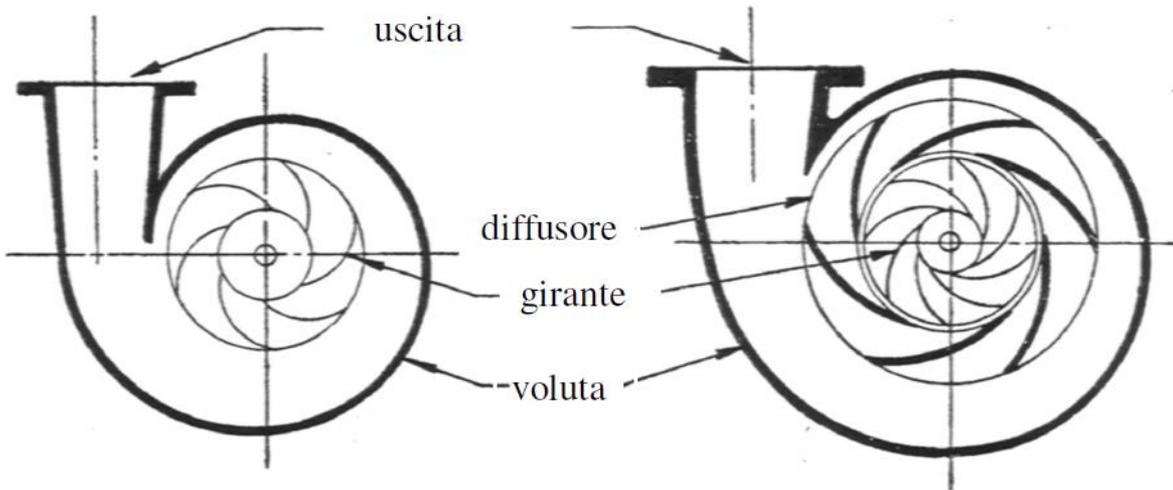
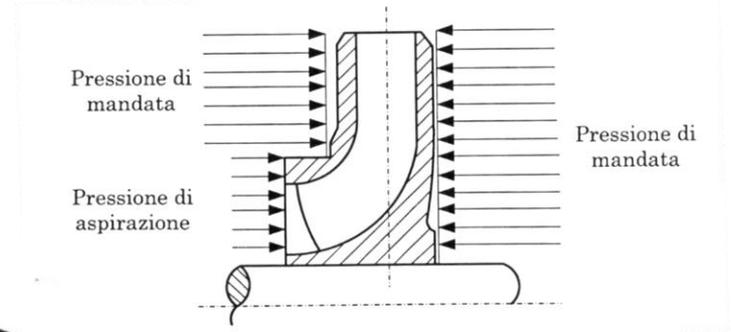
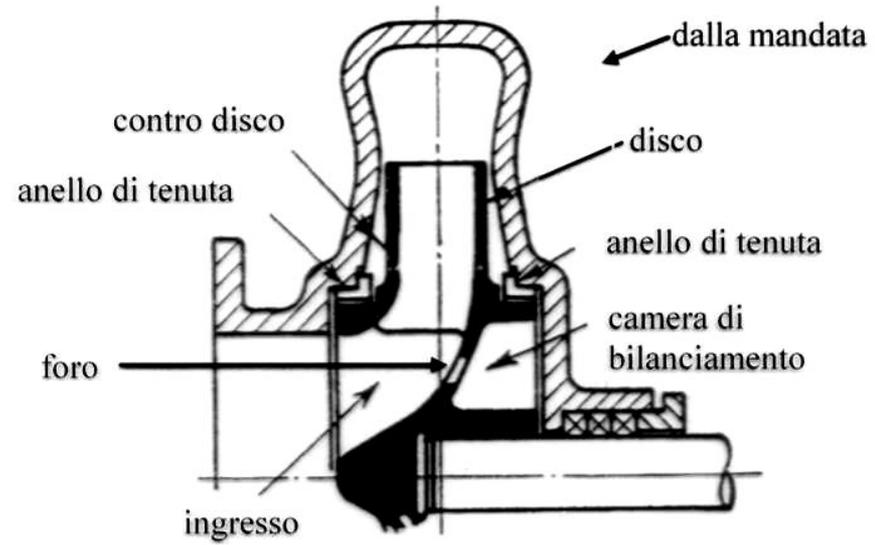
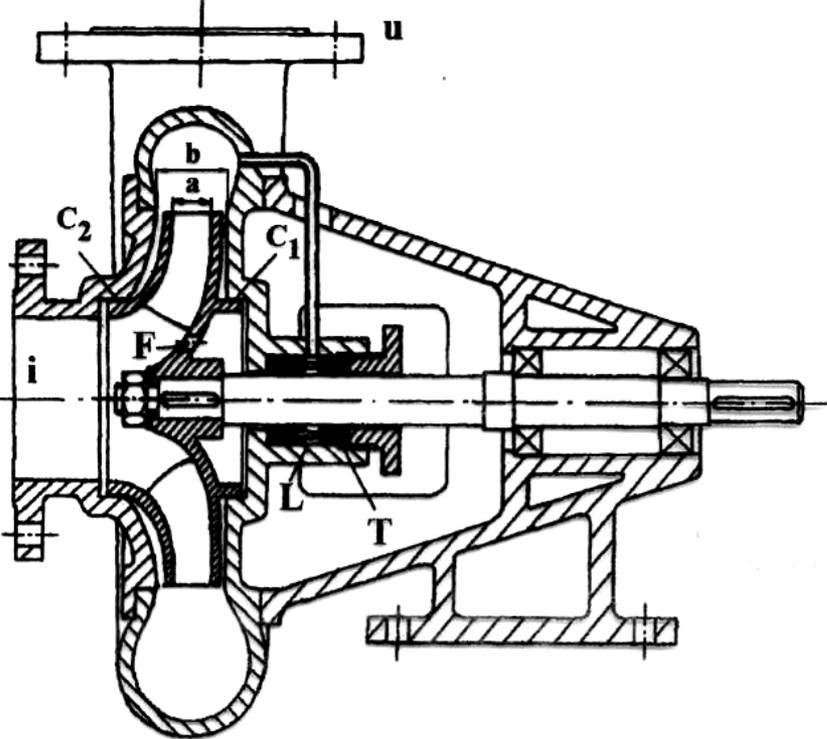
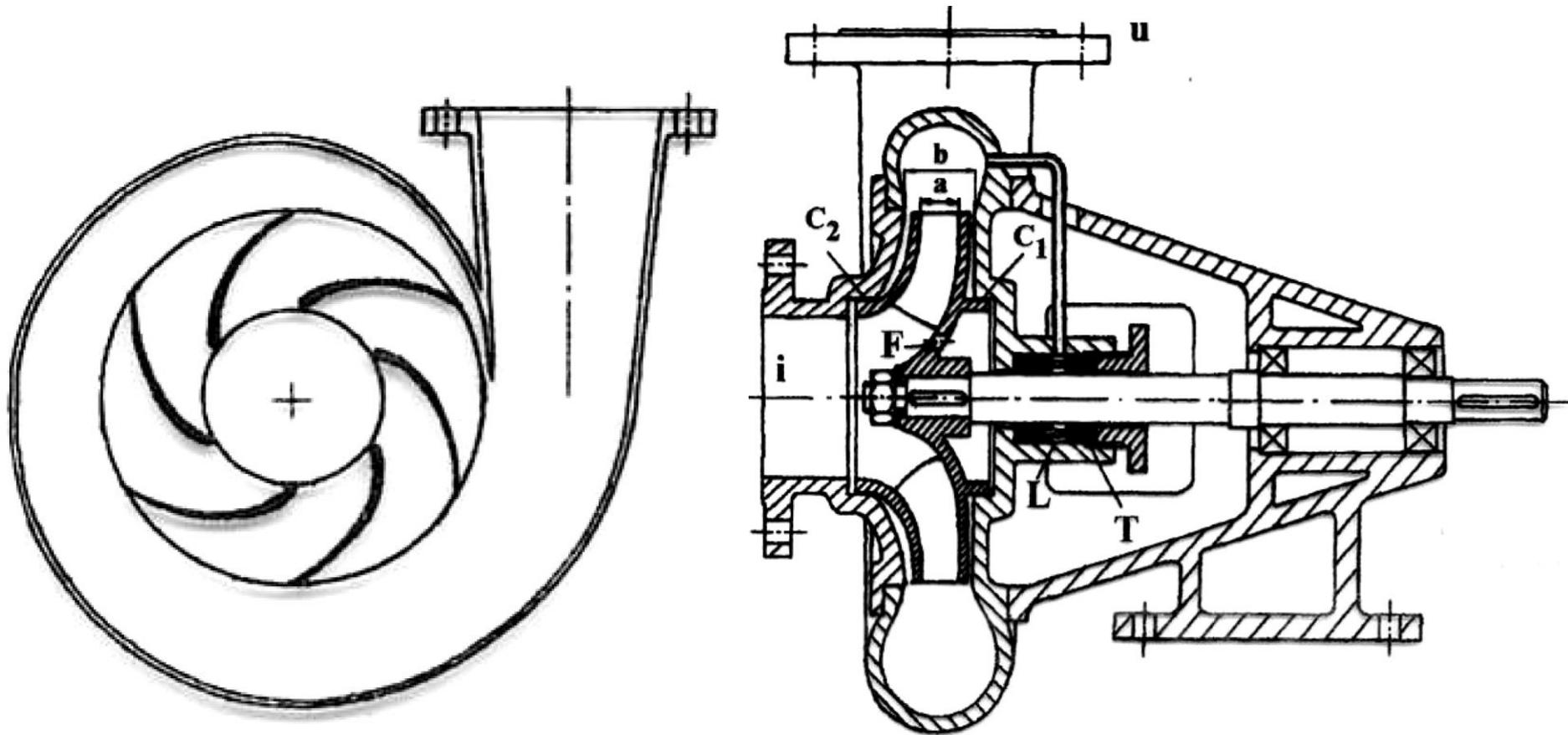
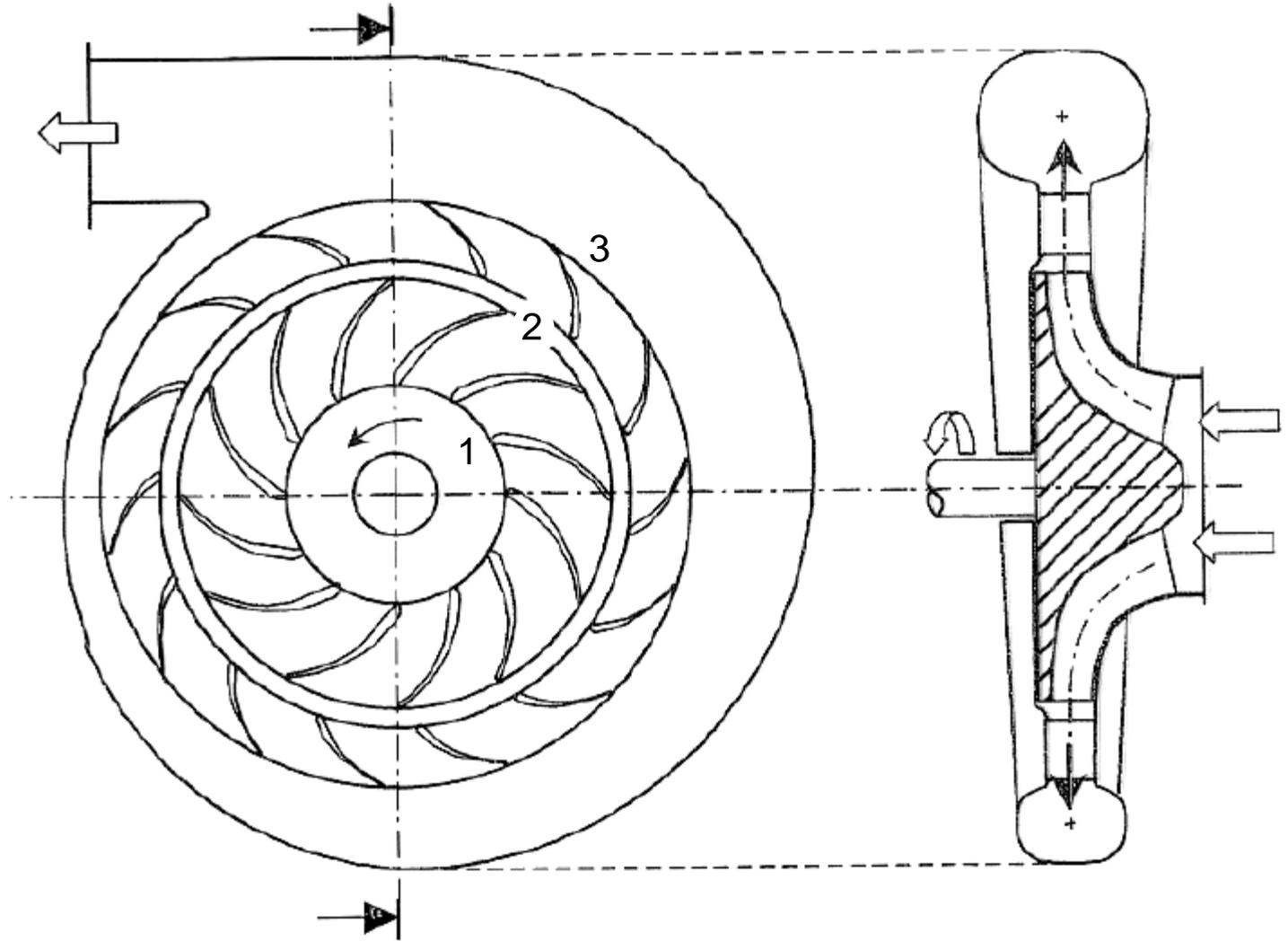
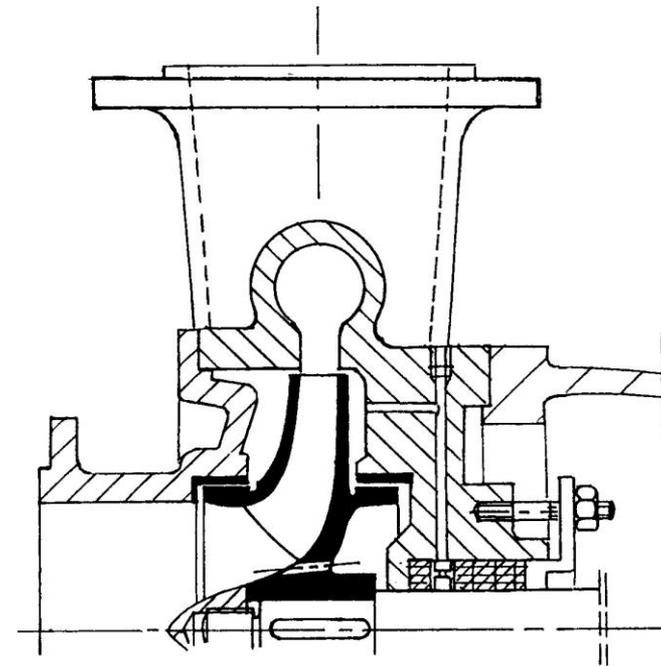
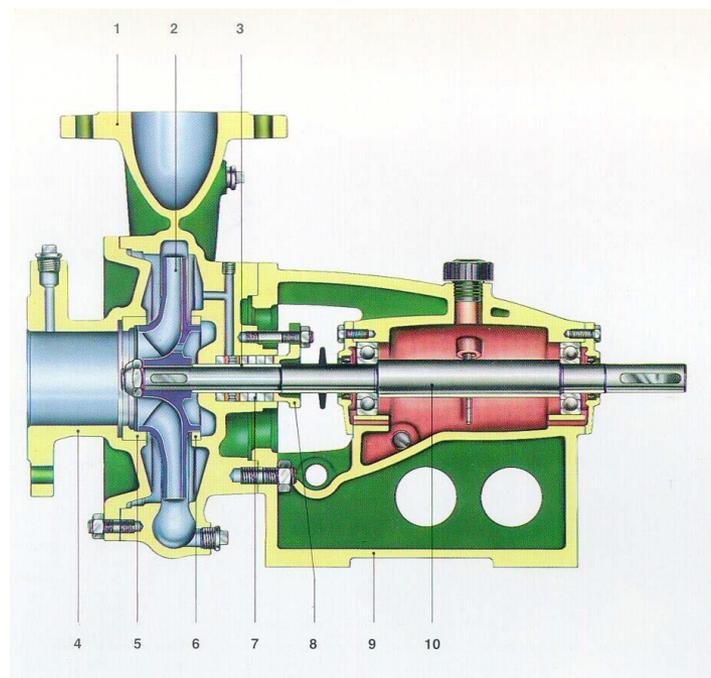
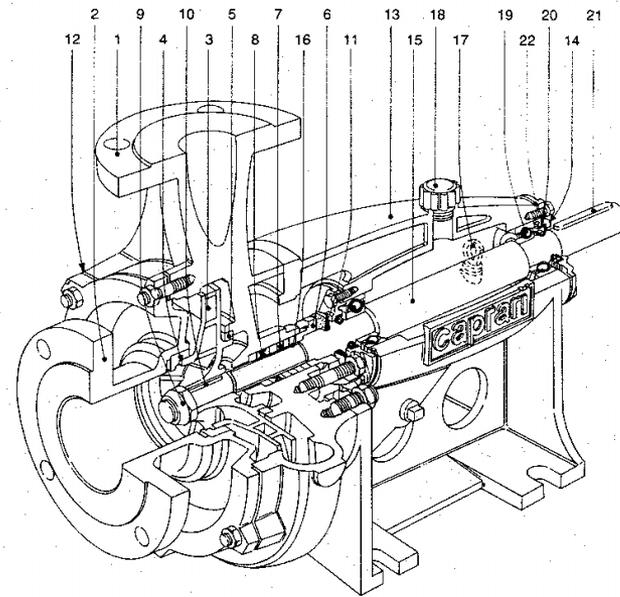


