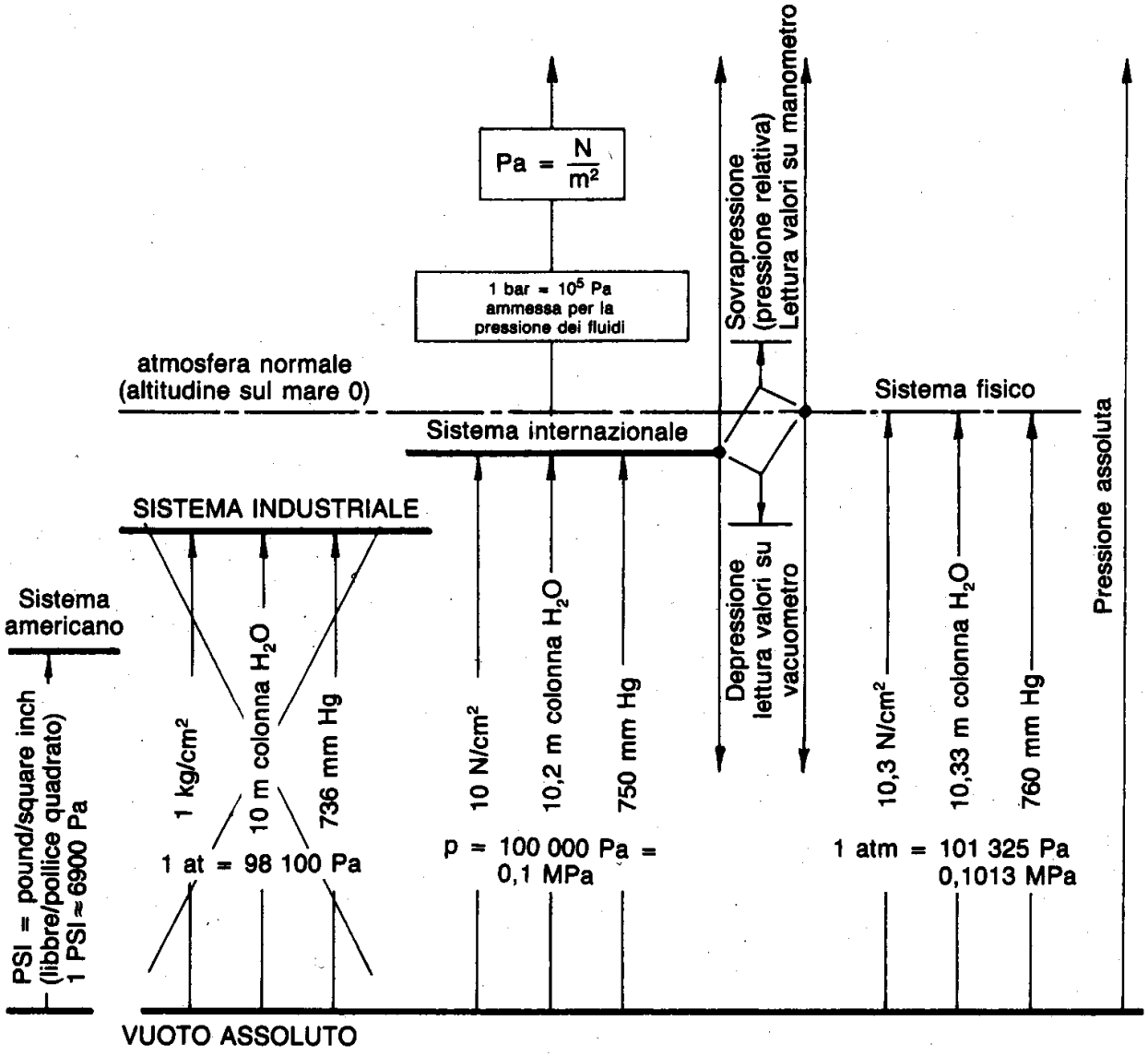
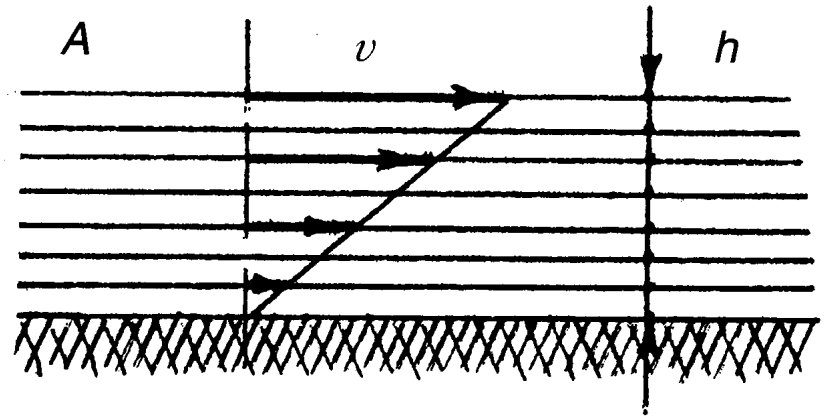
Scale pressioni



Viscosità dinamica



$$F = \mu A \frac{v}{h} \qquad \Rightarrow \qquad \mu = \frac{F\ h}{A\ v}$$

$$[\mu] = \frac{N\ m}{m^2\ m/s} = \frac{N}{m^2}\ s = Pa\ s$$

Viscosità cinematica

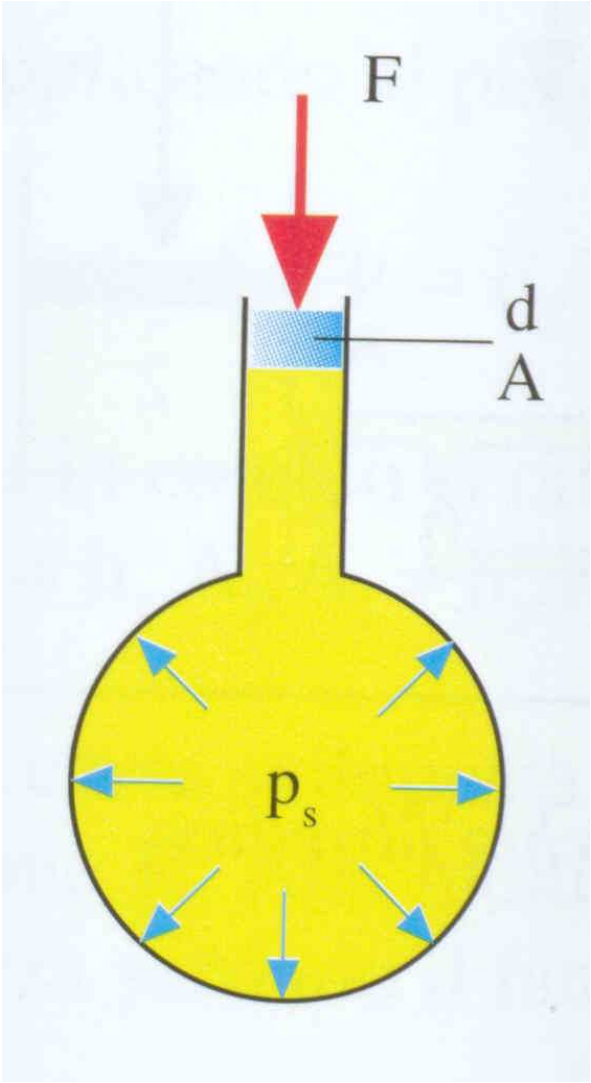
$$\nu = \frac{\mu}{\rho}$$

$$[\nu] = \frac{\frac{N}{m^2}\, s}{\frac{Kg}{m^3}} = \frac{m^2}{s}$$

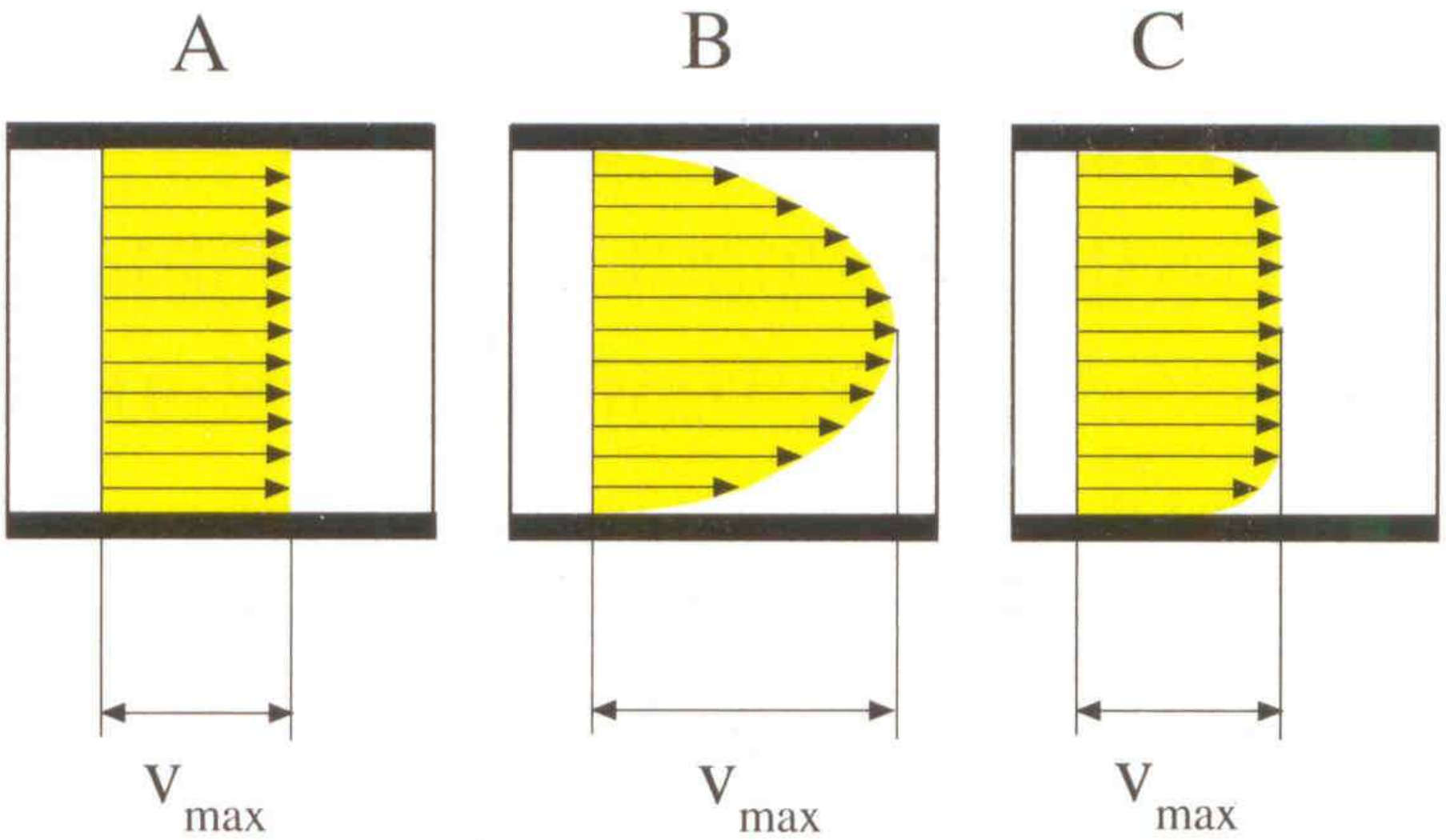
$$1St = 10^{-4}\ \frac{m^2}{s}$$

$$1cSt = 10^{-6}\ \frac{m^2}{s} = 1\ \frac{mm^2}{s}$$

Principio di Pascal



Moto di un fluido in condotto

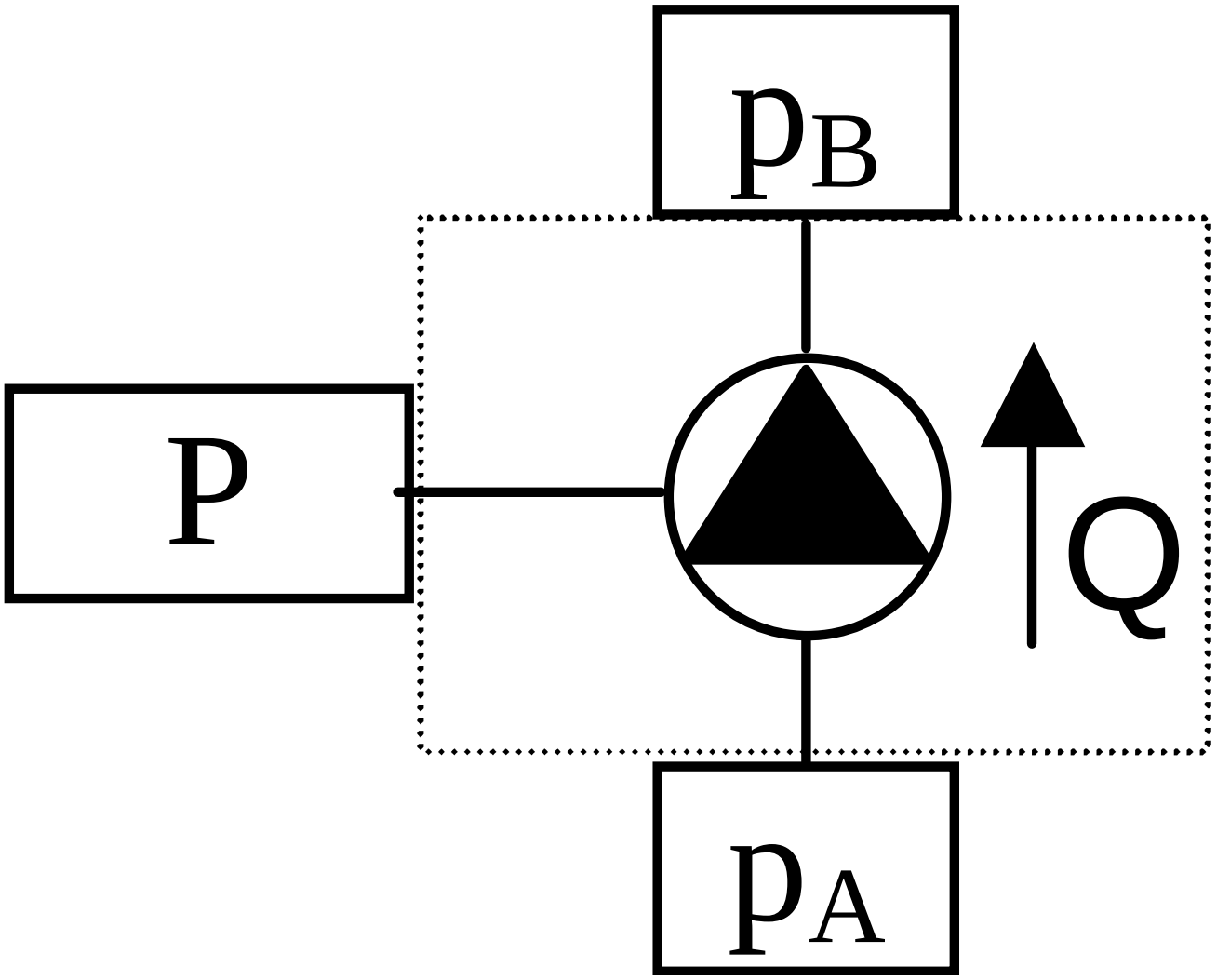


Equazione di Bernoulli

$$\frac{p}{\rho}+\frac{v^2}{2}+gz=cost \qquad \textit{nel SI (monomi in } m^2/s^2)$$

$$\frac{p}{\gamma}+\frac{v^2}{2g}+z=cost \qquad \textit{nel ST (monomi in } m)$$

Sistema di riferimento



Prevalenza fornita dalla pompa

Prevalenza manometrica — nel SI

$$H_m = \frac{P_B}{\rho g} - \frac{P_A}{\rho g}$$

nel ST

$$H_m = \frac{P_B}{\gamma} - \frac{P_A}{\gamma}$$

Prevalenza totale — nel SI

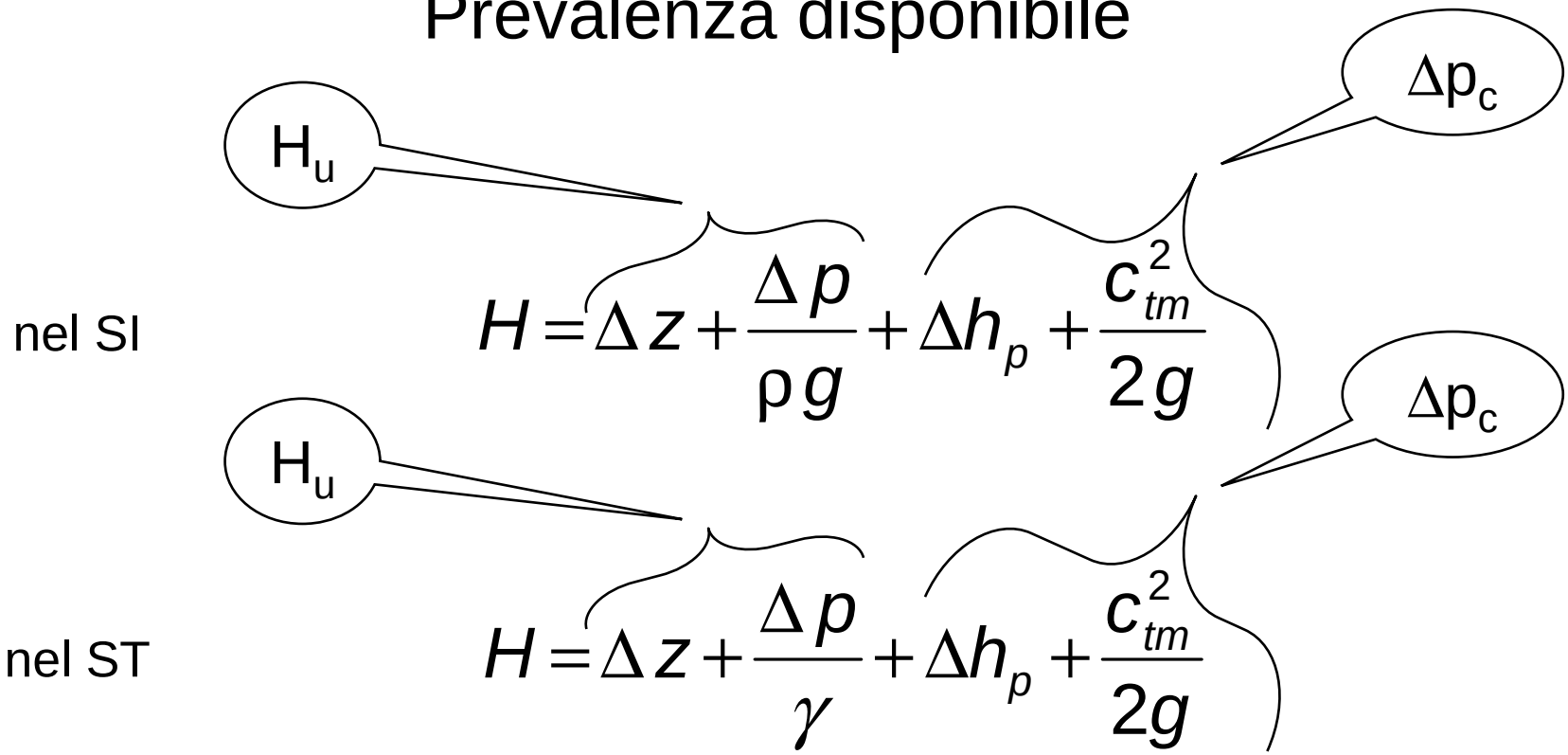
$$H = \frac{P_B}{\rho g} - \frac{P_A}{\rho g} + \frac{c_B^2}{2g} - \frac{c_A^2}{2g} + z_B - z_A$$

nel ST

$$H = \frac{P_B}{\gamma} - \frac{P_A}{\gamma} + \frac{c_B^2}{2g} - \frac{c_A^2}{2g} + z_B - z_A$$

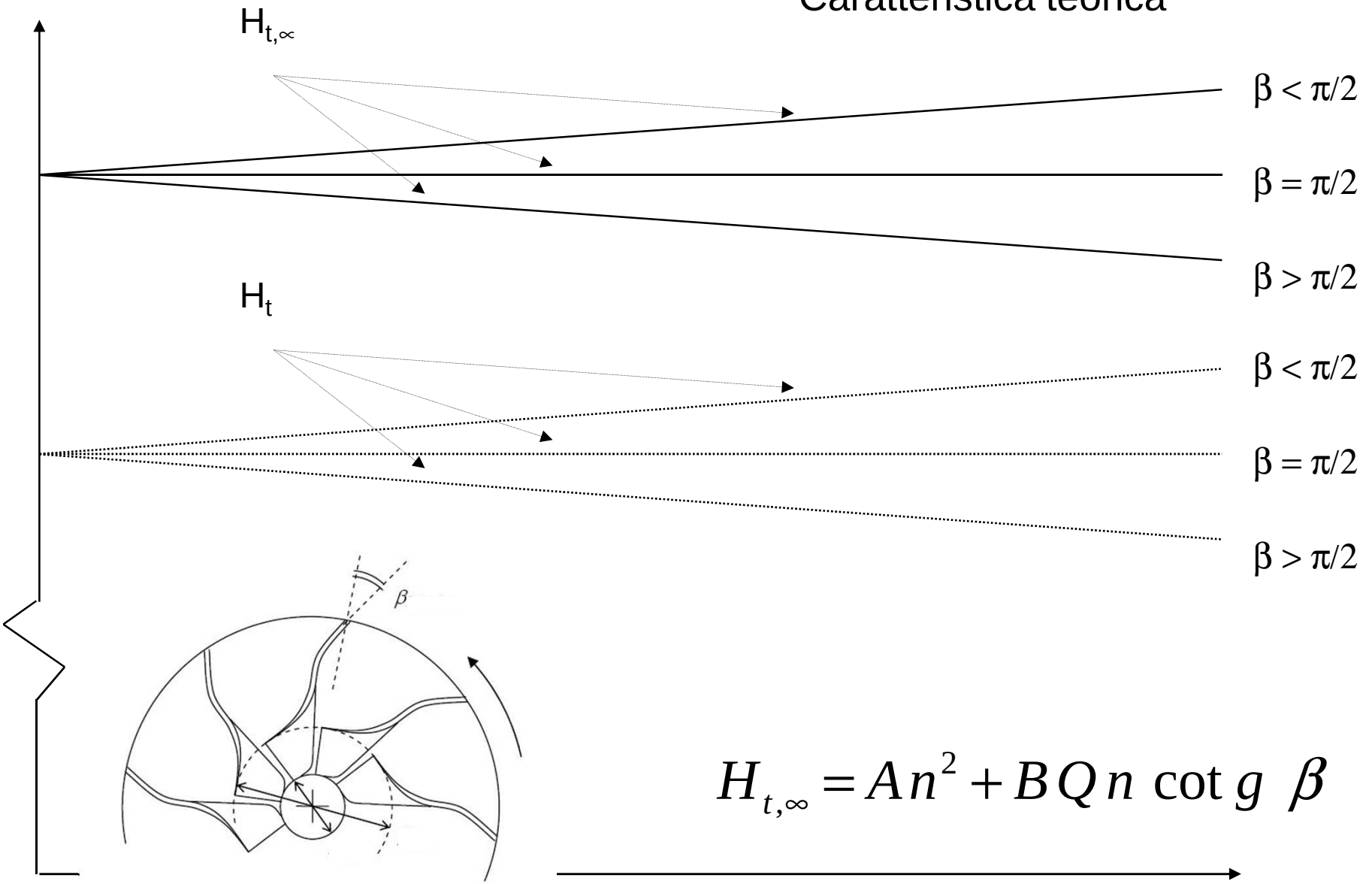
$$H = H_m + \frac{c_B^2}{2g} - \frac{c_A^2}{2g} + z_B - z_A \qquad [m]$$

