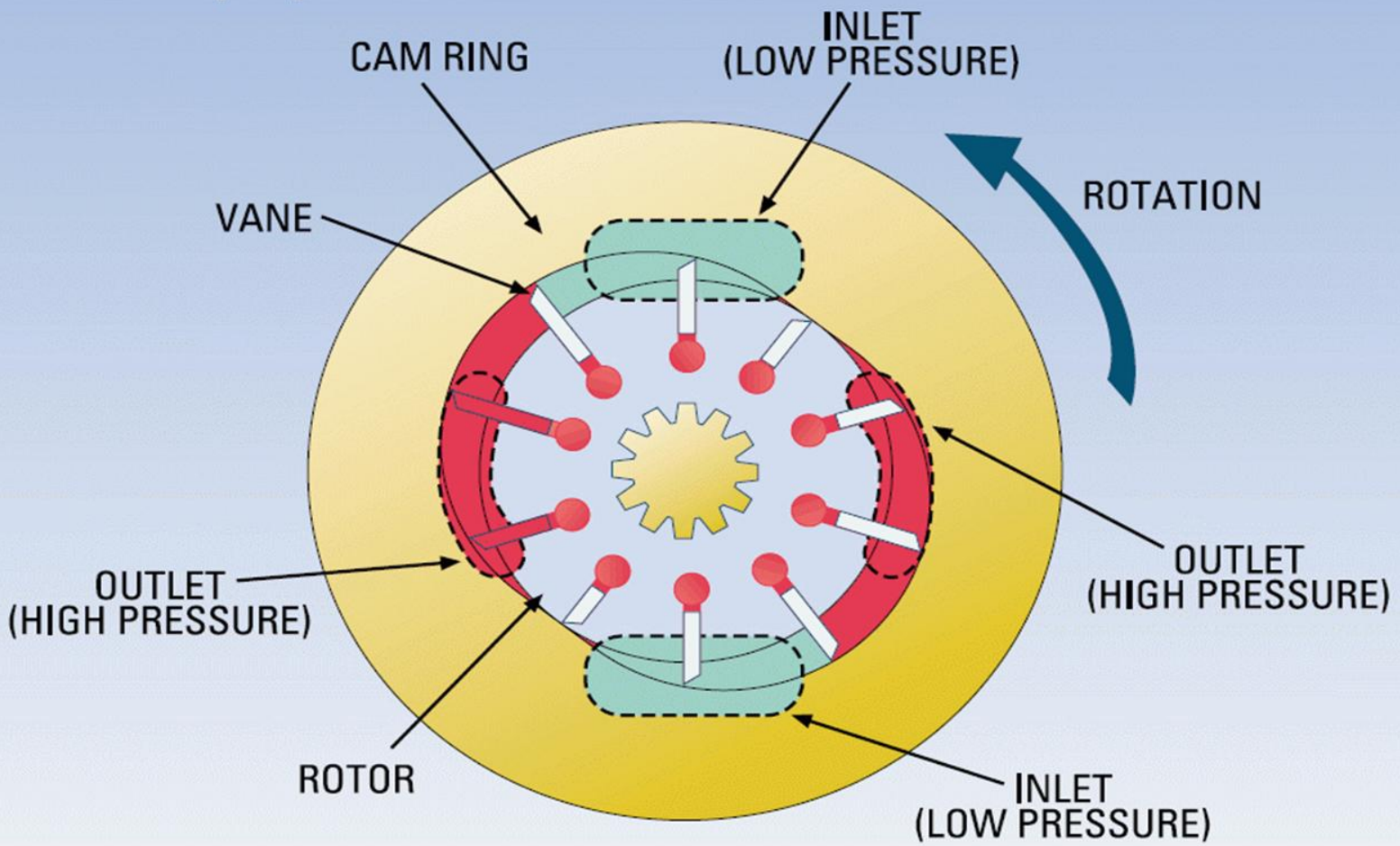


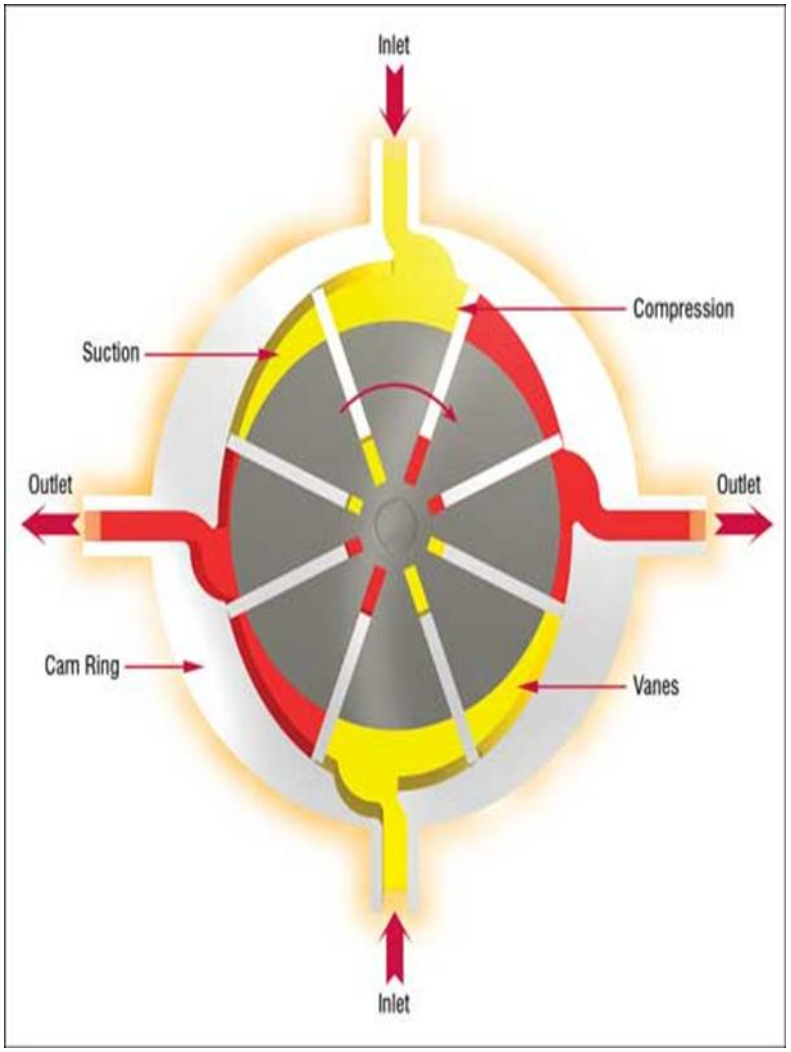


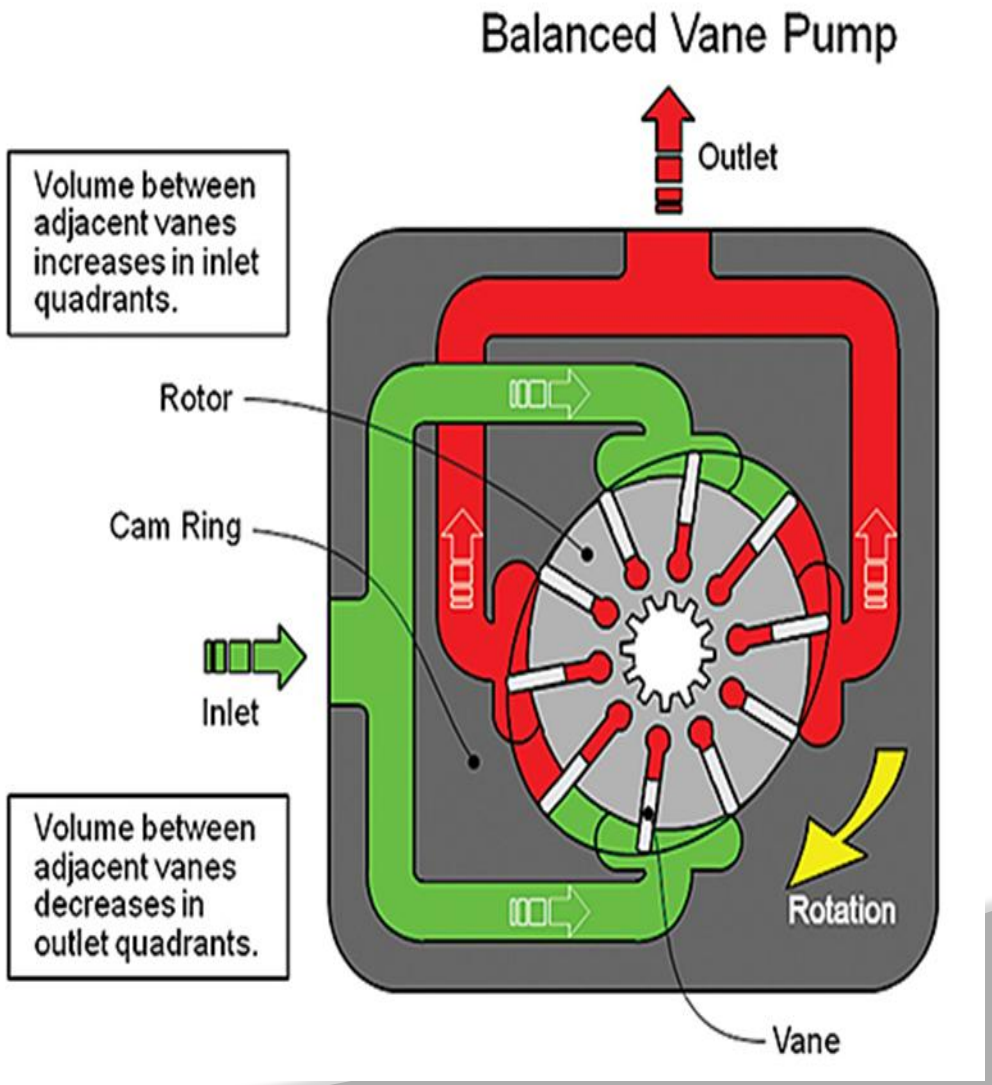
2- Balanced vane pump:

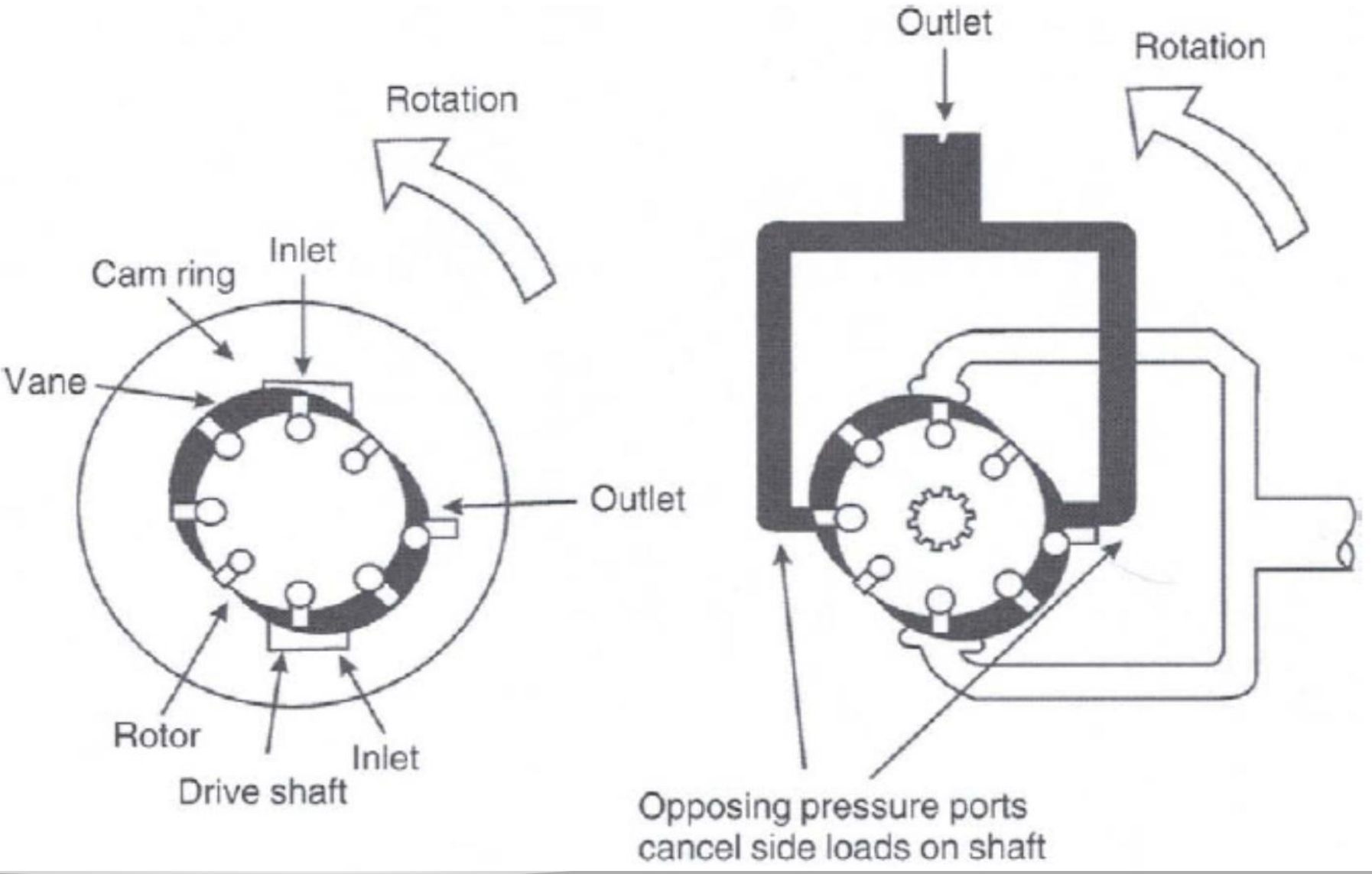
- A balanced vane pump is one that has two intake and two outlet ports diametrically opposite each other.
- Pressure ports are opposite each other and a complete hydraulic balance is achieved.
- One disadvantage of the balanced vane pump is that it can not be designed as a variable displacement unit.
- It have elliptical housing which formed two separate pumping chambers on opposite side of the rotor. This kind give higher operating pressure.

