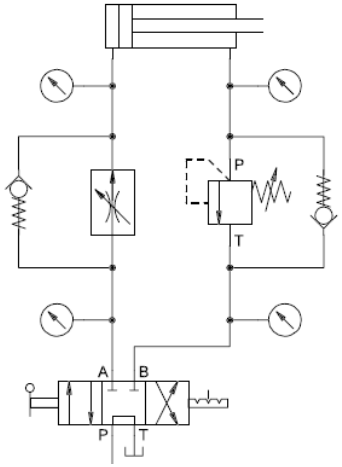

بسم الله الرحمن الرحيم

Hydraulic & Pneumatic Circuits



Tanta University

Faculty of Engineering
Mechanical power
Engineering Dept.

Lecture (2)

on

Basics of Hydraulic Control

By

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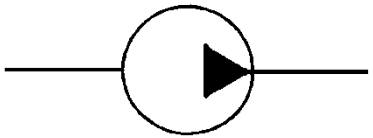
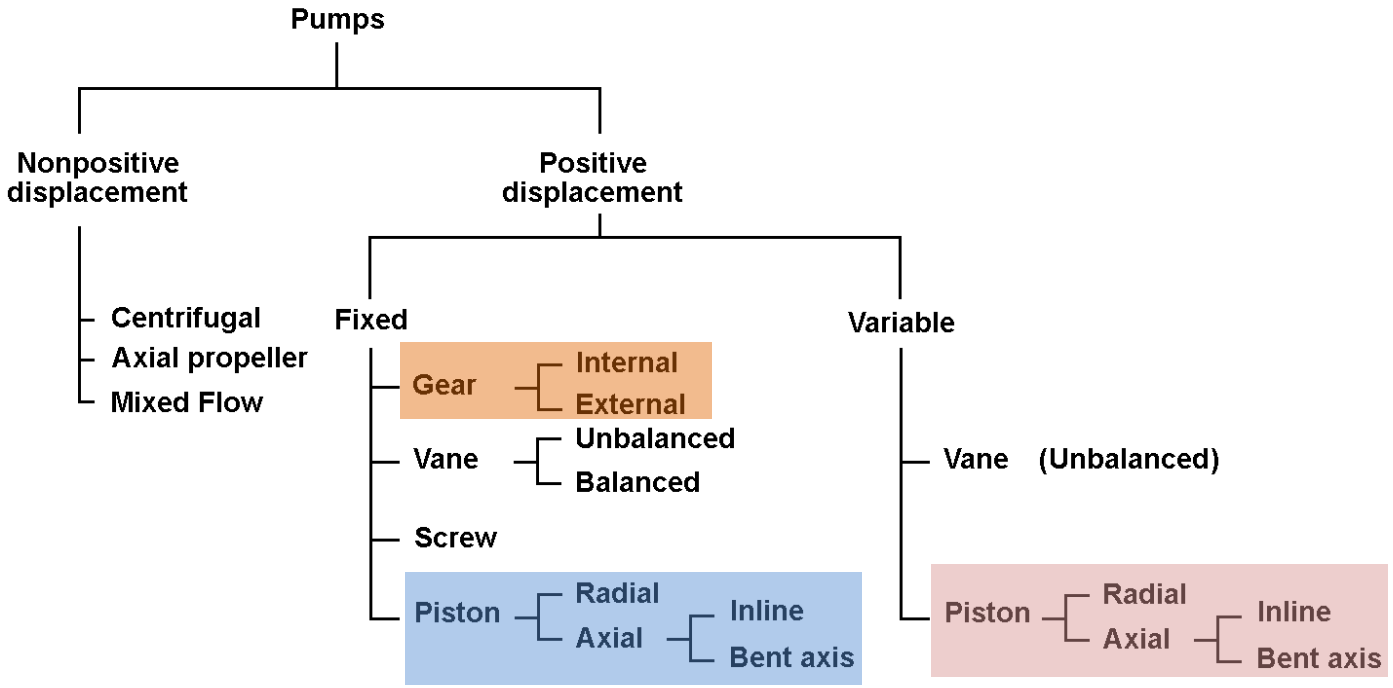
Industrial Engineering Dept.
Faculty of Engineering
Fayoum University

2014 - 2015

Hydraulic Pumps

Hydraulic pumps convert the mechanical energy transmitted by its prime mover (electric motor, internal combustion engine) into hydraulic working energy.


Hydraulic Pump Symbol

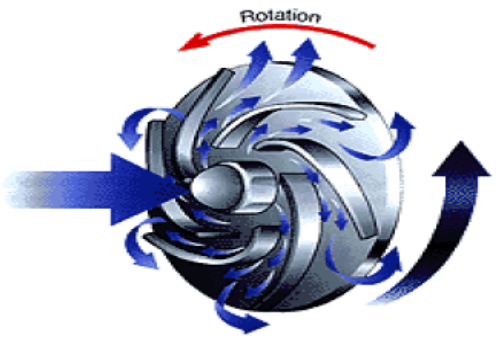


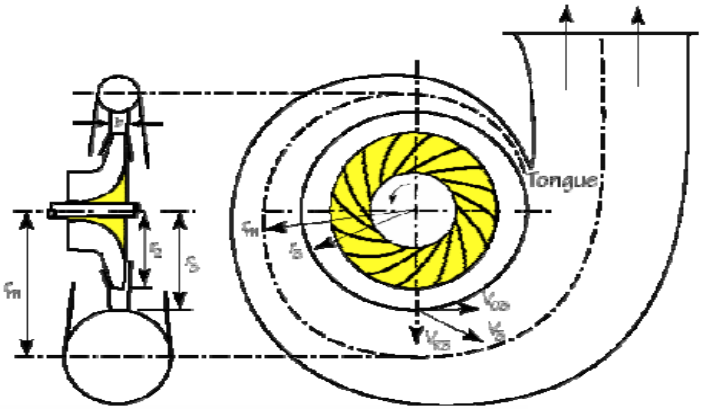
Hydraulic Pumps – Nonpositive Displacement Pumps

The common advantages nonpositive displacement pumps,

1. Low production cost,
2. Simplicity of operation,
3. High reliability,
4. Low maintenance factors,
5. Low noise level,
6. Ability to pump nearly all fluids without damage to internal parts.