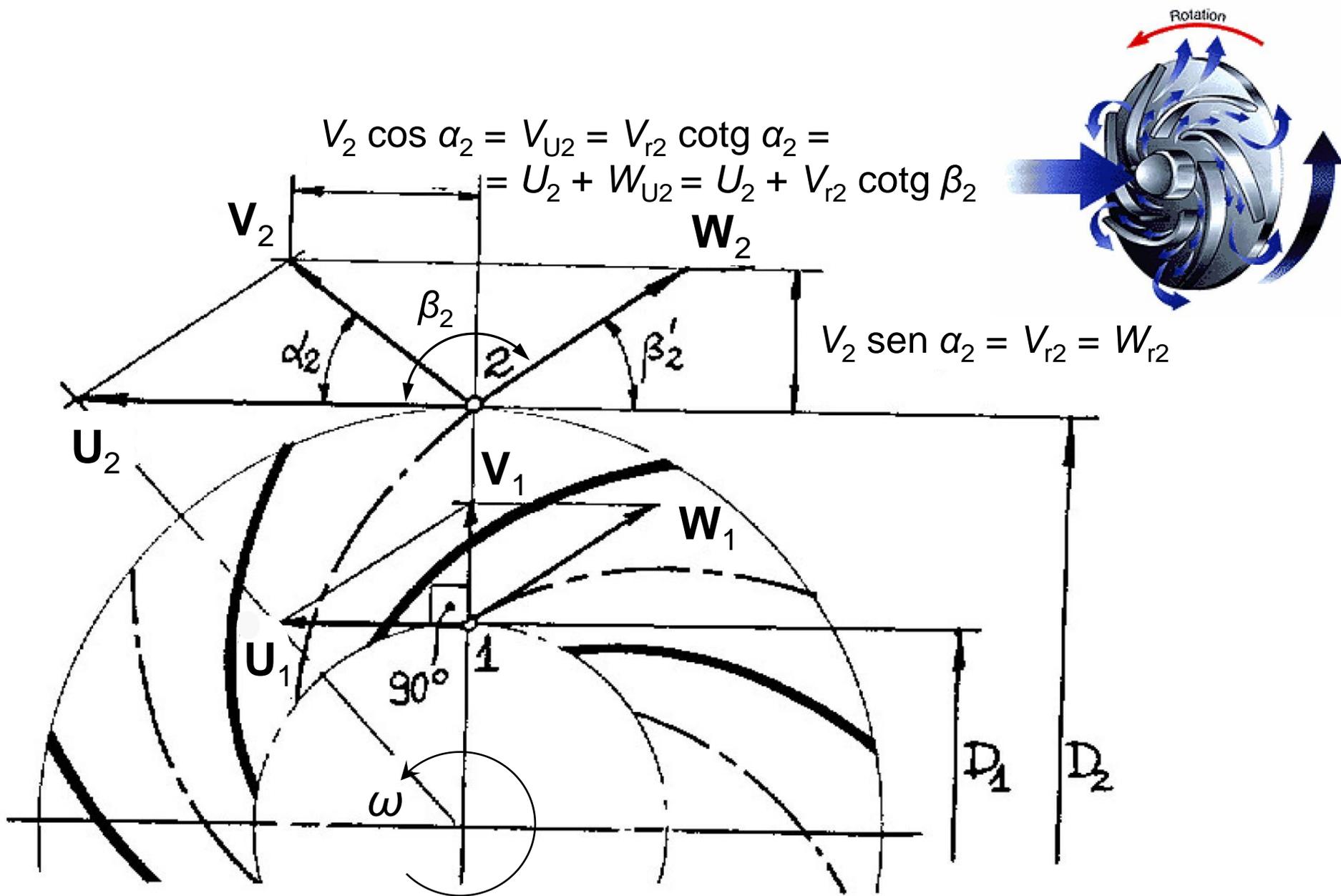
Pompe dinamiche

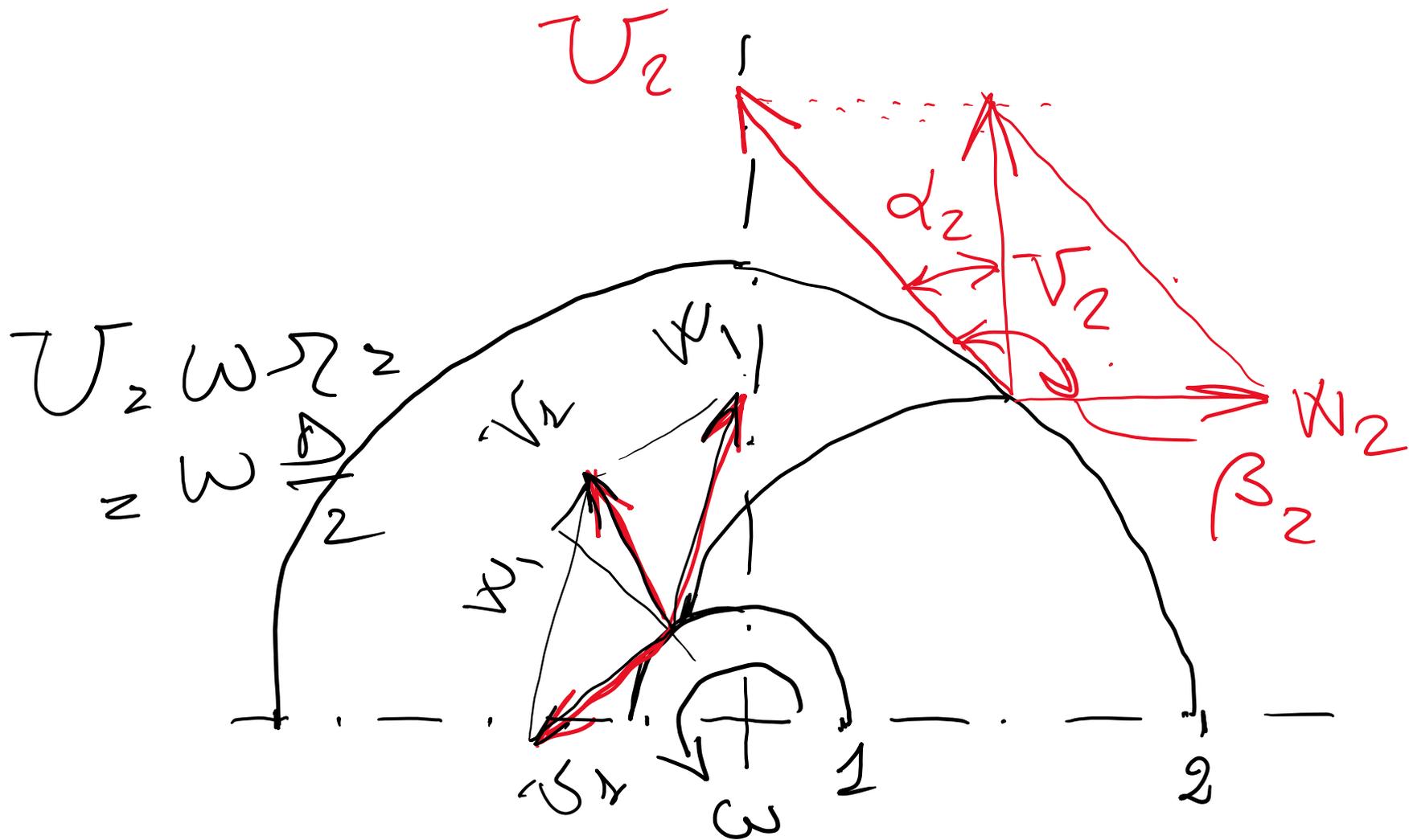


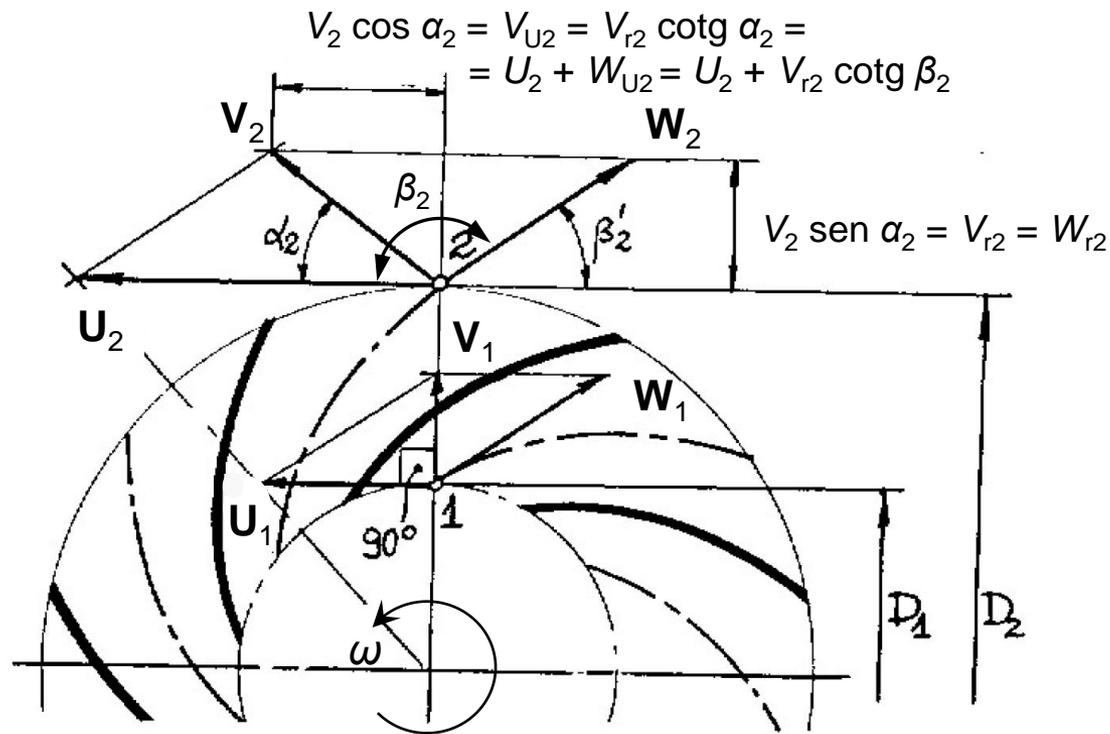








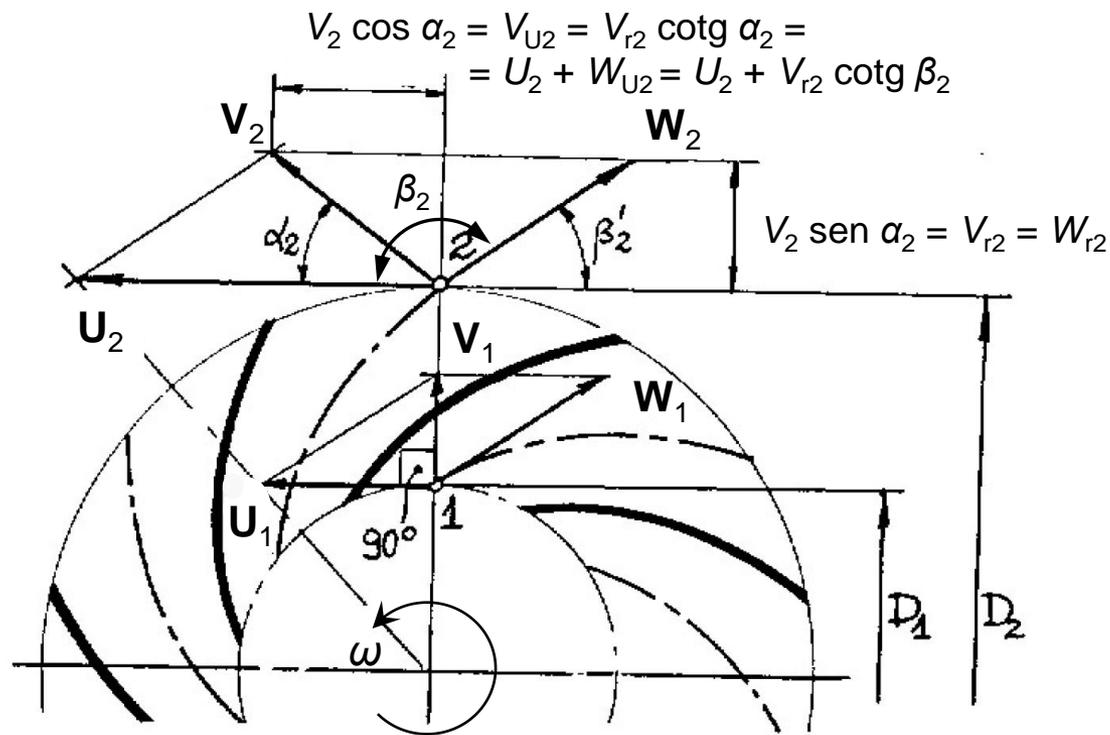




$$\begin{aligned}
 l_g &= \frac{V_2^2 - V_1^2}{2} + \frac{W_1^2 - W_2^2}{2} + \frac{U_2^2 - U_1^2}{2} = \\
 &= U_2 V_2 \cos \alpha_2 - U_1 V_1 \cos \alpha_1 = U_2 V_{U2} - U_1 V_{U1}
 \end{aligned}$$

Nel caso $\alpha_1 = 90^\circ$:

$$\begin{aligned}
 l_g &= U_2 V_2 \cos \alpha_2 = U_2 V_{U2} = \\
 &= U_2 (U_2 + V_{r2} \cotg \beta_2)
 \end{aligned}$$

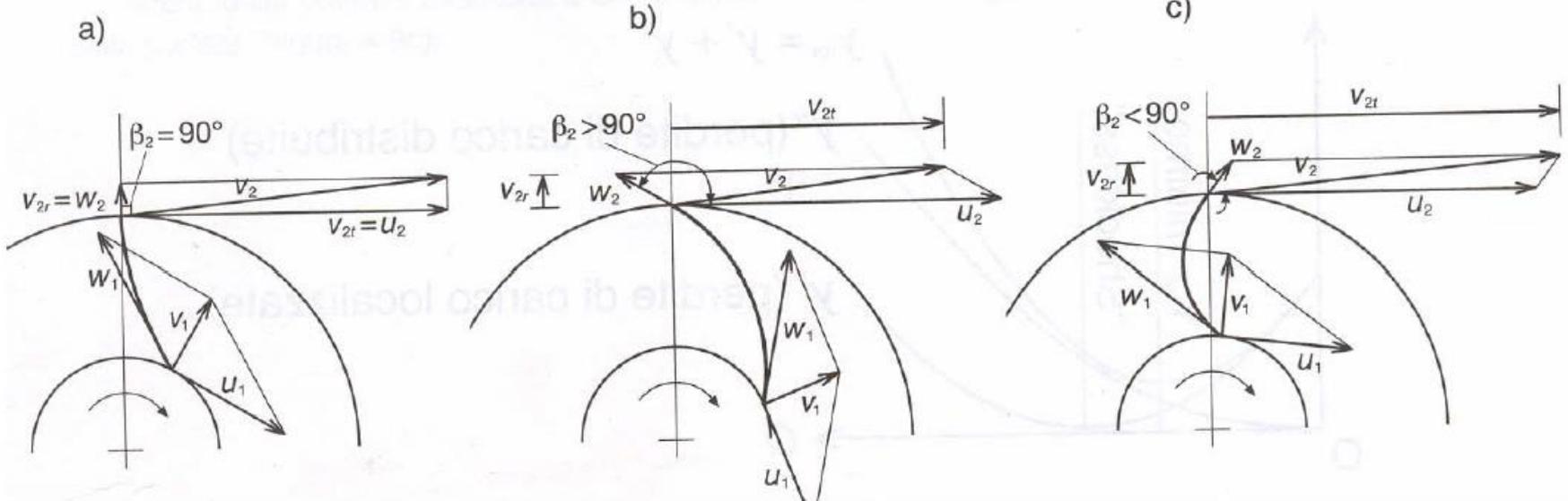
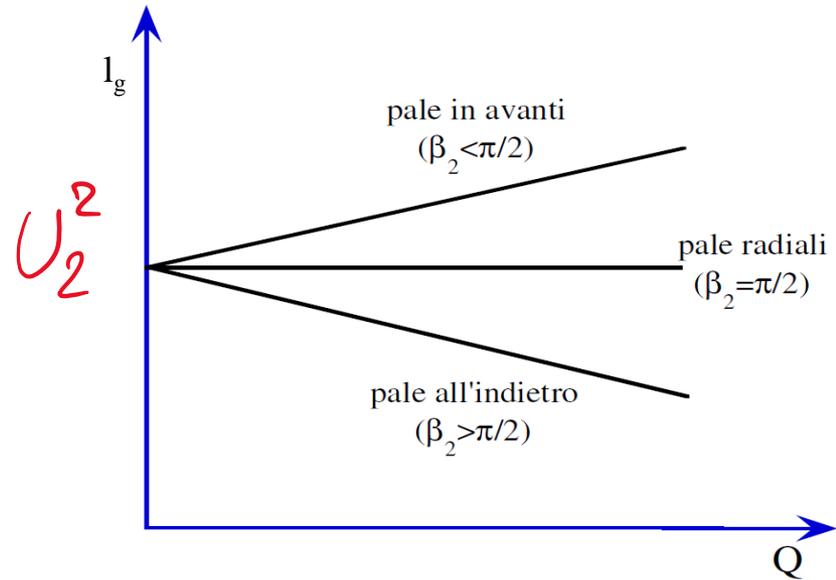


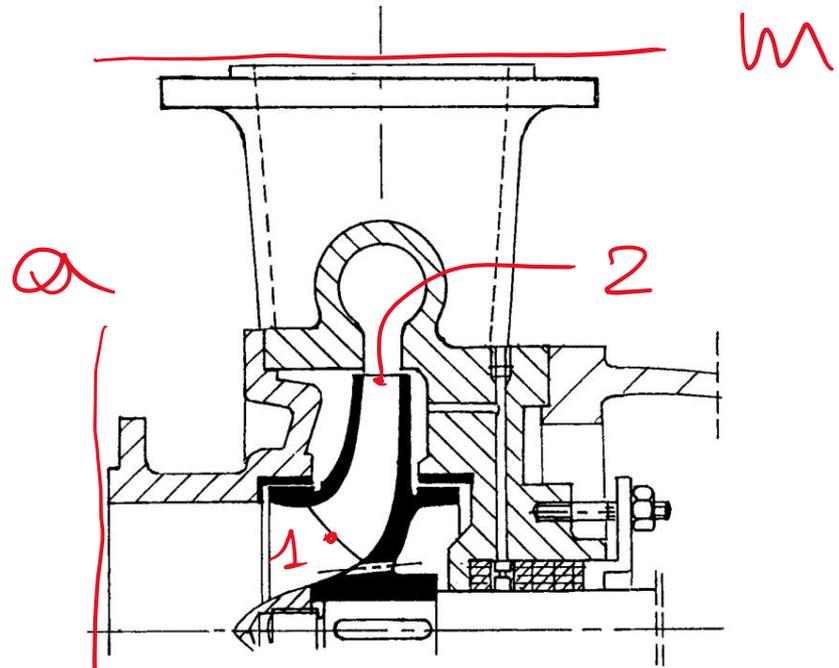
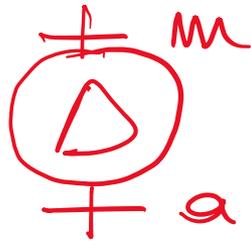
$$l_g = U_2(U_2 + V_{r2} \cotg \beta_2) = U_2 \left(U_2 + \frac{Q}{A_2} \cotg \beta_2 \right)$$

$$l_g = U_2 \left(U_2 + \frac{Q}{A_2} \cotg \beta_2 \right)$$

Forma della girante centrifuga:

- a) a scarico "radiale",
- b) a scarico "all'indietro" ($\beta_2 > 90^\circ$),
- c) a scarico "in avanti" ($\beta_2 < 90^\circ$).





