Unit II Class I

Linear actuator

Cylinders

Single acting

Double acting

PUMP Vs ACTUATOR

- PUMP which convert **mechanical input** into **fluid power output**.

- The actuator which converts fluid power into mechanical power output.

ACTUATORS

- Hydraulic systems are used to control & transmit power.
- A pump driven by prime mover (electric motor) creates **flow of fluid**.
- An actuator is used to convert the energy of the fluid back into mechanical power.
- Amount of output power developed depends upon the flow rate, pressure drop across the actuator & its overall efficiency

What Is a Linear Actuator?

A mechanical device that converts various types of energy into linear kinetic energy to perform mechanical work.

LINEAR ACTUATOR

- A **linear actuator** is an actuator that creates **motion in a straight line**.
- Linear actuators are used in **machine tools and industrial machinery, Valves**
- Hydraulic or pneumatic cylinders inherently produce linear motion.
- Many other mechanisms are used to generate **linear motion from a rotating motor**.

Types of Linear Actuators

- Electrical (Solenoids)
- Mechanical (Ball Screw, Pneumatic, Belt)

How do they work?

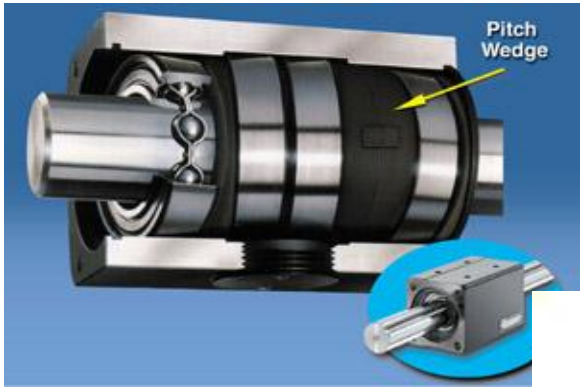
Components:

- Motor
- Gearing
- Linear Mechanism (belt, screw, etc.)
- Controller

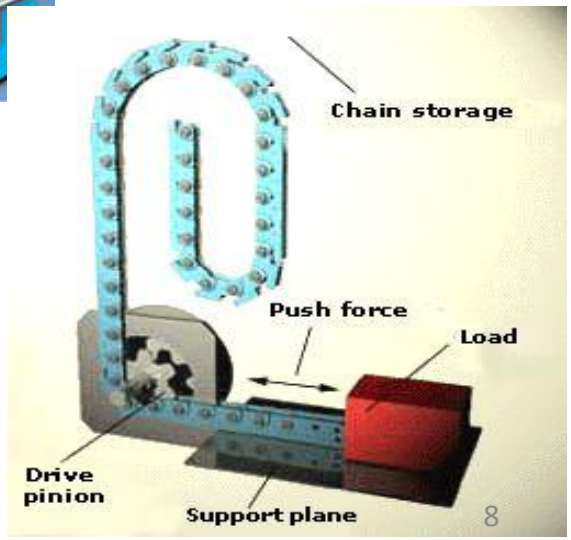
Other

- Air Muscles

- Rolling Ring



- Rigid Chain



TYPES OF ACTUATORS

- **Linear actuator**

  (single acting cylinders) or jacks (cylinder used for lifting)

