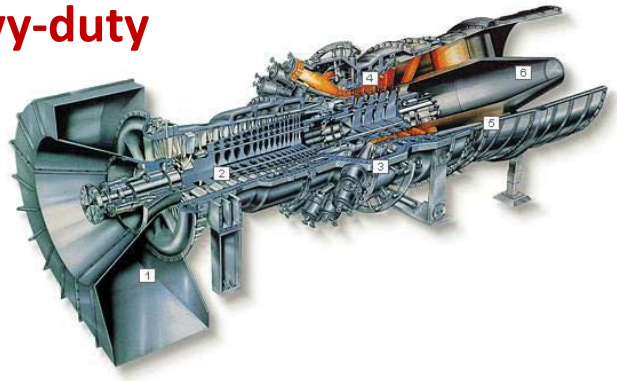
M. Motrici Termiche: T. a gas, T. a vapore

Turbine assiali a vapore



Turbine assiali a gas

Impianti terrestri
Heavy-duty





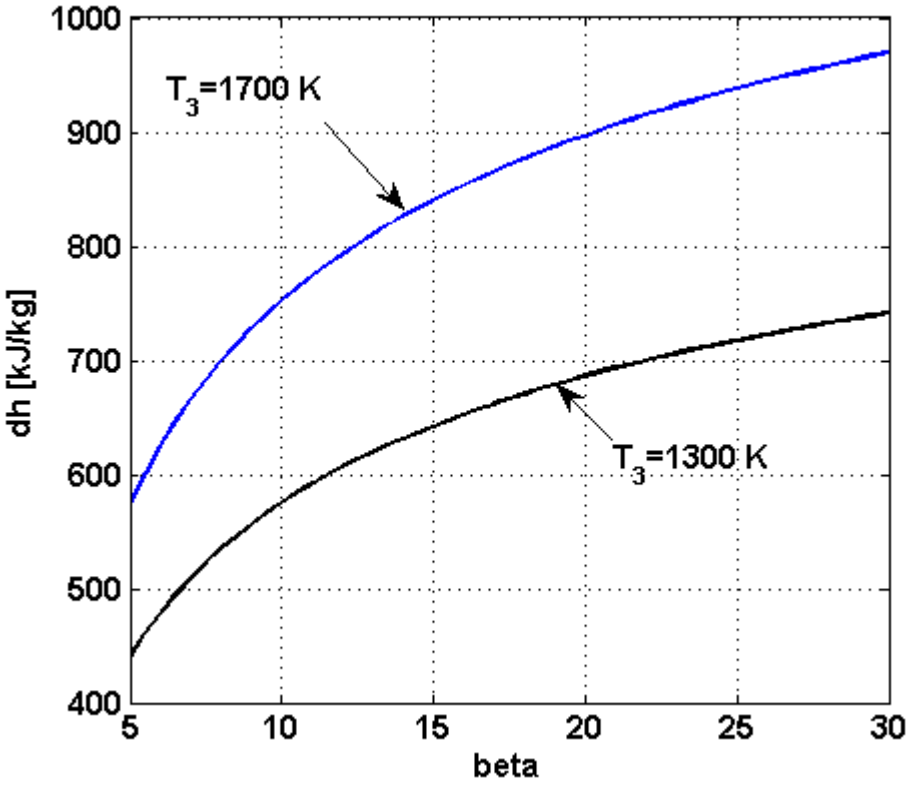
Motori aeronautici

Turbine a gas

$$\Delta h = C_p (T_{in} - T_{out}) = C_p T_{in} \left(1 - \frac{T_{out}}{T_{in}} \right)$$

$$\Delta h = C_p T_{in} \left[1 - \frac{1}{\beta^{\frac{(\gamma-1)}{\gamma}\eta_{pol}}} \right]$$

TG terrestri	*TG aero.*
1-2 MW mech drive 250 MW gen. pot.	
β = 7 - 12	β >30
T_3 = 1300 K	T_3 = 1700 K
N stadi 2-6	
n = 3000 rpm	n=8000 rpm

