GERADORES DE VAPOR

(CALDEIRAS)

CALDEIRAS - Definição

- Caldeiras ou geradores de vapor são equipamentos destinados a produzir e acumular vapor sob pressão superior à atmosférica, utilizando qualquer fonte de energia
- Fontes de energia para caldeiras:
  - Combustíveis convencionais
  - Combustível nuclear (usinas nucleares)
  - Energia elétrica
  - Caldeiras de recuperação

Funcionamento básico

O calor liberado na combustão é carregado pelos gases a altas temperaturas sendo transferido por troca térmica para a água que é aquecida e transformada em vapor.

Caldeiras - Classificação

Pela norma NR-13:

- Categoria A
  p > 20 kgf/cm^2 (1960 kPa)
- Categoria B
  p < 20 kgf/cm^2 (1960 kPa)
- Categoria C
  p < 6 kgf/cm^2 (588 kPa) e volume interno inferior a 100 litros

Caldeiras – Classificação informal

- Baixa pressão

  até 15 kgf/cm^2

- Média pressão

  de 15 a 50 kgf/cm^2

- Alta pressão

  acima de 50 kgf/cm^2

Tipos construtivos

- Flamotubular (fogotubular ou tubos de fumaça)
  - Água por fora dos tubos
  - Gases da combustão por dentro dos tubos
- Aquotubular (ou tubos de água)
  - Água por dentro dos tubos
  - Gases da combustão por fora dos tubos
- Mista: parte aquotubular (fornalha) e outra parte flamotubular

Normas para caldeiras

Normas de projeto e fabricação:

- No Brasil a norma mais adotada é o código ASME seção I da American Society of Mechanical Engineers
- ABNT: NB 227 Código para projeto e construção de geradores de vapor estacionários

Seções do código ASME

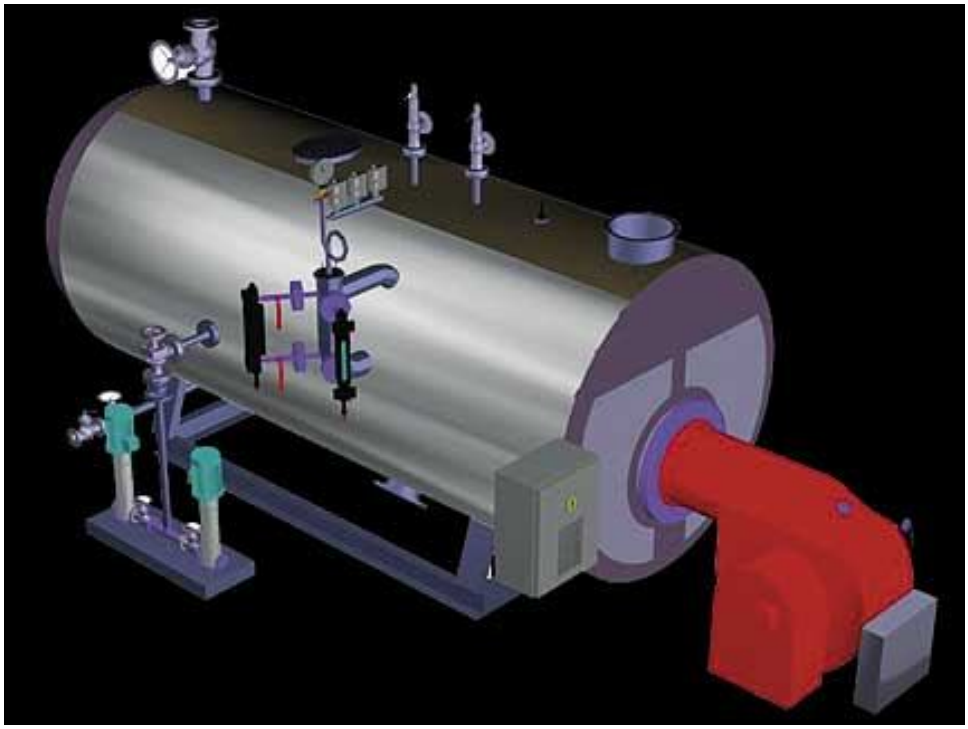
I. Power Boilers
II. Materials
III. Rules for Construction of Nuclear Facility Components
IV. Heating Boilers
V. Nondestructive Examination
VI. Recommended Rules for the Care and Operation of Heating Boilers
VII. Recommended Guidelines for the Care of Power Boilers
VIII. Pressure Vessels
IX. ...

