



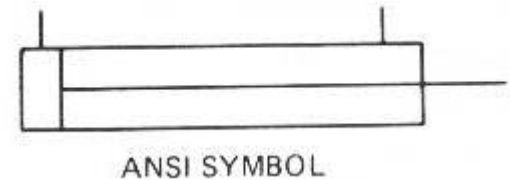
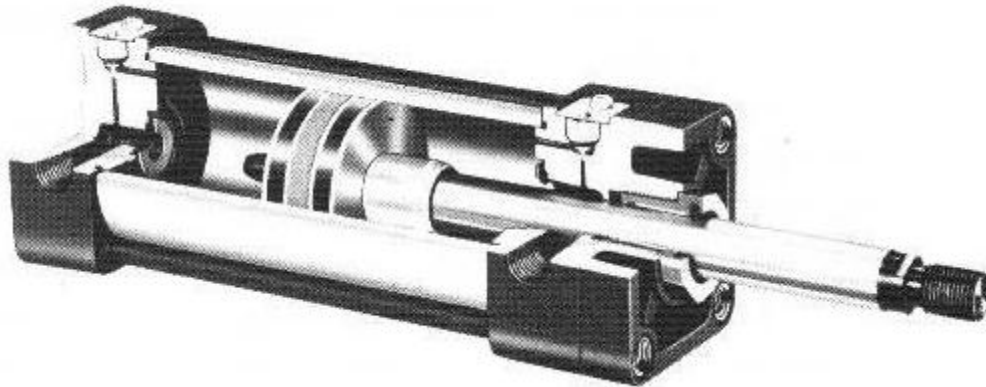
Unit III Class II

Pneumatic actuators

Introduction

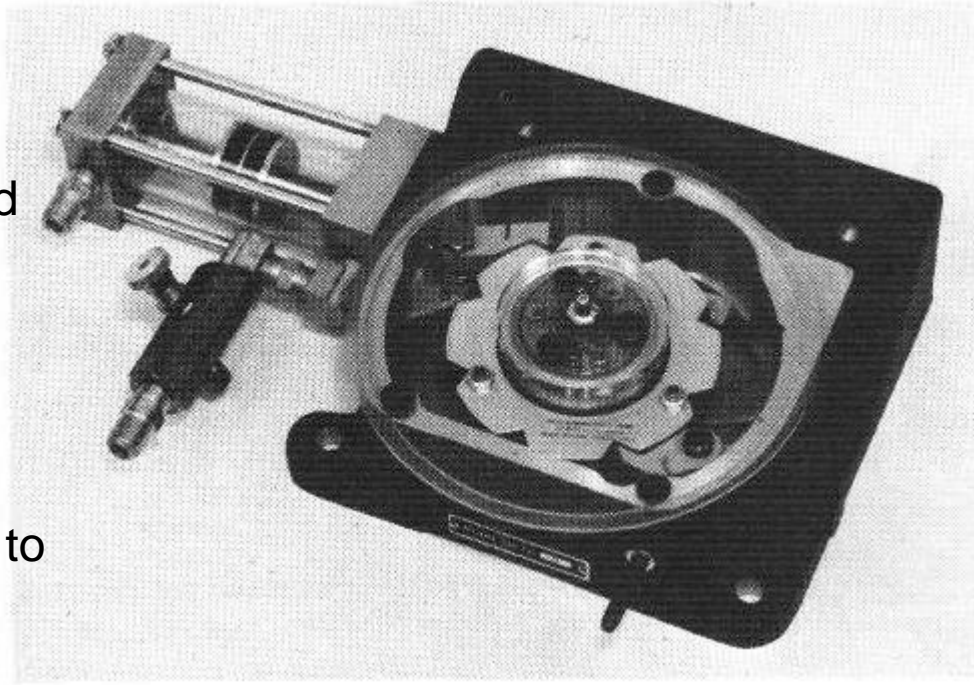
Pneumatic actuator

- Use Pressurized Air to achieve motion
- Add great deal of power and speed to any actuation system.
- Variety of Actuation mechanisms available
 - Cylinders
 - Grippers
 - Motors