Prevalenza disponibile



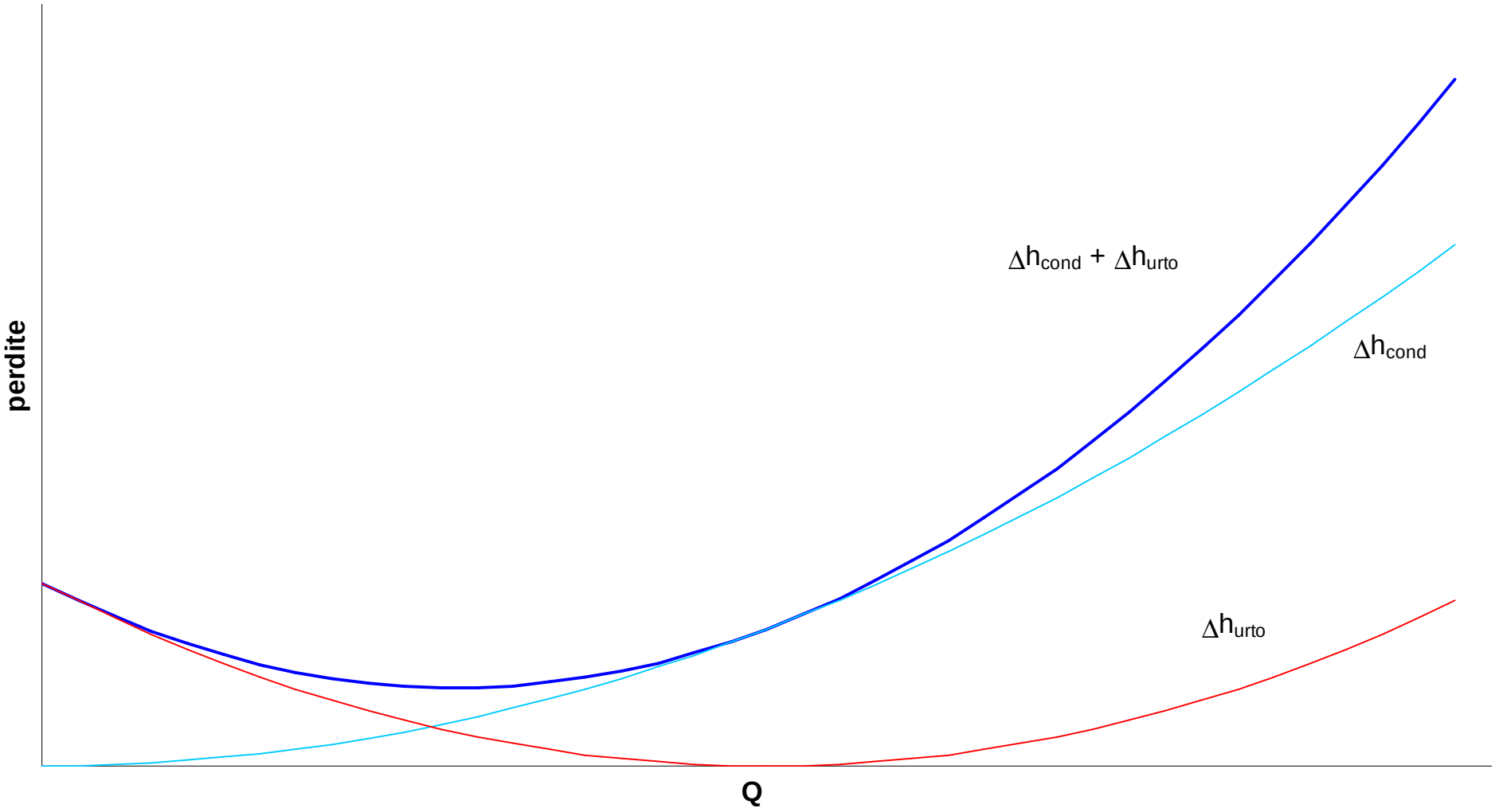
$$H = H_u + \Delta p_c$$

Caratteristica teorica

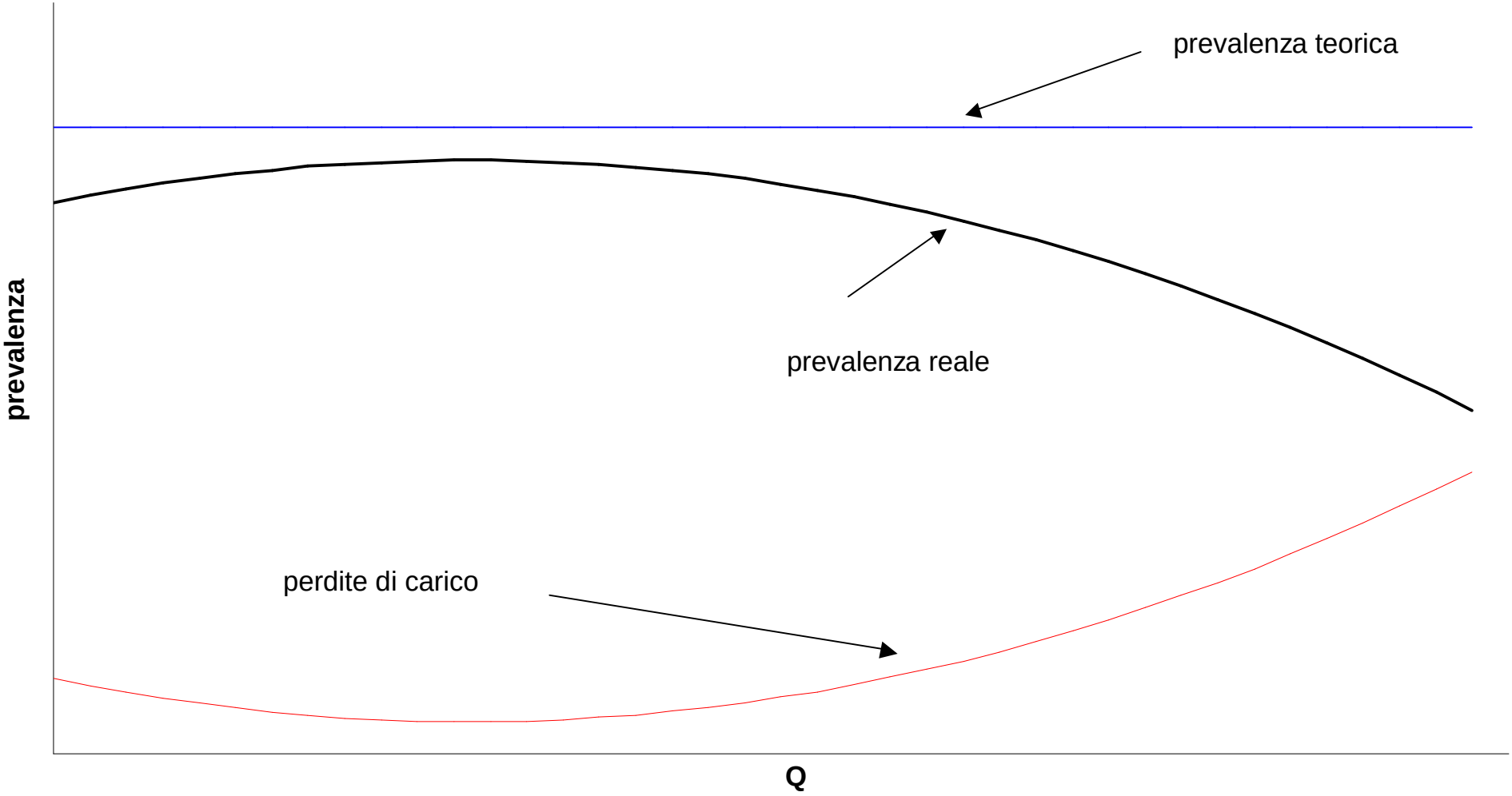


$$H_{t,\infty} = An^2 + BQn \cot g\ \beta$$

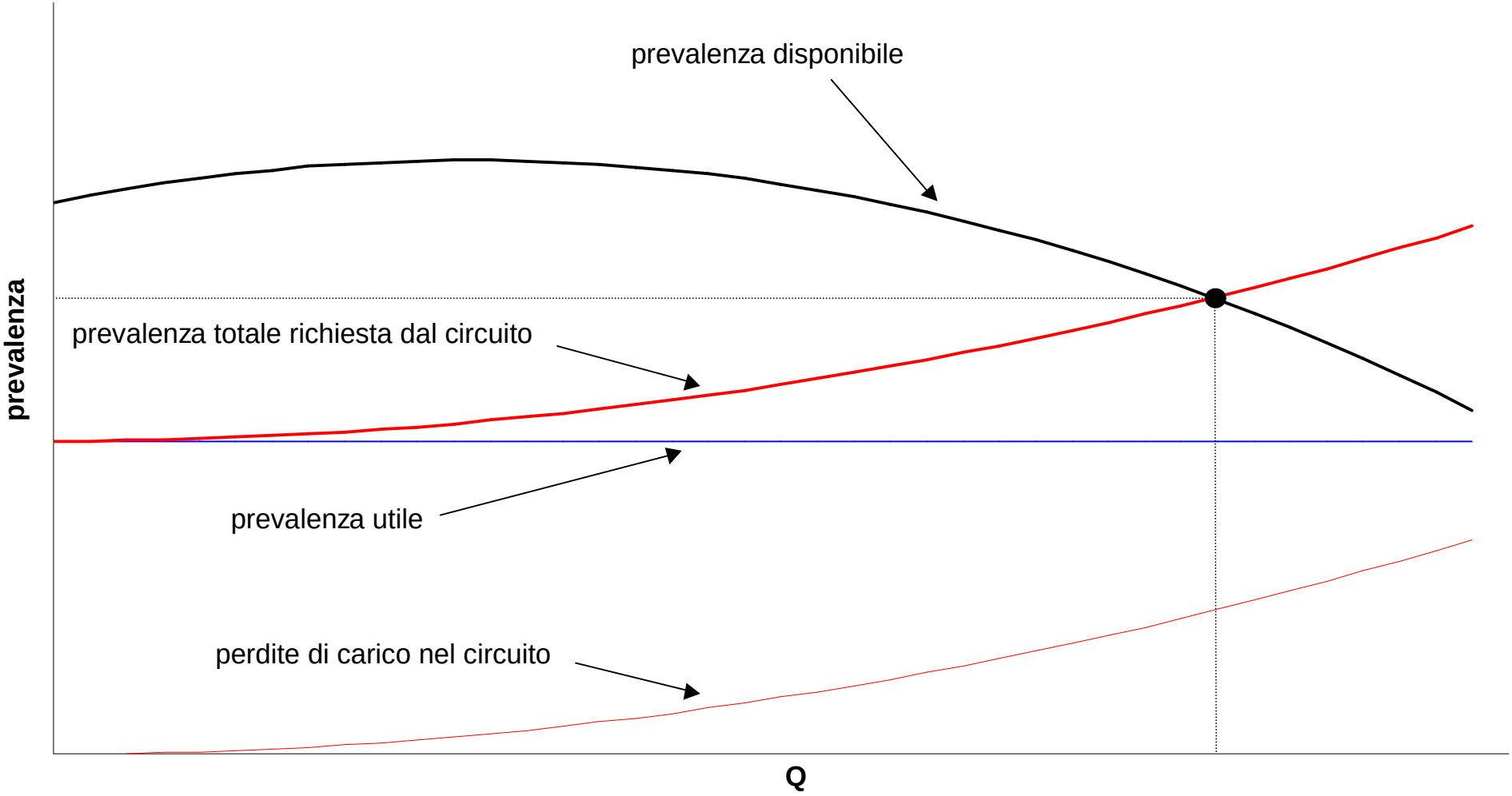
Perdite di carico nella pompa



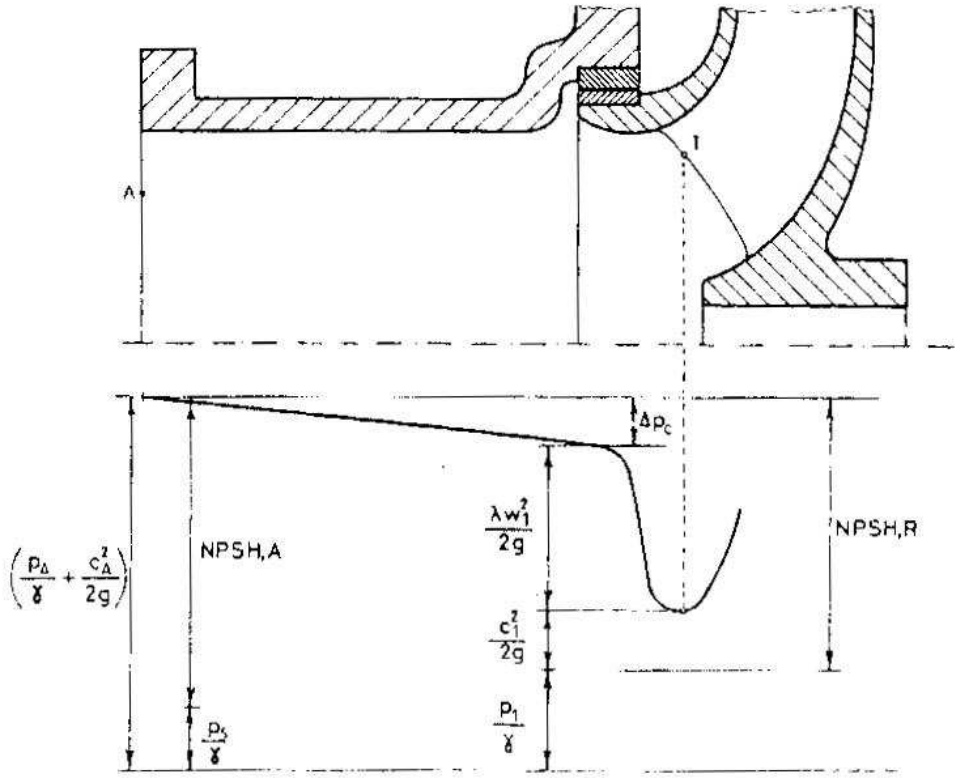
Caratteristica reale della pompa



Punto di funzionamento



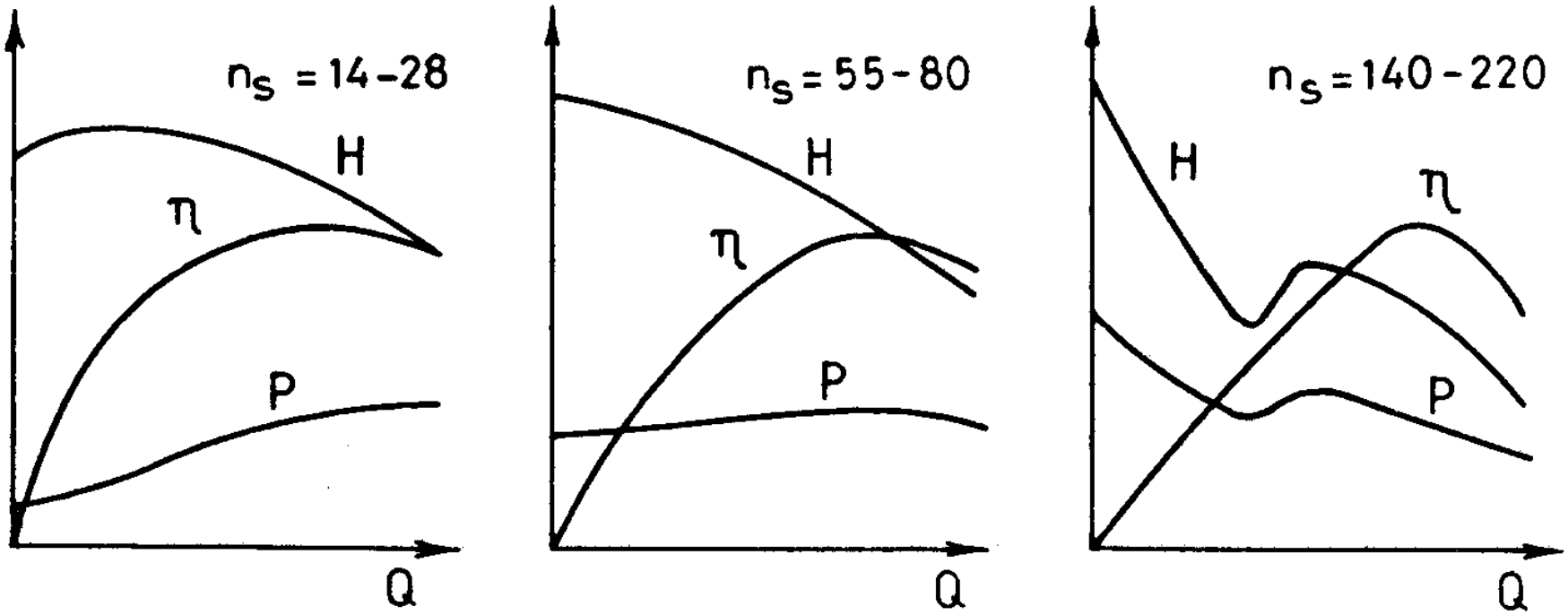
Cavitazione



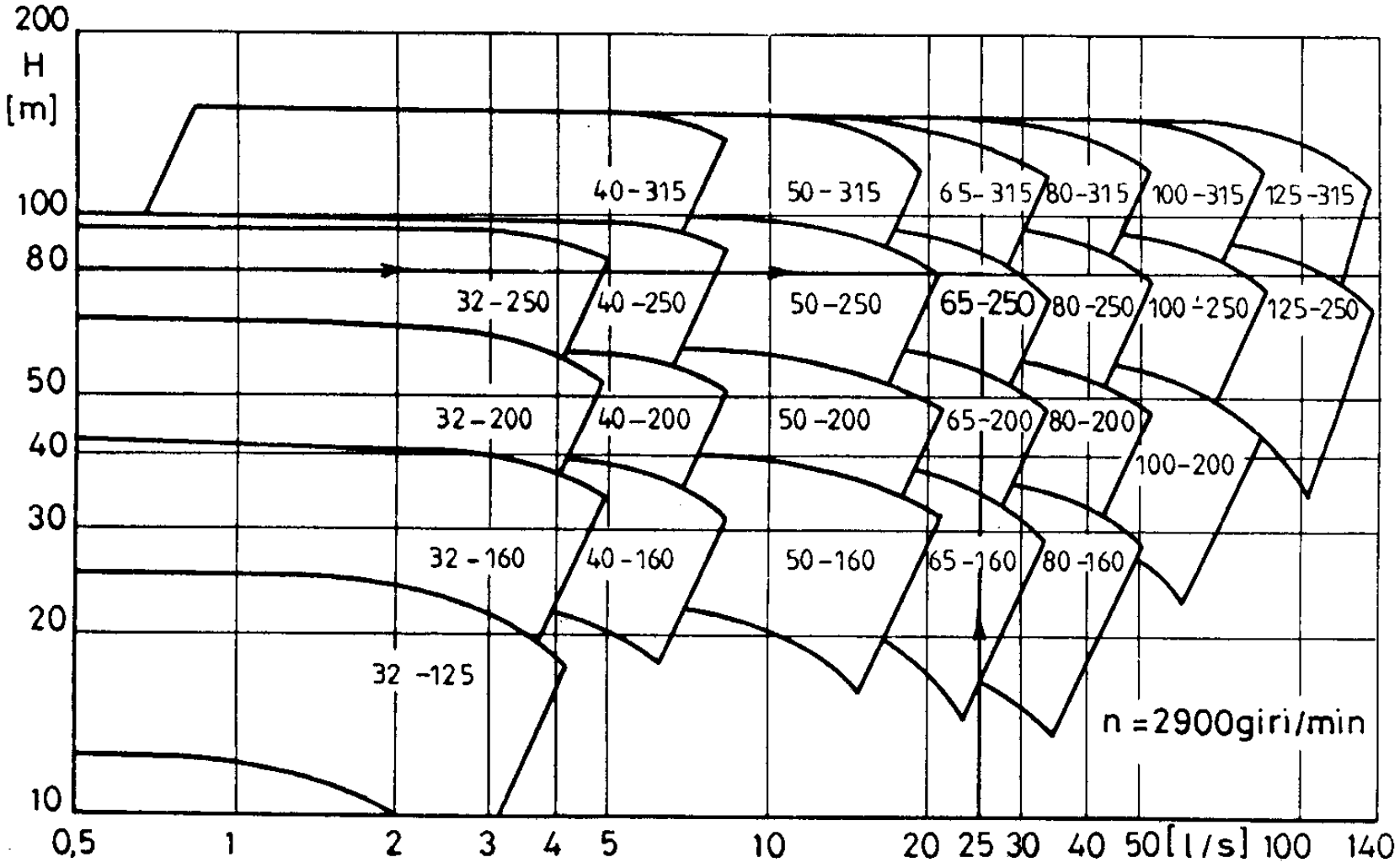
$$NPSH,_A = \left(\frac{p_A}{\gamma} + \frac{c_A^2}{2g}\right) - \frac{p_S}{\gamma}$$

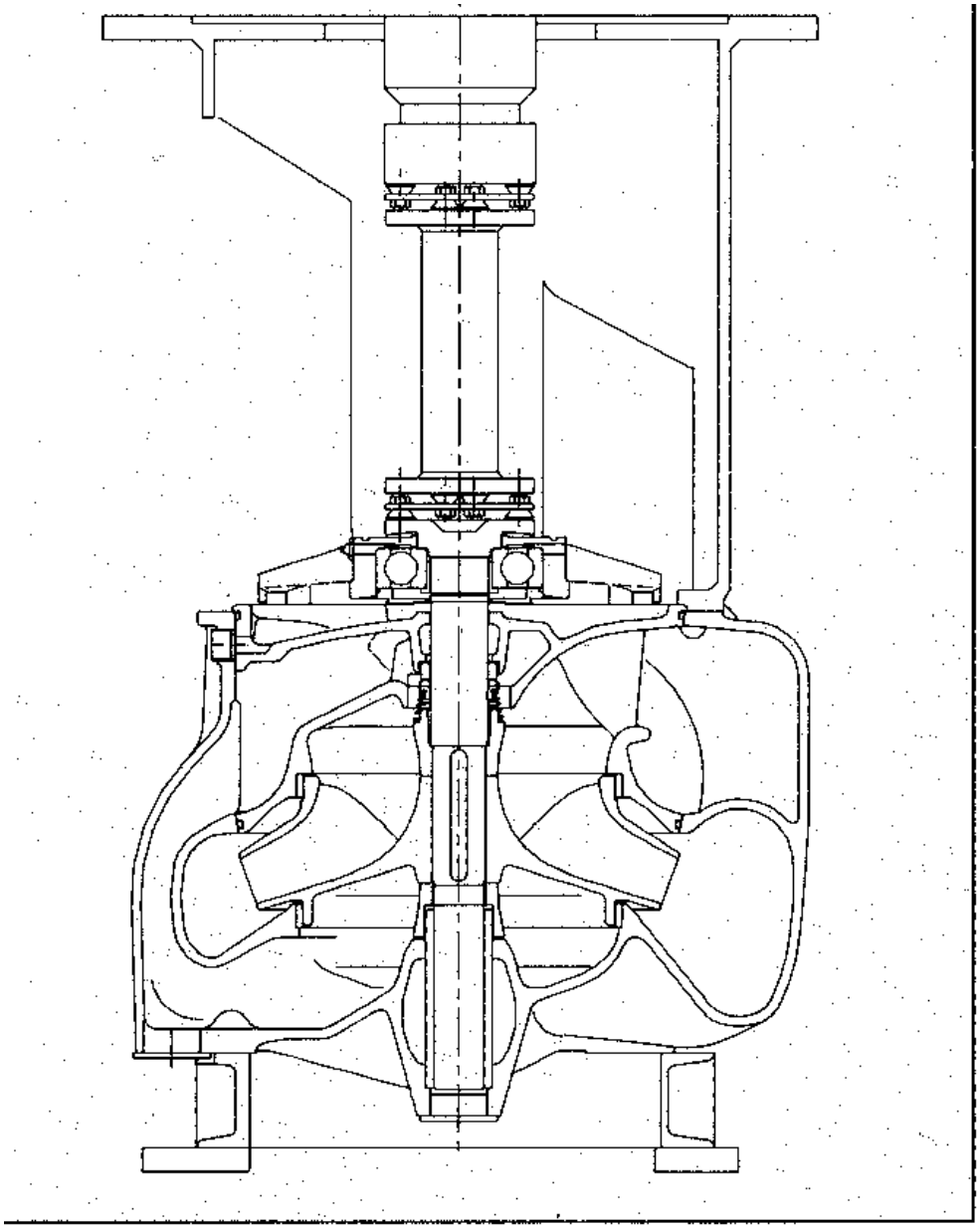
$$NPSH,_R = \left(\frac{c_1^2}{2g} + \Delta p_c + \lambda \frac{w_1^2}{2g}\right)$$