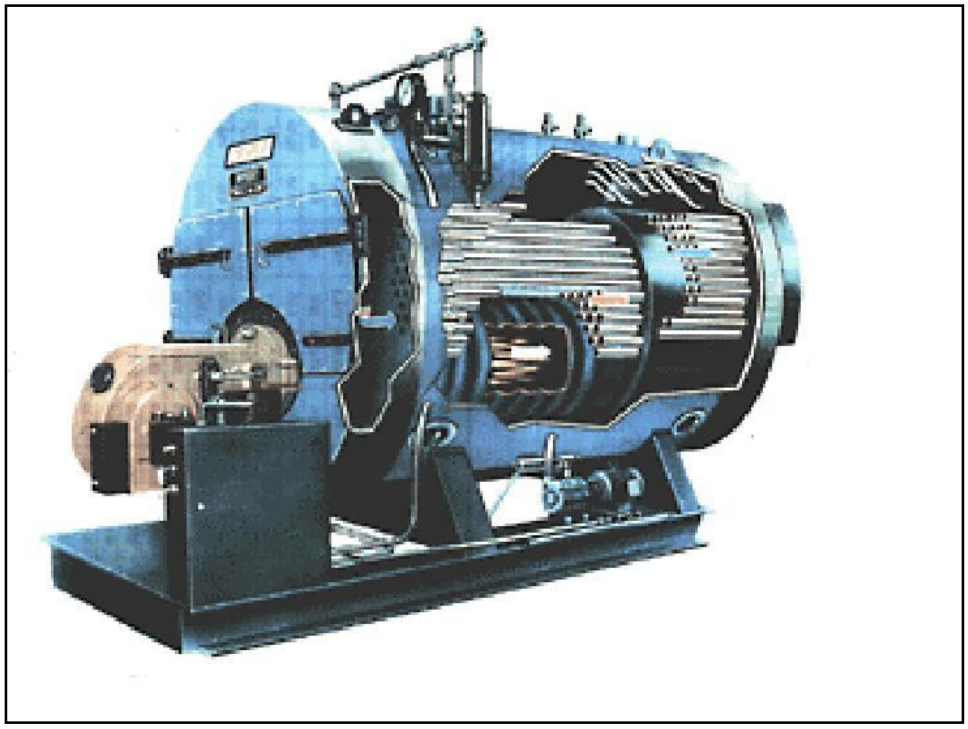
Normas para caldeiras

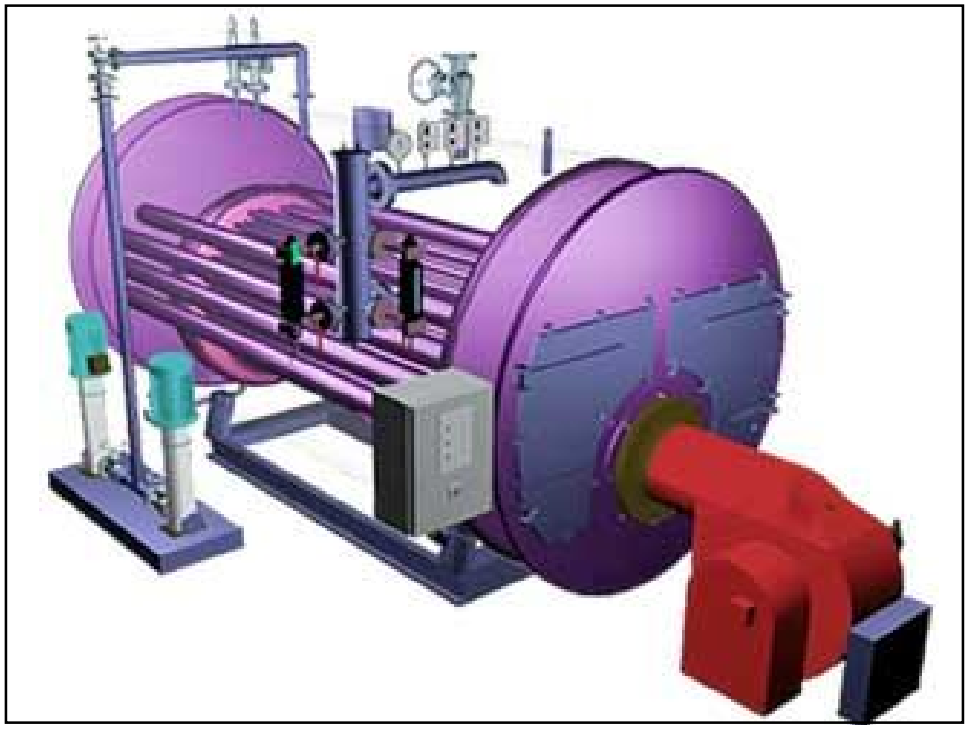
Normas de inspeção:

- NB 12177-1 para caldeiras flamotubulares
- NB 12177-2 para caldeiras aquotubulares


