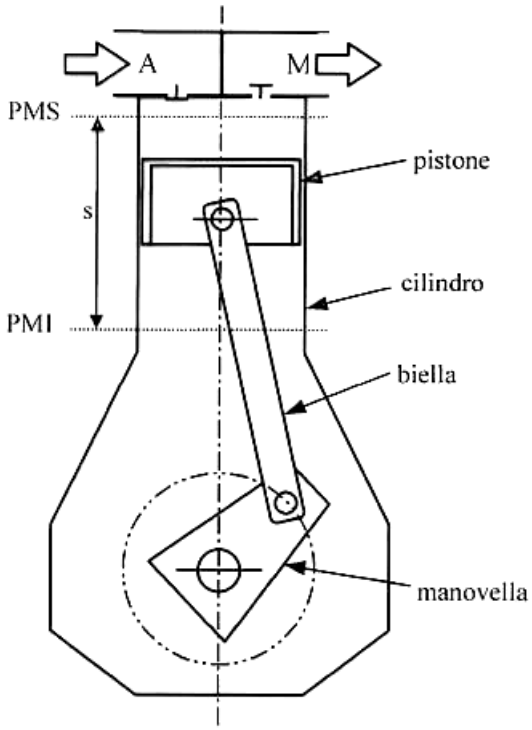
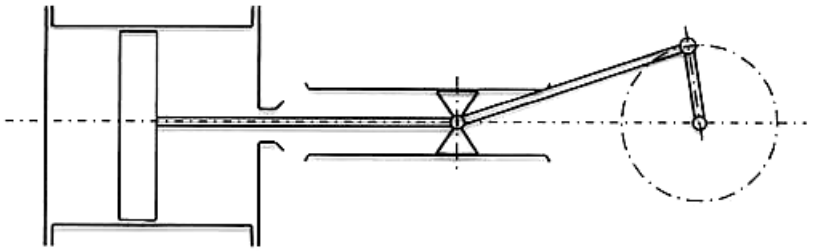
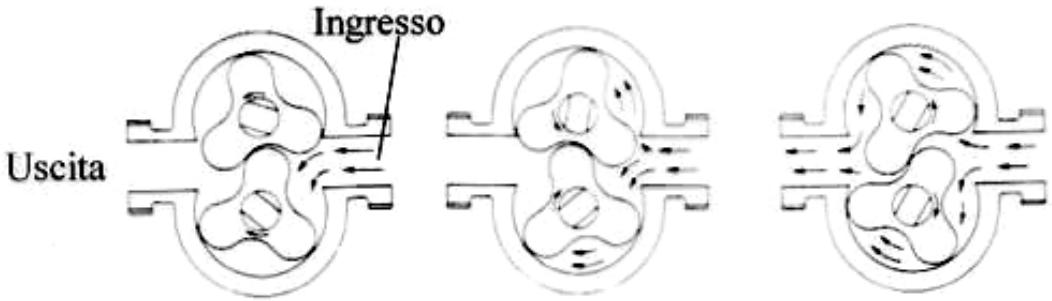
Pompe volumetriche