$$V dV + g dz + \frac{dp}{\rho} + dR = d\ell_0$$

$$a-m) \quad \frac{V_m^2 - V_a^2}{2} + g(2m - z_a) + \frac{P_m - P_a}{\rho} +$$

$$+ R_{a-m} = \ell g$$

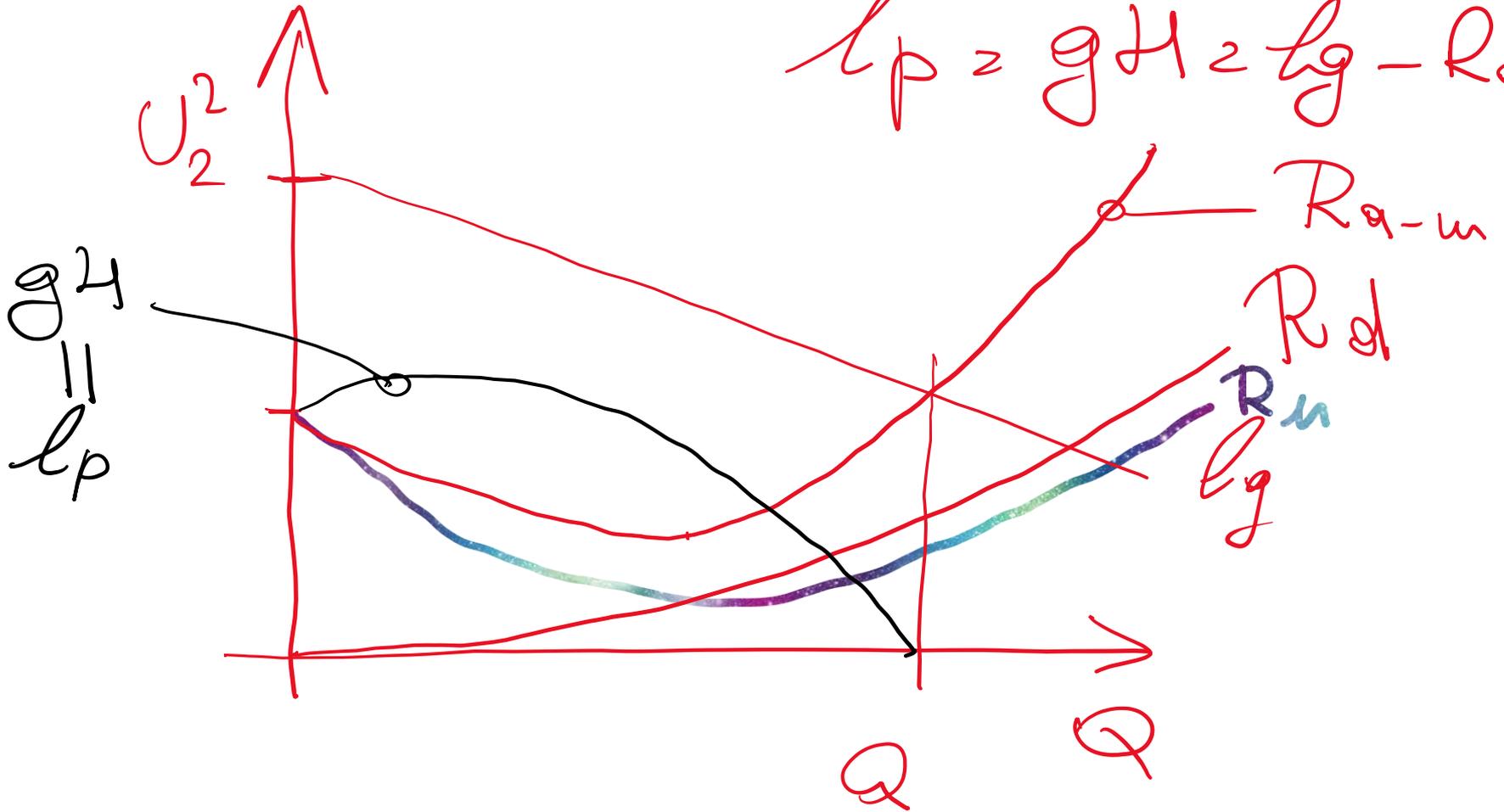
$$\frac{V_m^2 - V_a^2}{2} + g(z_m - z_a) + \frac{P_m - P_a}{\rho}$$

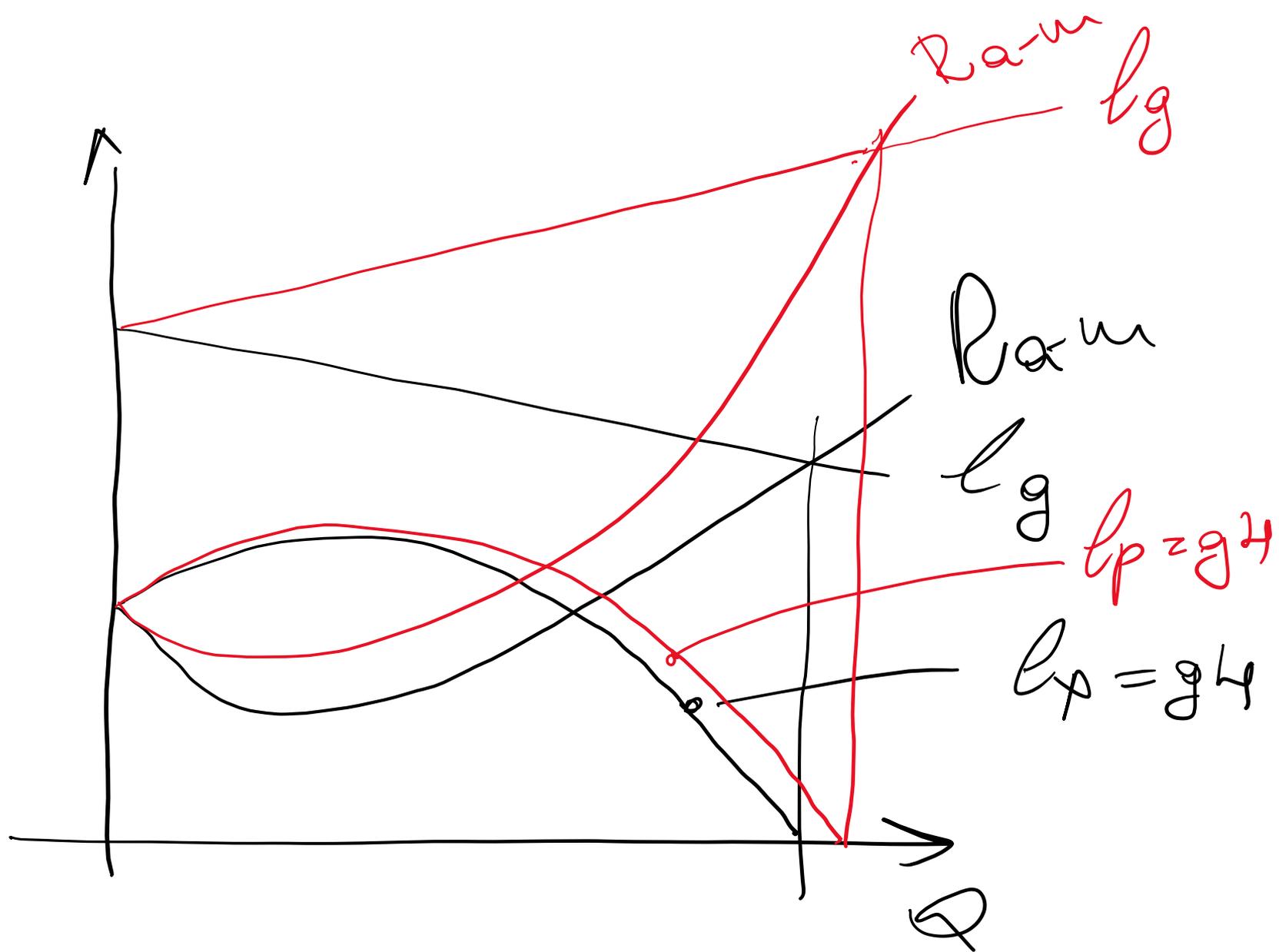
$\approx gH$ | \uparrow prevalenza
 della pompa

$$\approx \rho g - R_{a-m}$$

$$P_{a-m} \approx P_d + P_u$$

$$l_p = gH = l_g - R_{a-m}$$





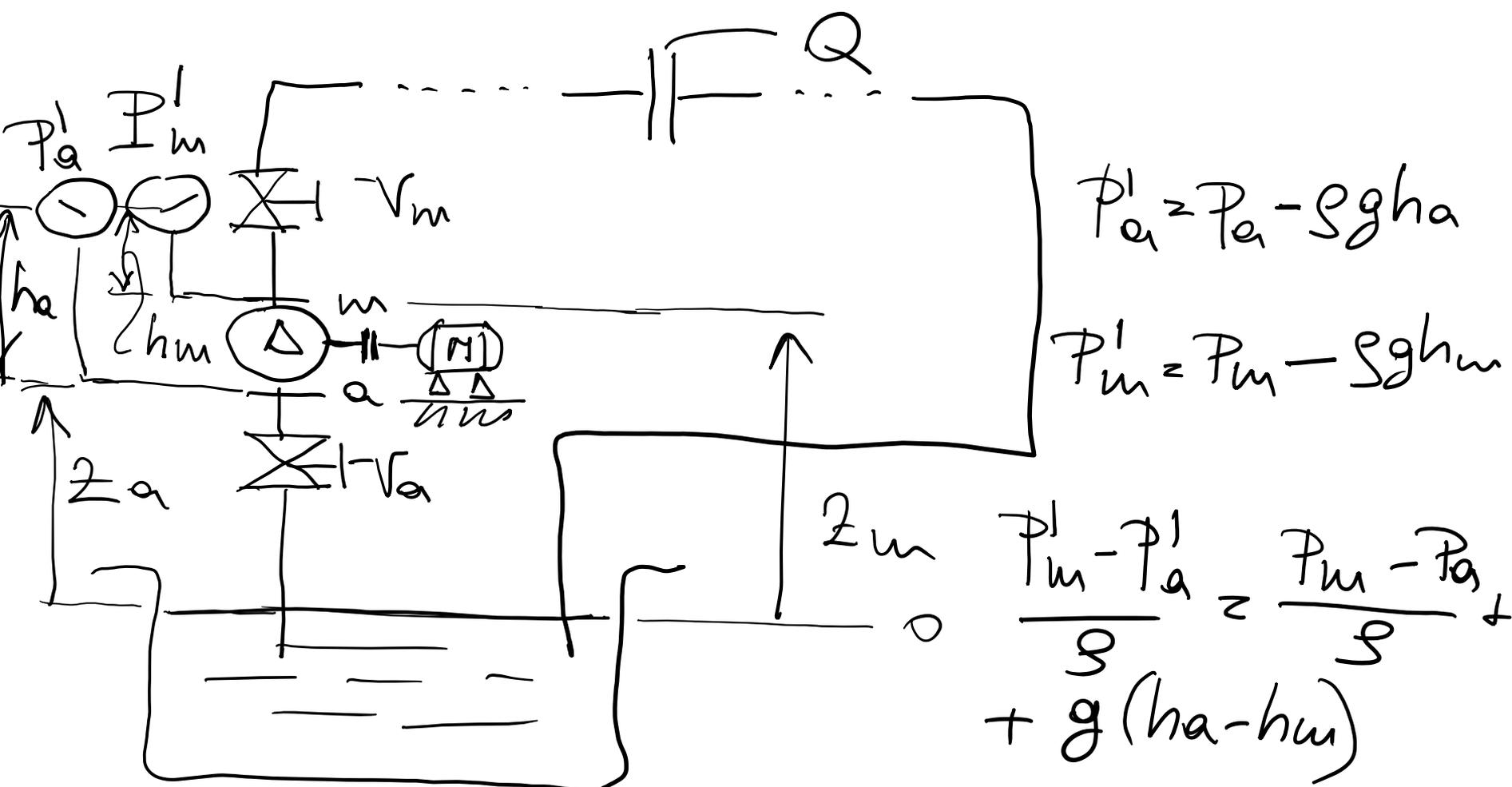
$$Z_i = \frac{gH}{\rho g} = \frac{\rho g - (\rho_{ol} + \rho_u)}{\rho g}$$

Rendimento idraulico o interno

$$Z_m = \frac{SQ \rho g}{P_m}$$

$$Z_{tot} = \frac{SQ gH}{P_m} = \frac{SQ gH}{SQ \rho g} \cdot \frac{SQ \rho g}{P_m}$$

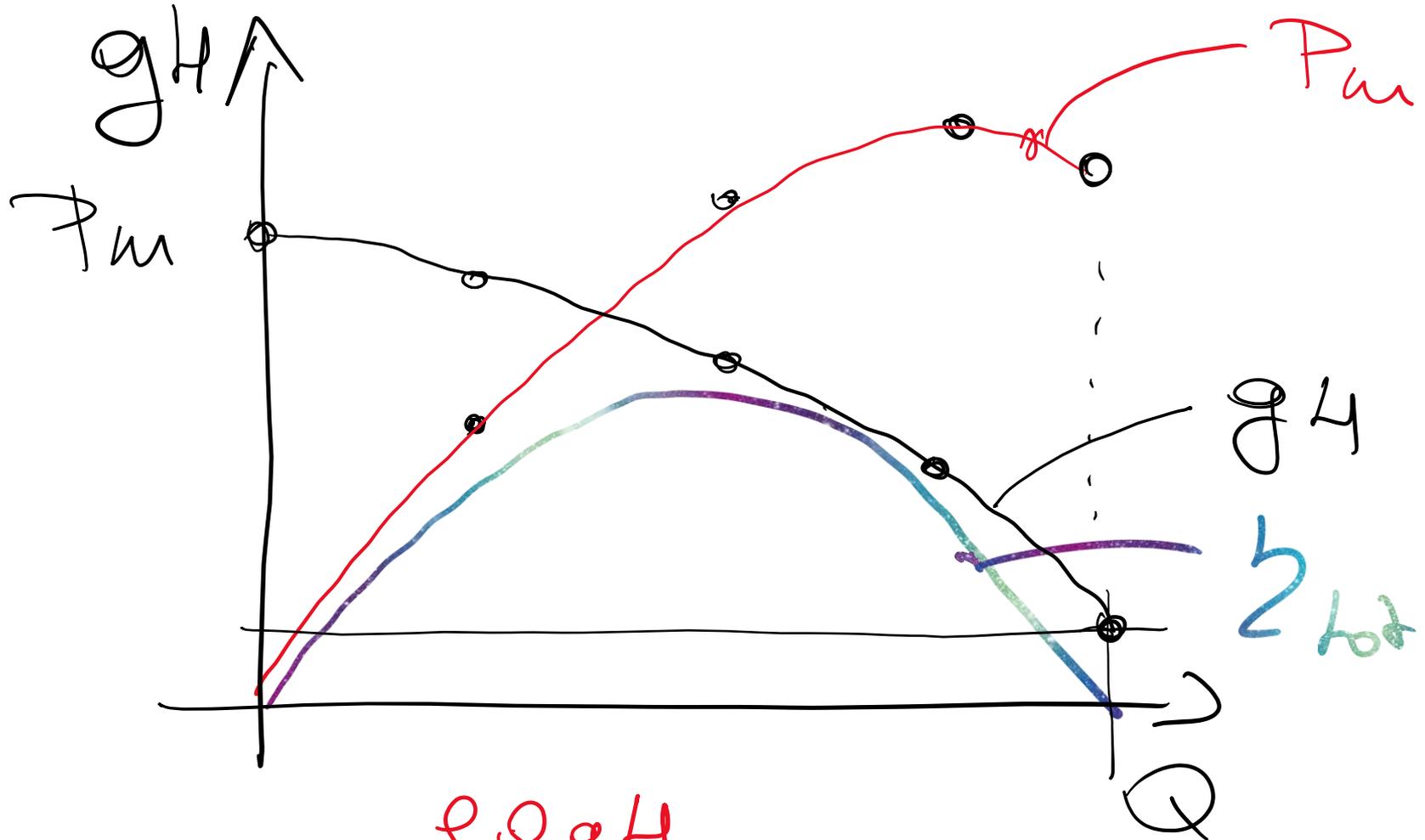
$$= Z_i \cdot Z_m \rightarrow SQ gH = P_m Z_{tot}$$



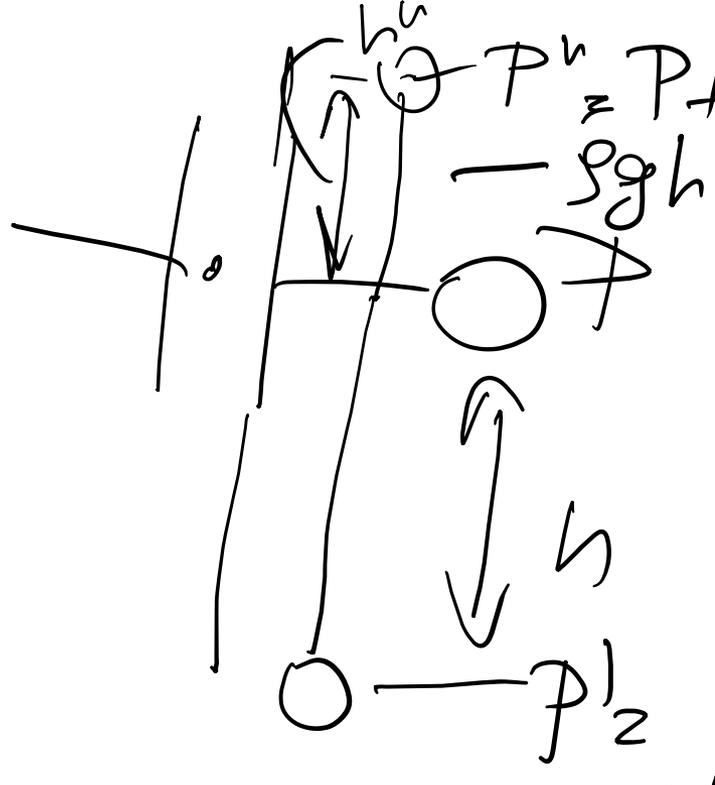
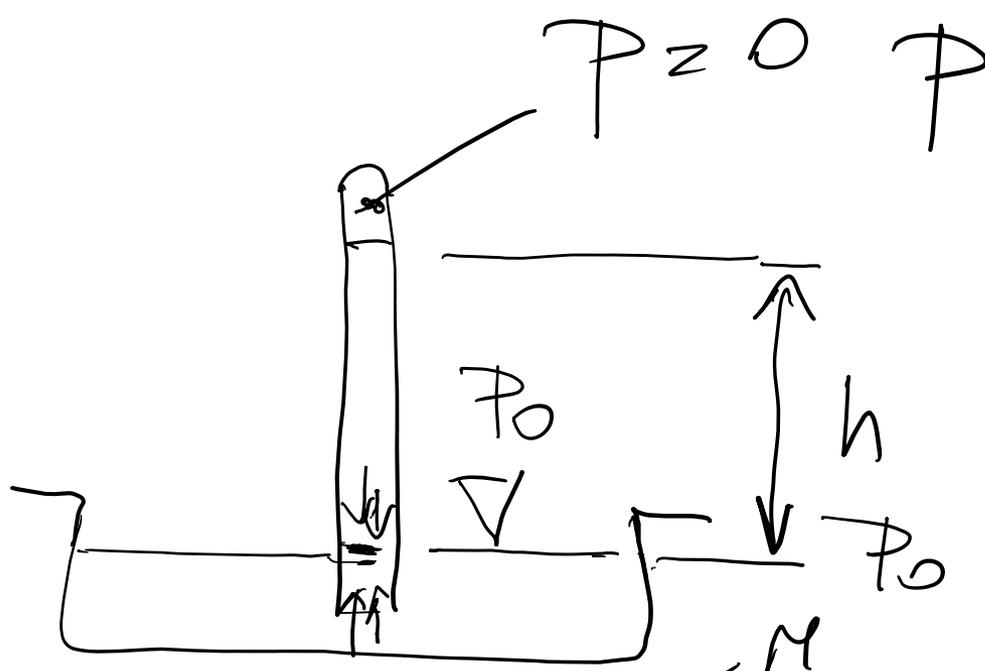
$$gH = \frac{V_m^2 - V_a^2}{2g} + g(z_m - z_a) + \frac{P_m - P_a}{\rho}$$

$$= (P'_m - P'_a) / \rho$$

Va sempre tutto aperto



$$\frac{\rho Q g H}{P_m} \approx \eta_{tot}$$



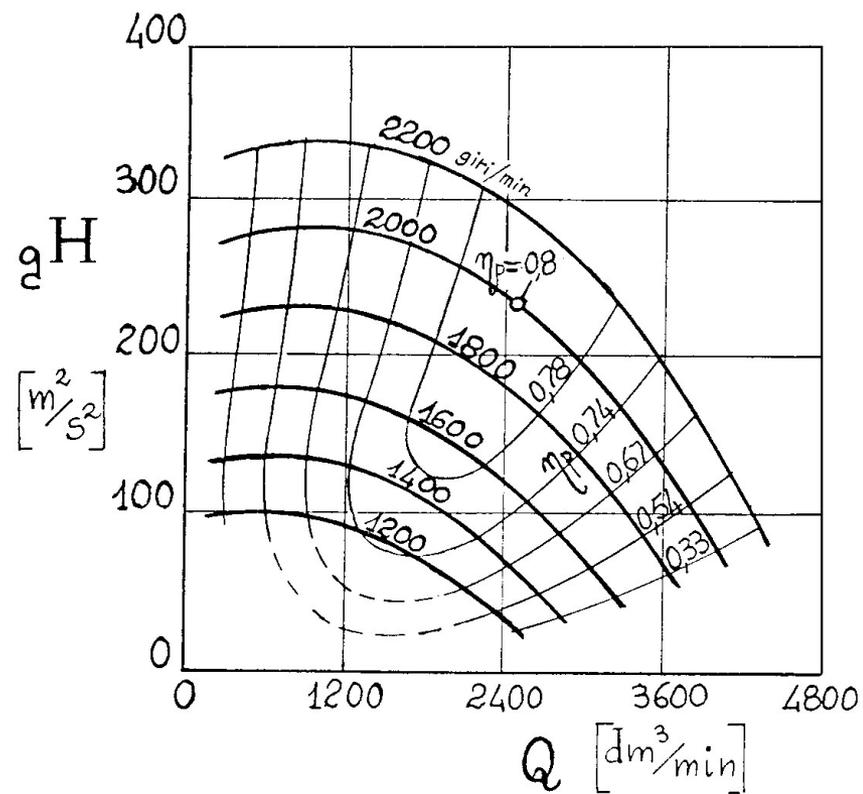
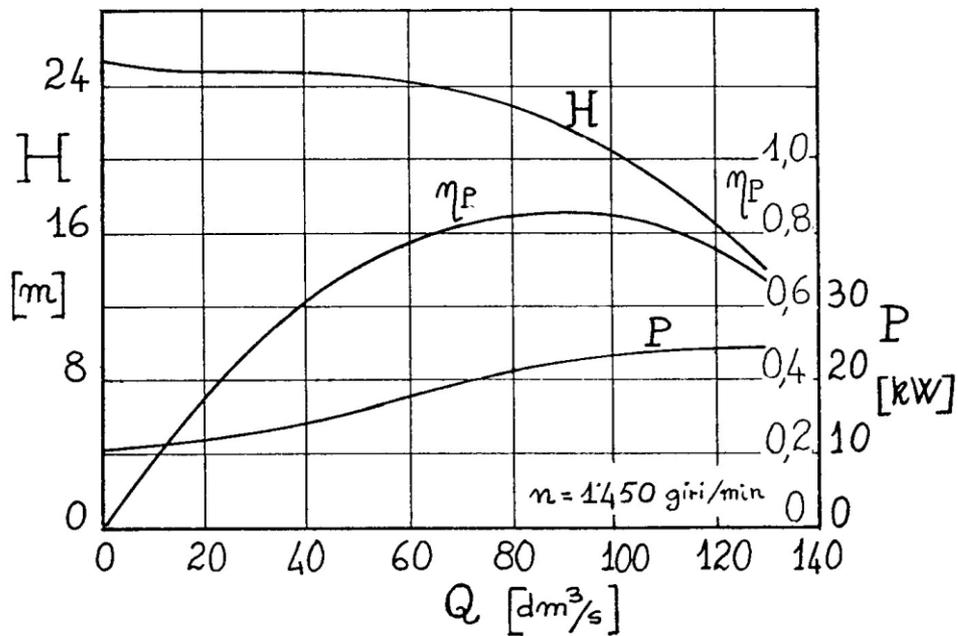
$$P_0 = \frac{F}{A} = \frac{\rho A h g}{A} = \rho g h$$