Dipendenza delle caratteristiche della pompa dal numero di giri specifico

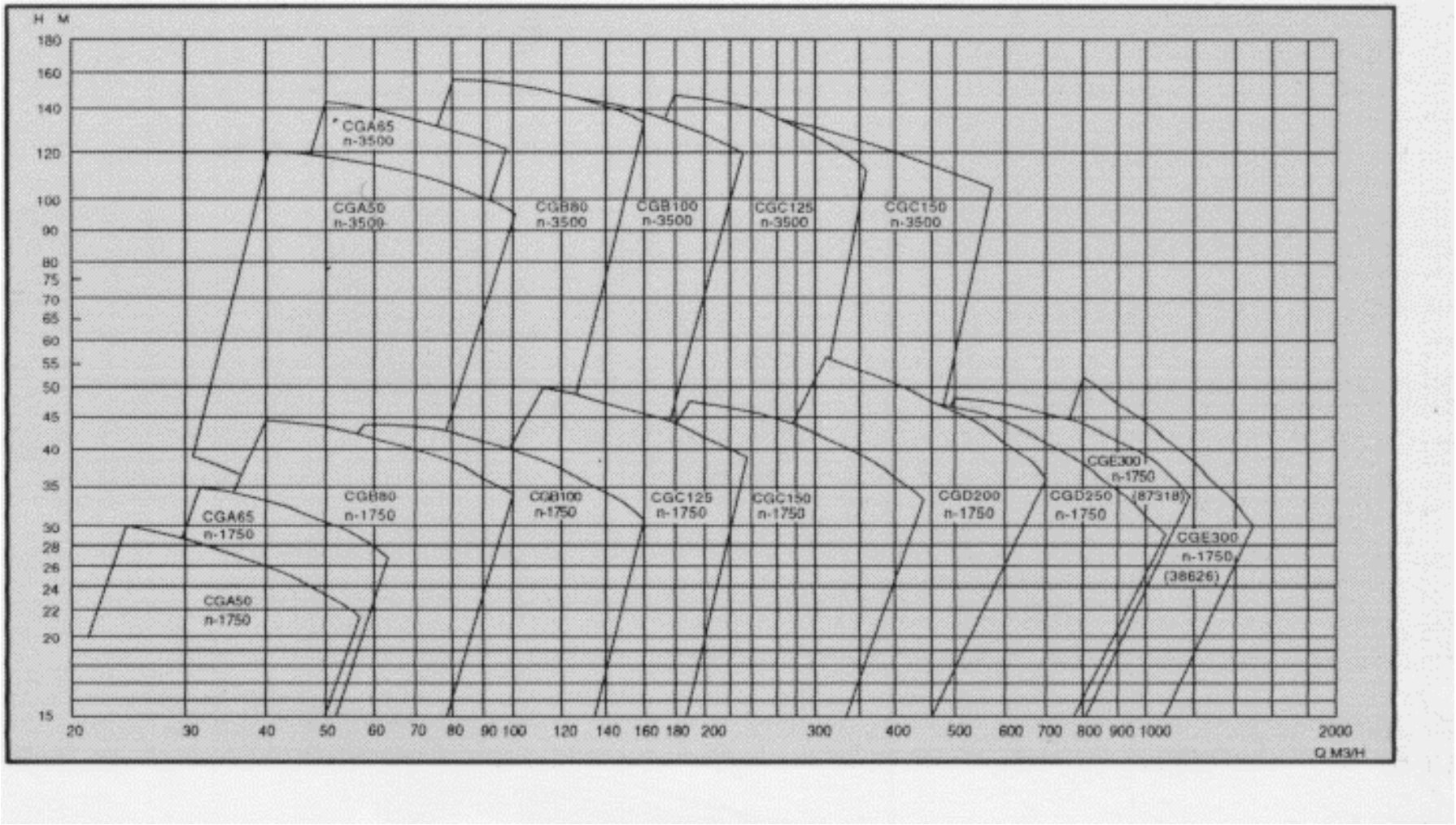


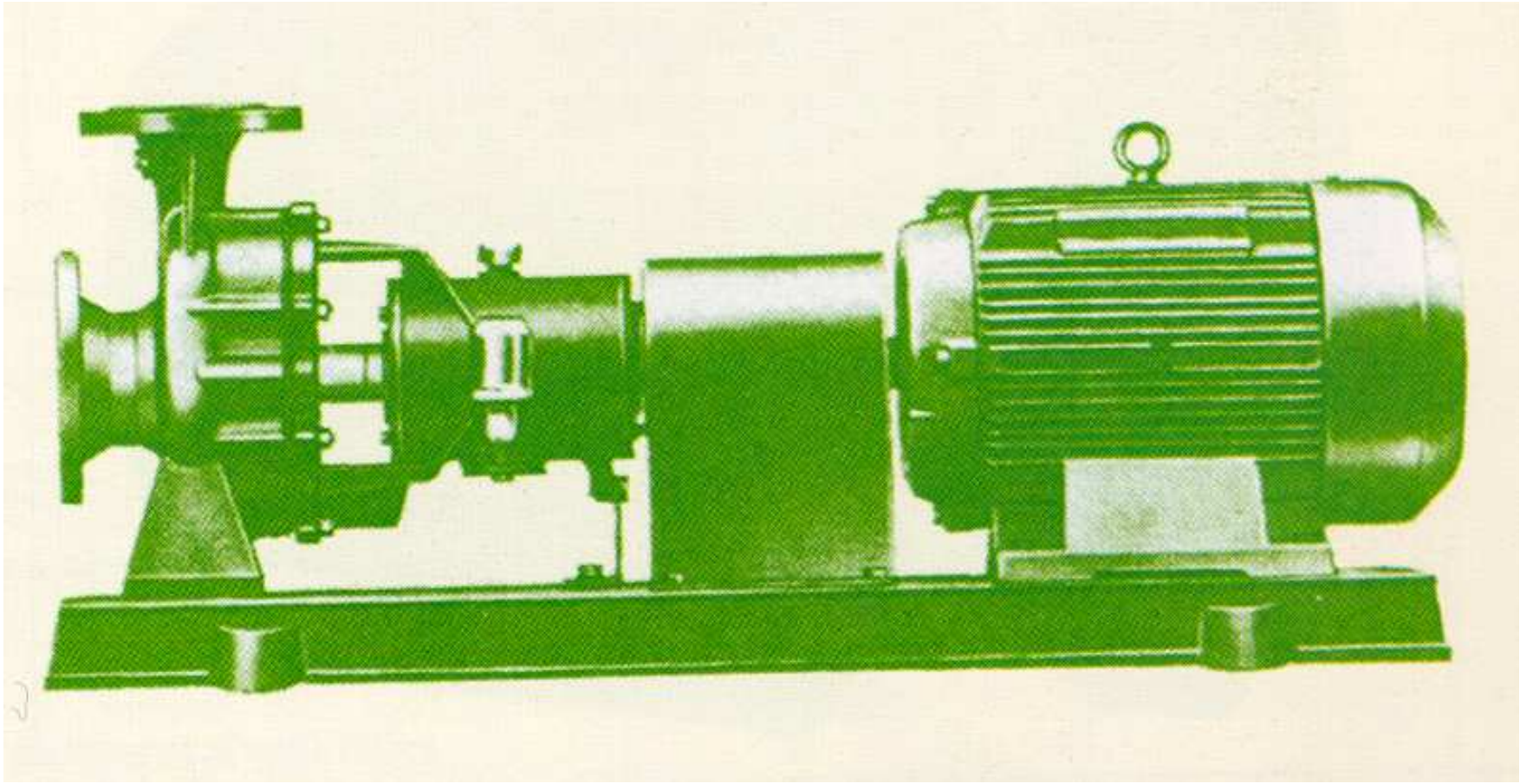
Diagrammi di layout

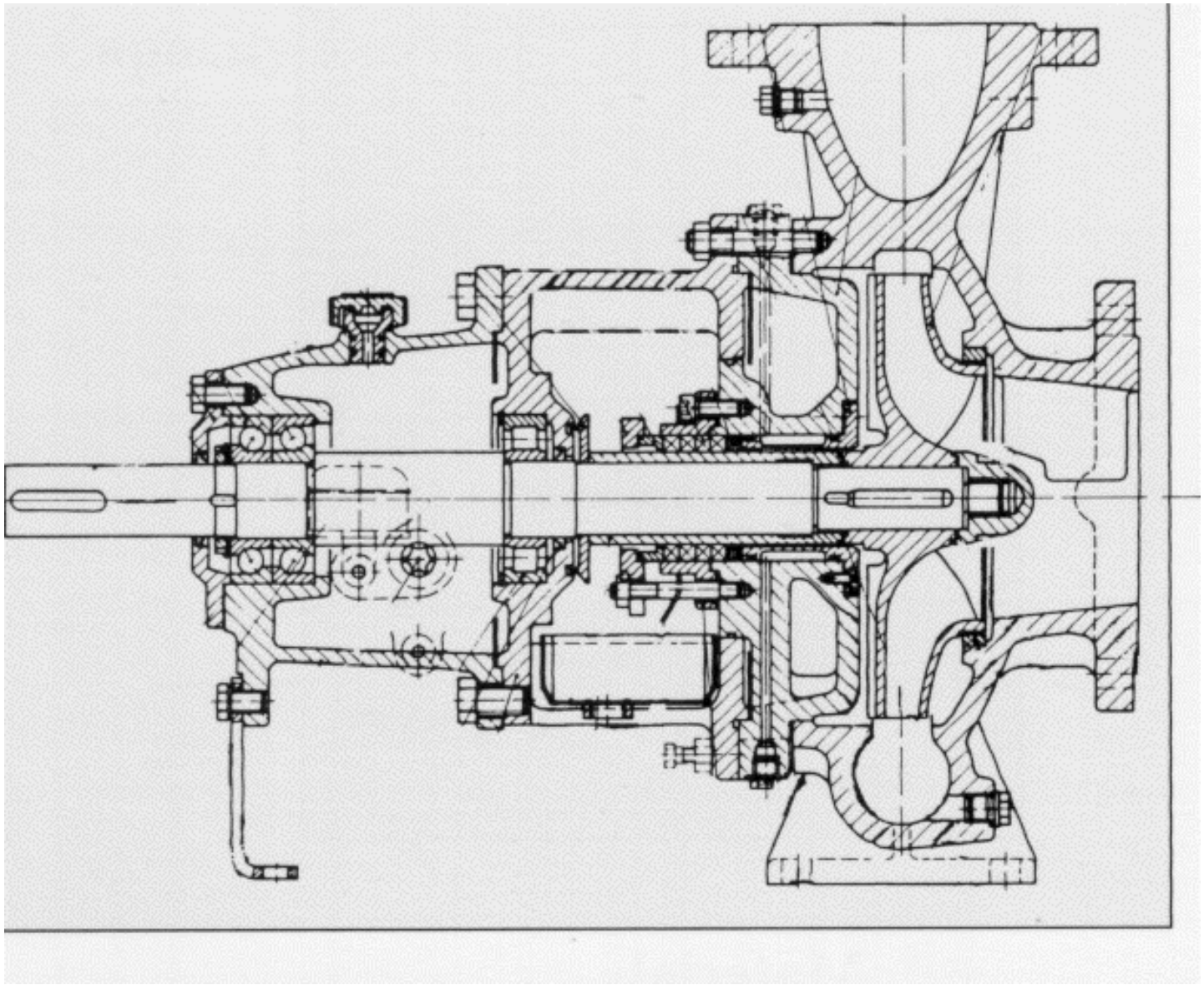




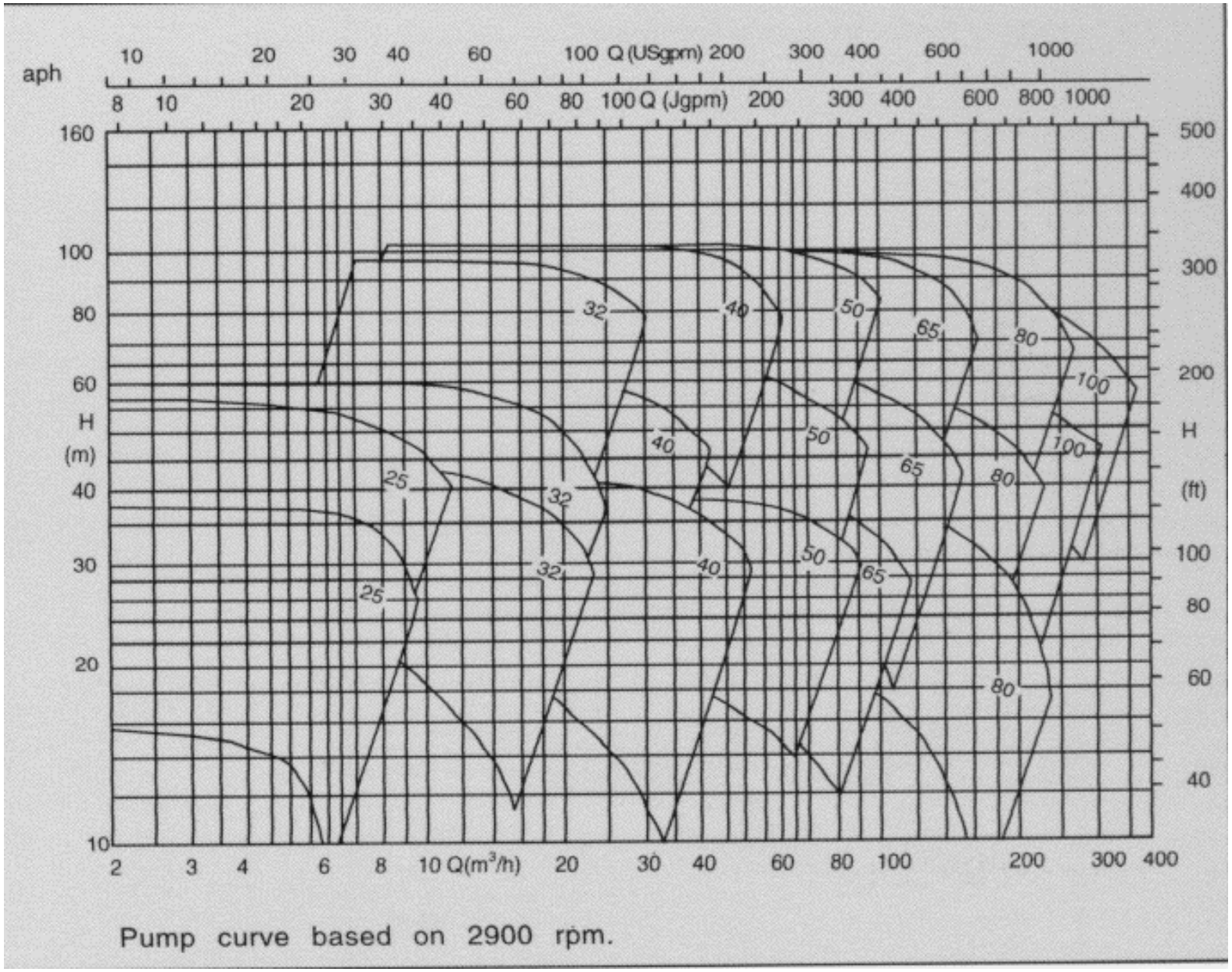
IN I.2


H M
180
160
140
120
100
90
80
75
70
65
60
55
50
45
40
35
30
28
26
24
22
20
15
CGA65 n-3500
CGA50 n-3500
CGB80 n-3500
CGB100 n-3500
CGC125 n-3500
CGC150 n-3500
CGA65 n-1750
CGA50 n-1750
CGB80 n-1750
CGB100 n-1750
CGC125 n-1750
CGC150 n-1750
CGD200 n-1750
CGD250 n-1750
CGE300 n-1750 (87318)
CGE300 n-1750 (38626)
20 30 40 50 60 70 80 90 100 120 140 160 180 200 300 400 500 600 700 800 900 1000 2000
Q M3/H

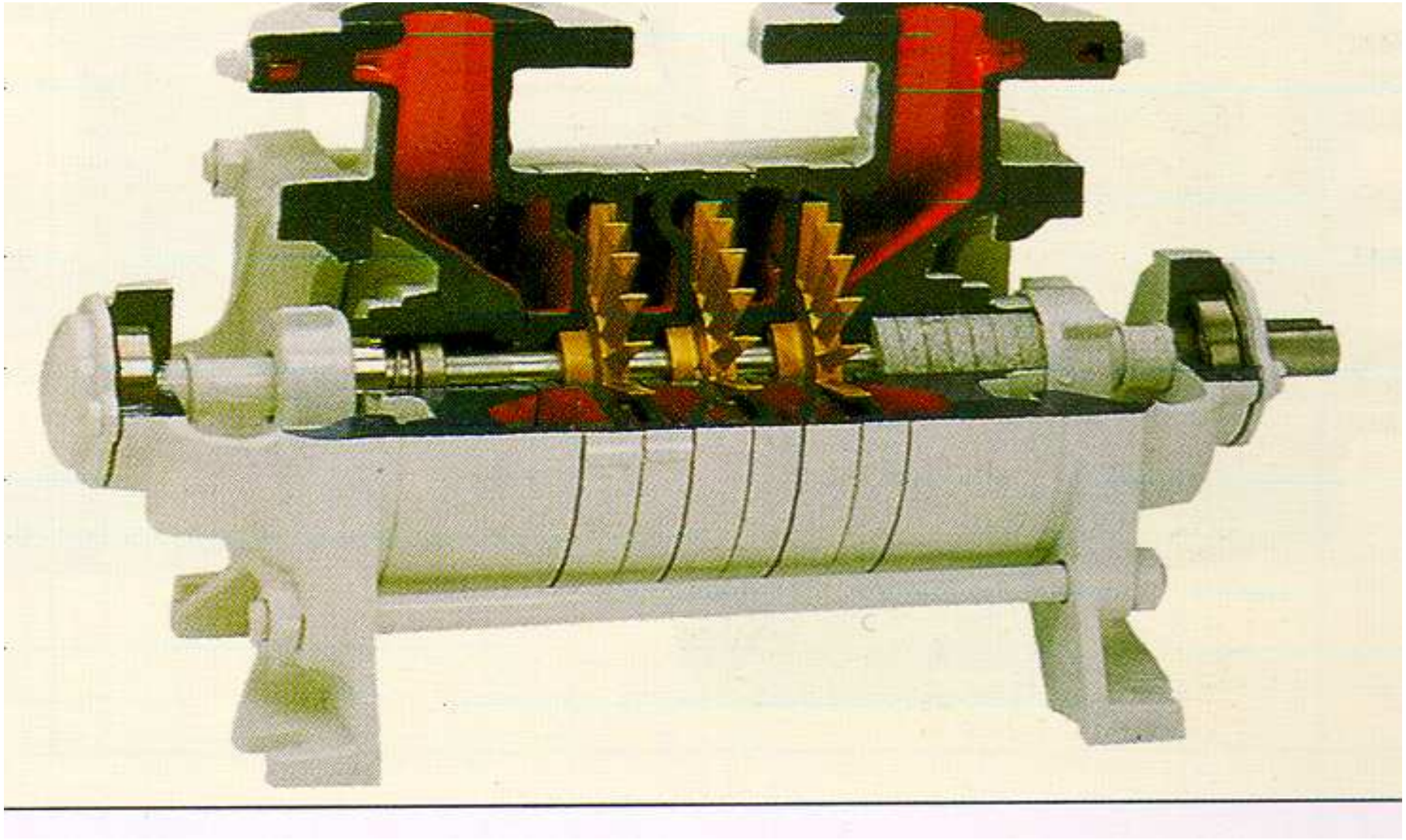


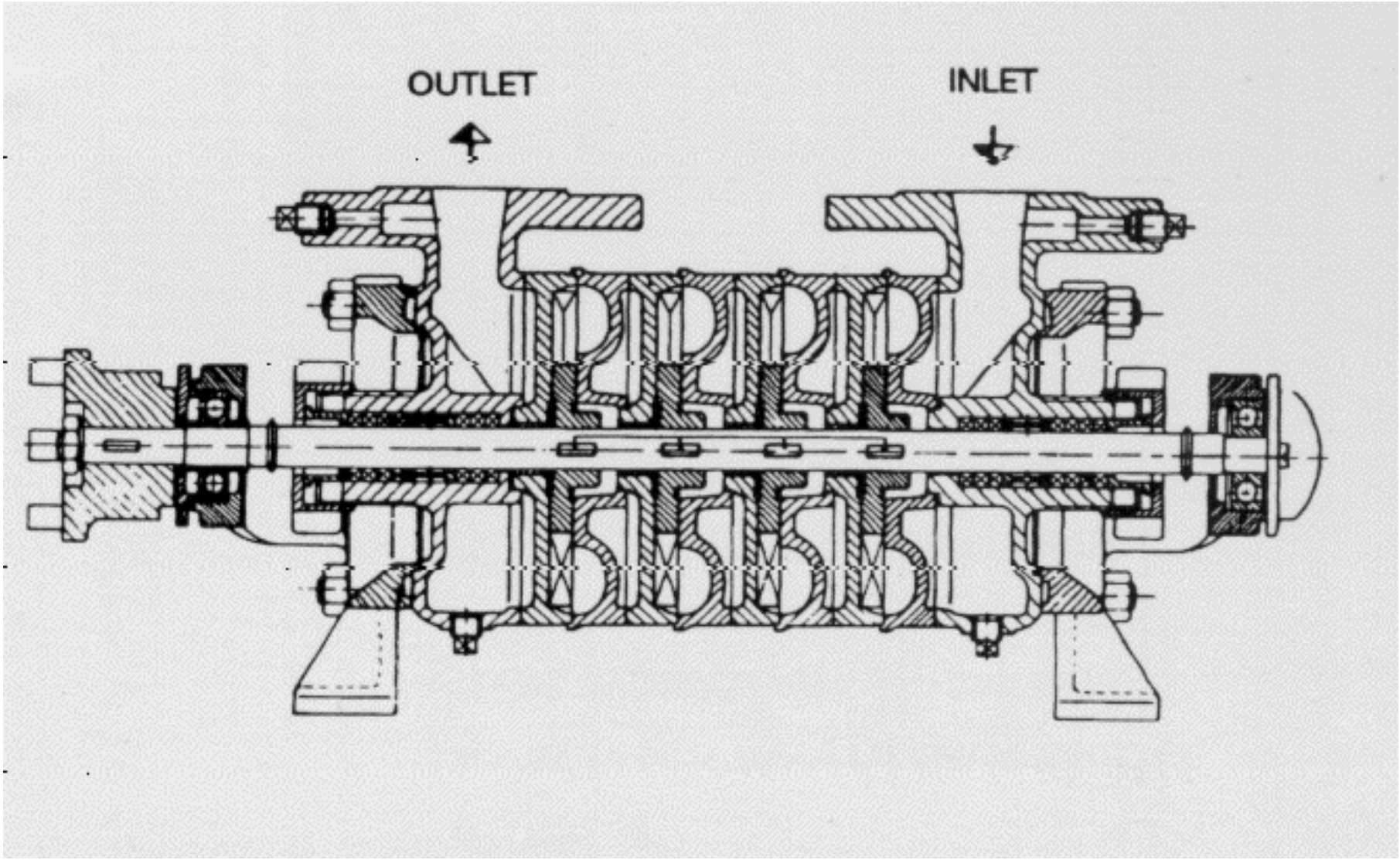


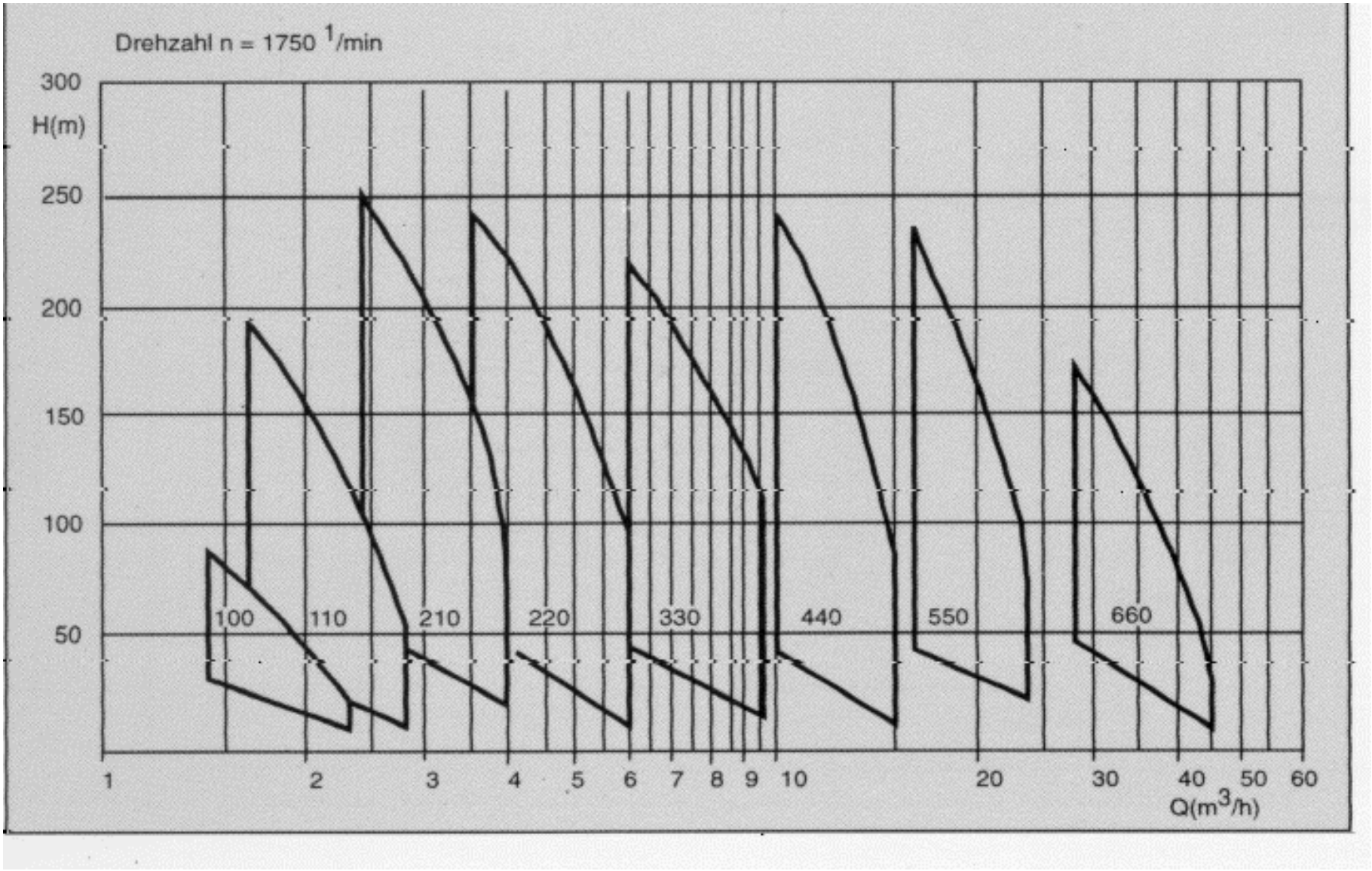
IN I.5

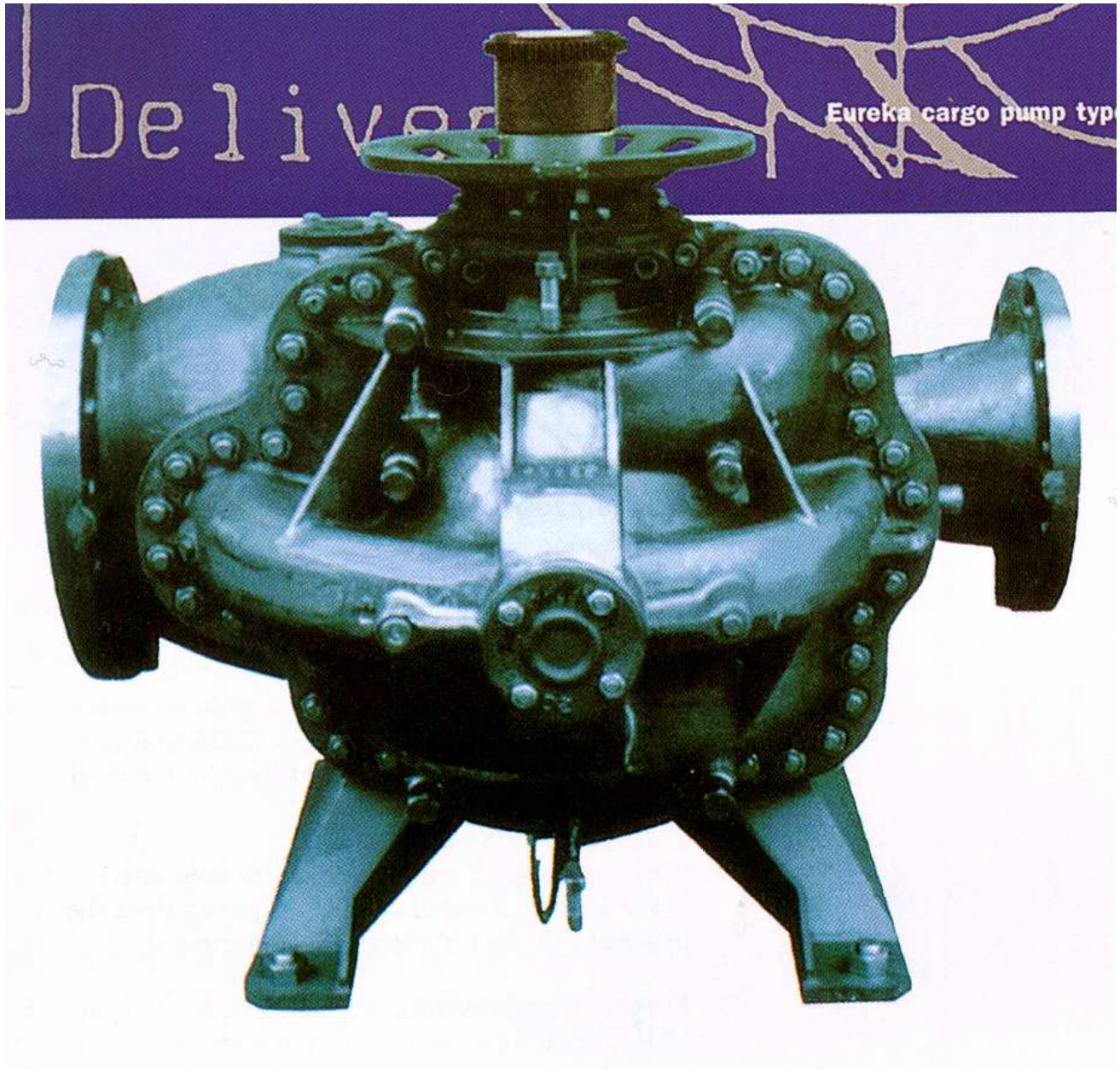

aph
10 20 30 40 60 100 Q (USgpm) 200 300 400 600 1000
8 10 20 30 40 60 80 100 Q (Jgpm) 200 300 400 600 800 1000
160 100 80 60 H (m) 40 30 20 10
500 400 300 200 H (ft) 100 80 60 40
25 32 40 50 65 80 100
2 3 4 6 8 10 Q(m³/h) 20 30 40 60 80 100 200 300 400
Pump curve based on 2900 rpm.

IN I.6

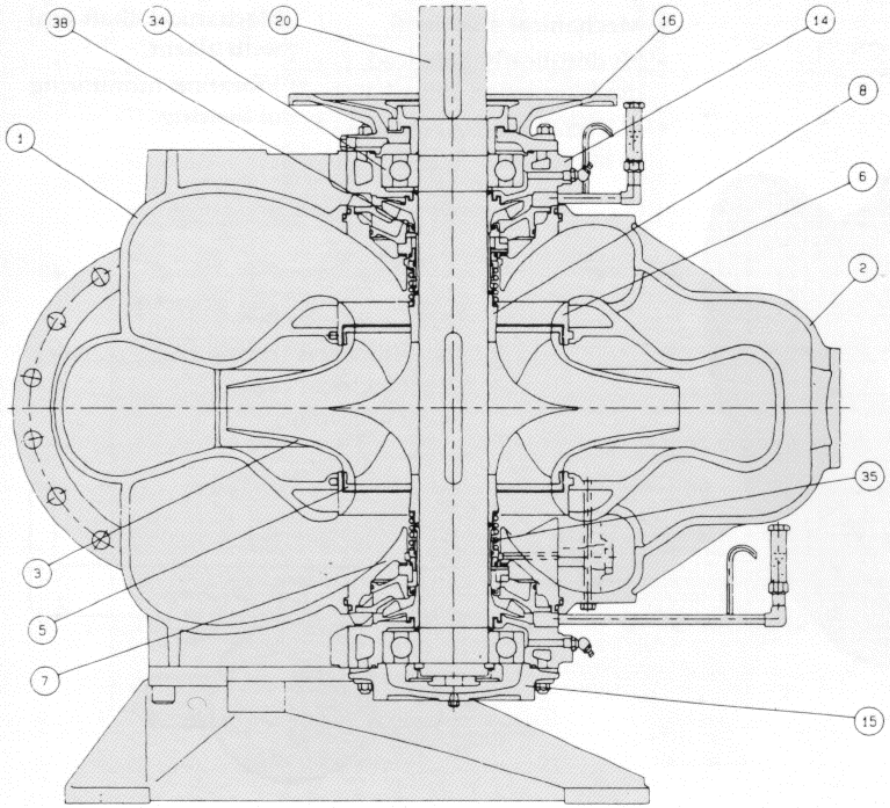



OUTLET
INLET


Drehzahl n = 1750 1/min
300
H(m)
250
200
150
100
50
100
110
210
220
330
440
550
660
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
Q(m3/h)