1. Vane Pump Operation




Inlet
Compression
Suction
Outlet
Outlet
Cam Ring
Vanes
Inlet


Balanced Vane Pump
Outlet
Volume between adjacent vanes increases in inlet quadrants.
Rotor
Cam Ring
Inlet
Volume between adjacent vanes decreases in outlet quadrants.
Rotation
Vane

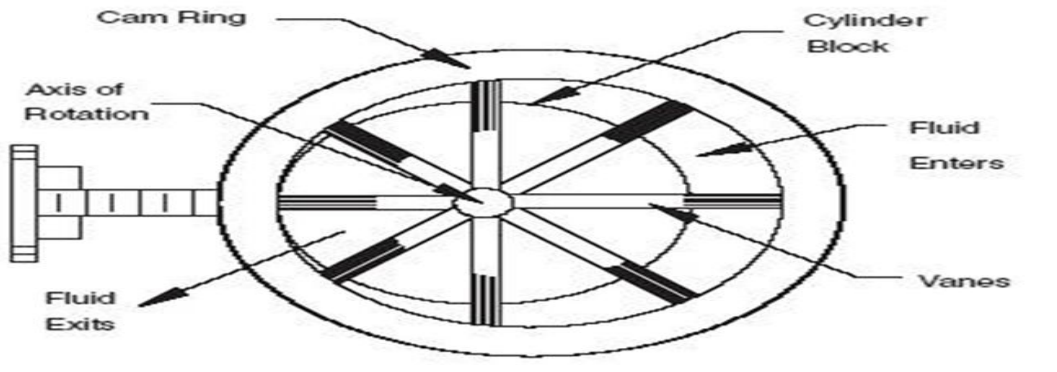

Rotation
Inlet
Cam ring
Vane
Outlet
Rotor
Inlet
Drive shaft
Outlet
Rotation
Opposing pressure ports
cancel side loads on shaft

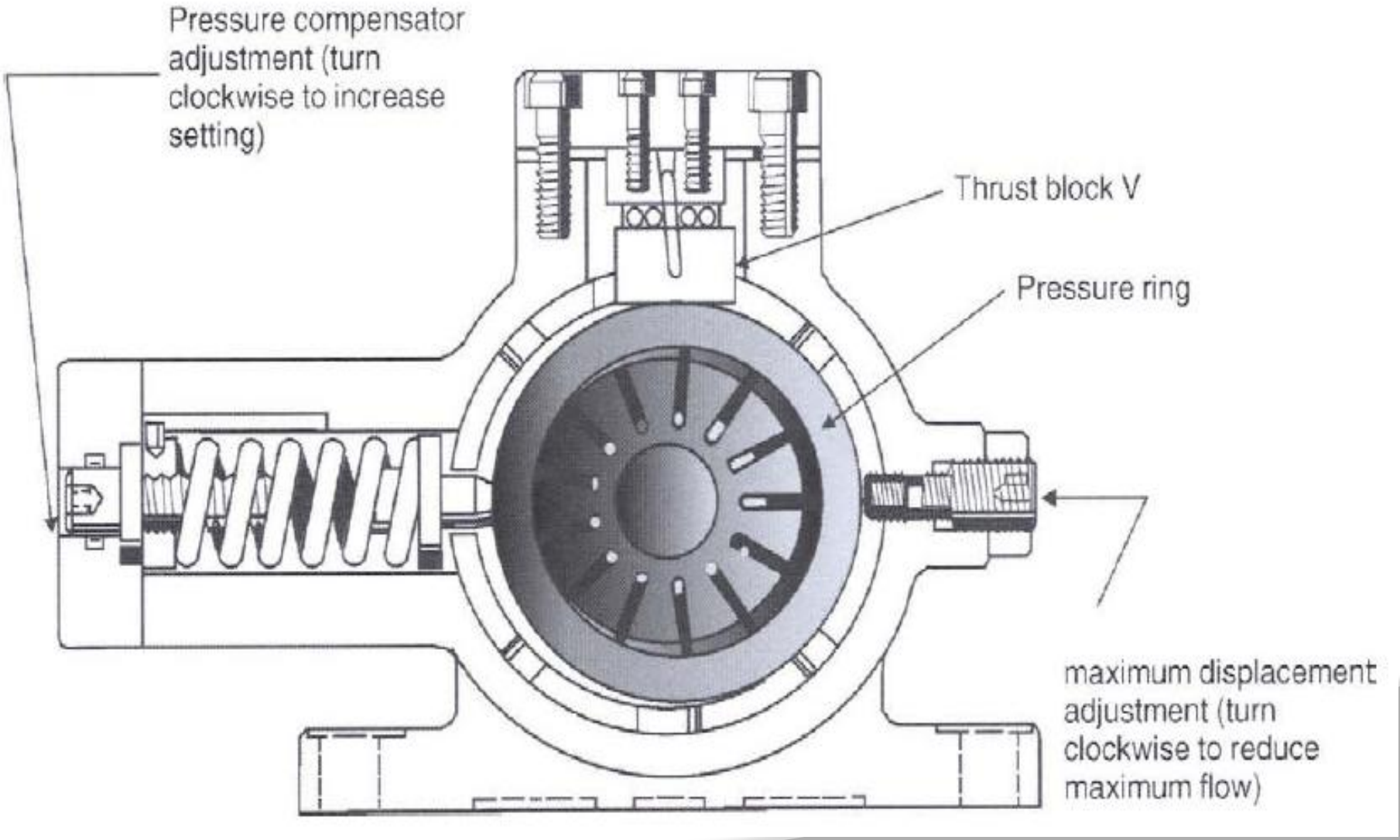
Advantage of balanced pump over unbalanced vane pump

- 1- it has bigger flow
- 2- it has bigger pressure
- 3- its life is bigger
- 4- constant volume displacement

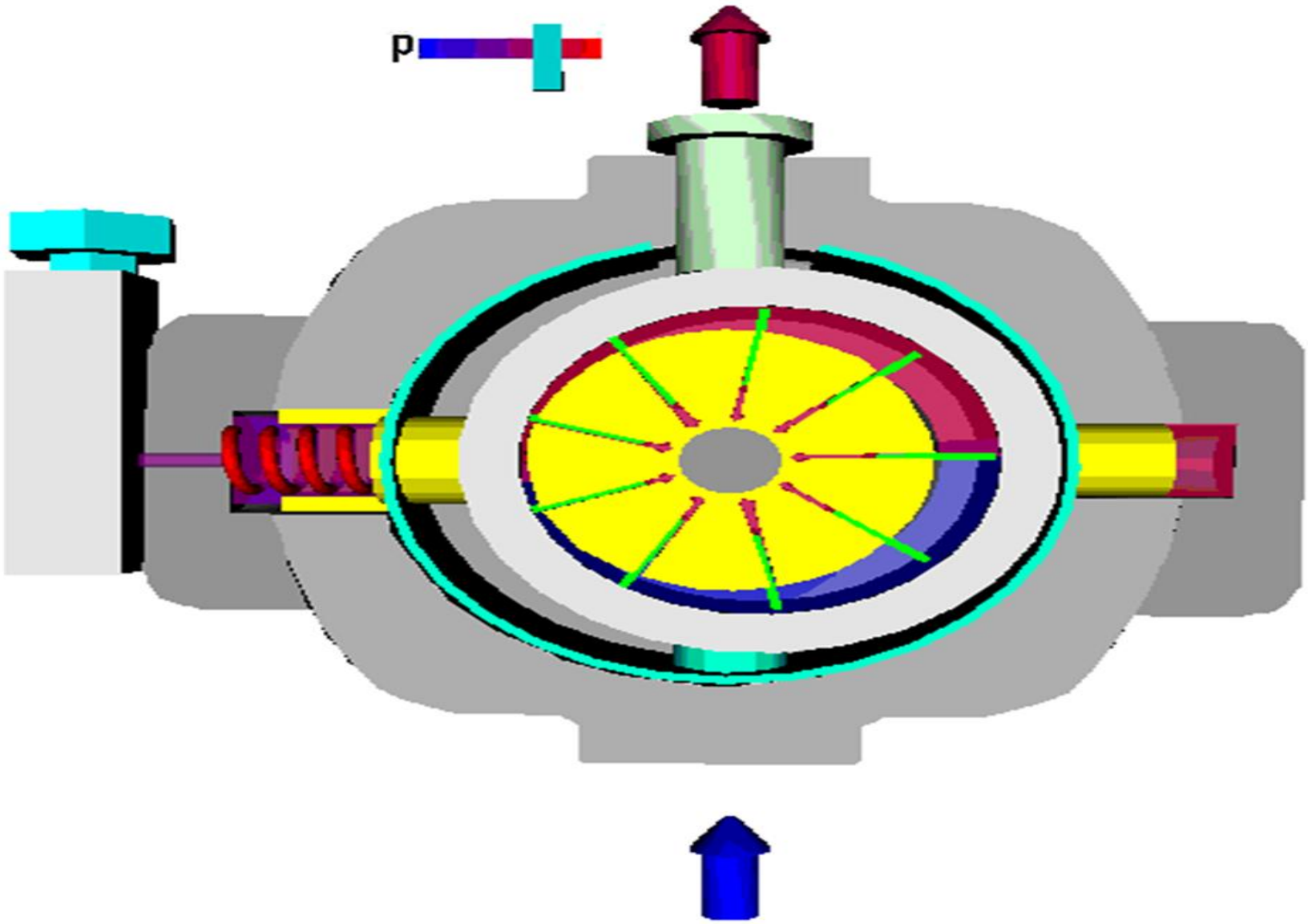
2-Variable Displacement Vane Pump

- In variable displacement the discharge of pump can be changed
- by varying the eccentricity between rotor and pump cam-ring.
- As eccentricity increases pump discharge increases.
- With decrease in eccentricity discharge decreases and oil flow
- completely stop when rotor becomes concentric to pump cam ring.




Pressure compensator adjustment (turn clockwise to increase setting)
Thrust block V
Pressure ring
maximum displacement adjustment (turn clockwise to reduce maximum flow)

Compressors



- Advantage of vane pump
- 1- low noise but higher than screw pump.
- 2- range of work from 500 – 1800 r.p.m
- 3- semi continuous flow
- 4- pressure of work between 50 – 80 bar
- 5-the vane motor must have spring backward to the vane to face the flow.

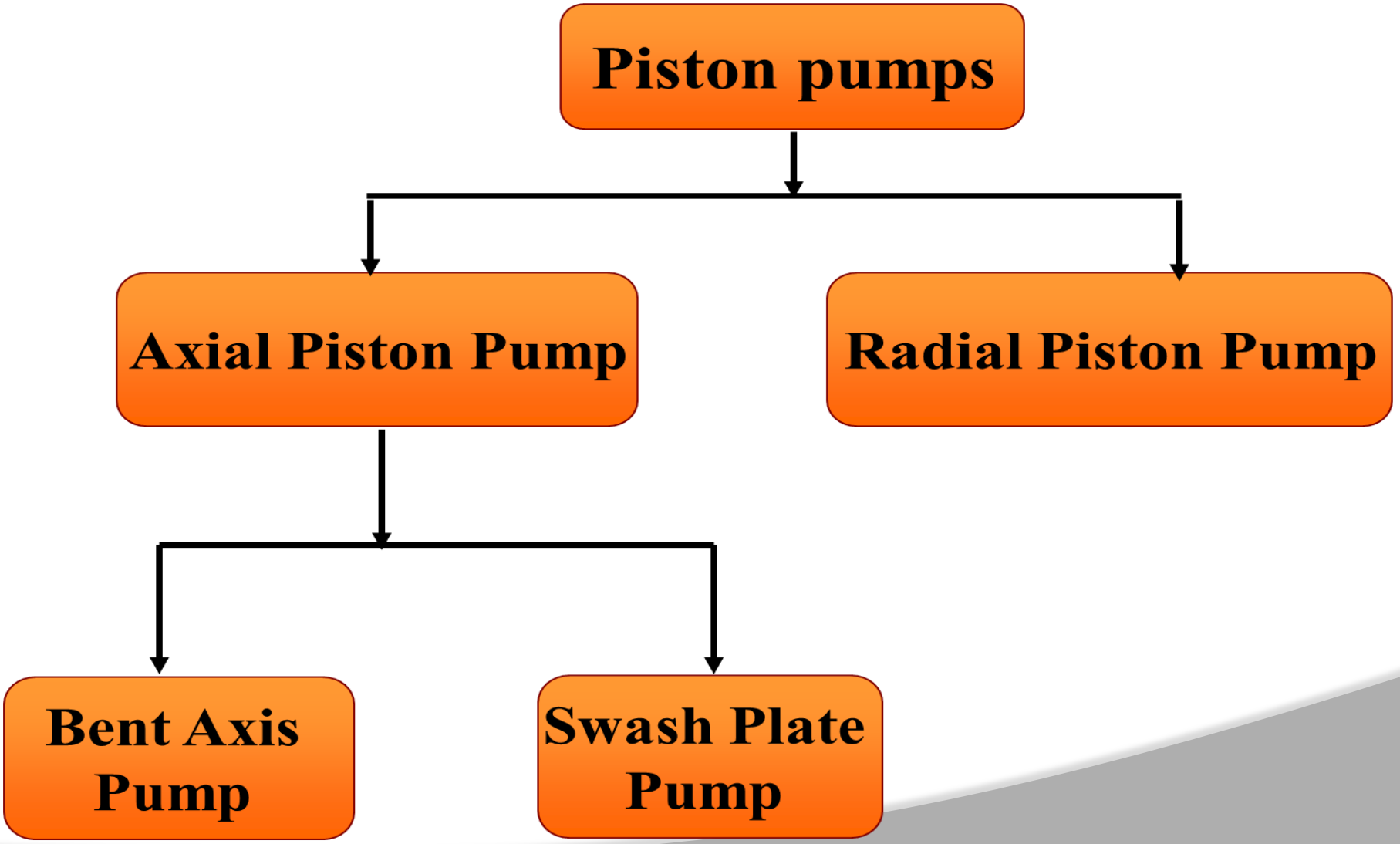
Piston pump

Piston pump mainly divided into two main types, axial design which having pistons that are parallel to the axis of the cylinder block. Axial design have three kinds,

1- bent axis pump.

2- swash plate pump.

The second type is the radial design, which has pistons arranged radially in a cylinder block.

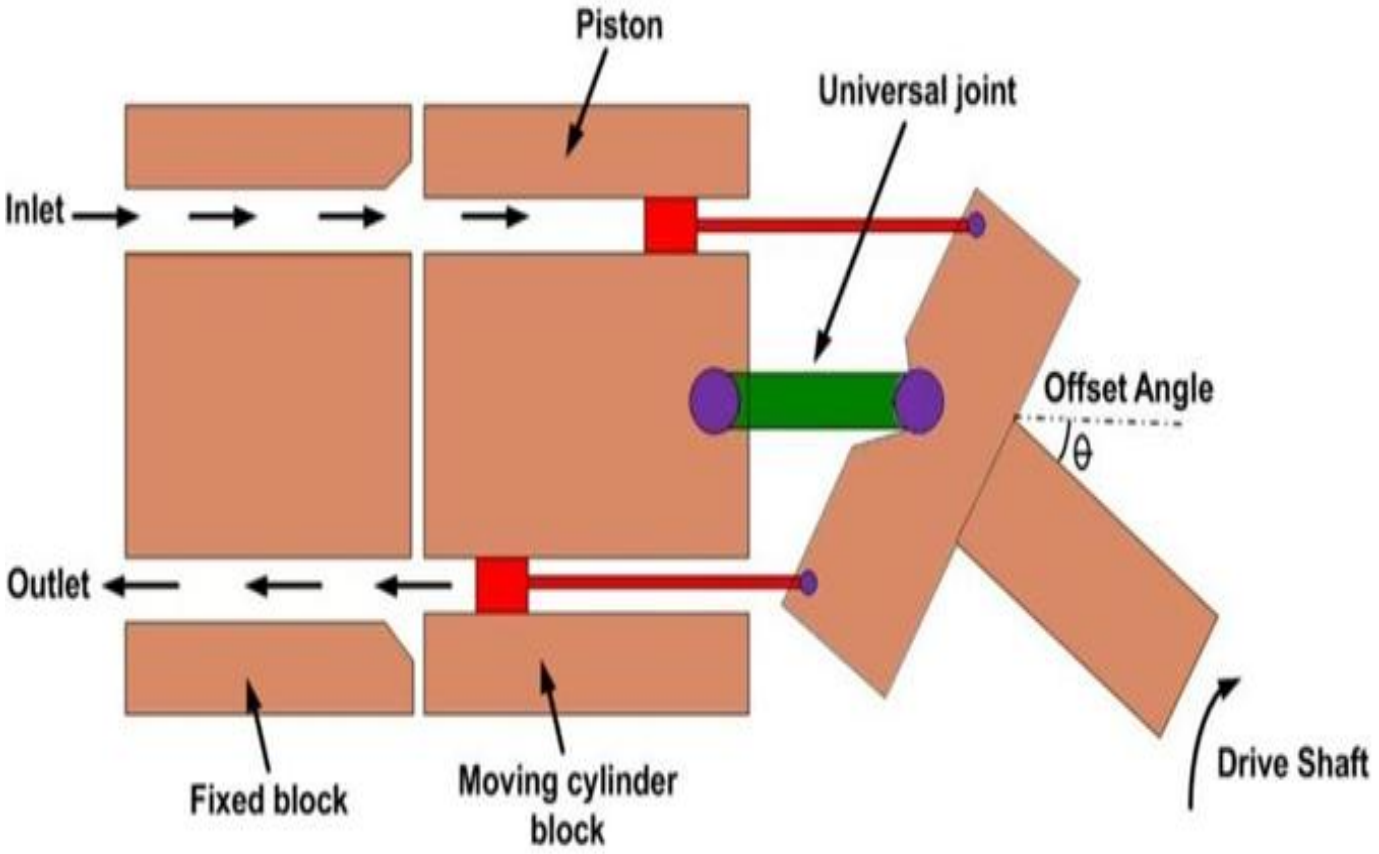

Piston pumps
Axial Piston Pump
Radial Piston Pump
Bent Axis Pump
Swash Plate Pump

Axial piston pump

- These consists of a number of pistons which are caused to reciprocate by the relative rotation of an inclined plate or by angling the piston block.