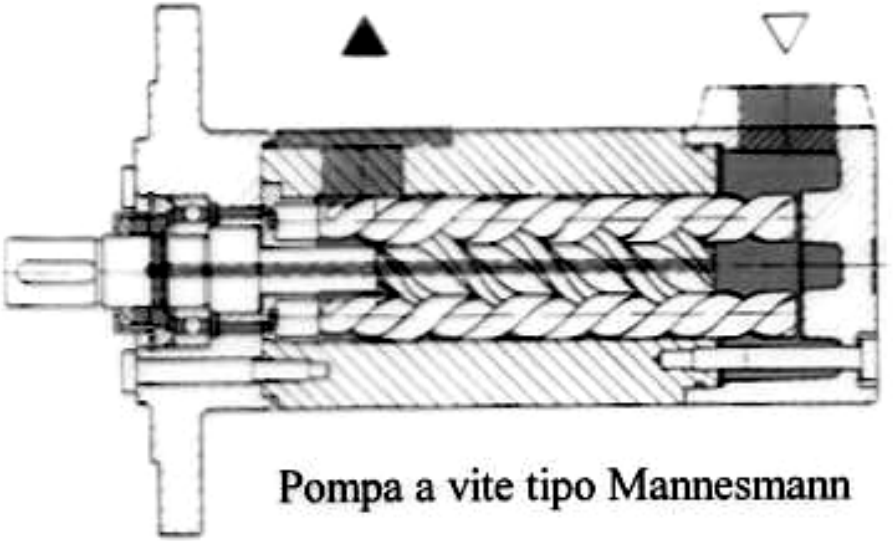


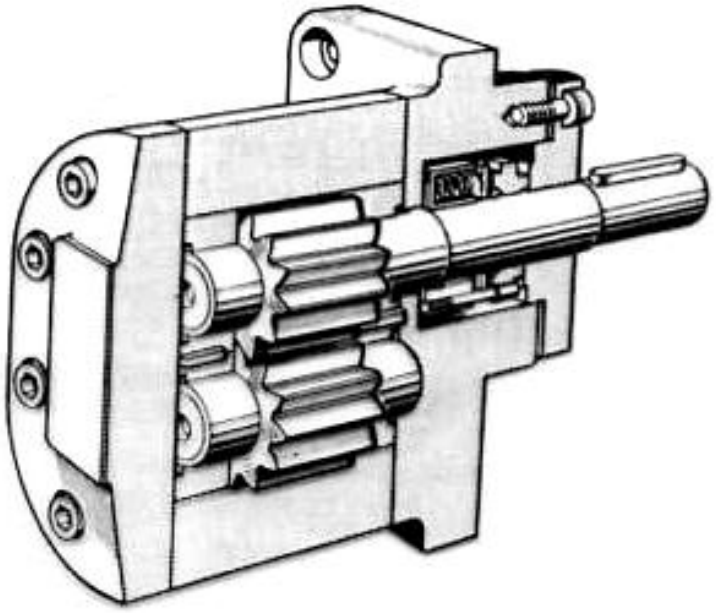
Pompa alternativa



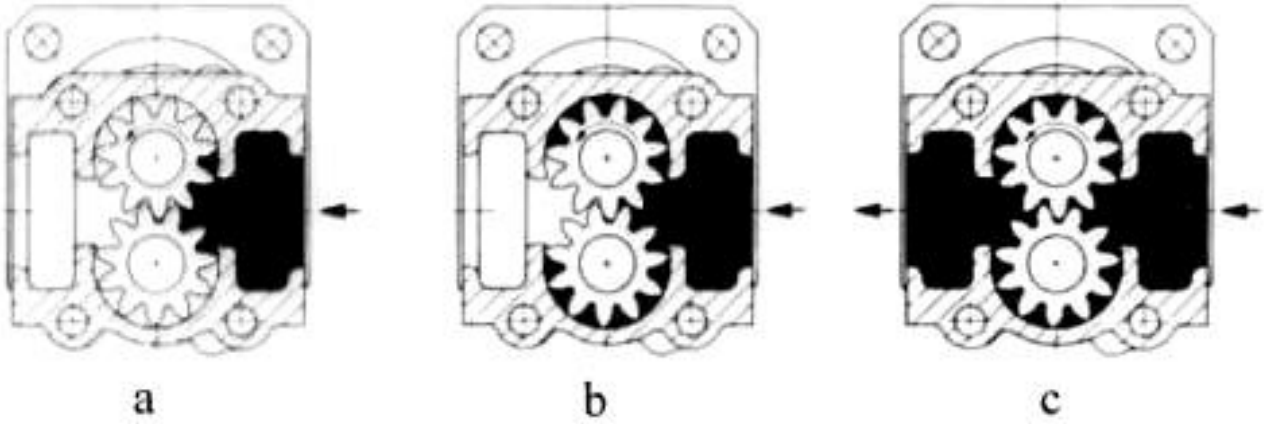


Pompa a lobi

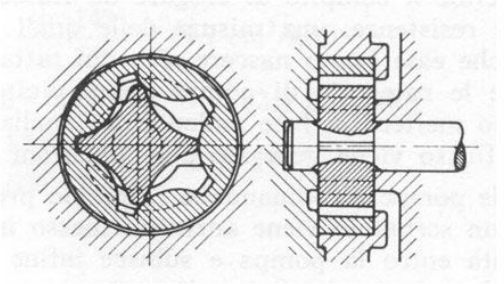




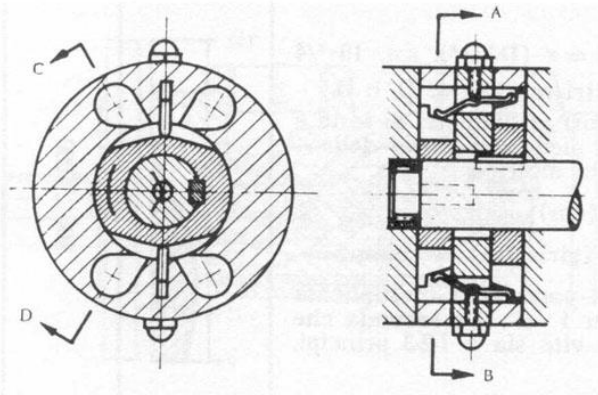
Pompa a ingranaggi



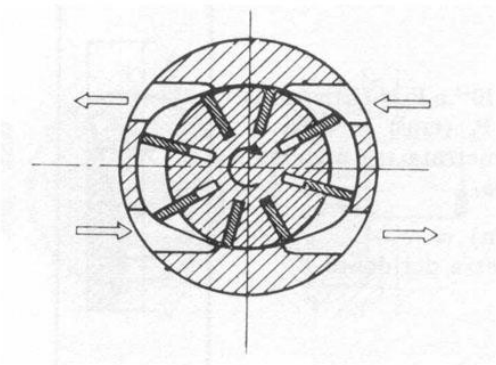
a) Aspirazione; b) Trasferimento; c) Mandata



