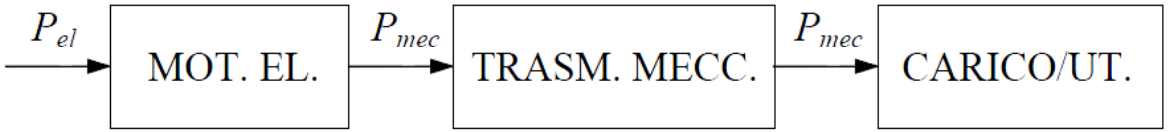
MECCANICA DEGLI AZIONAMENTI

Presentazione11: Oleodinamica

TRASMISSIONE MECCANICA



TRASMISSIONE OLEODINAMICA

Vantaggi:
- potenza/ingombro ↑↑, potenza/peso ↑↑
- capacità di regolazione e controllo ↑↑

Limiti:
- rendimenti inferiori
- apparati complessi e costosi per la sincronizzazione rigorosa dei movimenti
- precisione dei movimenti limitata a causa della comprimibilità del fluido e della variazione della viscosità con la temperatura

Richiami Meccanica dei Fluidi

$$p + \rho g h + \frac{1}{2}\rho w^2 = \text{costante}$$

$$\mathrm{Re} = \frac{w \cdot d_h}{\nu} \qquad \mathrm{Re}_{cr} \approx 2300$$

Se $\mathrm{Re} < \mathrm{Re}_{cr}$ il moto è laminare; se $\mathrm{Re} > \mathrm{Re}_{cr}$ il moto è turbolento.

$$\Delta p = \frac{1}{2}\lambda\ \rho w^2 \frac{L}{d}$$

a) $\lambda_{li} = \dfrac{64}{\mathrm{Re}}$ nel caso del regime laminare isotermico;

b) $\lambda_{la} = \dfrac{75}{\mathrm{Re}}$ nel caso del regime laminare adiabatico;

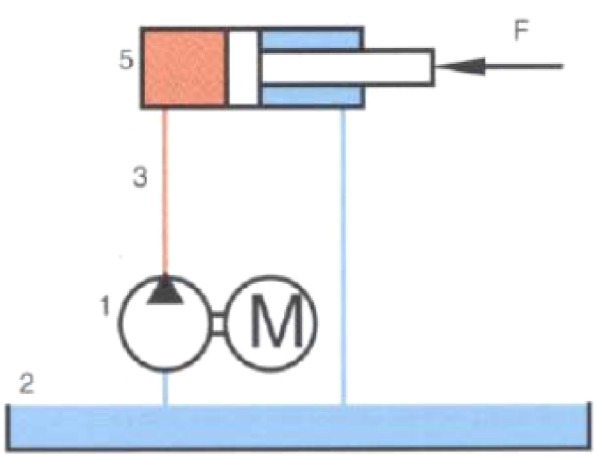
c) $\lambda_{turb} = \dfrac{0.316}{\sqrt[4]{\mathrm{Re}}}$ nel caso del regime turbolento.

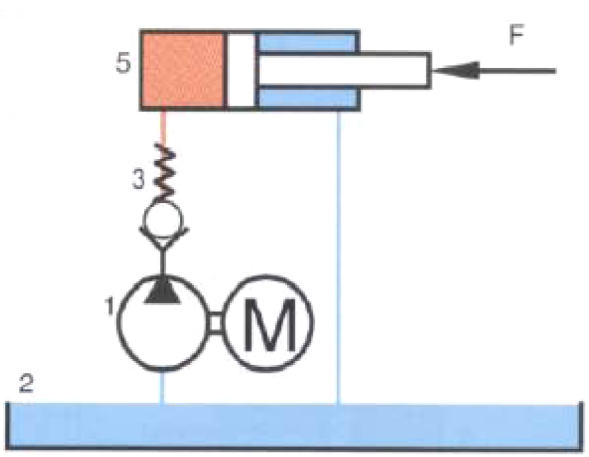
$$P = Q\Delta p$$

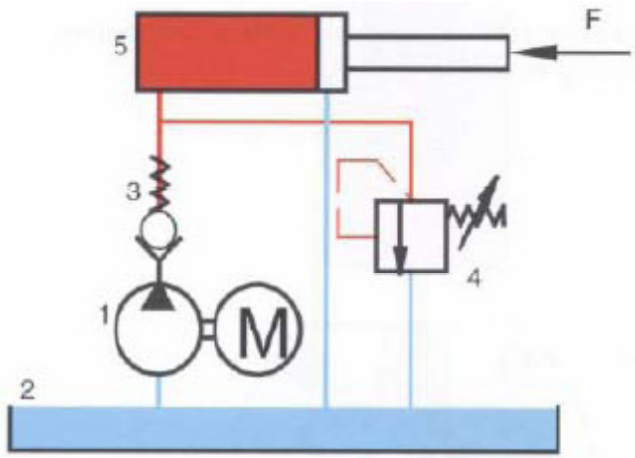
$$\Delta p = \frac{1}{2}\beta\rho w^2$$

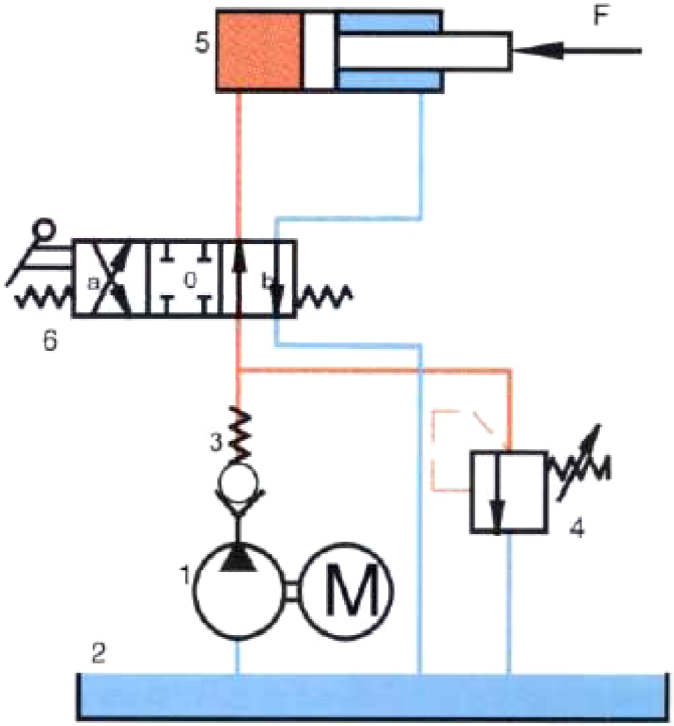
Configurazione	β
Gomito 90°	0.9
Gomito 45°	0.5
Giunzione a T fluente a 90°	1.8
Giunzione a T fluente a 180°	0.9
Valvola a saracinesca	0.2
Valvola a sfera	10
Contrazione brusca	1
Espansione brusca	0.5

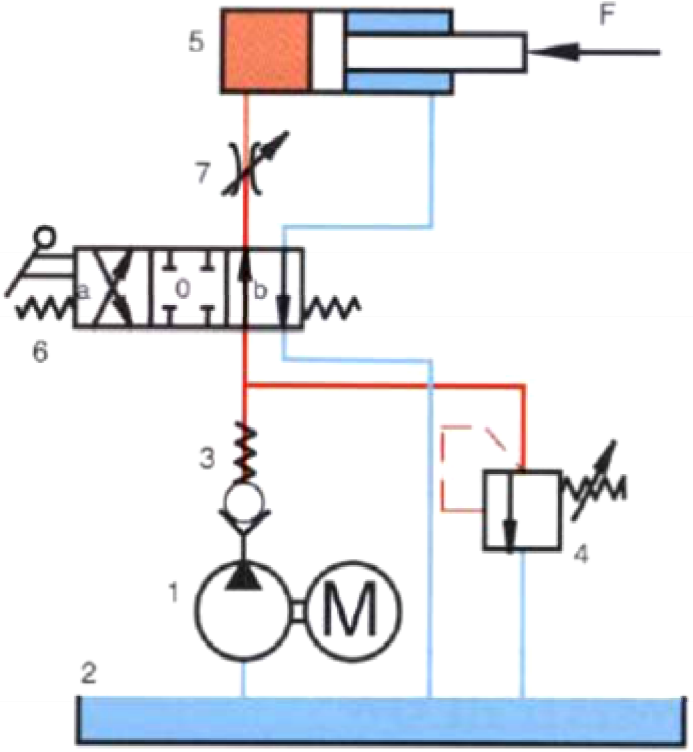
Circuito elementare











Pompe e Motori Idraulici

Pompe volumetriche

$$n_p : \frac{\text{giri}}{\text{min}}, \qquad \frac{n_p}{60} : \frac{\text{giri}}{\text{s}}$$

$$Q_{th} = V_p \frac{n_p}{60} \qquad \left[\frac{\text{m}^3}{\text{s}}\right]$$

$$Q = \eta_{vp} Q_{th} = \eta_{vp} V_p \frac{n_p}{60} \qquad \left[\frac{\text{m}^3}{\text{s}}\right]$$

$$P_{id} = Q\Delta p_p = \eta_{vp} Q_{th} \Delta p_p = \eta_{vp} V_p \frac{n_p}{60} \Delta p_p \qquad [\text{W}]$$

$$P_p = \frac{P_{id}}{\eta_{vp}\eta_{mp}} = \frac{Q_{th}\Delta p_p}{\eta_{mp}} = \frac{V_p n_p \Delta p_p}{60\eta_{mp}} \qquad [\text{W}]$$

$$\eta_{mp} = \eta_{mp}\left(n_p, \Delta p_p\right)$$

$$C_p = \frac{P_p}{\omega_p} = \frac{V_p n_p \Delta p_p}{60\eta_{mp}} \cdot \frac{60}{2\pi n_p} = \frac{V_p \Delta p_p}{2\pi\eta_{mp}} \qquad [\text{Nm}]$$

Motori idraulici rotativi

$$Q = \frac{V_m n_{thm}}{60} \quad \Rightarrow \quad n_{thm} = \frac{60Q}{V_m} \qquad \left[\frac{\text{giri}}{\text{min}}\right]$$

$$n_m = \eta_{vm} n_{thm} = \eta_{vm} \frac{60Q}{V_m} \qquad \left[\frac{\text{giri}}{\text{min}}\right]$$

$$P_{id} = Q\Delta p_m \qquad [\text{W}]$$

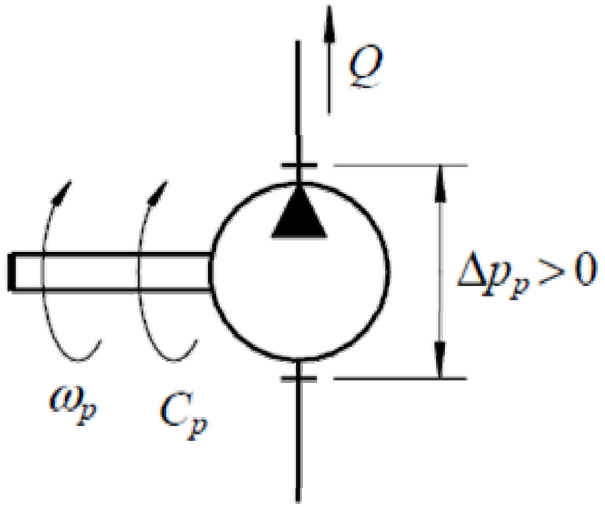
$$P_m = \eta_{vm}\eta_{mm} P_{id} = \eta_{vm}\eta_{mm} Q\Delta p_m = \eta_{mm} \frac{V_m n_m \Delta p_m}{60} \qquad [\text{W}]$$

$$C_m = \frac{P_m}{\omega_m} = \eta_{mm} \frac{V_m n_m \Delta p_m}{60} \cdot \frac{60}{2\pi n_m} = \eta_{mm} \frac{V_m \Delta p_m}{2\pi} \qquad [\text{Nm}]$$

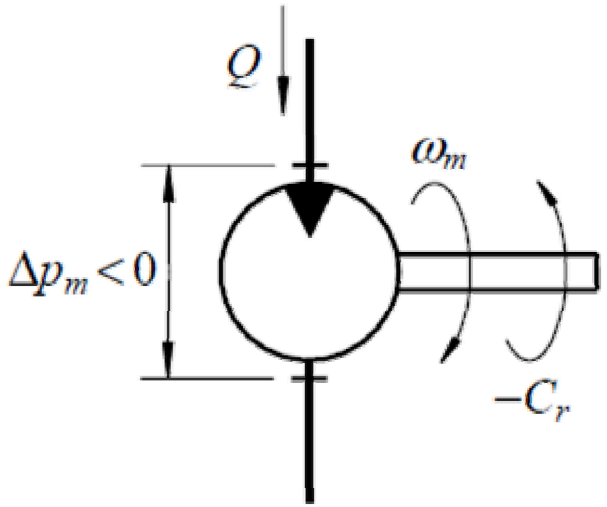
$$C_m = C_r \quad \Rightarrow \quad \Delta p_m = \frac{2\pi C_r}{\eta_{mm} V_m} \qquad [\text{Pa}]$$

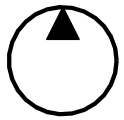
Pompe e Motori Idraulici

Pompa oleodinamica:



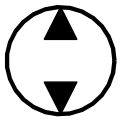
Motore oleodinamico:





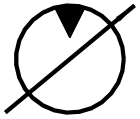
Unidirezionale a portata fissa

Unidi-rezionale a portata variabile



Bidirezionale a portata fissa

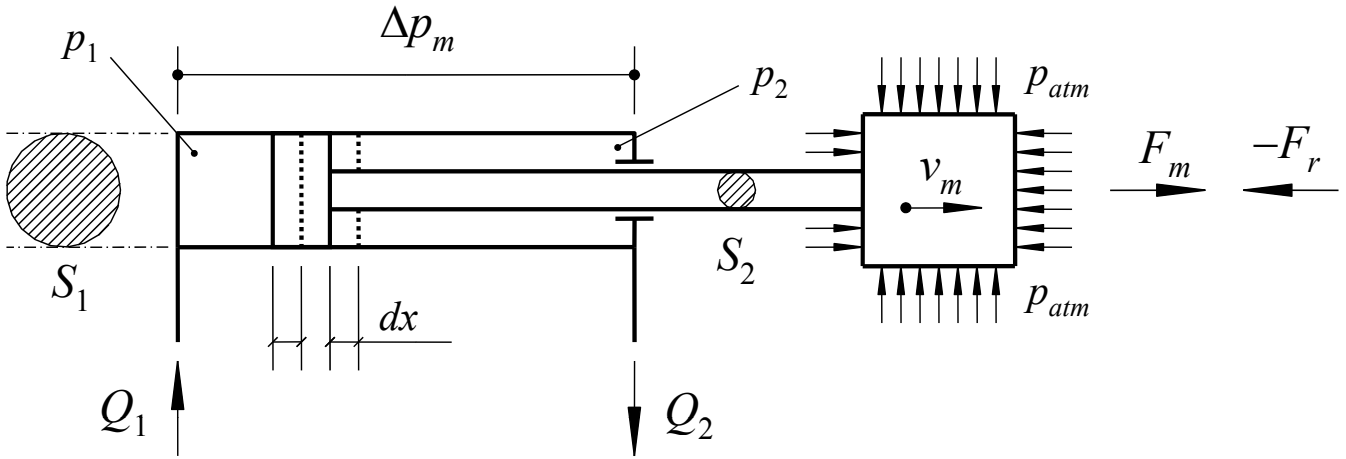
Unidirezionale a portata fissa



Unidi-rezionale a portata variabile

Bidirezionale a portata fissa

Motori Idraulici Lineari (Cilindri)



$$\eta_{vm} dV_1 = S_1 dx \quad \Rightarrow \quad \eta_{vm} Q_1 = S_1 v_m \quad \Rightarrow \quad v_m = \eta_{vm} \frac{Q_1}{S_1} \quad \left[\frac{\text{m}}{\text{s}}\right]$$

$$Q_1 = \text{cost.} \quad \Rightarrow \quad v_m = \text{cost.} = \frac{\Delta x}{\Delta t} \quad \Rightarrow \quad \Delta t = \frac{\Delta x}{v_m} = \frac{S_1}{\eta_{vm} Q_1} \Delta x$$

$$dV_2 = (S_1 - S_2) dx + (1 - \eta_{vm}) dV_1$$

$$Q_2 = (S_1 - S_2) v_m + (1 - \eta_{vm}) Q_1 = (S_1 - S_2) \eta_{vm} \frac{Q_1}{S_1} + (1 - \eta_{vm}) Q_1 =$$

$$= Q_1 \left(1 - \frac{S_2}{S_1} \eta_{vm}\right)$$

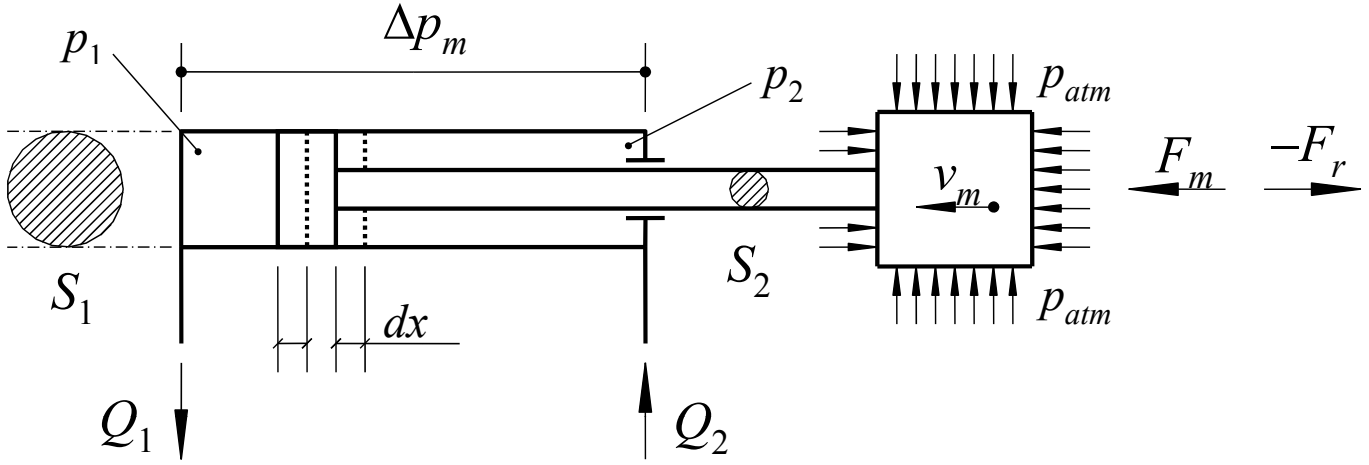
$$F_m = \eta_{mm} \left[p_1 S_1 - p_2 (S_1 - S_2) \right] =$$

$$= \eta_{mm} \left[(p_1 - p_2) S_1 + p_2 S_2 \right] =$$

$$= \eta_{mm} \left[\Delta p_m S_1 + p_2 S_2 \right] \quad [\text{N}]$$

$$F_m = F_r \quad \Rightarrow \quad \Delta p_m \approx \frac{F_r}{\eta_{mm} S_1} \quad [\text{Pa}]$$

Motori Idraulici Lineari (Cilindri)



Fase rientro stelo:

$$v_m = \eta_{vm} \frac{Q_2}{S_1 - S_2} \qquad \left[\frac{\text{m}}{\text{s}}\right]$$

$$dV_1 = S_1 dx + (1 - \eta_{vm}) dV_2$$

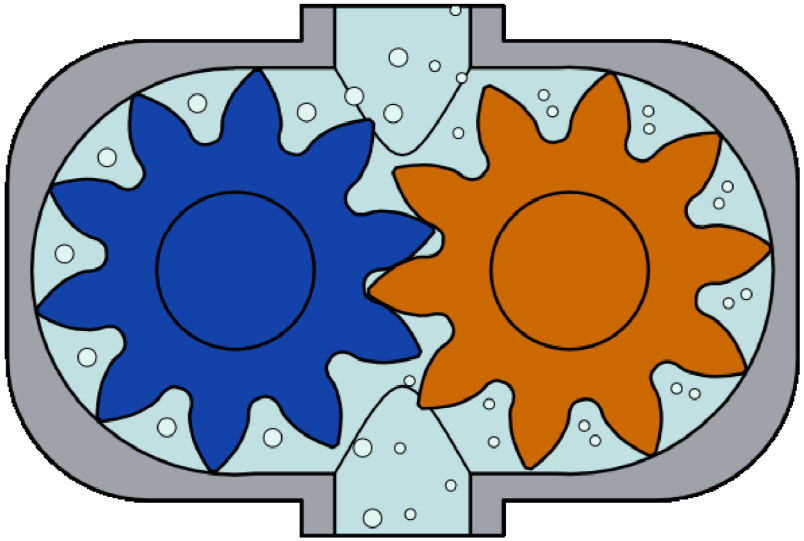
$$Q_1 = Q_2 \left(1 + \frac{S_2}{S_1 - S_2} \eta_{vm}\right)$$

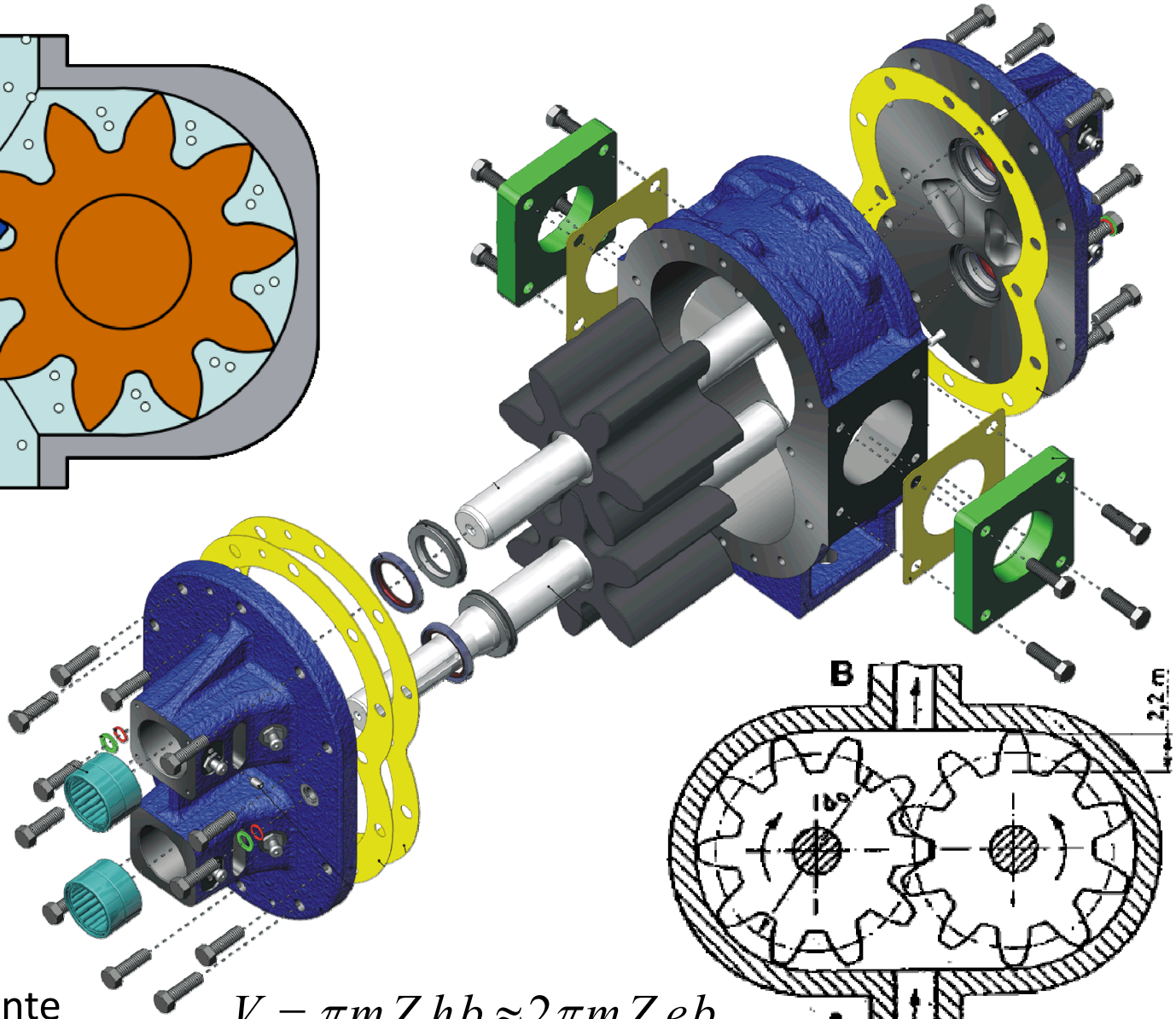
$$F_m = \eta_{mm} \left[p_2 (S_1 - S_2) - p_1 S_1 \right] \qquad [\text{N}]$$

$$p_2 \approx 0, \qquad F_m = F_r$$

$$\Rightarrow \qquad \Delta p_m \approx \frac{F_r}{\eta_{mm} (S_1 - S_2)} \qquad [\text{Pa}]$$

Pompa a ingranaggi

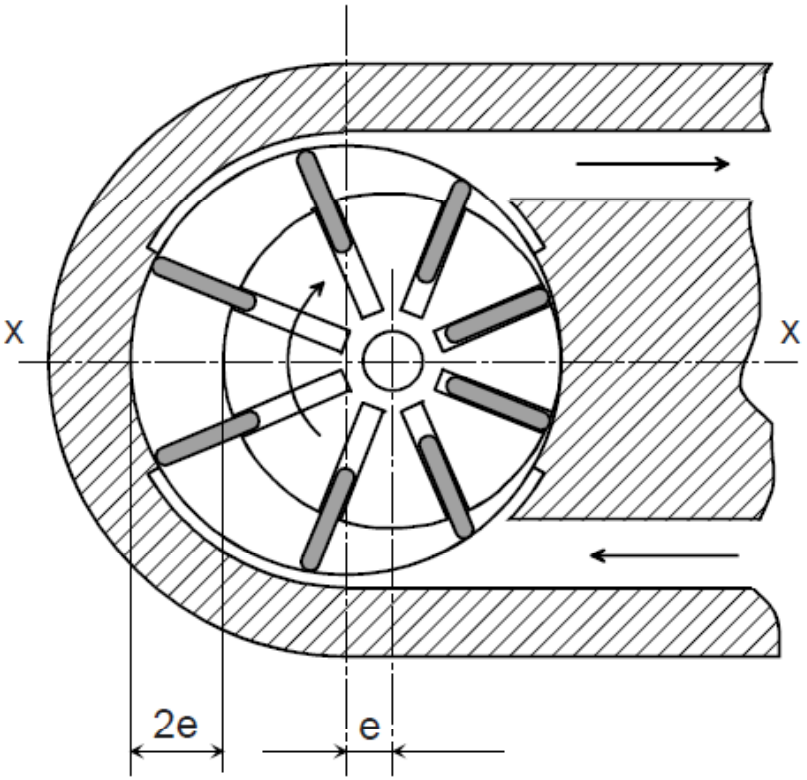




e = addendum dente

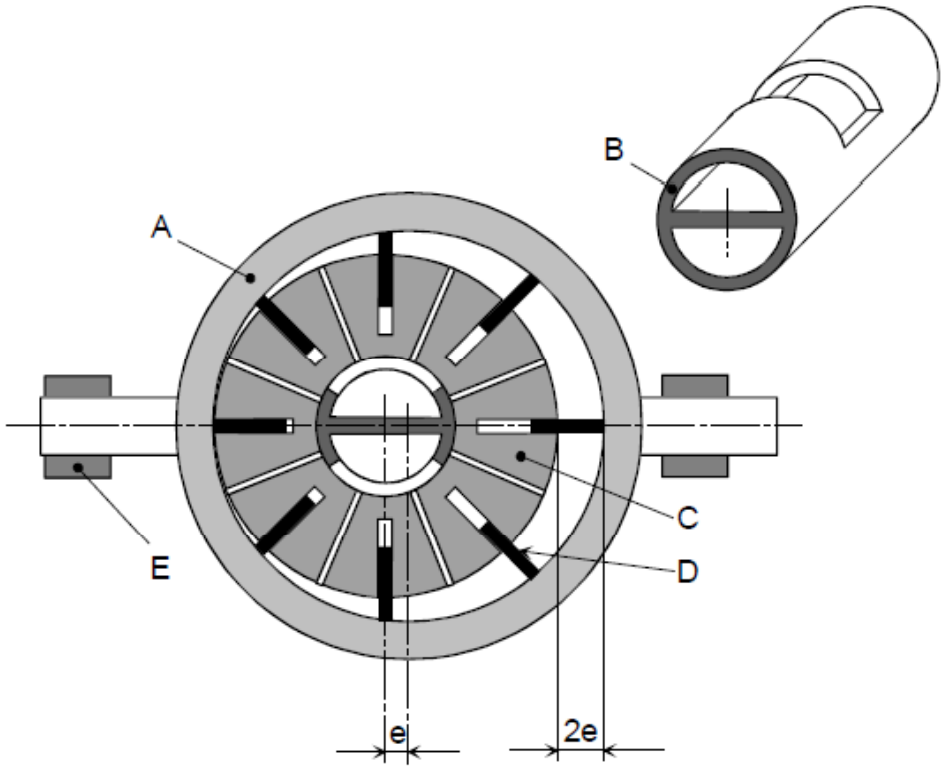
$$V = \pi m Z h b \approx 2\pi m Z e b$$