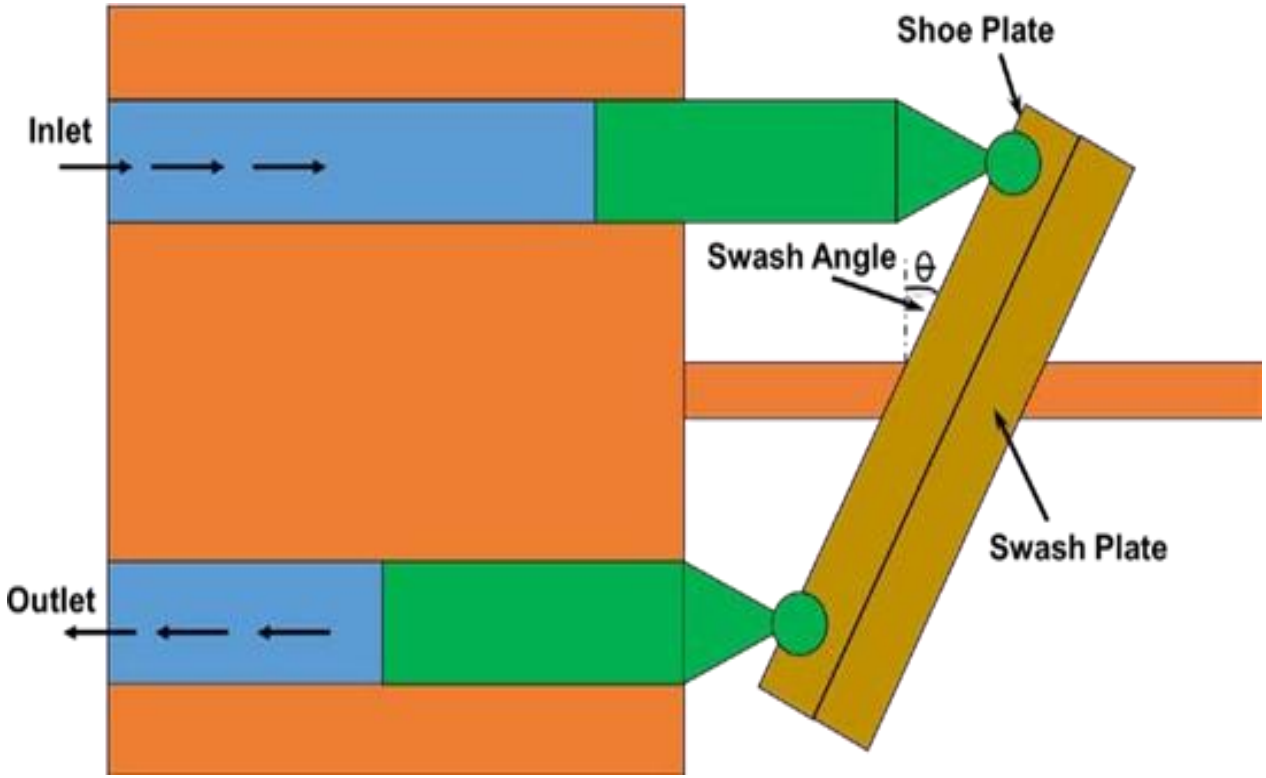
- Axial piston pumps are positive displacement pumps which converts rotary motion of the input shaft into an axial reciprocating motion of the pistons. These pumps have a number of pistons (usually an odd number) in a circular array within a housing which is commonly referred to as a cylinder block, rotor or barrel. In general, these systems have a maximum operating temperature of about 120 °C. Therefore, the leakage between cylinder housing and body block is used for cooling and lubrication of the rotating parts. This cylinder block rotates by an integral shaft aligned with the pistons.

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.
- The cylinder block is turned by the drive shaft through a universal link. The cylinder block is set at an offset angle with the drive shaft.
- The cylinder block contains a number of pistons along its periphery. These piston rods are connected with the drive shaft flange by ball-and- socket joints.
- These pistons are forced in and out of their bores as the distance between the drive shaft flange and the cylinder block changes. A universal link connects the block to the drive shaft, to provide alignment and a positive drive.

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 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).

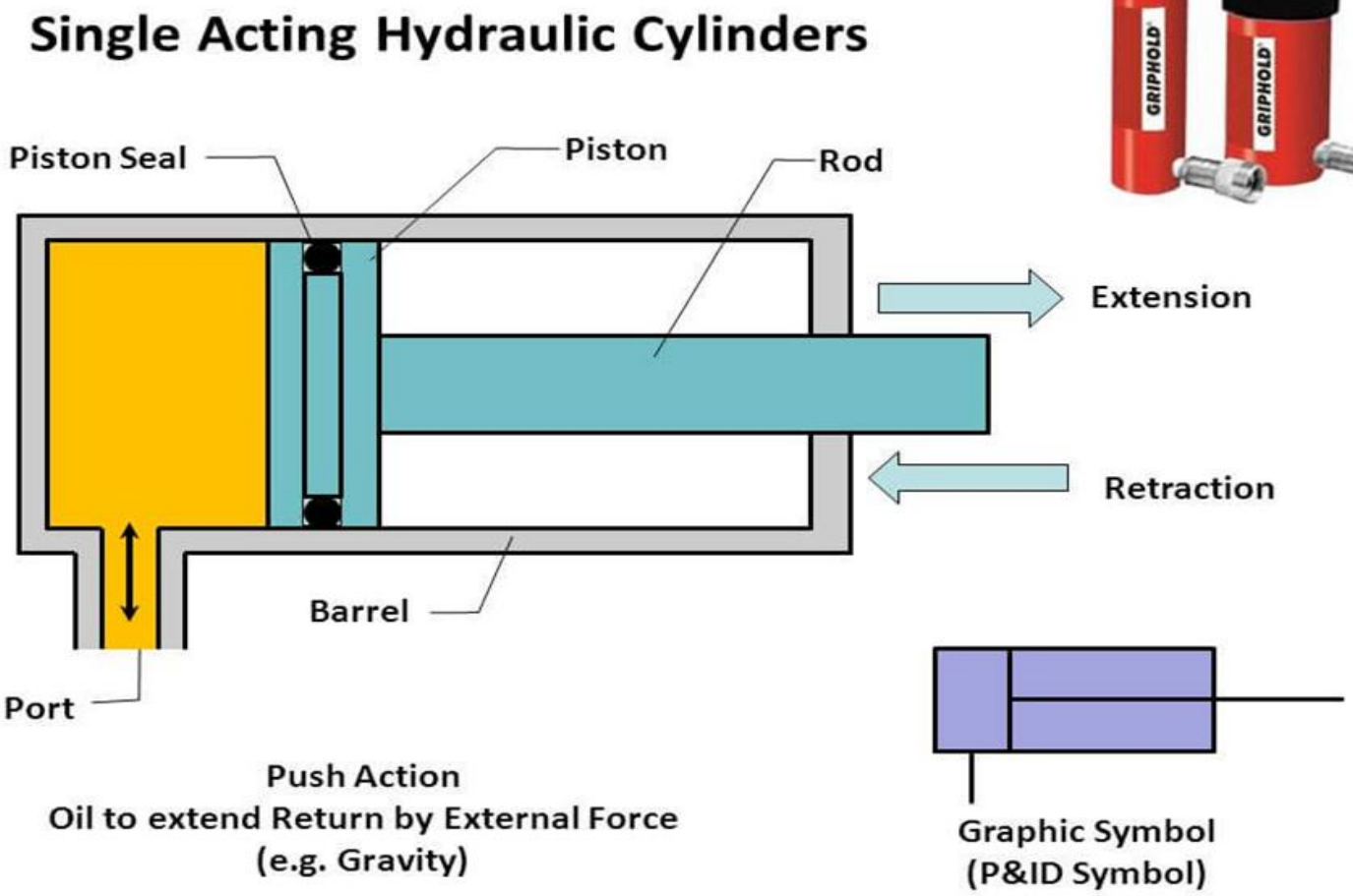
UNIT – III

HYDRAULIC POWER PACK

HYDRAULIC POWER PACK

- A hydraulic pump unit (HPUs) is an arrangement of interconnected components that control hydraulic energy. It is an integral component in most hydraulic systems.
- A hydraulic system is any component that uses a fluid to generate and transmit energy from one point to another within the enclosed system. This force can be in the form of linear motion, force or rotary motion.
- This is based on the Pascal's Laws.
- Therefore, whenever you refer to hydraulic power units, it is basically a system that generates pressure or force based on the above fundamental aspects. You can use them in applications that require heavy and systematic lifting.

Single acting hydraulic cylinders:



- In single acting hydraulic cylinders, the hydraulic fluid acts on only one end of the piston.
- Therefore, to push the piston back to its original position (retraction), the cylinder uses a compressed air, mechanical spring, a flying wheel or gravity load.

A double acting hydraulic cylinders:

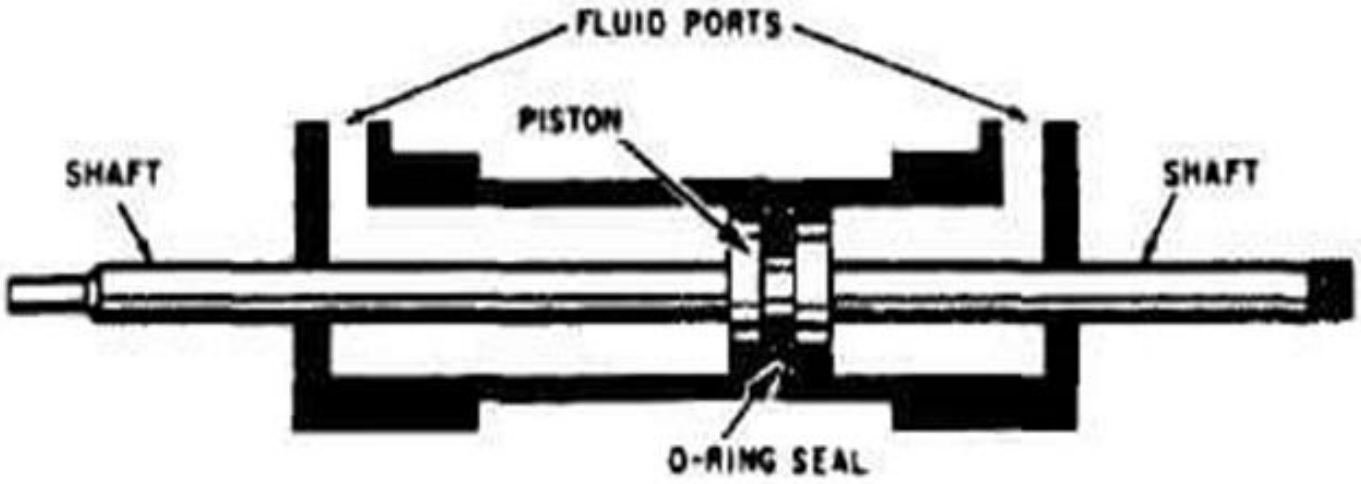
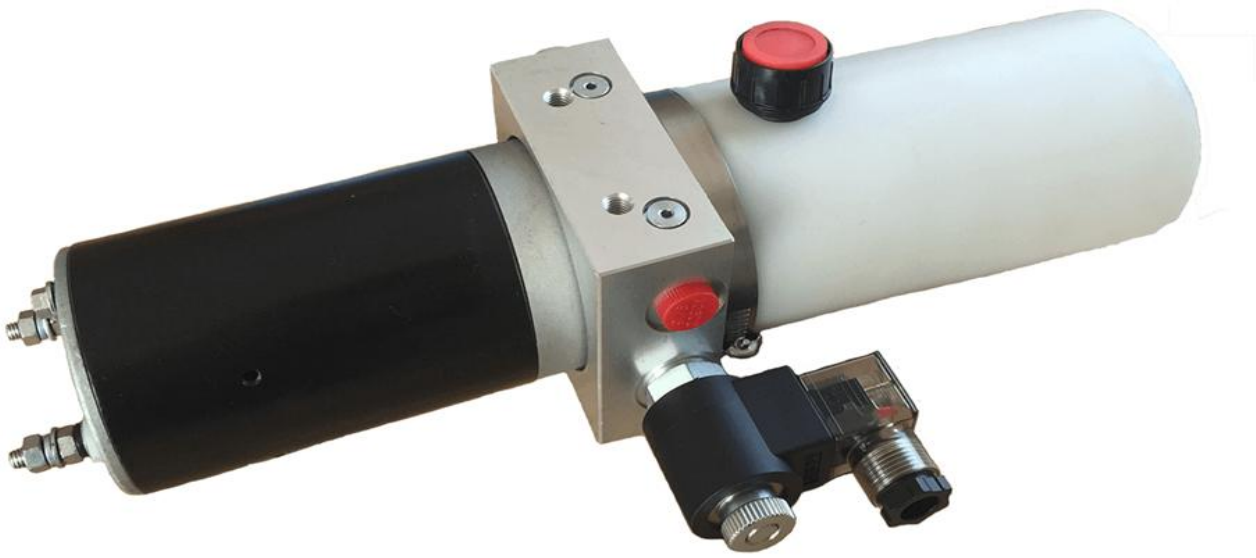


Figure 10-8.-Balanced, double-acting piston-type actuating cylinder.

- A double acting power pack unit is where the working hydraulic fluids acts alternately on the two ends of the piston.
- That is, it uses the hydraulic power to extend and retract the piston.

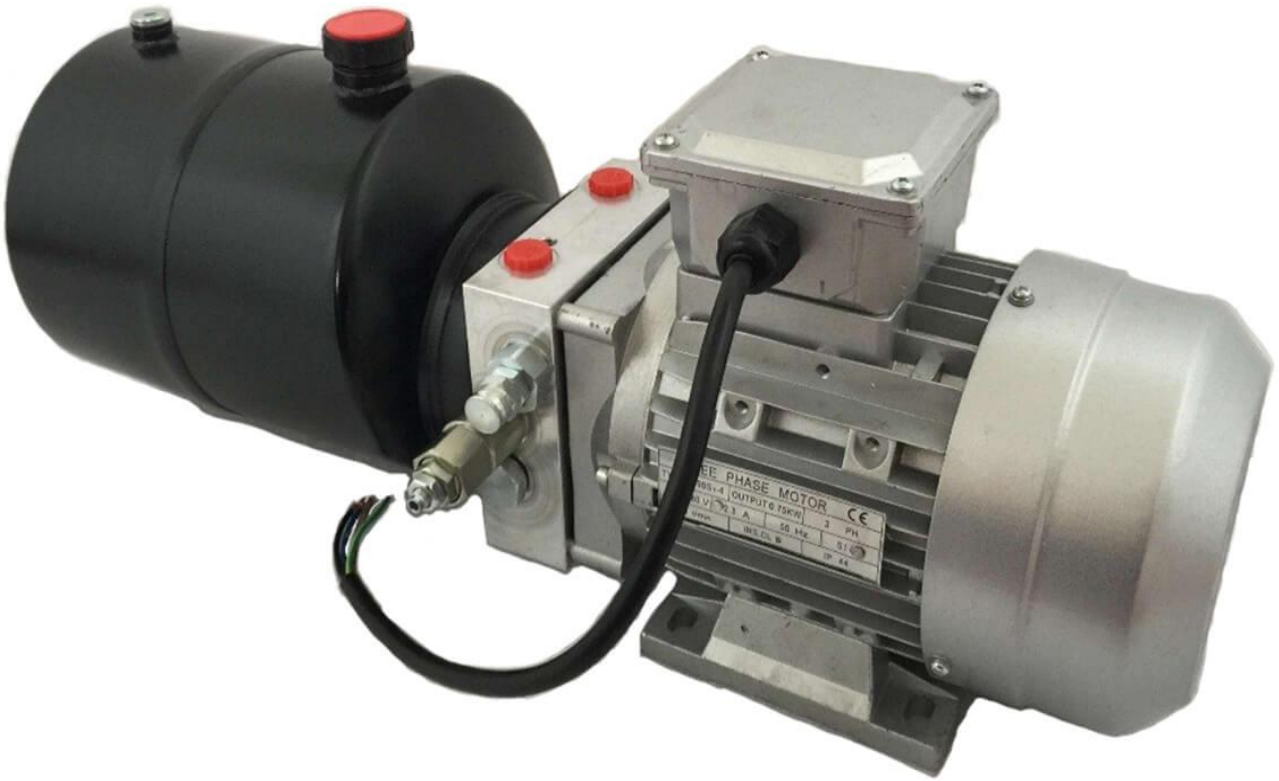
Micro Power Pack Units:



- The Micro hydraulic power packs are suitable for applications where space is limited. They are portable due to their small size.
- They are compact in size and available as either single or double acting.
- Due to their flexibility, you can operate them in either single or double acting without necessarily having a solenoid control valve.
- All you need to do is reverse the motor movement. Such micro power packs have dual pressure relief valves, giving separate control options.