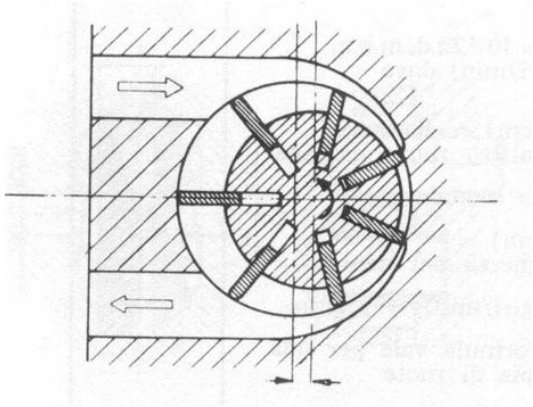
Pompa a ingranaggi interni

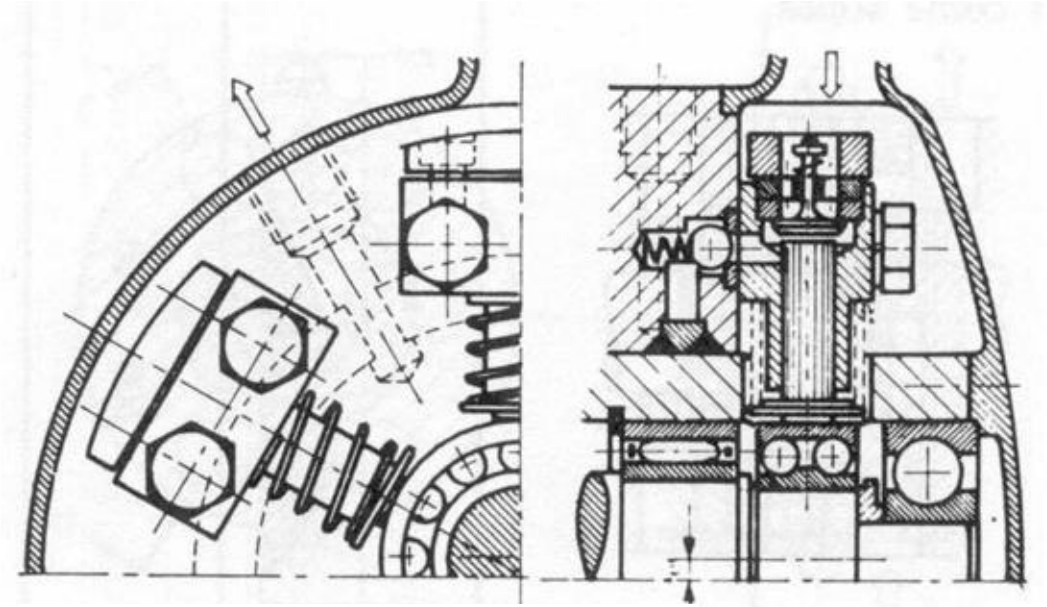


Pompa a palette statoriche

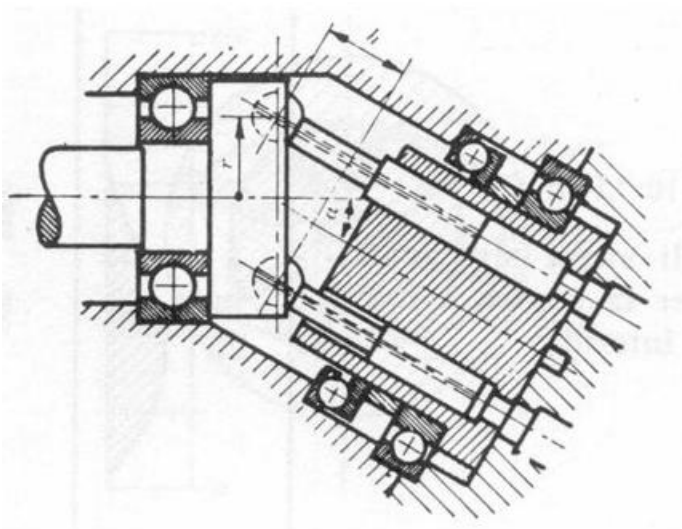


Pompa a palette

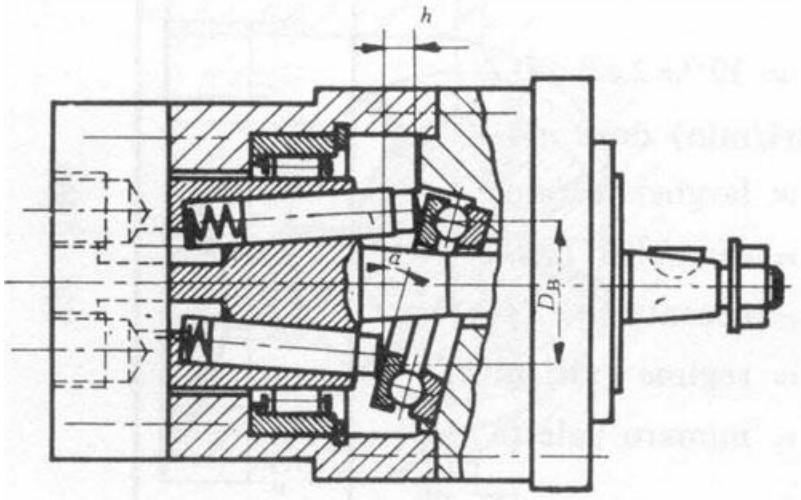




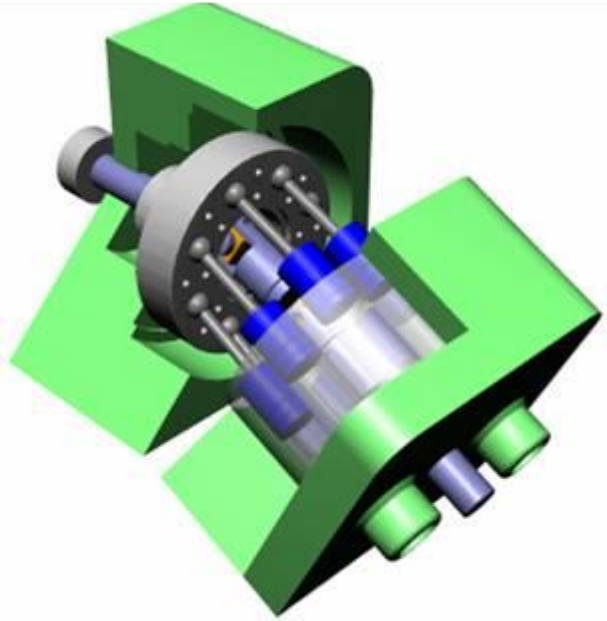