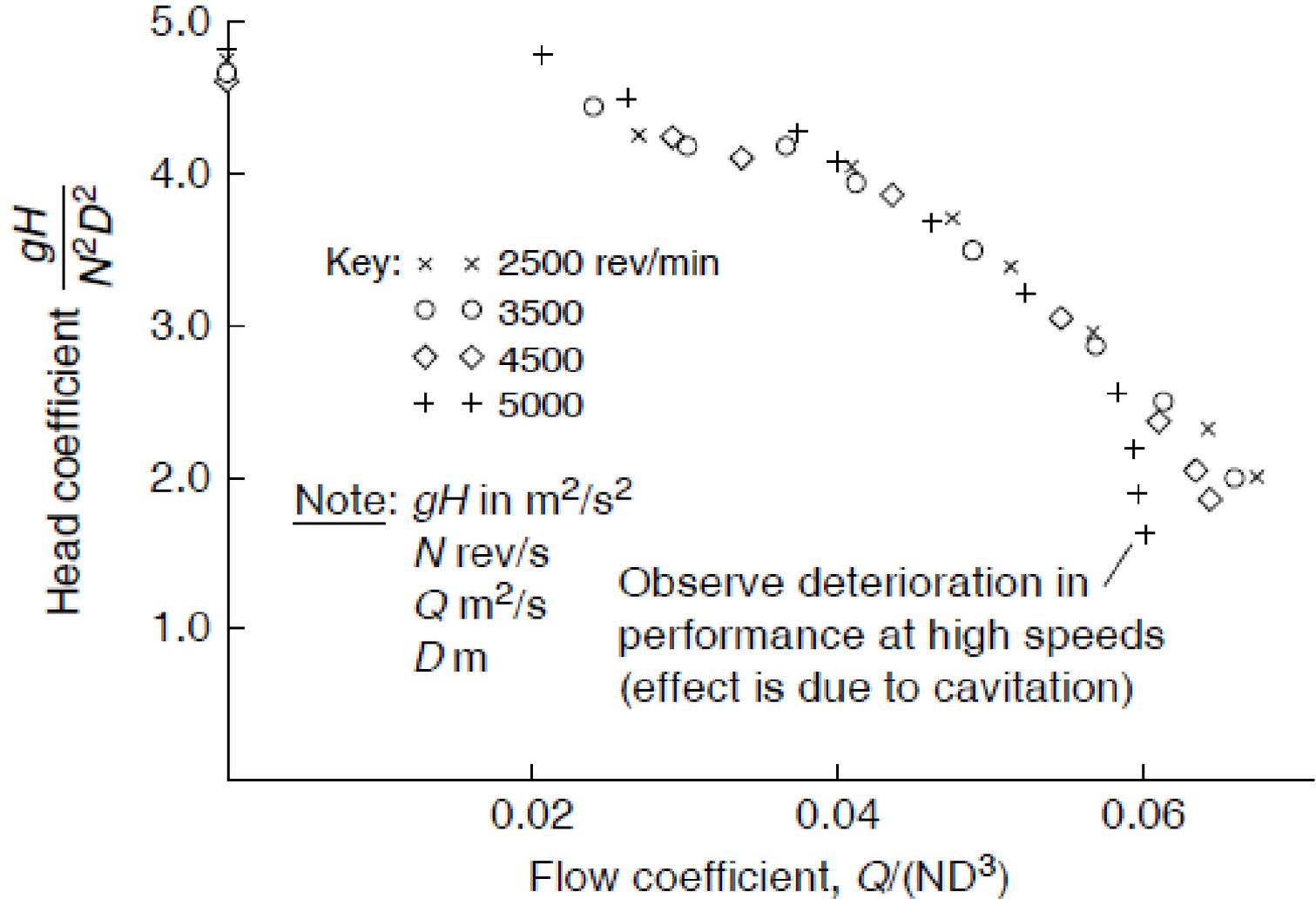
$$= P + \rho g h$$

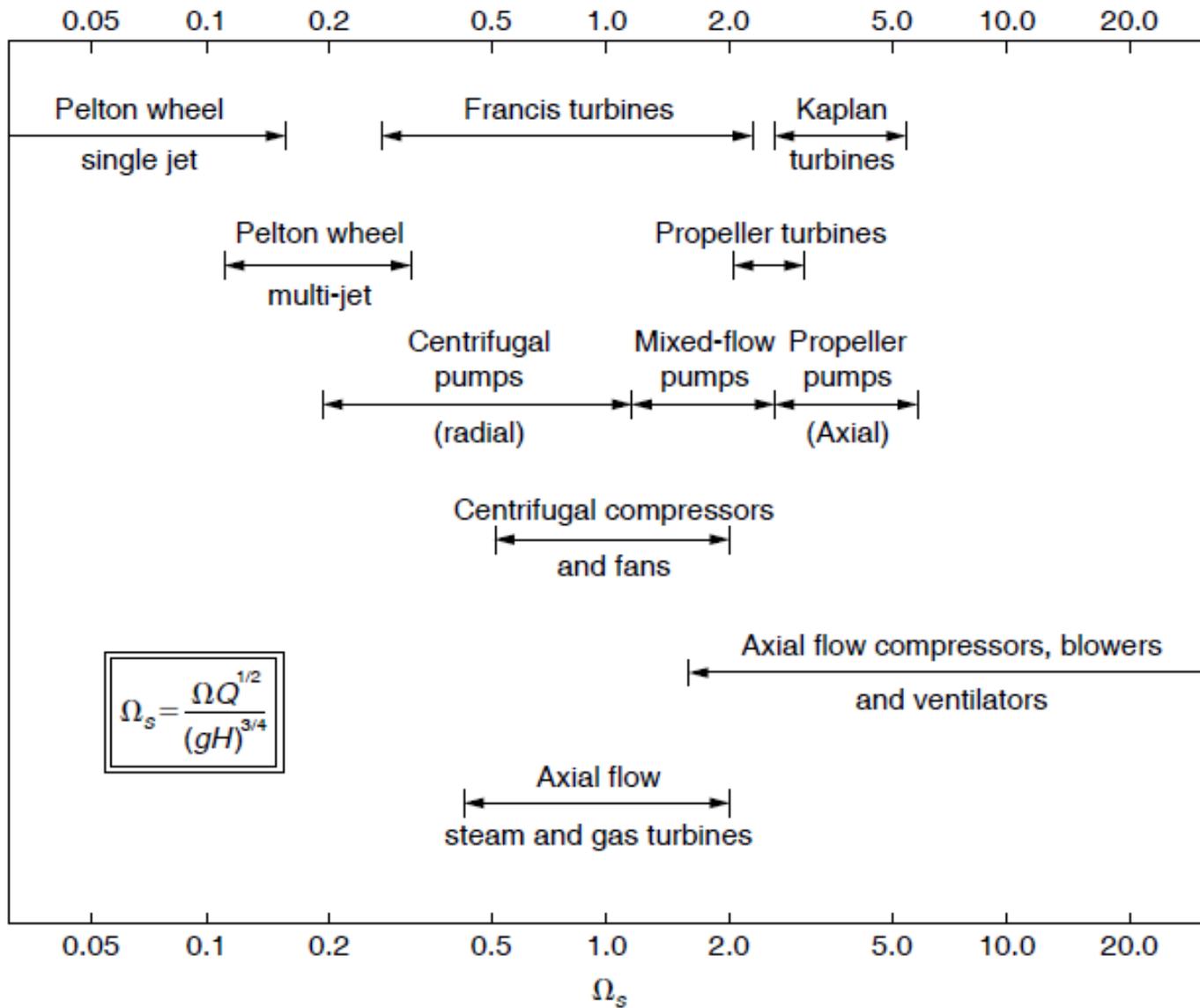
$$D_a = D_m \Rightarrow V_a = V_m \Rightarrow$$

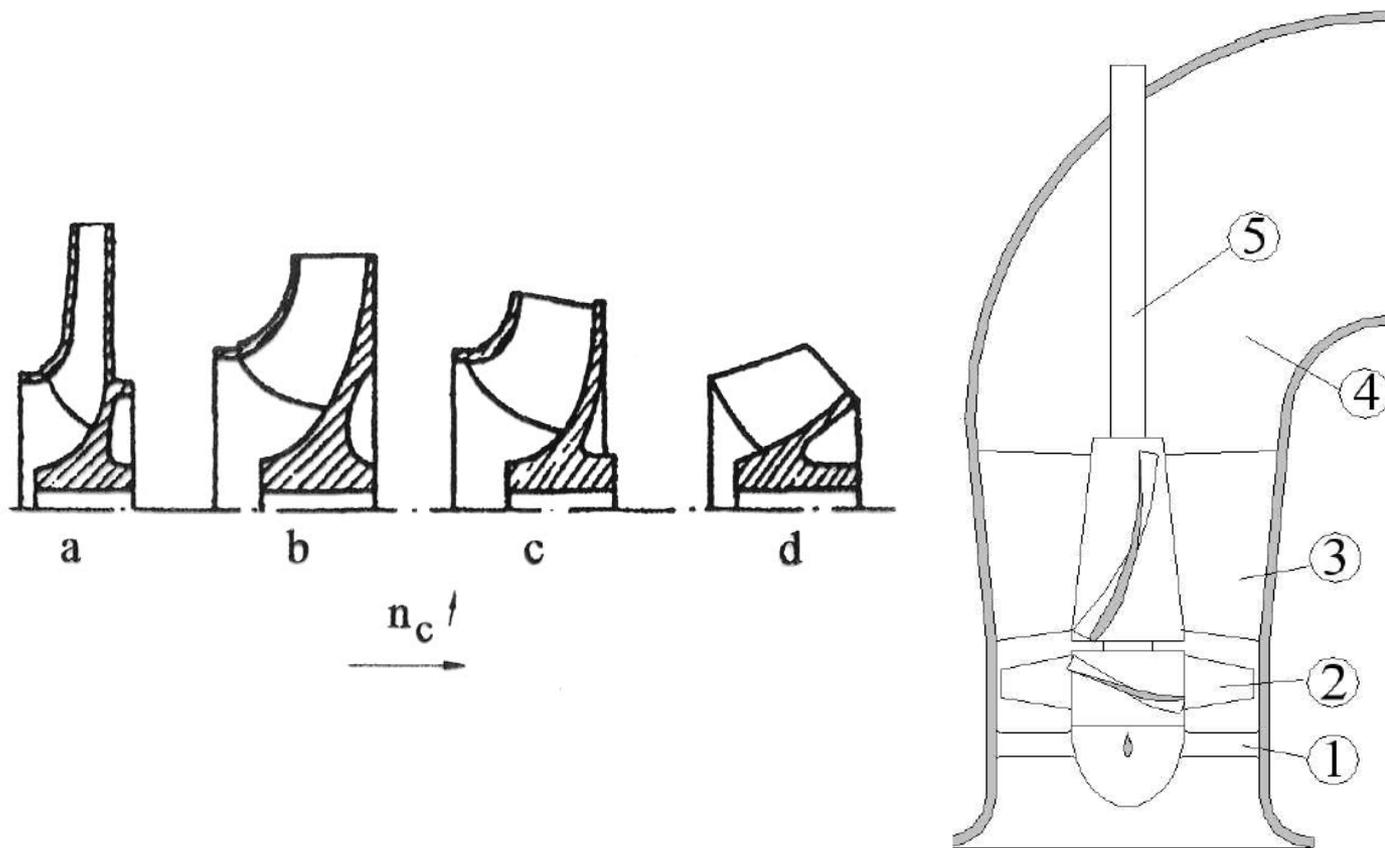
$$\Rightarrow gH = g(z_m - z_a) + \frac{P_m - P_a}{\rho}$$

$$\approx \frac{P_m - P_a}{\rho}$$

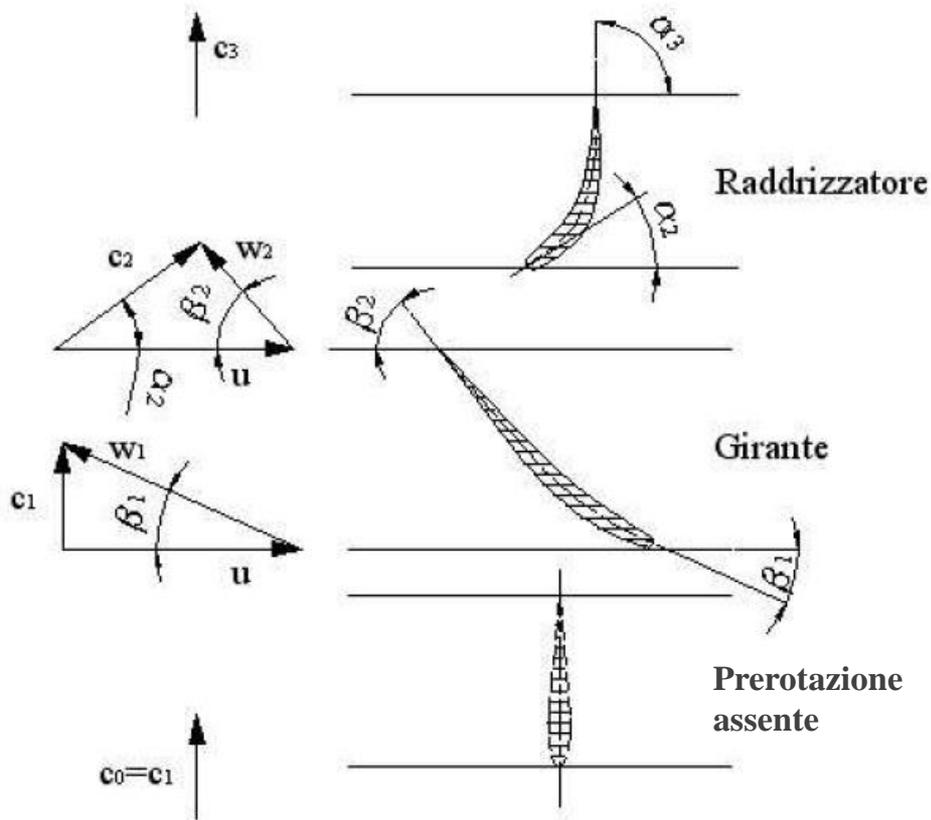




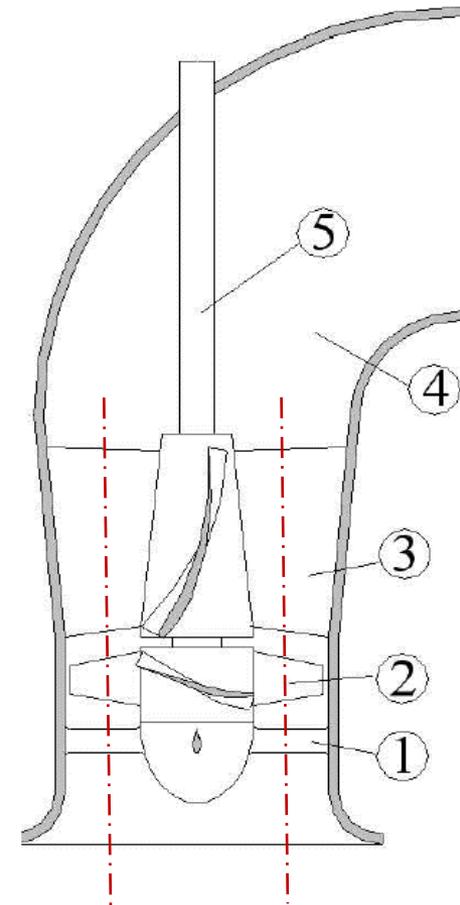




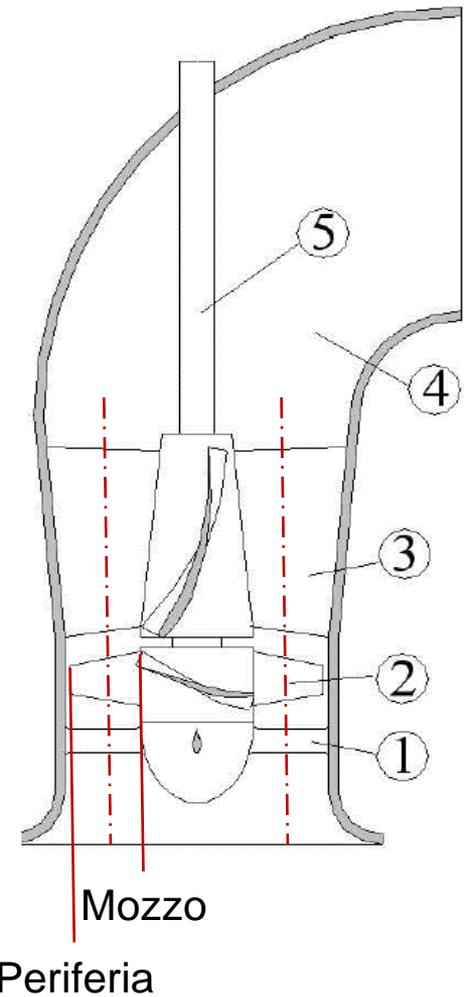
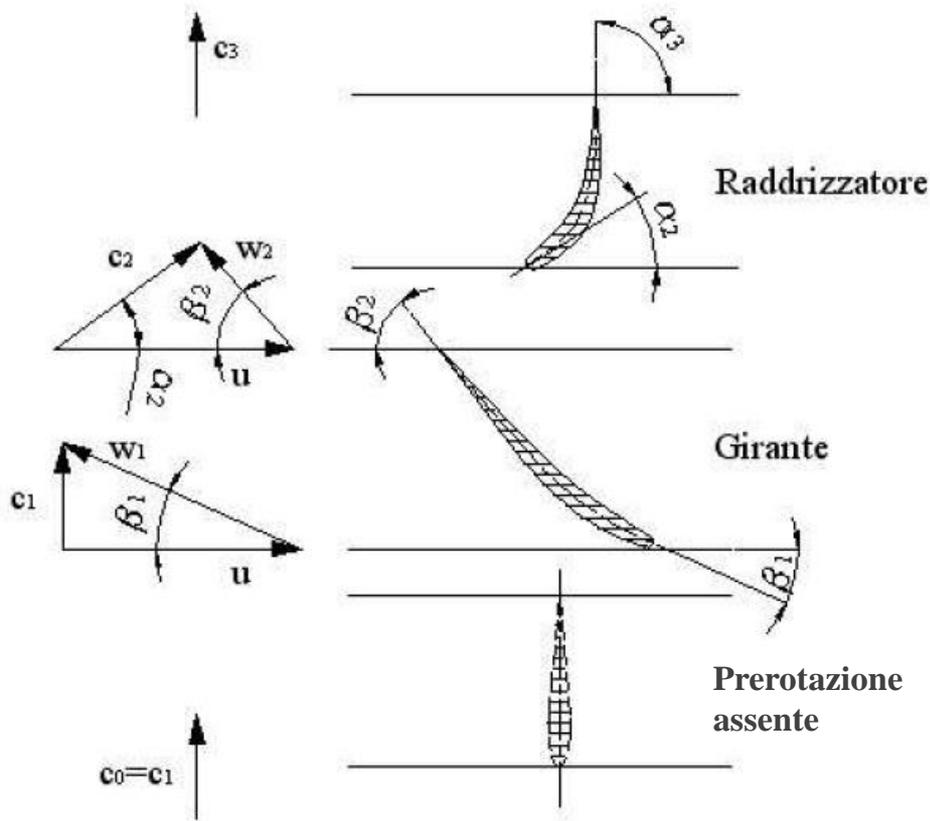
Schema di una pompa assiale: 1-predistributore, 2-girante, 3-raddrizzatore, 4-diffusore, 5-albero