Steamworks



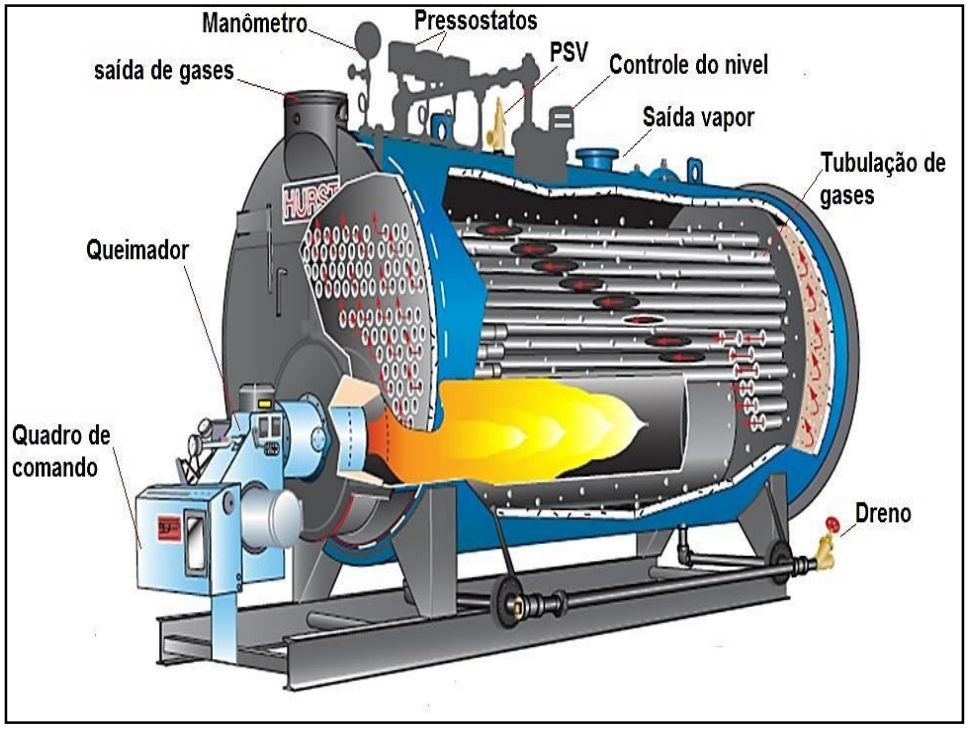


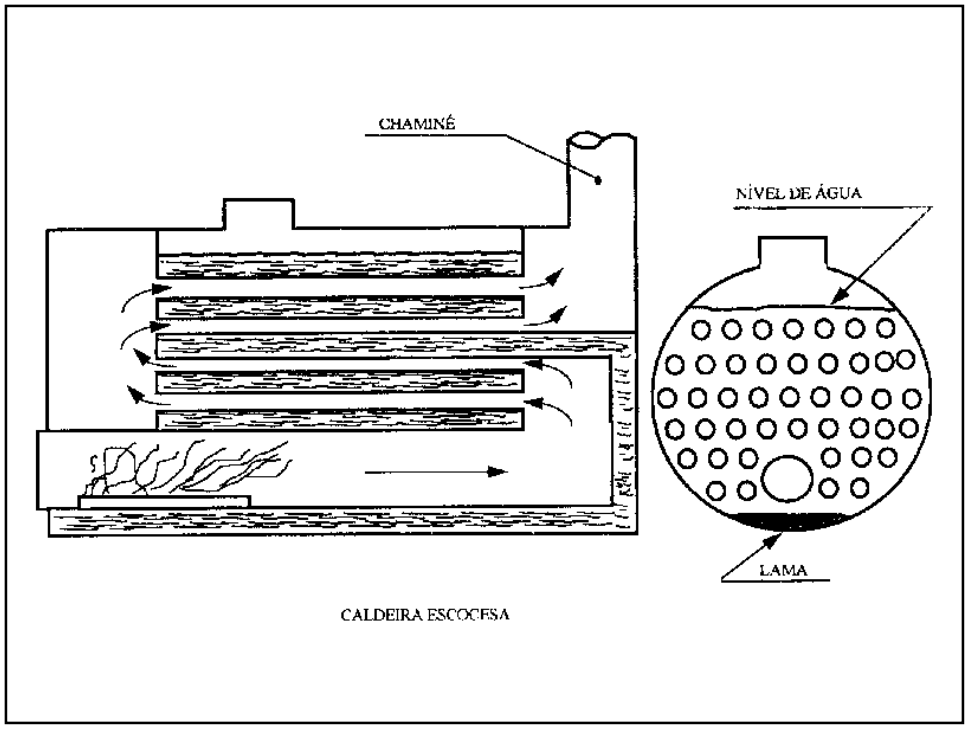



Modelo TERMODUL
Tipo Aguatubular
Tipo de vapor Saturado / Supersaturado
Capacidades 10 a 50 t vapor/h
Presión de trabajo Asi 42 kg/cm²
Temperatura de vapor supersaturado Asi 400° C
Combustibles Gas-oil / o Gas