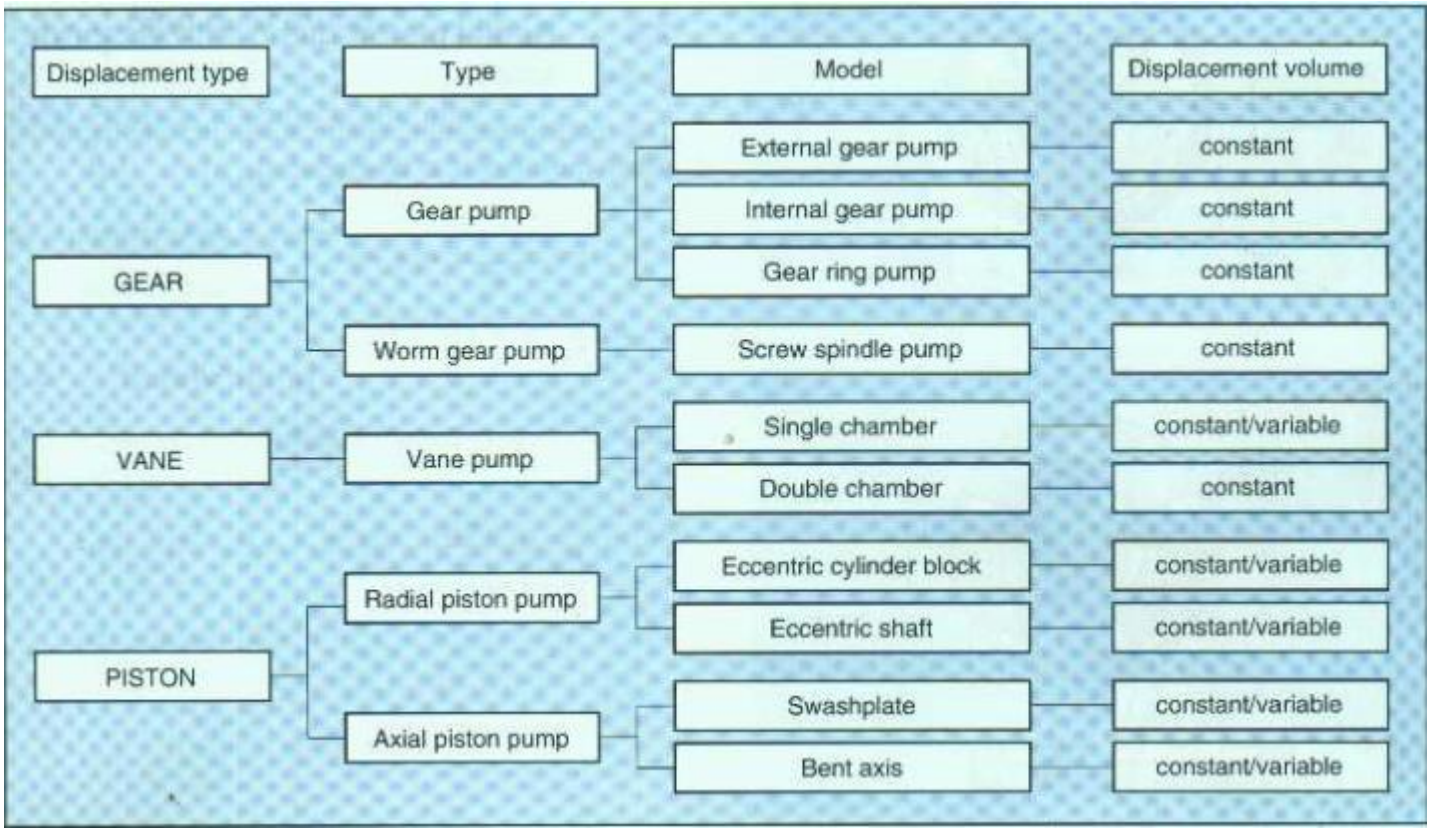
Used to pump large volumes of fluids at relatively low pressures



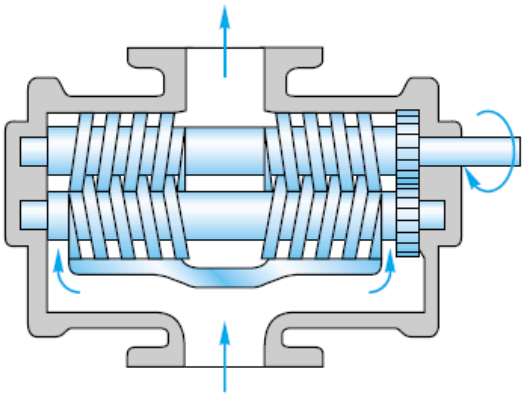


Hydraulic Pumps – Positive Displacement Pumps

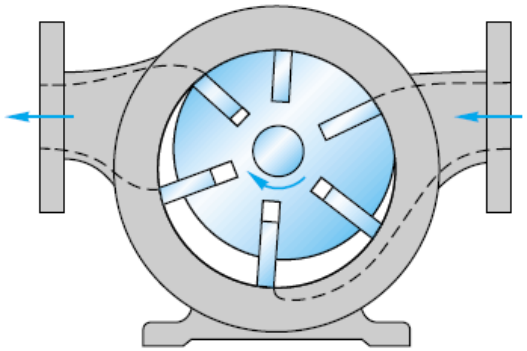
Positive displacement pumps transfer a constant amount of fluid for each cycle of operation.



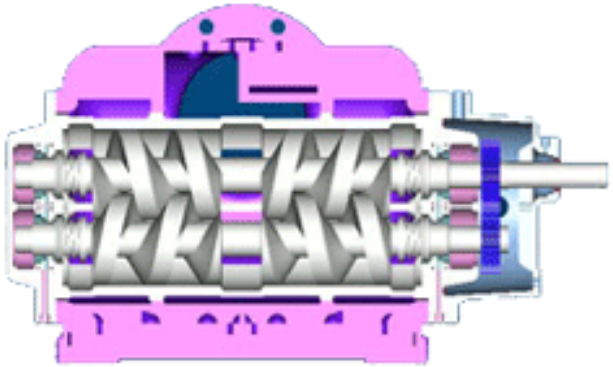
Hydraulic Pumps - Positive Displacement Pumps

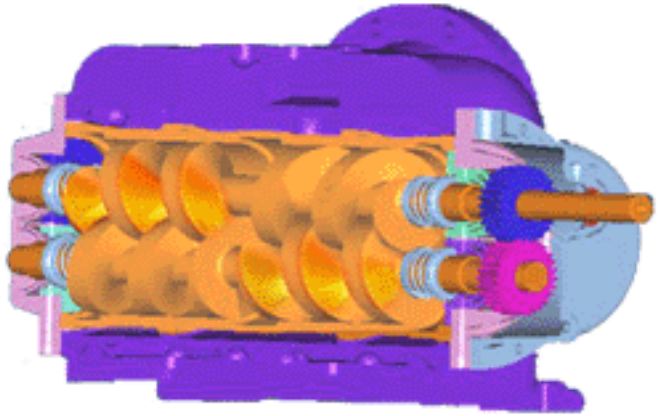


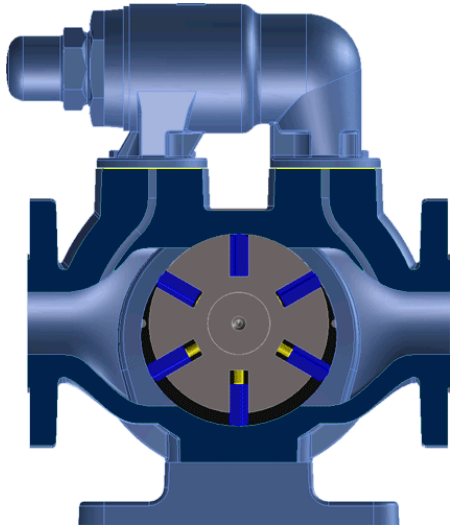
double-screw pump.