Deliver
Eureka cargo pump typ

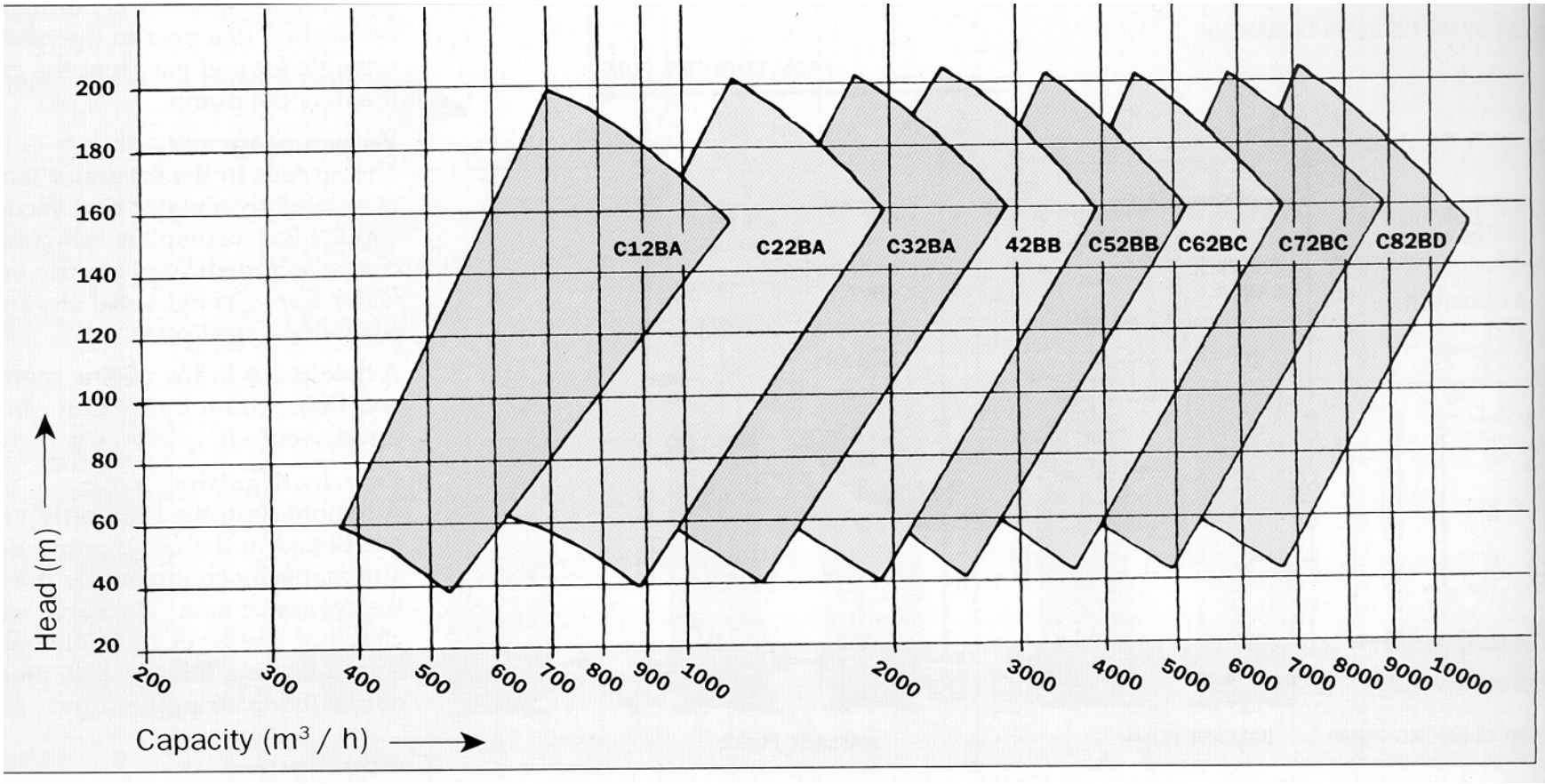
Sectional Drawing

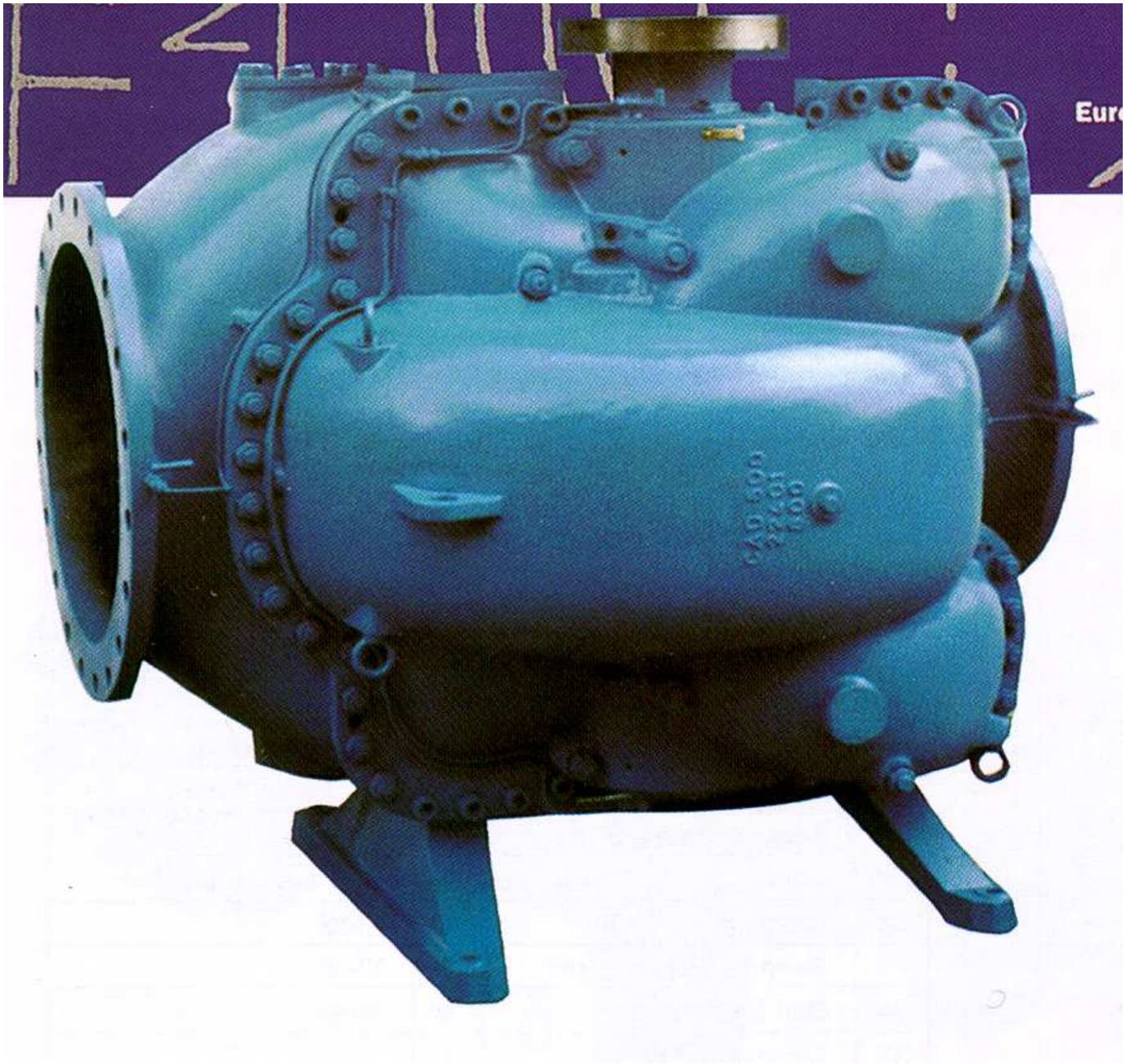


Materials List

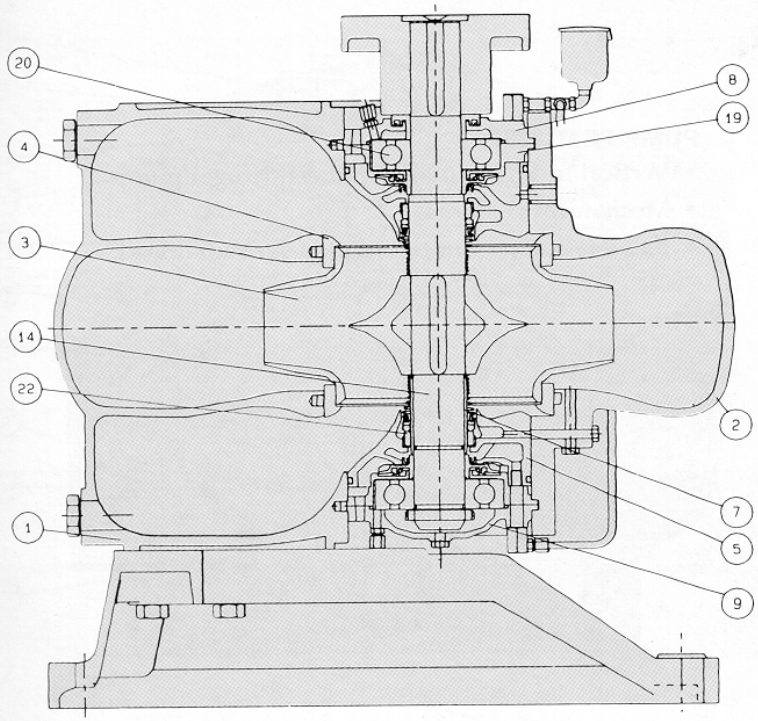
REF	NAME OF PART	NO. OFF	MATERIAL
1	Casing Rear Half	1	Ni-Al-Bronze
2	Casing Front Half	1	Ni-Al-Bronze
3	Impeller	1	Ni-Al-Bronze
5	Impeller Ring	2	Ni-Al-Bronze
6	Casing Ring	2	Bronze
7	Casing Cone	2	Bronze
8	Shaft Sleeve	2	Bronze
14	Bearing Housing	2	Cast Iron
15	Bearing cover	1	Cast Iron
16	Bearing Cover	1	Cast Iron
20	Shaft	1	Stainless Steel
34	Ball Bearing	2	Steel
35	Mechanical Seal	2	
38	Oil Seal	2	Rubber/St Steel

Other casing and impeller material is also available on request.


C12BA
C22BA
C32BA
42BB
C52BB
C62BC
C72BC
C82BD
Head (m)
200
180
160
140
120
100
80
60
40
20
200
300
400
500
600
700
800
900
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Capacity (m³ / h)



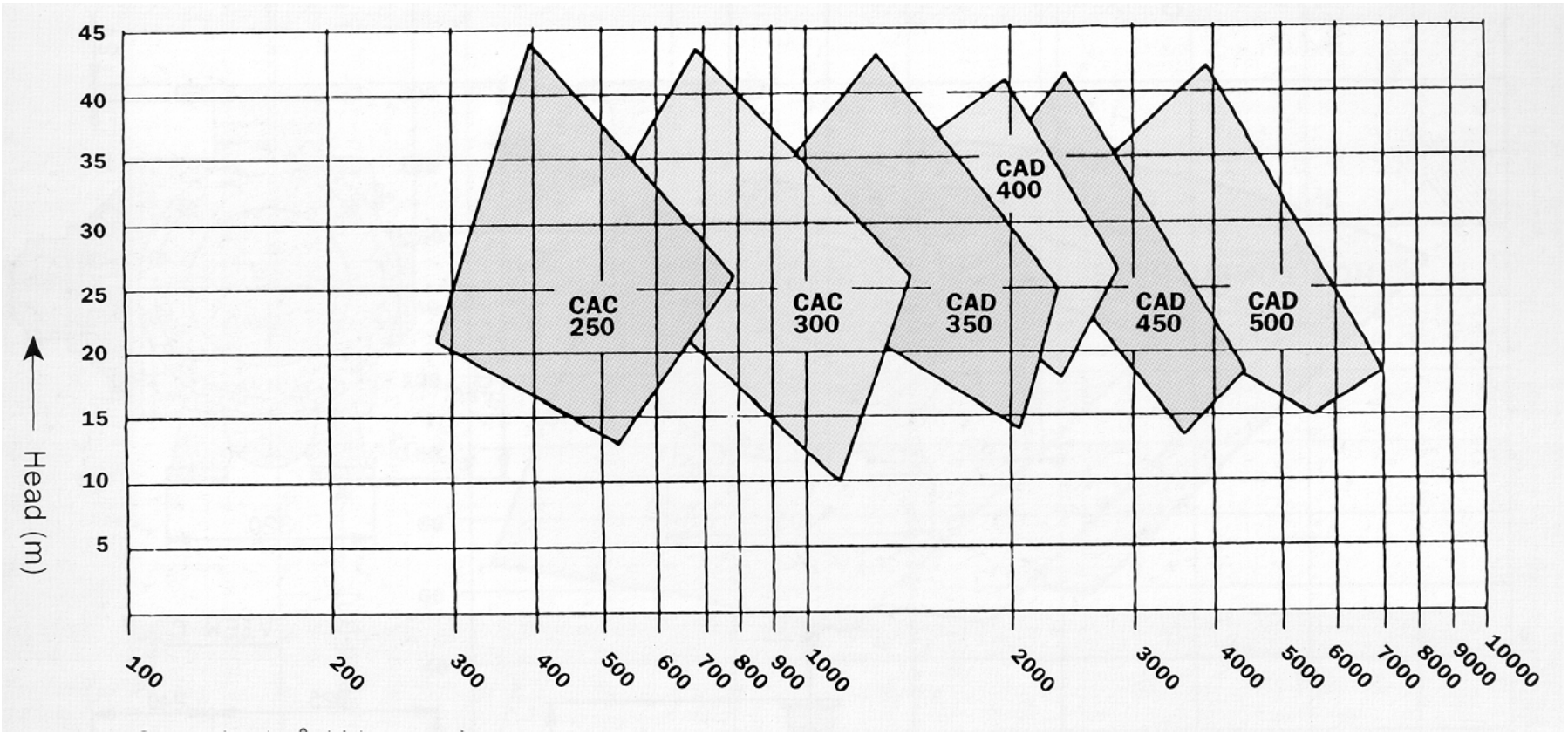
Sectional Drawing



Materials List

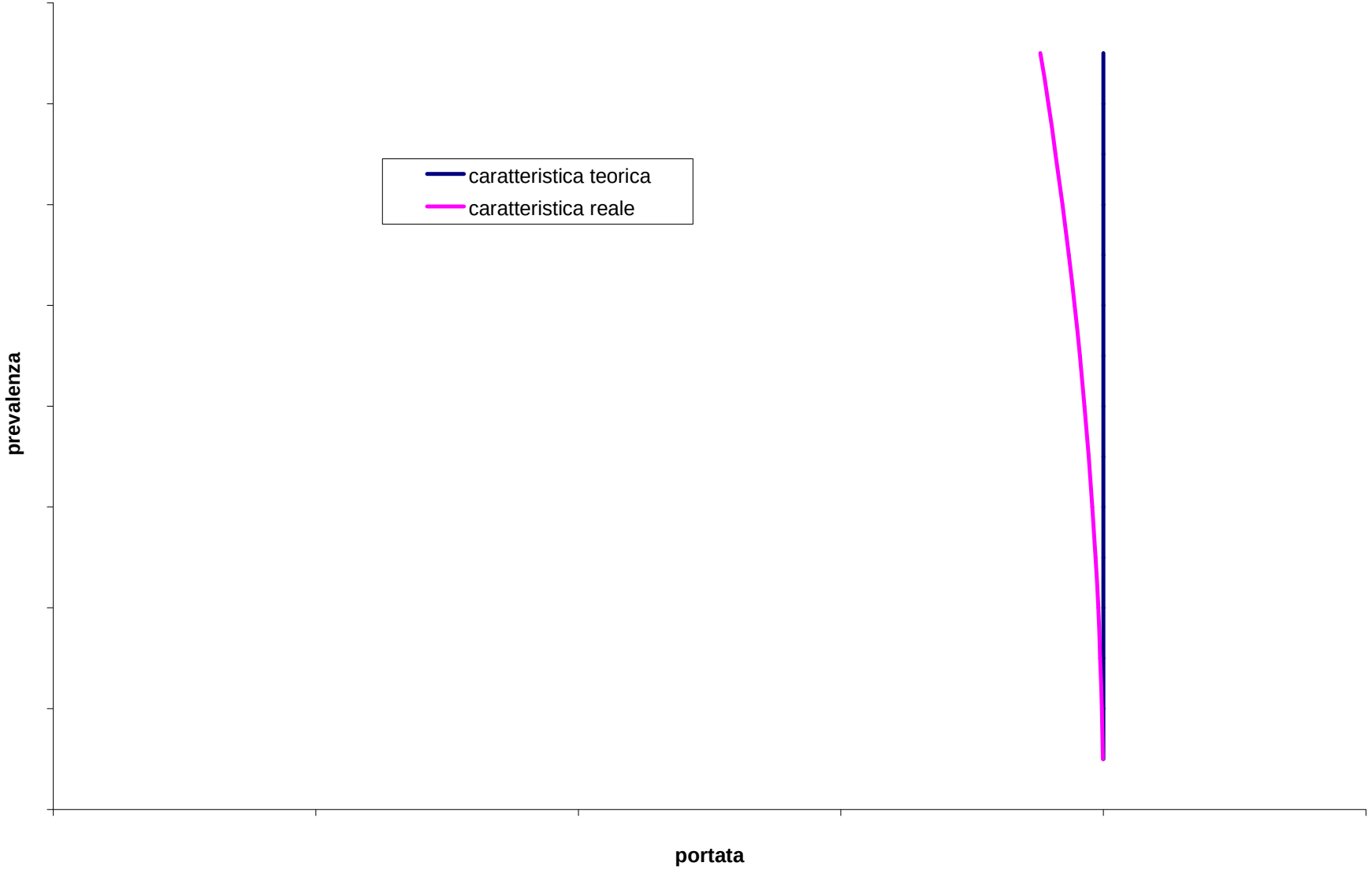
REF	NAME OF PART	NO. OFF	MATERIAL
1	Casing	1	Bronze
2	Casing Cover	1	Bronze
3	Impeller	1	Ni-Al-Bronze
4	Casing Ring	2	Bronze
5	Casing Cone	2	Bronze
7	Shaft Sleeve	2	Stainless Steel
9	Bearing Cover	2	Cast Iron
14	Shaft	1	Stainless Steel
15	Mechanical Seal	2	
19	Bearing House	2	Cast Iron
20	Ball Bearing	2	Steel
66	Shaft Sleeve	2	Bronze

Other casing and impeller material is also available upon request.

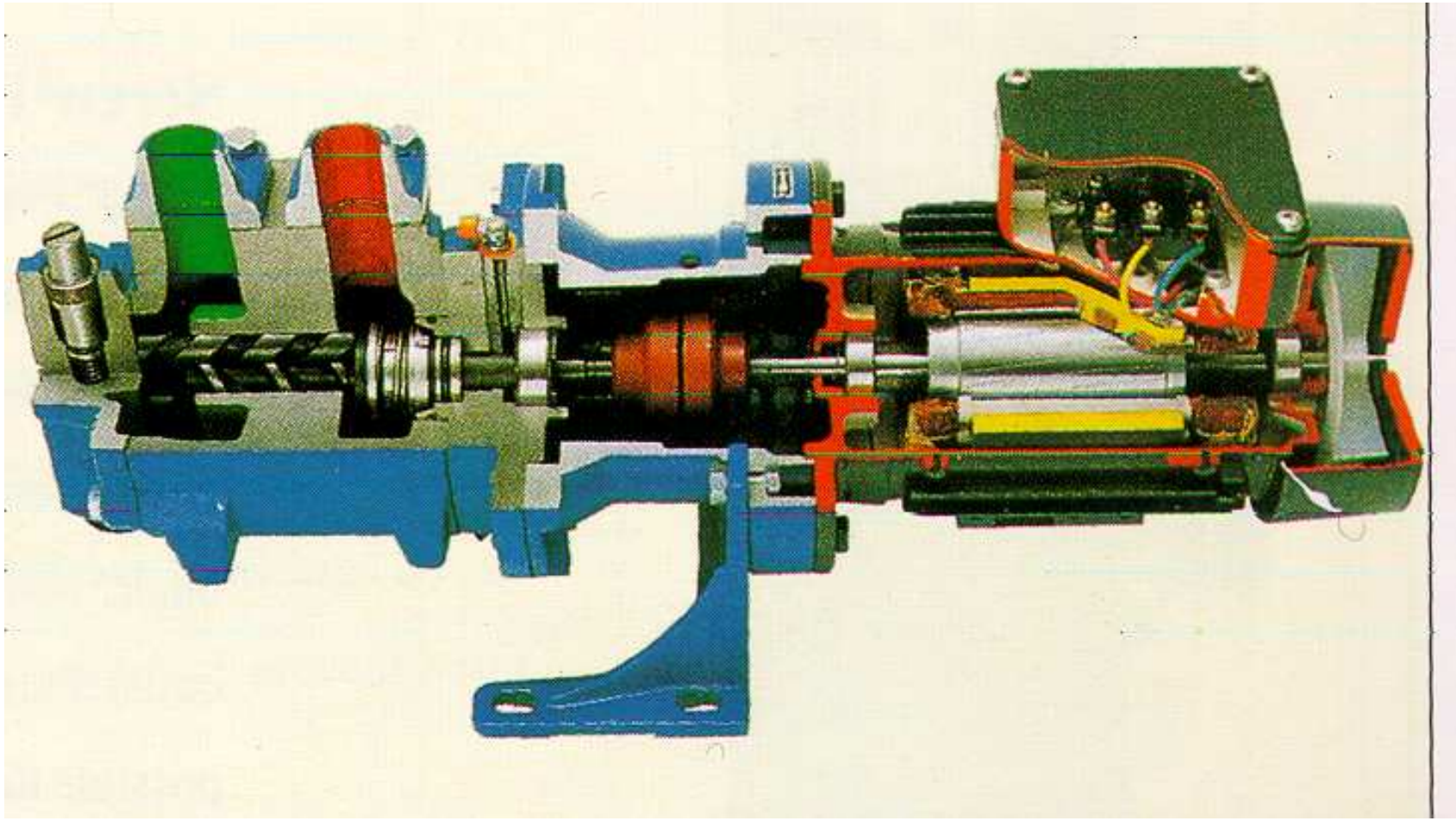

Head (m)
45
40
35
30
25
20
15
10
5
CAC 250
CAC 300
CAD 350
CAD 400
CAD 450
CAD 500
100
200
300
400
500
600
700
800
900
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

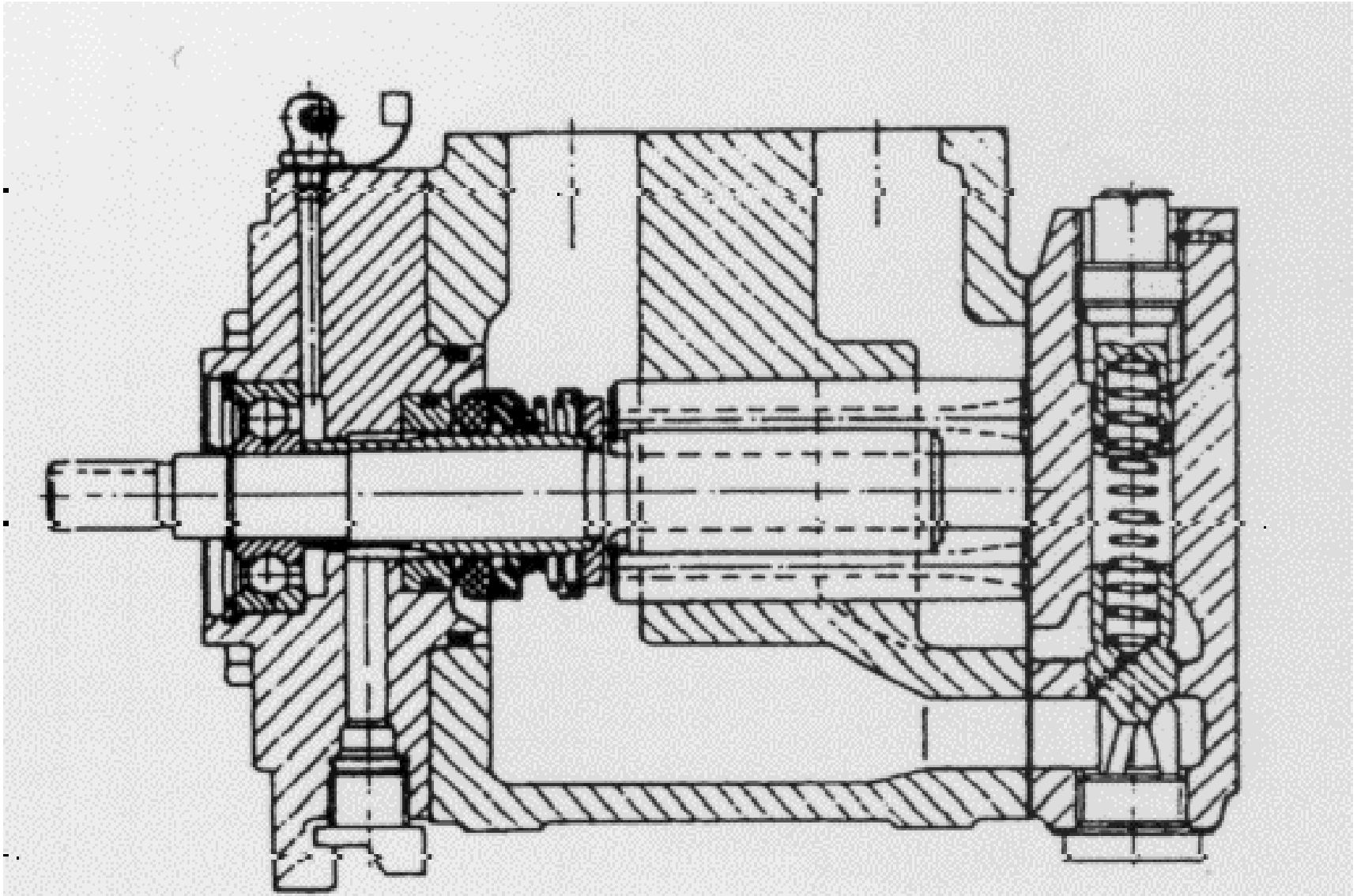
IN I.20

Caratteristica della pompa volumetrica

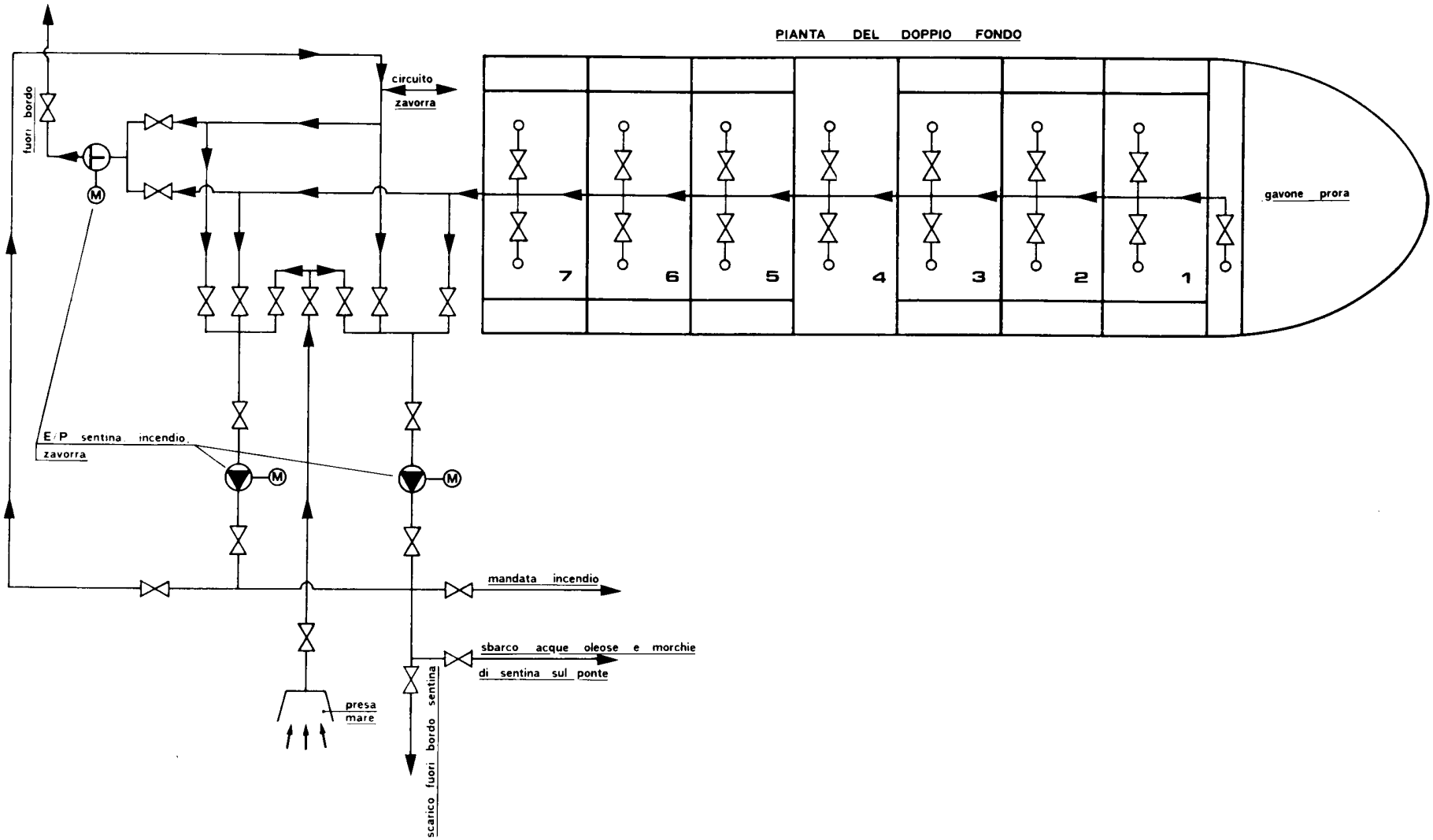


IN O.90



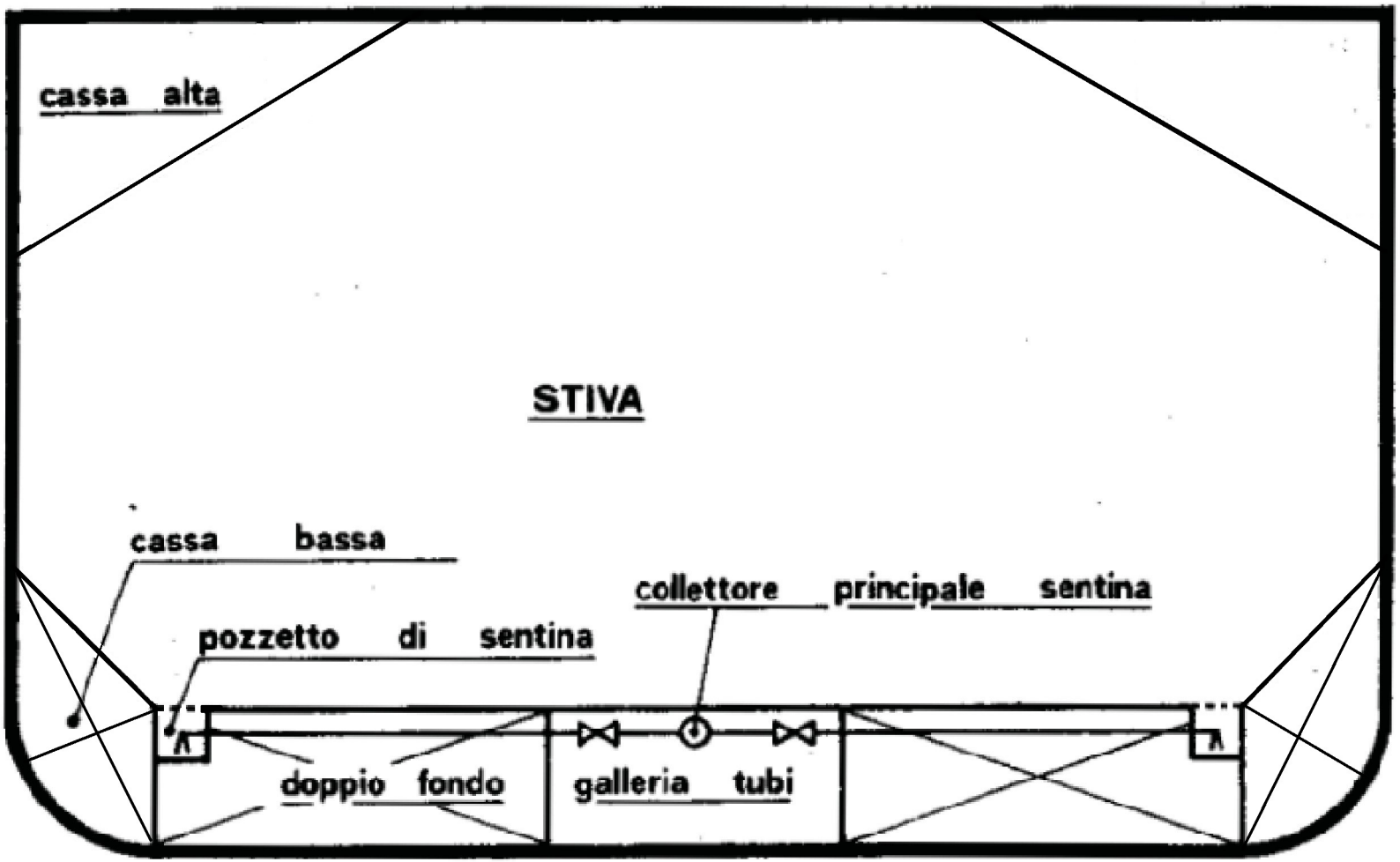


Schema sentina fuori AM



IN Z.7

Schema sentina fuori AM



IN Z.20

Prescrizioni SOLAS sull'impianto di sentina fuori AM

(norme SOLAS, reg. 21 for cargo and passenger ships)

navi passeggeri	min 3 pompe
navi da carico	min 2 pompe
criterio di servizio (SOLAS) > 30	1 pompa indipendente
criterio di servizio (SOLAS) > 30 oppure L > 91.5 m	pompa sotto campana

Calcolo del diametro del collettore di sentina

(norme SOLAS, reg. 21 for passenger ships)

$$d = 1.68\sqrt{L(B+D)} + 25$$

dove:

d	diametro interno collettore principale di sentina [mm]
L	lunghezza della nave [m]
B	larghezza della nave [m]
D	altezza di costruzione della nave [m]