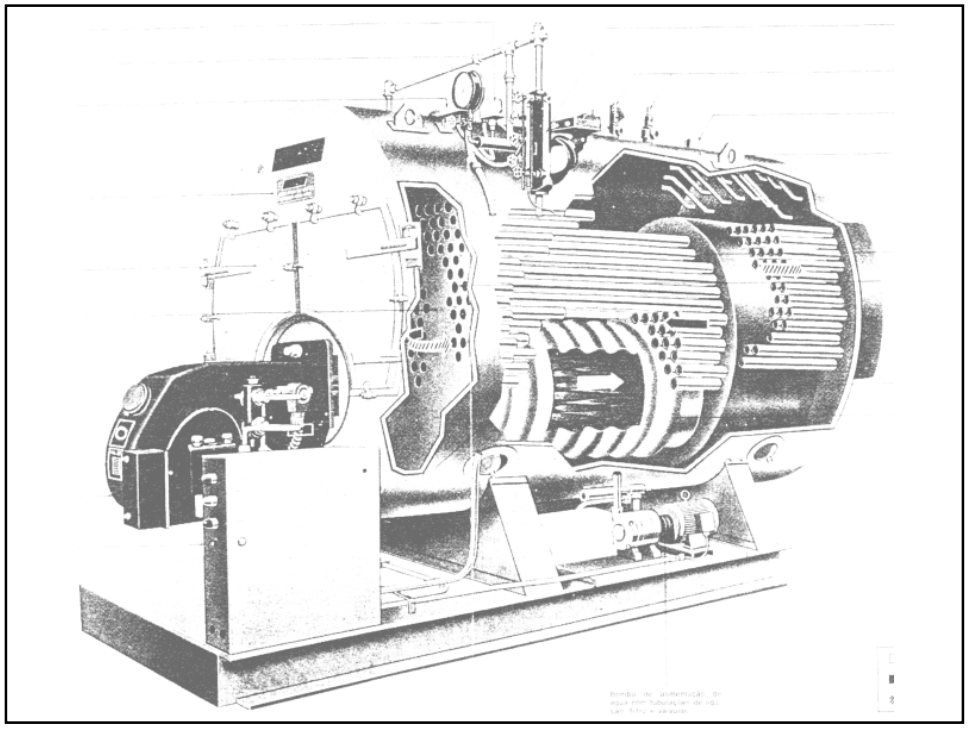
Caldeiras Flamotubulares

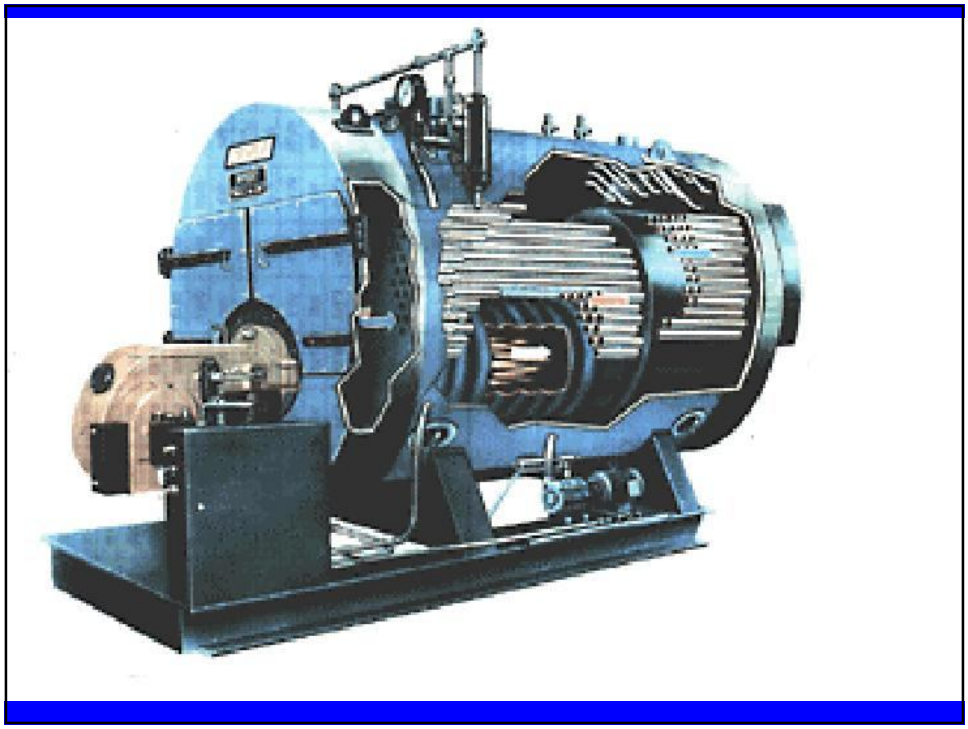
- Partes constituintes principais
  - Corpo (casco ou carcaça)
  - Espelhos
  - Fornalha / queimador / tubo fornalha
  - Feixe tubular
- Funcionamento