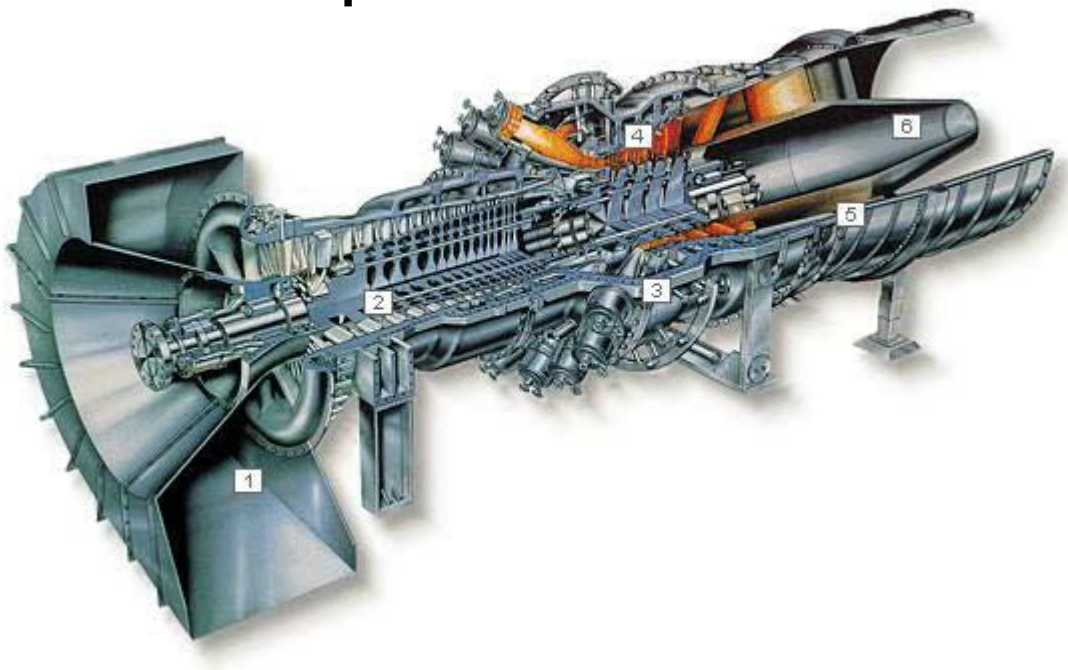


Turbine a gas heavy-duty

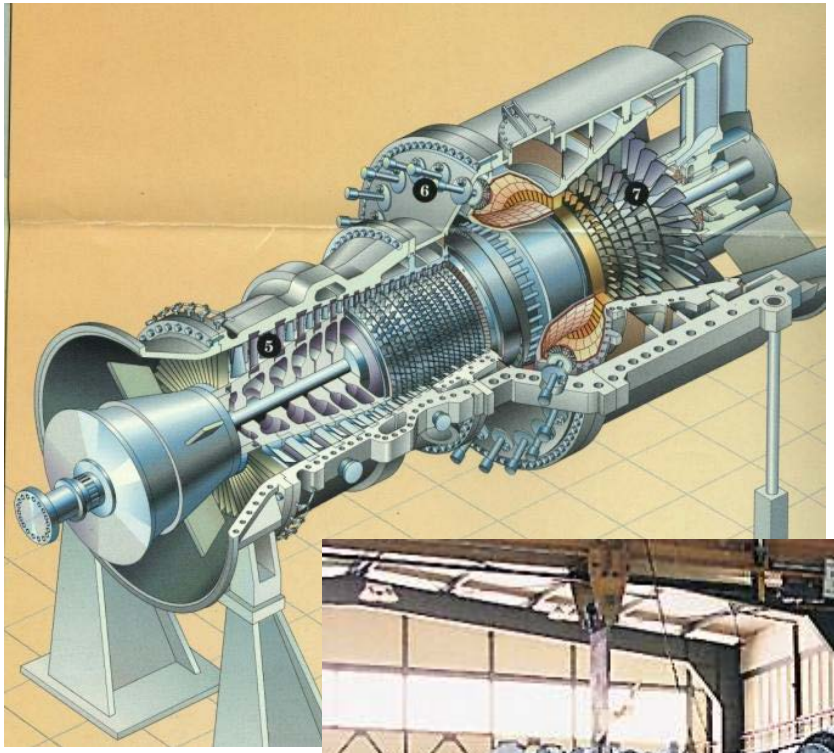
Criterio moderno di progettazione: pochi stadi ad elevato carico funzionanti in regime transonico.

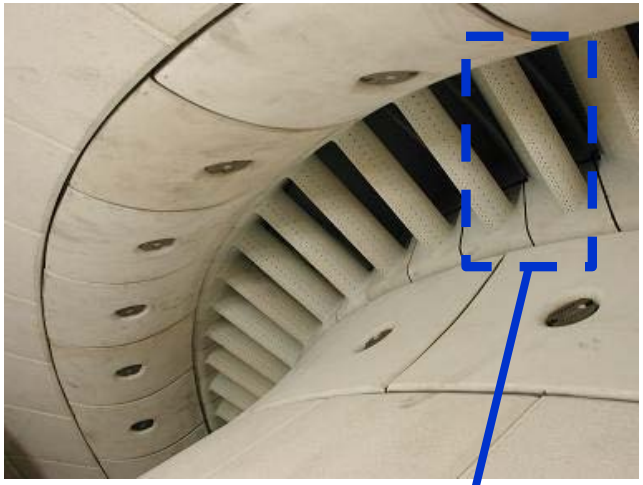
Le T.G. per produzione di energia elettrica operano a velocità costante e sono realizzate in soluzione monoalbero.

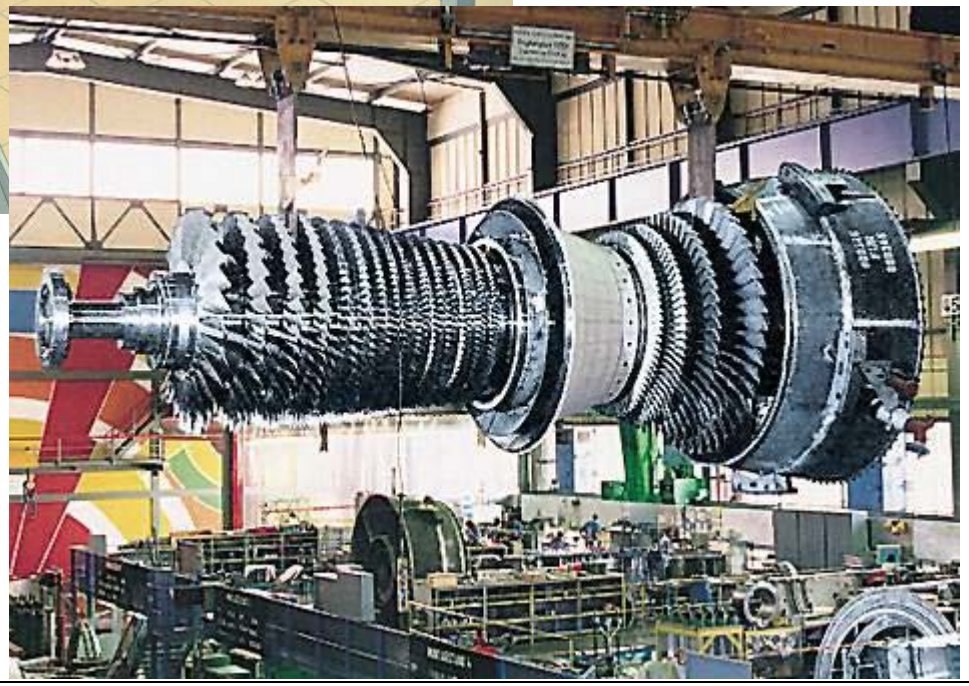
Le T.G. utilizzate per mechanical-drive operano a velocità variabile e sono in genere bialbero