Pompa a palette

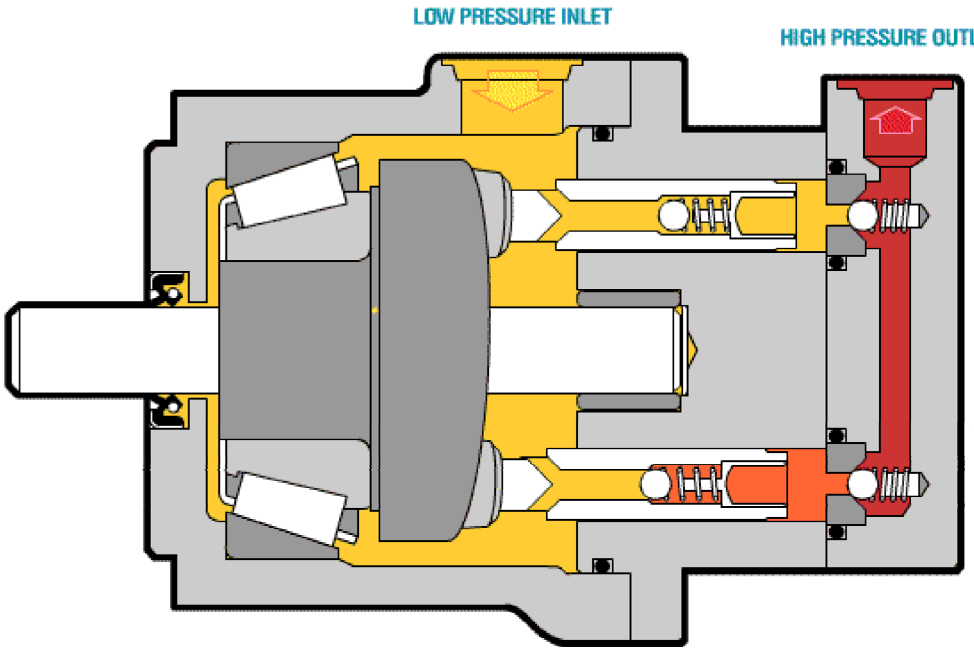


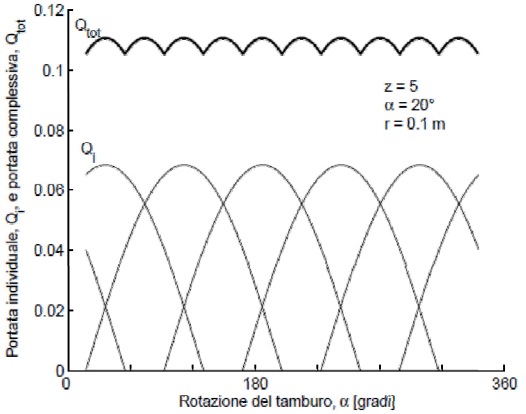
$$V_F = d_m \pi 2eb$$

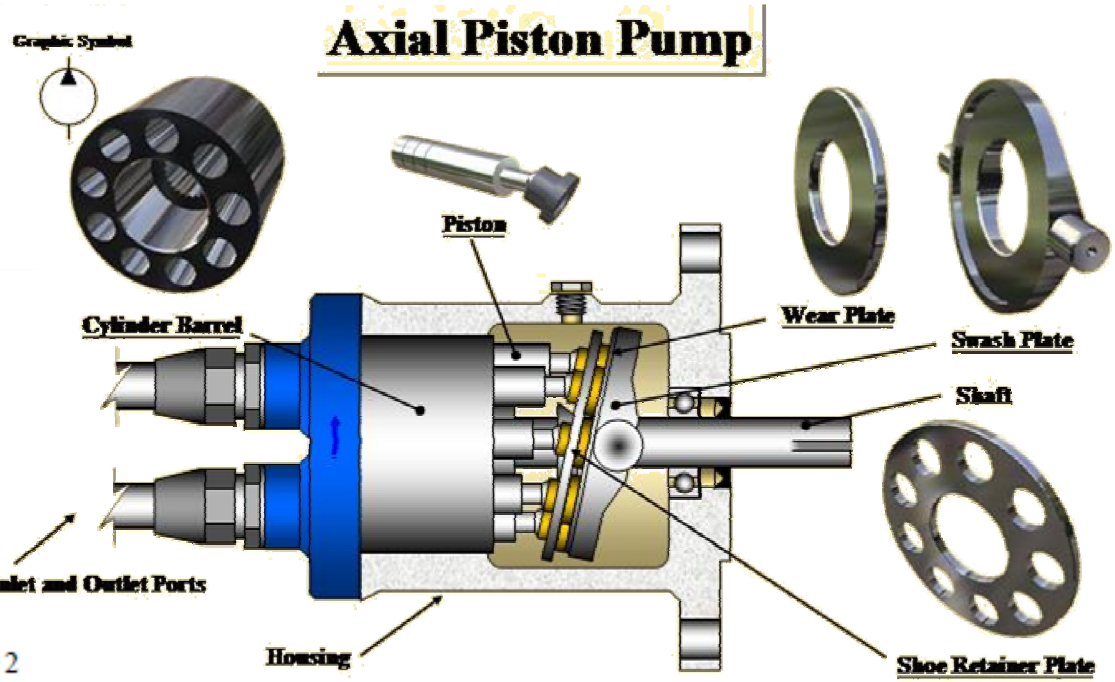
$$d_m = d + e$$

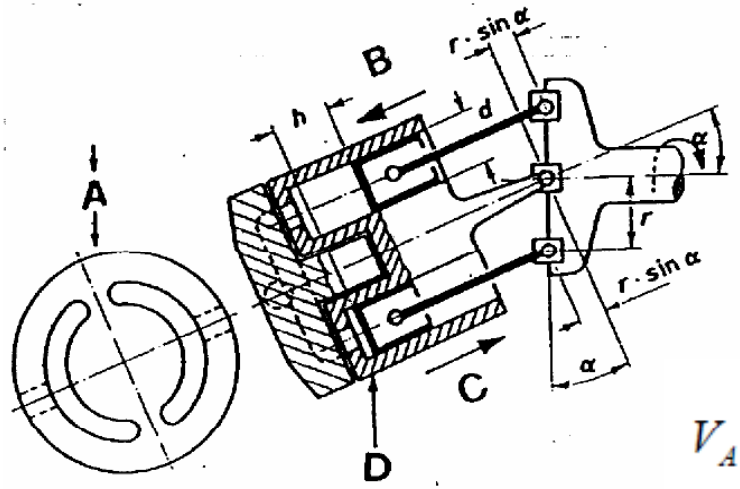


Pompa a pistoni assiali



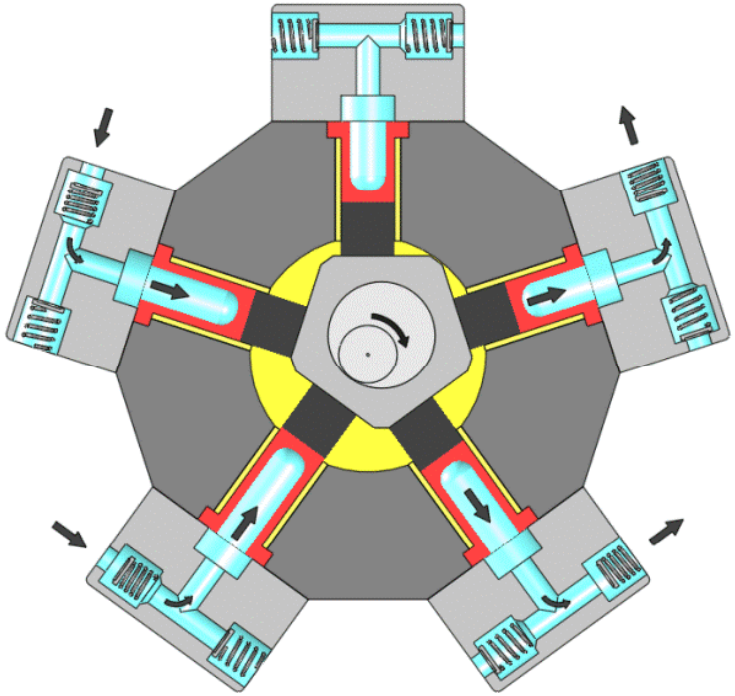






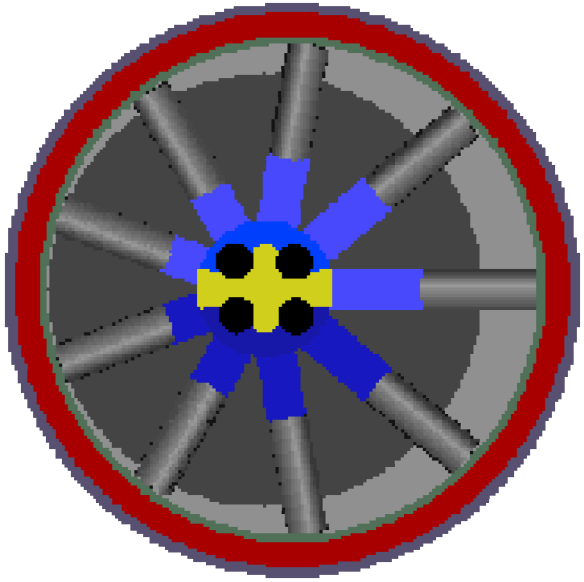
$$V_A = z\frac{\pi d^2}{4} 2r\sin\alpha$$

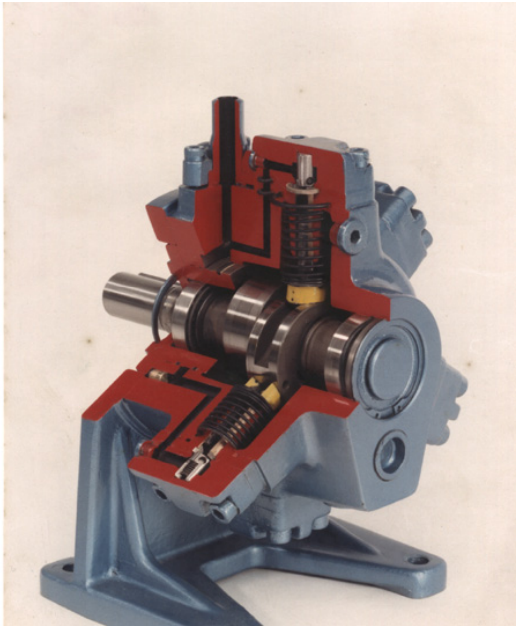
Pompa a pistoni radiali



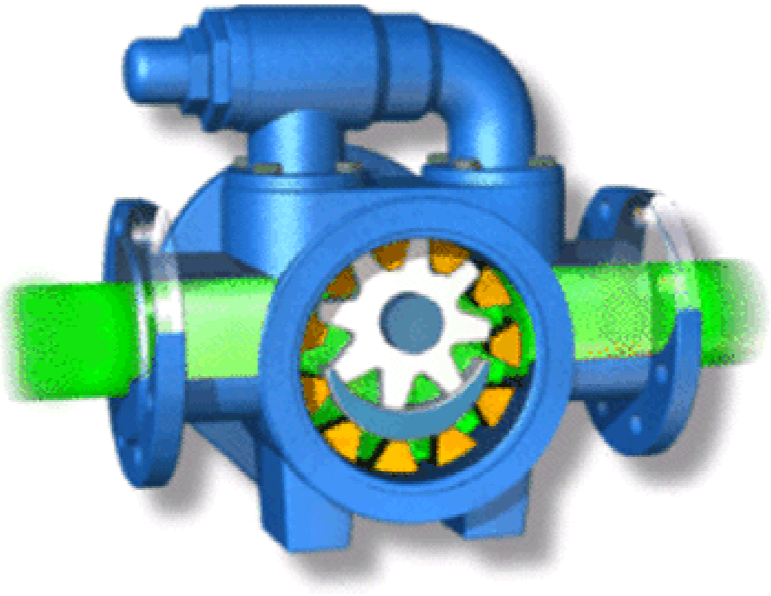
$$V = \frac{1}{2}\pi d^2 e Z$$

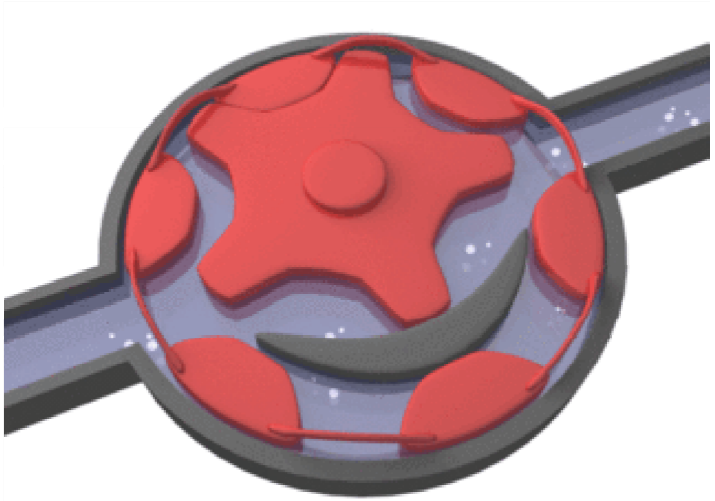
d = alesaggio cilindri



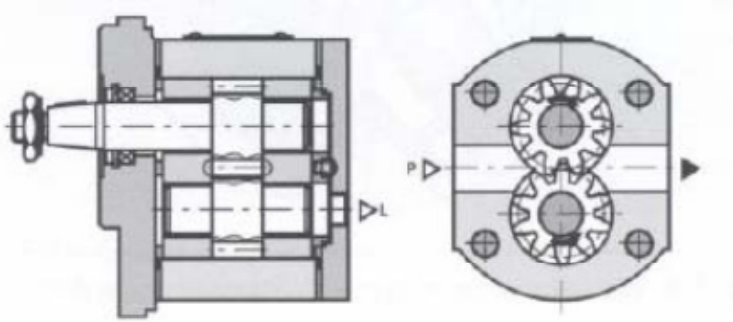
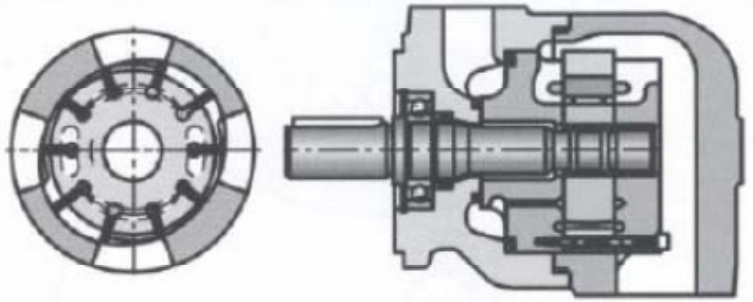
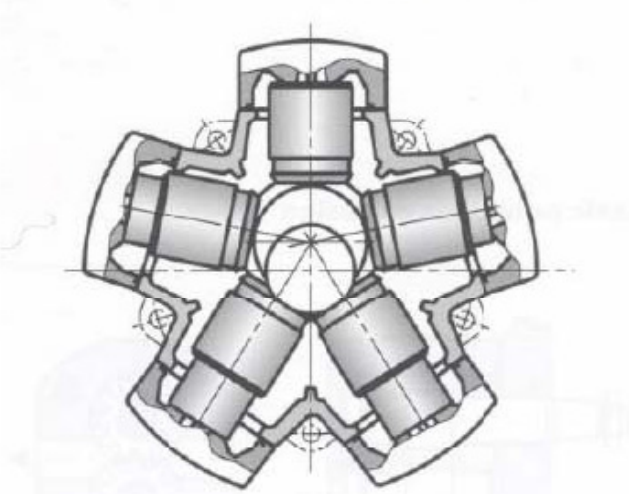


Pompa Orbitale (Gerotor)