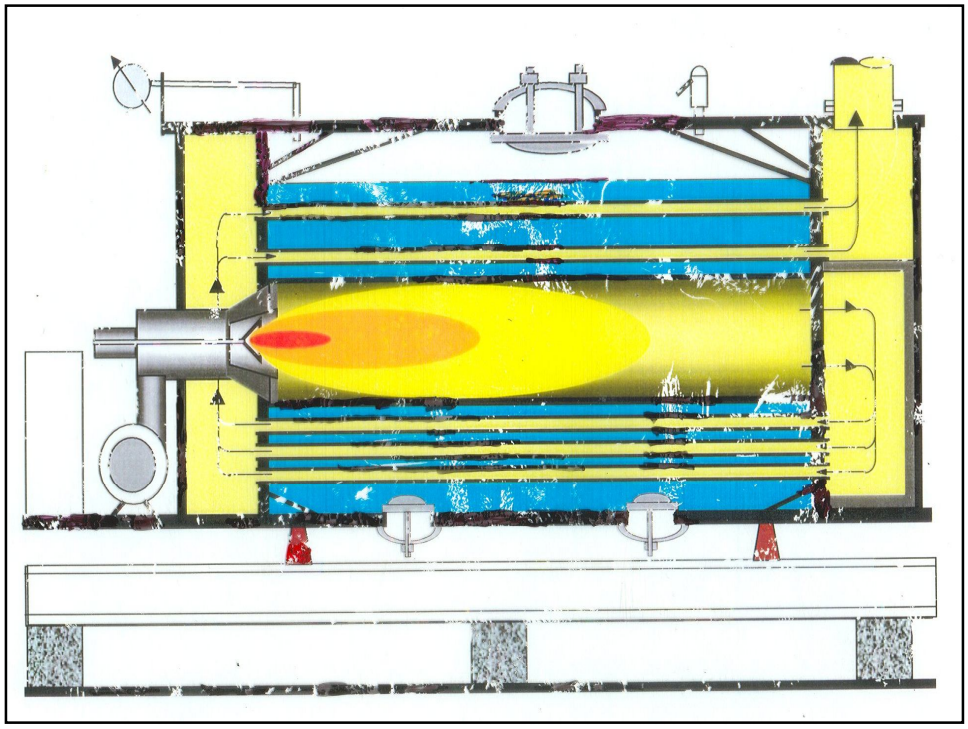


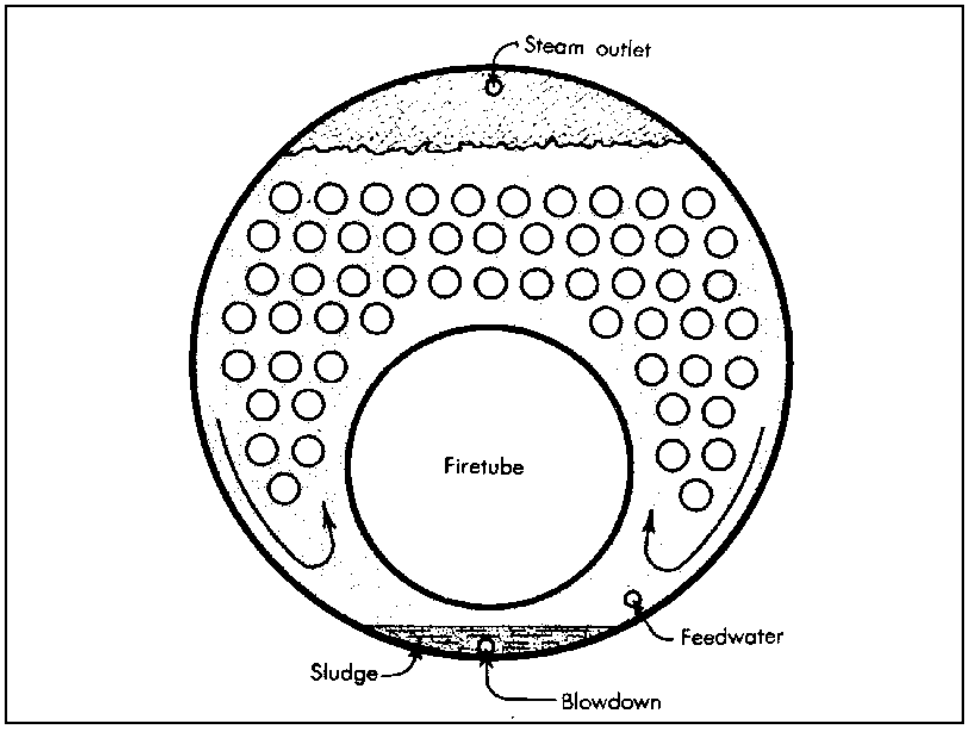


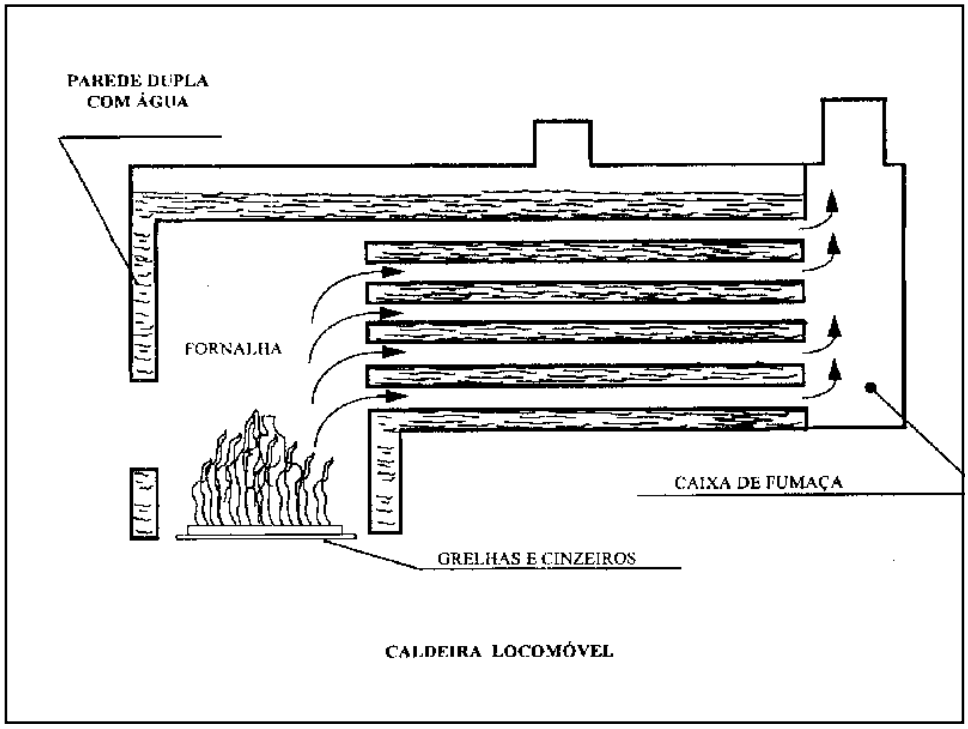
CALDEIRA ESCOCESA



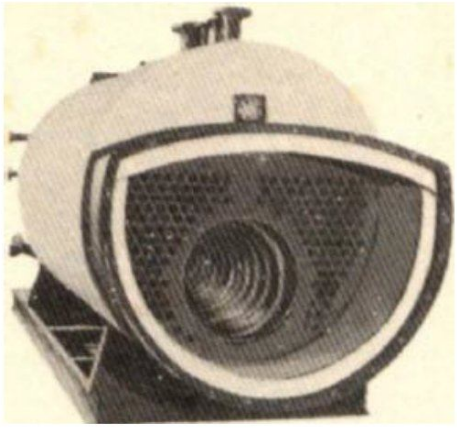


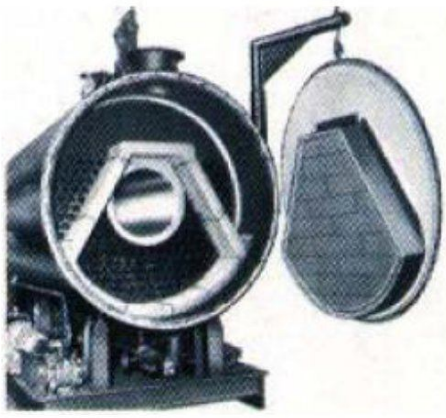



Steam outlet
Firetube
Feedwater
Sludge
Blowdown



CALDEIRA LOCOMÓVEL



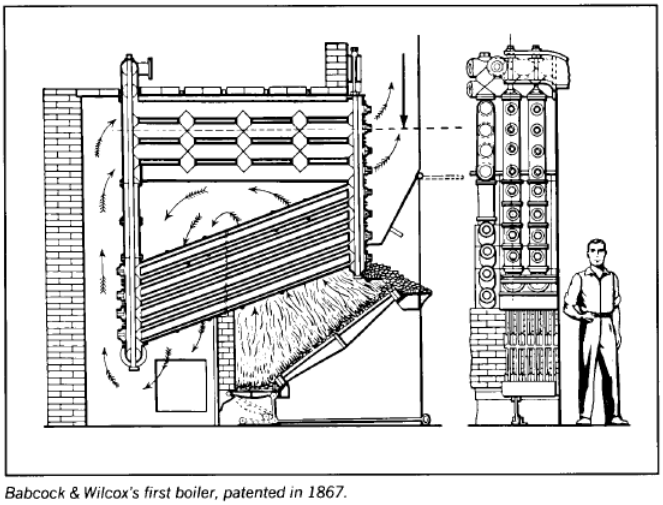


Caldeiras Aquotubulares

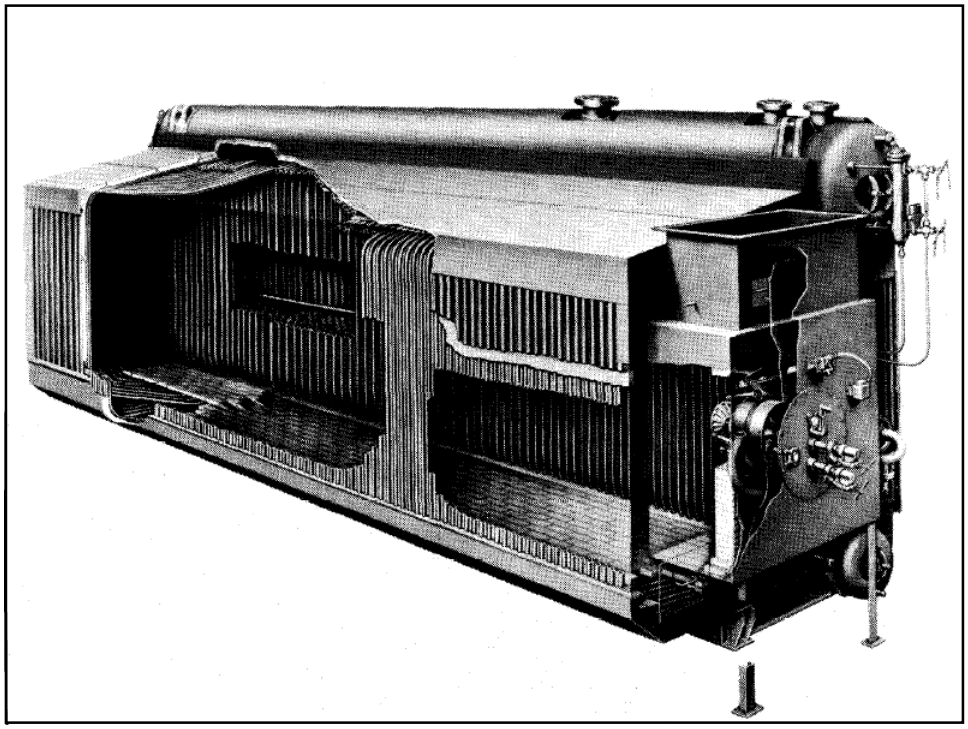