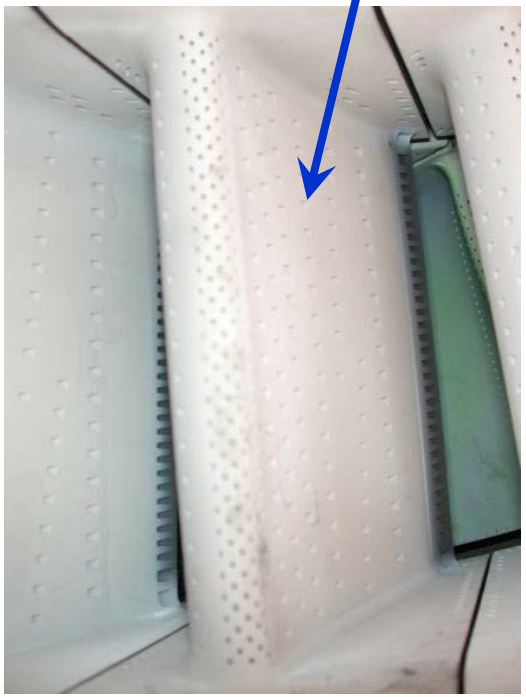


MACCHINE A FLUIDO







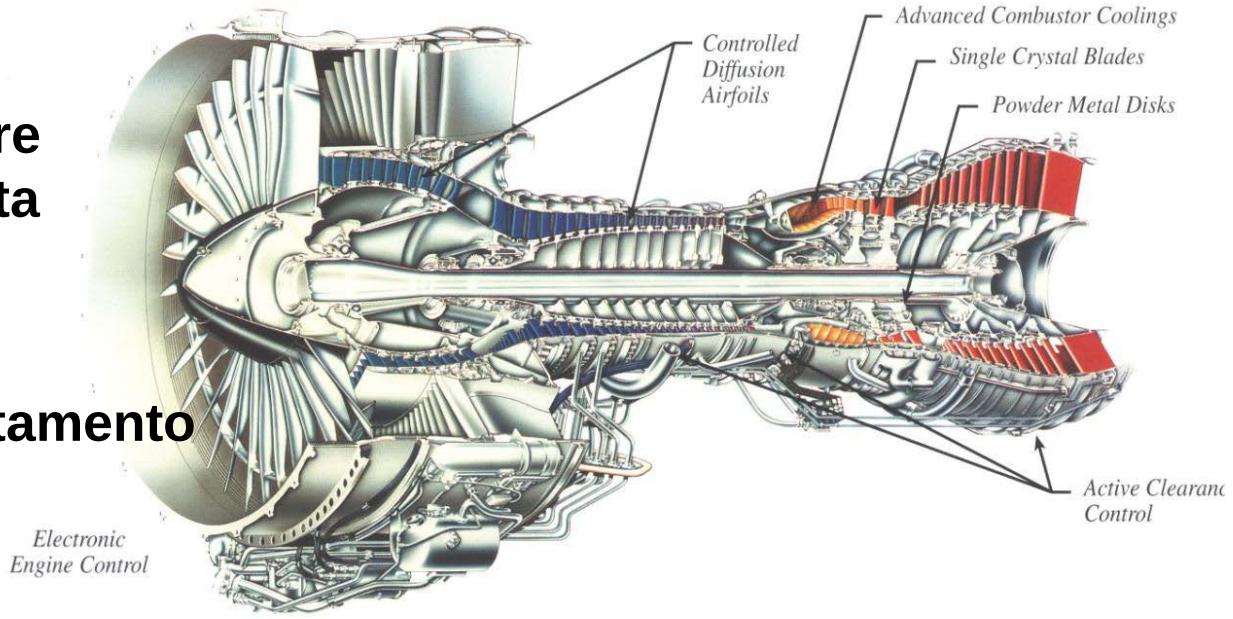


Turbine a gas aeronautiche

Sono macchine a due o tre alberi per garantire elevata efficienza e flessibilità.

Le turbine operano in condizioni di autosostentamento con compressore e fan.

F117-PW-100 Turbofan Engine
Dependable Power for the C-17



Vital Statistics

Thrust	41,700 pounds (167.3 kN)
Weight	7,100 pounds (3,220 kg)
Length	146.8 inches (3.73 m)
Inlet Diameter	78.5 inches (1.99 m)
Maximum Diameter	84.5 inches (2.15 m)
Bypass Ratio	5.9 to 1
Overall Pressure Ratio	30.8 to 1