Sezioni dei profili palari e triangoli di velocità sulla superficie di corrente cilindrica al raggio medio sviluppata su un piano

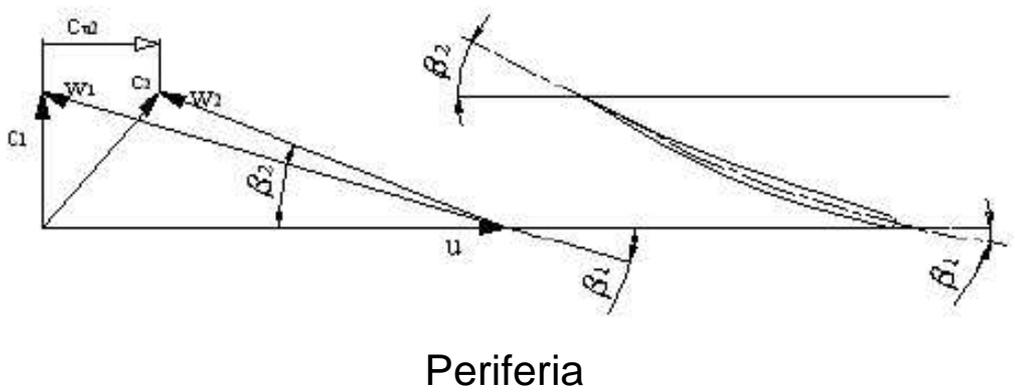
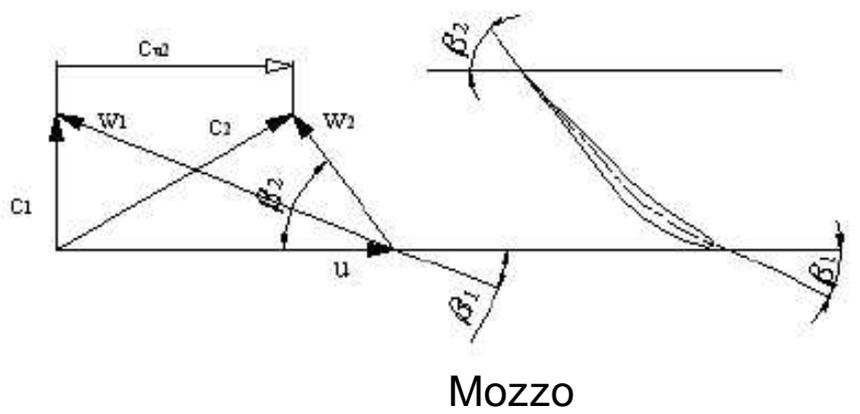
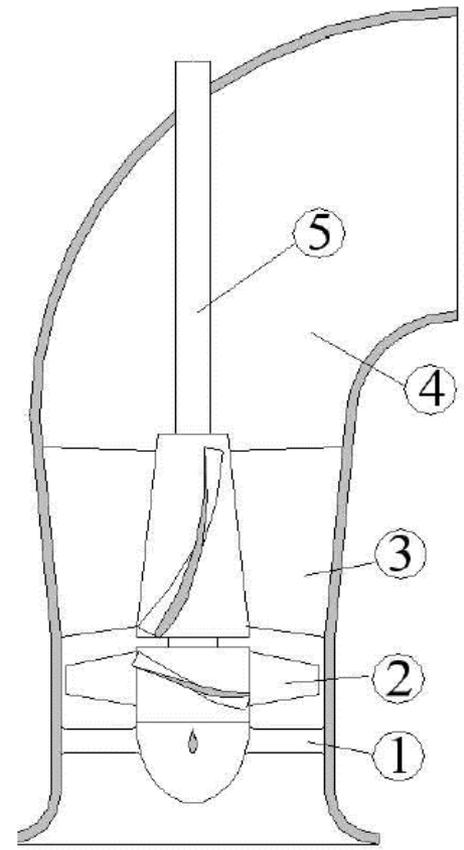
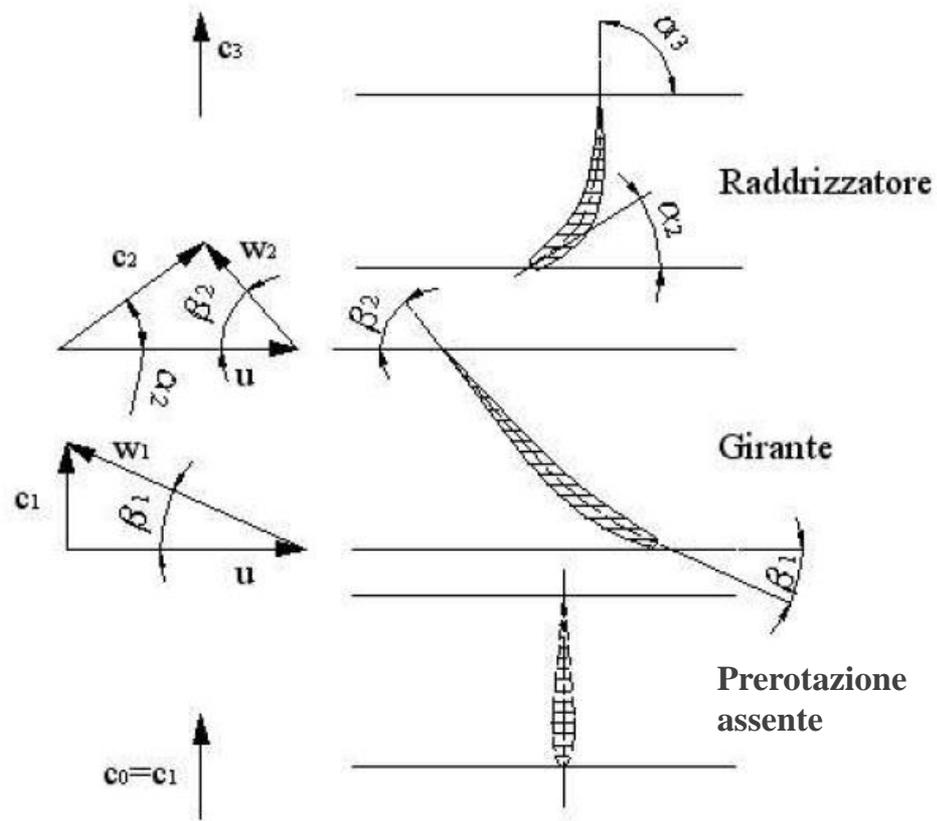


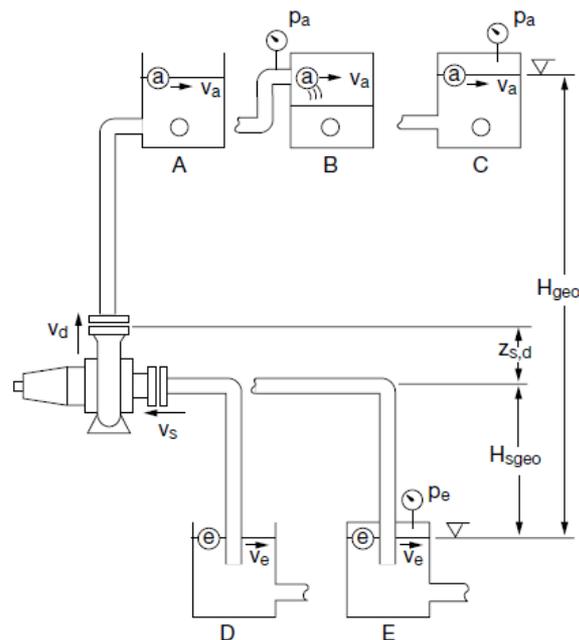
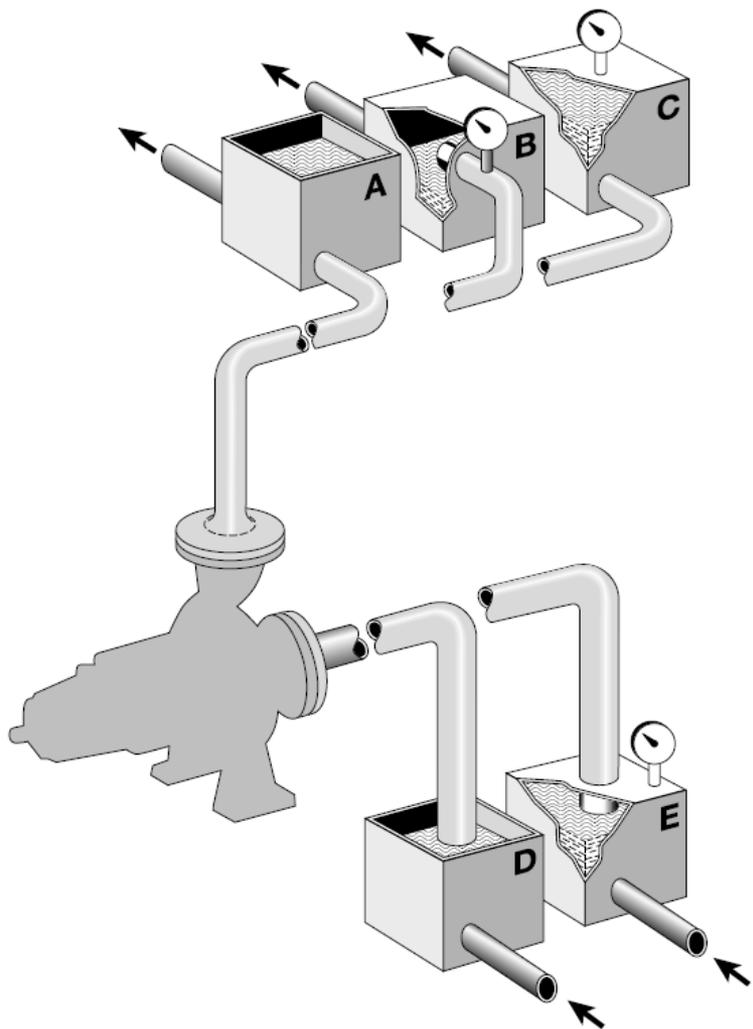
Traccia superficie di corrente cilindrica al raggio medio



$$l_{g,m} = \omega r_m c_{u2,m} = l_{g,p} = \omega r_p c_{u2,p} \rightarrow r_m c_{u2,m} = r_p c_{u2,p}$$

$$\frac{u_m}{r_m} = \frac{u_p}{r_p} = \omega$$





Impianti di pompaggio funzionanti in aspirazione, con serbatoi in esecuzioni diverse

A = Serbatoio di mandata aperto con sbocco del tubo sotto il livello dell'acqua

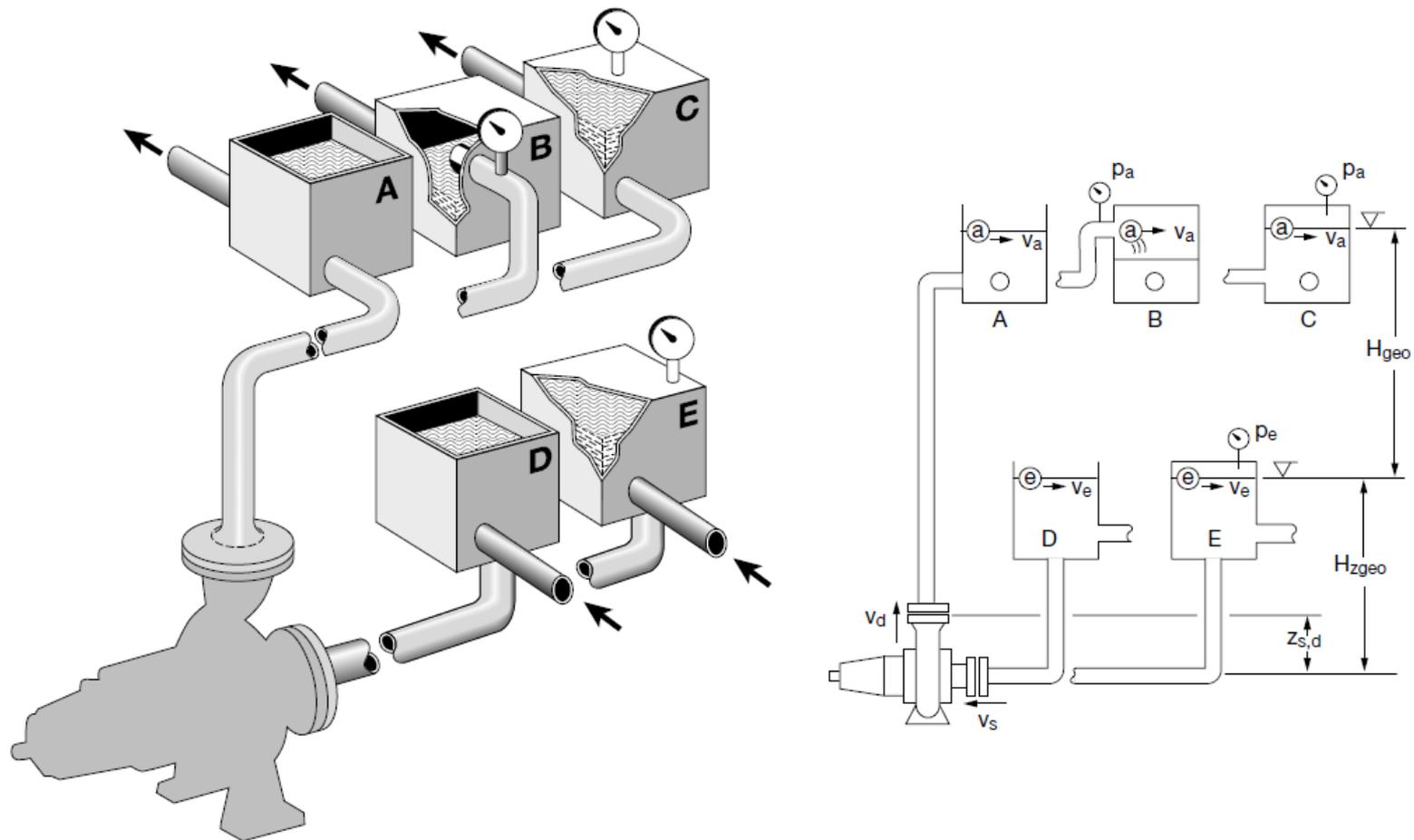
B = Serbatoio di mandata chiuso con uscita libera dal tubo

C = Serbatoio di mandata chiuso con sbocco del tubo sotto il livello del liquido

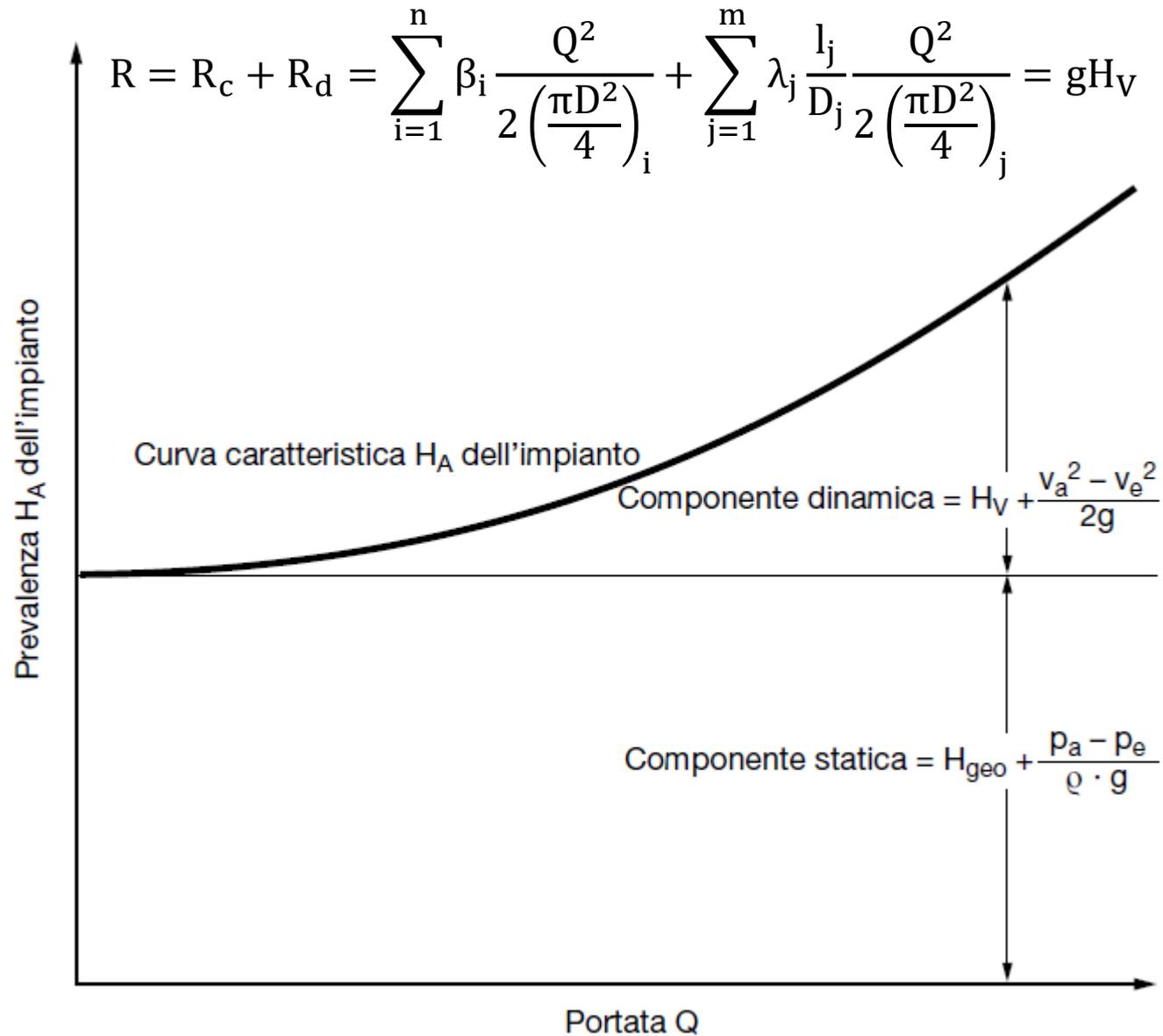
D = Serbatoio di aspirazione o serbatoio di carico aperti