Pompa a pistoni radiali

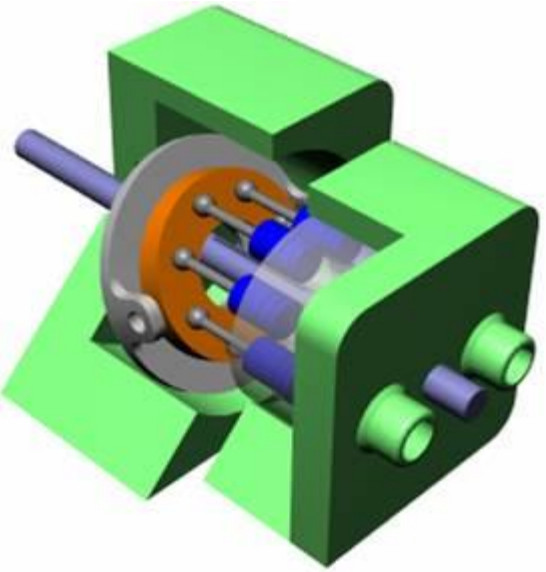


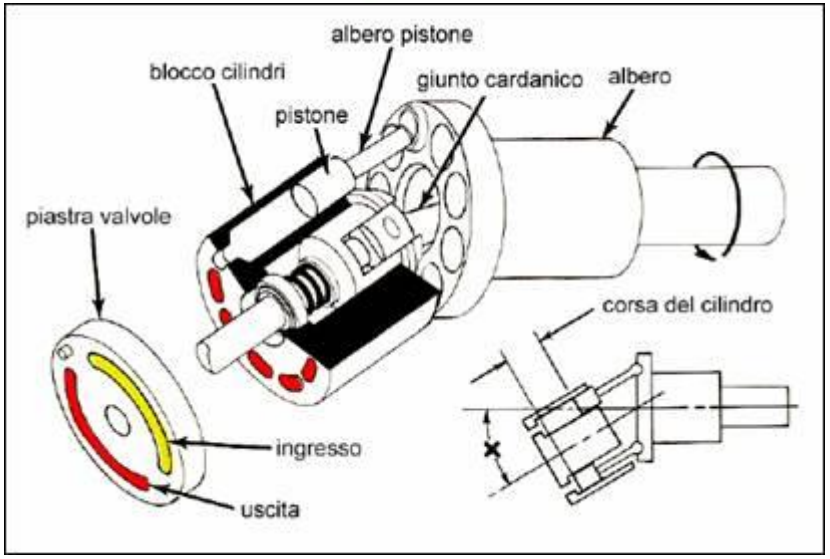
Pompa a pistoni assiali (blocco inclinato)

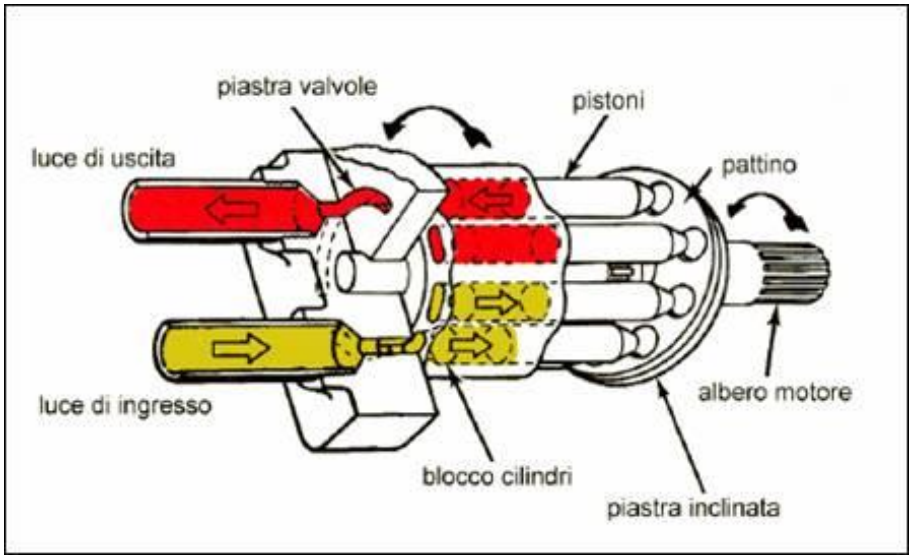


Pompa a pistoni assiali (piastra inclinata)