Calcolo della portata nel collettore di sentina

$$Q = \frac{\pi d^2}{4} w$$

ipotizzando che w = 2 m/s

$$Q = 0.0000045 \left[\sqrt{L(B+D)} + 25 \right]^2 \qquad \left[m^3 / s \right]$$

$$= 0.0162 \left[\sqrt{L(B+D)} + 25 \right]^2 \qquad \left[m^3 / h \right]$$

Q	portata della pompa [m^3/h]
w	velocità acqua nel collettore principale
L	lunghezza della nave [m]
B	larghezza della nave [m]
D	altezza di costruzione della nave [m]

Caratteristiche delle pompe di sentina fuori AM

⇒ **innesco facilitato**

⇒ **prevalenze non eccessive**

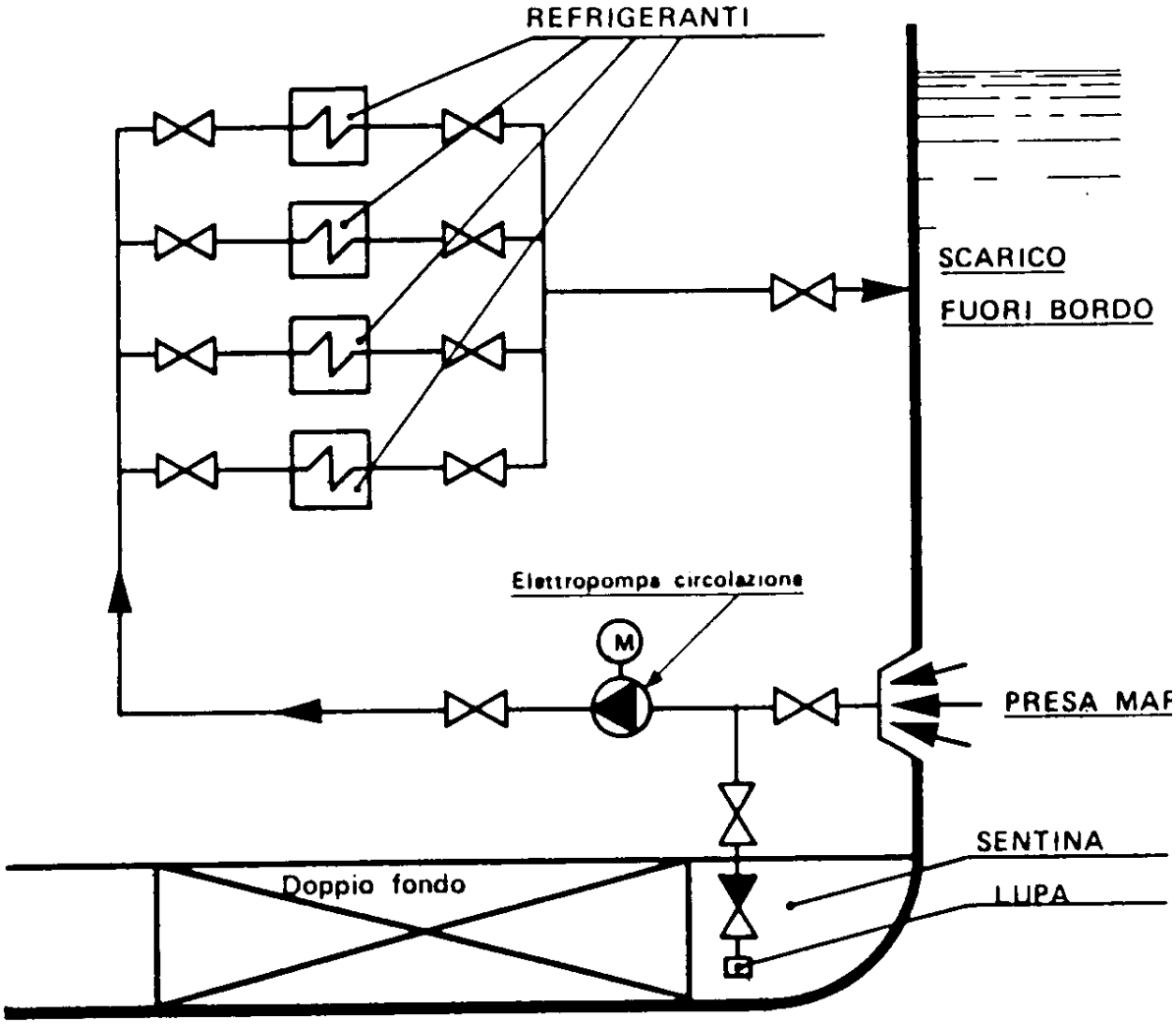
⇒ **buon trattamento liquidi non omogenei**

prevalenze:

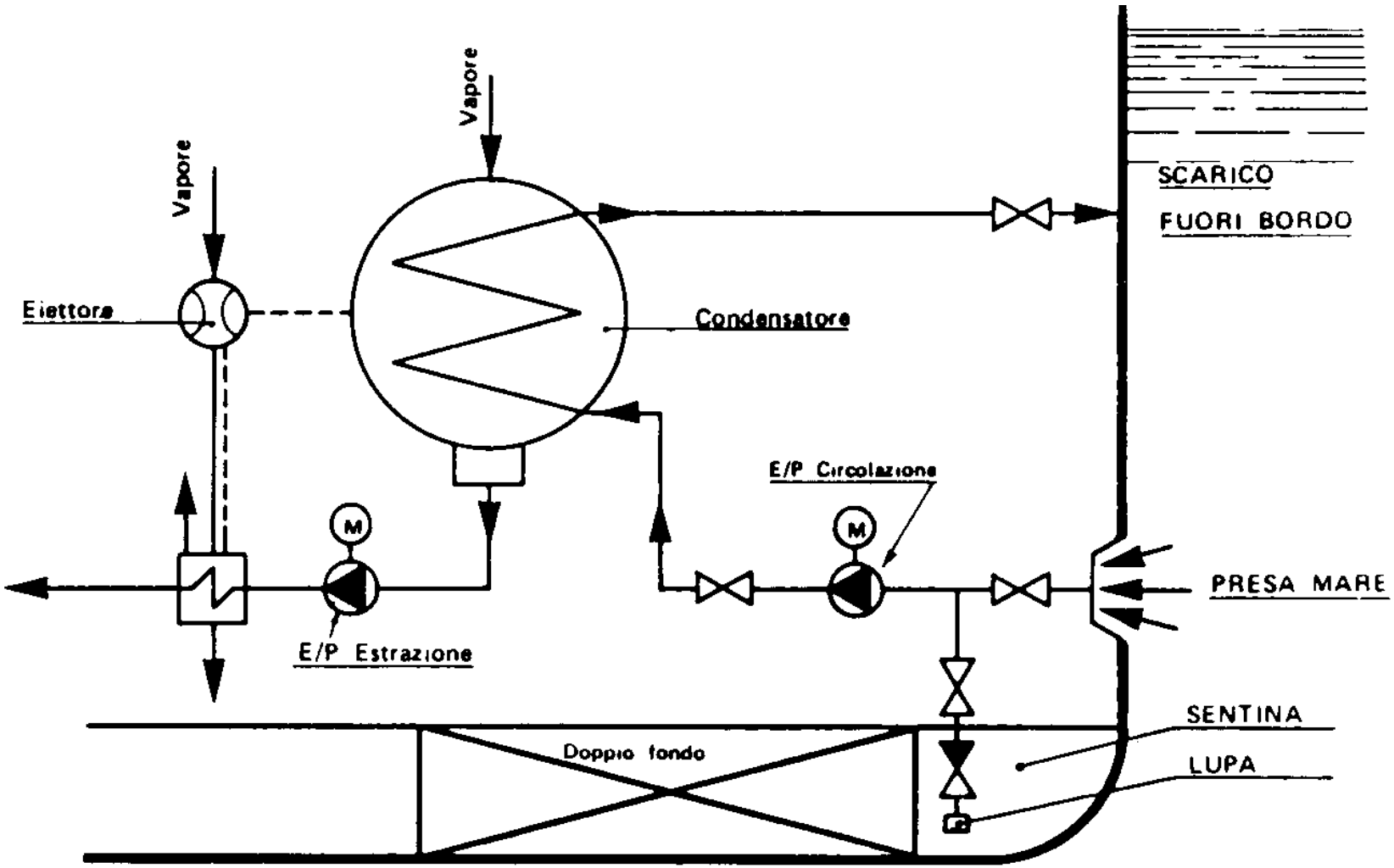
circuiti destinati a sola sentina/zavorra	35 - 50 m H_2O
circuiti anche antincendio	80 m H_2O
velocità minima acqua nei tubi	2 m/s

Pompa di sentina in AM

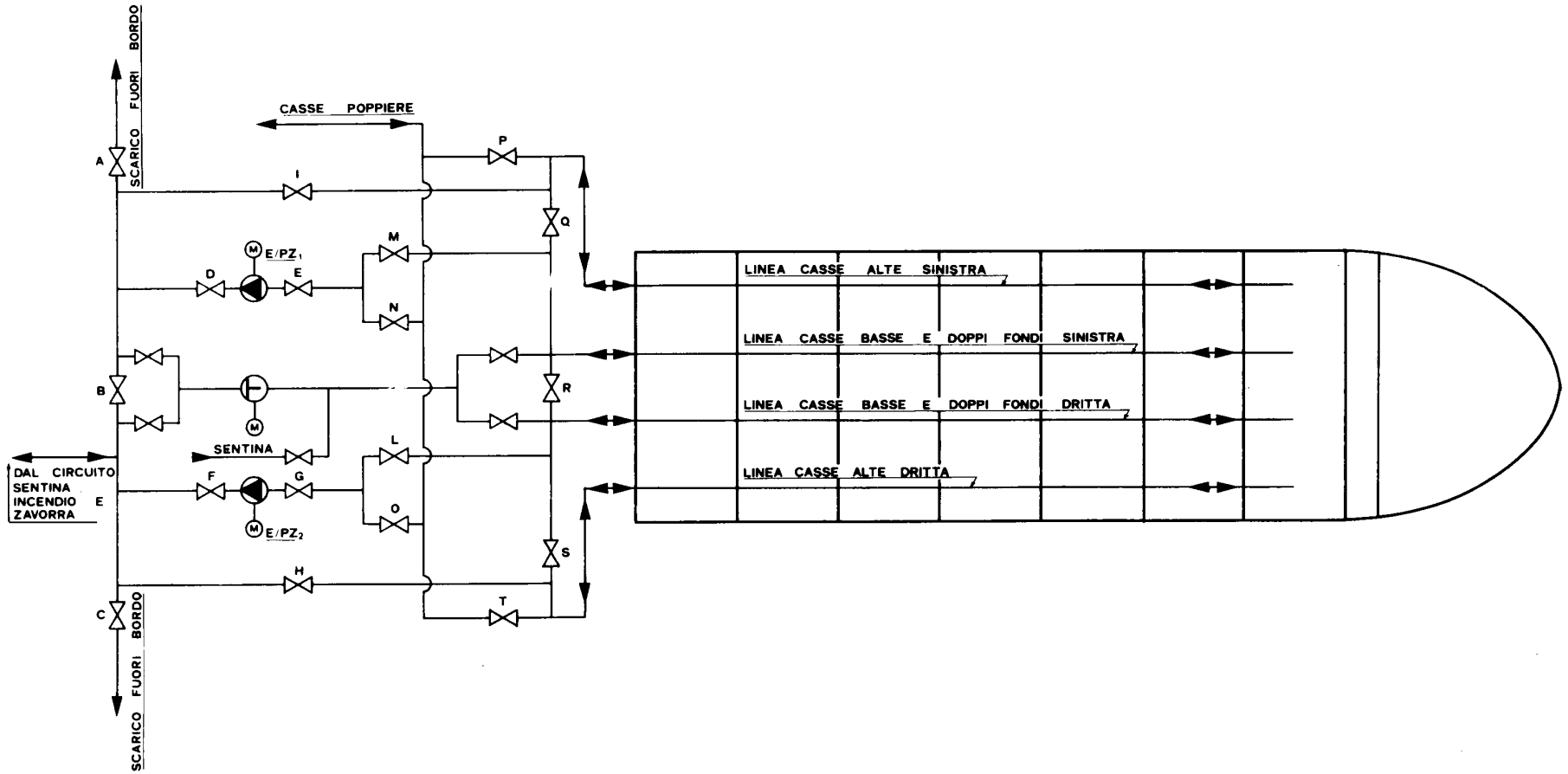
Lupa in AM con motore Diesel



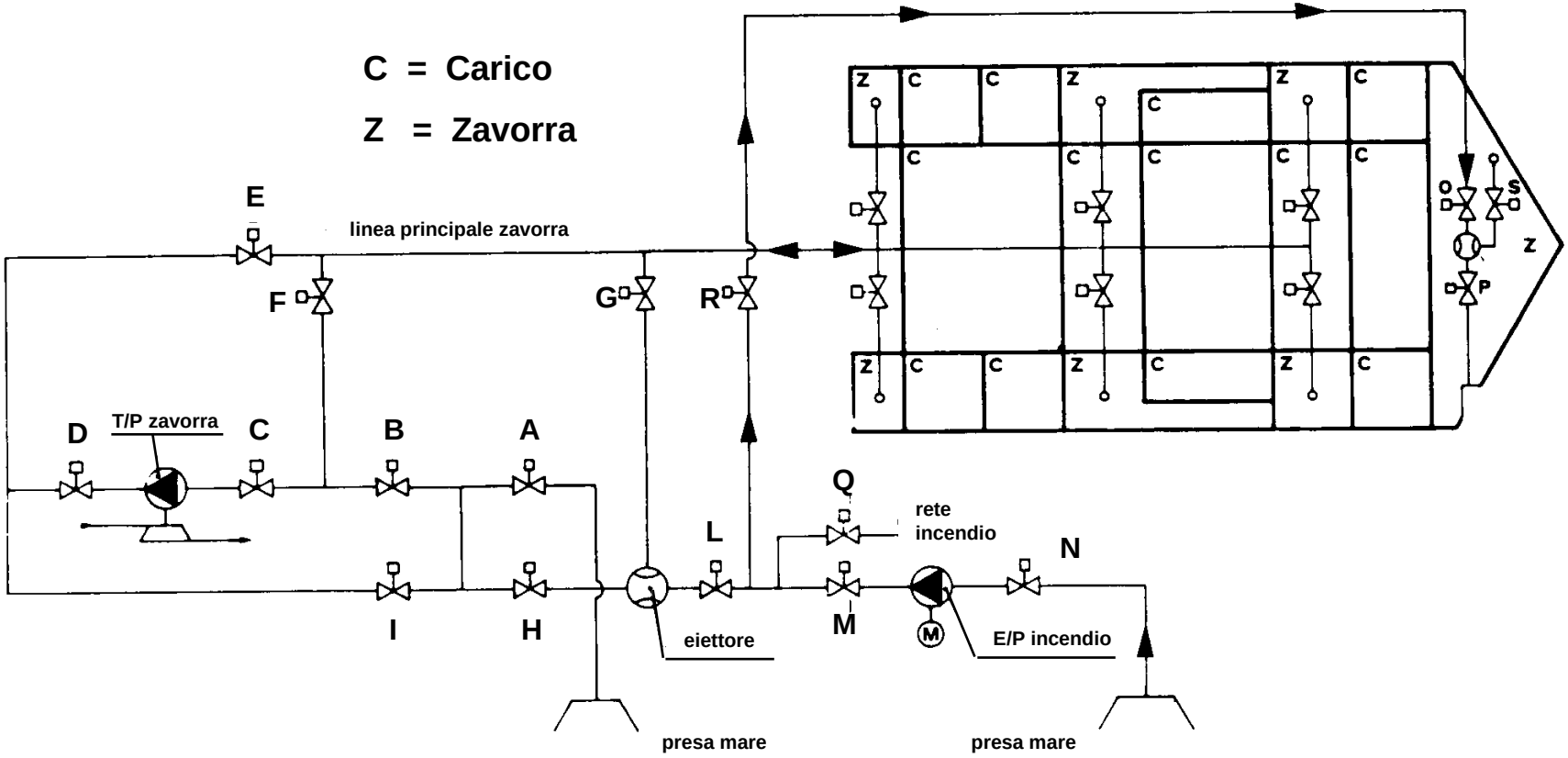
Lupa in AM con TV



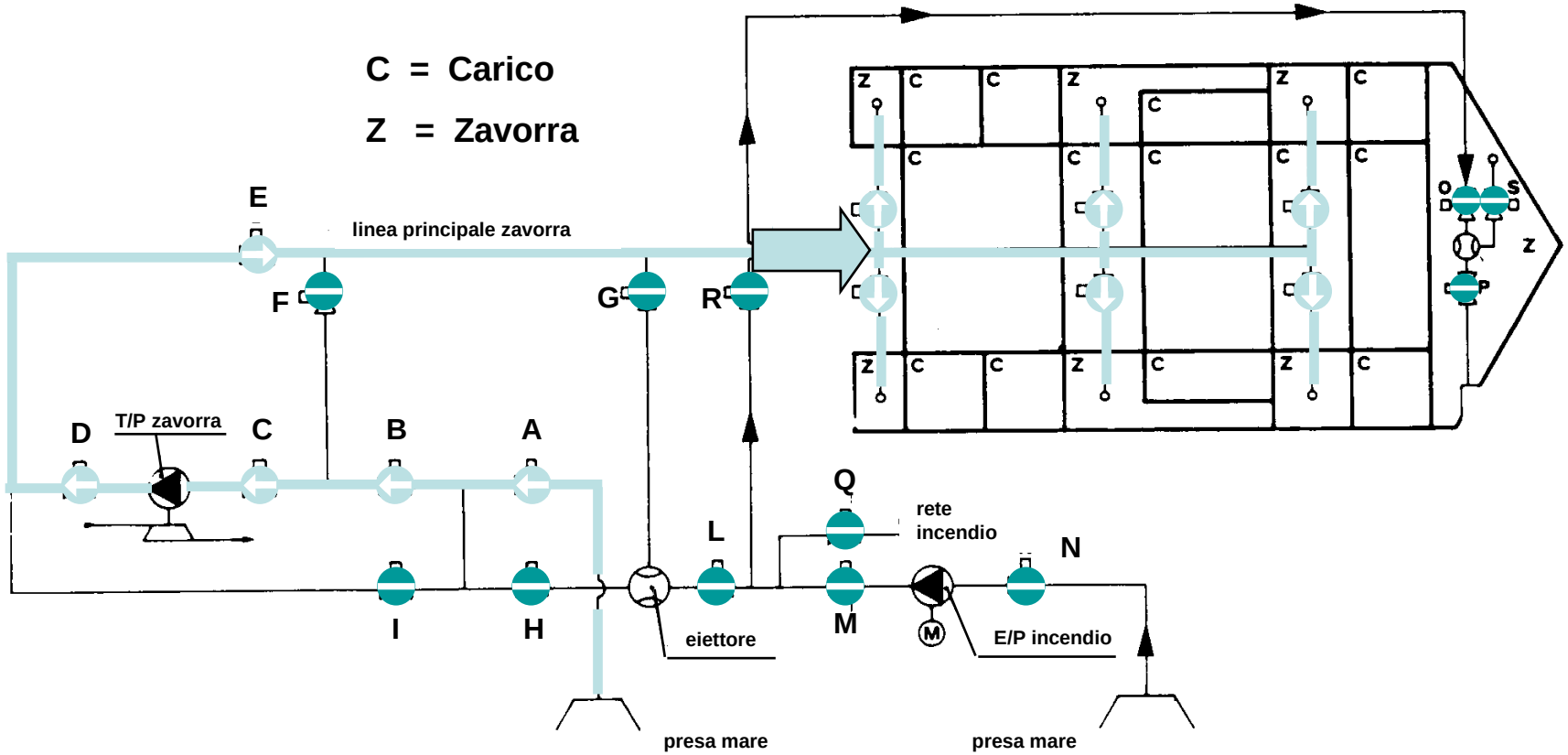
Schema servizio zavorra (bulk carrier)



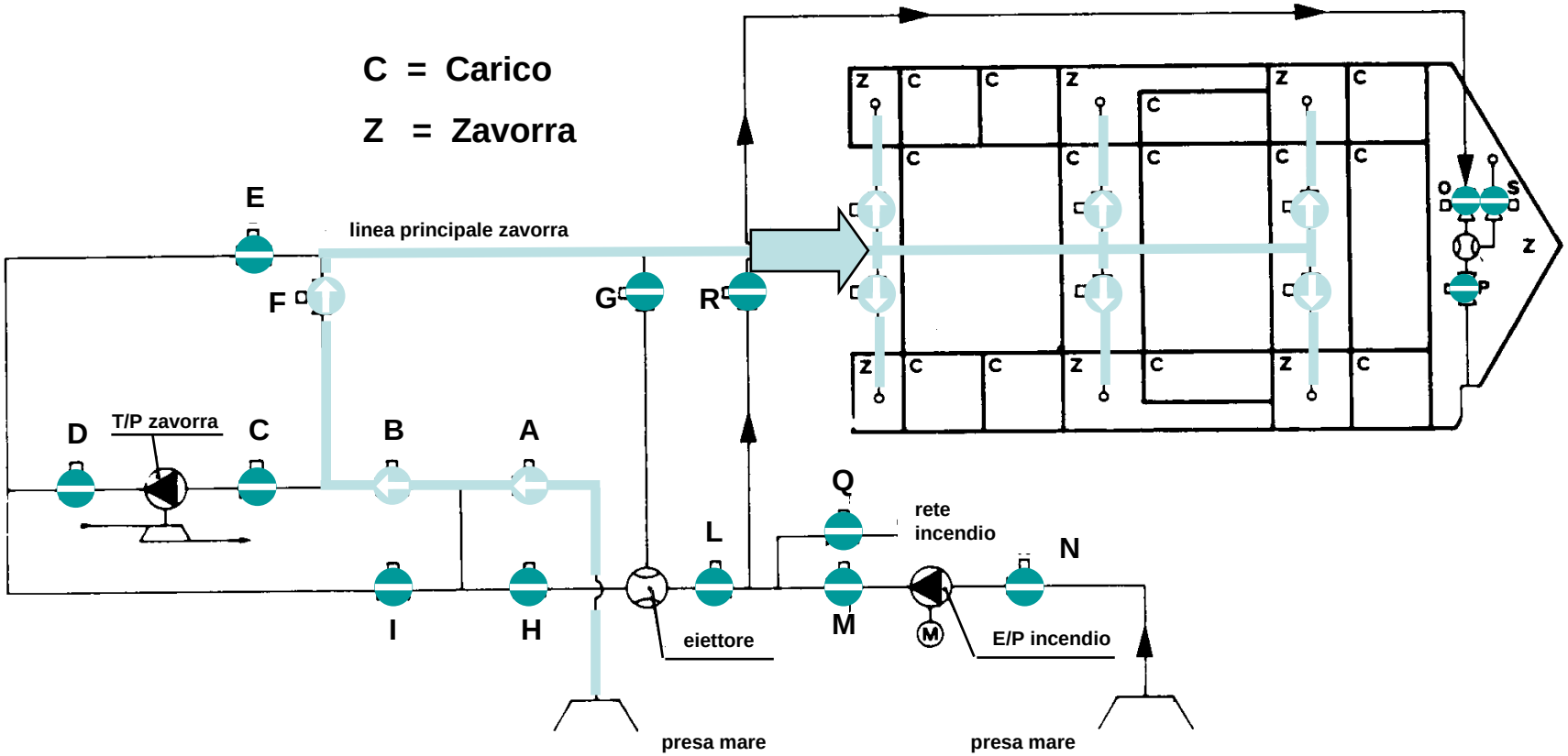
Schema servizio zavorra (nave cisterna)



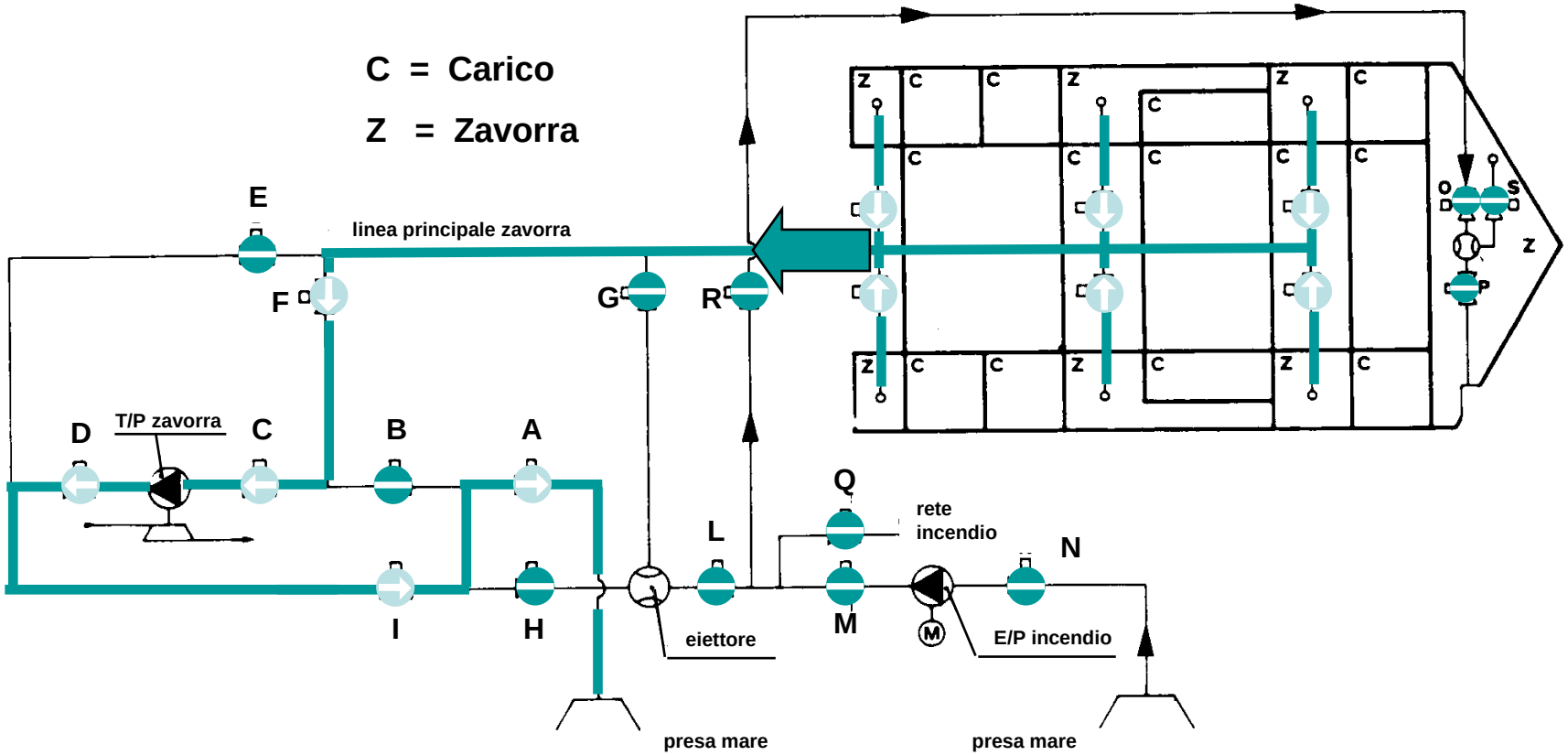
Servizio zavorra nave cisterna
carico casse con T/P



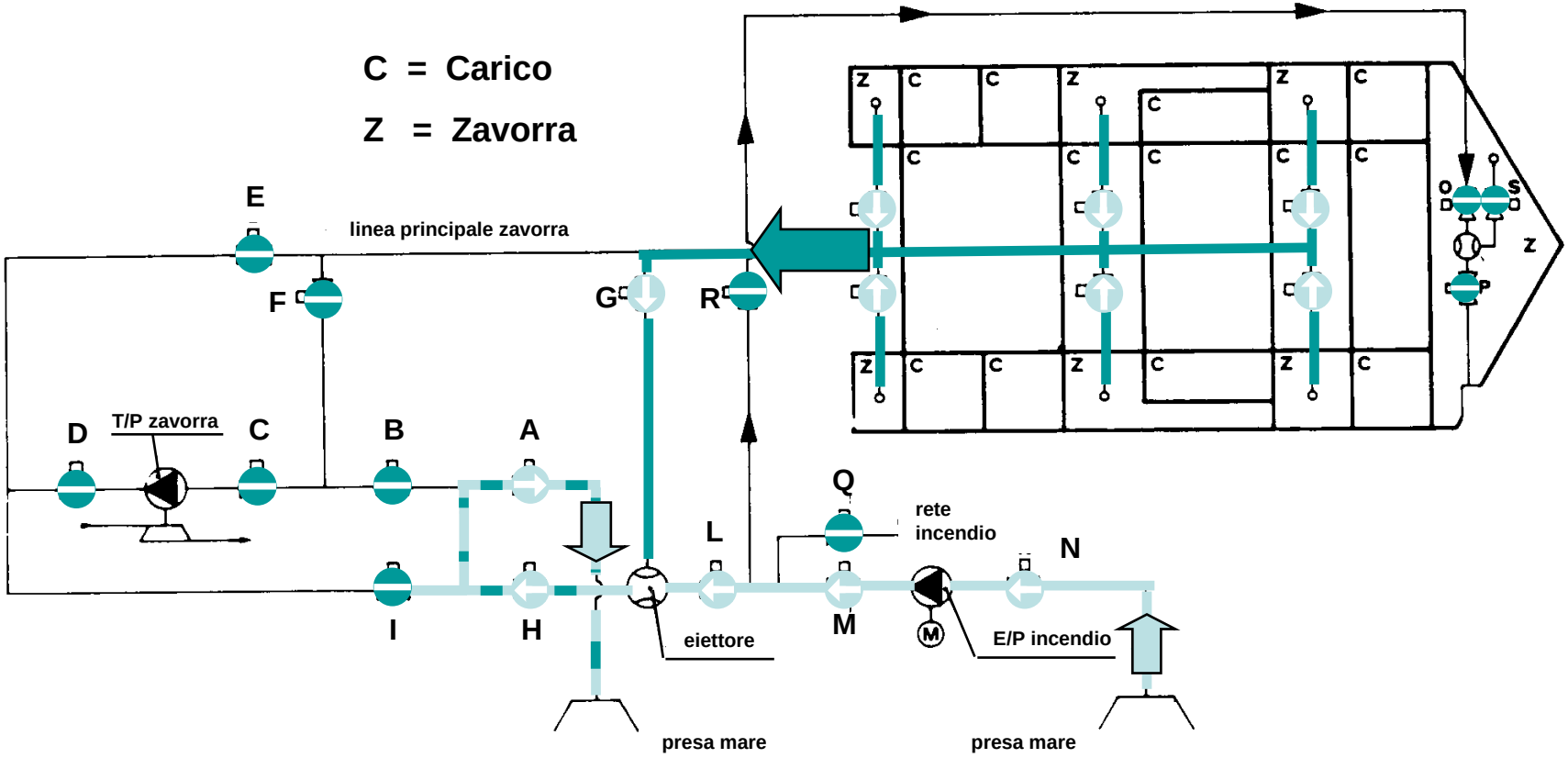
Servizio zavorra nave cisterna
carico casse senza T/P