Mini Power Pack Units:

- They are available in different configurations such as horizontal or vertical mounting with a reservoir tank capacity ranging between 0.8 and 30liters.
- It uses a DC 0.8kW to 4.0kW motor, or AC 0.75kW to 7.5kW motor.
- The voltage of DC motors is DC 12V/24V or DC36v/48v, and the voltage of AC motors is AC 110V/220V/230V/380V/415V.
- With the advancement in technology, there are portable hydraulic power units that come with remote control options.


PHASE MOTOR
OUTPUT 0.75KW
50 Hz
3
PH

Standard Hydraulic Power Pack Units:

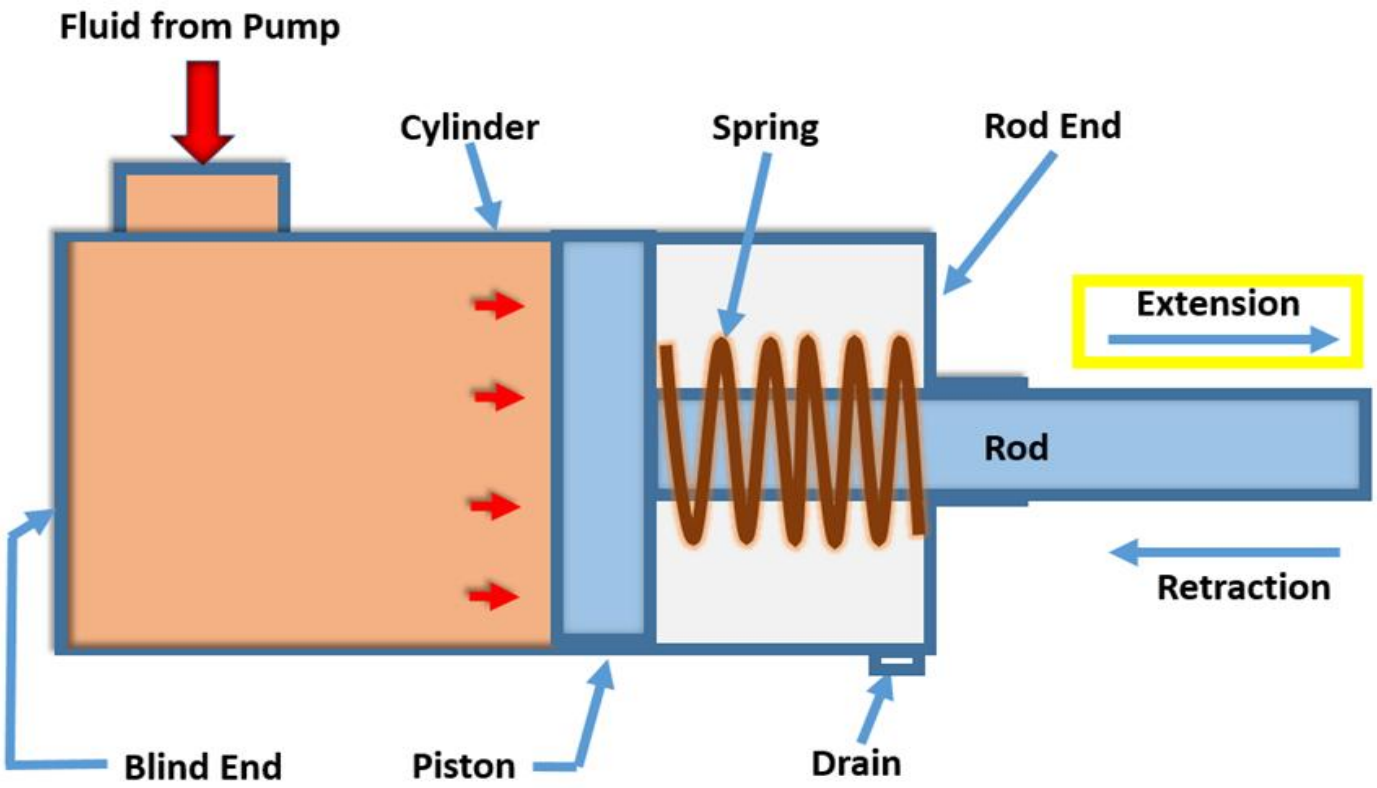
- The standard hydraulic power pack units are designed for in-plant operations. They are mainly used for industrial applications.
- Such hydraulic power packs create huge power and high flow rates. They can handle heavy loads for a long period of time.
- Their tank capacity is about 180 liters, with a flow rate of about 100 liters/minute. In most cases, you'll find that most standard hydraulic power packs have a motor rating of about 30kW.

Hydraulic Power Unit Stations:

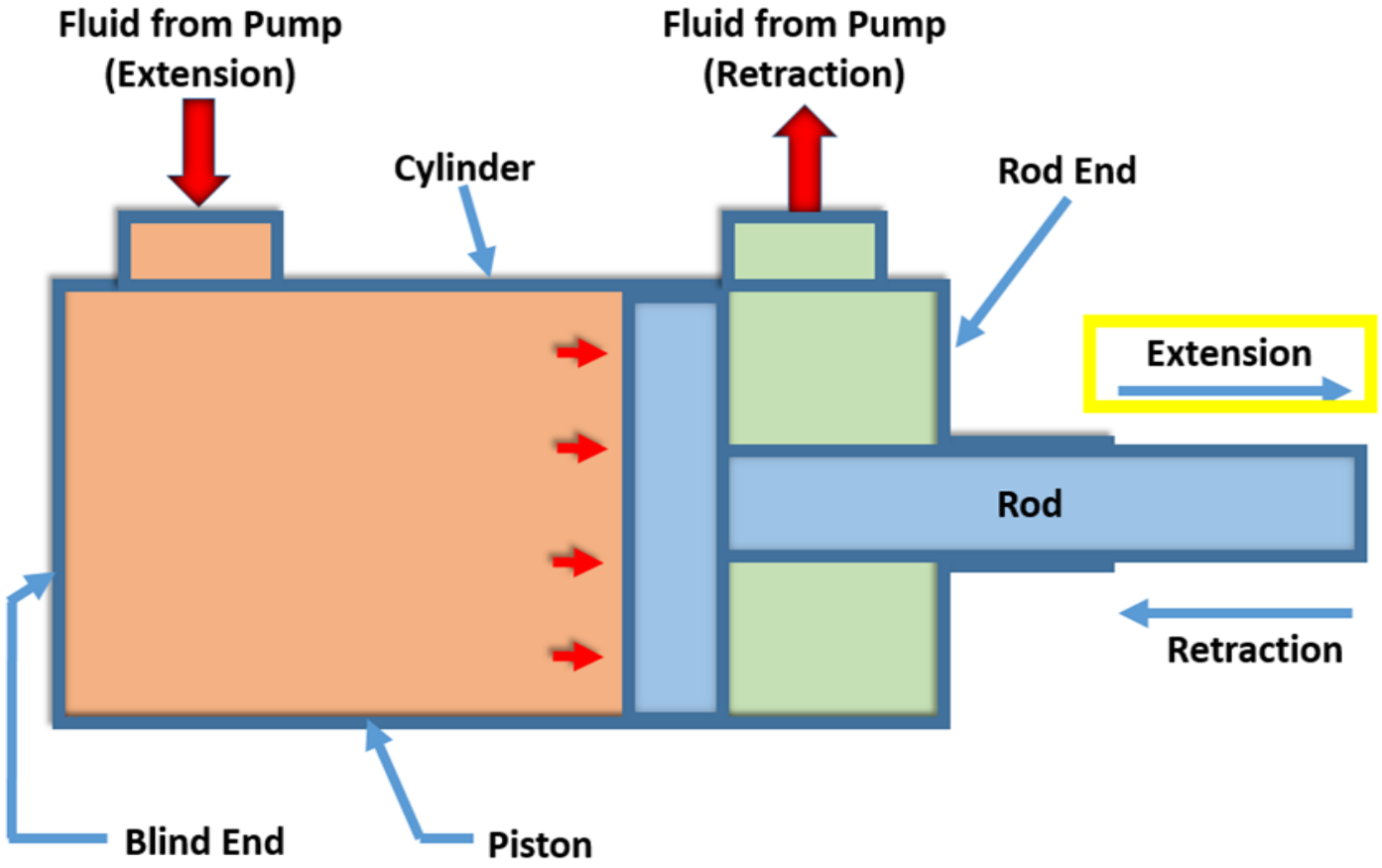
- The Hydraulic power unit stations are designed for specific applications. These may include sewage treatment, construction and mining applications, just to mention a few.
- Mostly, they are available in custom designs to meet the specific requirement of any unique application.
- Broadly, these are the main types of hydraulic power packs available in the market.
- As you can see, as the sizes increase, their capacity and power also increases.

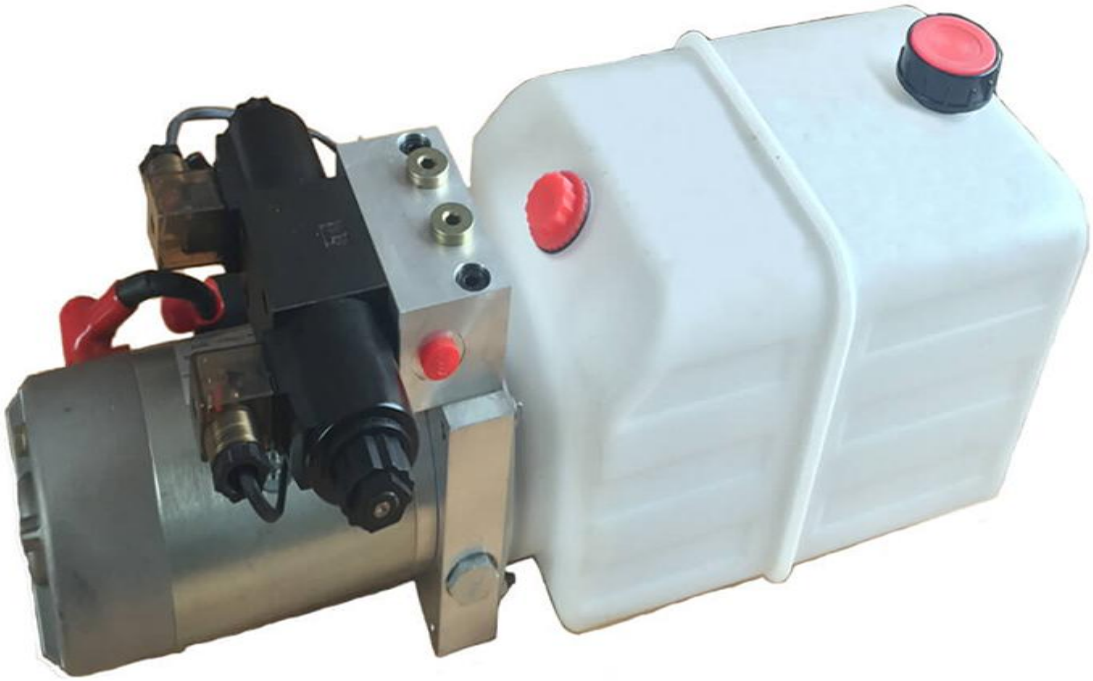

120 VOLTS

Single Acting, Single ended Cylinder



Double Acting, Single ended Cylinder





Application of Hydraulic Power Pack:

- Lifting heavy motors, Hay or offloading trucks.
- Hydraulic systems provide a perfect solution to this problem.
- The transportation, lifting and distributing heavy equipment with the help of a hydraulic system. hydraulic technology in very many industries such as agriculture, automotive, manufacturing industries, garbage collection, mobile hydraulics, etc.
- Plastic tube thermal melting welders
- Steering gears
- Transmission systems
- Hydraulic motor
- Hydraulic wrench
- Hydraulic road blocker

Pressure Control Valve:

- **Pressure control valve on the hydraulic power unit with pressure relief valve, sequence valve, relief valve, pressure relay-based .**
- **Almost each hydraulic power unit complete with a relief valve. Sequence valve, relief valve and pressure switch on some special hydraulic power unit having a sequence of actions and the same system have different working pressures used, such as Dock leveler hydraulic power units for logistics equipment and Paper Cutter production line hydraulic power units.**