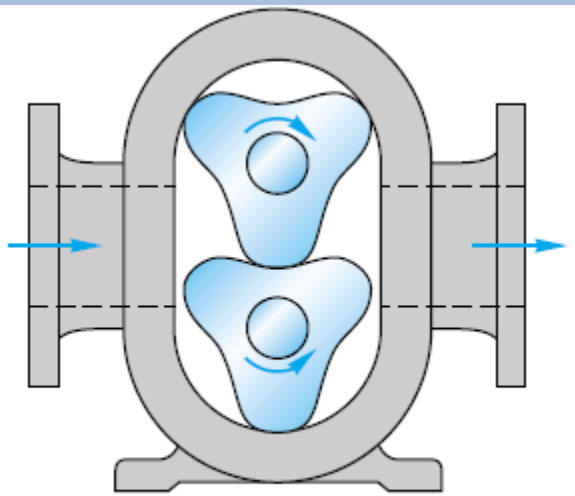
sliding vane.



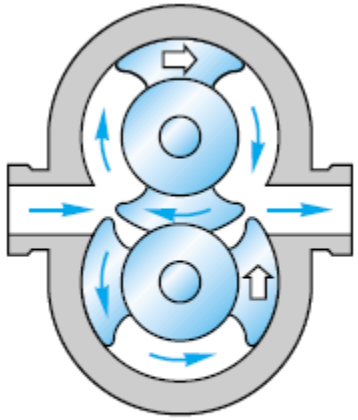




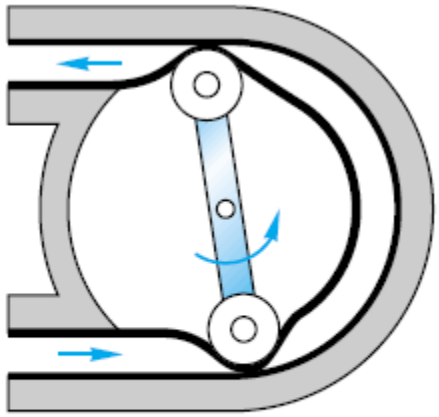
Hydraulic Pumps – Positive Displacement Pumps



three lobe pump,

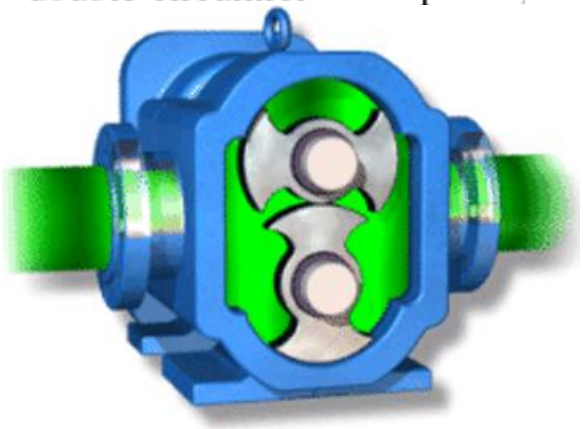


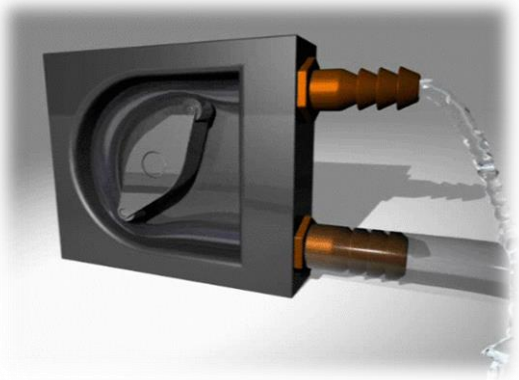
double circumfer ential piston,



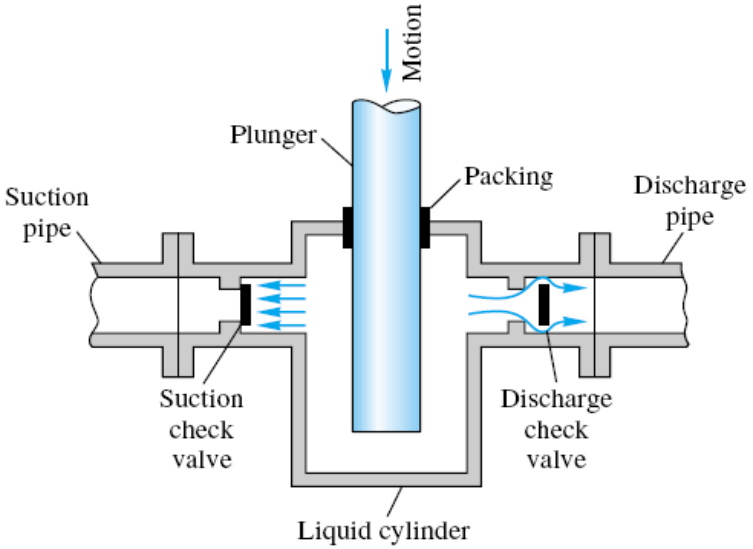
flexible-tube squeegee.

Clockwise

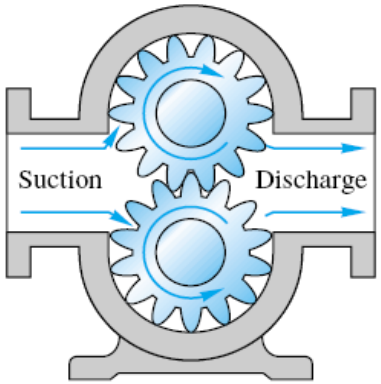




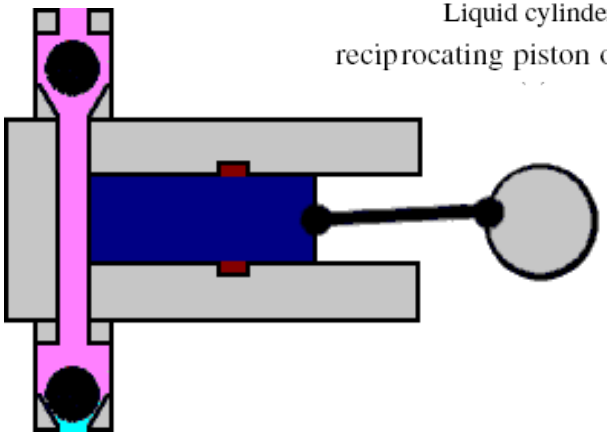
Hydraulic Pumps – Positive Displacement Pumps

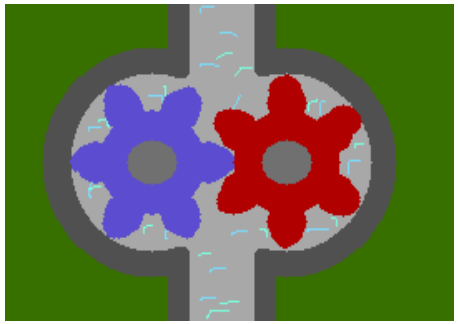


reciprocating piston or plunger.



external gear pump.