E = Serbatoio di aspirazione o serbatoio di carico chiusi

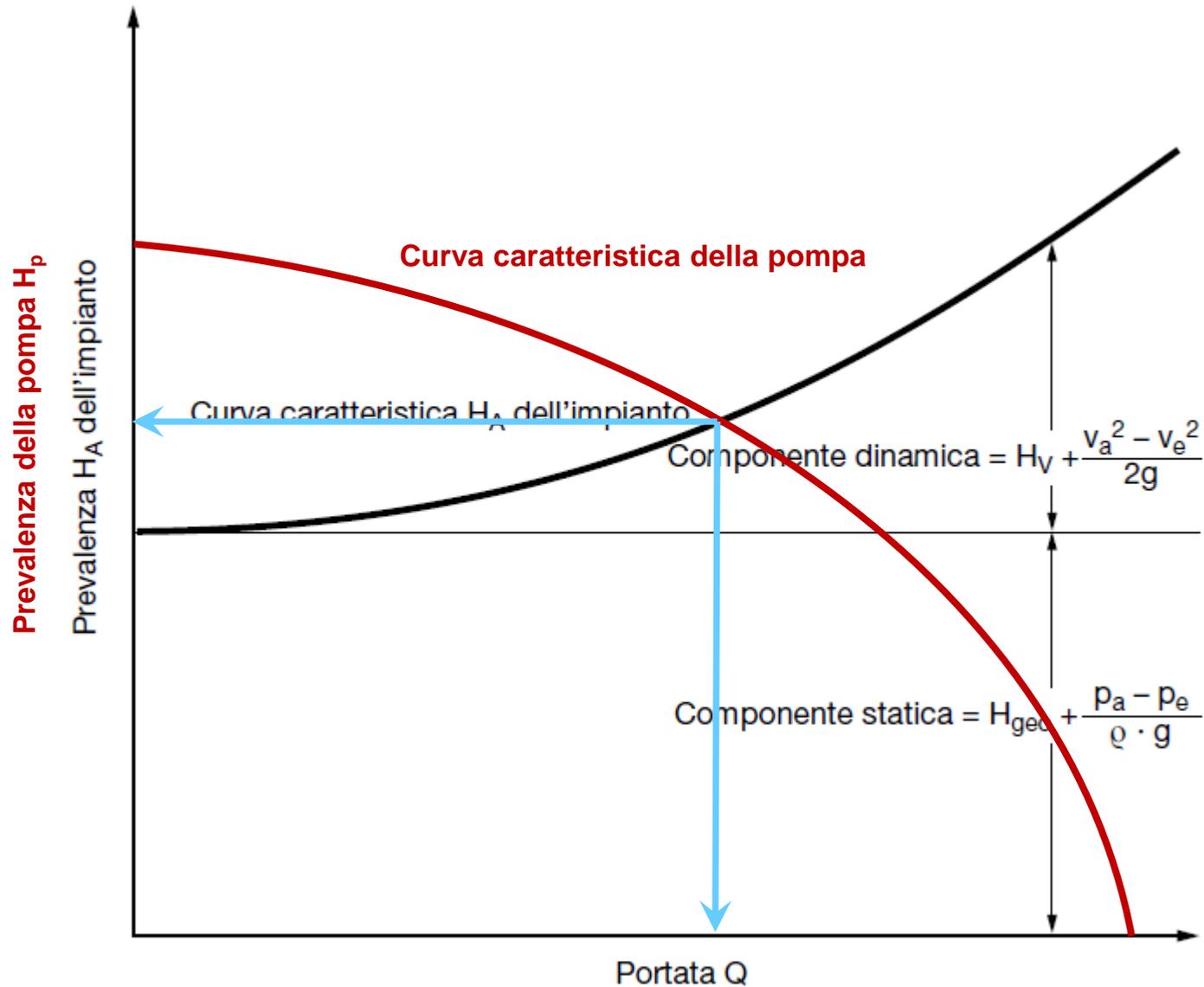
v_a e v_e sono rispettivamente le velocità del fluido (per lo più piccole da trascurare) nei serbatoi A e C nei punti @ e nei serbatoi D ed E nei punti ⊕, nel caso B invece v_a è la velocità non trascurabile di efflusso dalla sezione di tubo @.



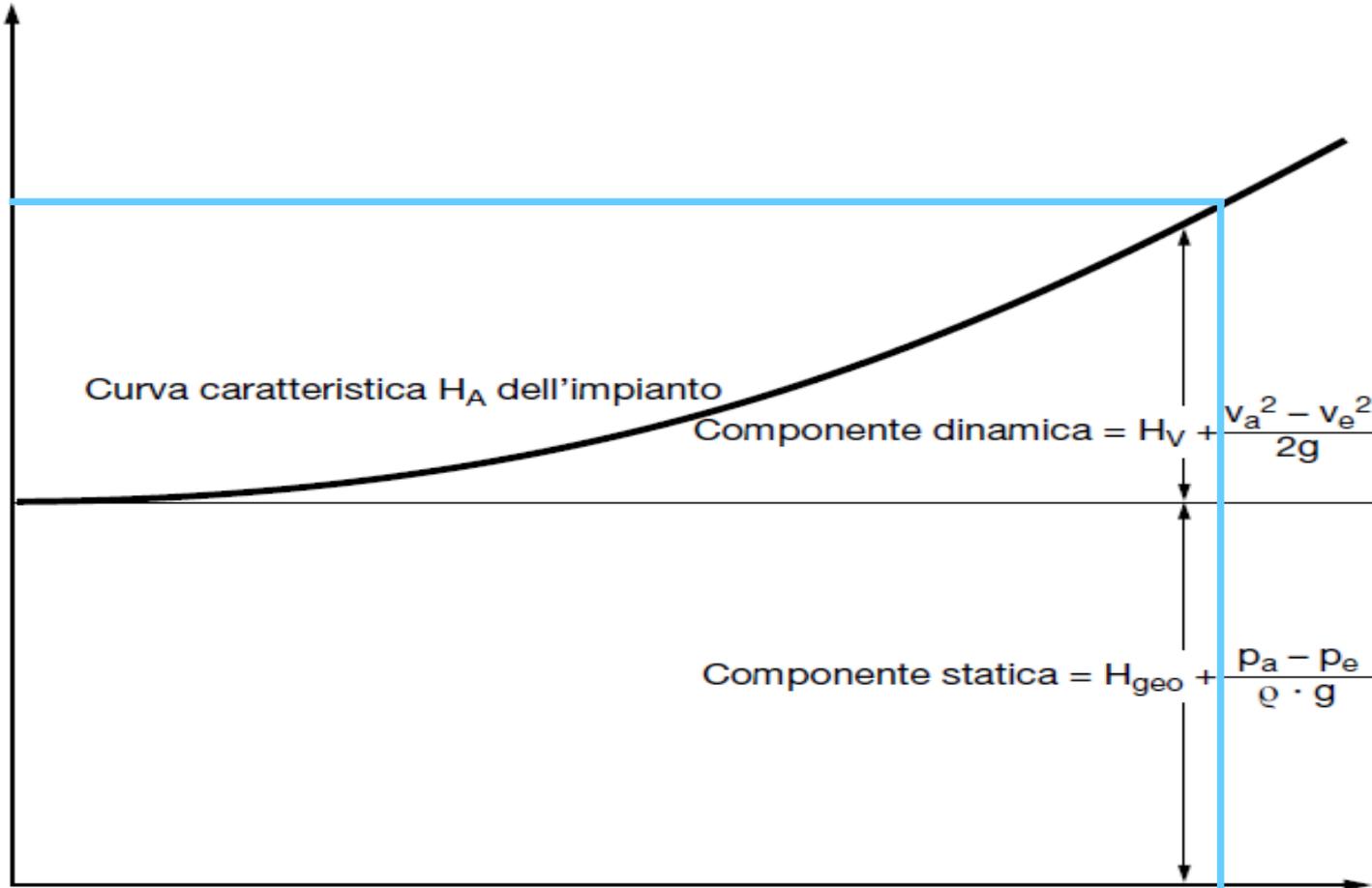
Impianti di pompaggio funzionanti sotto battente, con serbatoi in esecuzioni diverse