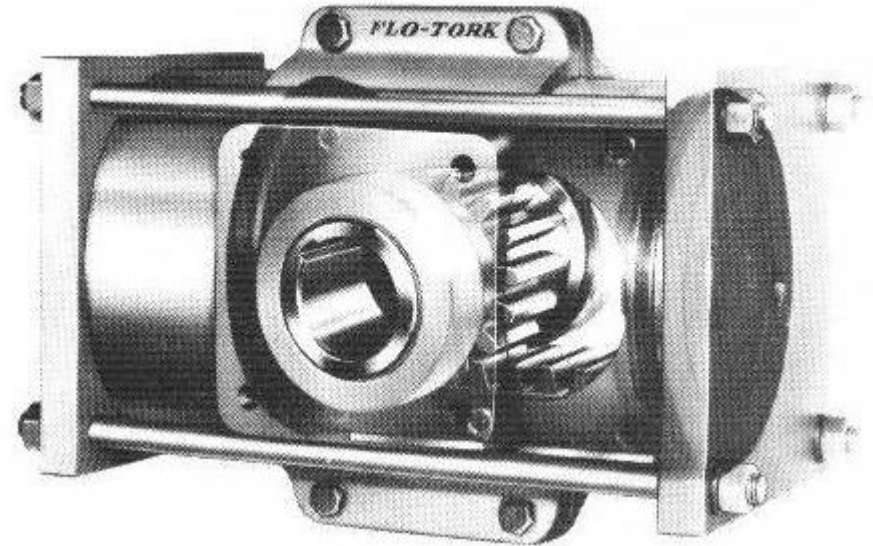
- Pneumatic systems make use of actuators in a fashion similar to that of hydraulic systems.
- However, because air is the fluid medium rather than hydraulic oil, pressures are lower, and hence pneumatic actuators are of lighter construction.
- For example, air cylinders make extensive use of aluminum and other nonferrous alloys to reduce weight, improve heat transfer characteristics, and minimize corrosive action of air.

- Rotary index table driven by a double-acting pneumatic cylinder.
- The inlet pressure can be adjusted to provide exact force for moving the load and to prevent damage in case of accidental obstructions.
- A rack and gear drive transmits the straight-line motion of (the air cylinder to the rotary motion with full power throughout its cycle.
- Through the use of different cams, the table can be indexed in 90° , 60° , 45° , 30° , or 15° increments.