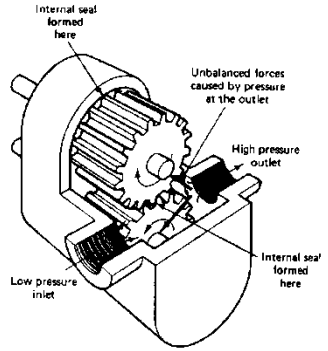




Hydraulic Pumps – External gear pumps

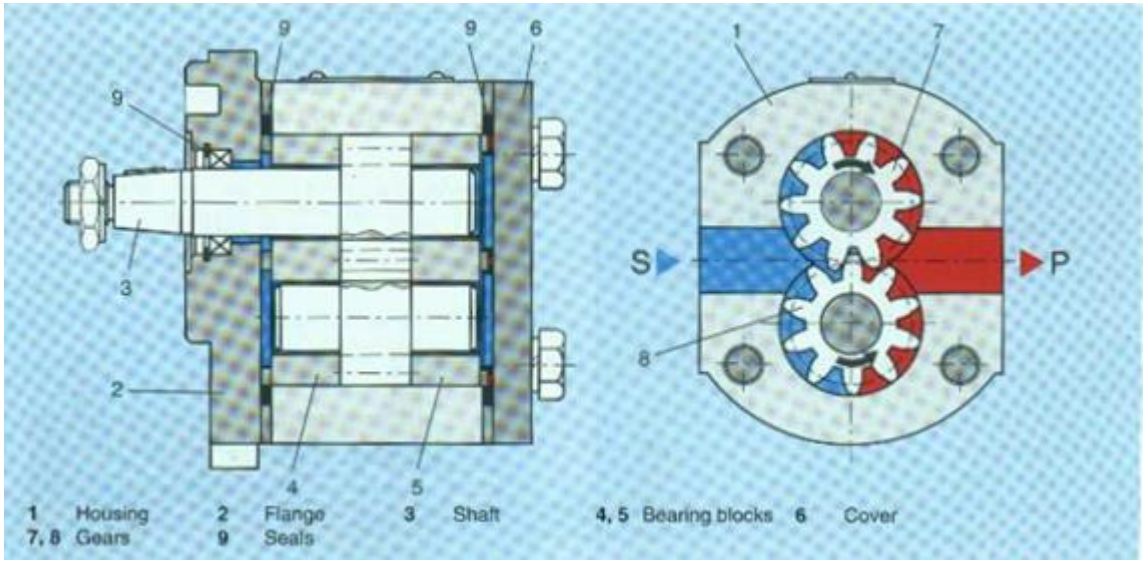
Main features

1. Simple in design
2. Inexpensive to manufacture and maintain
3. Wide range of speeds
4. Wide temperature/viscosity range



Important parameters

1. Displacement volume: 0.2 to 200 cm^3
2. Max. pressure: up to 300 bar (size dependant)
3. Range of speeds: 500 to 6000 rpm



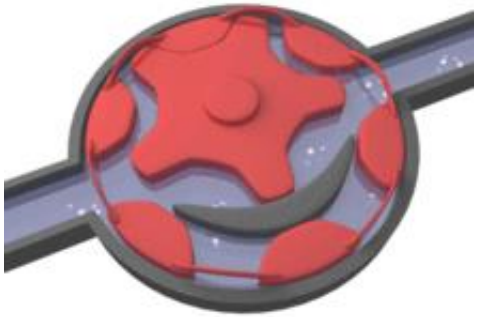
Hydraulic Pumps – Internal gear pumps

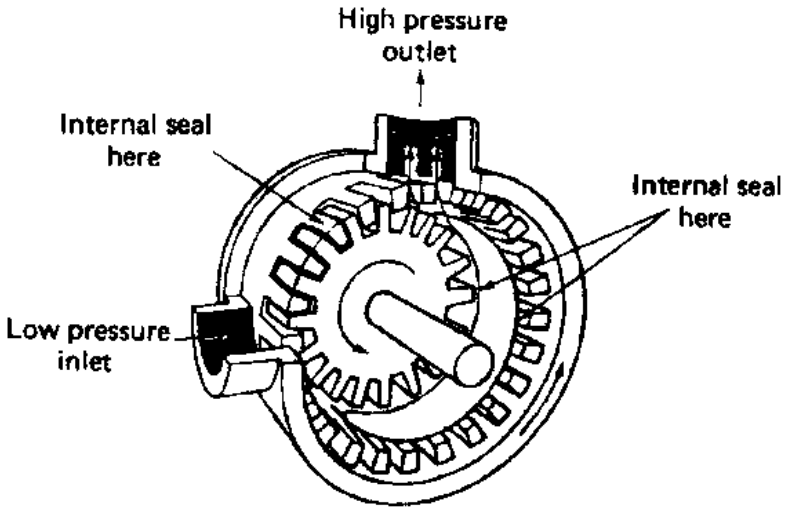
Main features

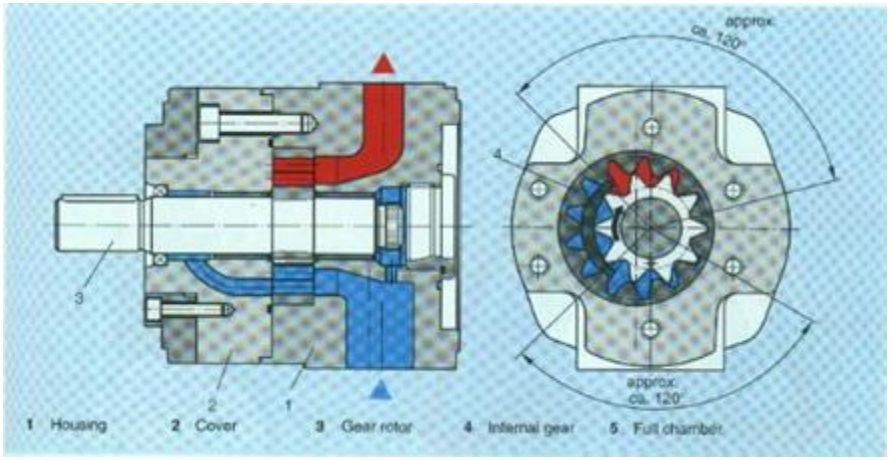
1. Very low noise level

Important parameters

1. Displacement volume: 3 to 250 cm^3
2. Max. pressure: up to 300 bar (size dependant)
3. Range of speeds: 500 to 3000 rpm (size dependant)