Schedule

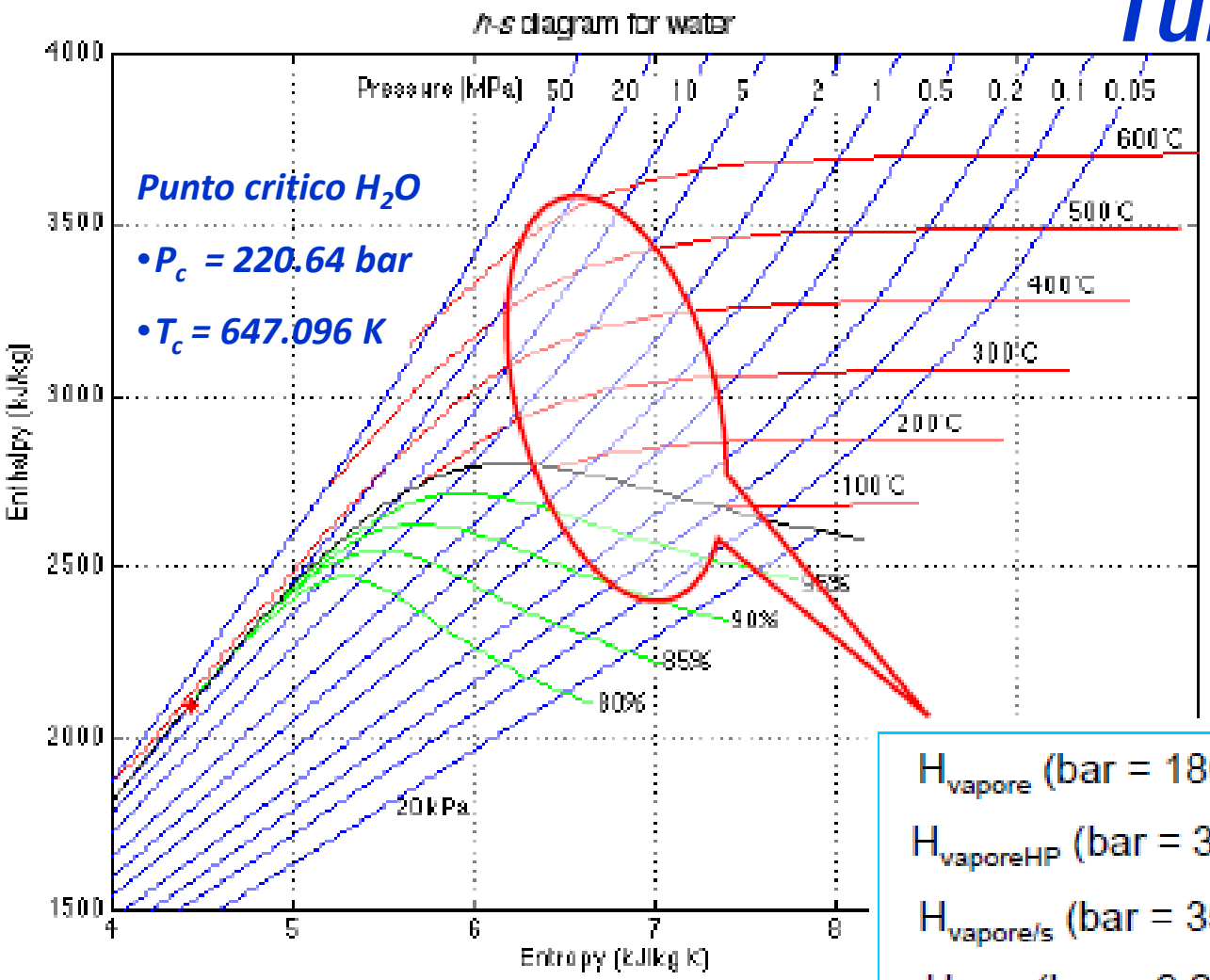
PW2037 FAA Certification	1983
PW2037 Begins Commercial Service on Boeing 757	1984
PW2040 FAA Certification	1987
PW2040 Begins Commercial Service on B757PF	1987
Deliver F117 Ground Test Engine	1988
Deliver First F117 Flight Test Engine	1989
F117 First Flight in U.S. Air Force/McDonnell Douglas C-17	1991
First C-17 for Operational Service Delivered	1993
C-17/F117 Initial Operating Capability	1995

Pratt & Whitney
A United Technologies Company

P.O. Box 109600
West Palm Beach, FL 33410-9600
561 796-2000

C Printed in USA

Turbine a vapore



- p_{max} = 180 -230 bar
- T_{max} = 550 *C
- T_{min} = 30°C
- P_{min} = 0.05 bar
- Δh = 1-2 MJ/kg
- N stadi = 15-20
- n=3000 rpm (conv.)
- n=1500 rpm (nucleari)

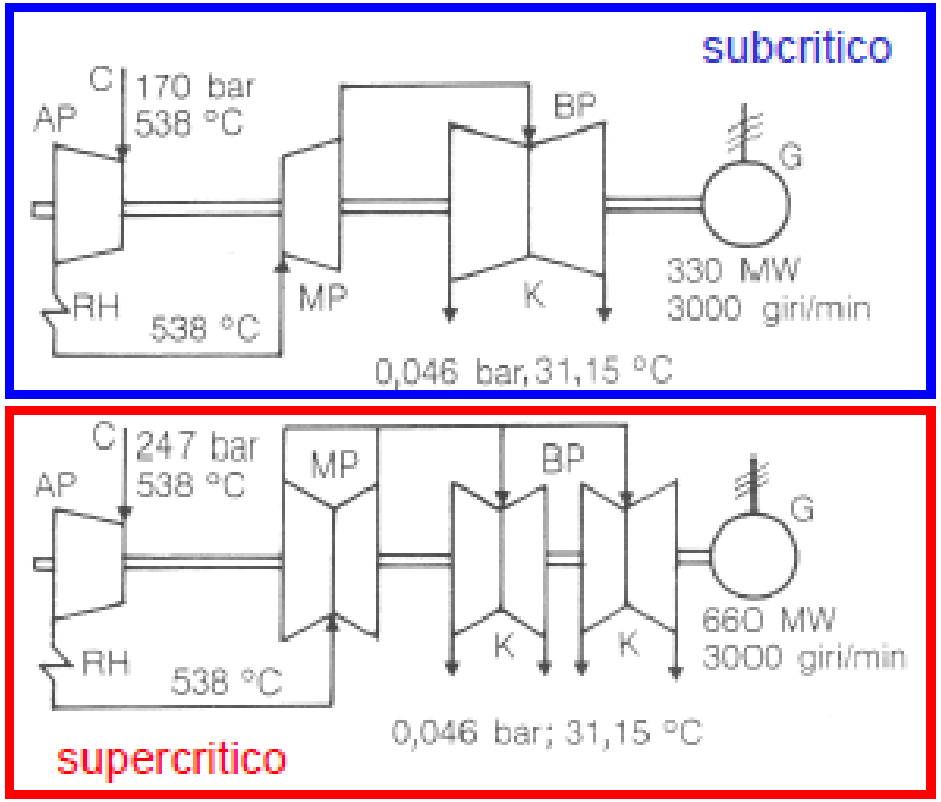
H_{vapore} (bar = 180, T= 550 C°) ≈ 3500 kJ/kg