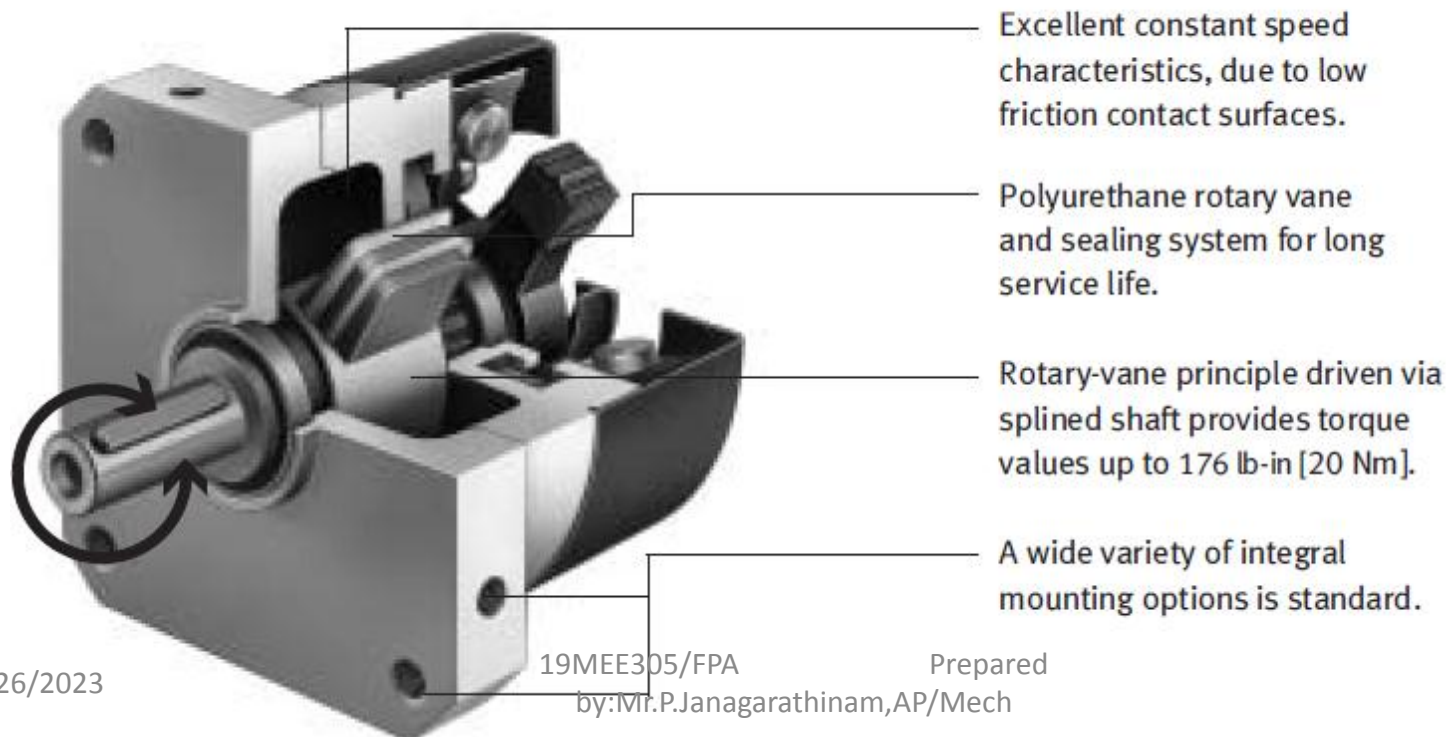
Pneumatic Rotary actuator

- The cylinder heads at each end serve as positive internal stops for the enclosed floating pistons.
- The linear motion of the piston is modified into rotary motion by a rack and pinion made of hardened steel for durability.



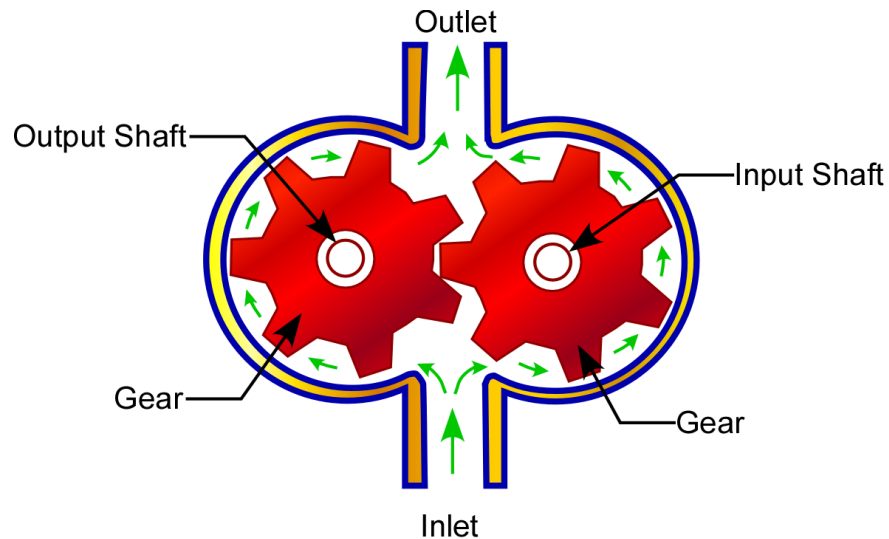
Rotary air motors

- It can be utilized to provide a smooth source of power.
- They are not susceptible to overload damage and can be stalled for long periods of time without any heat problems.
- They can be started and stopped very quickly and with pressure regulation and metering of flow can provide infinitely variable torque and speed.