- **Common Types**
  - Single acting cylinder, Double acting cylinder

- **Special Types**

  Plunger or ram, Telescoping, Cable, Diaphragm, Bellow, Tandem, Duplex,

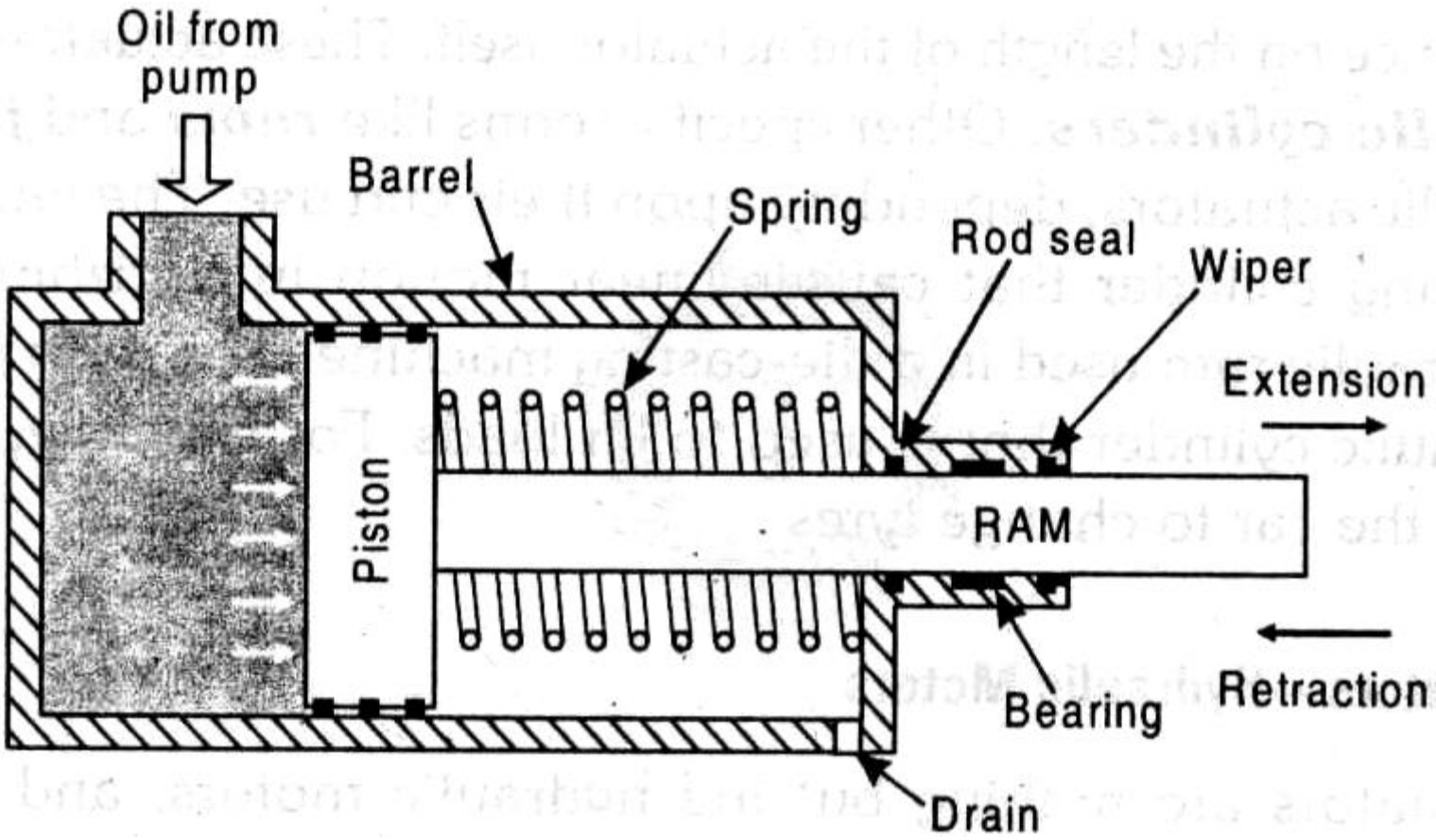
- **Rotary actuators** (Hydraulic motors)- Produces **continuous rotational motion**-Pump shaft is rotated to generate flow, a motor shaft is caused to rotate by fluid being **forced into the driving chambers**
- **Semi rotary actuators-**

  Produces non-continuous rotational motion- Limited to less than one revolution (<360°)- Used to produce oscillatory motions in mechanisms

ROTARY ACTUATOR

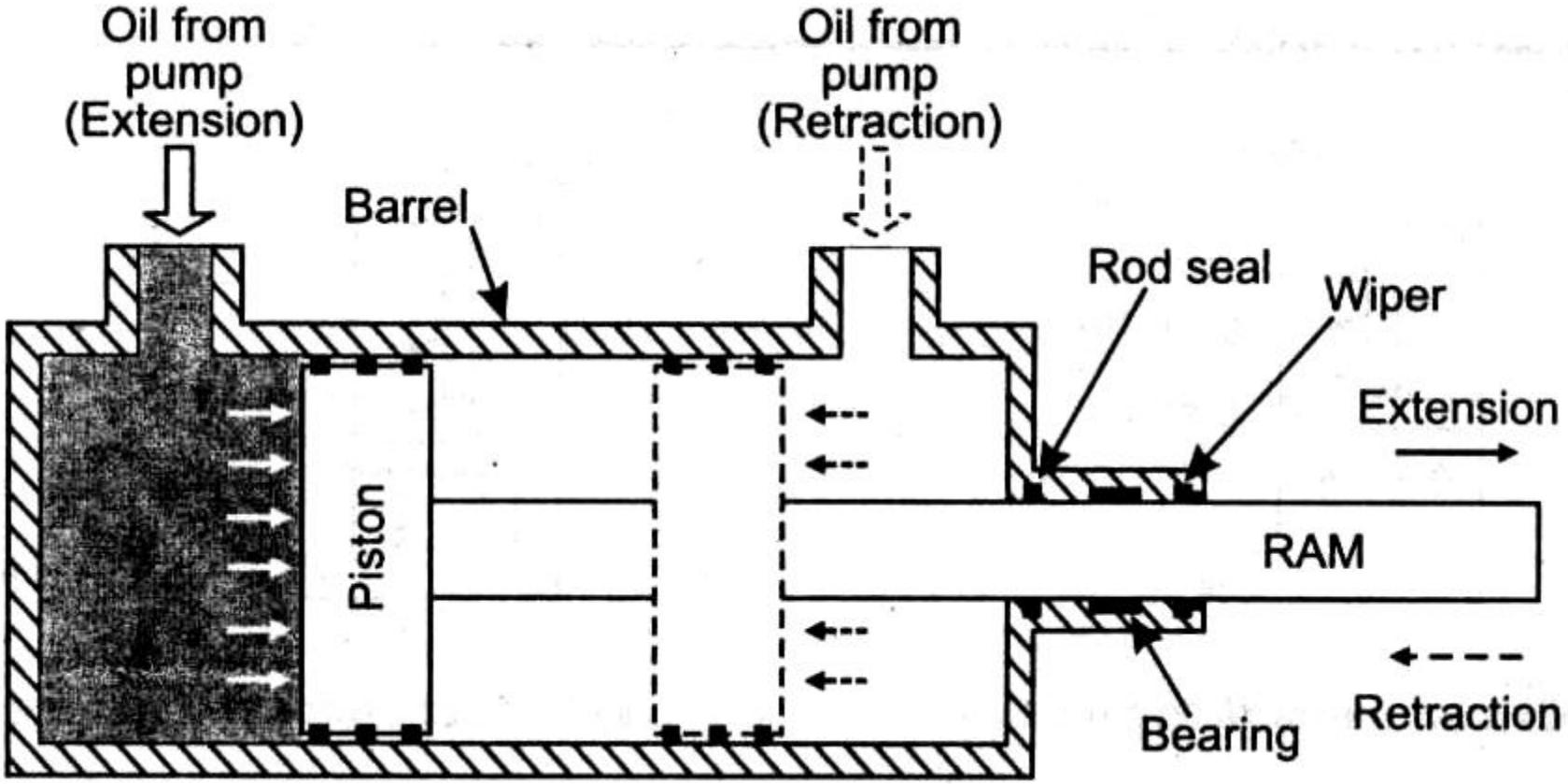
- GEAR MOTOR
- VANE MOTOR
- PISTON MOTOR