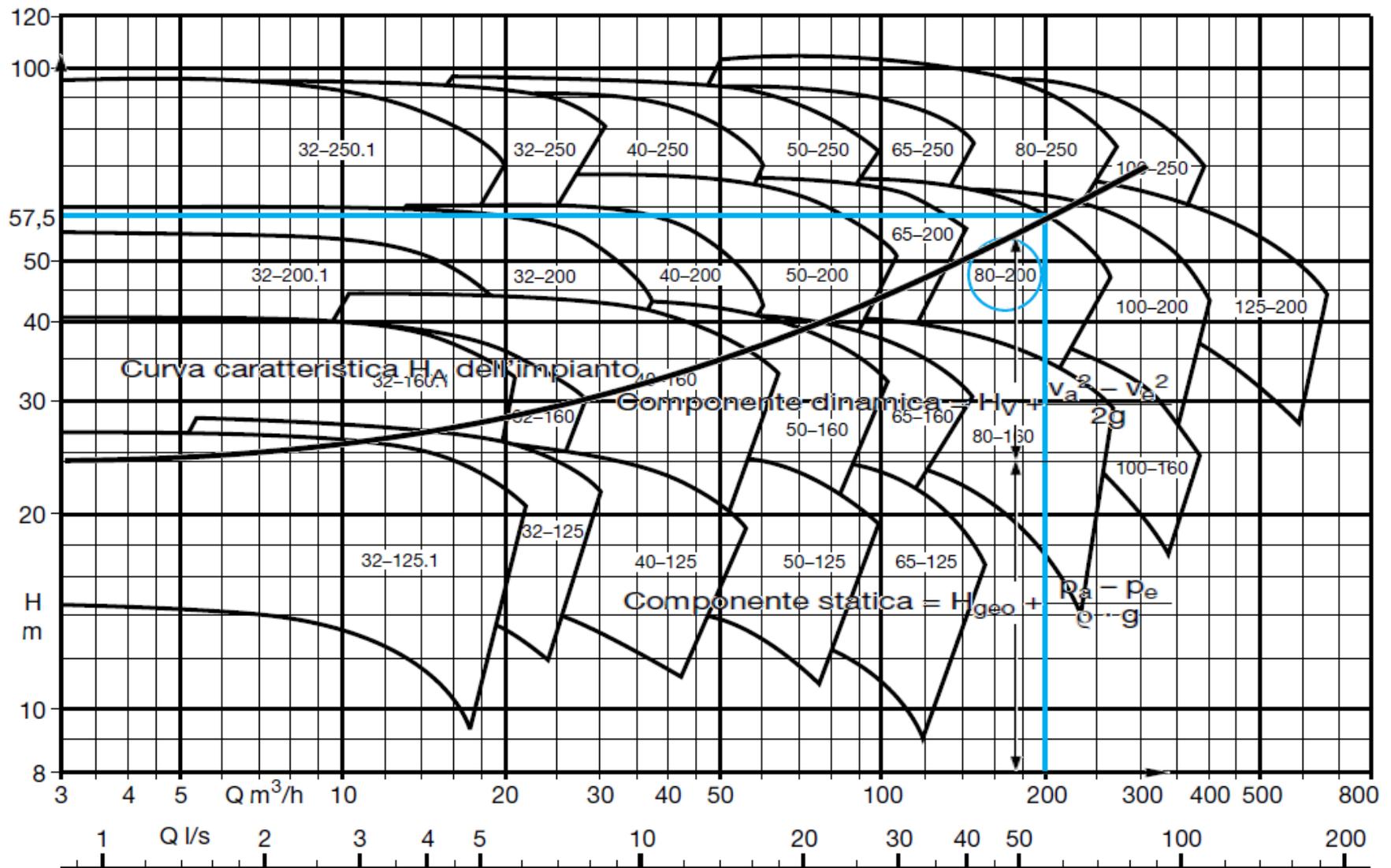


Punto di funzionamento della pompa

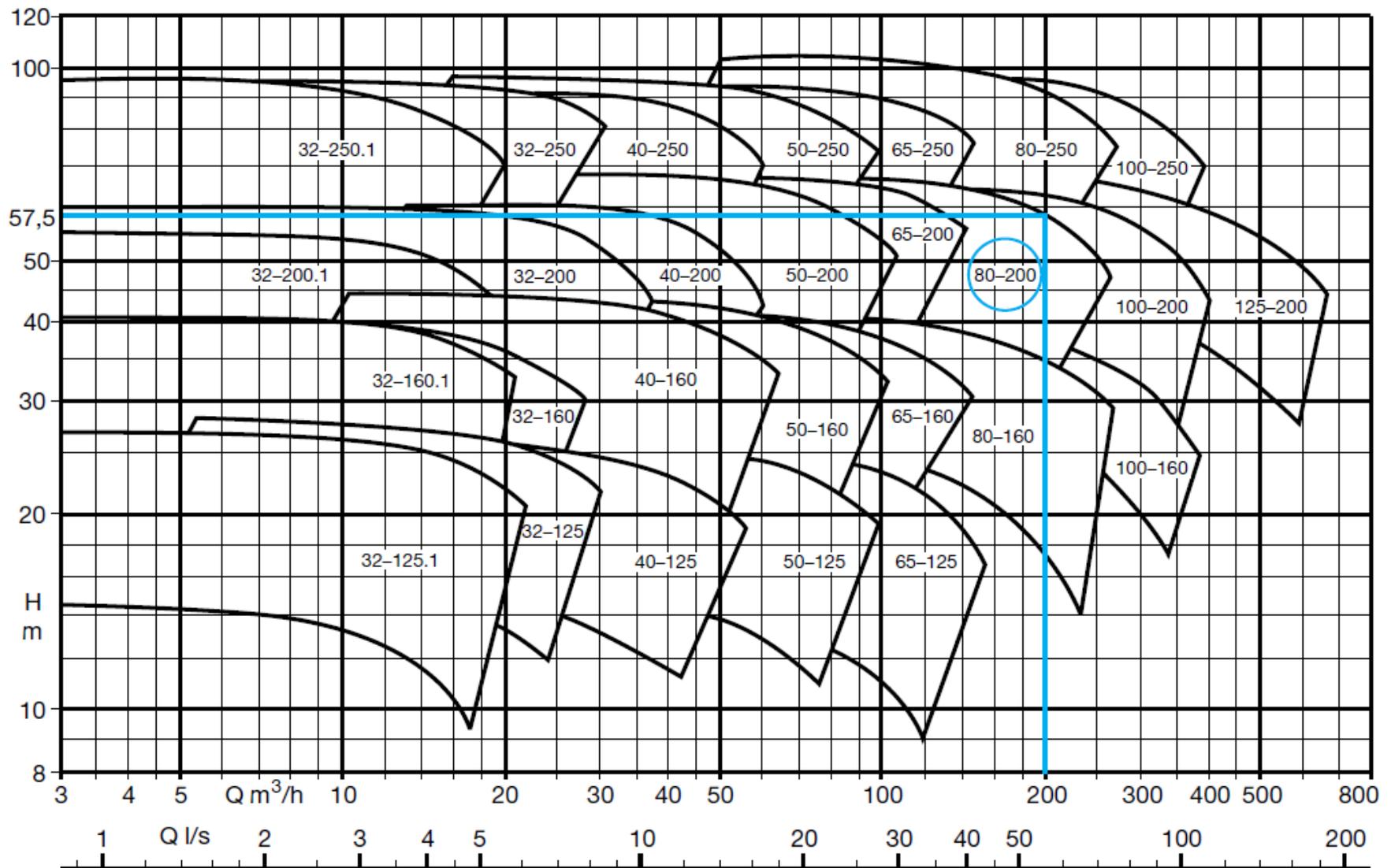


Scelta della pompa

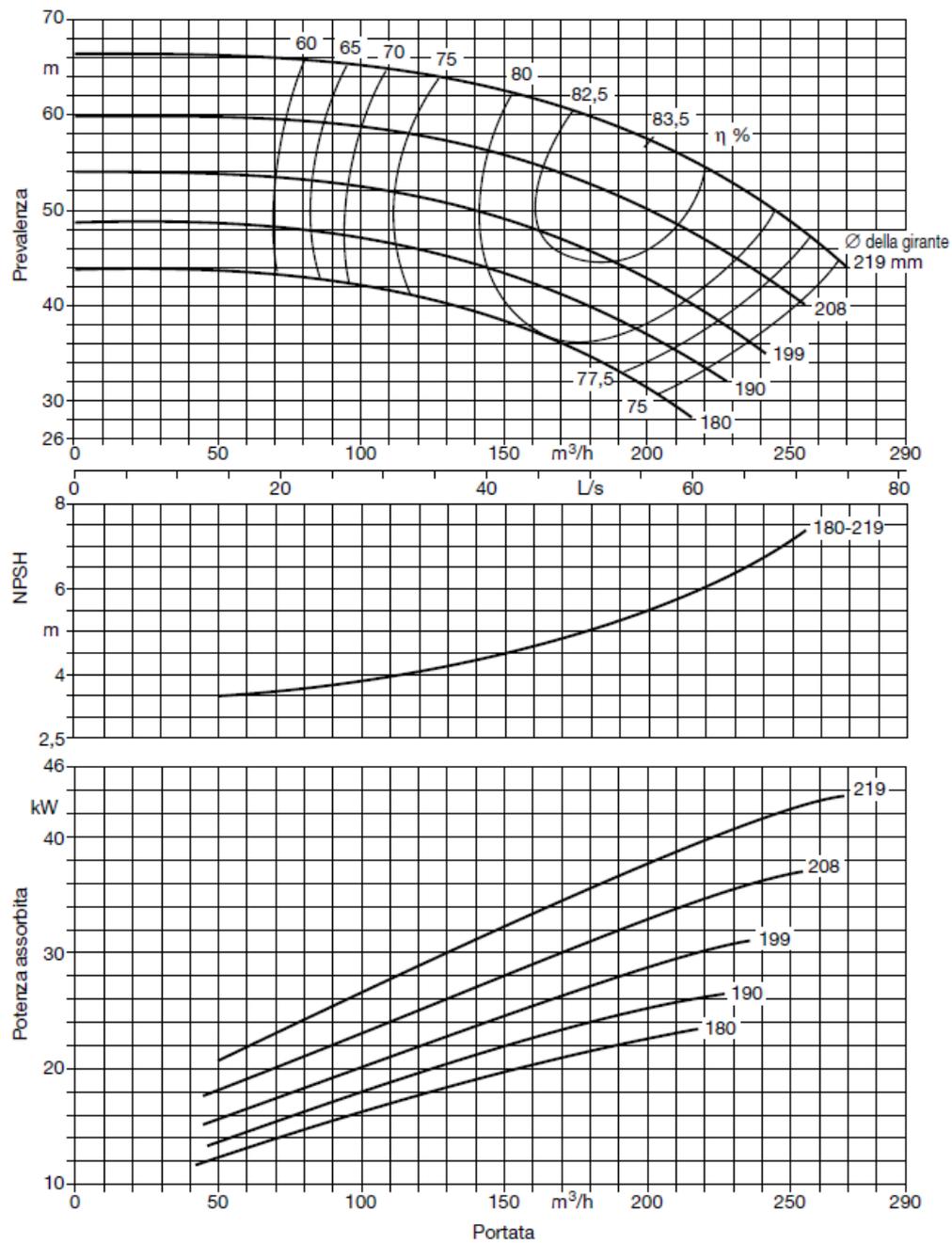


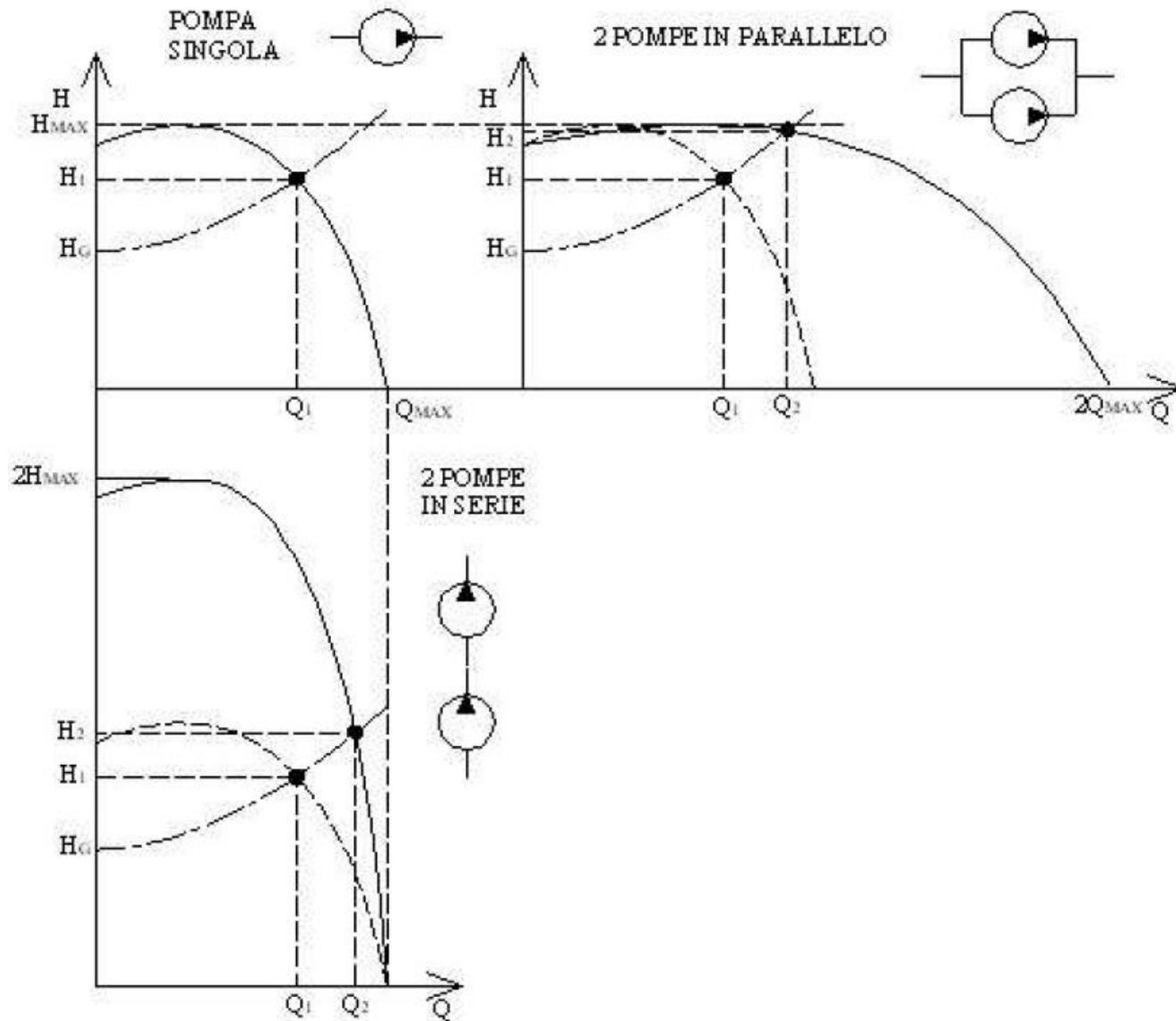


Campo caratteristico complessivo di una serie costruttiva di pompe con corpo a spirale a $n = 2900 \text{ min}^{-1}$ (1° numero = diametro nominale della bocca premente, 2° numero = diametro nominale della girante)

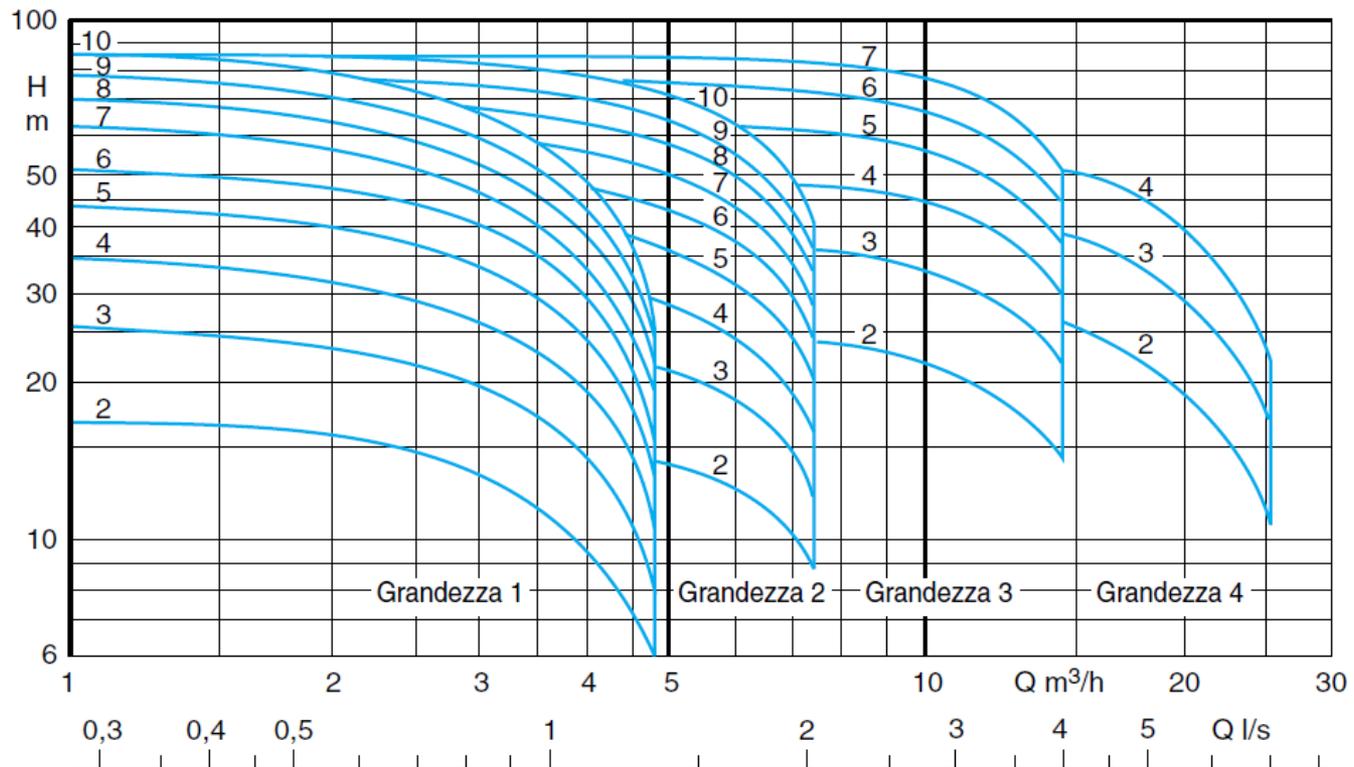
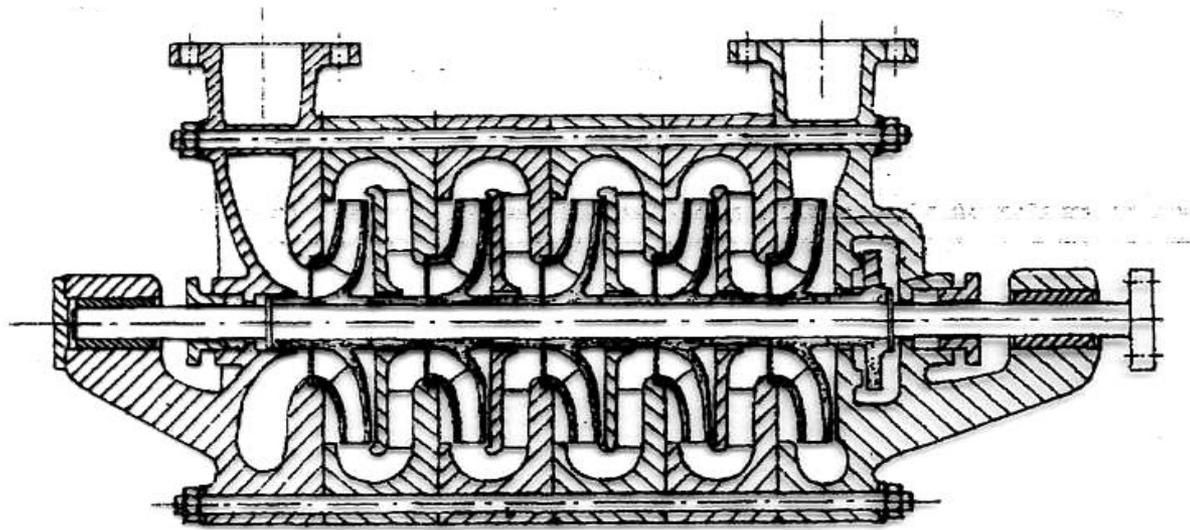


Campo caratteristico complessivo di una serie costruttiva di pompe con corpo a spirale a $n = 2900 \text{ min}^{-1}$ (1° numero = diametro nominale della bocca premente, 2° numero = diametro nominale della girante)





Curva caratteristica di prevalenza per pompe centrifughe in serie e in parallelo



Cavitazione: *galleria*

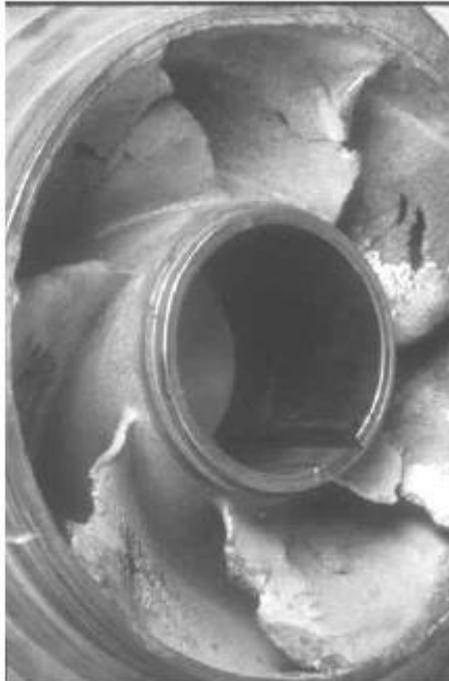
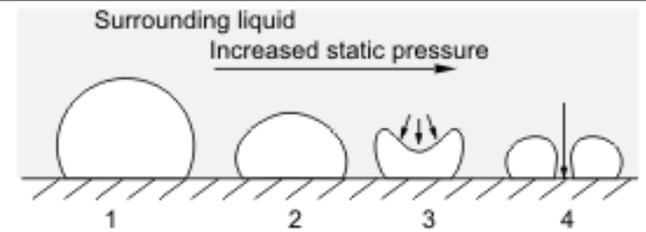
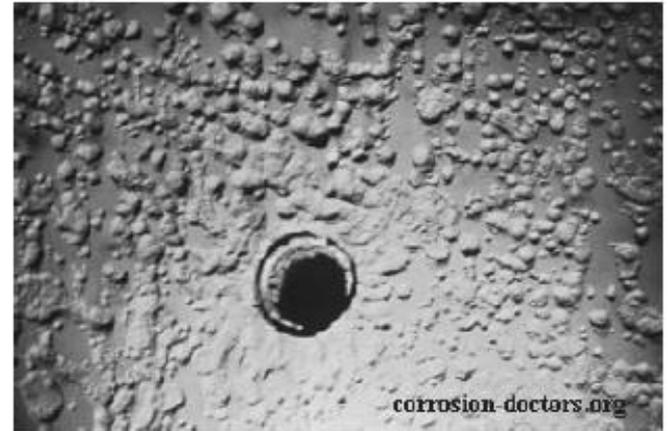


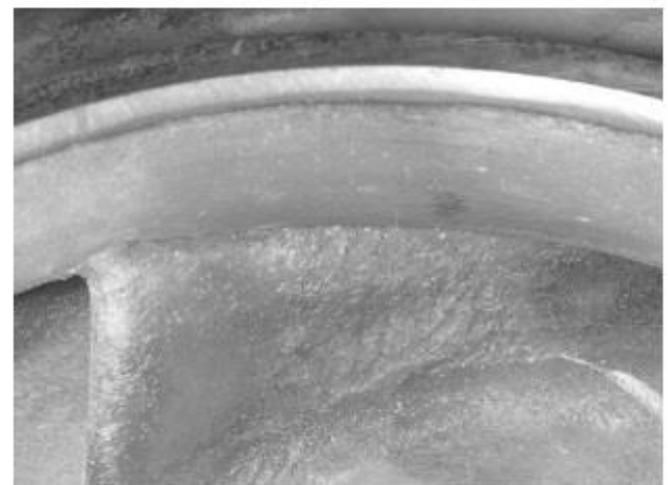
Figure 34 Cavitation on the leading edge, suction side of a runner
Maha, Pankaj Das, Acharya. Bureau of Reclamation photo.

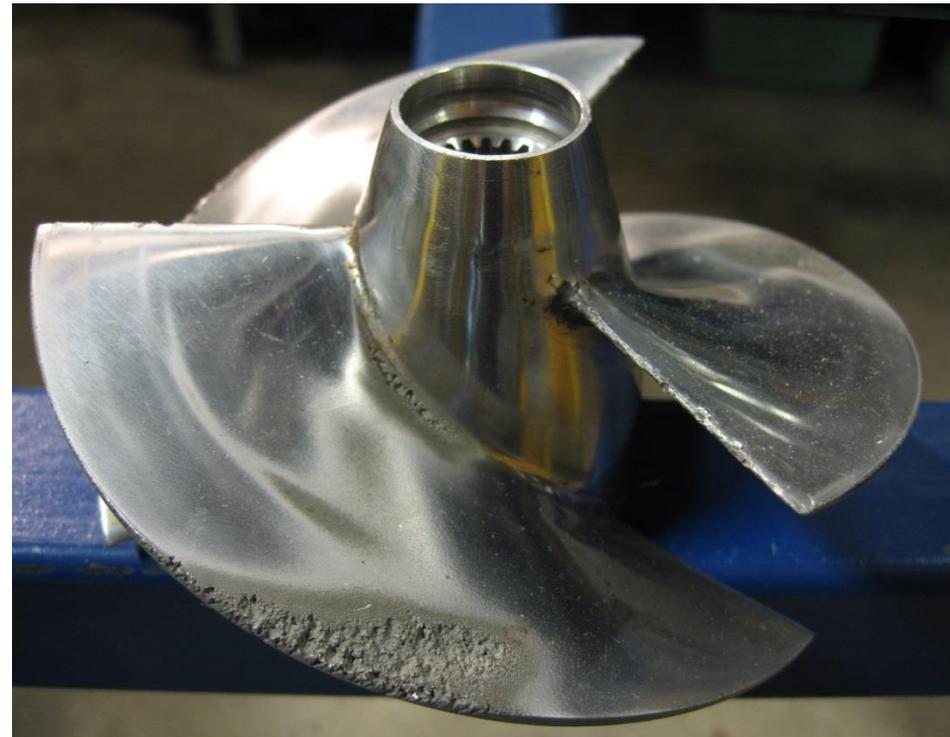


Cavitation bubble imploding close to a fixed surface generating a jet (4) of the surrounding liquid.



corrosion-doctors.org



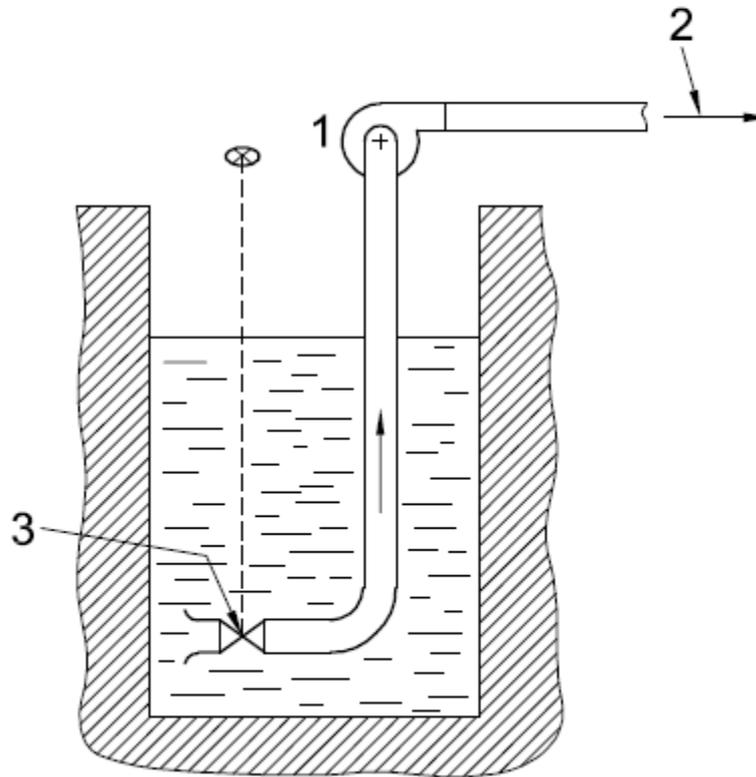


Norma UNI EN ISO 9906 - 2002

Prove di cavitazione: Variazione dell'NPSH mediante una valvola di regolazione della pressione di aspirazione

Legenda

- 1 Pompa di prova
- 2 Alla valvola di regolazione del flusso e al flussometro
- 3 Valvola di regolazione della pressione di aspirazione

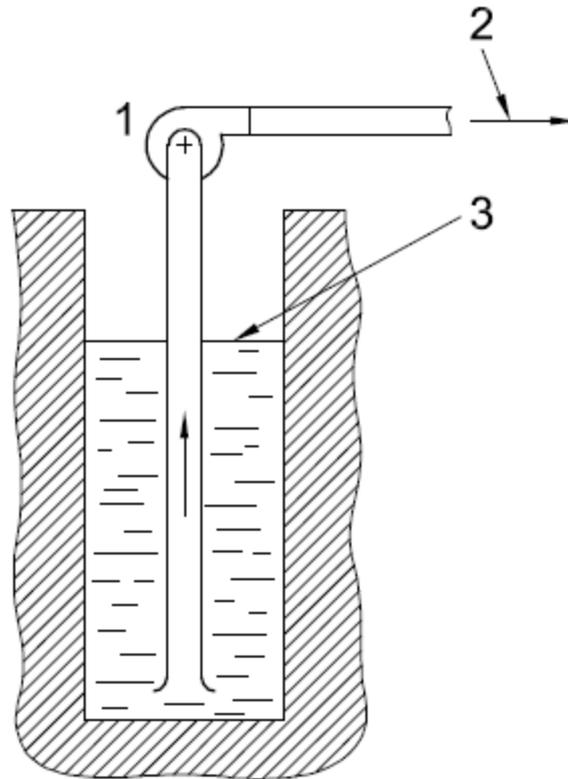


Norma UNI EN ISO 9906 - 2002

Prove di cavitazione: Variazione dell'NPSH mediante regolazione del livello del liquido nella vasca di aspirazione