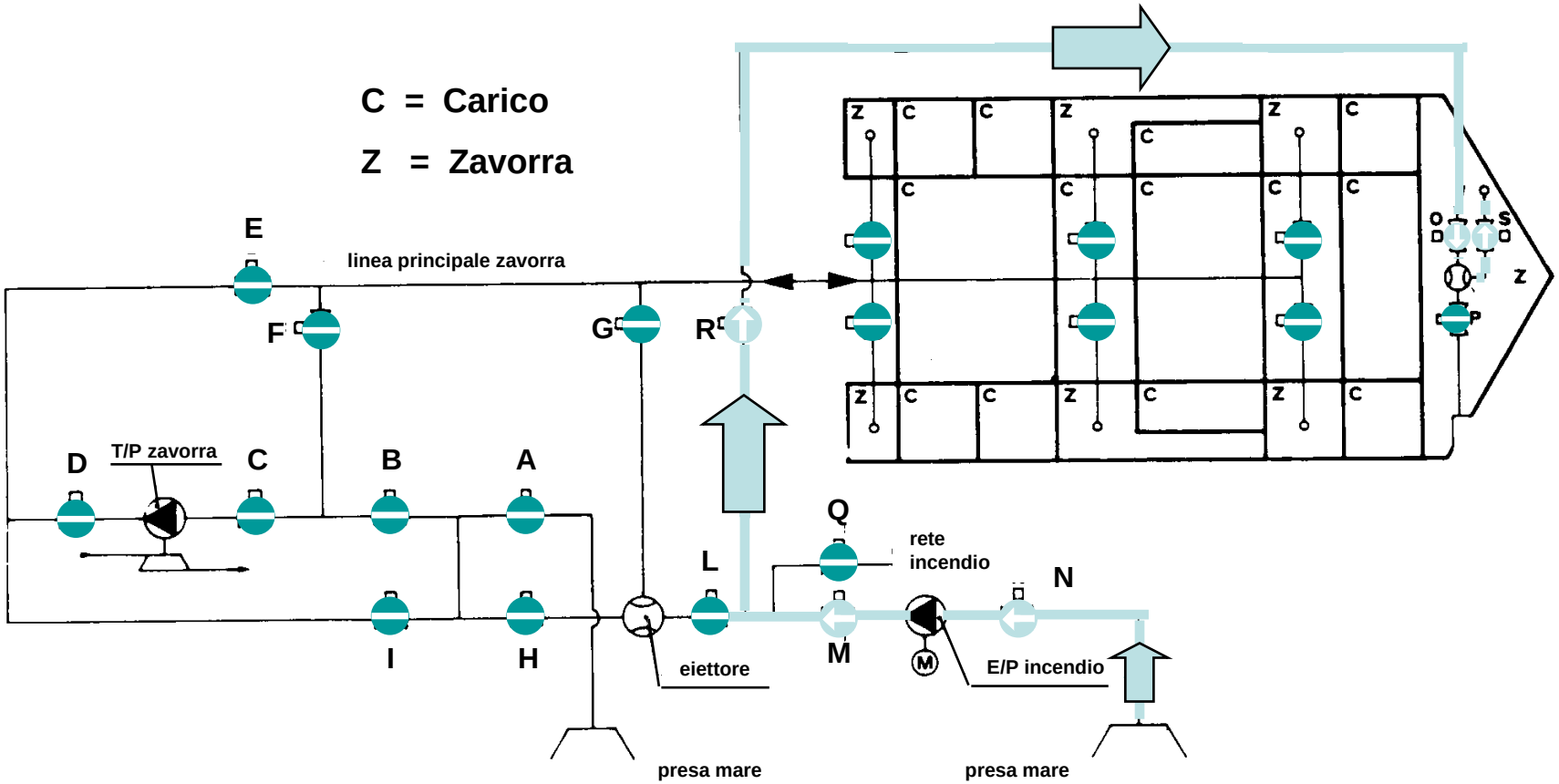
Servizio zavorra nave cisterna
scarico casse con T/P



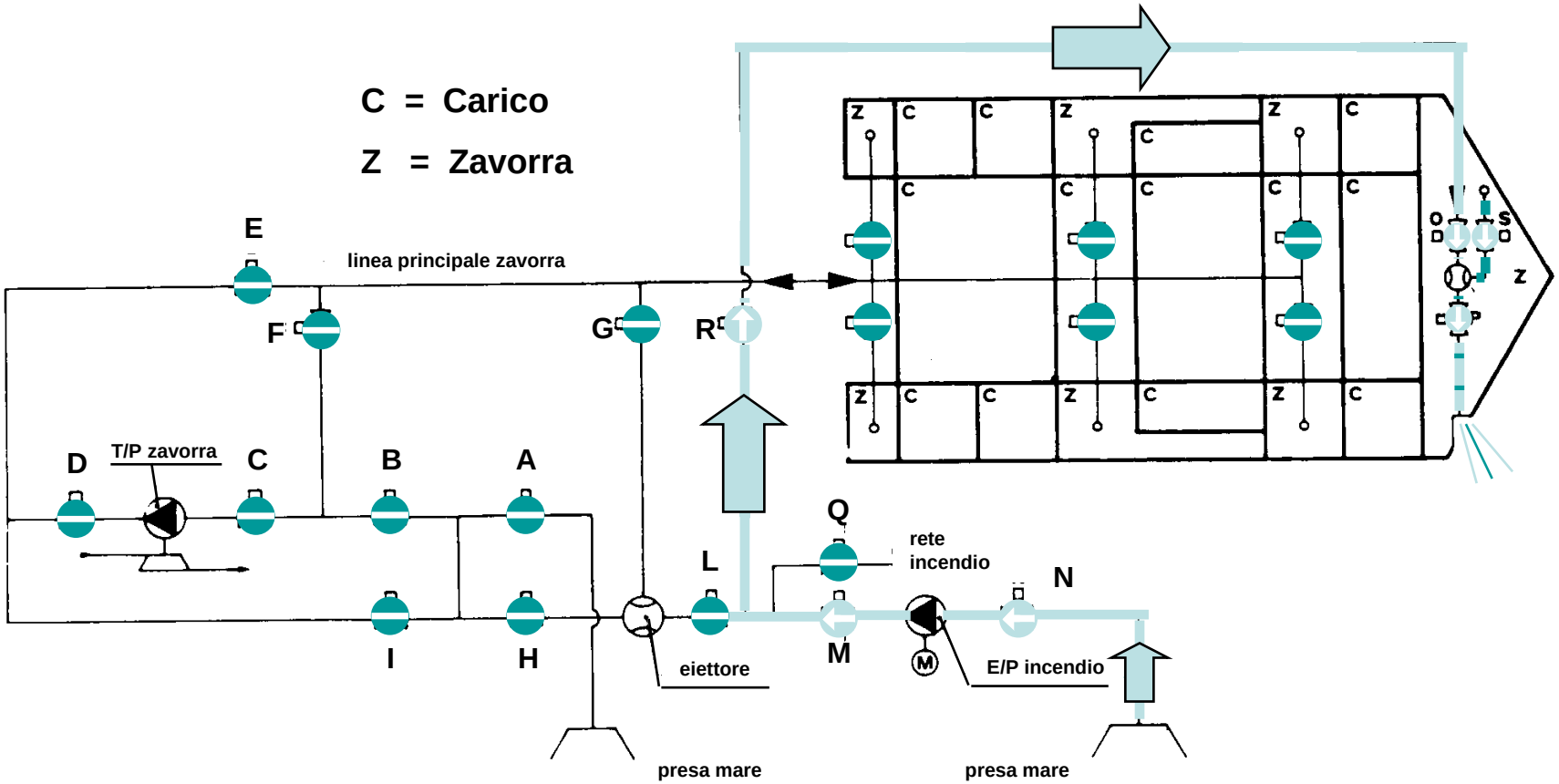
Servizio zavorra nave cisterna
scarico completo con eiettore ed E/P incendio



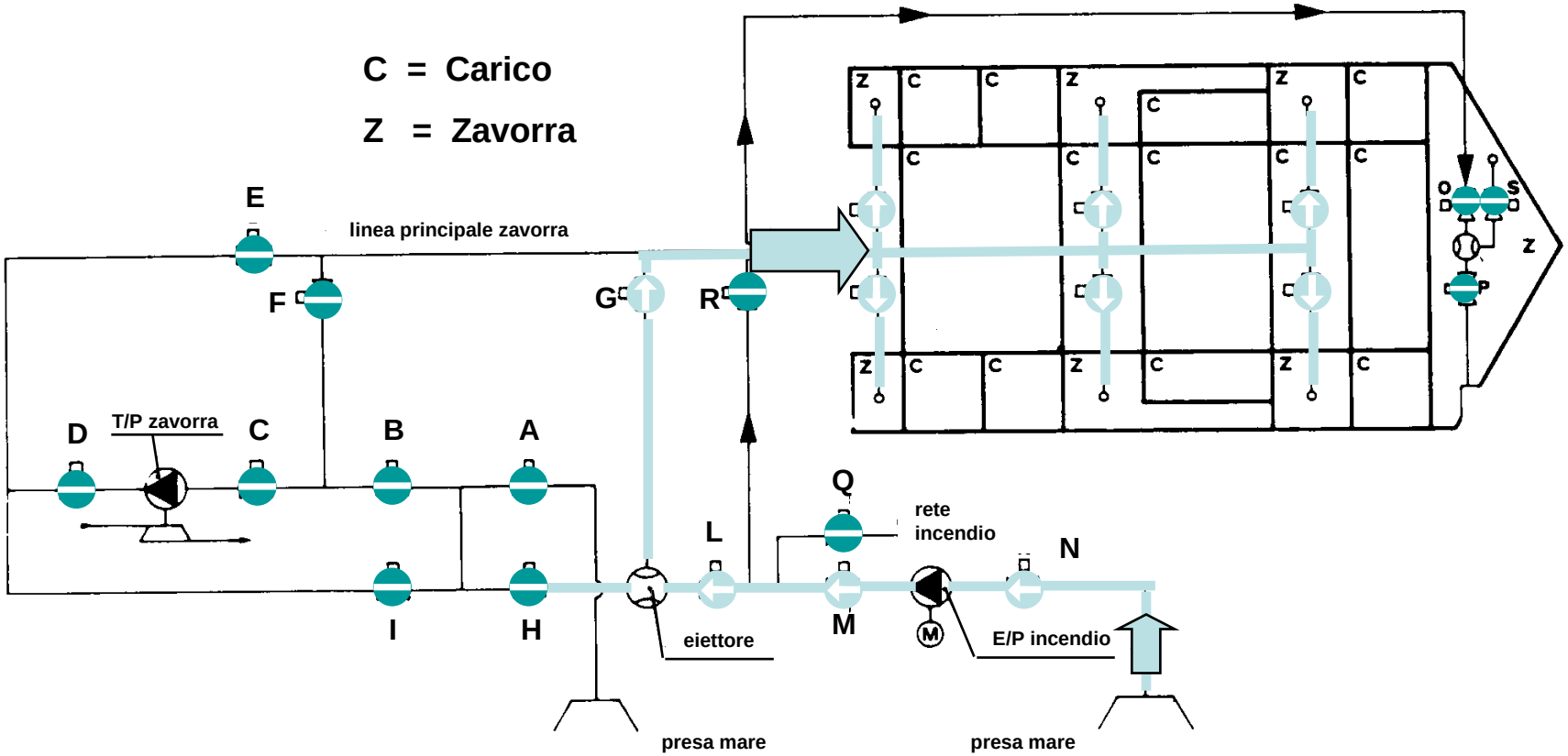
Servizio zavorra nave cisterna
carico gavone prua con E/P incendio



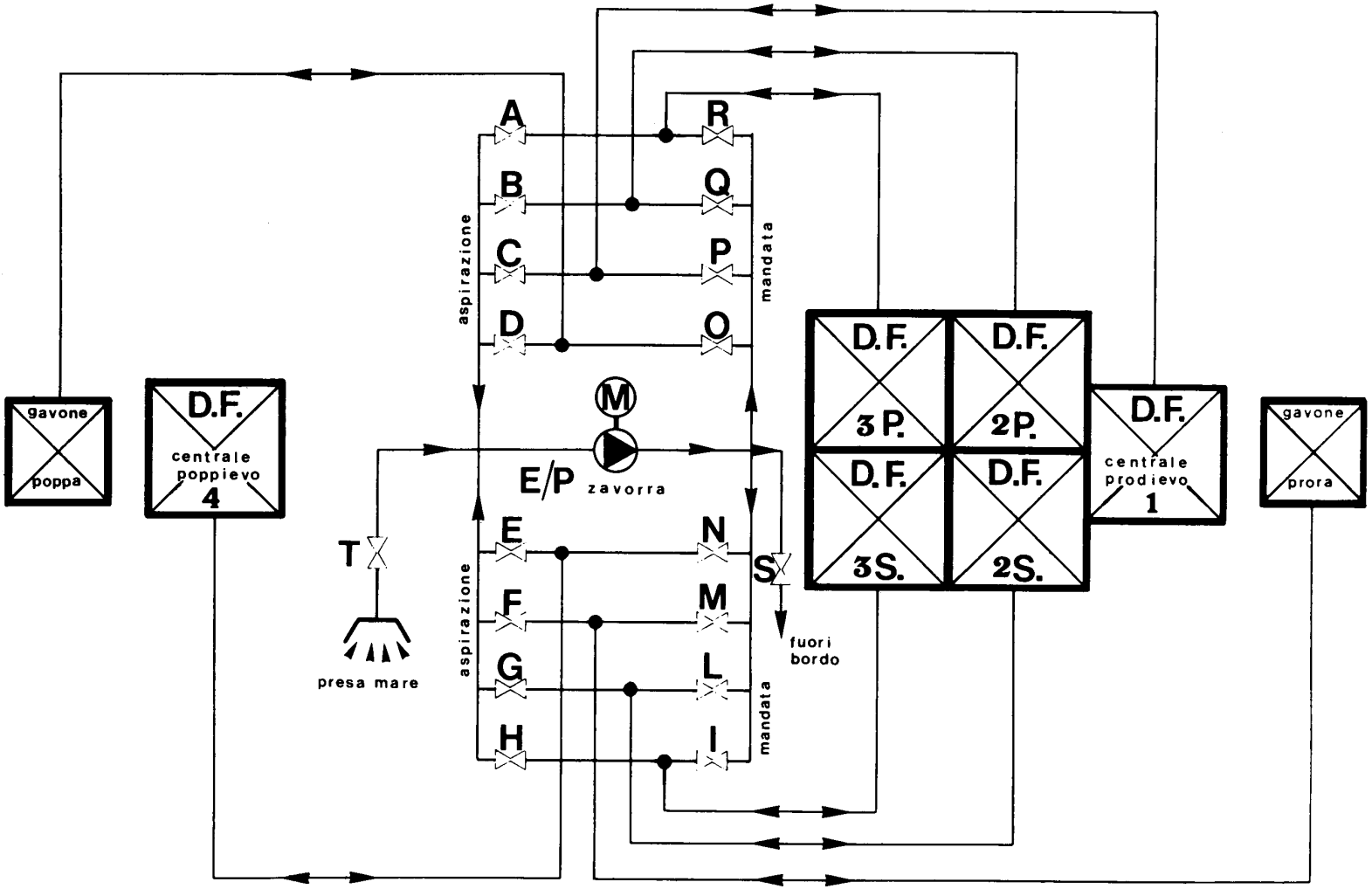
Servizio zavorra nave cisterna
svuotamento gavone prua con E/P incendio



Servizio zavorra nave cisterna
zavorramento d'emergenza con E/P incendio

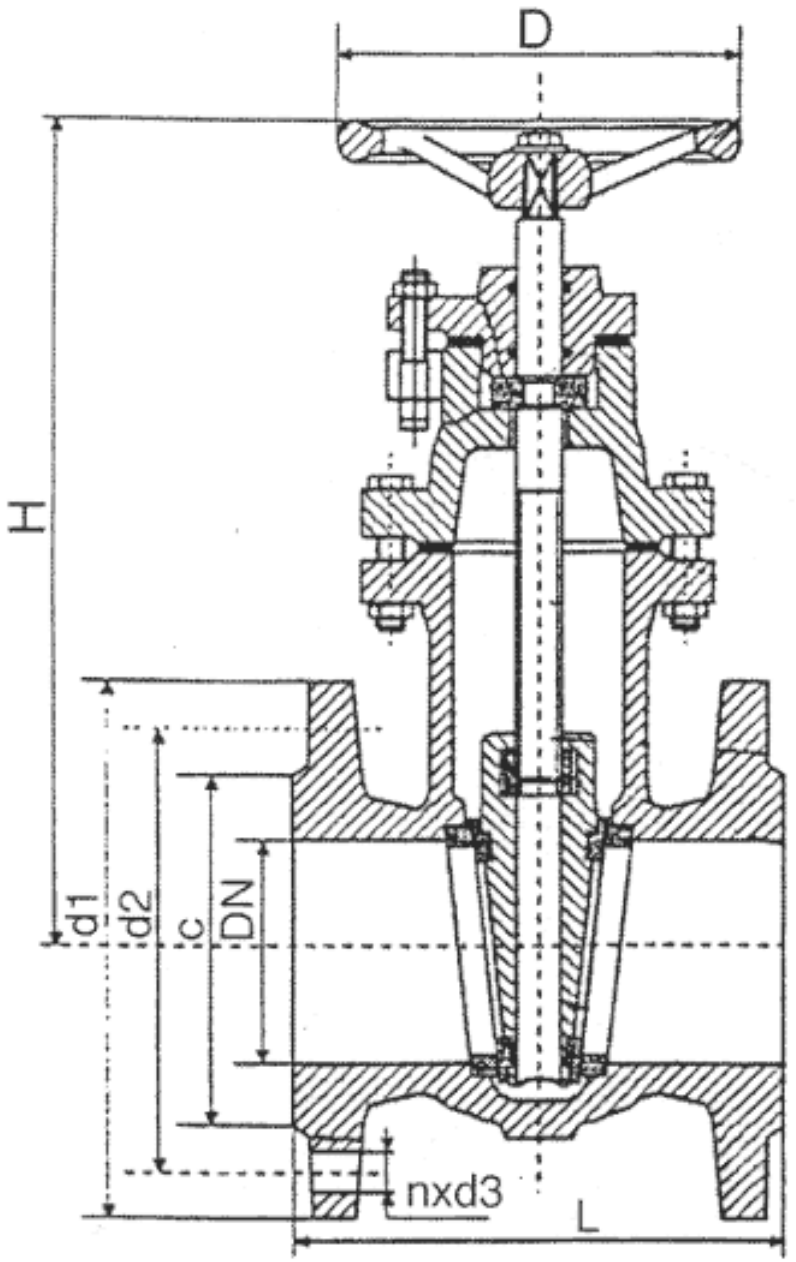


Schema servizio zavorra (nave passeggeri)