$H_{vaporeHP}$ (bar = 35, T= 250 C°) ≈ 3000 kJ/kg

$H_{vapore/s}$ (bar = 35, T= 550 C°) ≈ 3600 kJ/kg

H_{Cond} (bar = 0,05, T= 32 C°) ≈ 2400 kJ/kg

$\Delta H \approx 500+1200 \approx 1700$ kJ/kg

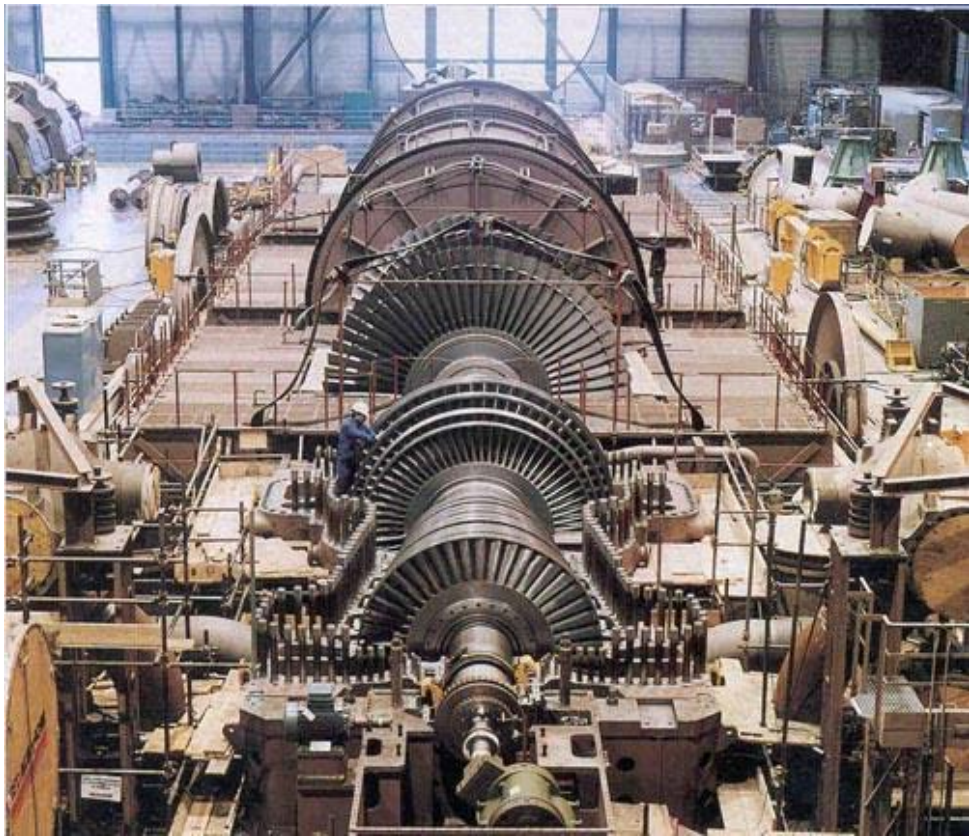


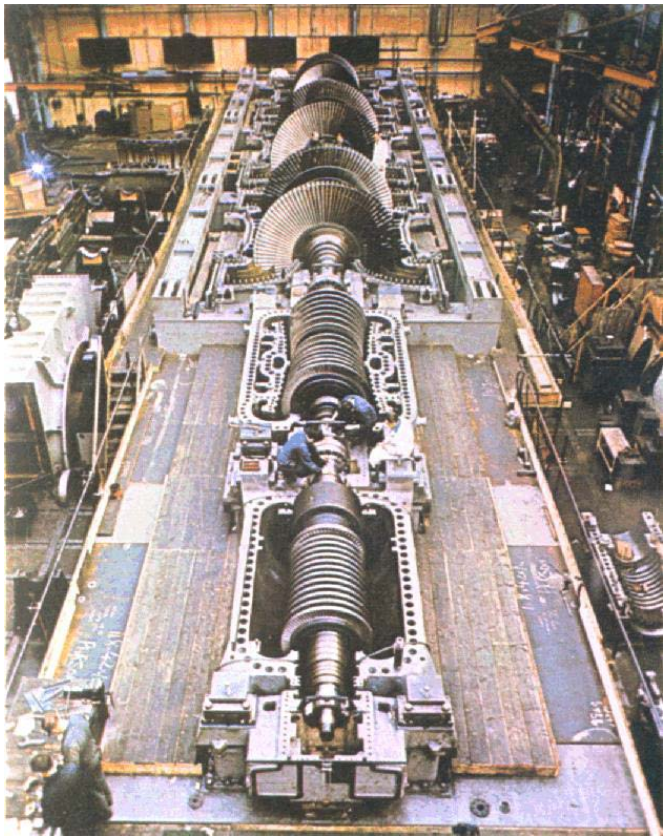
Turbine a vapore

Caratt. Impianti	320 MW fossile	660 MW fossile	1000 MW nucleare
P_{nom} [MW]	320	660	980
P [MPa]	17	24.8	6.3
T[°C]	538	538	278
M [t/h]	1020	2090	5577
η_{netto}	40%	40.8%	33.4%