Legenda

- 1 Pompa di prova
- 2 Alla valvola di regolazione del flusso e al flussometro
- 3 Livello dell'acqua regolabile

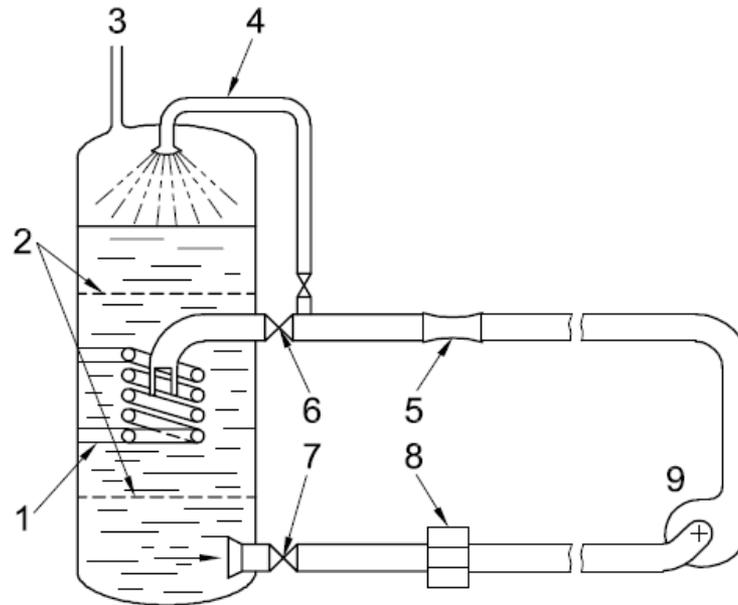


Norma UNI EN ISO 9906 - 2002

Prove di cavitazione: Variazione dell'NPSH in circuito chiuso con regolazione della pressione e/o della temperatura

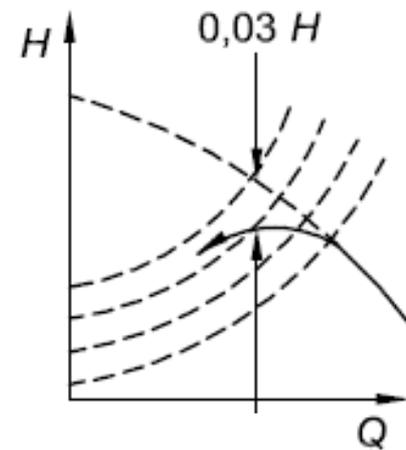
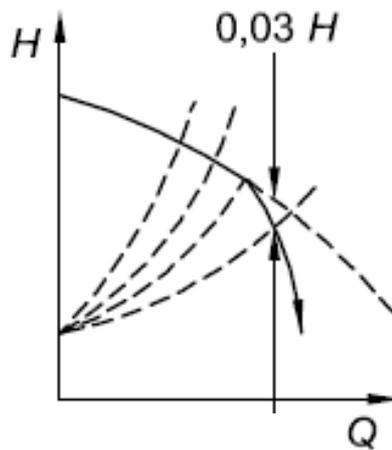
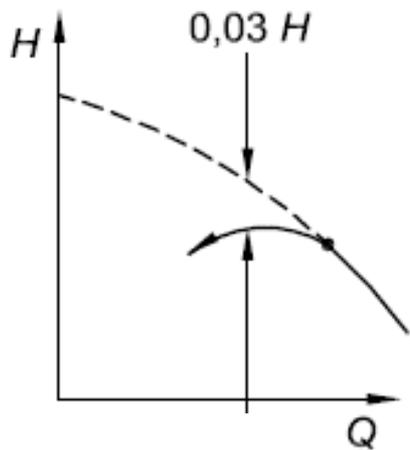
Legenda

- 1 Serpentini di raffreddamento o di riscaldamento
- 2 Schermi di calma
- 3 Al vuoto o alla regolazione della pressione
- 4 Spruzzatore per la disaerazione del liquido
- 5 Flussometro
- 6 Valvola di regolazione del flusso
- 7 Valvola di intercettazione
- 8 Punto di misura per il contenuto di gas
- 9 Pompa di prova



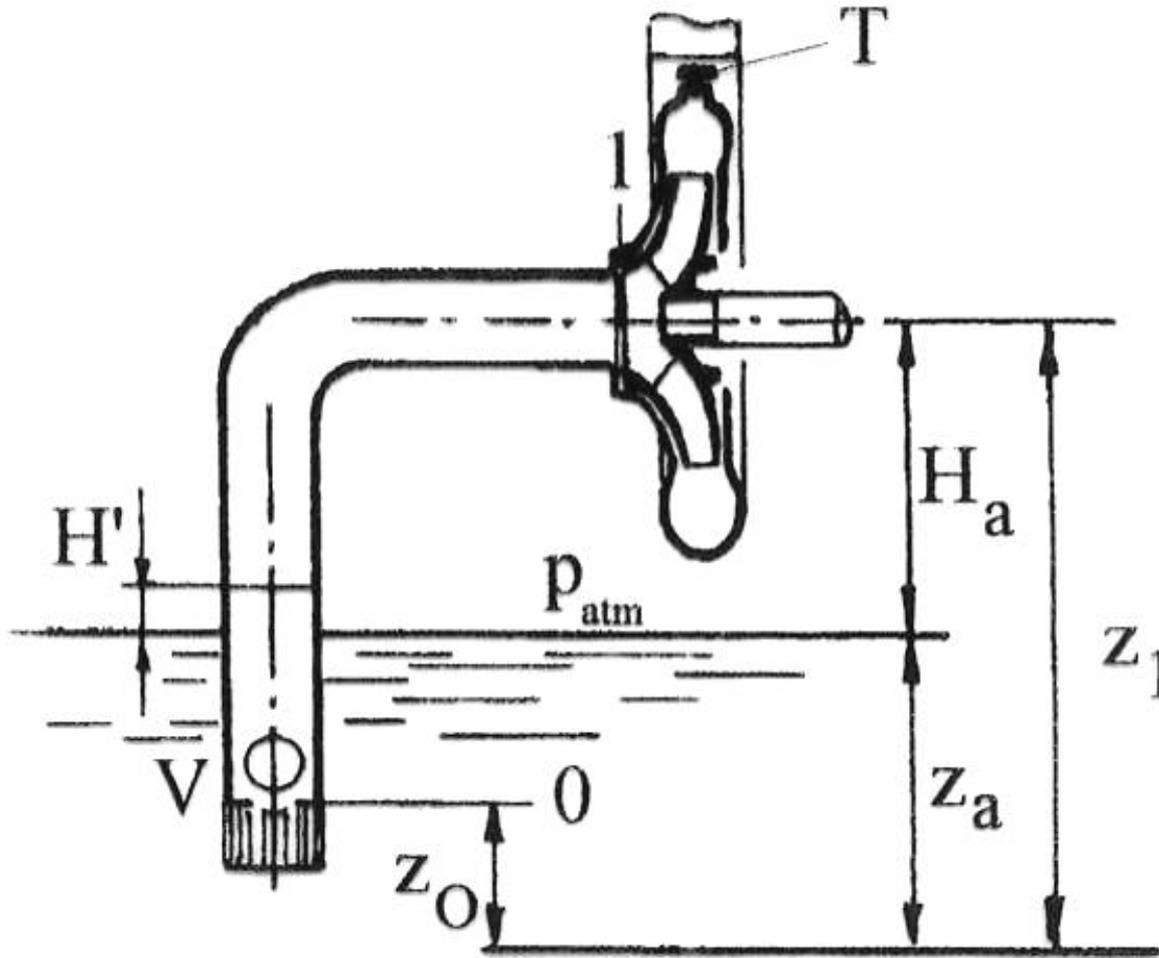
Nota Il raffreddamento mediante serpentino può essere sostituito da un'iniezione di acqua fresca sopra la superficie libera del liquido e dall'estrazione dell'acqua riscaldata.

Norma UNI EN ISO 9906 - 2002



Variabile indipendente	Valvola di strozzamento di entrata	Valvola di strozzamento di uscita	Livello dell'acqua
Costante	Valvola di strozzamento di uscita	Valvola di strozzamento di entrata	Valvole di strozzamento di entrata e di uscita
Grandezze la cui variazione dipende dalla regolazione	Altezza totale, portata, NPSHA, livello dell'acqua	Altezza totale, portata, NPSHA, livello dell'acqua	Altezza totale, portata, NPSHA

Adescamento



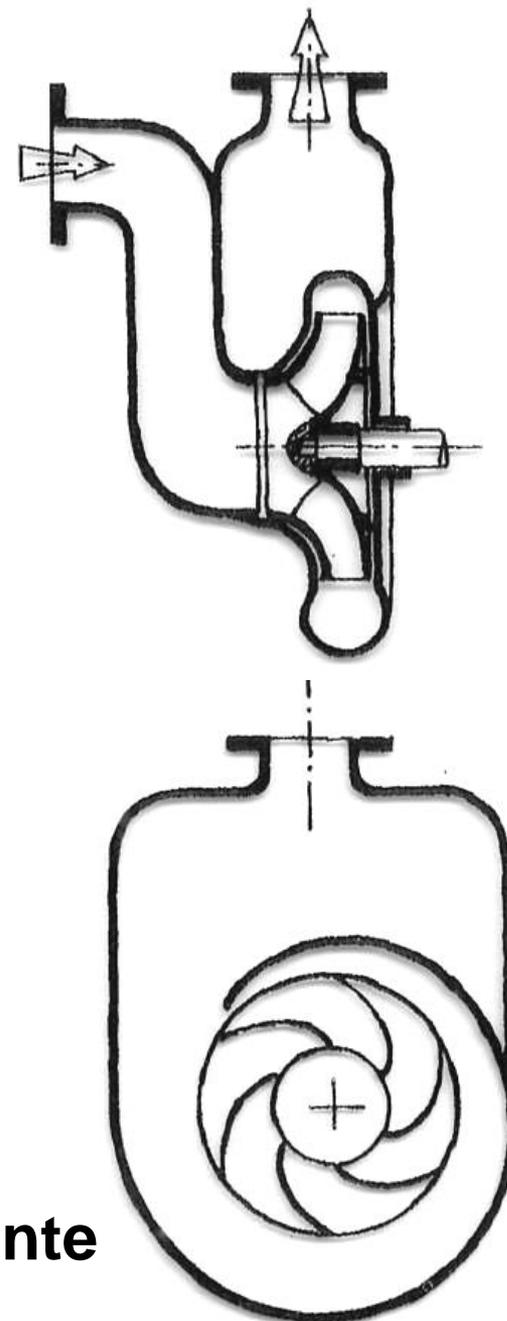
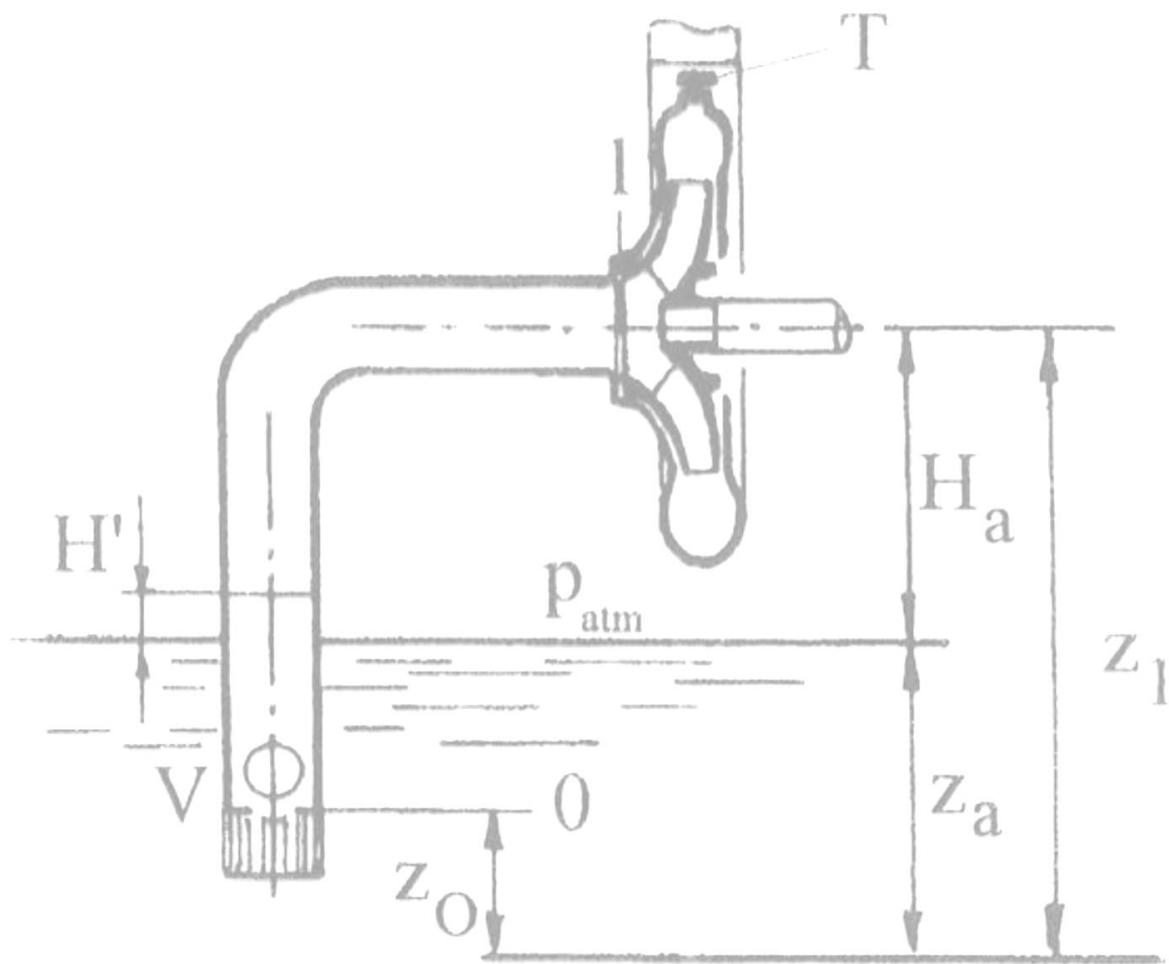
$$gH = \frac{\Delta p_{acqua}}{\rho_{acqua}} \cong \frac{\Delta p_{aria}}{\rho_{aria}}$$

$$\Delta p_{aria} = \frac{\rho_{aria}}{\rho_{acqua}} \Delta p_{acqua}$$

$$\Delta p_{aria} = \rho_{aria} gH = \rho_{acqua} gH'$$

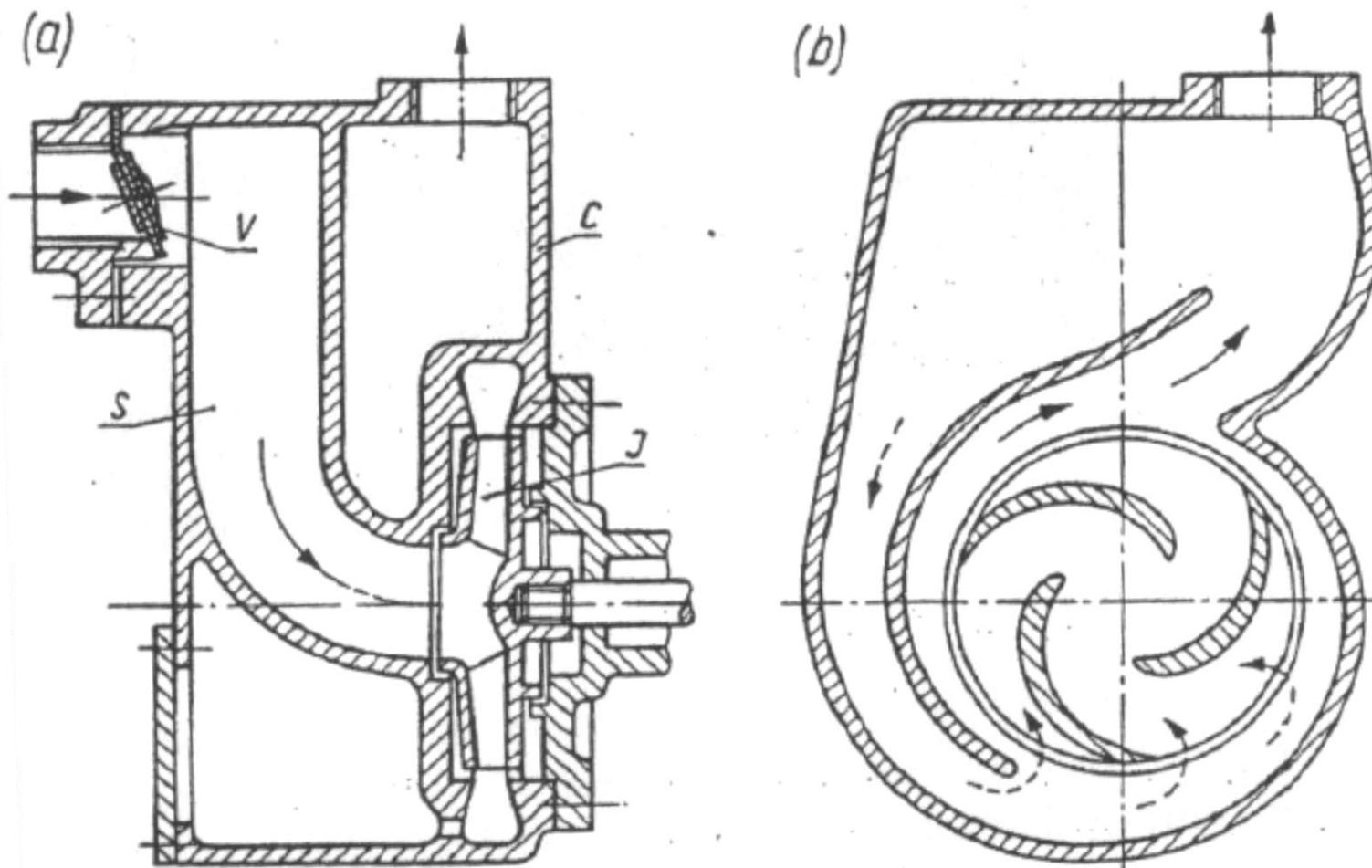
$$H' = \frac{\rho_{aria}}{\rho_{acqua}} H$$

Adescamento



Pompa centrifuga autoadescante

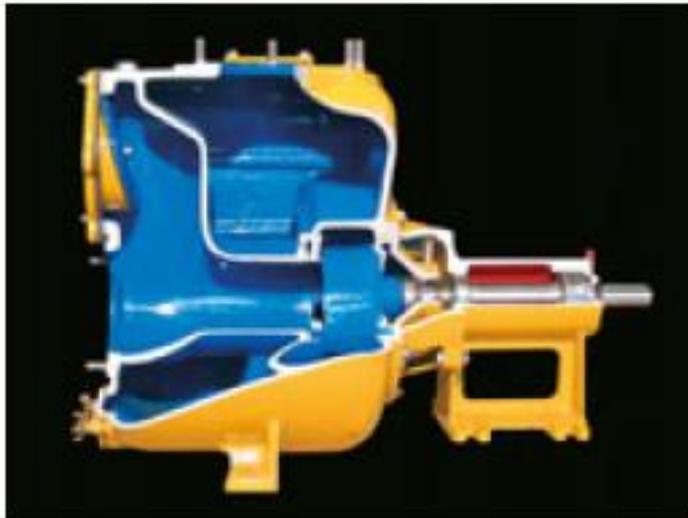
Pompa centrifuga autoadescante "solid handling"



Self-priming centrifugal pump with double volute: (a) longitudinal section,
(b) cross-section (INGERSOLL-RAND);

C — casing, J — impeller, S — suction chamber, V — non-return valve.

Pompa centrifuga autoadescante "solid handling"



Pompa centrifuga autoadescante "solid handling"