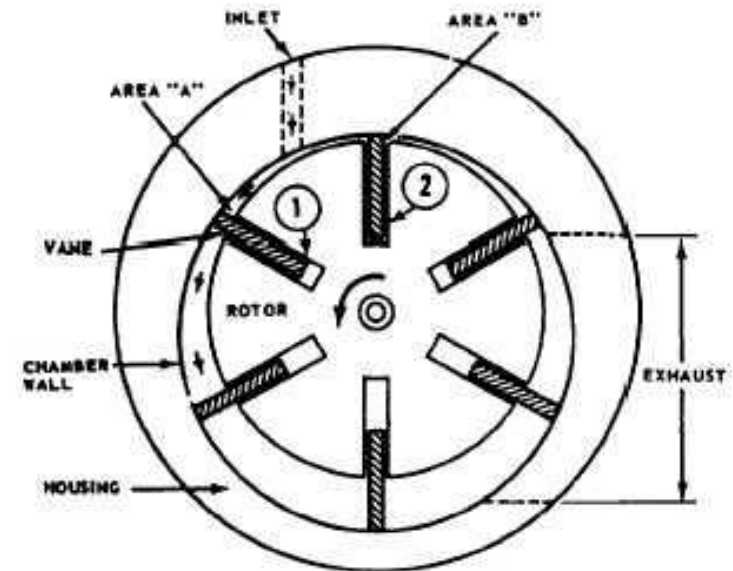
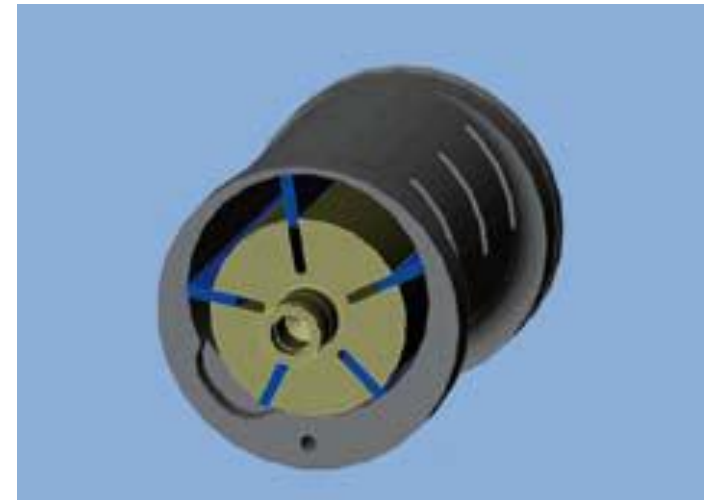
Gear motors

- Gear motors are generally very compact relative to their displacement and are able to operate at high speed.
- They are also less expensive than a piston or vane motor.
- They can be noisy and are the least efficient of the 3 motor types.
- Gear motors can be operated in a reversible (bi-directional) manner.