SINGLE ACTING CYLINDER



Produces linear motion in one direction

- Consists of cylinder (barrel), piston, piston-rod (ram) & inlet port at piston end or blank end (other end is known as rod end)
- Cylinder is machined to high surface finish (honing)
- Fluid enters through inlet port into piston end or blank end –pressure build up-force generation on piston-movement of piston –EXTENSION or FORWARD STROKE
- RETRACTION or RETURN by compression spring or under the influence of gravity (only in case of vertical mounting)


Oil from pump (Extension)
Oil from pump (Retraction)
Barrel
Rod seal
Wiper
Extension
Piston
RAM
Bearing
Retraction

Produces linear motion in two directions

- May be single rod ended or double rod ended
- Piston is connected to smaller diameter piston rod
- Fluid pressure acts on either side of piston alternatively
- Both sides of piston has oil ports
- **Fluid enters through left port causing extension stroke** while when it enters through right port causes retraction stroke, for present case
- For a given pressure double acting cylinder (single rod type) exerts **greater force** when extending than **when retracting**

Questions

1. What is an actuator?
2. How do you classify actuator?
3. What are the applications of cylinder?
4. How single acting cylinder is retracted?
5. Compare single and double acting cylinder.
6. Why double acting cylinders are preferred over single acting cylinder?

Summary

- ✓ *The **actuators** are the devices used for converting hydraulic energy into mechanical energy, and therefore have a function opposite to that of pumps.*

- ✓ ***Types of hydraulic actuators :** Based on the type of motion actuators produce, they are categorized into :*
  1. *Linear actuators (also called 'hydraulic cylinders'), and*
  2. *Rotary actuators (also called 'hydraulic motors')*
     - *(a) Continuous rotary actuators, and*
     - *(b) Limited rotation rotary actuators.*
- ✓ *The hydraulic actuators can be used for lifting, tilting, clamping, opening, closing, metering, mixing, turning, swinging, counter balancing, bending, and for many other operations.*
- ✓ *The important **types of hydraulic cylinders** are :*
  1. *Single-acting cylinders,*
  2. *Double-acting cylinders,*
  3. *Telescopic cylinders,*
  4. *Tandem cylinders,*
  5. *Dual linear cylinders, and*
  6. *Through rod cylinders.*

MCQ

1. A ram cylinder can only have_____in one direction.
A.movement B. force C. Rotation

2. A ram cylinder has:
A. a piston with seals to guide it. B. no piston or seals to guide it.
C. a non sealing guide only.

3. The area of a cylinder is figured with the formula:
A. F=PA B. π r2 C. π d2

4. Cylinder force or thrust is figured by the formula:
A. F=PA B. π r2 C. π d2

5. A 2:1 area ratio cylinder has a rod that is:
A. half the diameter of the piston.
B. twice the diameter of the piston.
C. half the area of the piston.

Answer

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Higher Order Question

- Identify the usage of cylinders for the following.