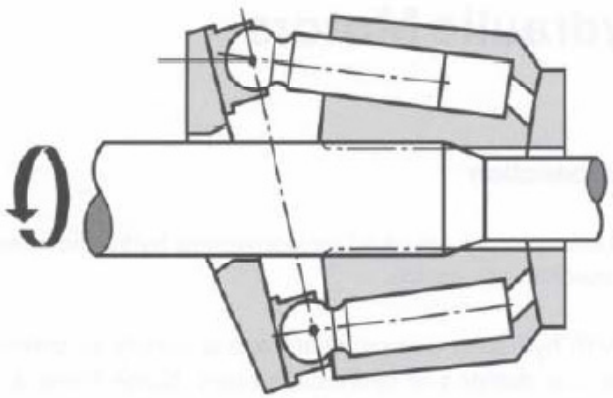
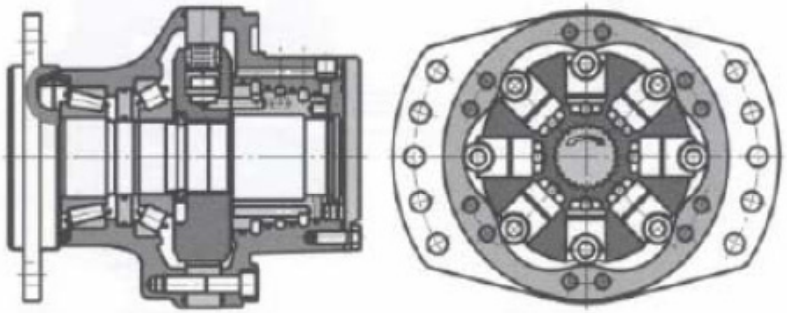
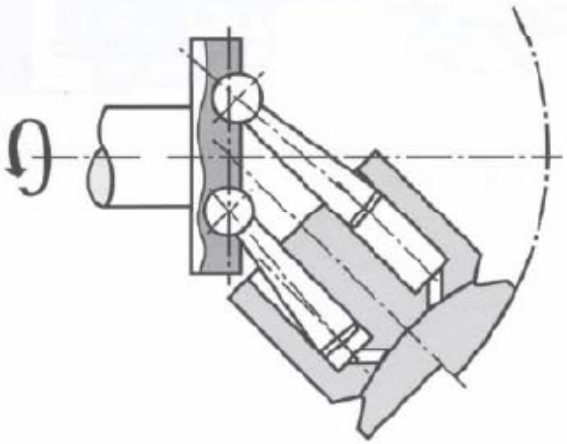




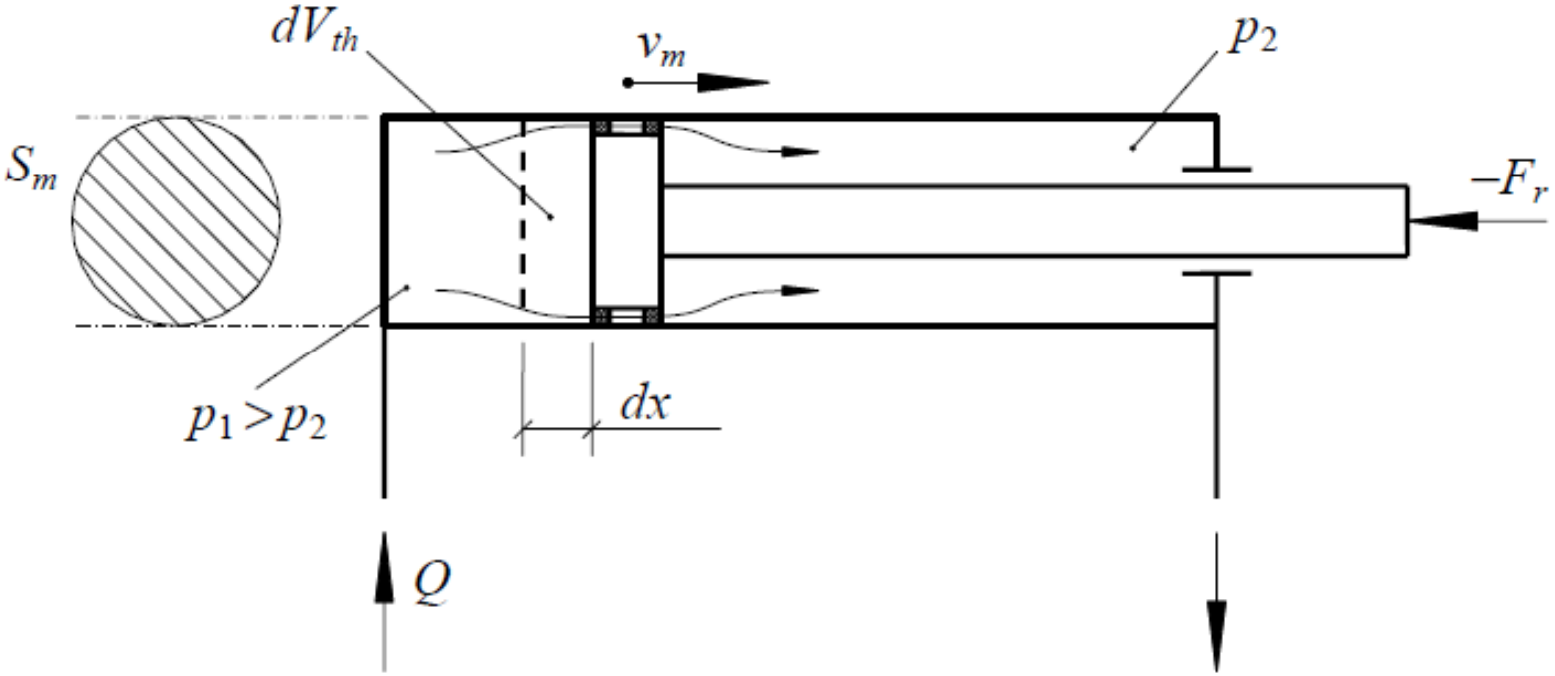
Motori Idraulici

Motore ad ingranaggi	
Motore a palette	
Motore a pistoni radiali con eccentrico interno	

Motori Idraulici

Motore a pistoni assiali con piatto oscillante	
Motore a pistoni radiali con camma esterna	
Motore a pistoni assiali con asse inclinato	

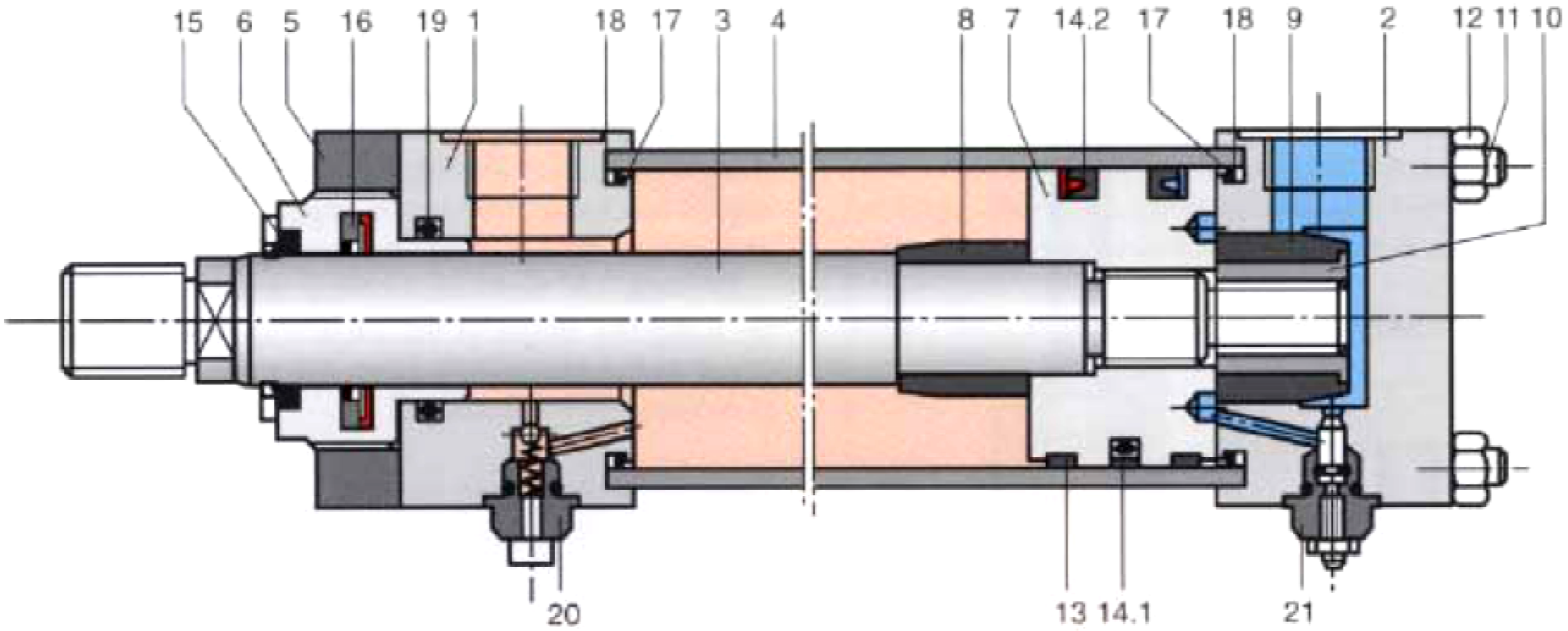
Cilindri Oleodinamici



$$dV_m = \eta_v dV_{th} = \eta_v Q dt, \quad \eta_v < 1$$

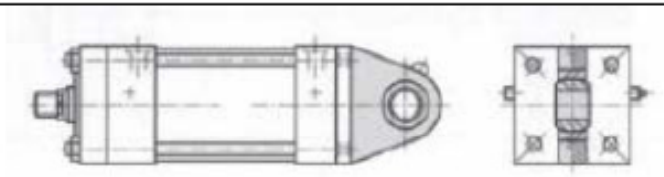
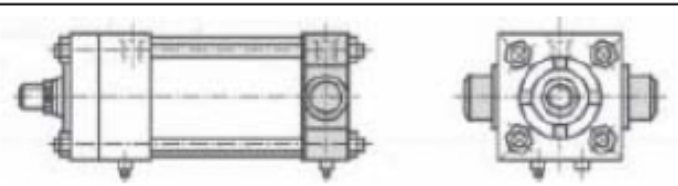
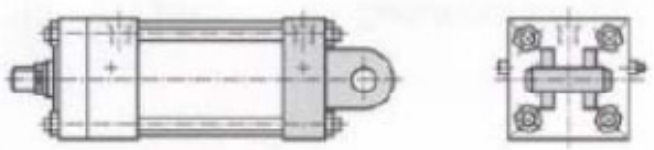
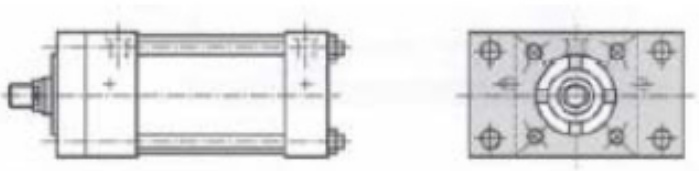
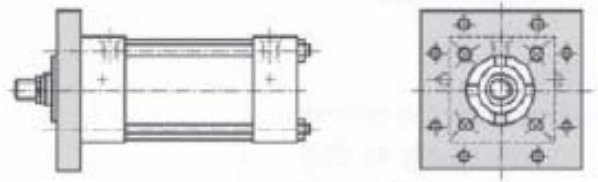
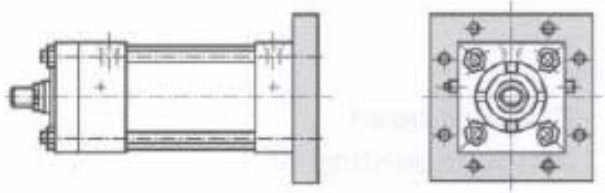
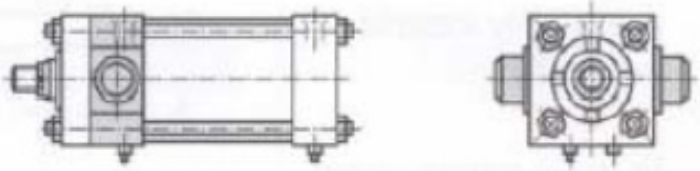
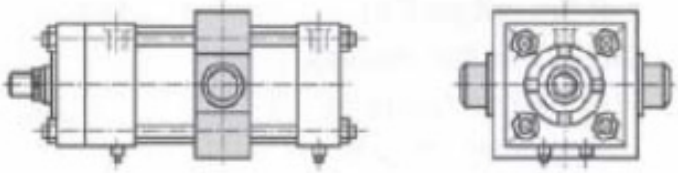
$$dV_m = S_m dx = S_m v_m dt \quad \Rightarrow \quad v_m = \eta_v \frac{Q}{S_m}$$

Cilindri Oleodinamici



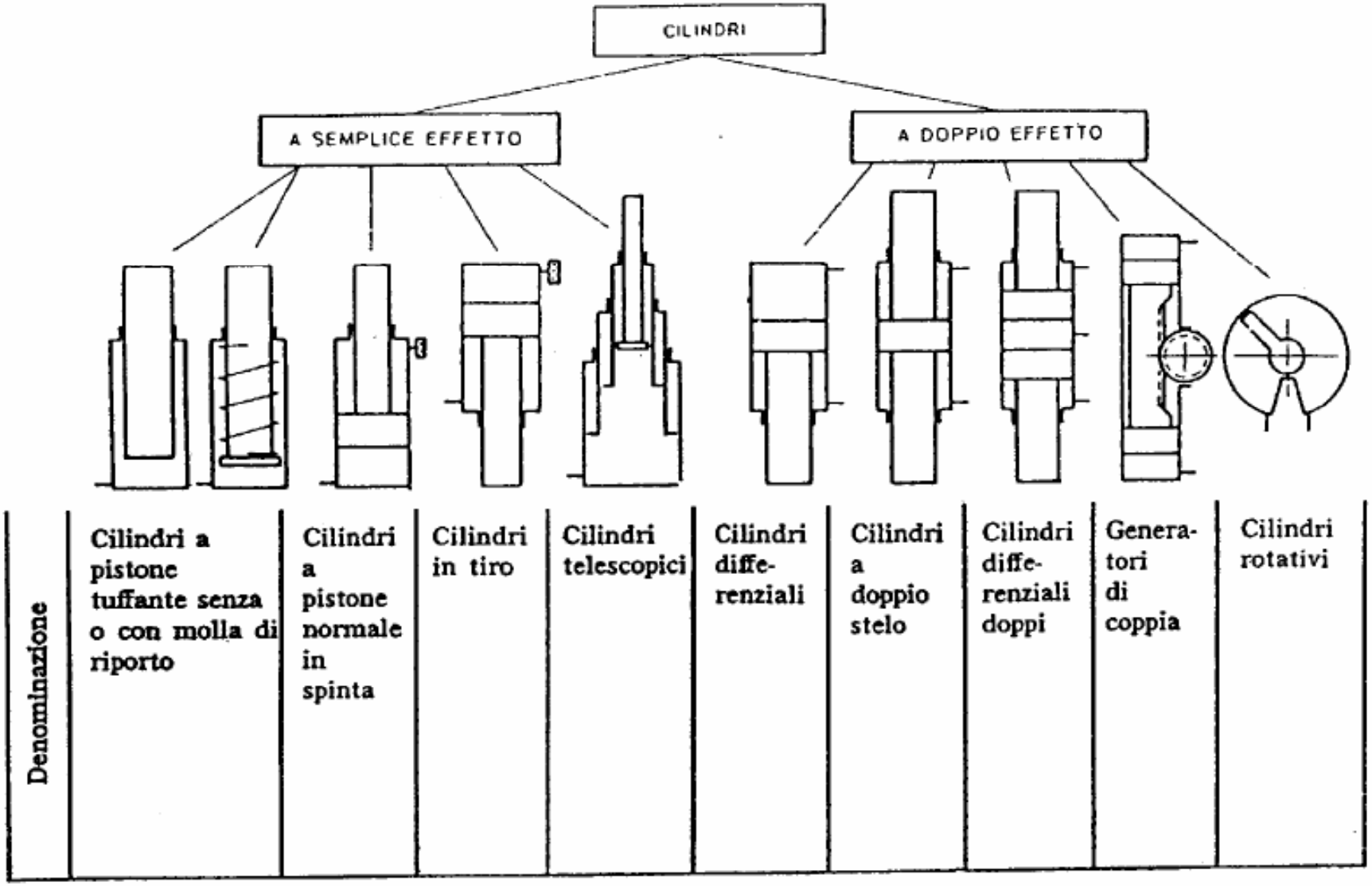
Cilindri Oleodinamici

Sistemi di fissaggio

Staffa semplice alla base		Perni alla base	
Staffa doppia alla base		Montaggio con piedini	
Flangia rettangolare in testa		Flangia quadrata in testa	
Flangia rettangolare alla base		Flangia quadrata alla base	
Perni in testa		Perni al centro	