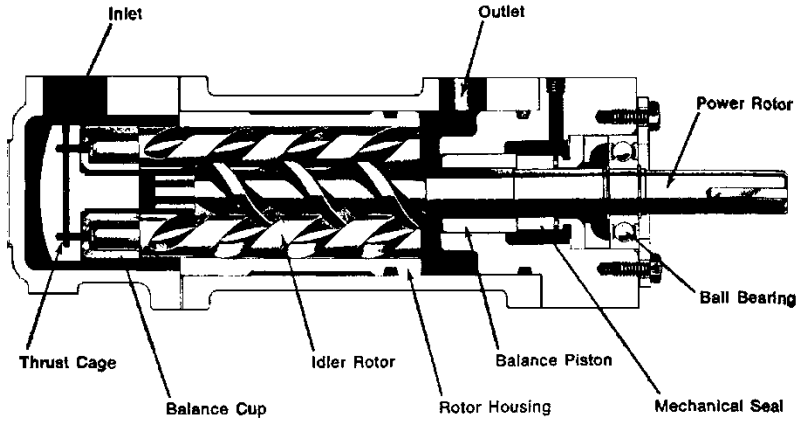
Hydraulic Pumps – Screw pumps

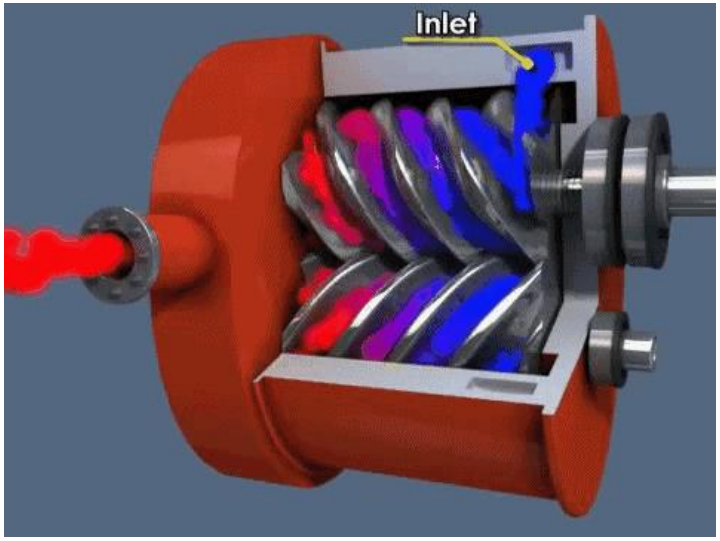
Main features

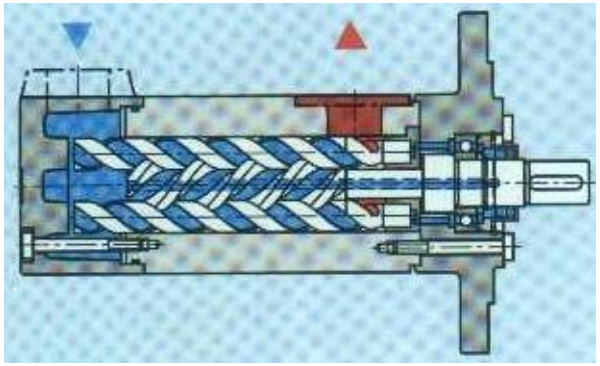
1. Very low noise level

Important parameters

1. Displacement volume: 15 to 3500 cm^3
2. Max. pressure: up to 200 bar
3. Range of speeds: 1000 to 3500 rpm







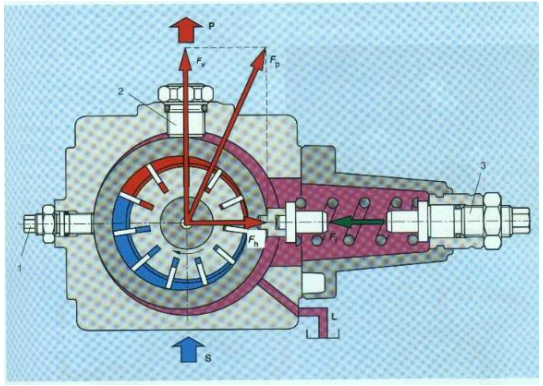
Hydraulic Pumps – Single chamber vane pumps

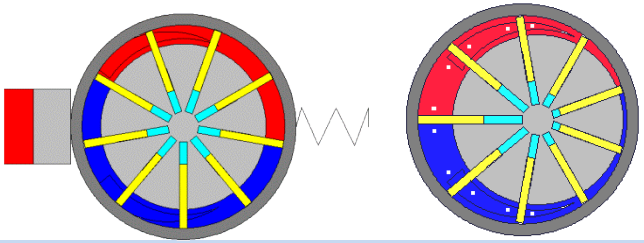
Main features

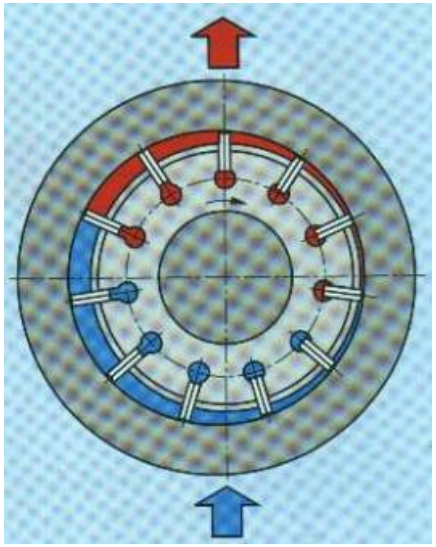
1. **Very low noise level**

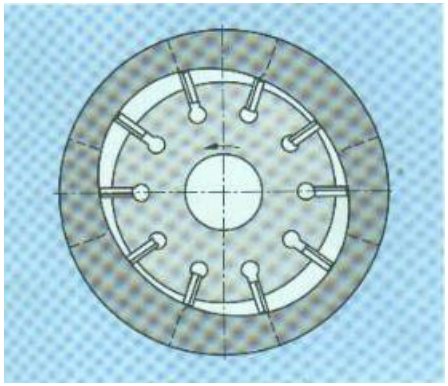
Important parameters

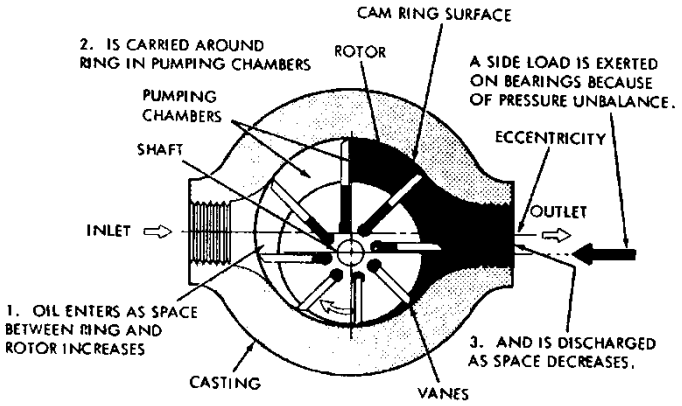
1. **Displacement volume: 5 to 100 cm³**
2. **Max. pressure: up to 100 bar**
3. **Range of speeds: 1000 to 2000 rpm**