Pompa rotativa a pistoni a blocco inclinato

Pompa rotativa a pistoni a piastra inclinata

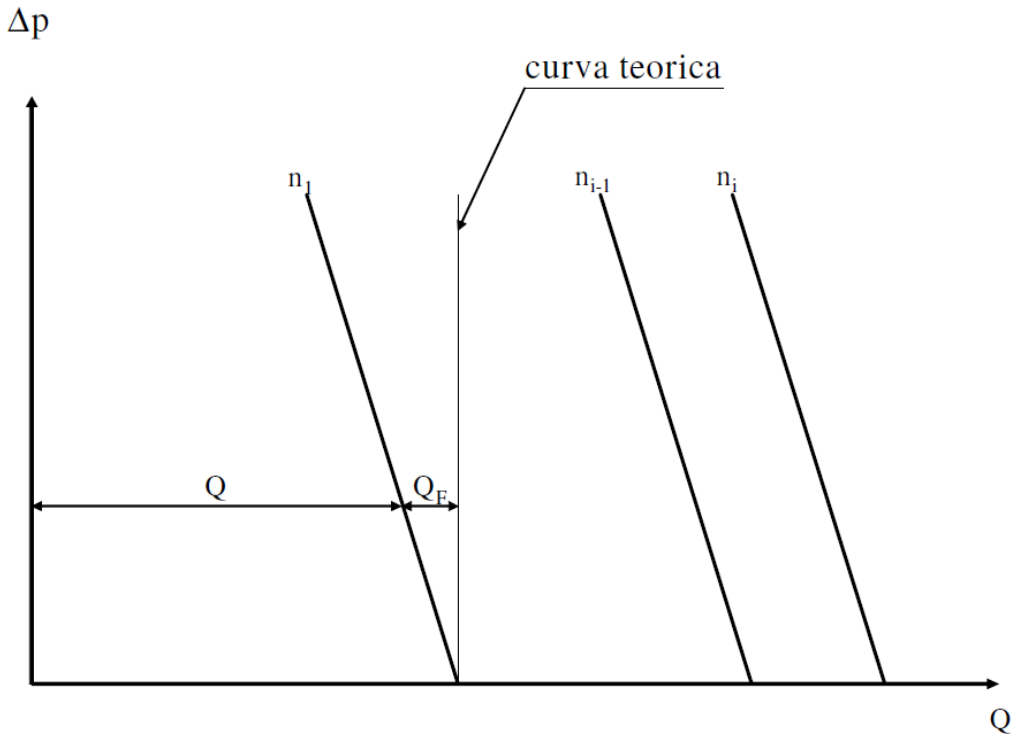
Tipologia pompa		Range cilindrate (cm^3)	Pressione massima (bar)	Velocità rotazione (min^{-1})	Rendimento	Regolarità	Rumorosità	Costo
Cilindrata fissa	Ingranaggi esterni	0,2-200	250-300	500-6000	85-90	mediocre	mediocre	ottimo
	Ingranaggi interni	3-250	200-250	500-3000	90	eccellente	eccellente	buono
	Pistoni radiali	0,4-100	700	1000-3500	90	mediocre	ottima	mediocre
	Pistoni assiali	10-1000	400-450	1000-3000	>90	buona	buona	mediocre
	A palette	10-36	160-180	900-3000	85	ottima	ottima	buono
	A viti	15-3500	200	1000-3500		eccellente	eccellente	mediocre
Cilindrata variabile	Pistoni assiali (piastra inclinata)	28-250	400-450	500-4000	>90	buona	buona	mediocre
	Pistoni assiali (blocco inclinato)	20-1000	400-450	500-4000	>90	buona	buona	mediocre
	A palette	5-125	150-160	900-2000	85	ottima	ottima	buono

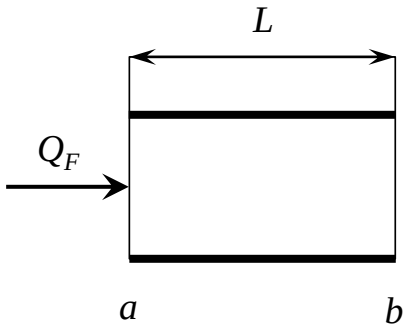
Cilindrata V_c di una pompa volumetrica: volume geometricamente generato dall'elemento mobile della pompa ad ogni giro

$$Q_t = V_c\, N$$

$$Q = Q_t - Q_F$$

Dato che il moto dei flussi di trafilamento attraverso le tenute interne ed esterne è laminare, Q_F è proporzionale a Δp





Flussi di trafilamento attraverso le tenute interne ed esterne

$$\frac{V_b^2 - V_a^2}{2} + g(z_b - z_a) + \frac{p_b - p_a}{\rho} + R_{a-b} = 0$$

$$g(z_b - z_a) \approx 0 \quad , \quad \frac{V_b^2 - V_a^2}{2} \approx 0$$

$$\downarrow$$

$$R_{a-b} = \lambda \frac{L}{D_h} \frac{Q_F^2}{2A_F^2} = \frac{64}{Re} \frac{L}{D_h} \frac{Q_F^2}{2A_F^2} = \frac{32}{\frac{Q_F}{A_F} D_h} \frac{\mu}{\rho} \frac{L}{D_h} \frac{Q_F^2}{A_F^2} = 32 \frac{\mu}{\rho} \frac{L}{D_h^2} \frac{Q_F}{A_F} =$$

$$= \frac{p_a - p_b}{\rho} = \frac{\Delta p}{\rho} \quad \rightarrow \quad \boxed{Q_F = A_F \frac{D_h^2}{L} \frac{\Delta p}{32\,\mu}}$$

Rendimento volumetrico della pompa:

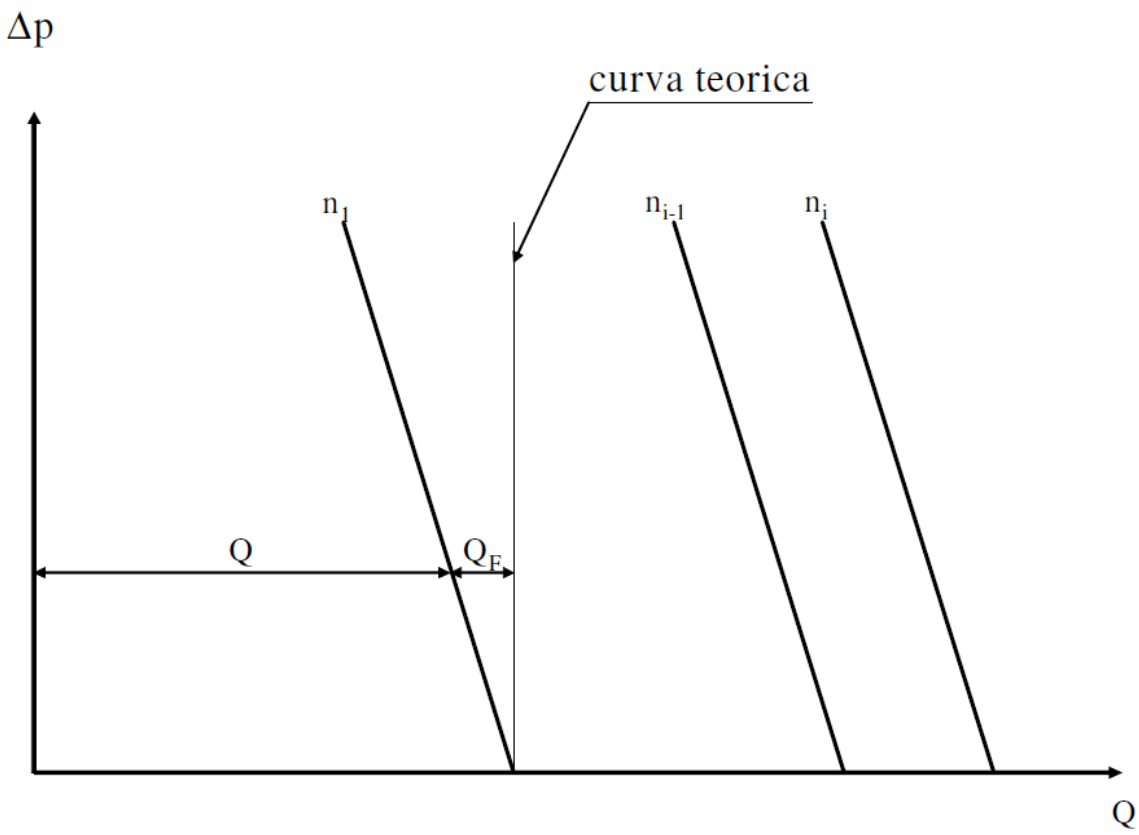
$$\eta_V = \frac{Q}{Q_t} = \frac{Q_t - Q_F}{Q_t} = 1 - \frac{Q_F}{V_c\, N}$$

$$Q_F = A_F \frac{D_h^2}{L} \frac{\Delta p}{32\,\mu}$$

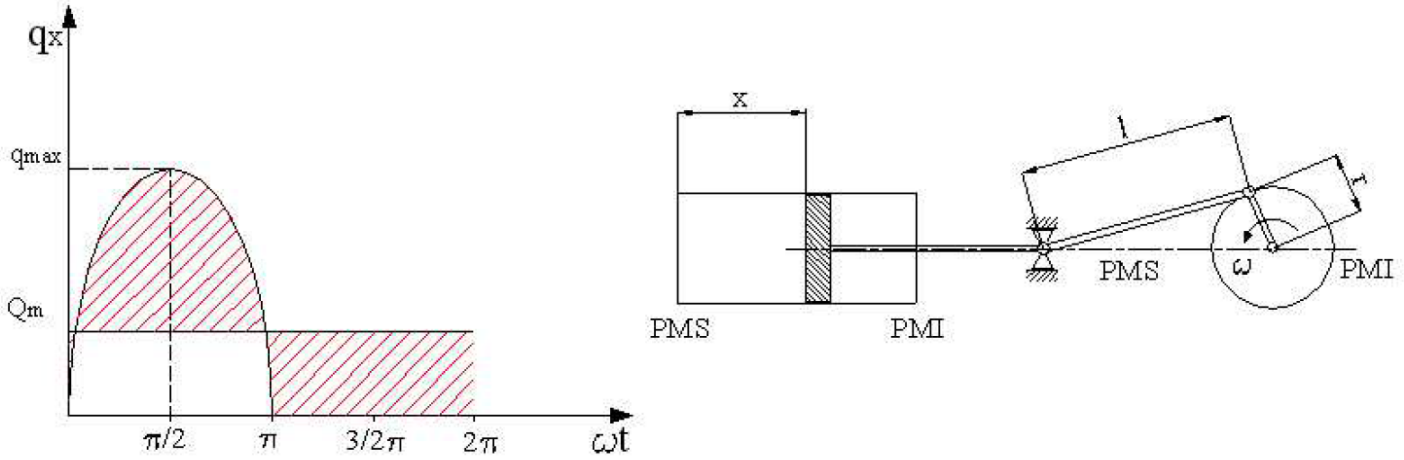
$N \uparrow \rightarrow \eta_V \uparrow$