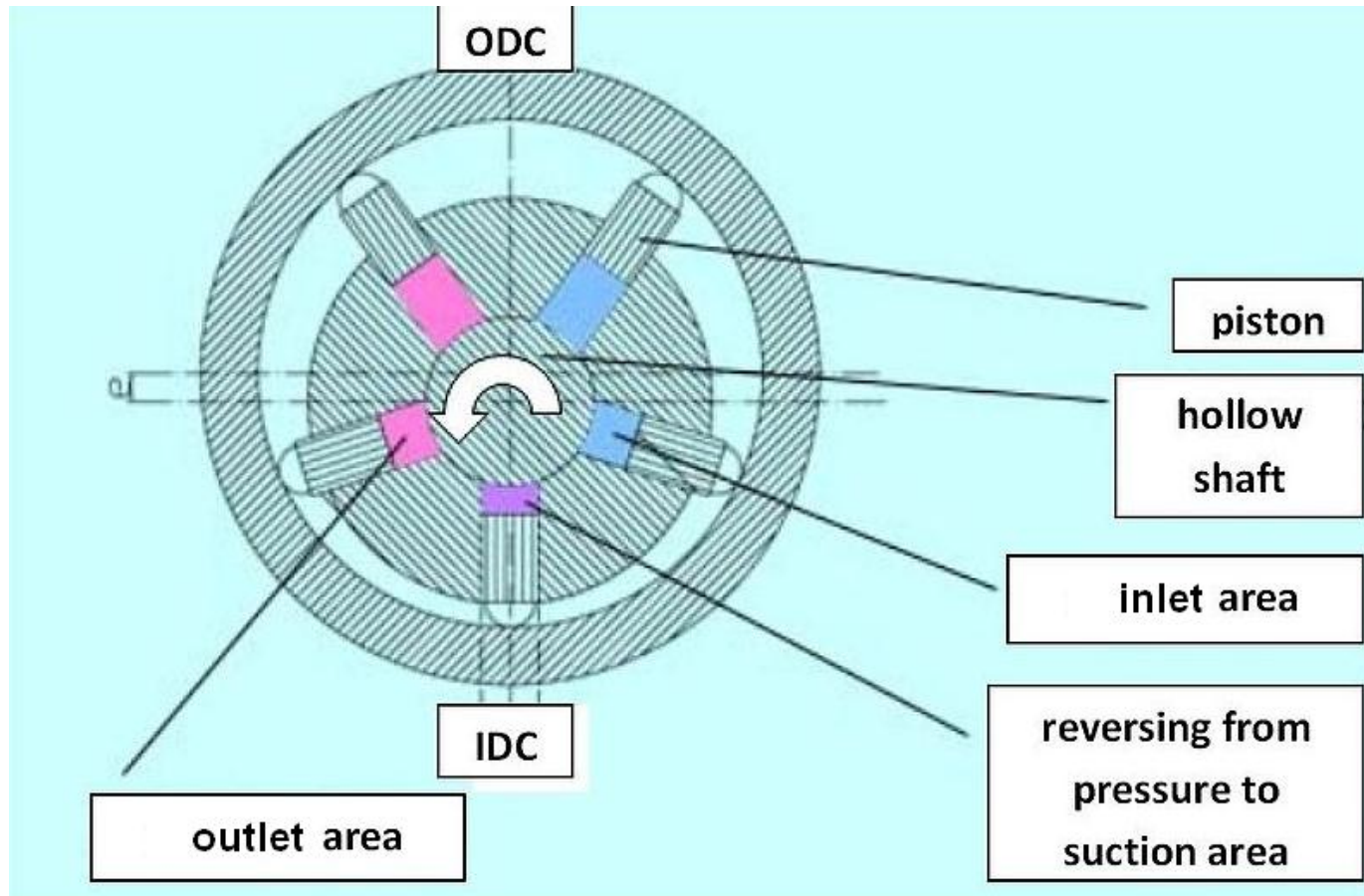


Vane motor

- Pressurized air (4 to 6 bars) is injected in the multi-vane air motor via the injection point (I).
- It arrives in the first chamber (C1) which is put under pressure. Each of the sides of this compression chamber will receive a proportional force to their respective surface.
- The sides delimited by the vanes (P1) and (P2) with different surface area will both receive different forces.
- The volume of the chamber C1 will increase and the air which is inside will release its pressure.
- The chamber C2 is now under compression.
- The same processes are repeated and this allows the constant rotation of the rotor.
- After the rotation of the rotor, the chamber C1 will be in exhaust position, releasing air outside of the motor.