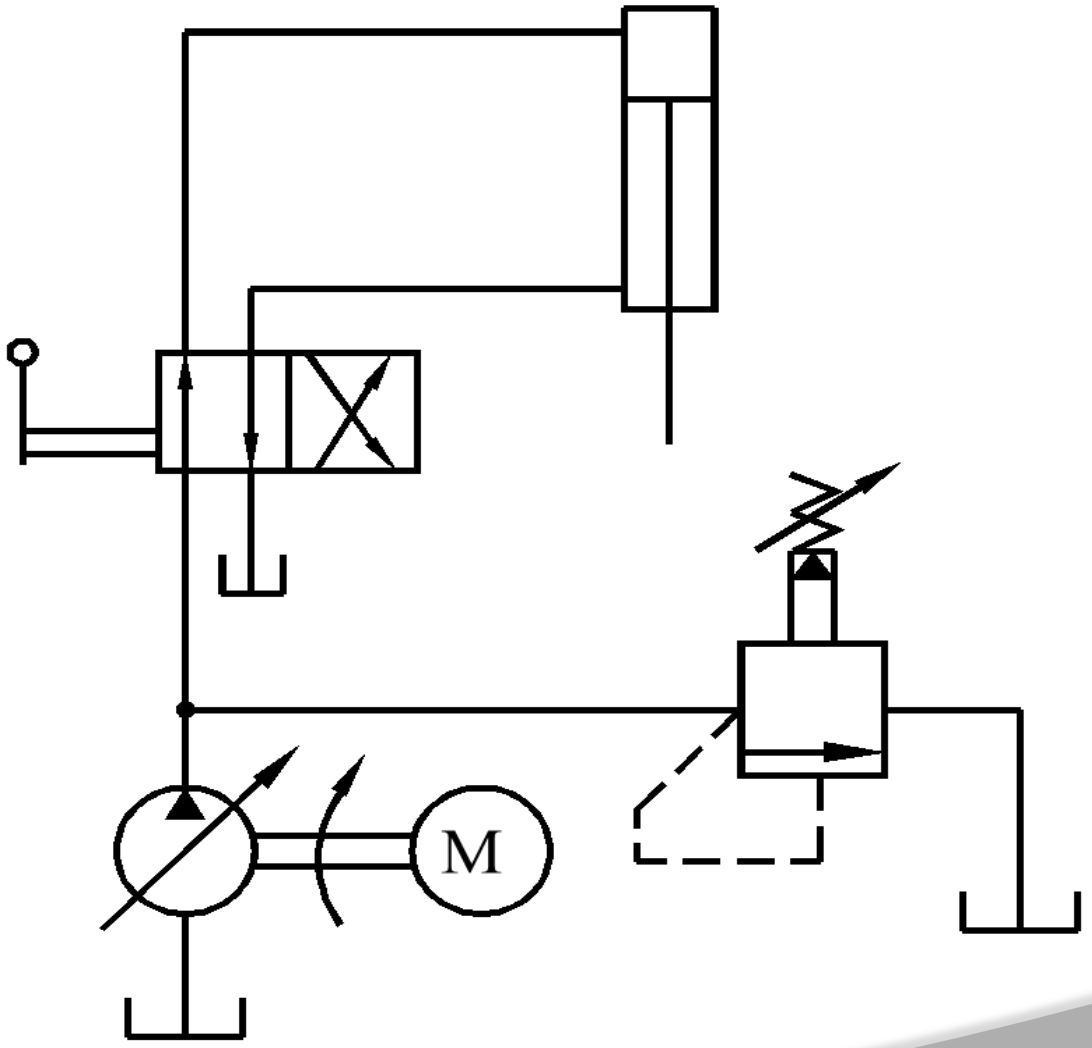
UNIT – IV

Hydraulic Circuits and Accumulator

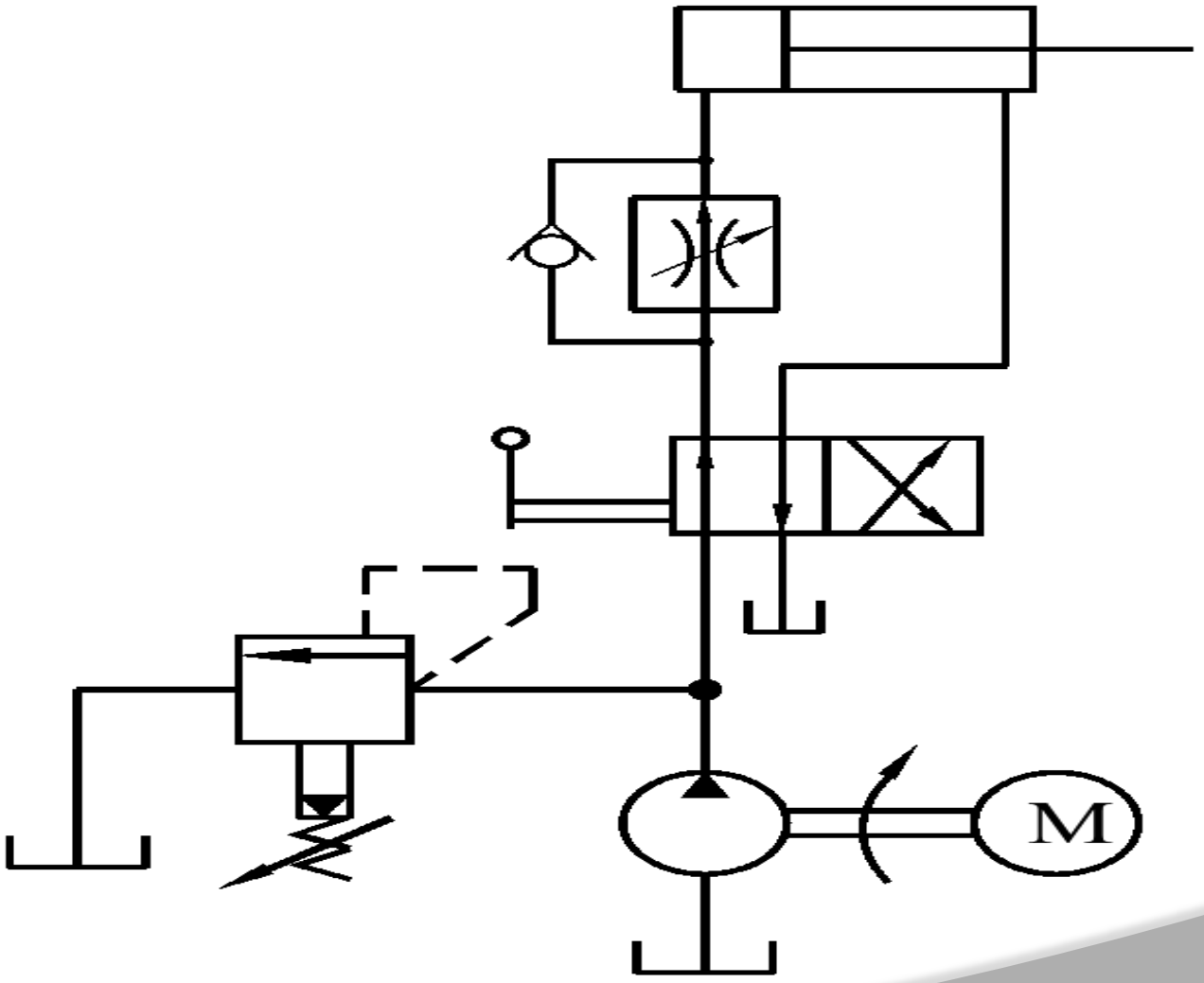
Good Hydraulic Circuit requirements:

- **Satisfy The Specifications Of The Operation With Safety**
- **Perform Smooth Operation**
- **Low Energy Consumption – Low Heat Generation**
- **Reduce Initial Cost & Running Cost**
- **Make Maintenance Easy**

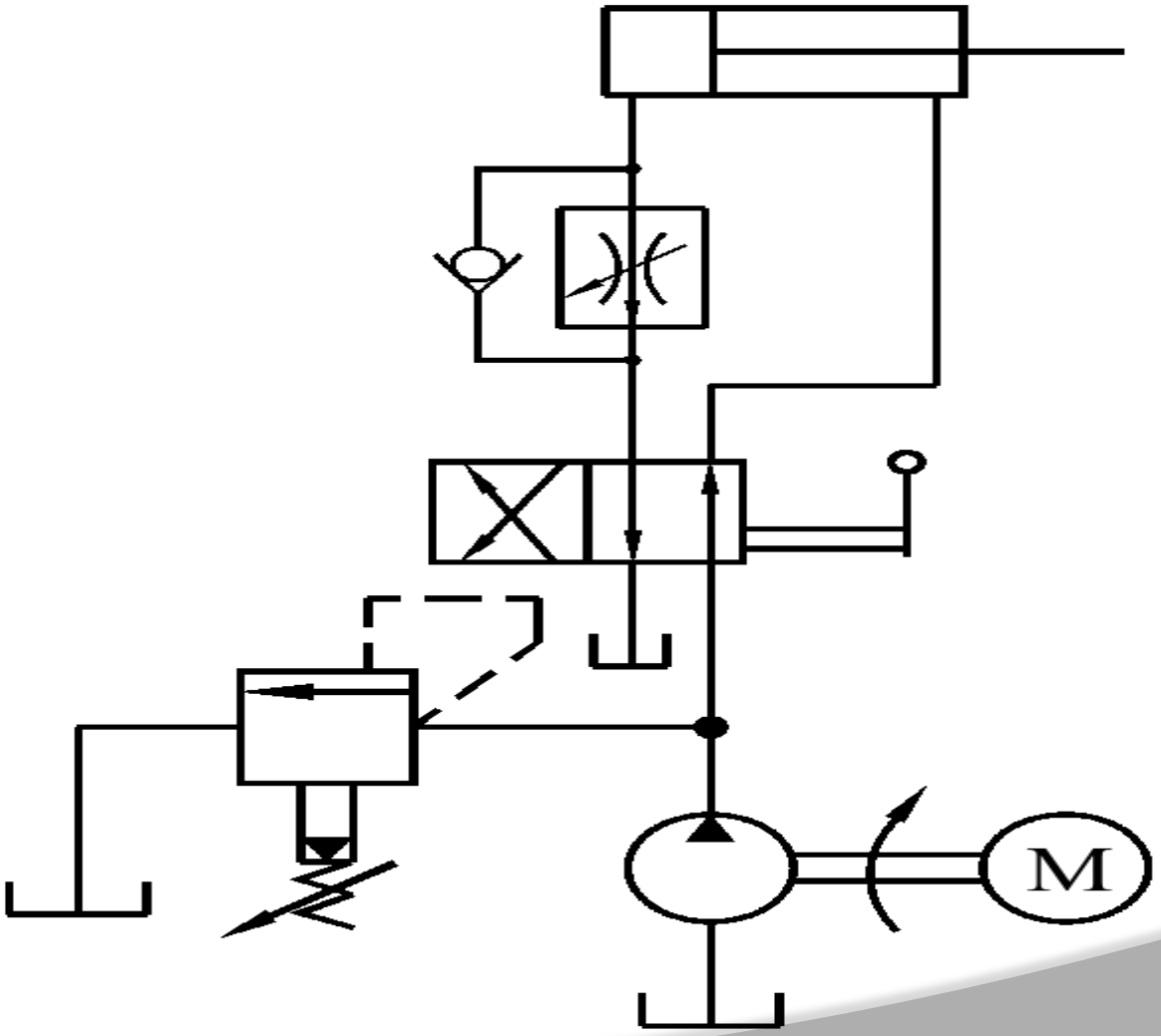
Hydraulic circuit: Variable Displacement Pump Circuit



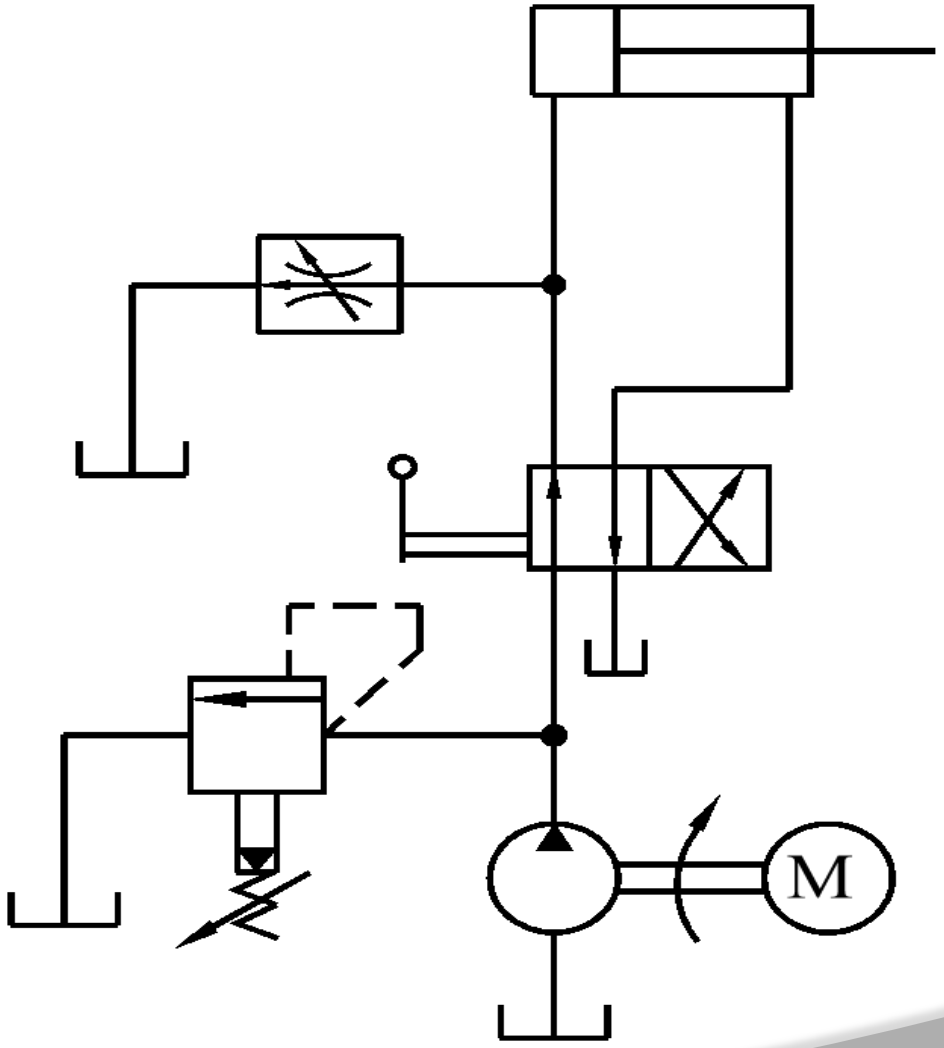
Meter In -Circuit:



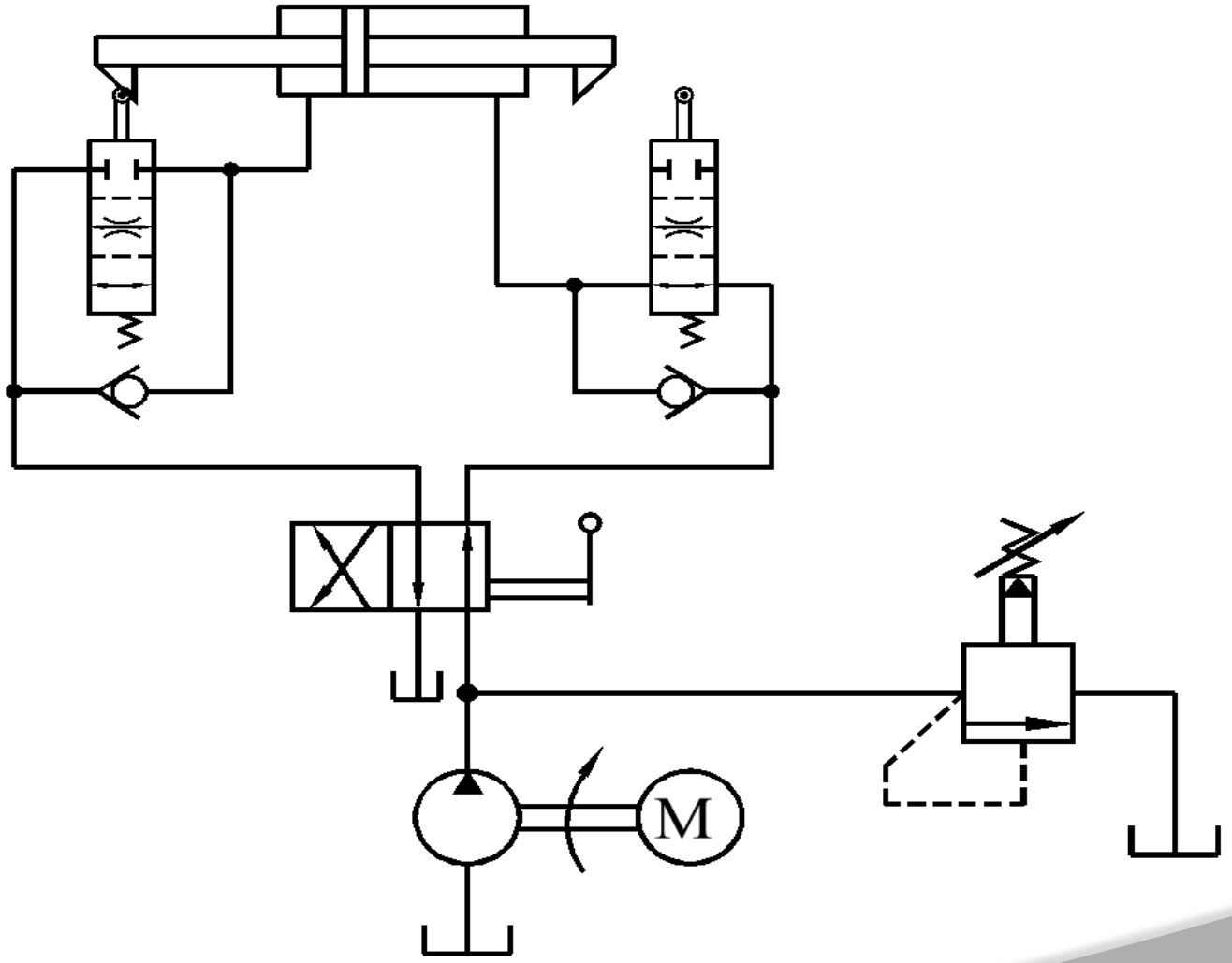
Meter Out -Circuit:



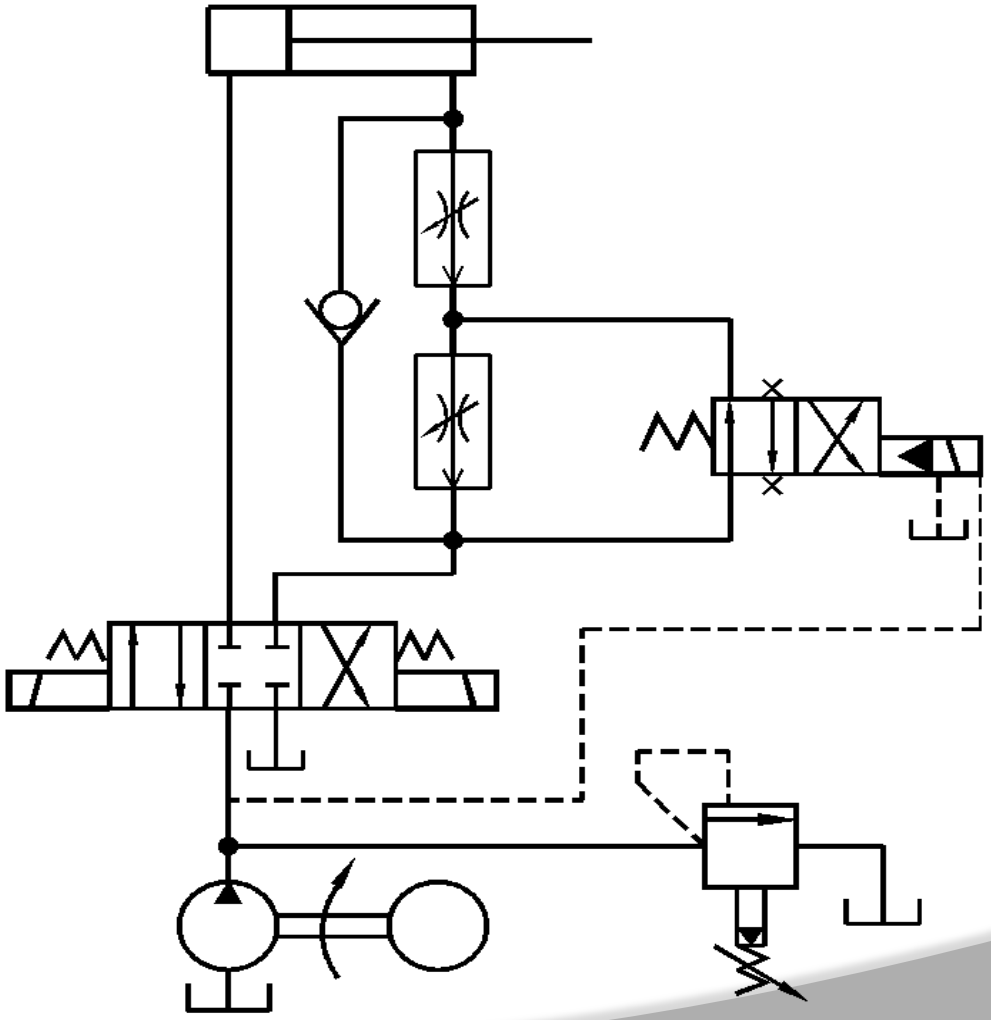
Bleed -Off Circuit



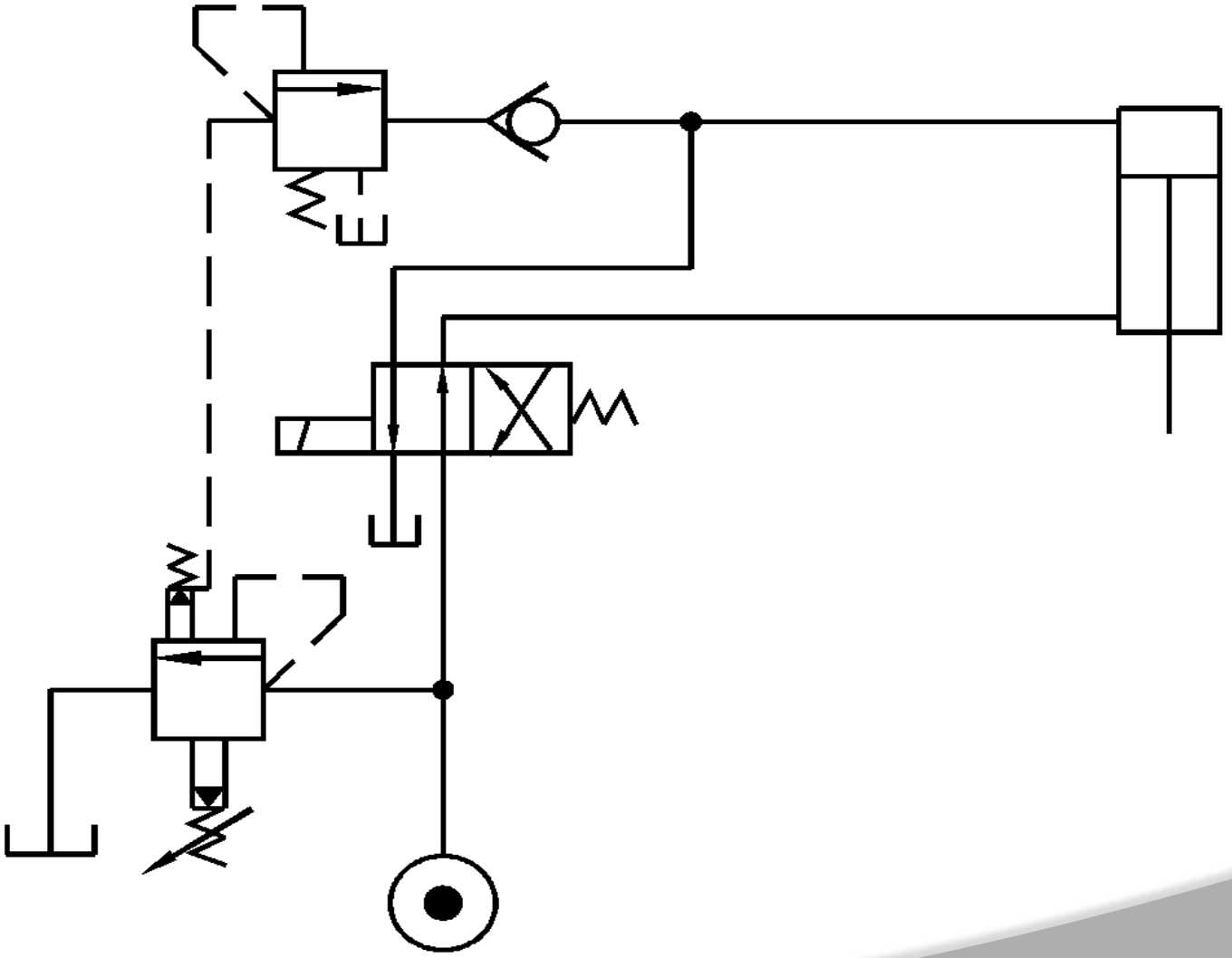
Deceleration Circuit



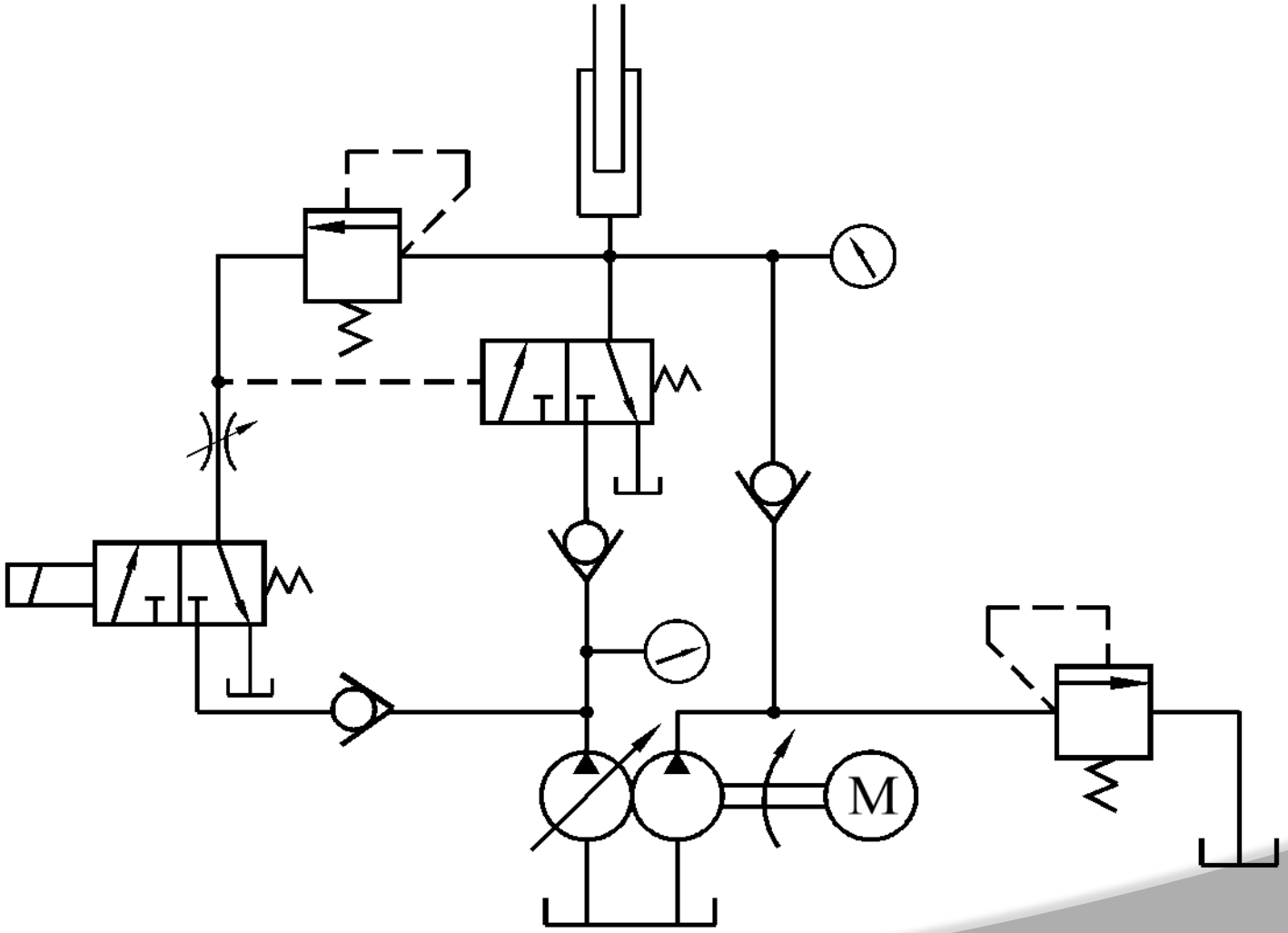
Multi Speed Circuit



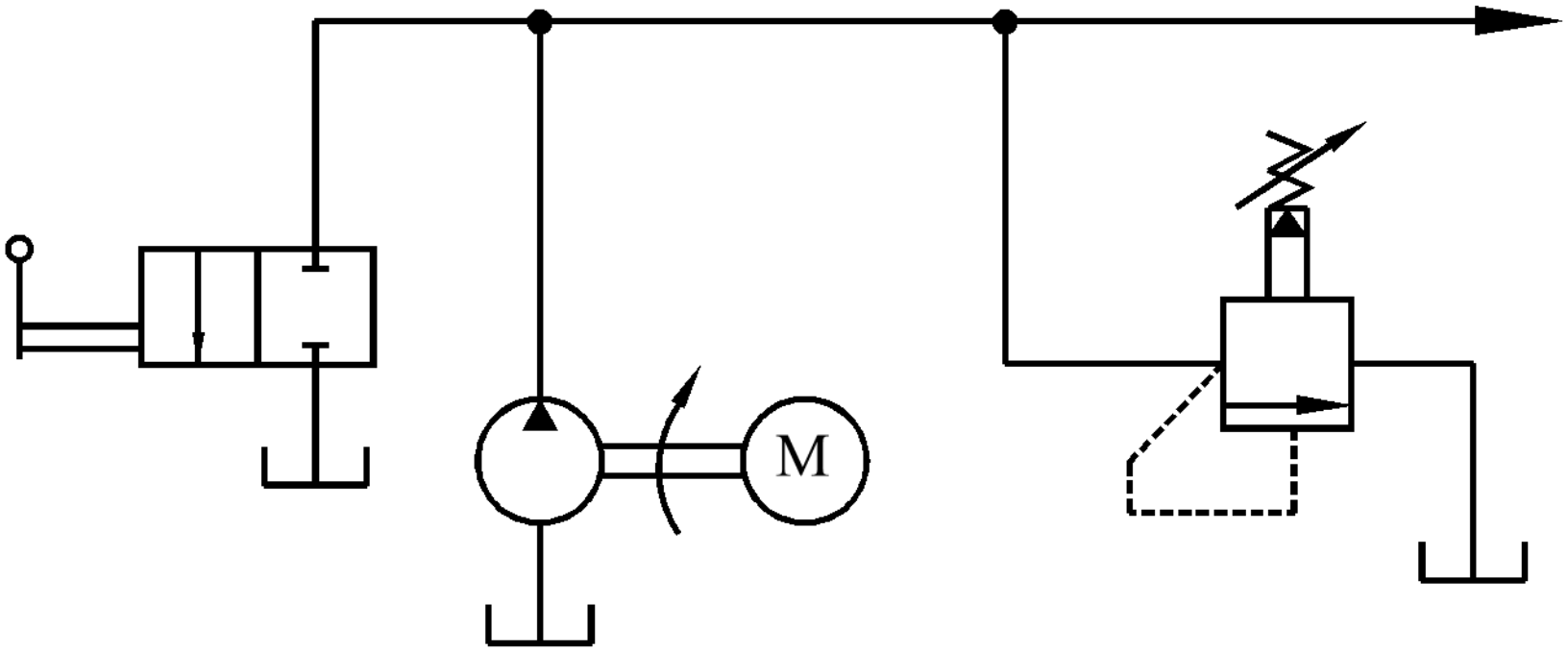
Low Pressure Return Circuit

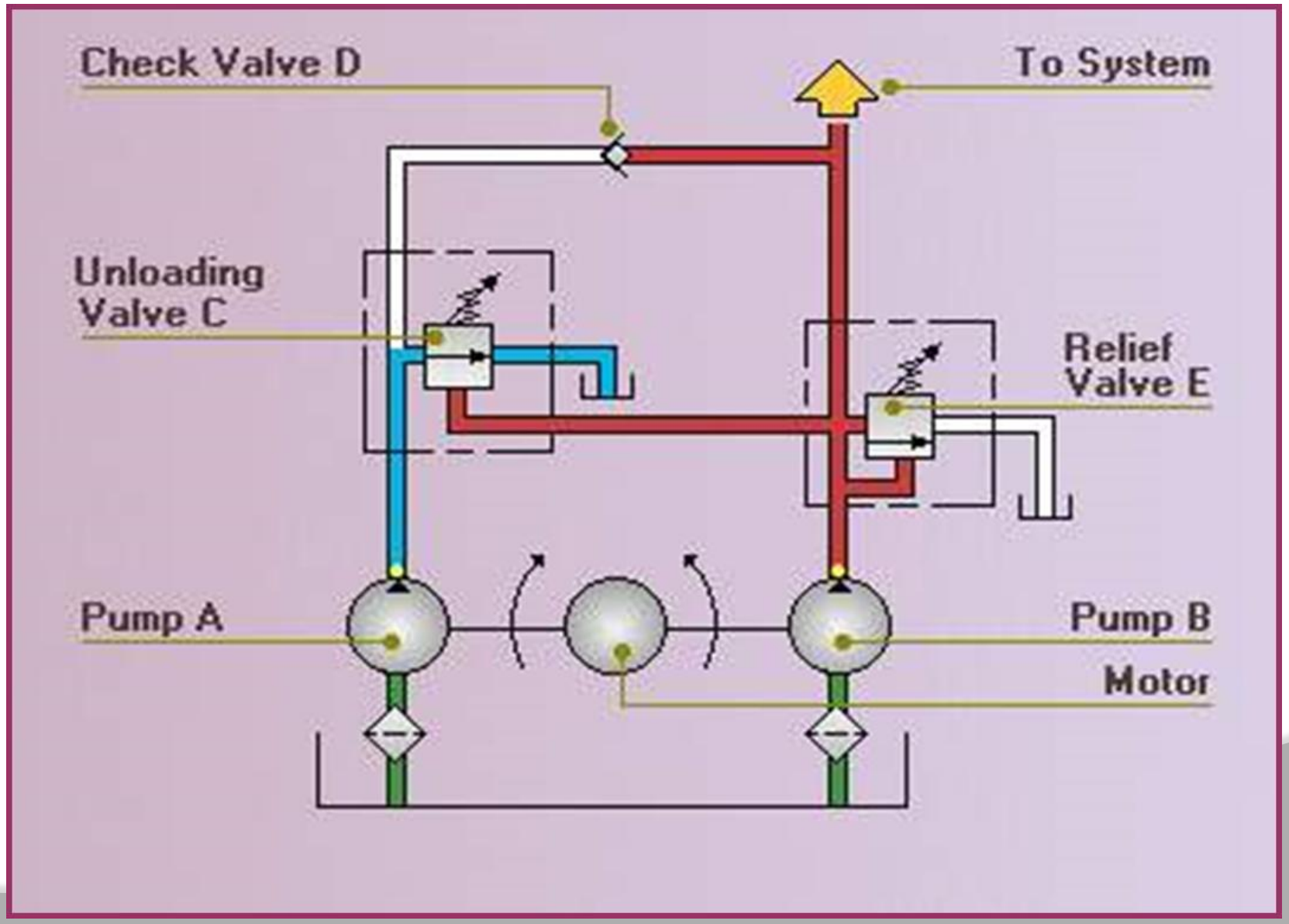


Decompression Circuit

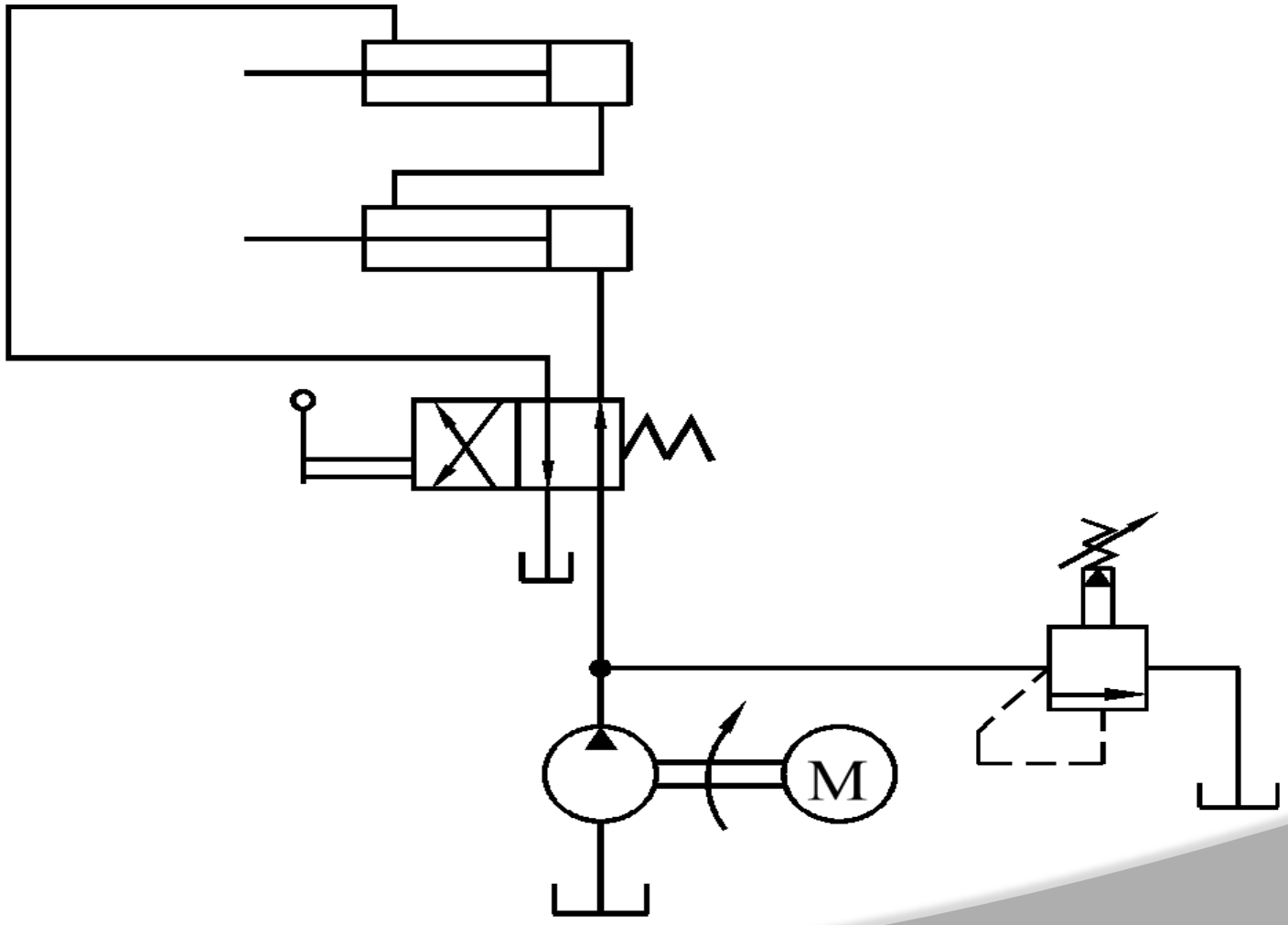


UNLOADING CIRCUIT

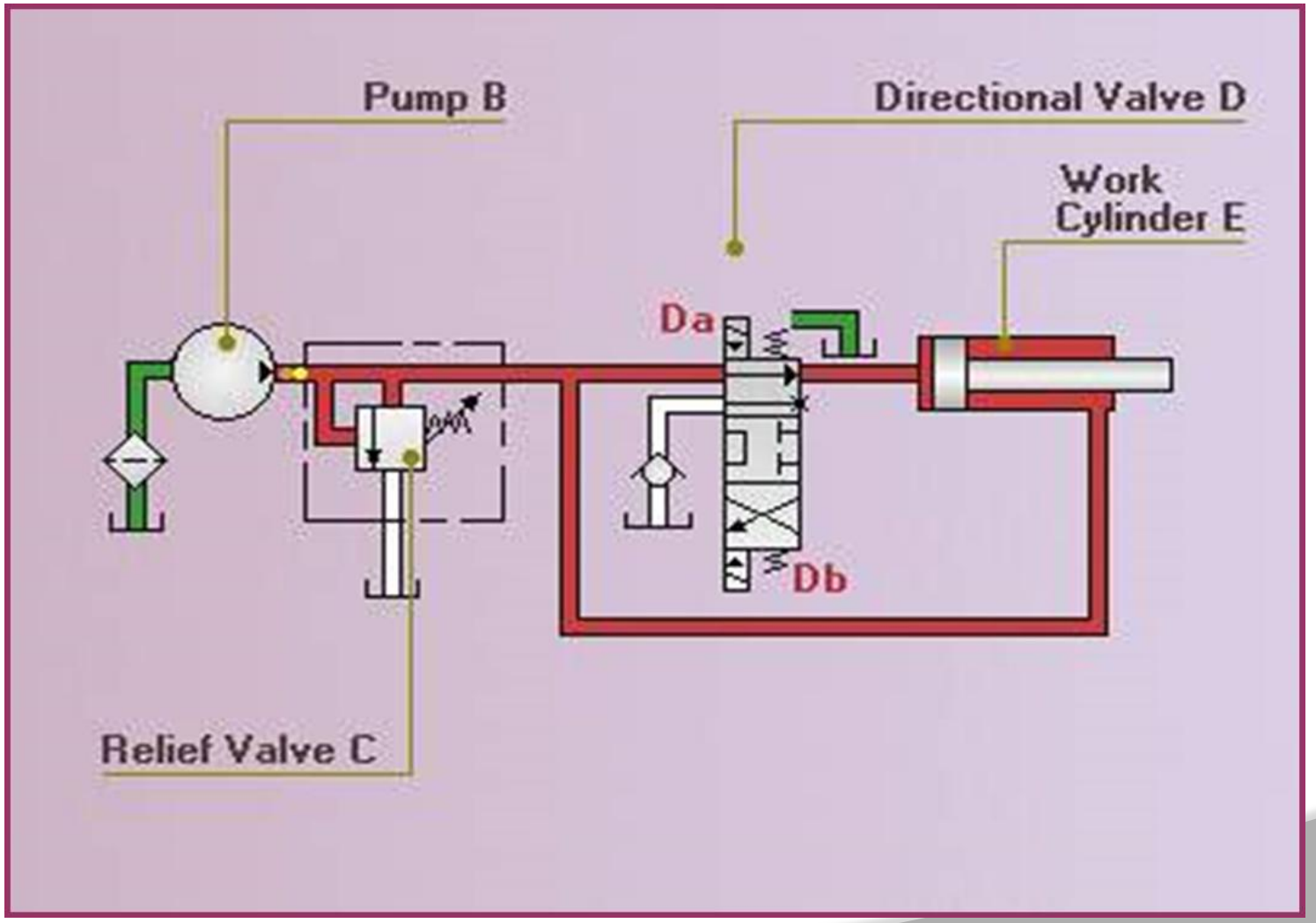



Check Valve D
To System
Unloading
Valve C
Relief
Valve E
Pump A
Pump B
Motor

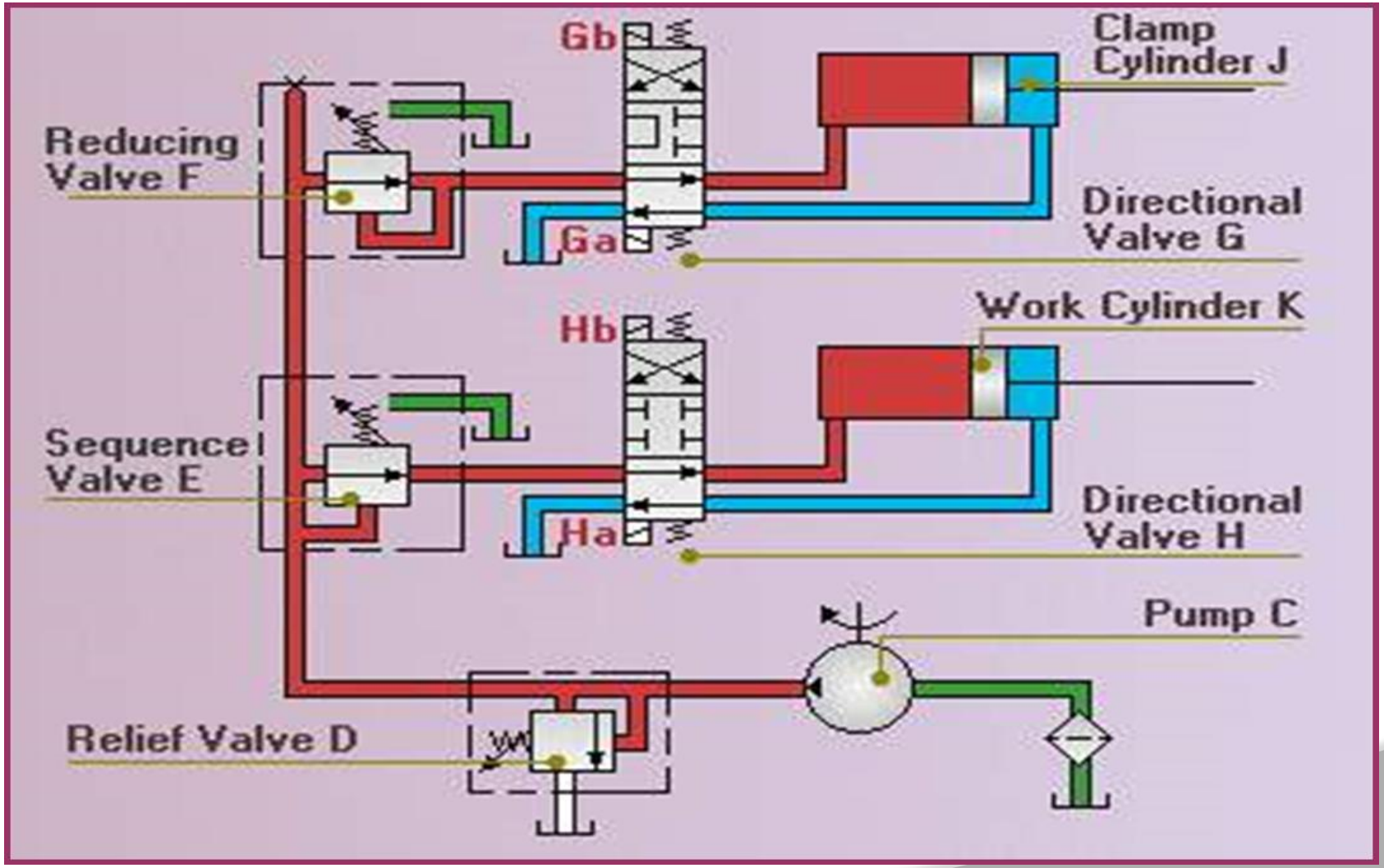
SYNCHRONIZING CIRCUIT



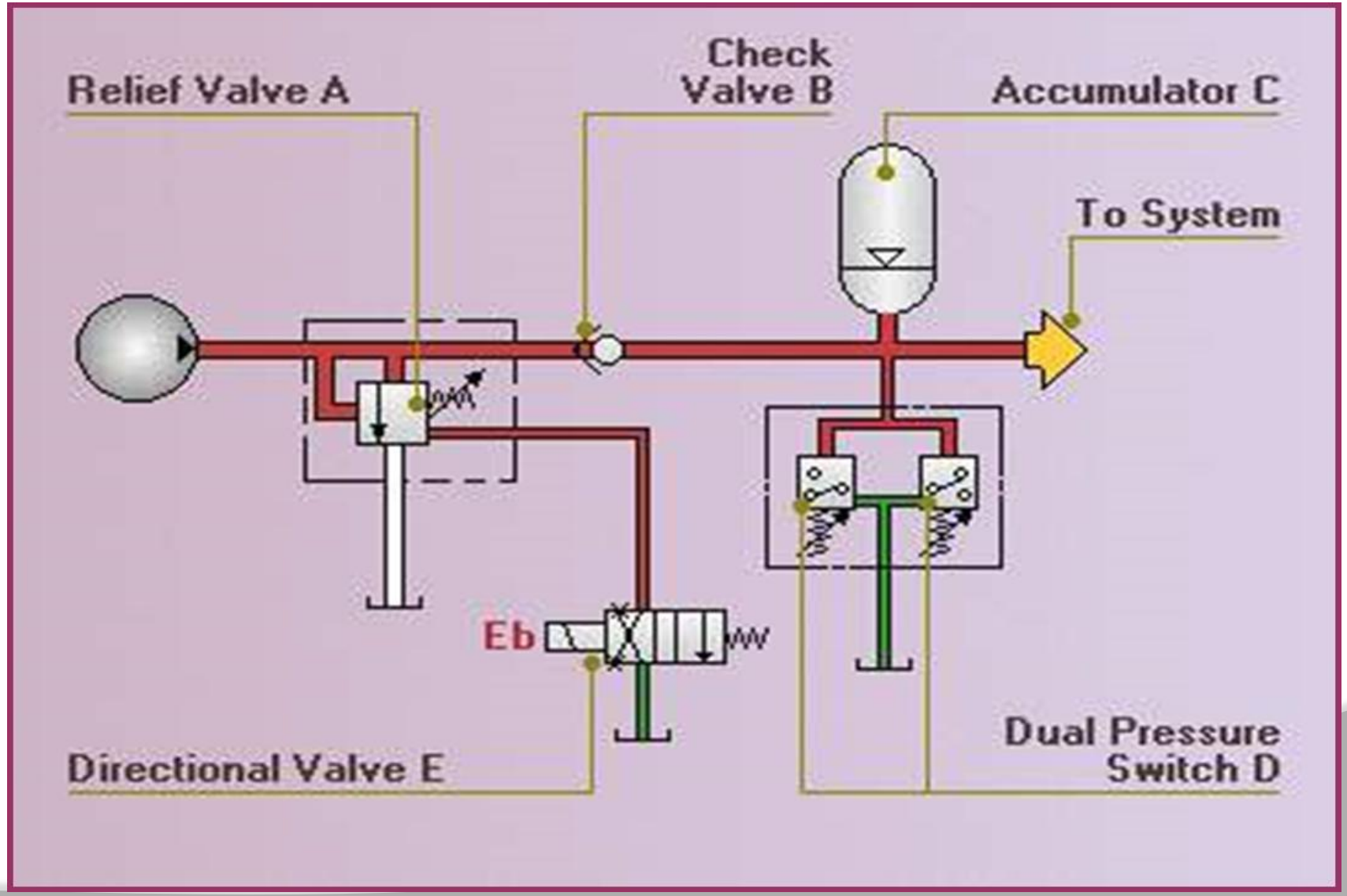
REGENERATIVE CIRCUIT



CLAMPING AND SEQUENCING CIRCIT



Accumulator Unloading circuit



Accumulators:

- A hydraulic accumulator is a device that stores the potential energy of an incompressible fluid held under pressure by an external source against some dynamic force. This dynamic force can come from different sources. The stored potential energy in the accumulator is a quick secondary source of fluid power capable of doing useful work. There are three basic types of accumulators:
- The main task of the hydraulic accumulator is to accumulate fluid under pressure and return it when necessary. Since the accumulator contains a fluid under pressure, it is treated as a pressure tank and must therefore be sized for the maximum operating pressure according to test regulations in force in the country where it is installed. To achieve the volume compensation and get the accumulation of energy, the fluid is pre-loaded by a weight, a spring or a compressed gas.