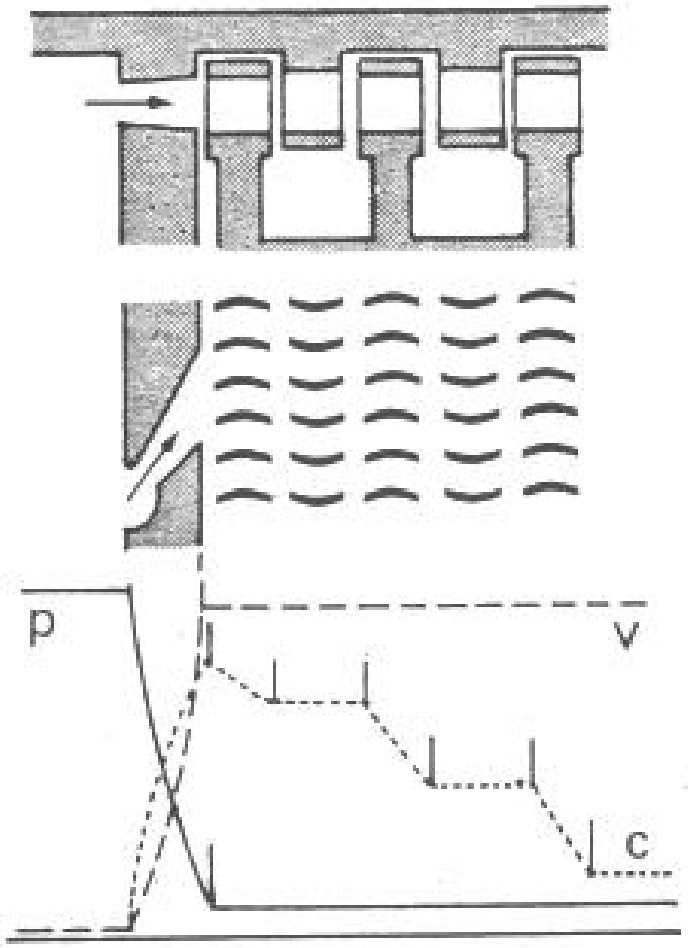
Turbine a vapore

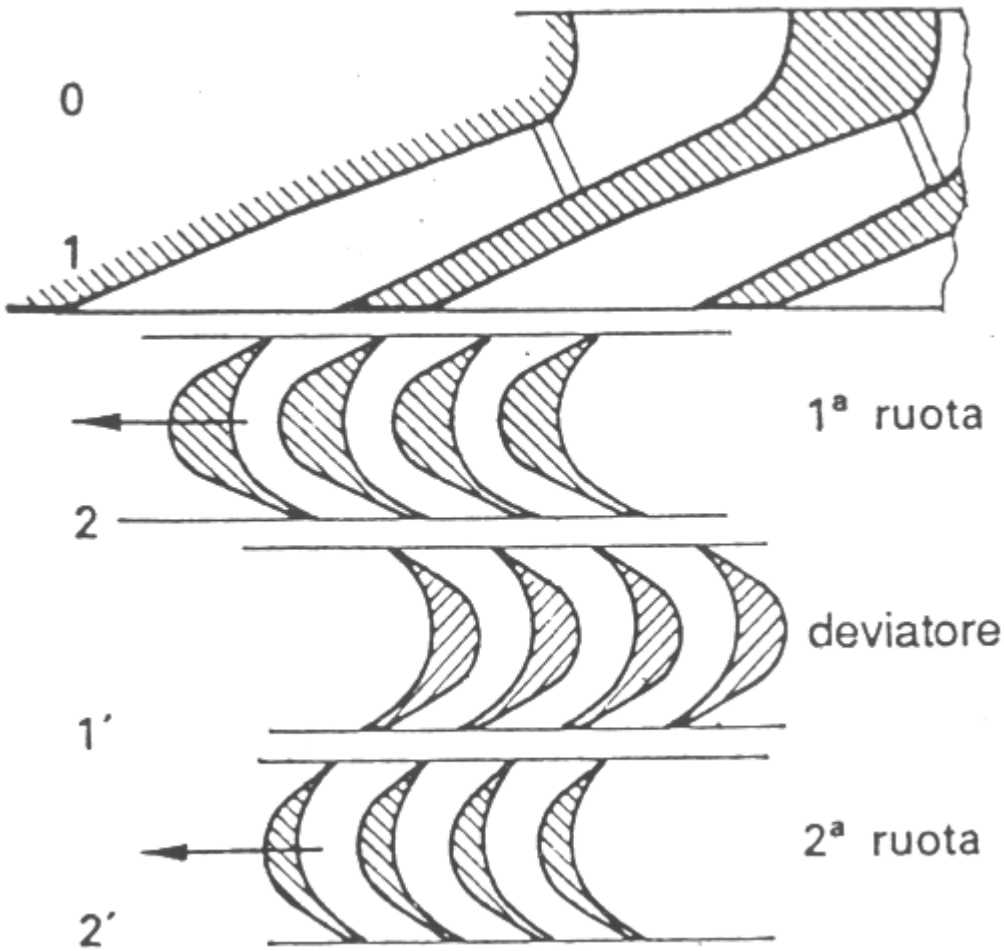
Le turbine a vapore sono di norma macchine con molti stadi, e di potenza elevata