- Partes constituintes principais
  - Fornalha / queimadores / paredes de água
  - Tubulão superior (de vapor)
  - Tubulão inferior
  - Feixe tubular
- Podem possuir também
  - Superaquecedor
  - Economizador (pré-aquecedor de água)
  - Aquecedor de ar

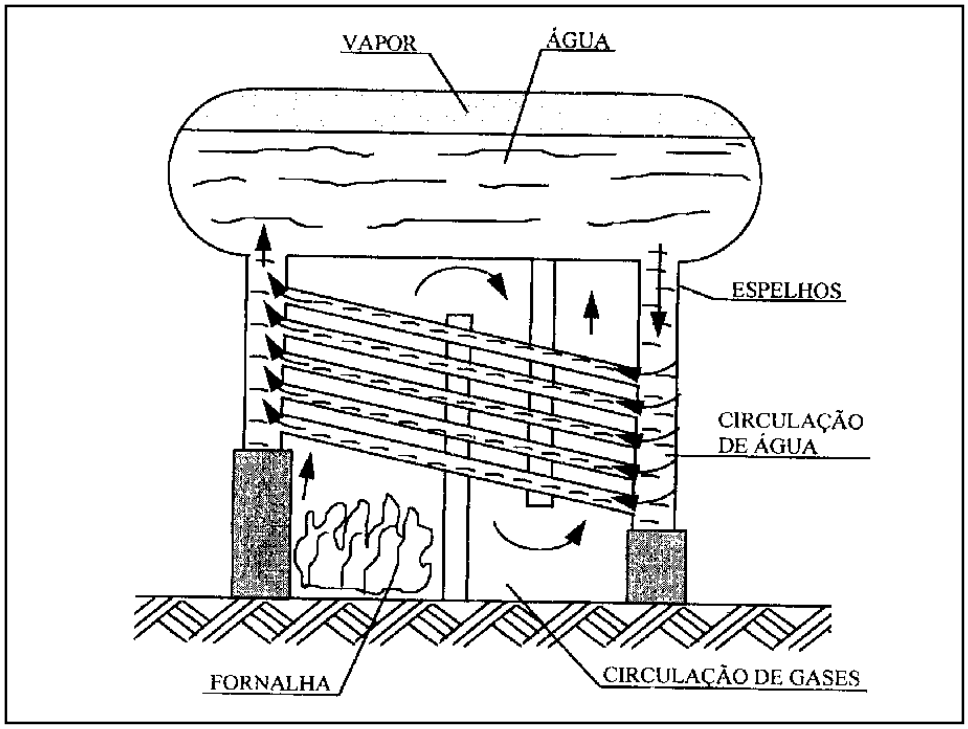
History

Since its founding in 1867, Babcock & Wilcox has been an acknowledged leader in the steam generation business. The most dependable utility and industrial boilers being built today, continuously satisfying the worldwide need for steam, evolved from Stephen Wilcox's early water-tube safety boiler patents. This outstanding record is due to the fact that the name Babcock & Wilcox has always been--and will continue to be--synonymous with quality, dependability and service.



Babcock & Wilcox's first boiler, patented in 1867.