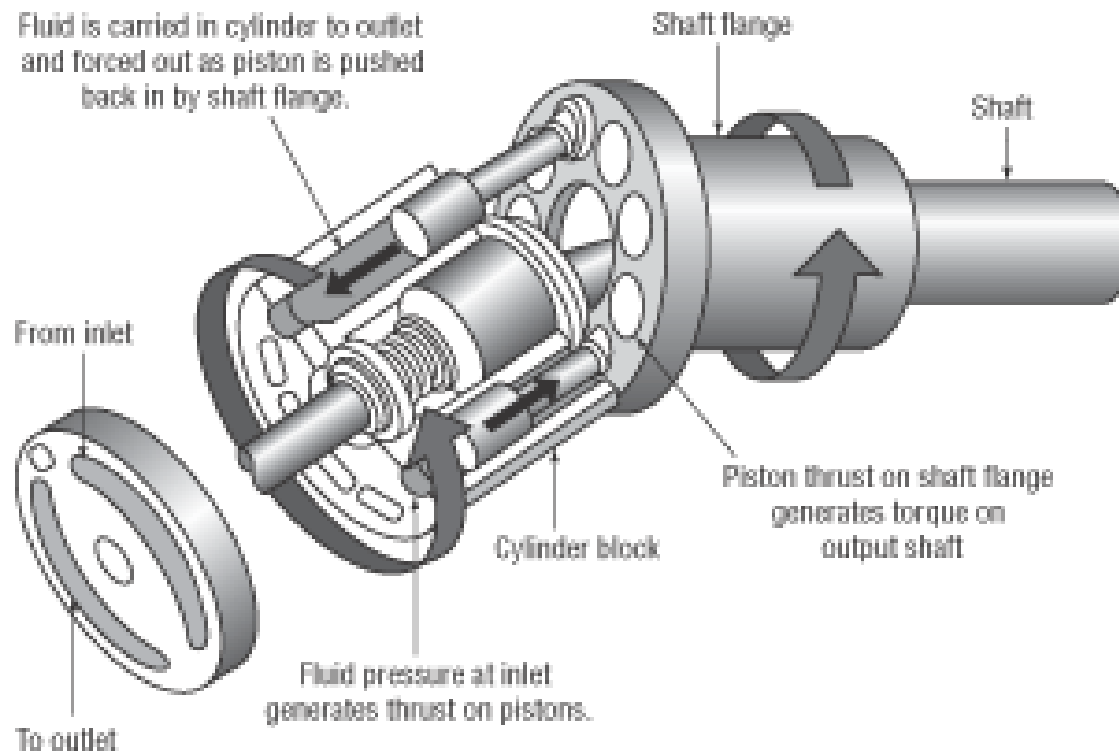


Radial Piston motor



- Piston air motors are used in applications requiring high power, high starting torque, and accurate speed control at low speeds.
- They have either two, three, four, five, or six cylinders arranged either axially or radially within a housing.
- Output torque is developed by pressure acting on pistons that reciprocate within the cylinders.
- Power developed by a piston motor depends on the inlet pressure, the number of pistons, and piston area, stroke, and speed.

Axial Piston motor



Radial- and axial-piston motors have one significant limitation:

they are internally lubricated, so oil and grease supplies must be checked periodically and replenished.

Radial-piston motors :

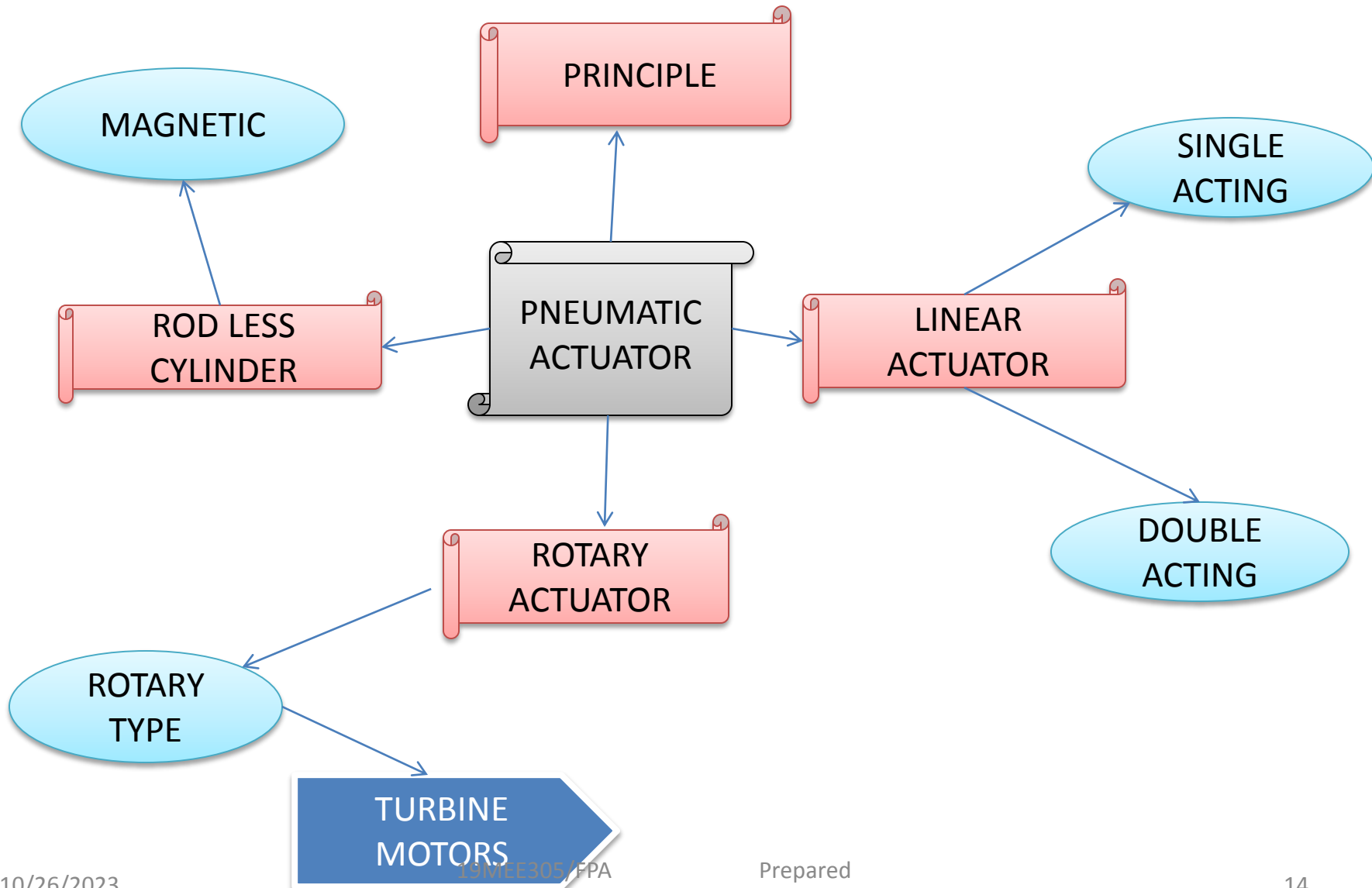
- Feature robust, oil-lubricated construction and are well-suited to continuous operation.
- They have the highest starting torque of any air motor and are particularly beneficial for applications involving high starting loads.
- Overlapping power impulses provide smooth torque in both forward and reverse directions.
- Sizes range to about 35 hp for speeds to 4,500 rpm.