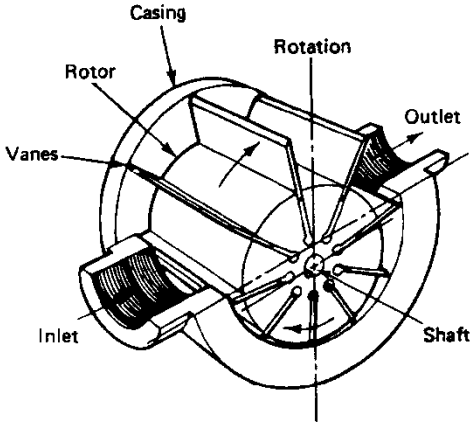




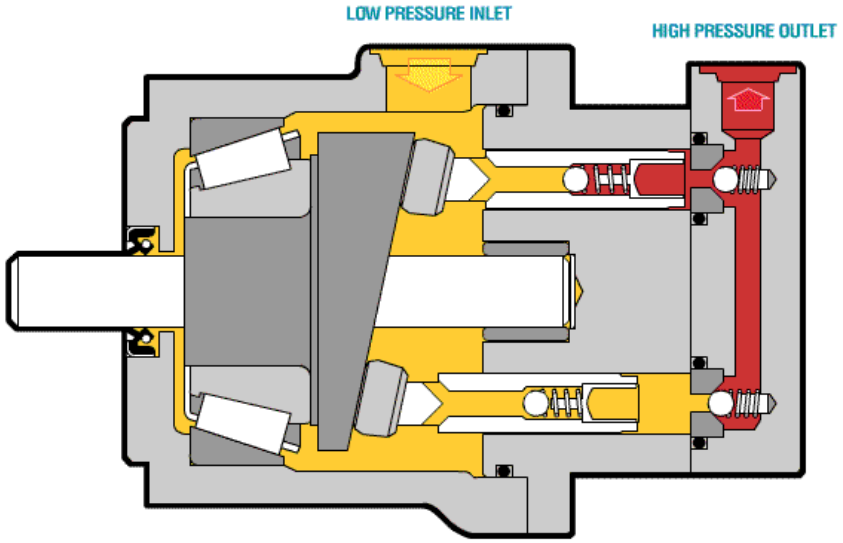


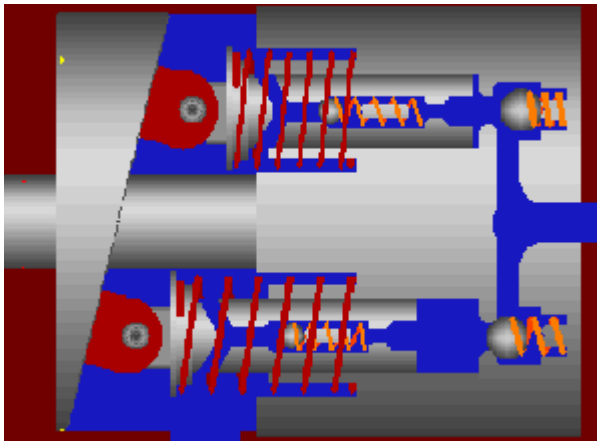


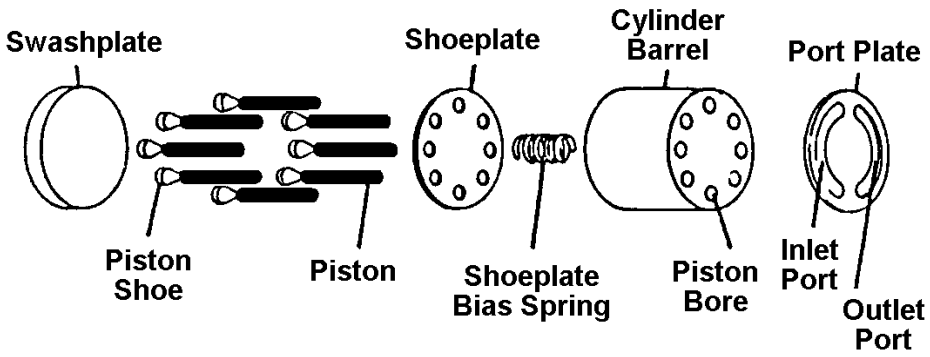




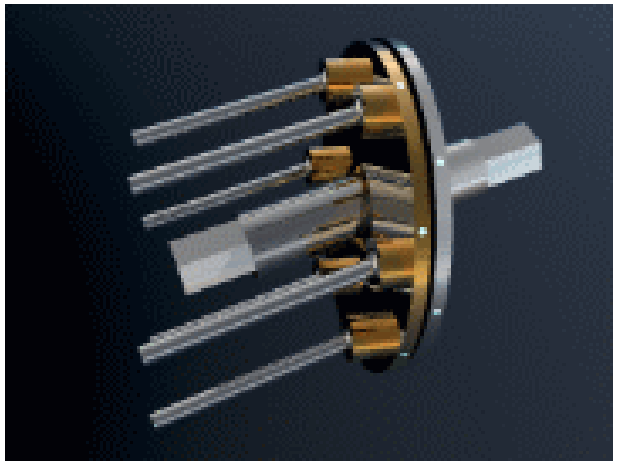
Hydraulic Pumps – Swash plate piston pump