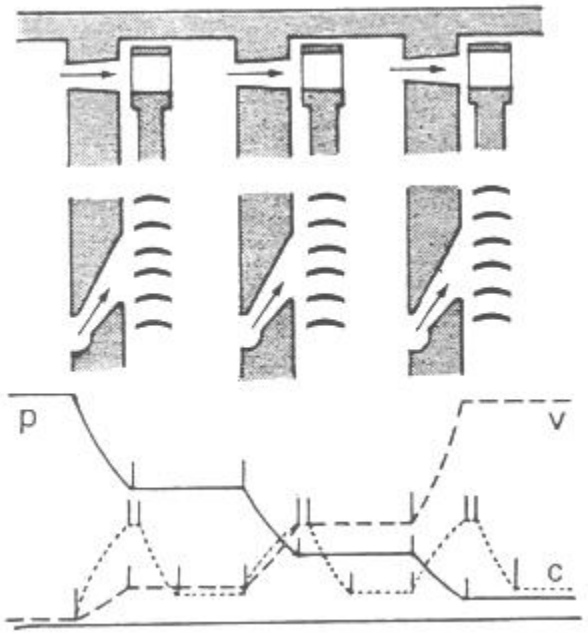


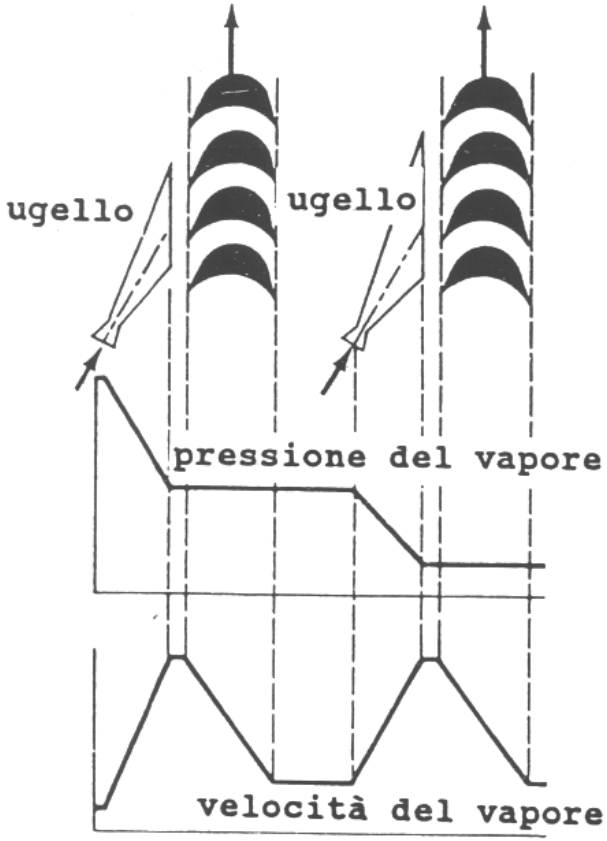
Turbina ad azione a salti di velocità - Curtis

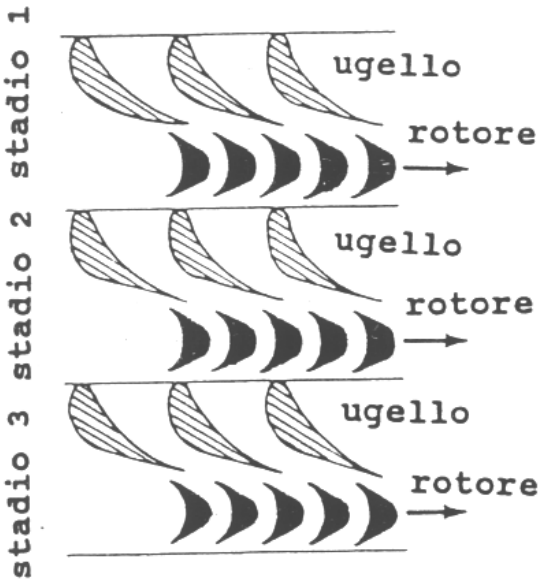




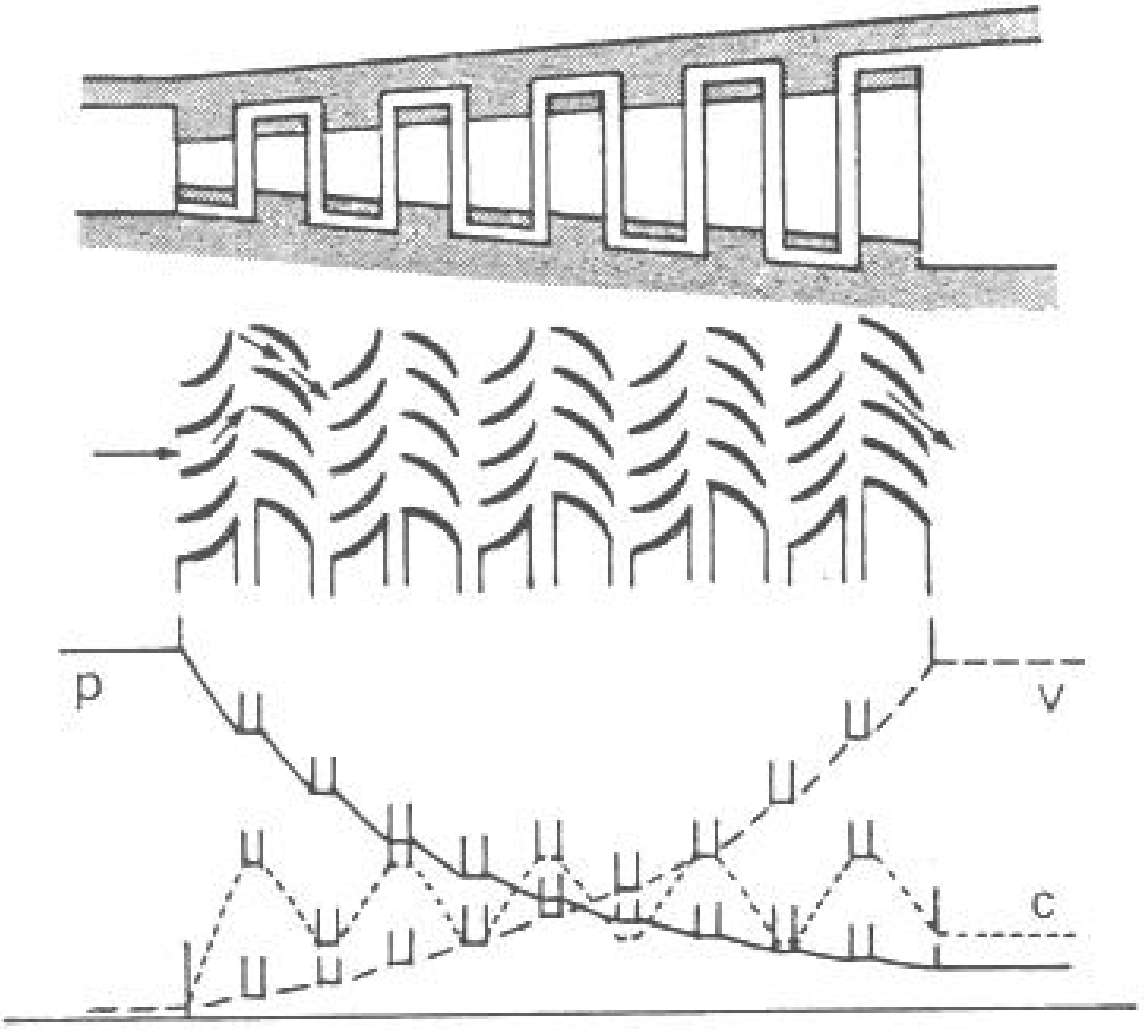
Turbina ad azione a salti di pressione - Rateau