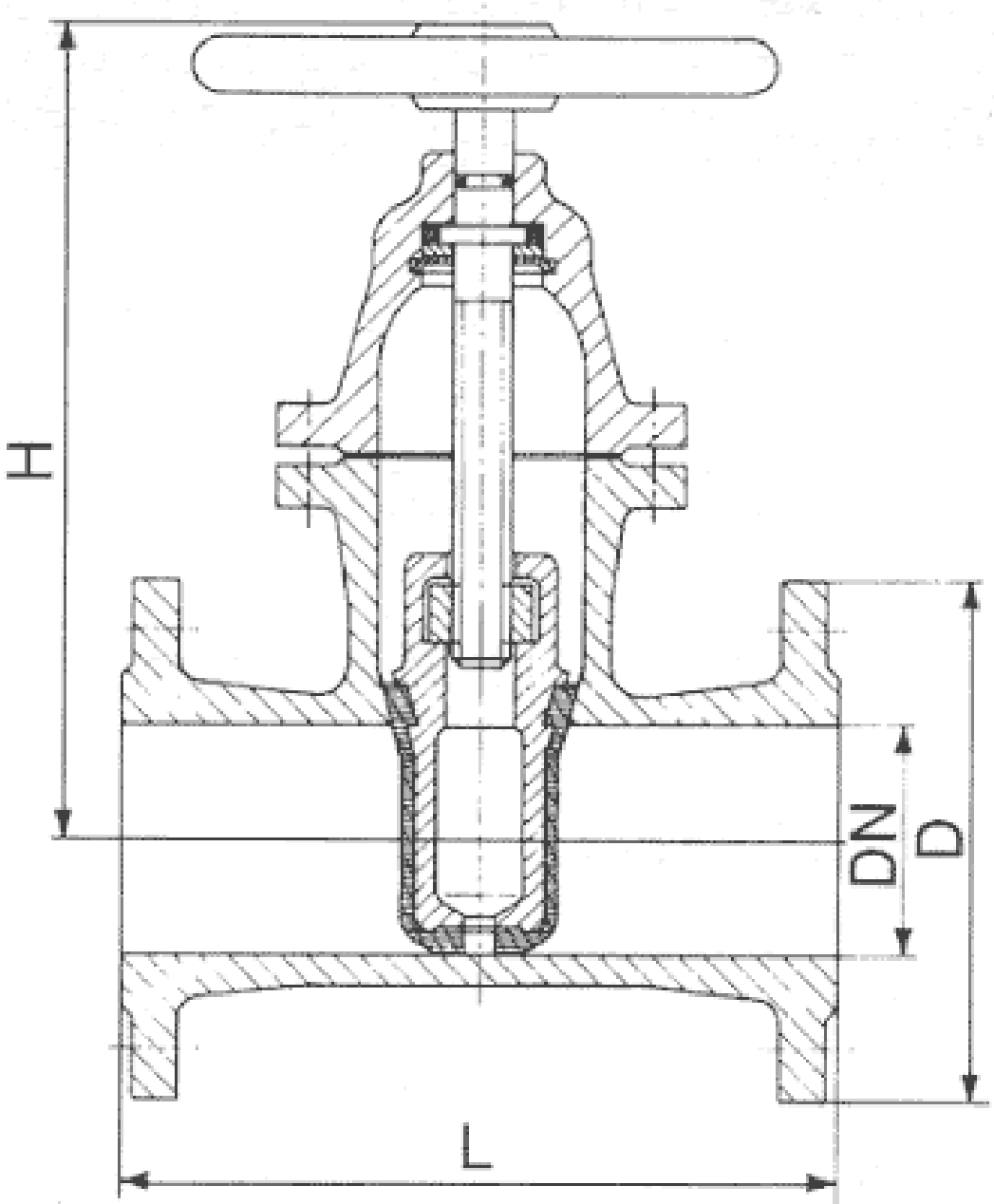
IN Z.17

Valvola ON OFF a saracinesca



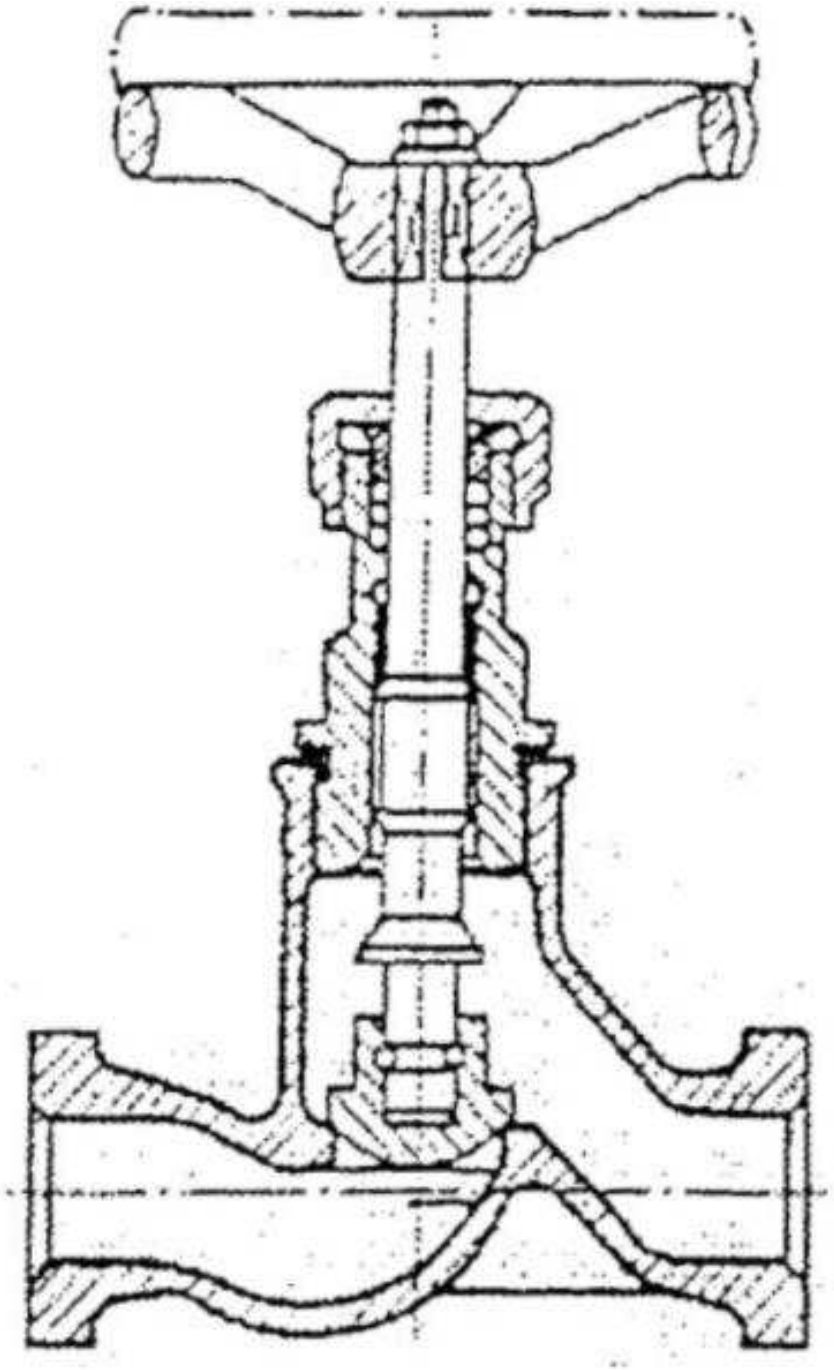
IN Z.19

Valvola ON OFF a saracinesca



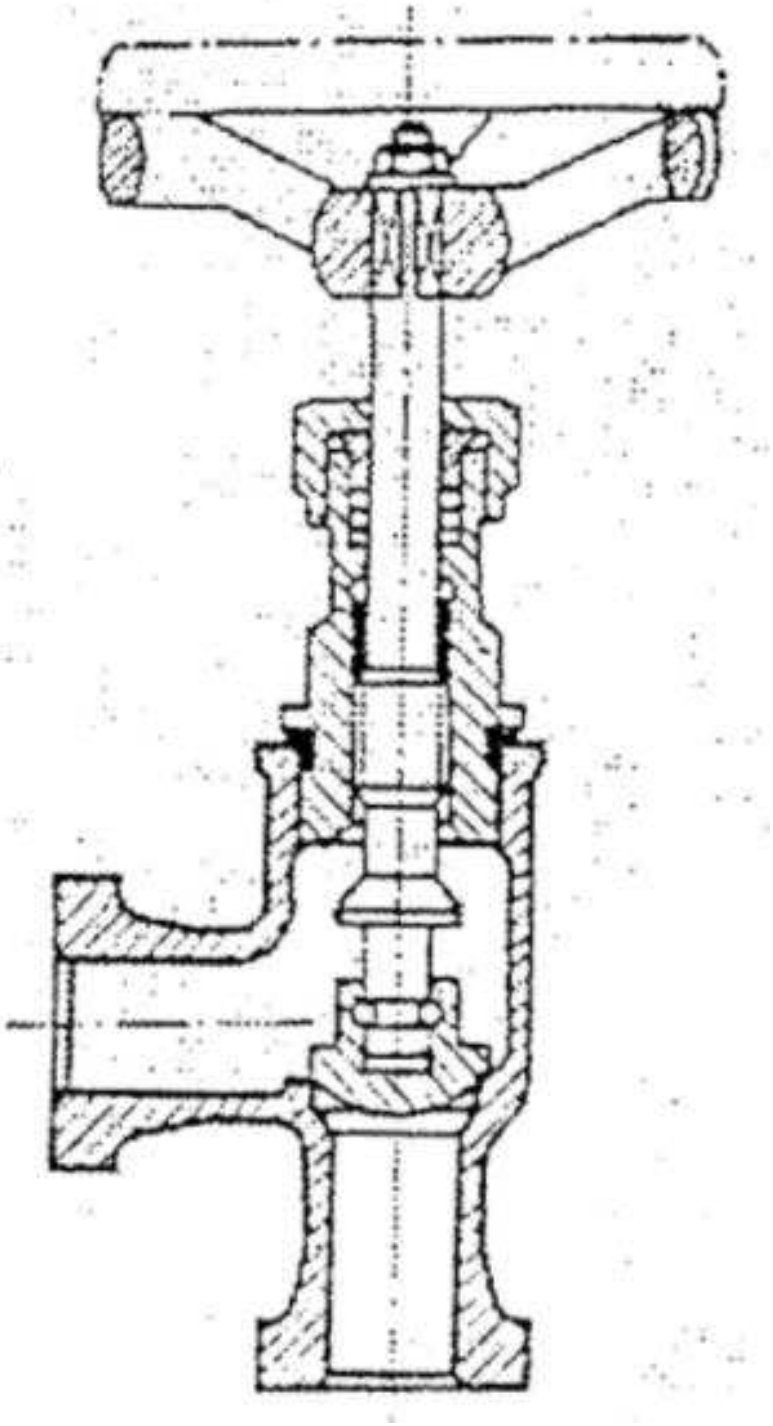
IN Z.20

Valvola ON OFF a globo



IN Z.21

Valvola ON OFF a globo

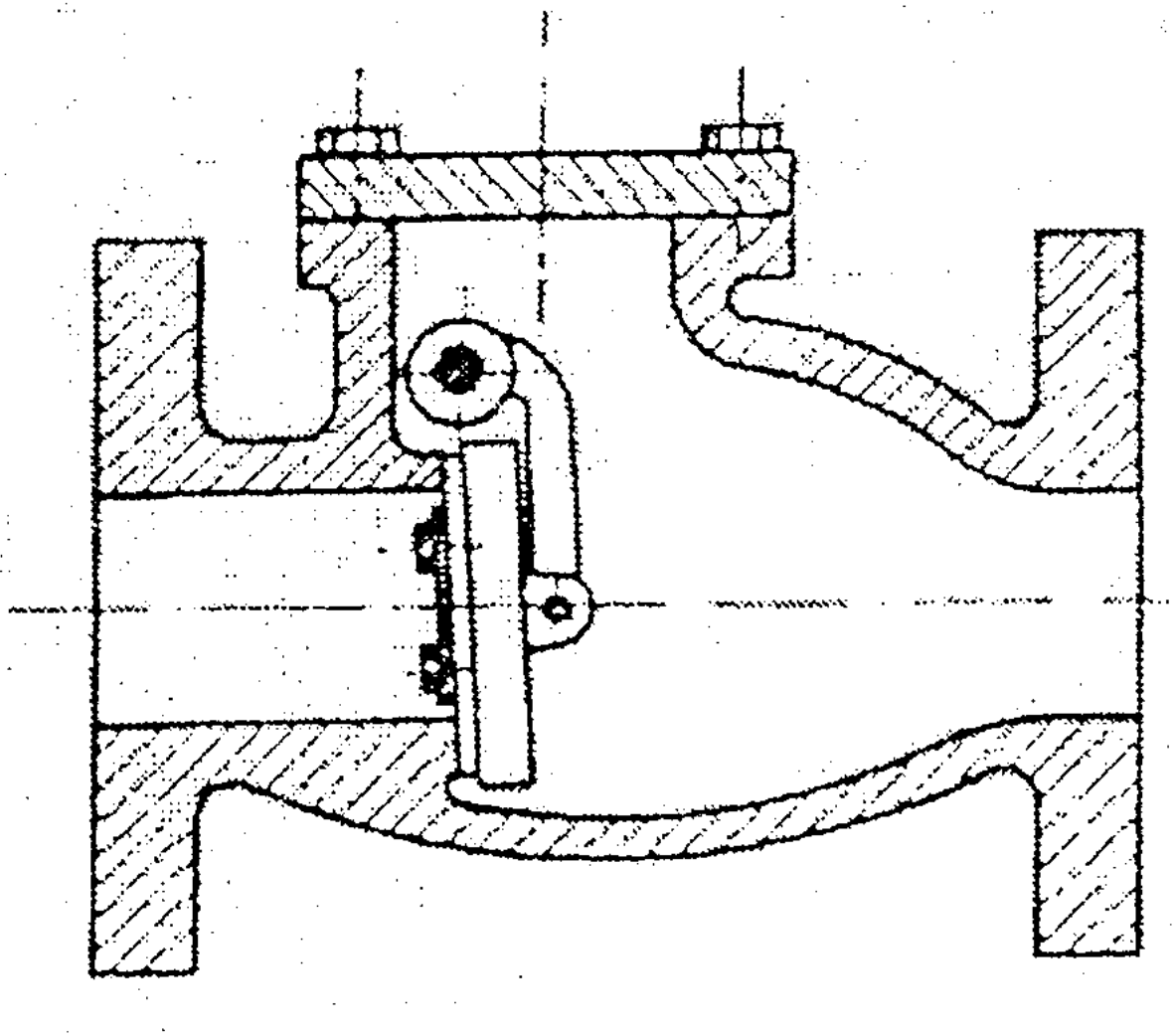


IN Z.22

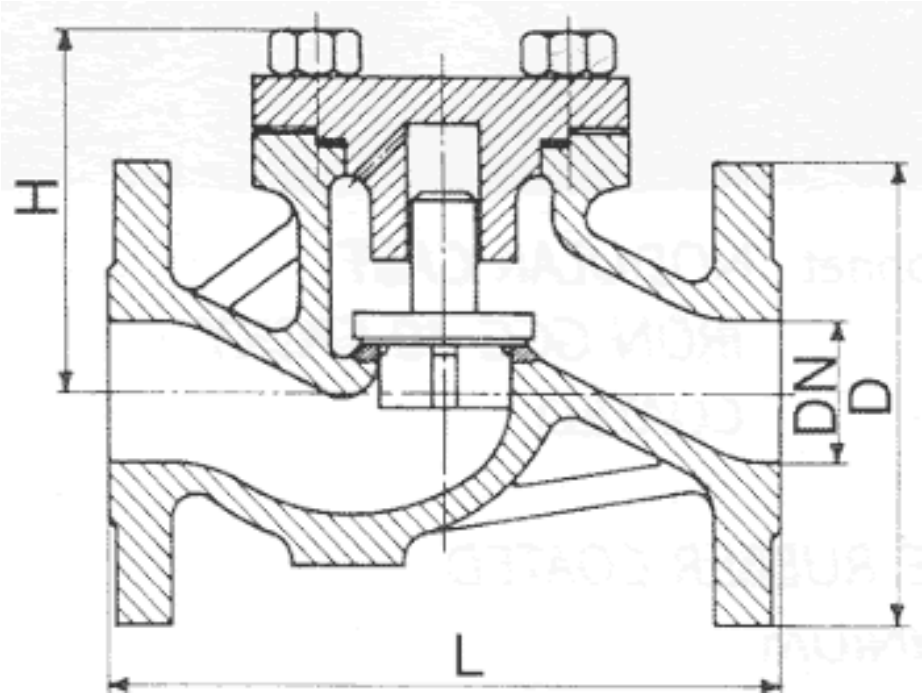
Valvola a farfalla (butterfly)

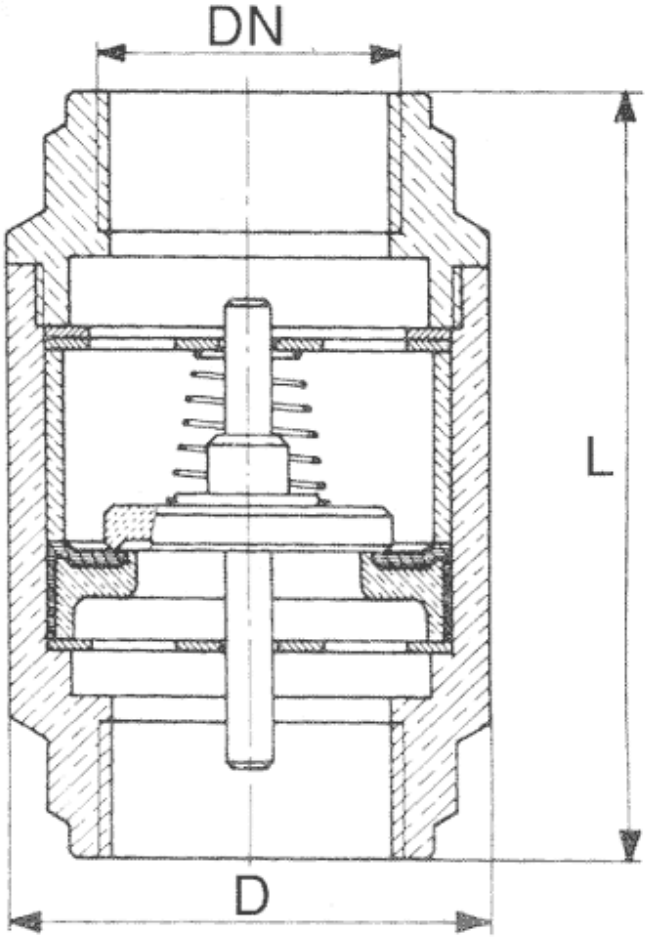
Valvola a sfera

Valvola di ritegno

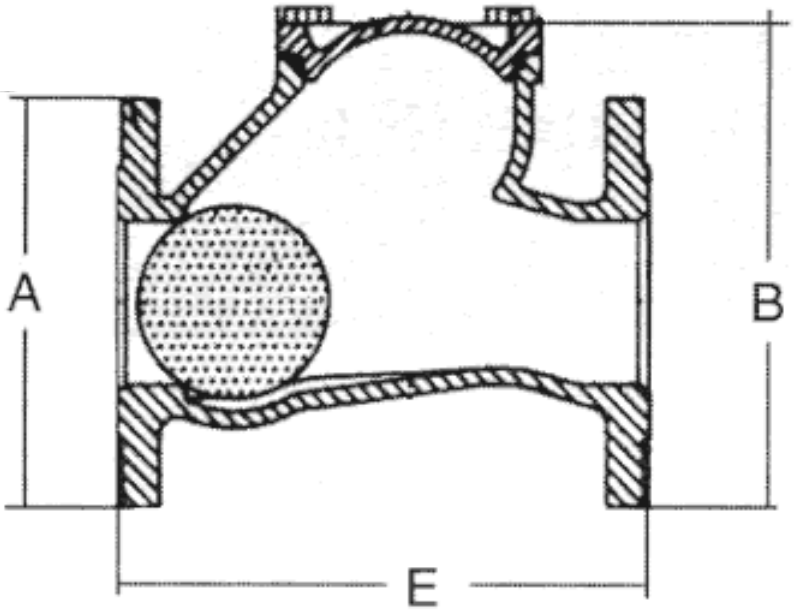


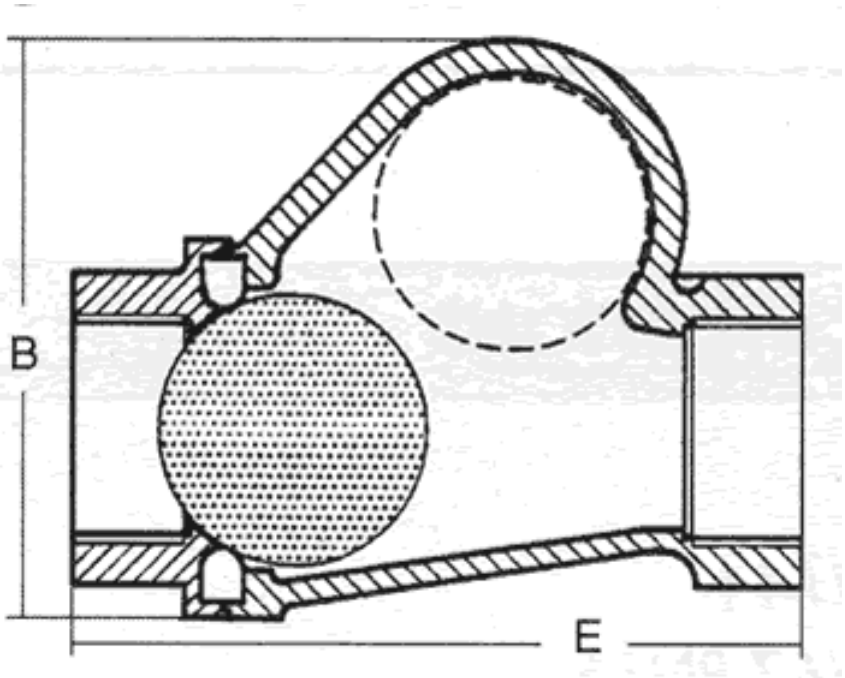
Valvole di ritegno



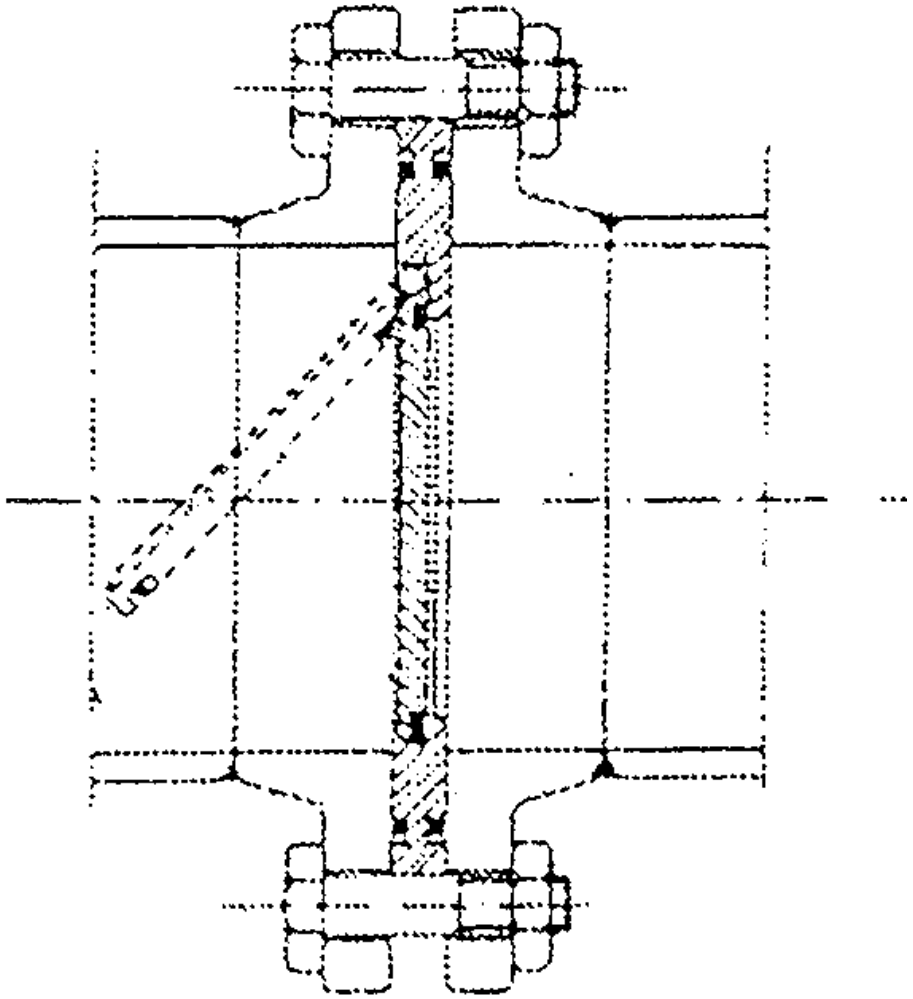


Valvole di ritegno

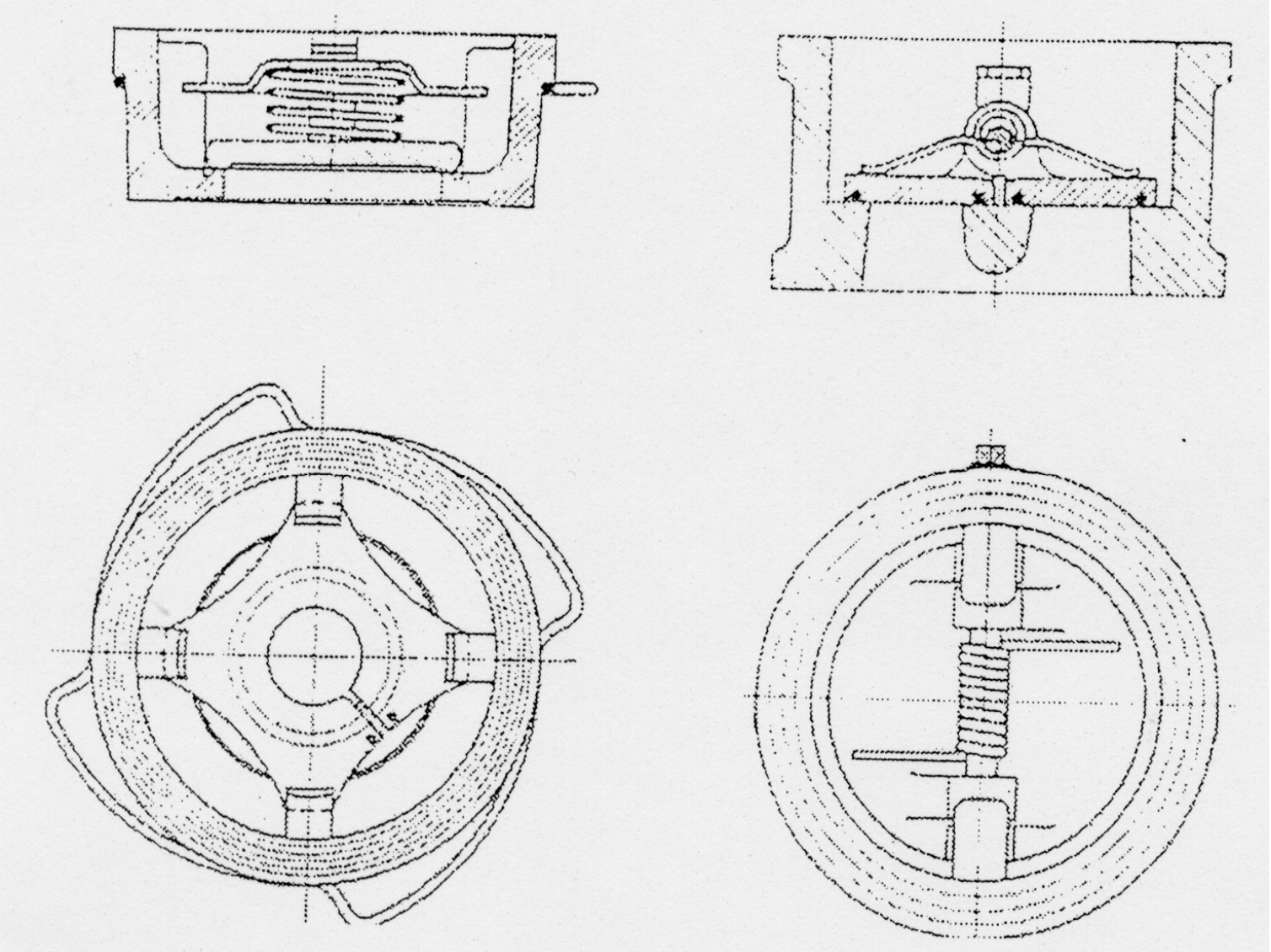




Valvola di ritegno (Wafer)

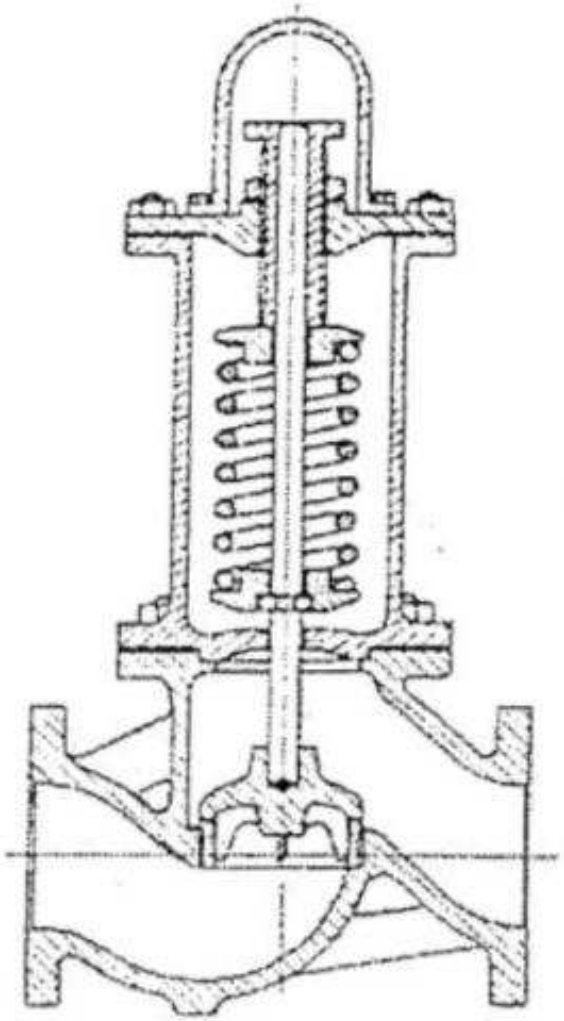


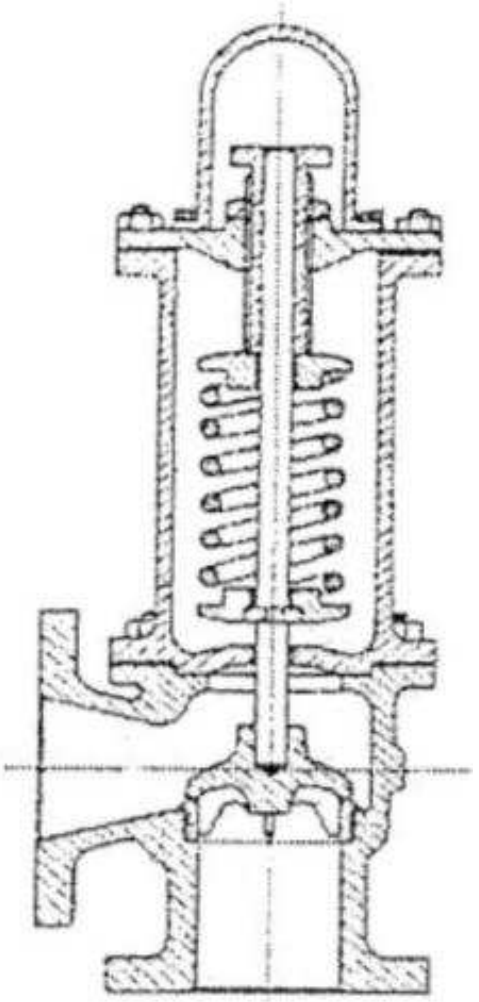
Valvole di ritegno a piattello



IN Z.29

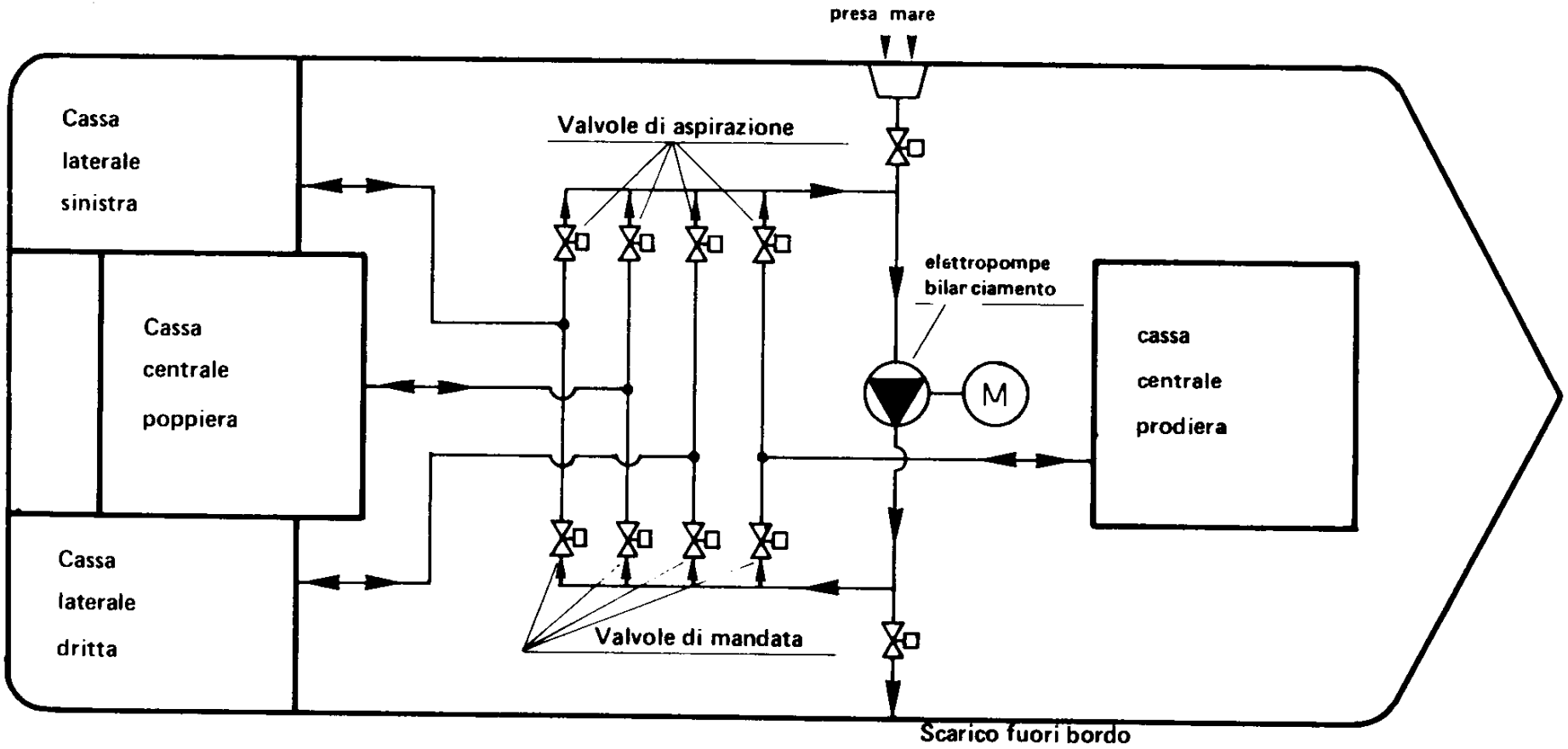
Valvole di sicurezza
(di massima pressione)