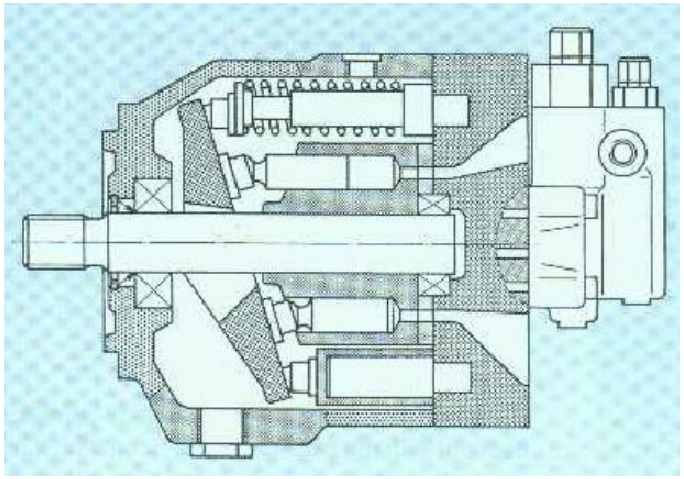


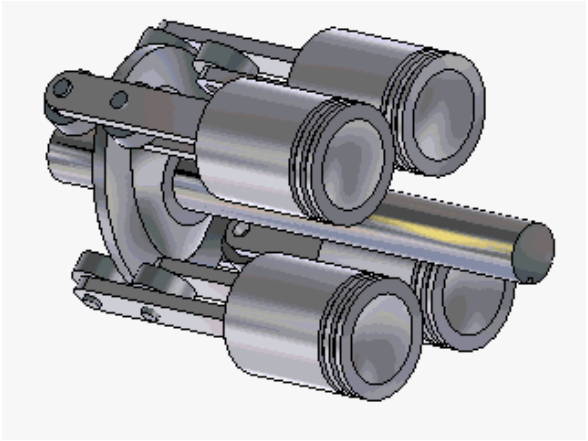


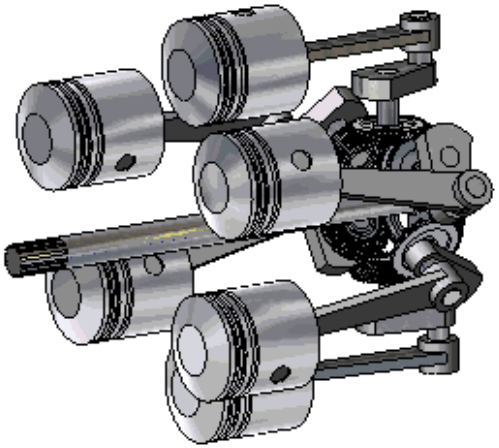


Hydraulic Pumps – Swash plate piston pump

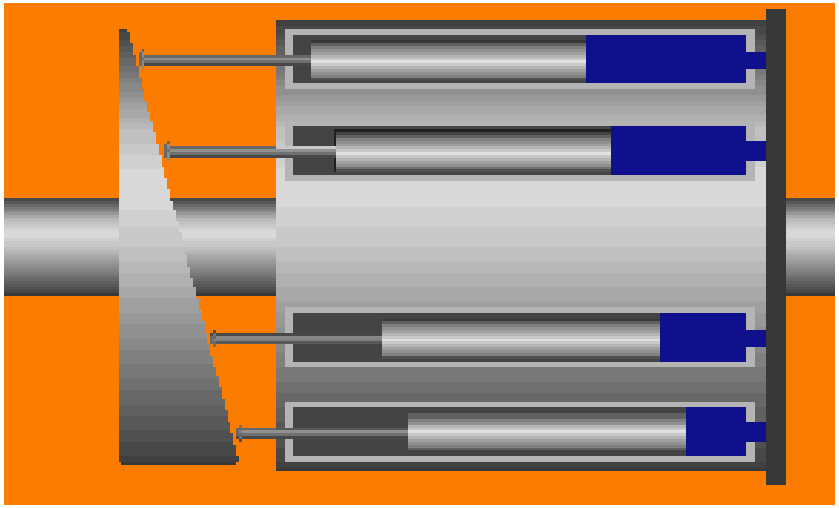






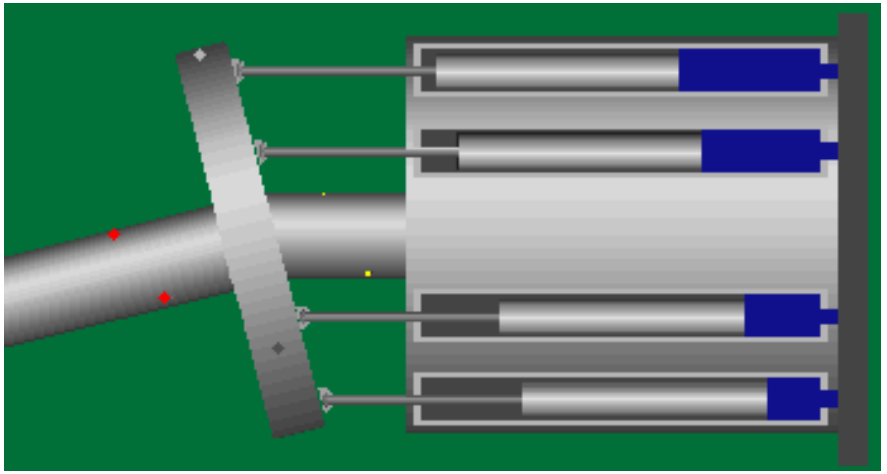


Hydraulic Pumps - Swash plate and Bent axis piston pump



Important parameters

1. **Normal pressure: up to 400 bar**
2. **Max. pressure: up to 450 bar**



Hydraulic Pumps - Swash plate and Bent axis piston pump

Depending on the system, a weighting is given:

1 = very good/very large

2 = good/large

3 = satisfactory

4 = poor

External gear pump	= AZP
Internal gear pump	= IZP
Gear ring pump	= ZRP
Screw spindle pump	= SSP
Single chamber vane pump	= FZPE
Double chamber vane pump	= FZPD
Radial piston pump with eccentric shaft	= RKPI
Radial piston pump w. eccentric cylinder block	= RKPA
Axial piston pump with bent axis	= AKPSA
Axial piston pump with swashplate	= AKPSS

Criteria	Type									
	AZP	IZP	ZRP	SSP	FZPE	FZPD	RKPI	RKPA	AKPSA	AKPSS
Useable range of speeds	1	2	2	2	3	3	2	2	2	2
Useable range of pressures	2	2	3	3	3	3	1	1	1	1
Viscosity range	1	2	3	1	3	3	1	1	1	1
Max. noise level	4	1	2	1	2	2	3	3	3	3
Serivce life	3	2	2	1	1	1	2	2	2	2
Price	1	2	2	3	2	2	3	3	3	3

Hydraulic Pumps – Selection criteria

Depending on the system, a weighting is given:

1 = very good/very large

2 = good/large

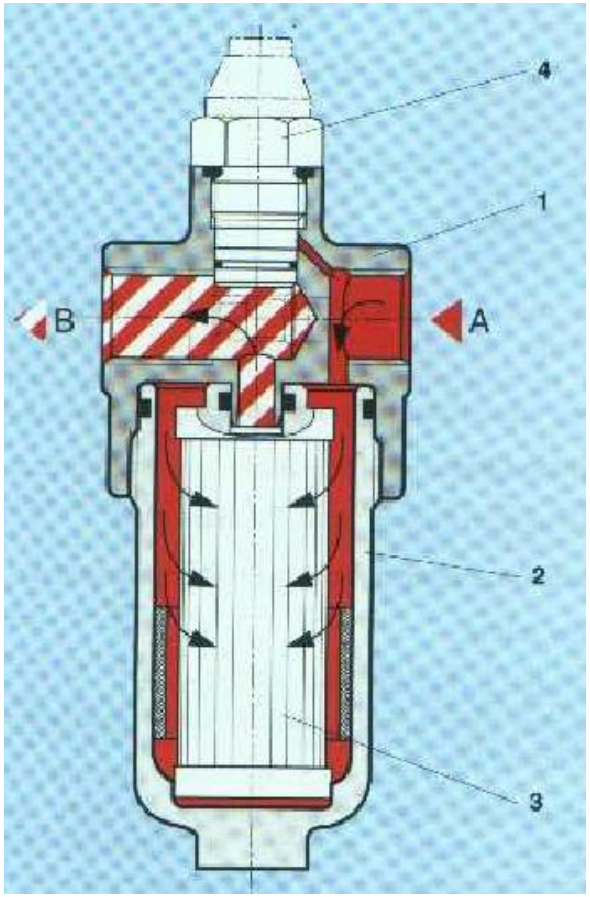
3 = satisfactory

4 = poor

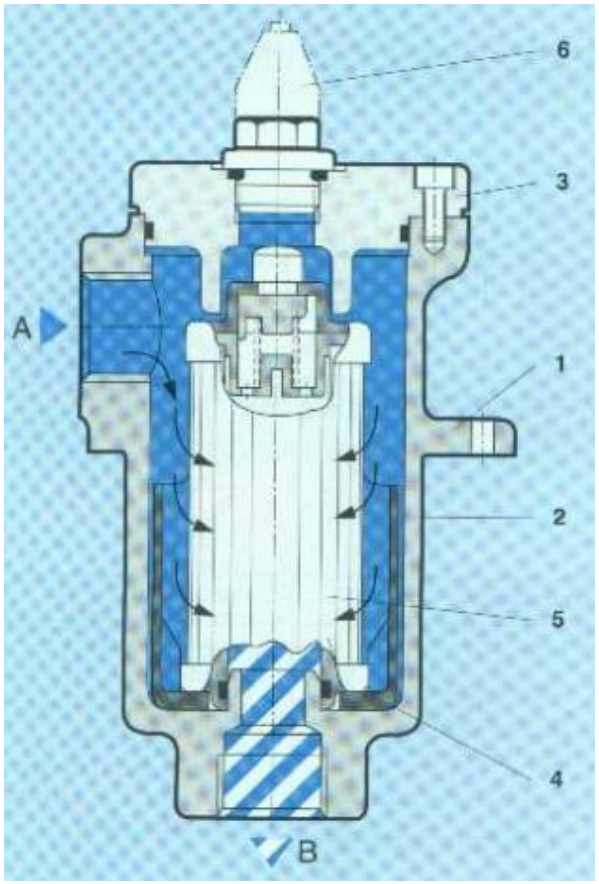
External gear pump	= AZP
Internal gear pump	= IZP
Gear ring pump	= ZRP
Screw spindle pump	= SSP
Single chamber vane pump	= FZPE
Double chamber vane pump	= FZPD
Radial piston pump with eccentric shaft	= RKPI
Radial piston pump w. eccentric cylinder block	= RKPA
Axial piston pump with bent axis	= AKPSA
Axial piston pump with swashplate	= AKPSS

Criteria	Type									
	AZP	IZP	ZRP	SSP	FZPE	FZPD	RKPI	RKPA	AKPSA	AKPSS
Useable range of speeds	1	2	2	2	3	3	2	2	2	2
Useable range of pressures	2	2	3	3	3	3	1	1	1	1
Viscosity range	1	2	3	1	3	3	1	1	1	1
Max. noise level	4	1	2	1	2	2	3	3	3	3
Serivce life	3	2	2	1	1	1	2	2	2	2
Price	1	2	2	3	2	2	3	3	3	3

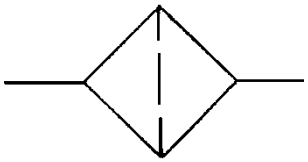
Strainers and Filters



Line strainer

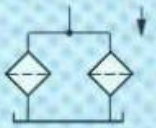
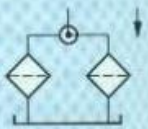


Return line filter

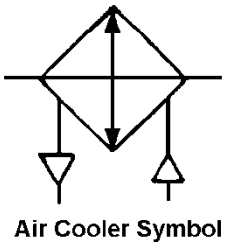


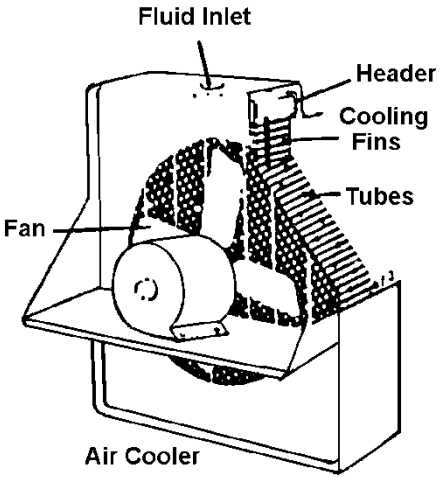
Filter Symbol

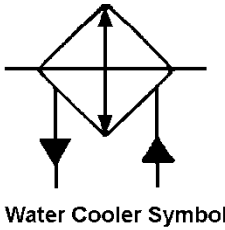
Strainers and Filters

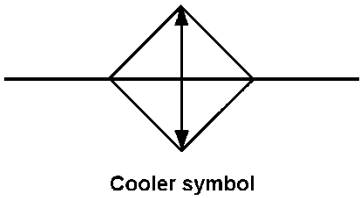
Type	Suction line filter		Mounted return line filter		
Model	Without housing	With housing	Simple	Double	Switchable
Place of installation	Tank, suction line	Tank, suction line	Tank	Tank	Tank
Diagram					
Symbol					
Max. operating pressure	1 bar	1 bar	25 bar	25 bar	25 bar
Filter pore size	20 to 200 µm	20 to 200 µm	3 to 100 µm	3 to 100 µm	3 to 100 µm
Typical applications	Pump protection, hydrostatic units, injection molding machines, construction machines	Pump protection, hydrostatic units, injection molding machines, construction machines	Working filter in hydraulic systems, construction machines	Working filter in hydraulic systems, construction machines	Systems dependent on manufacture
Remark	Usually only used to protect pump. Clogging indicator essential.	Usually only used to protect pump. Clogging indicator essential.	Standard model with bypass valve. With connection to fill system.	Standard model with bypass valve. With connection to fill system.	Standard model with bypass valve. With connection to fill system.

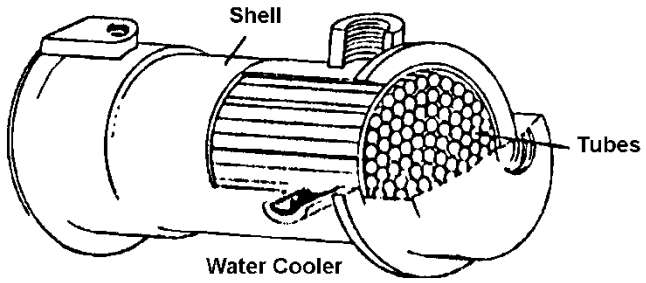
Coolers


Air Cooler Symbol


Fluid Inlet
Header
Cooling Fins
Tubes
Fan
Air Cooler


Water Cooler Symbol


Cooler symbol


Shell
Tubes
Water Cooler