Axial-piston motors:

- Are more compact than radial-piston motors, making them ideal for mounting in close quarters.
- Their design is more complex and costly than vane motors, and they are grease lubricated.
- However, axial-piston motors run smoother and deliver maximum power at much lower speeds than vane motors can. axial-piston motors also tolerate higher ambient temperatures. Maximum size is about 3-1/2 HP.

Questions

1. What is the difference between hydraulic and pneumatic actuators?
2. What is linear actuator?
3. What is the difference between single and double acting cylinder?
4. Differentiate between short stroke and single acting cylinder.
5. What is the function of through rod cylinder?
6. What is the use of through rod cylinder?
7. What is the function of telescopic rod cylinder?



Summary

- **Pneumatic Actuators**
- **Pneumatic Cylinders**
 - The cylinders converts the energy of the compressed air into linear motion which extend or retract the piston rod.
 - Single acting cylinder – produces one stroke by fluid
 - Double acting cylinder – produces two strokes by fluid
 - Special cylinder
 - Tandem
 - Telescopic
 - Double rod cylinder
 - Rodless cylinder

- **Pneumatic Rotary Actuators**

- The rotary actuators converts the energy into a rotary motion.
 - Fluid motor
 - Gear motor
 - Vane motor
 - Piston motor
 - Radial-piston motors
 - Axial-piston motors

- **Pneumatic Semi-Rotary Actuators**

- Limited rotary motion can be achieved by incorporating a rack and pinion into a linear actuator or as seen opposite by a Vane Mechanism within the body of the cylinder.

MCQ

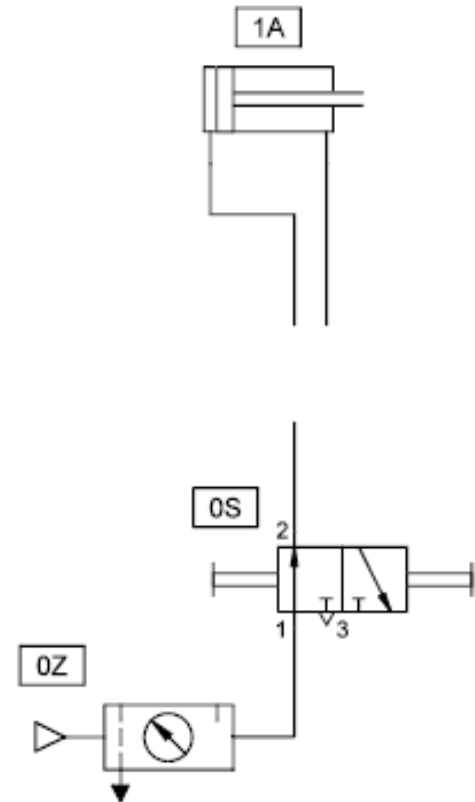
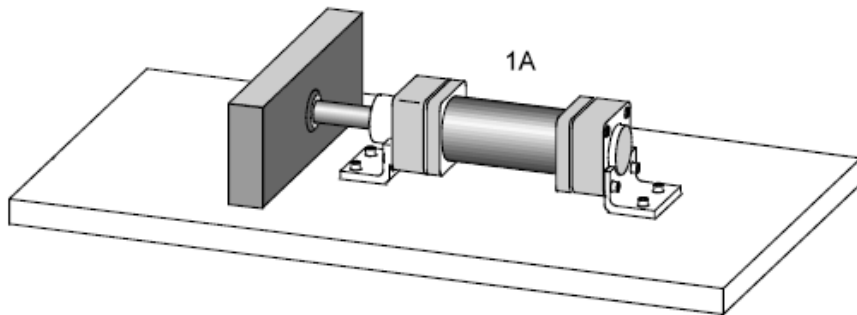
1. A ram cylinder can only have _____ in one direction.
 - A. movement
 - B. force
 - C. rotation
2. A ram cylinder has:
 - A. a piston with seals to guide it.
 - B. no piston or seals to guide it.
 - C. a non sealing guide only.
3. A 2:1 area ratio cylinder has a rod that is:
 - A. half the diameter of the piston.
 - B. twice the diameter of the piston.
 - C. half the area of the piston.
4. A double rod end cylinder with the same pressure at either end can have:
 - A. equal force and speed in both directions of travel.
 - B. higher force in one direction of travel.
 - C. either of the above.
5. With the same pressure at either end a single rod end cylinder has:
 - A. equal force in both directions of travel.
 - B. more force extending.
 - C. more force retracting.