$\mu \uparrow \rightarrow \eta_V \uparrow$

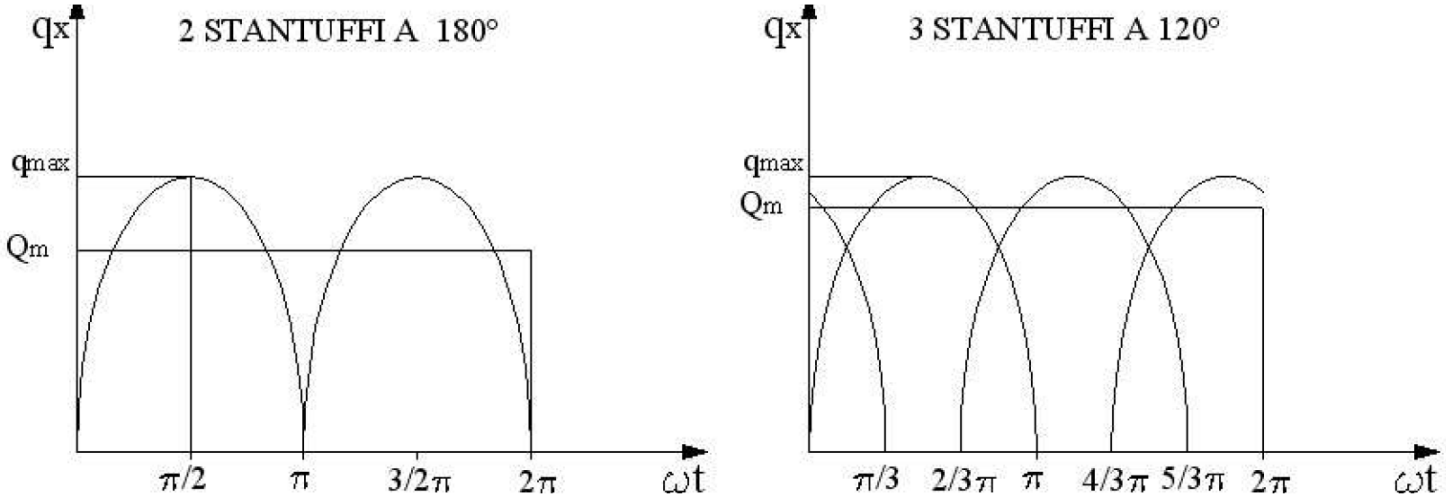
$\Delta p \uparrow \rightarrow \eta_V \downarrow$



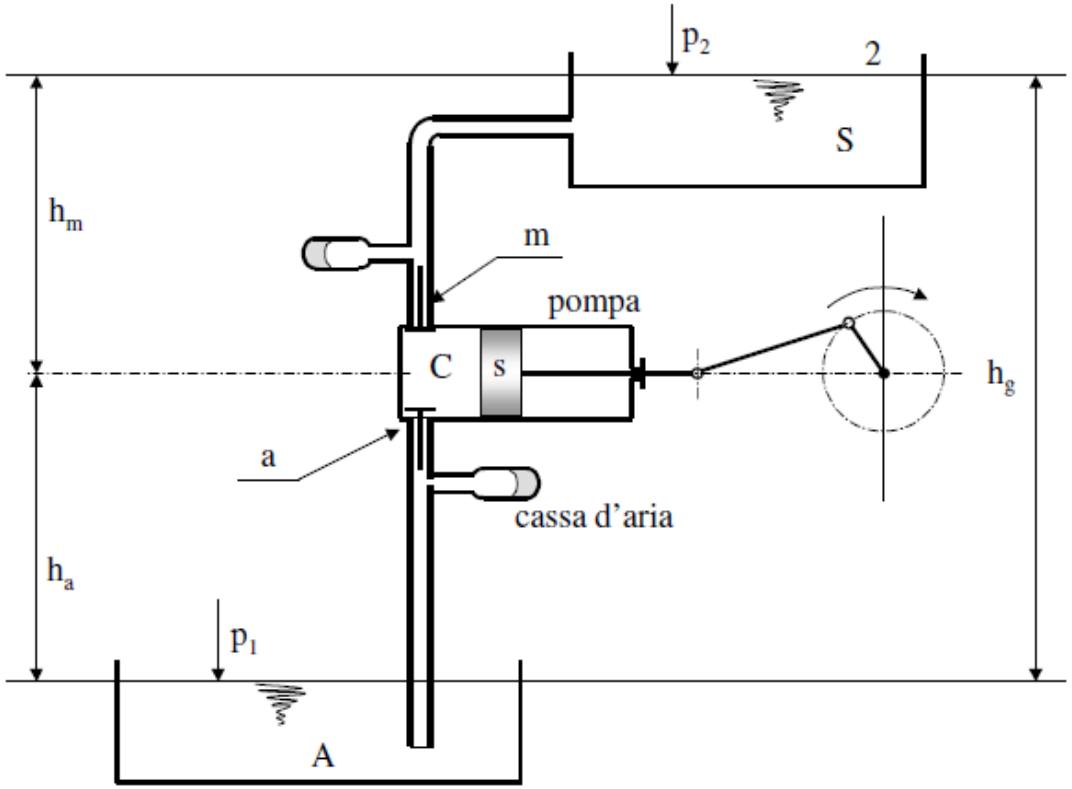
Variabilità della portata istantanea



Portata istantanea e media di una pompa volumetrica a singolo stantuffo: l'area tratteggiata in rosso indica la variazione istantanea della portata rispetto alla portata media (ΔV)