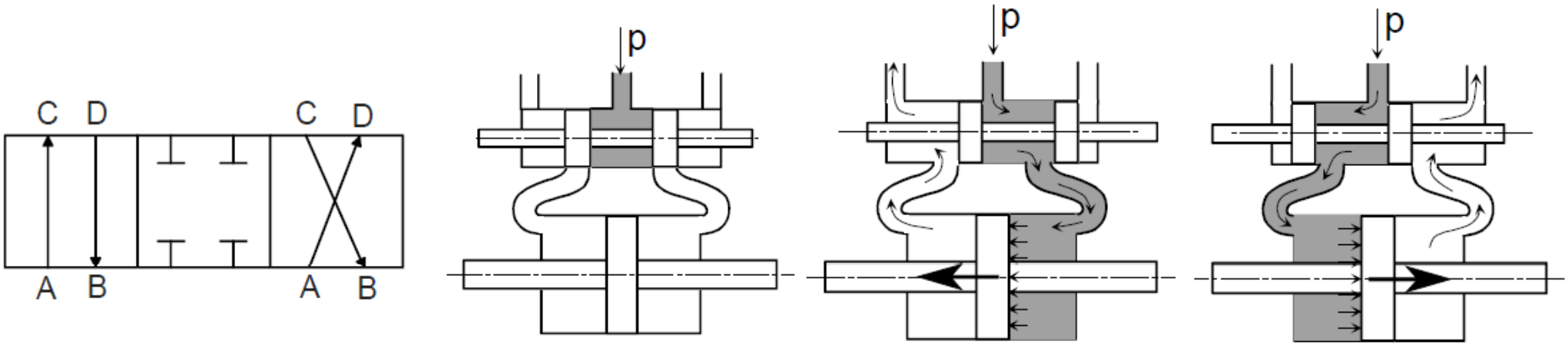
Cilindri Oleodinamici

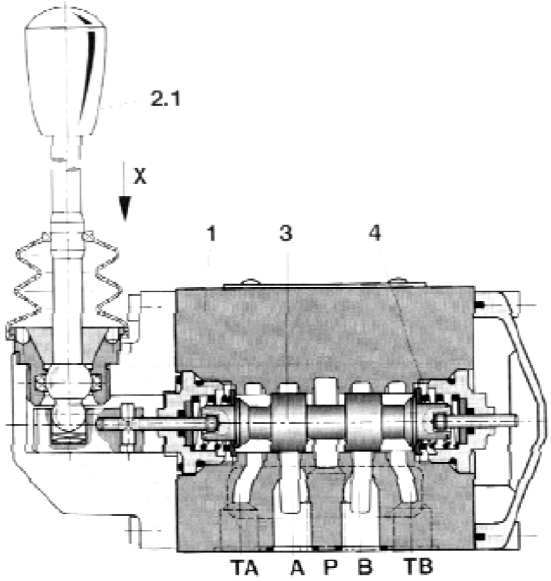
Tipo di movimento



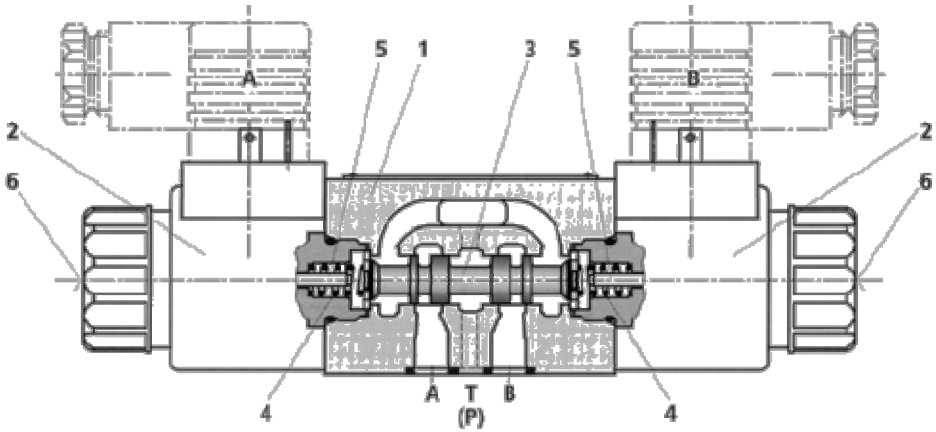
Altri componenti

Valvole di distribuzione





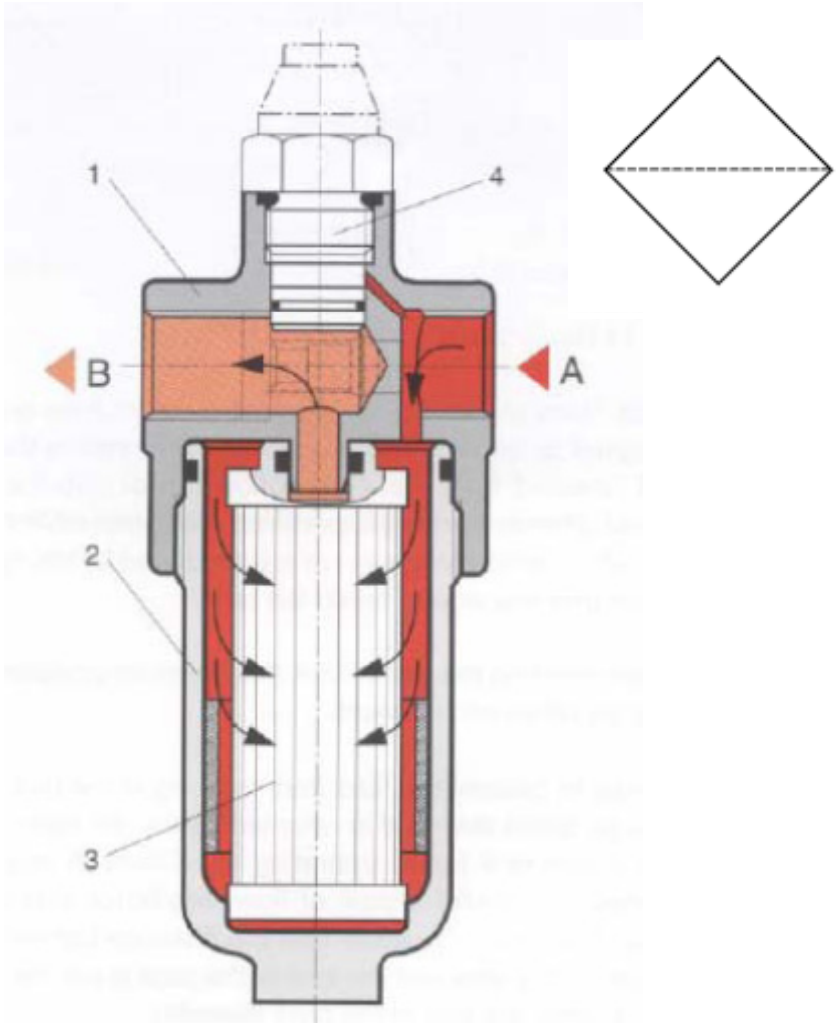
a) distributore 4/3 a comando manuale



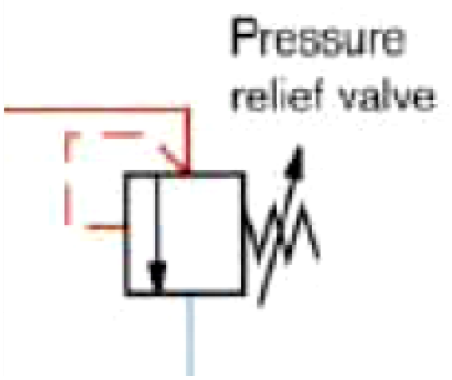
b) distributore 4/3 con solenoidi

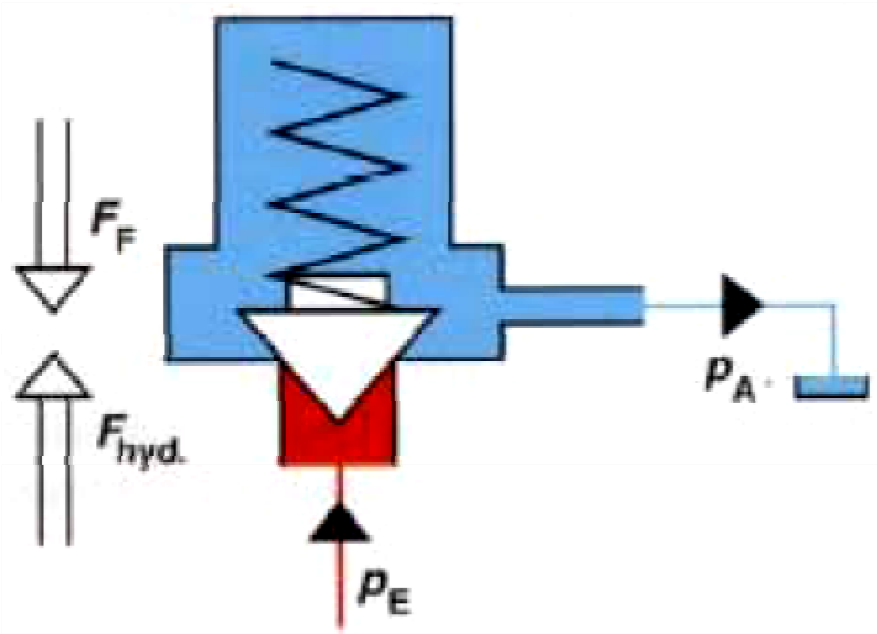
Altri componenti

Filtri



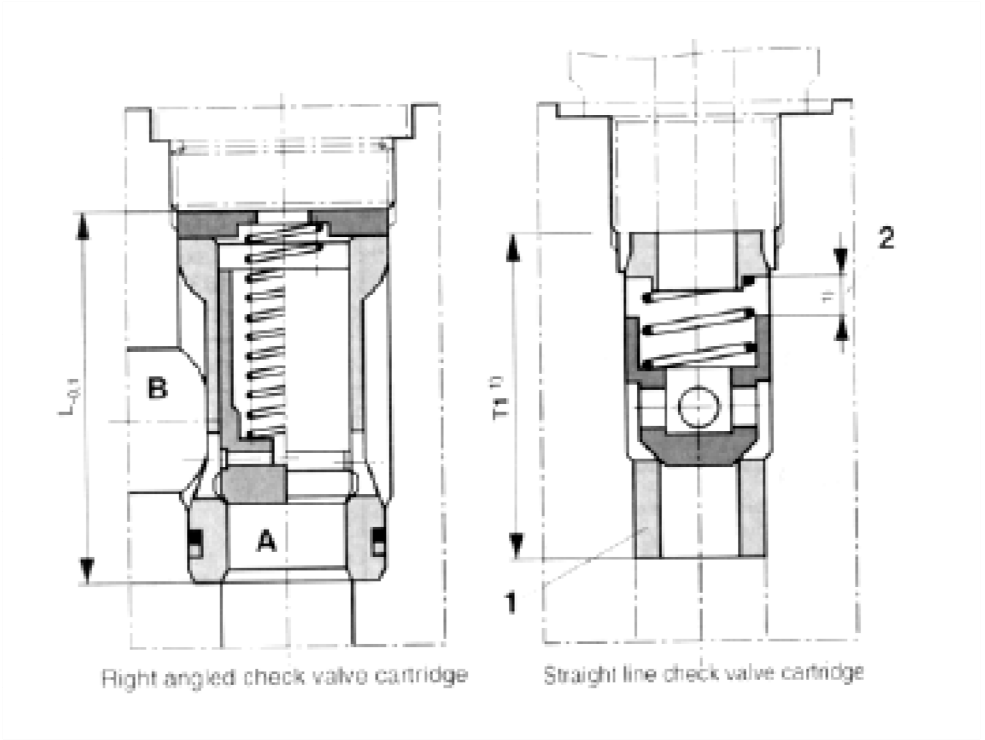
Limitatori di pressione

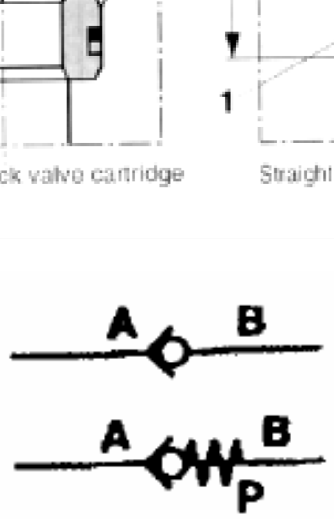




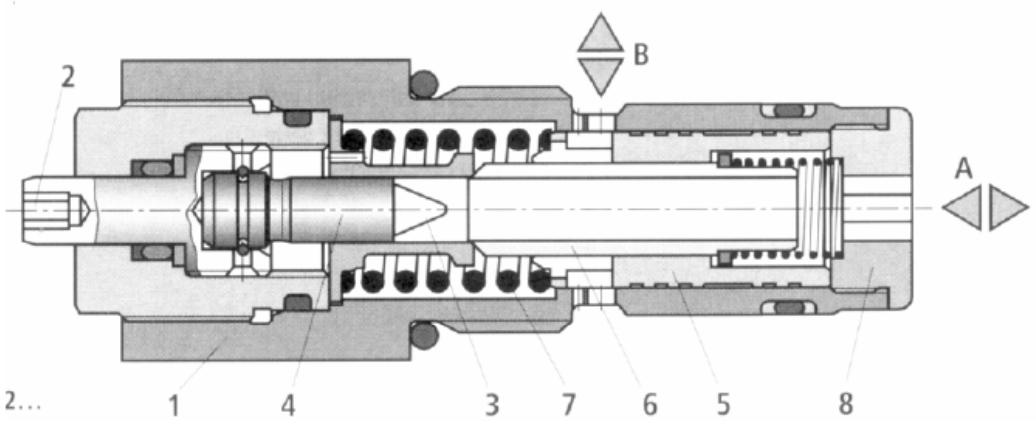
Altri componenti

Valvole di non ritorno

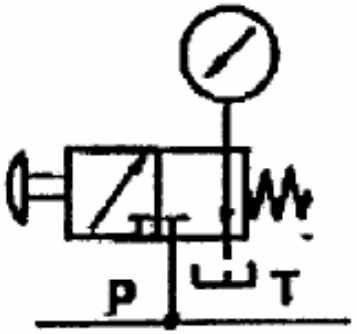




Regolatori di portata

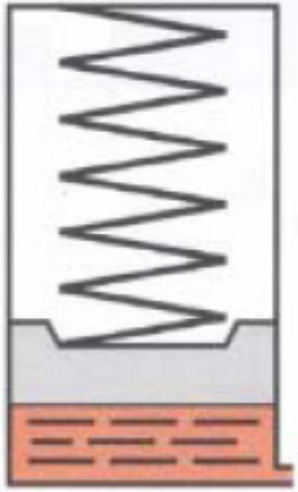


Manometri



Altri componenti

Accumulatori

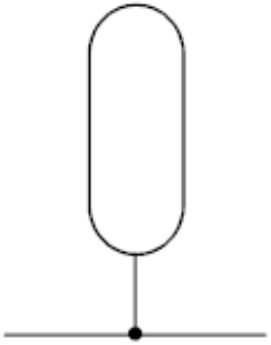


Elemento separatore tra gas e liquido

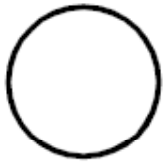
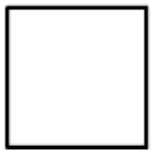
pistone