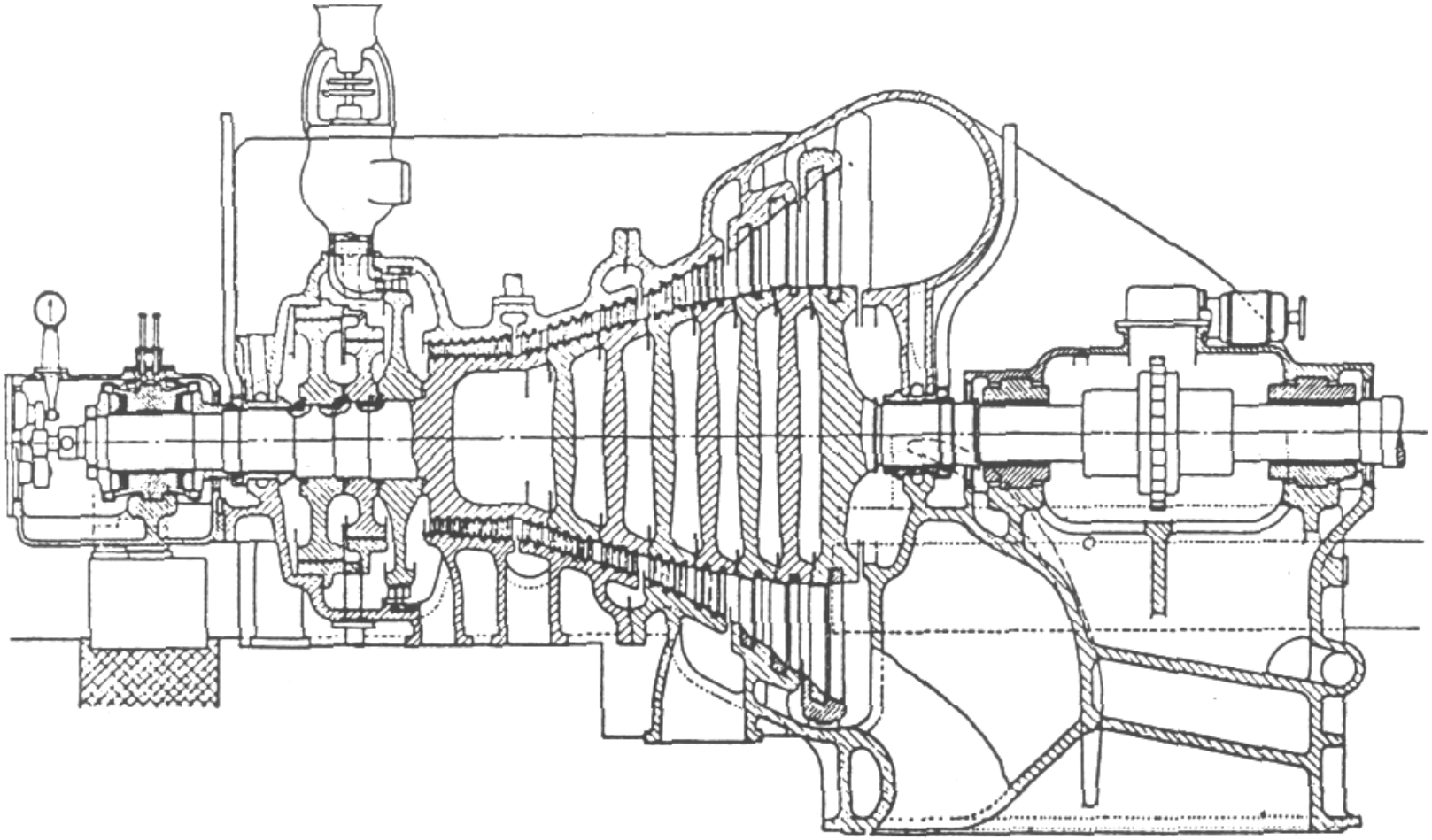




Turbina a reazione - Parsons



Turbina a stadi misti – Brown Boveri



Turbina Brown Boveri. Rotore a tamburo costituito da elementi saldati.