Portata istantanea e media di una pompa volumetrica a due e tre stantuffi


p2
2
S
hm
m
pompa
C
s
hg
a
cassa d'aria
ha
p1
A

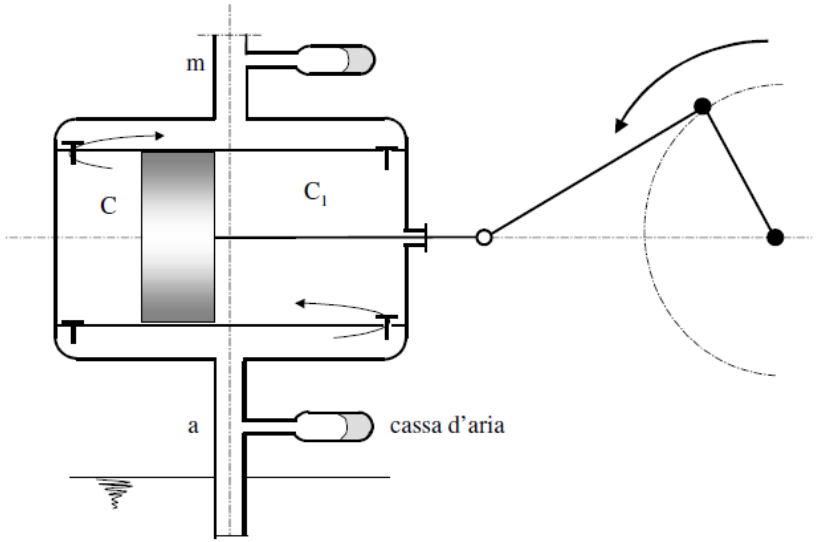
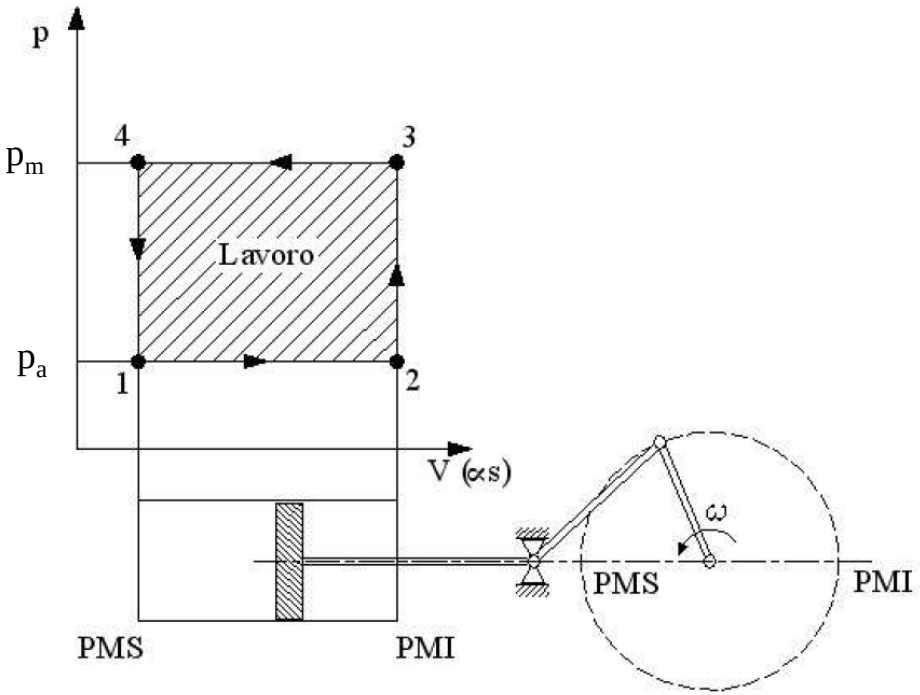
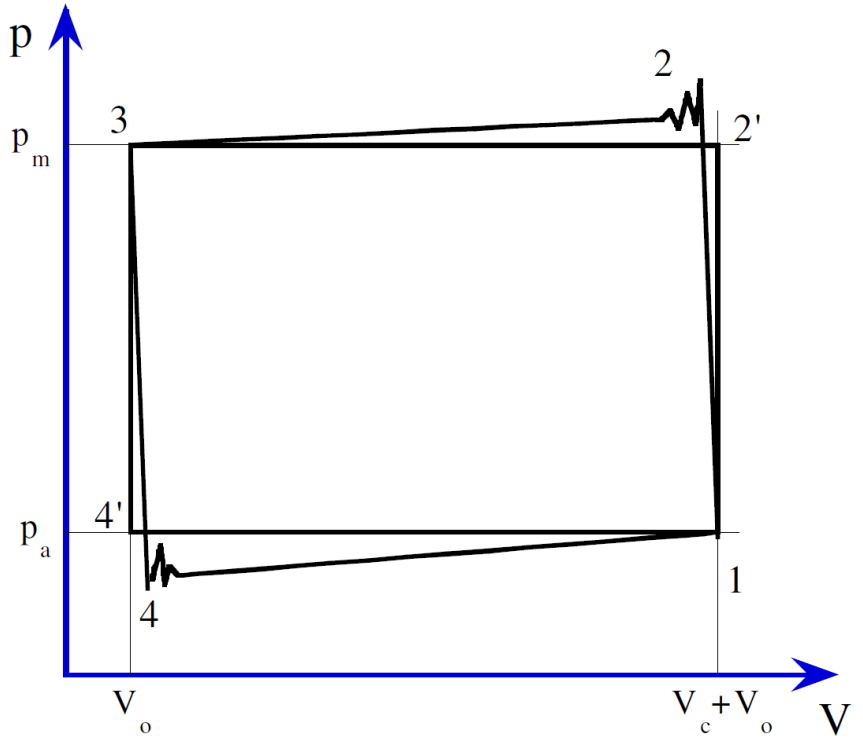

m
C
C1
a
cassa d'aria

Diagramma di indicatore



Ciclo ideale di una pompa volumetrica a stantuffo



Ciclo reale di una pompa volumetrica a stantuffo

Caratteristiche pompe volumetriche

- Non presentano il problema dell'adescamento
- Buona resistenza alla cavitazione ($NPSHr_{\text{volumetriche}} < NPSHr_{\text{dinamiche}}$)
- Buon comportamento con fluidi ad elevata μ
- Maggiori costi e ingombri a parità di portata rispetto ad una pompa dinamica