sacca

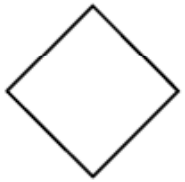
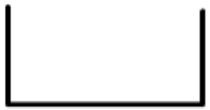
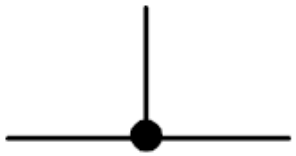
membrana



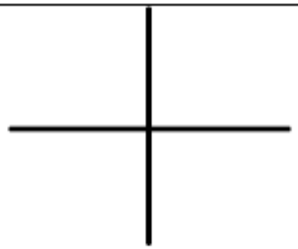
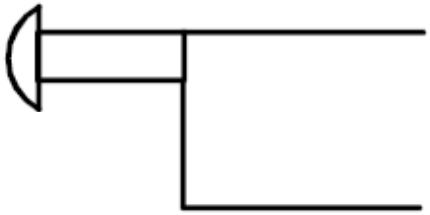
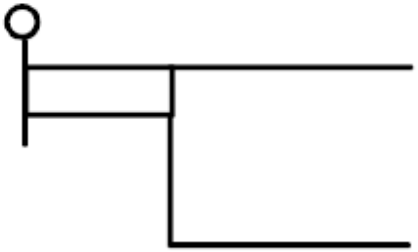
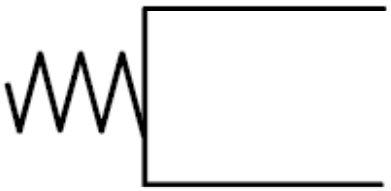
Simbologia (da UNI ISO 1219)

	Condotta di lavoro, condotta di pilotaggio dell'alimentazione, condotta di ritorno, condotta elettrica
	Condotta di pilotaggio (comando) interna e esterna. Condotta di drenaggio, spurgo o scarico. Filtro. Posizioni intermedie.
	Inquadramento di due o più funzioni riunite in un solo blocco o in una sola unità di montaggio.
	Connessioni meccaniche (albero, leva, stelo di pistone).
	Apparecchi di conversione dell'energia (pompa, compressore, motore).
	Strumenti di misura.
	Valvola di ritegno, giunto rotante, connessione meccanica, rotella (sempre con un punto al centro).
	Componenti di comando.

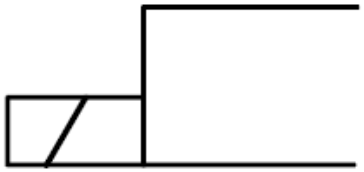
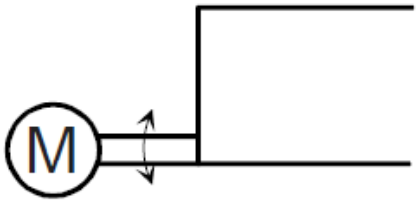
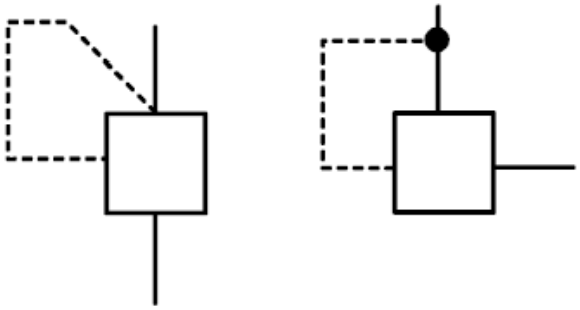
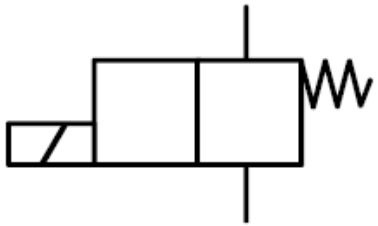
Simbologia (da UNI ISO 1219)

	Apparecchi di condizionamento (filtro, separatore, lubrificatore, scambiatore di calore).
	Serbatoio.
	Oleoidraulico.
	Pneumatico.
	Raccordo.

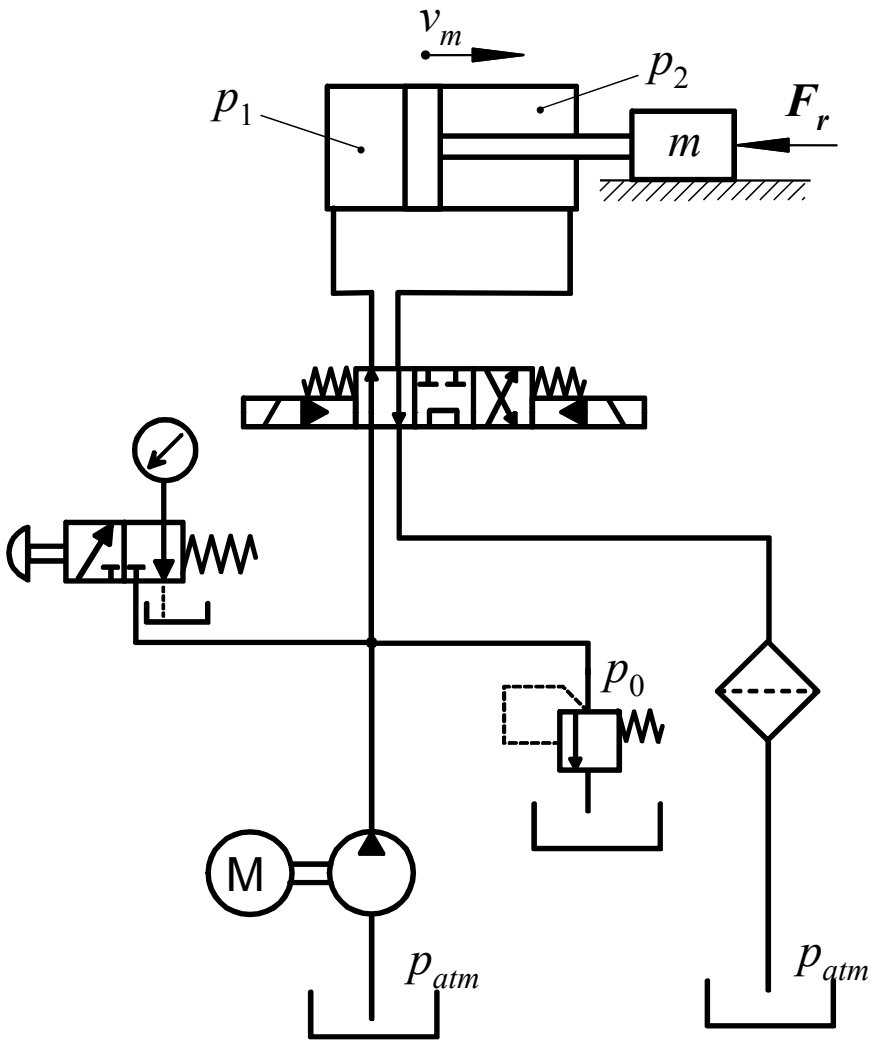
Simbologia (da UNI ISO 1219)

	Incrocio senza connessione.
	Comando manuale (pulsante).
	Comando manuale (leva).
	Comando meccanico (molla).

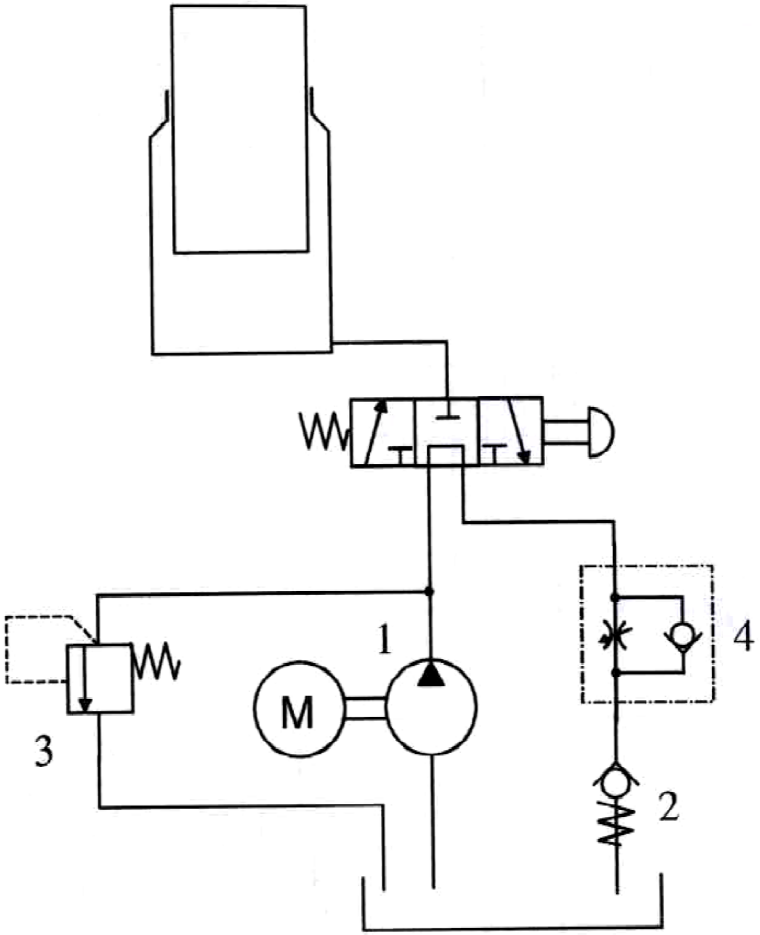
Simbologia (da UNI ISO 1219)

	Comando elettrico (con 1 bobina).
	Motore elettrico.
	Comando mediante applicazione o scarico della pressione. a) la via del comando è situata all'interno dell'unità; b) la via del comando è situata all'esterno dell'unità.
	Regole di applicazione dei simboli di comandi multipli nei simpoli completi di apparecchiature. I simboli dei tipi di comando unidirezionale sono rappresentati adiacenti al simbolo dell'elemento comandato, in modo tale che le forze immaginarie agenti sul simbolo siano tali da muoverlo in un'altra posizione.