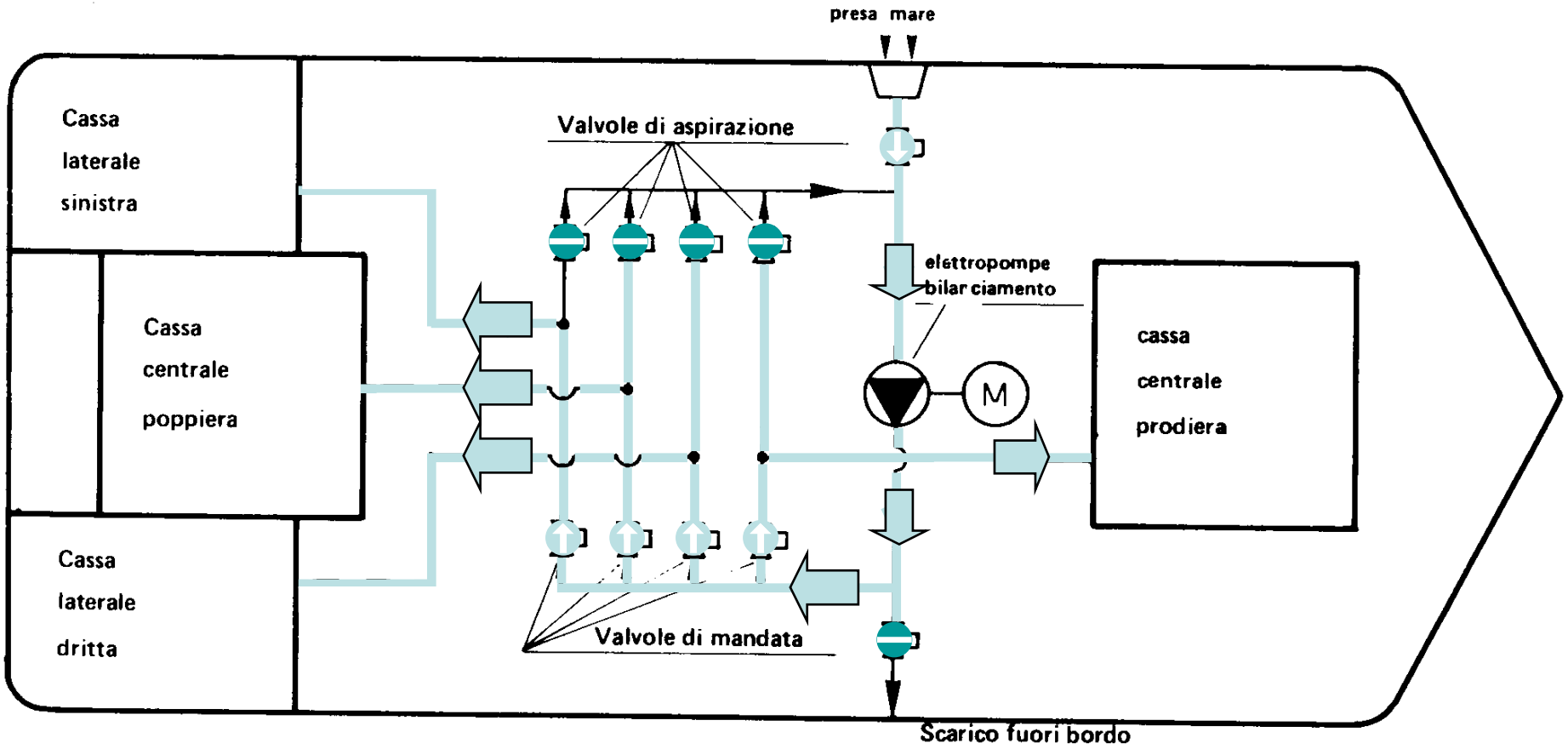


IN Z.30

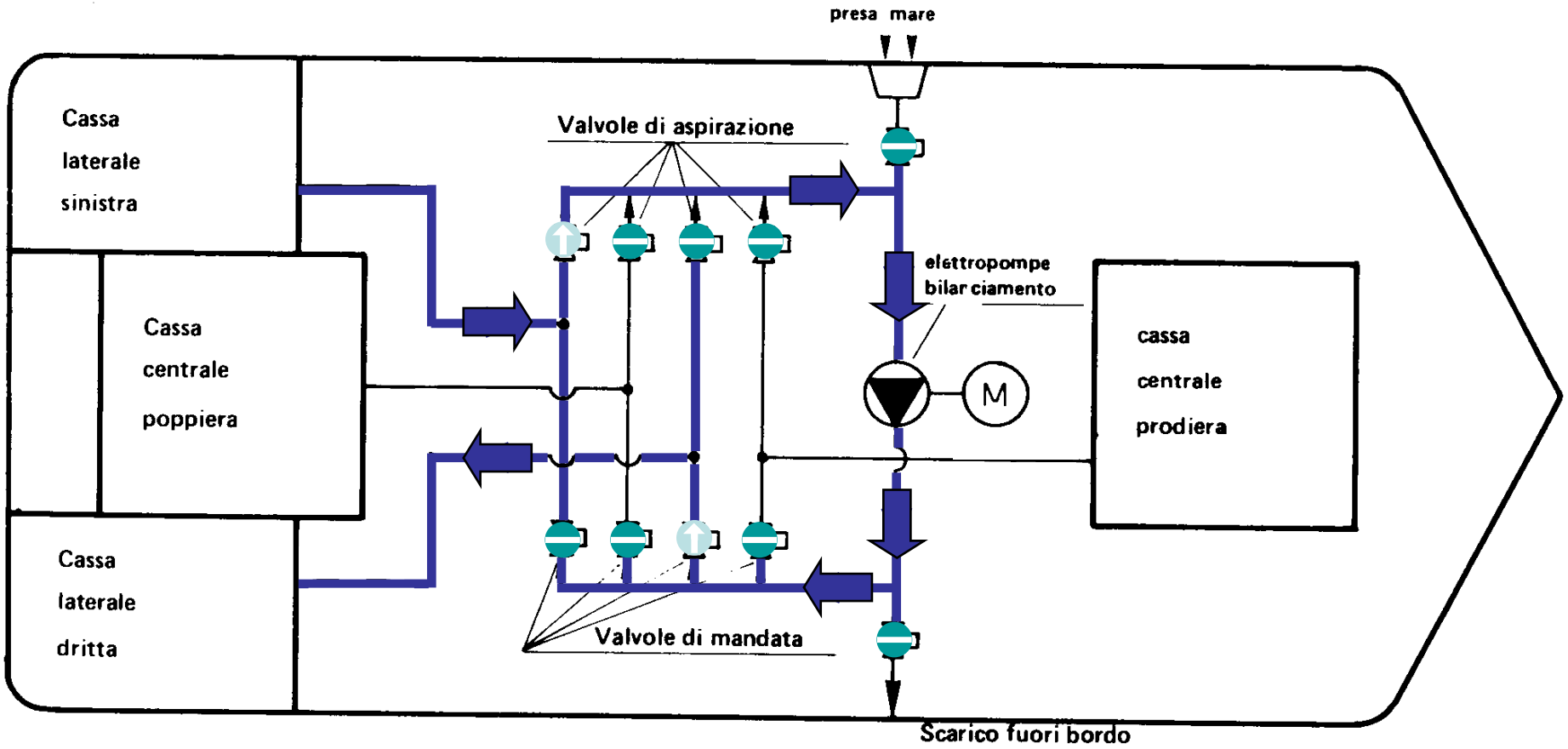
Schema impianto di bilanciamento



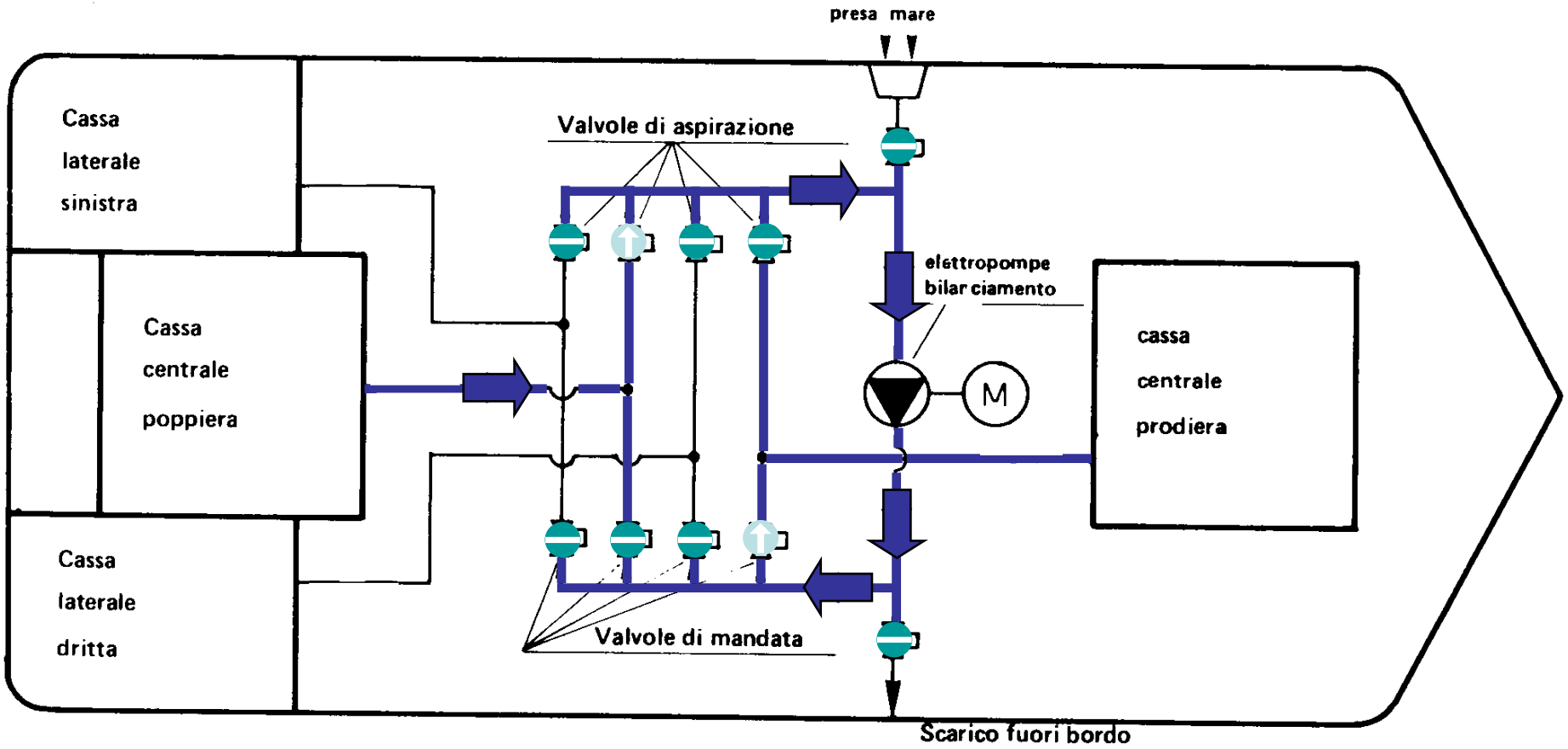
Impianto di bilanciamento carico casse



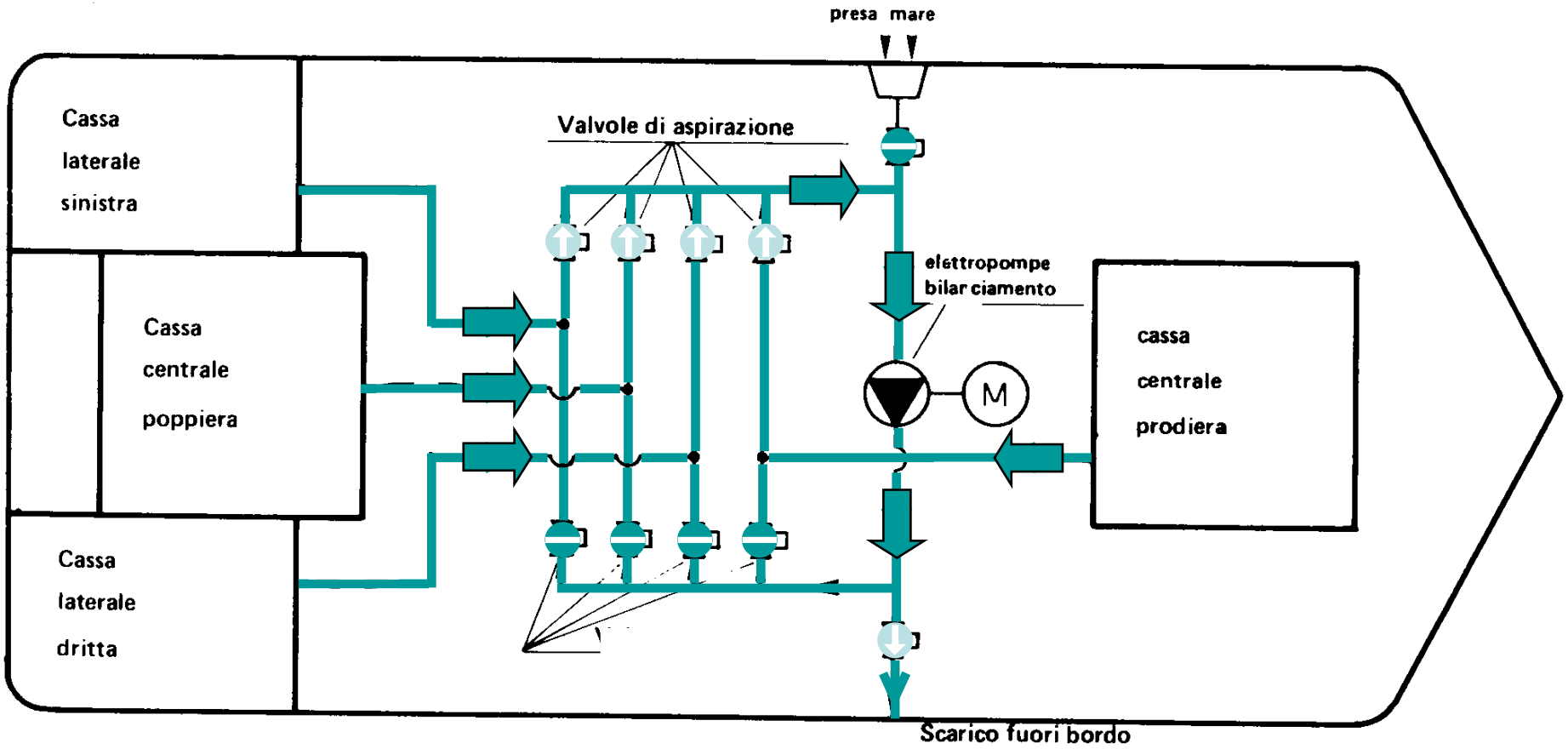
Impianto di bilanciamento
travaso acqua dalla cassa di sinistra a quella di dritta



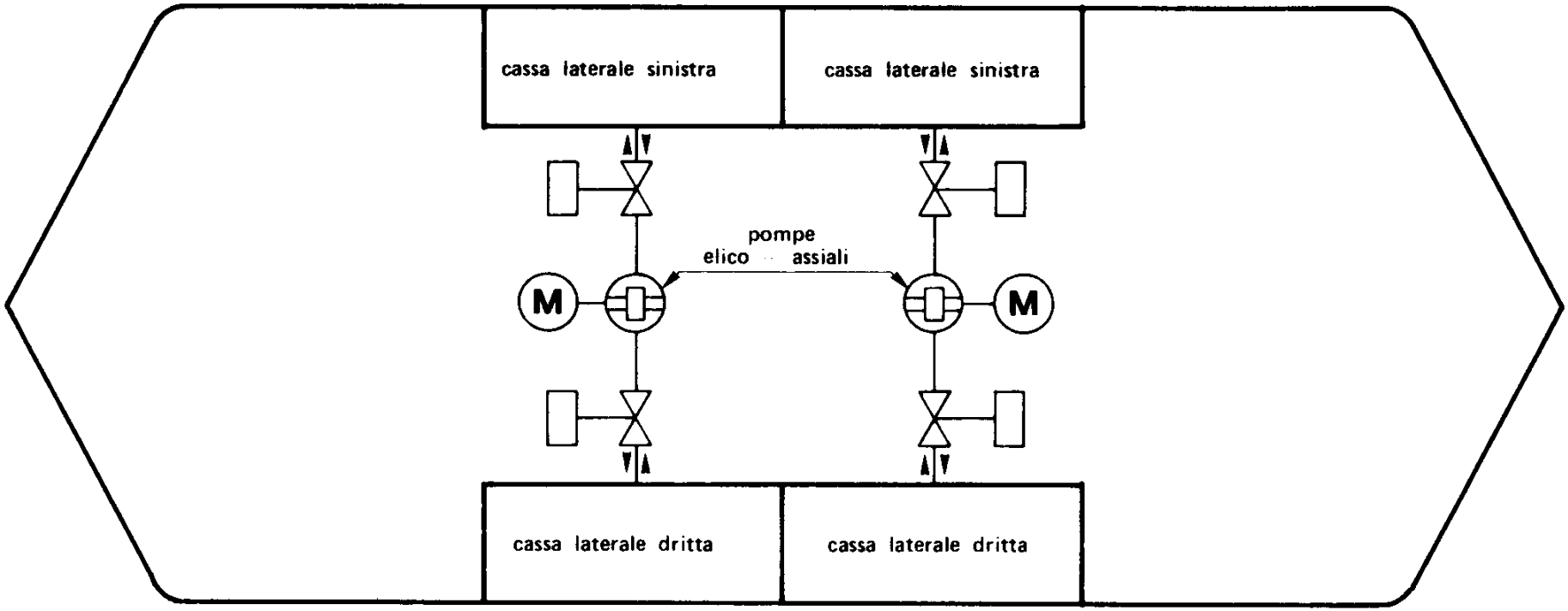
Impianto di bilanciamento
travaso acqua dalla cassa di poppa a quella di prua



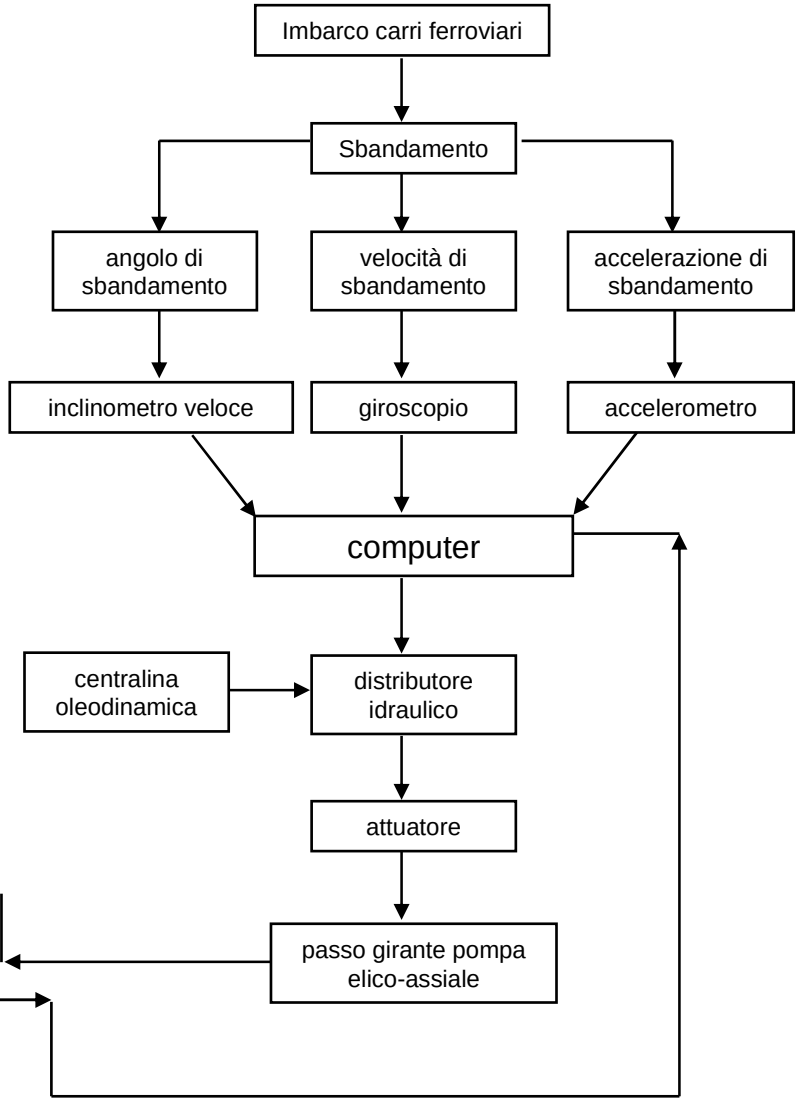
Impianto di bilanciamento scarico acqua dalle casse



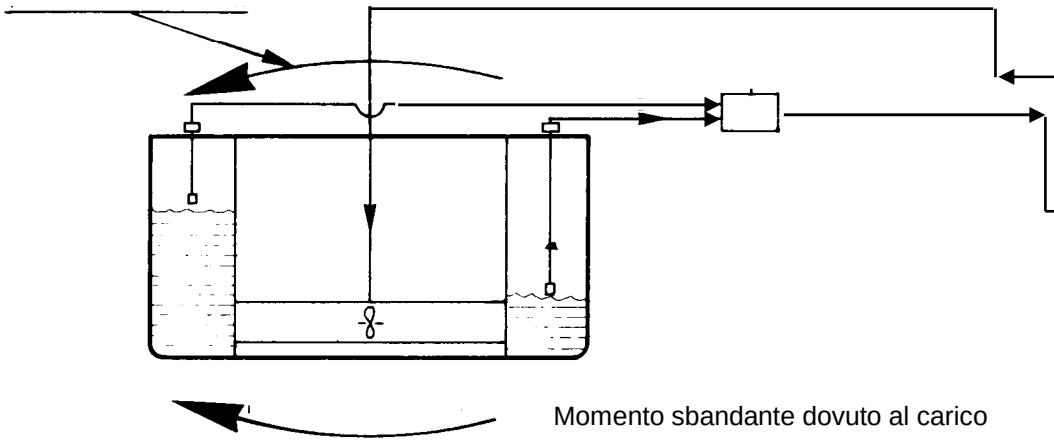
Bilanciamento trasversale di traghetti per il trasporto i carri ferroviari



Logica d'intervento del sistema di bilanciamento trasversale

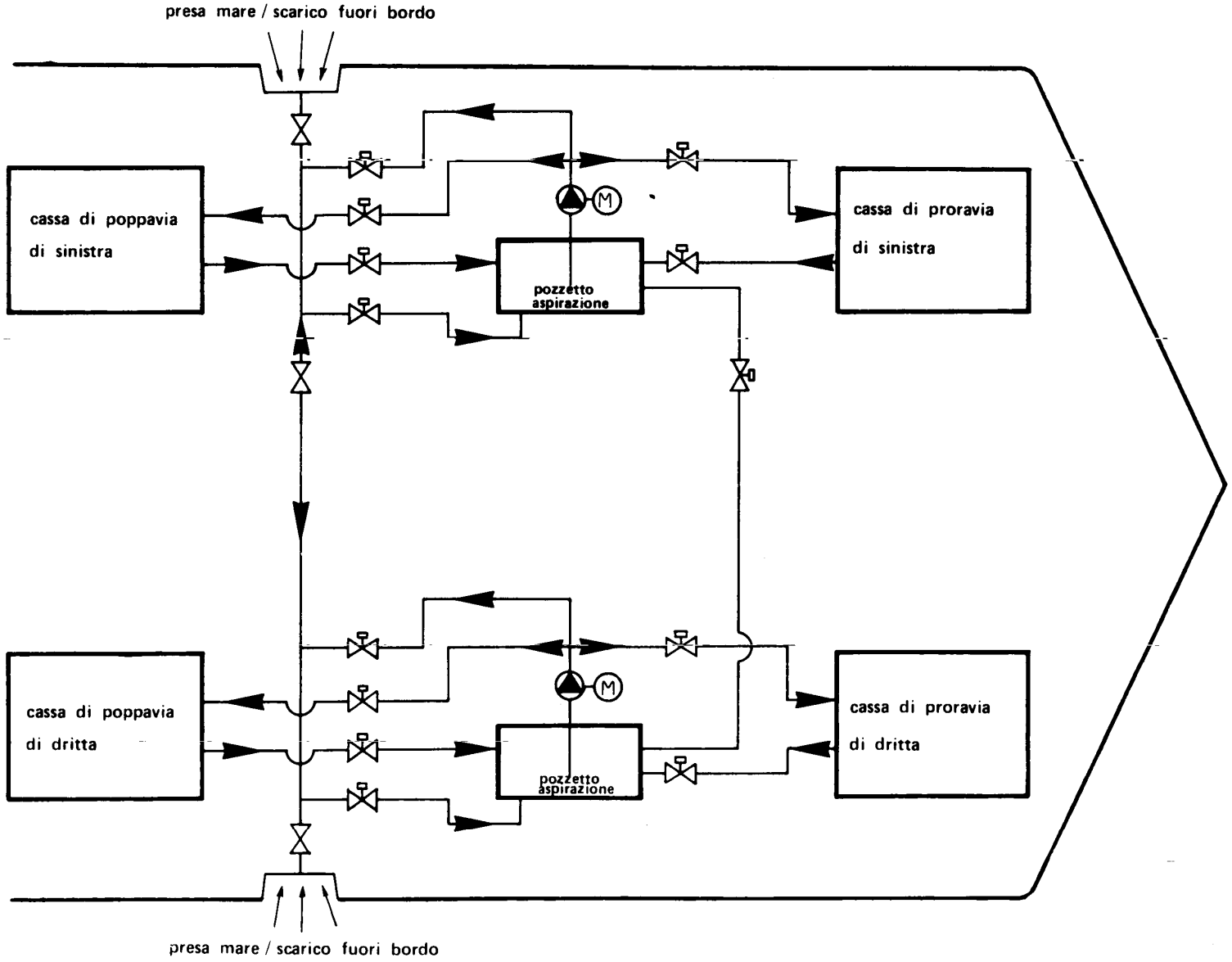


Momento raddrizzante dovuto alla variazione di livello dell'acqua nelle casse di bilanciamento

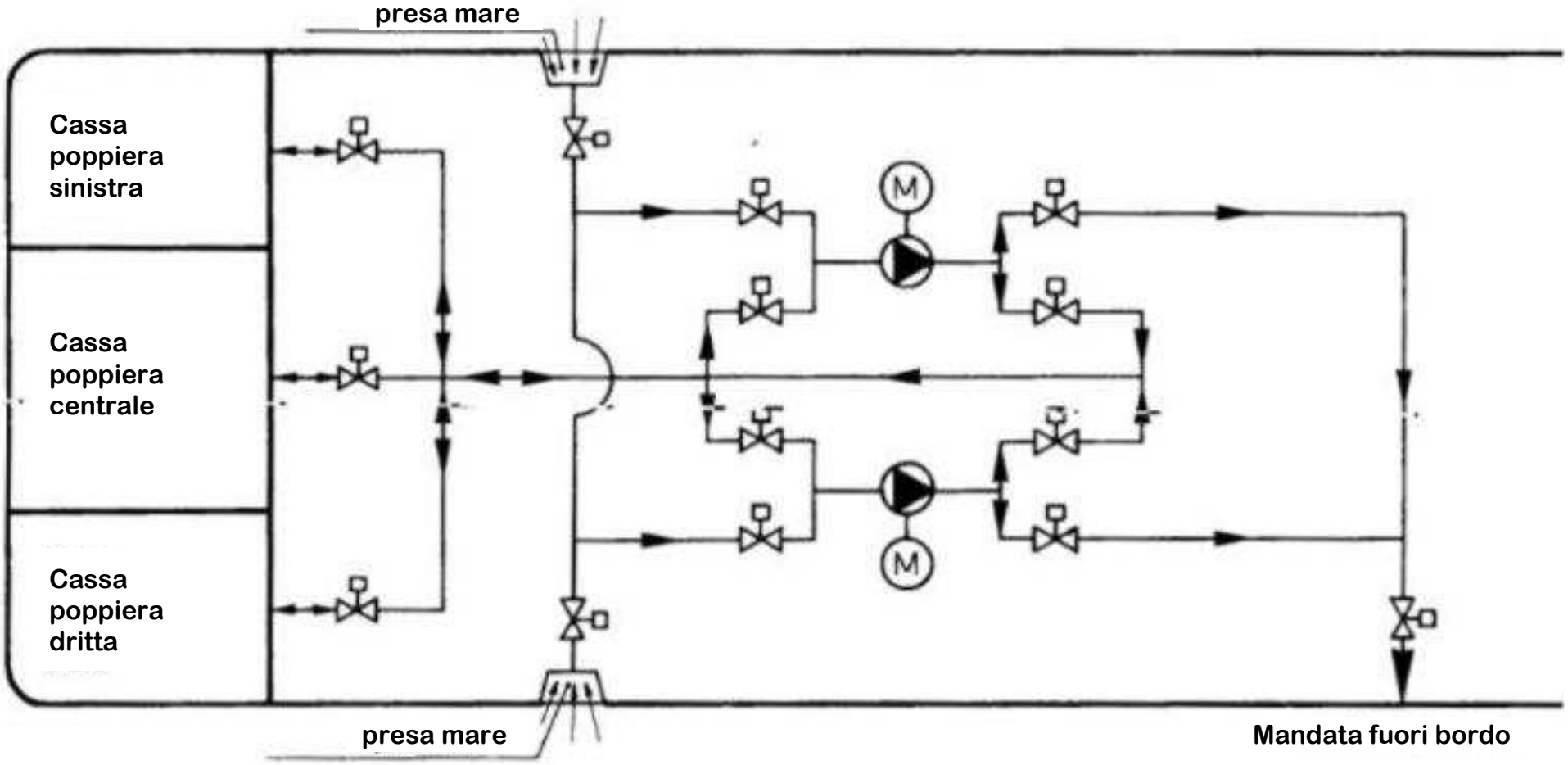


Momento sbandante dovuto al carico

Sistema di bilanciamento longitudinale di prua



Sistema di bilanciamento longitudinale di poppa



Navi adibite a trasporto automezzi

pompe:

portate modeste (100 - 300 m^3/h ossia 0.028 - 0.083 m^3/s)

prevalenze: 15 - 20 m H_2O

casse

volumi 50 - 300 m^3

Caratteristiche carri ferroviari

peso 28 - 30 t

lunghezza 15 m

velocità di imbarco: 3 m/s (10.8 km/h)

Navi traghetto adibite a trasporto carri ferroviari

impianto per il bilanciamento trasversale

pompe:

portate elevate (fino a 11000 m^3/h ossia 3 m^3/s)

prevalenze: 15 - 20 m H_2O

casse

volumi: circa 300 m^3

Navi traghetto adibite a trasporto carri ferroviari

impianto prodiero per il bilanciamento longitudinale

pompe:

portate modeste (circa 100 m^3/h ossia 0.028 m^3/s)

prevalenze: 10 m H_2O

casse

volumi: circa 300 m^3

Navi traghetto adibite a trasporto carri ferroviari

impianto poppiero per il bilanciamento longitudinale

pompe:

portate modeste (circa 100 m^3/h ossia 0.028 m^3/s)

prevalenze: 80 m H_2O *

casse

volumi: circa 300 m^3

* la prevalenza di queste pompe è maggiore in quanto esse sono coinvolte nei servizi di sentina e zavorra