Answer

1. A ram cylinder can only have _____ in one direction.
 - A. movement
 - B. force**
 - C. rotation
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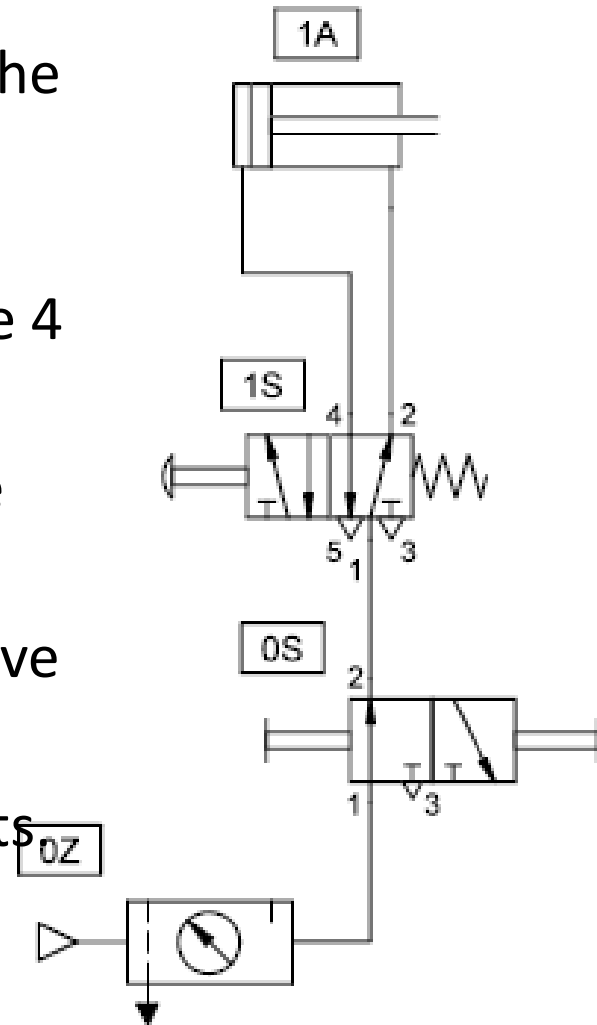
Higher Order Question

A double-acting cylinder is to extend when a push button is operated. Upon release of the push button the cylinder is to retract. The cylinder is of small bore (25 mm diameter) requiring a small flow rate to operate at the correct speed.



Solution

- In the initial position, the valve is unactuated, pressure is applied at the piston rod side and the piston rod of the cylinder is retracted.
- On operating the push button, the air passes through the valve from 1 to the 4 port and advances the piston rod.
- The displaced air flows to atmosphere via the ports 2 and 3.
- On release of the push button, the valve spring returns the control valve to its initial position and the cylinder retracts.



- Air returns from the cylinder via the exhaust port 5.
- The push button is released, the direction of movement is immediately reversed and the piston rod retracts.
- It is therefore possible to change the direction of movement without the piston rod reaching its initial or end position.