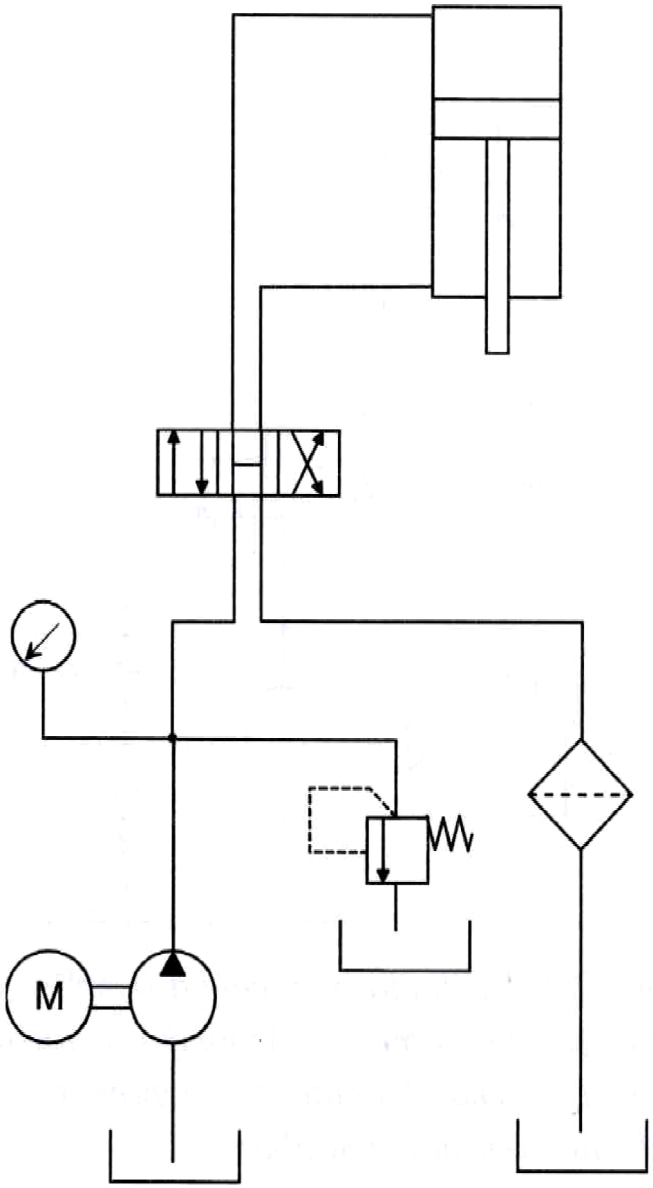
Circuiti elementari



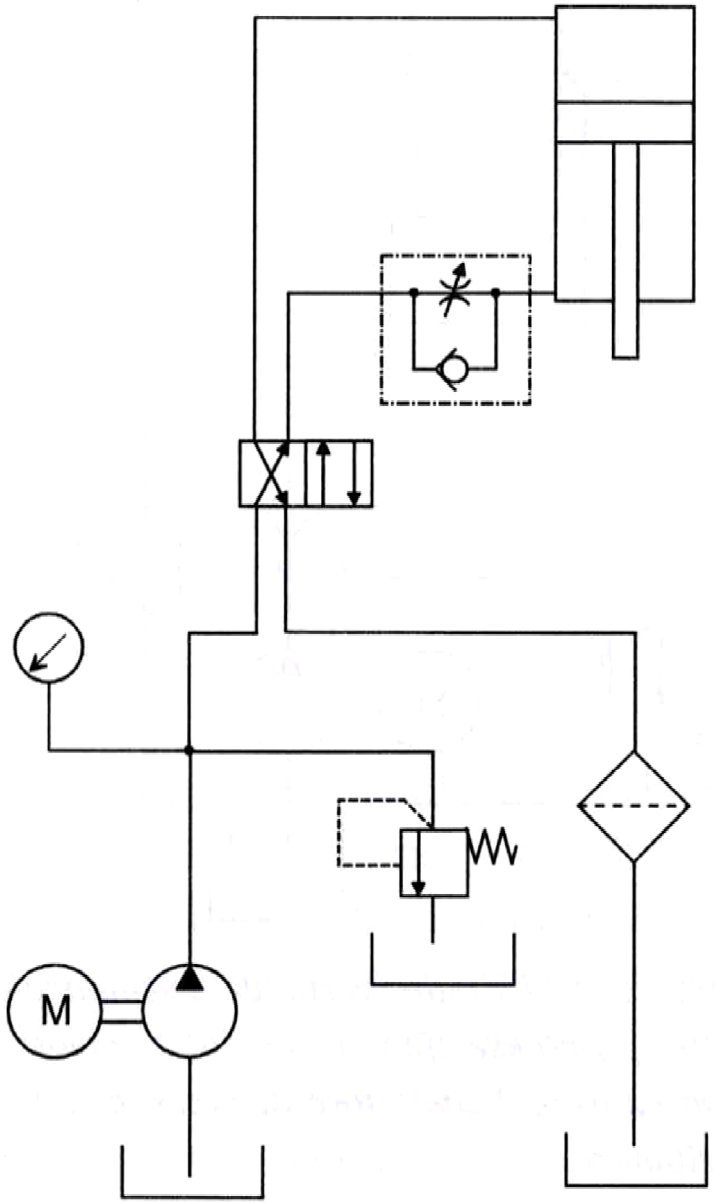
Circuiti elementari



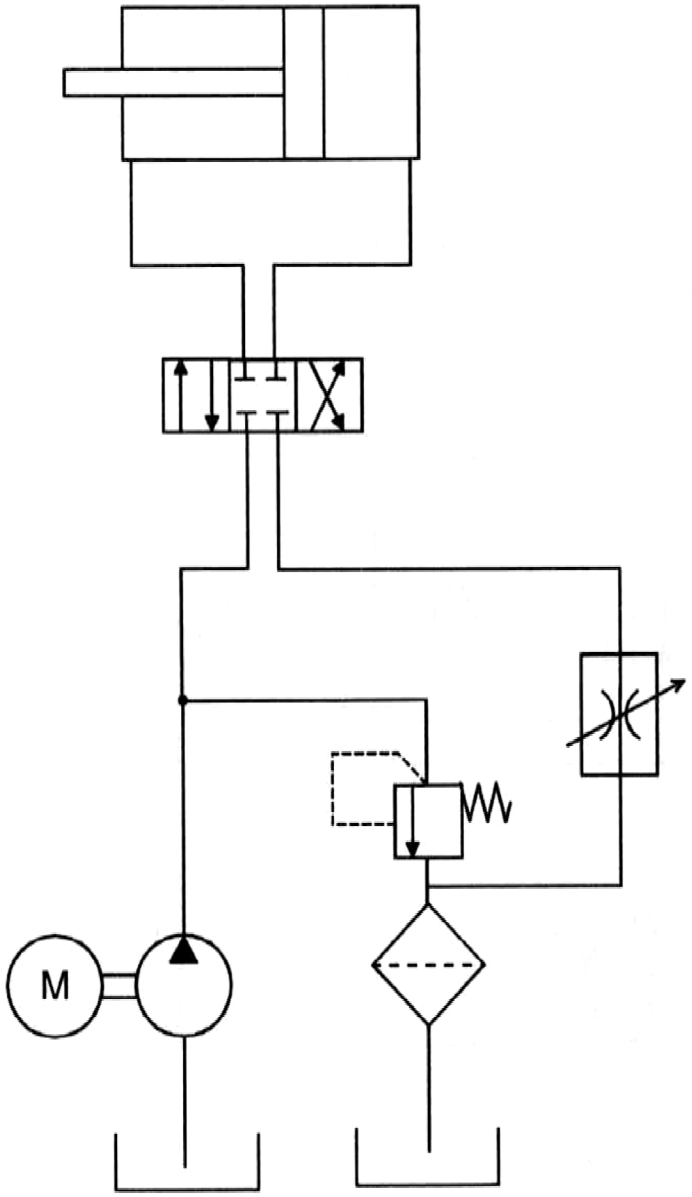
Circuiti elementari



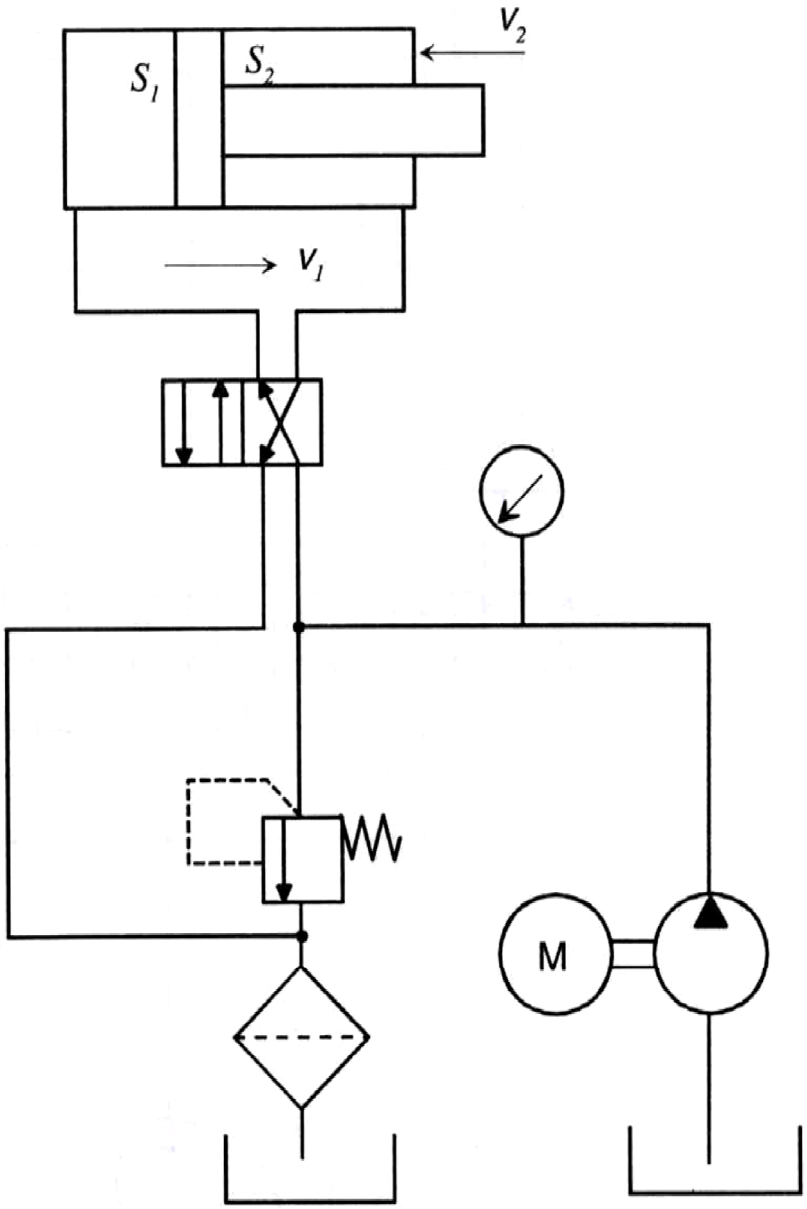
Circuiti elementari



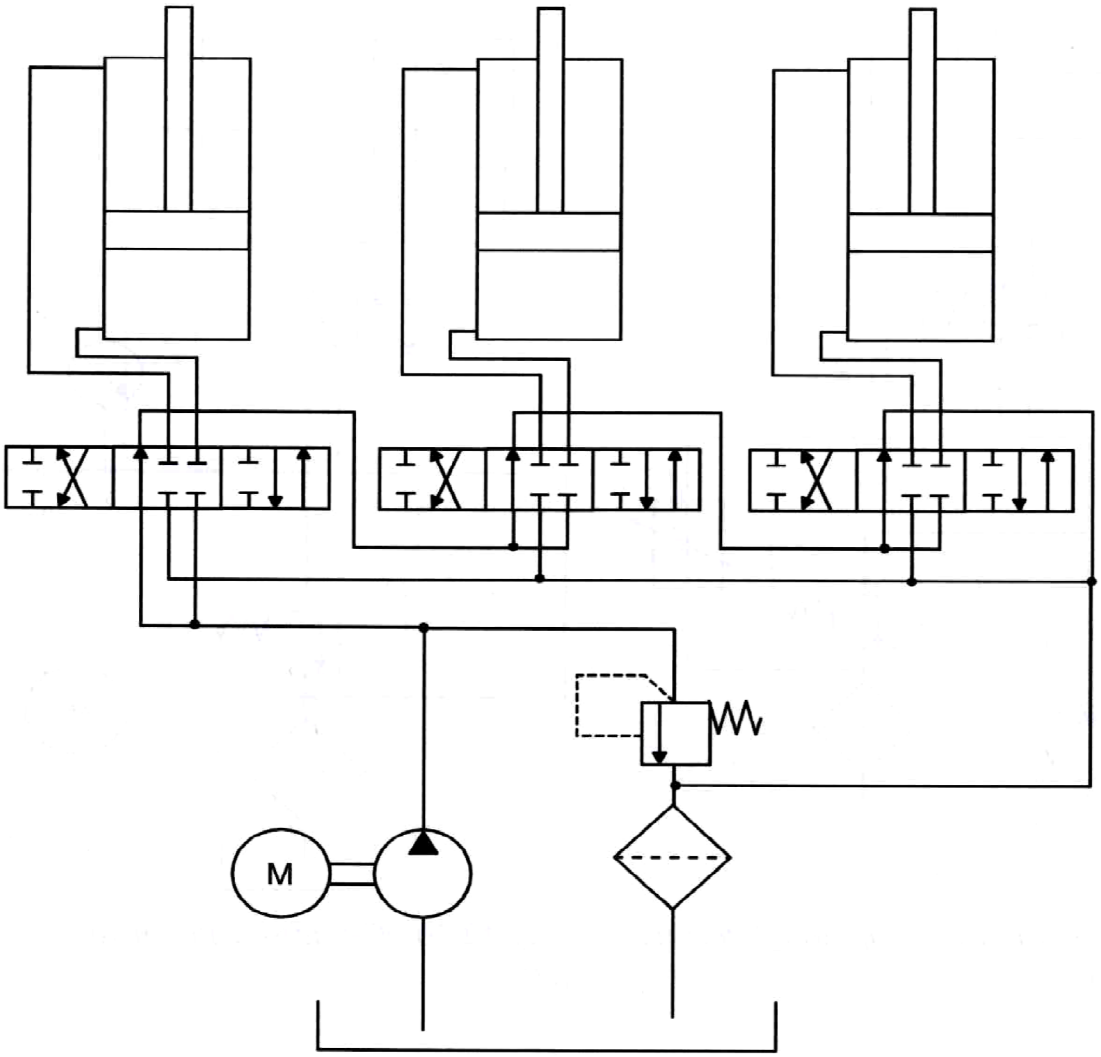
Circuiti elementari



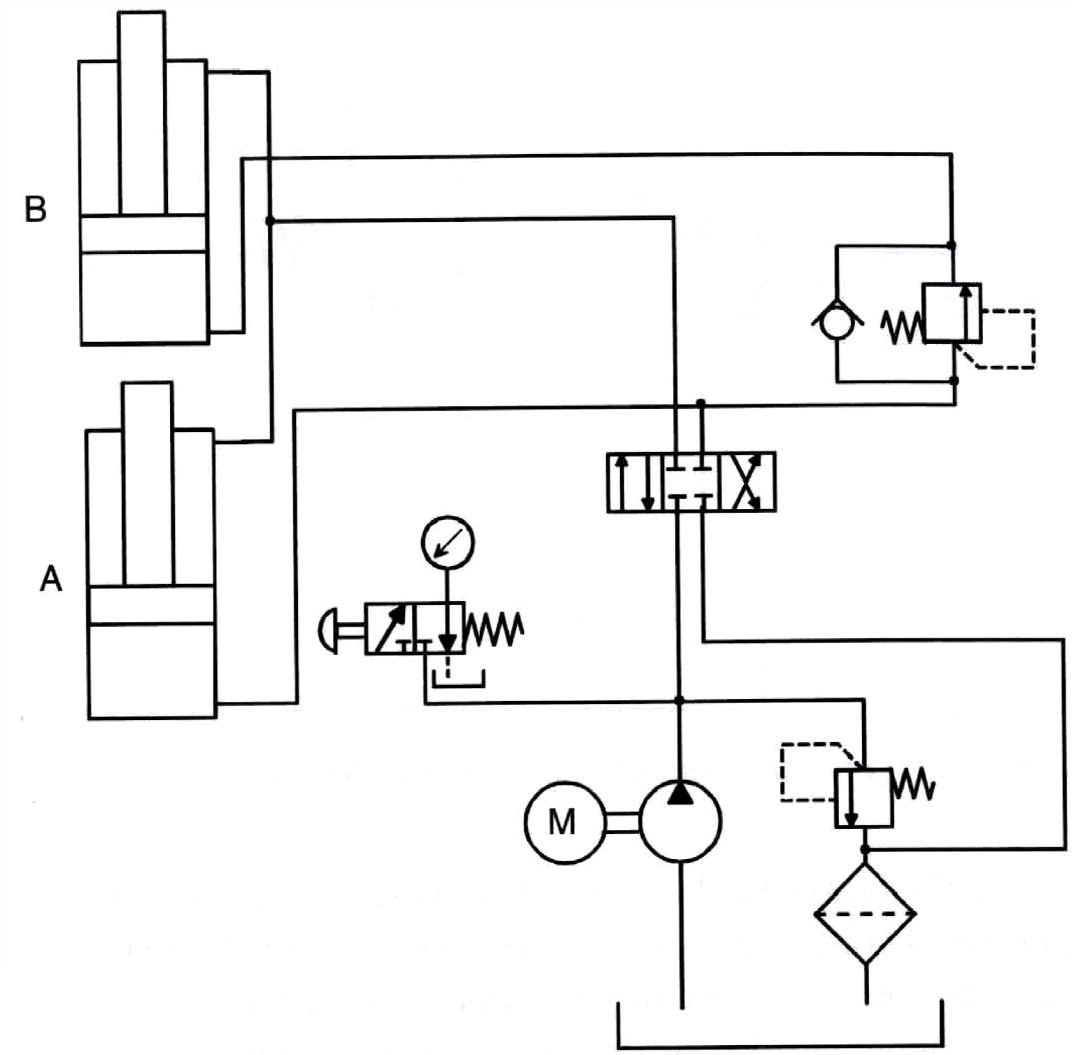
Circuiti elementari



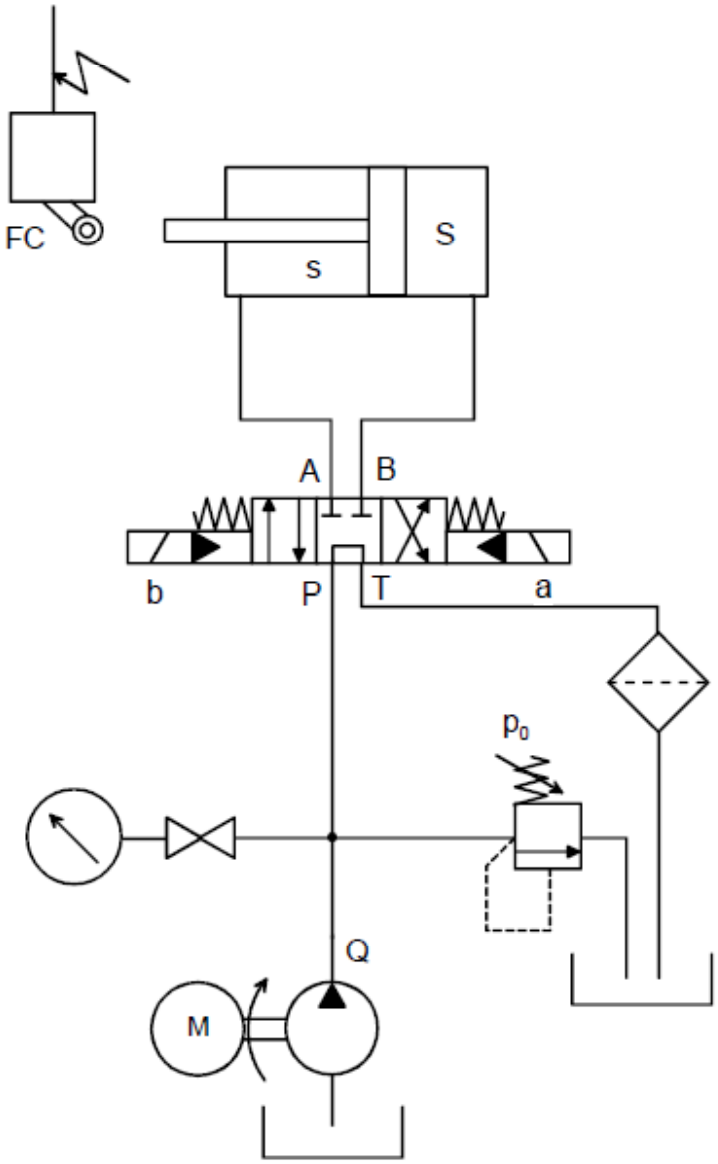
Circuiti elementari



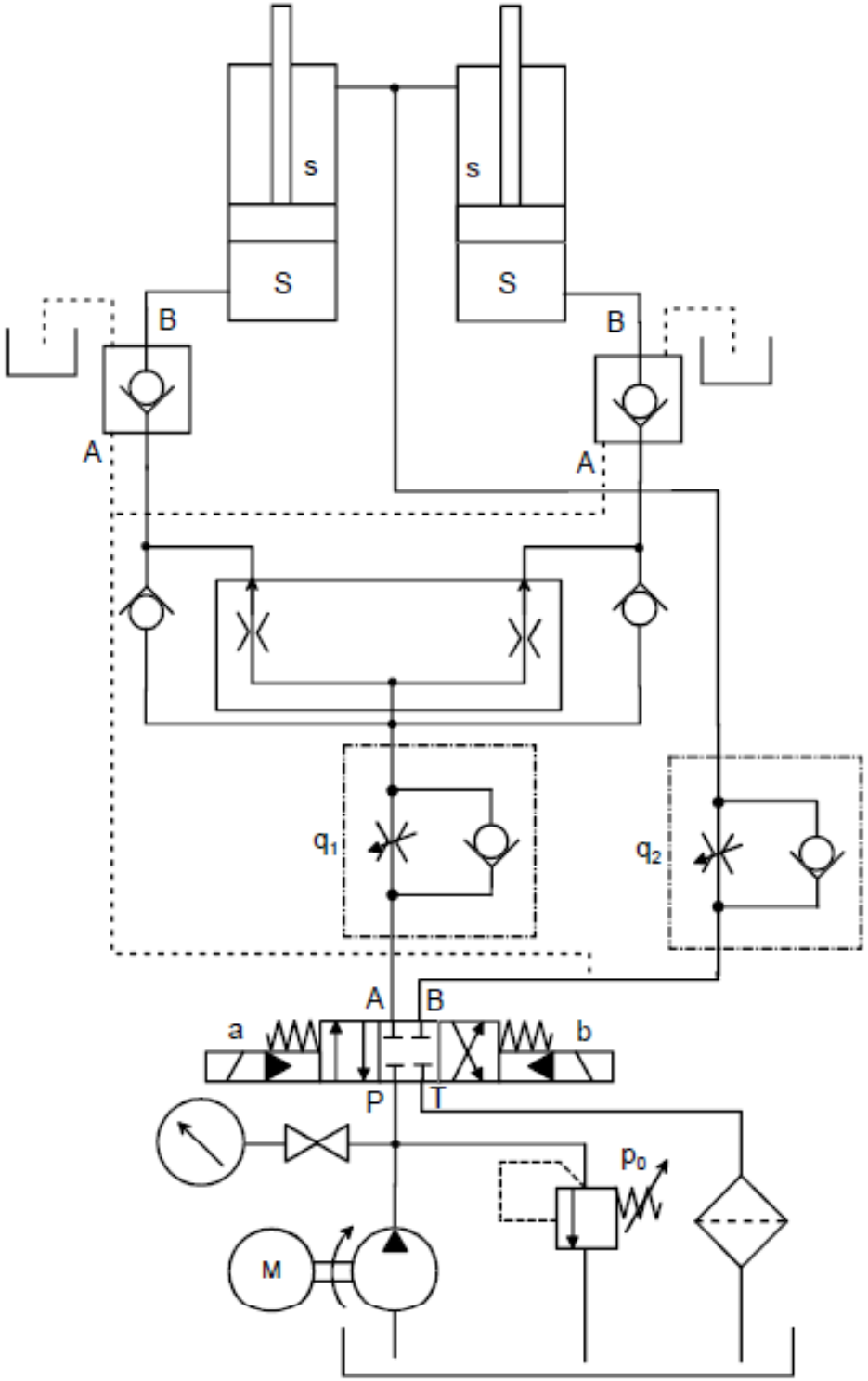
Circuiti elementari



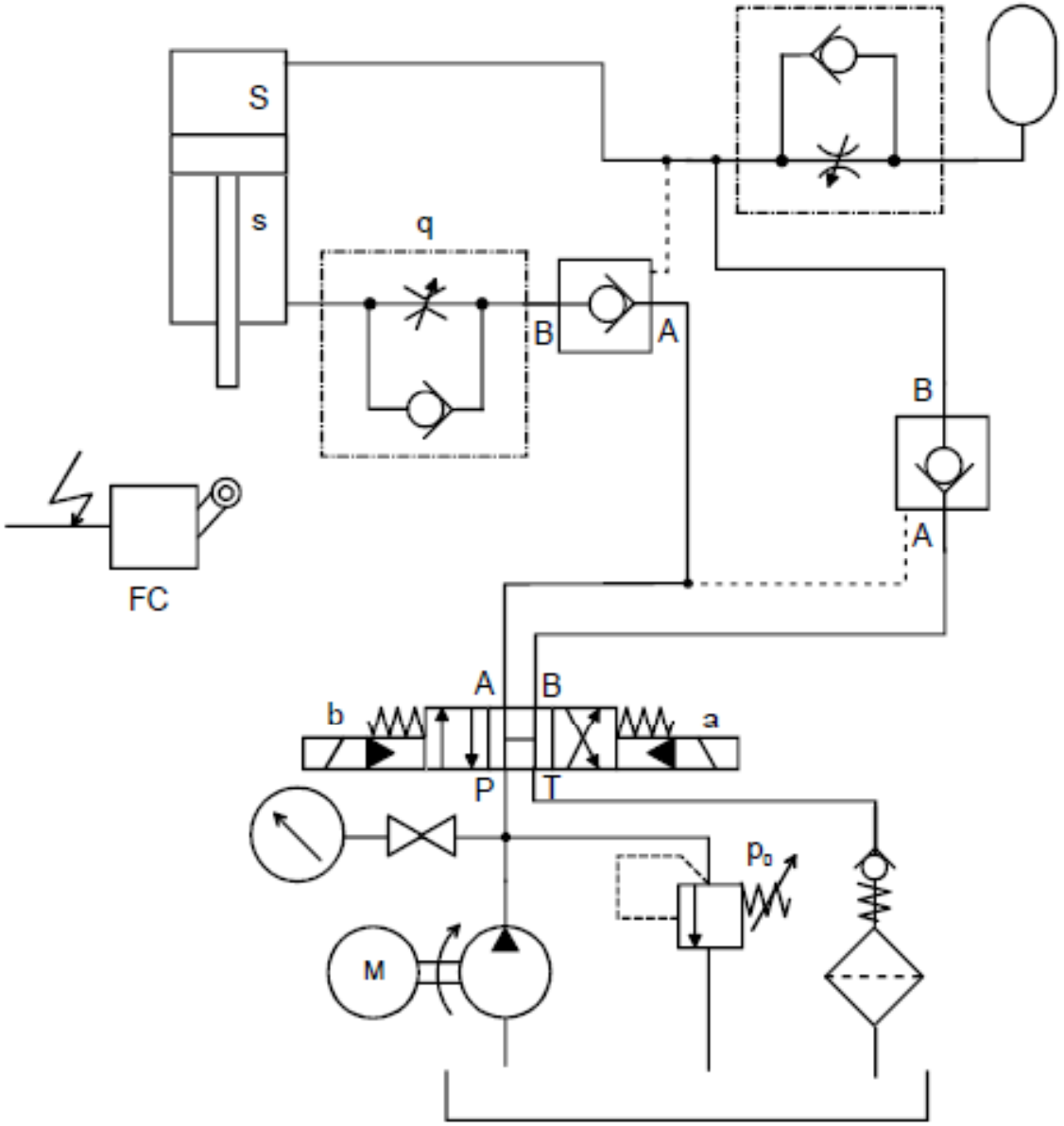
Circuiti elementari



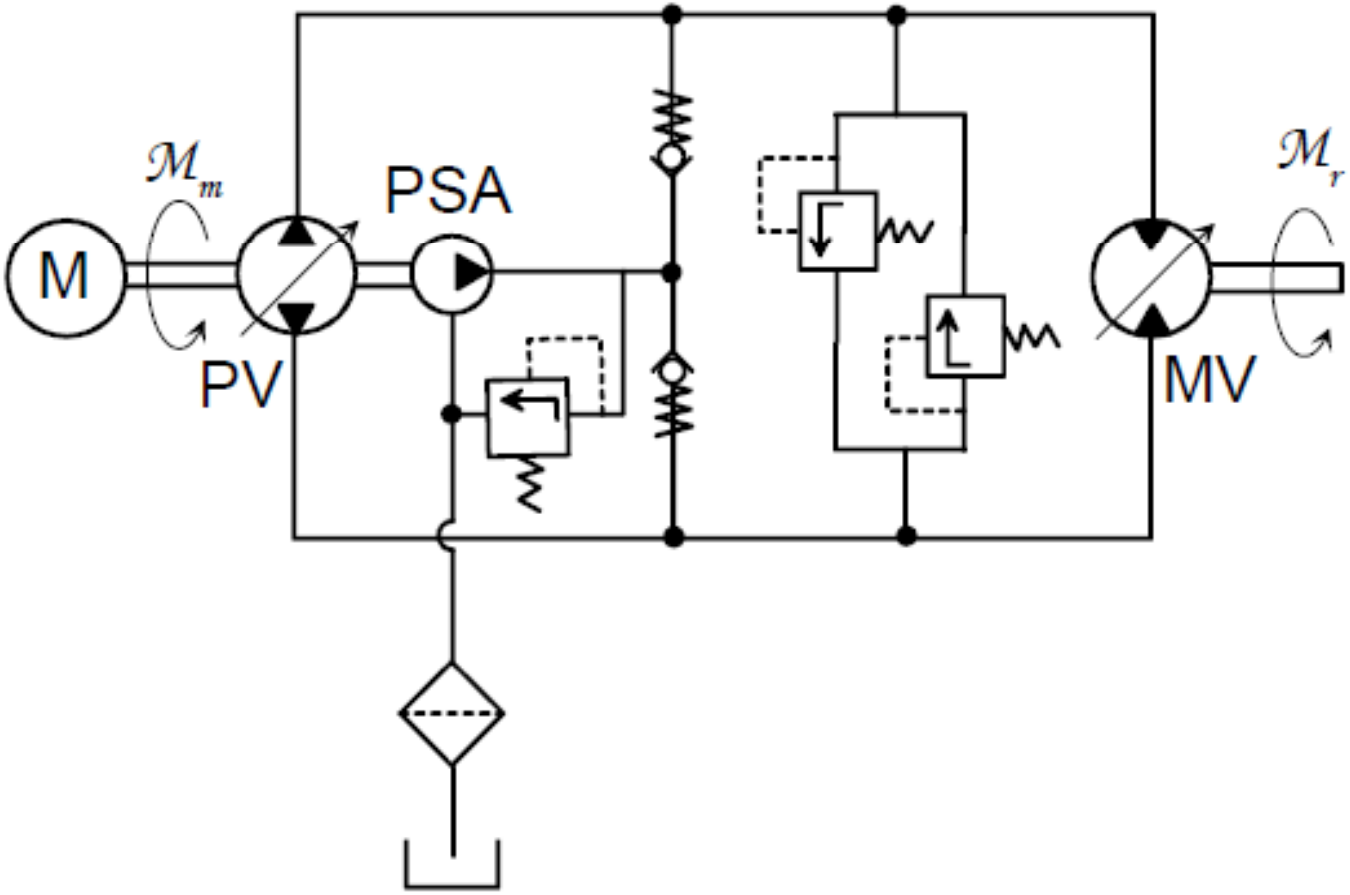
Circuiti elementari



Circuiti elementari



Trasmissioni idrostatiche



Bibliografia

- E. Funaioli, A. Maggiore, U. Meneghetti, *Lezioni di Meccanica Applicata alle Macchine - Seconda Parte: Elementi di Meccanica degli Azionament*i, Patron, Bologna, 2009.
- U. Belladonna, *Elementi di Oleodinamica,* Hoepli, Milano, 2001
- H. Speich, A. Bucciarelli, *Manuale di Oledinamica,* Tecniche Nuove, Milano, 2002.
- B. Allotta, L. Pugi, *Meccatronica: Azionamenti Elettrici e Oleodinamici,* Progetto Leonardo – Esculapio Editore, Bologna, 2012
- Manuale di Oleodinamica (SMC Italia S.p.a.), scaricabile all'indirizzo: http://ebookbrowse.com/manuale-di-oleodinamica-pdf-d127892937