Spring-loaded accumulator:

- A spring-loaded accumulator stores energy in the form of a compressed spring.
- A hydraulic fluid is pumped into the accumulator, causing the piston to move up and compress the spring.
- The compressed spring then applies a force on the piston that exerts a pressure on the hydraulic fluid.
- This type of accumulator delivers only a small volume of oil at relatively low pressure. Furthermore, the pressure exerted on the oil is not constant as in the dead-weight-type accumulator.
- As the springs are compressed, the accumulator pressure reaches its peak, and as the springs approach their free lengths, the accumulator pressure drops to a minimum.

Gas-loaded accumulator:

- A gas-loaded accumulator is popularly used in industries. Here the force is applied to the oil using compressed air. Schematic diagram of a gas loaded accumulator.
- A gas accumulator can be very large and is often used with water or high water-based fluids using air as a gas charge.
- Typical application is on water turbines to absorb pressure surges owing to valve closure and on ram pumps to smooth out the delivery flow.
- The exact shape of the accumulator characteristic curve depends on pressure–volume relations.

Piston-type accumulator:

- It consists of a cylinder with a freely floating piston with proper seals. Its operation begins by charging the gas chamber with a gas (nitrogen) under a pre-determined pressure.
- This causes the free sliding piston to move down. Once the accumulator is pre-charged, a hydraulic fluid can be pumped into the hydraulic fluid port.
- As the fluid enters the accumulator, it causes the piston to slide up, thereby compressing the gas that increases its pressure and this pressure is then applied to the hydraulic fluid through the piston.
- Because the piston is free sliding, the pressure on the gas and that on the hydraulic fluid are always equal.

Diaphragm accumulator:

In this type, the hydraulic fluid and nitrogen gas are separated by a synthetic rubber diaphragm.

The advantage of a diaphragm accumulator over a piston accumulator is that it has no sliding surface that requires lubrication and can therefore be used with fluids having poor lubricating qualities.

It is less sensitive to contamination due to lack of any close-fitting components.

Bladder accumulator:

It functions in the same way as the other two accumulators..

Here the gas and the hydraulic fluid are separated by a synthetic rubber bladder.

The bladder is filled with nitrogen until the designed pre-charge pressure is achieved.

The hydraulic fluid is then pumped into the accumulator, thereby compressing the gas and increasing the pressure in the accumulator.

The port cover is a small piece of metal that protects the bladder from damage as it expands and contacts the fluid port.

Accumulator Selections :

- - failure modes
- - flow rate
- - response time
- - high frequency cycling
- - external forces
- - output volume
- - fluid type
- - shock suppression
- - sizing information
- - temperature effect
- - safety
- - certification.

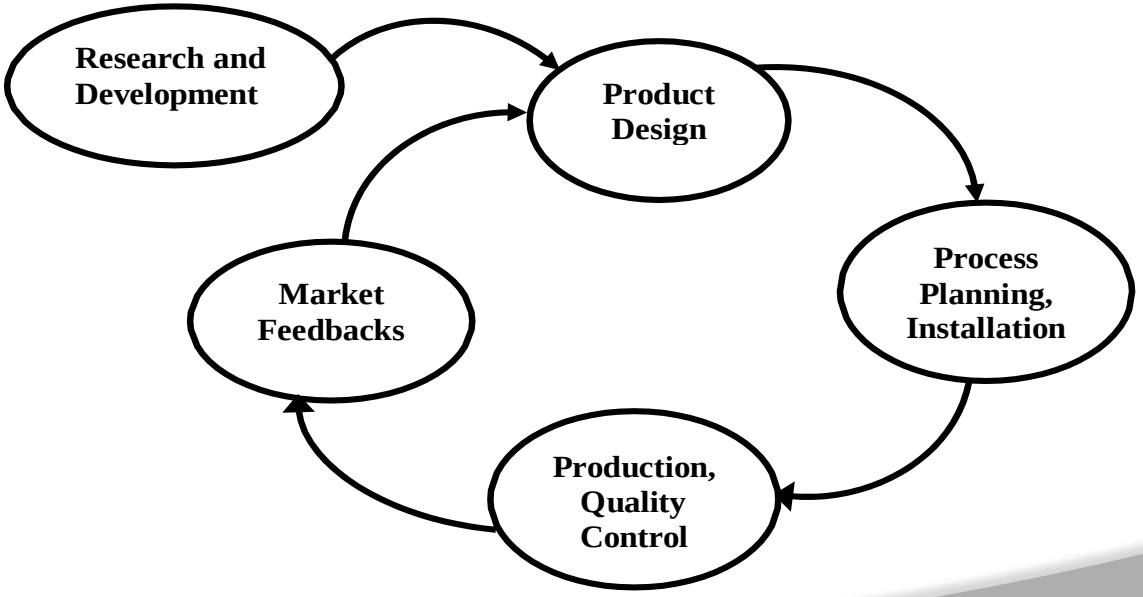
UNIT – V

AUTOMATION

Introduction to Automation;

- The overall production time for a product is affected by various factors. Automation affects all of these factors. Firstly, automated machines have significantly lower production times.
- For example, in machine tools, manufacturing a variety of parts, significant setup times are needed for setting the operational configuration and parameters whenever a new part is loaded into the machine.
- This can lead to significant unproductive for expensive machines when a variety of products is manufactured. In Computer Numerically Controlled (CNC) Machining Centers set up time is reduced significantly with the help of Automated Tool Changers, Automatic Control of Machines from a Part Program loaded in the machine computer

- Automation also reduces the overall product life cycle i.e., the time required to complete
- (i) Product conception and design
- (ii) Process planning and installation
- (iii) Various stages of the product life cycle



Types of Automation Systems

Fixed Automation:

It is used in high volume production with dedicated equipment, which has a fixed set of operation and designed to be efficient for this set. Continuous flow and Discrete Mass Production systems use this automation. e.g. Distillation Process, Conveyors, Paint Shops, Transfer lines etc.

A process using mechanized machinery to perform fixed and repetitive operations in order to produce a high volume of similar parts.

Programmable Automation:

It is used for a changeable sequence of operation and configuration of the machines using electronic controls.

However, non-trivial programming effort may be needed to reprogram the machine or sequence of operations.

Investment on programmable equipment is less, as production process is not changed frequently.

It is typically used in Batch process where job variety is low and product volume is medium to high, and sometimes in mass production also. e.g. in Steel Rolling Mills, Paper Mills etc.

Flexible Automation:

It is used in Flexible Manufacturing Systems (FMS) which is invariably computer controlled. Human operators give high-level commands in the form of codes entered into computer identifying product and its location in the sequence and the lower level changes are done automatically. Each production machine receives settings/instructions from computer. These automatically loads/unloads required tools and carries out their processing instructions.

After processing, products are automatically transferred to next machine. It is typically used in job shops and batch processes where product varieties are high and job volumes are medium to low. Such systems typically use Multi purpose CNC machines, Automated Guided Vehicles (AGV) etc.

Integrated Automation:

It denotes complete automation of a manufacturing plant, with all processes functioning under computer control and under coordination through digital information processing.

It includes technologies such as computer-aided design and manufacturing, computer-aided process planning, computer numerical control machine tools, flexible machining systems, automated storage and retrieval systems, automated material handling systems such as robots and automated cranes and conveyors, computerized scheduling and production control.

It may also integrate a business system through a common database. In other words, it symbolizes full integration of process and management operations using information and communication technologies.

Typical examples of such technologies are seen in Advanced Process Automation Systems and Computer Integrated Manufacturing (CIM)

Parallel and series circuits:

- There are parallel and series type circuits in fluid power systems. Pneumatic and hydraulic circuits may be parallel type, while only hydraulic circuits are series type.
- However, in industrial applications, more than 95% of hydraulic circuits are the parallel type.
- All pneumatic circuits are parallel design because air is compressible it is not practical to use it in series circuits.
- In parallel circuits, fluid can be directed to all actuators simultaneously.
- Hydraulic parallel circuits usually consist of one pump feeding multiple directional valves that operate actuators one at a time or several in unison.

Hydraulics Applications:

Industrial:

Electrohydraulic is the mechanism used for controlling the industrial applications of hydraulics. Precise and fast response is an advantage of this. Plastic processing machinery, steel making and primary metal extraction applications, automated production lines, machine tool industry, paper industries, loaders, crushers, presses, textile industry machinery, etc. are some of the examples of industrial hydraulics.

Mobile Hydraulics:

In mobile hydraulics, the hydraulic system is controlled manually. Building and construction equipment like cranes, excavators, backhoe, earth moving equipment, etc., tractors, irrigation system, material handling equipment, tunnel boring equipment, rail equipment, etc. are some examples of mobile hydraulics.

Automobiles:

Hydraulics have many interesting applications in the automobile industry. Most of the important work using the principle of hydraulics. Power steering, shock absorbers, windshields, and brake are the common applications of hydraulics in vehicles. Two-post lifts and four-post lifts are used in the automobile industry to lift vehicles for servicing and inspecting.

Marine Applications:

Hydraulics plays an important role in maintaining the stability and control of ships. Steering gears, bow and stern thrusters, engine room maintenance systems including pumps and jacks, deck machineries like cranes, winches, hatch covers, mooring drums and others are examples of hydraulics in the marine industry.

Aerospace Applications:

Airplanes, rockets, spaceships, etc.. use hydraulic systems for various applications. Aerospace industry uses hydraulics for adjusting wings, retraction and extension of landing gears, opening/closing of doors, brakes, steering, etc.

Mining:

Hydraulic fracturing is one of the advanced mining technology used for extracting unused gases/oils beneath the earth surface. In this approach, a high-pressure mixture of water, sand and other chemical additives are passed into the cracks.

Pneumatics Applications:

Automobile:

Automobile industry use pneumatic systems for dismantling vehicle tire, filling compressed air in the tire, vehicle painting, opening and closing of doors, air brakes on heavy vehicles, etc.

Transporting Goods:

Pneumatics is used to transport goods from shelf to other location inside the company. The cylinder will push the item on the shelf into the moving belt if the button is pushed.

Industrial Applications:

Material handling, drilling, sawing, filling, packaging, clamping, shifting, etc. are some of the general applications of the pneumatic system.

Hydraulic and pneumatic circuit:

Design Considerations :

Safety of Operation :

1.Pressure and Temperature ratings.

2. Interlocks for sequential operations

3. Emergency shutdown features.

4. Power failure locks.

5. Operation speed.

6. Environment conditions.

Meet functional requirements :

1. Meet required performance specification.
2. Life expectancy same as machine.
3. Facilitate good maintenance practice.
4. Compatibility with electrical and mechanical components.
5. Withstand operational hazards.

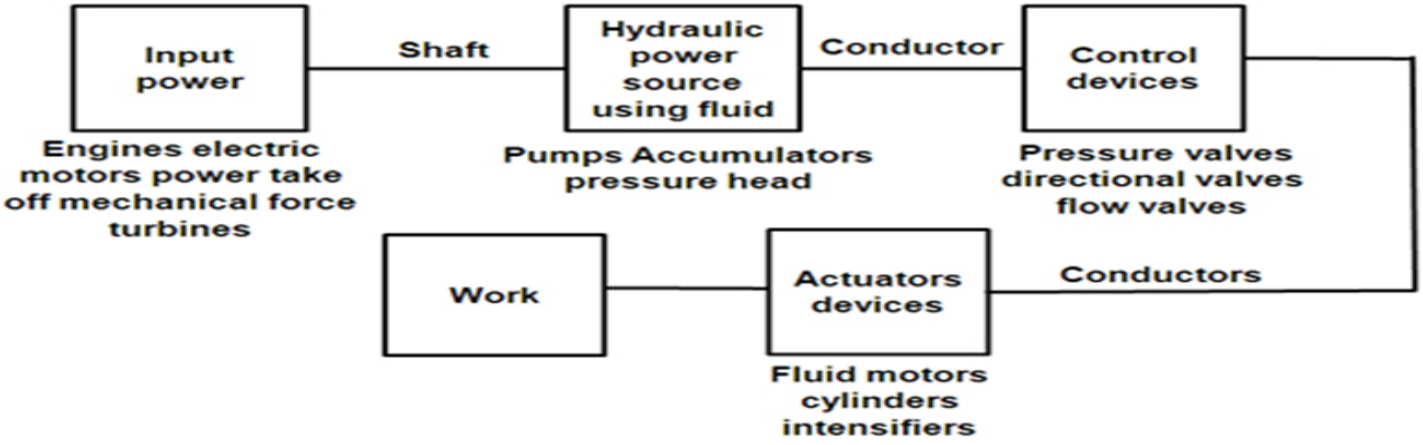
Efficiency of Operation :

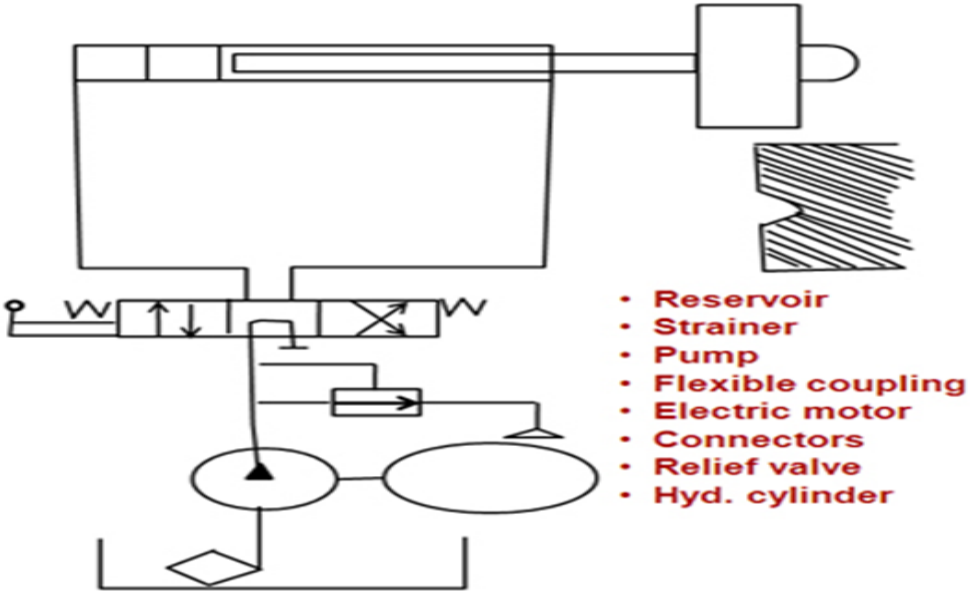
1. Keep system Simple, Safe and Functional.
2. Access to parts need repair or adjustment.
3. Design to keep min operational cost.
4. Design to prevent and remove contamination.

Safety of Operation :

1. Pressure and Temperature ratings.
2. Interlocks for sequential operations
3. Emergency shutdown features.
4. Power failure locks.
5. Operation speed.
6. Environment conditions.

LINEAR CIRCUIT





- Reservoir
- Strainer
- Pump
- Flexible coupling
- Electric motor
- Connectors
- Relief valve
- Hyd. cylinder

HYDRAULIC CIRCUIT