VAPOR
ÁGUA
ESPELHOS
CIRCULAÇÃO
DE ÁGUA
FORNALHA
CIRCULAÇÃO DE GASES


acities,
d PFM boilers that
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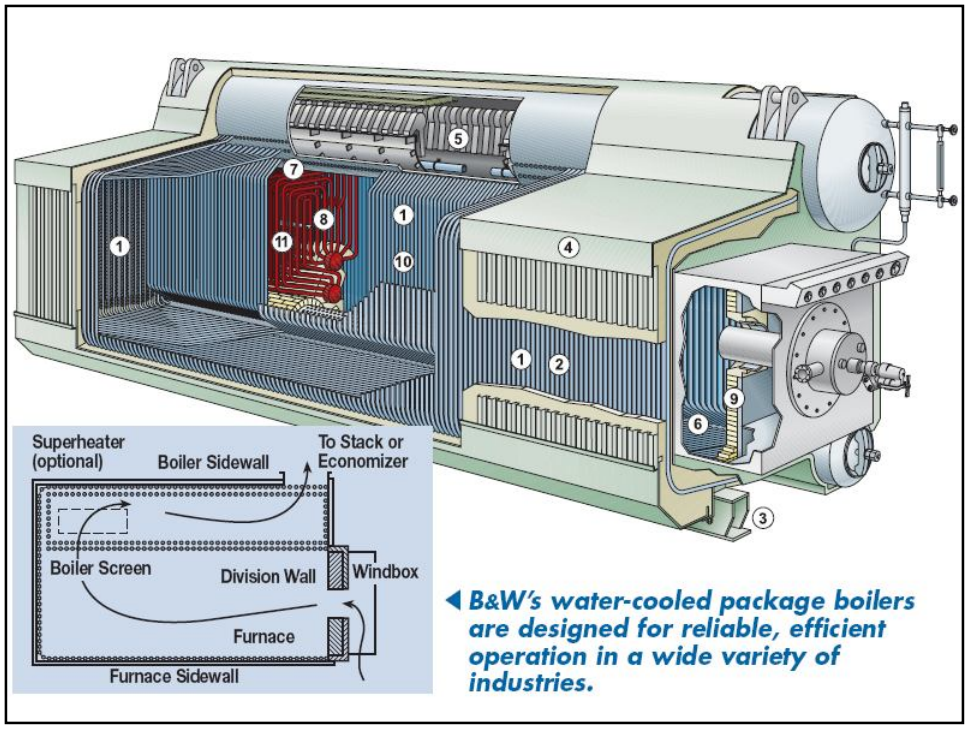
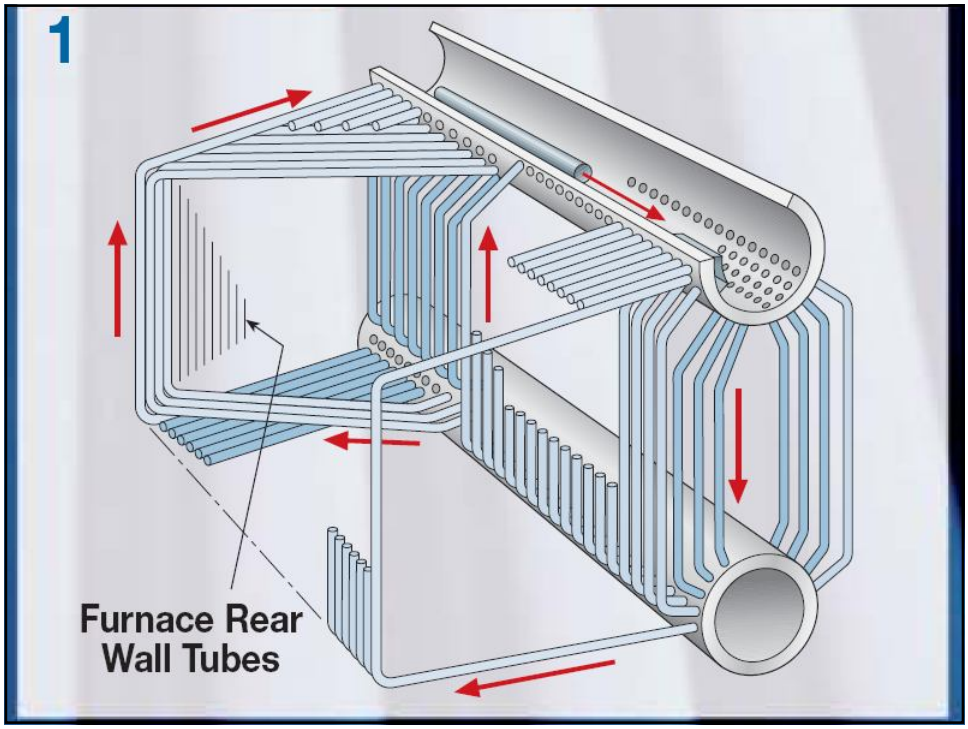
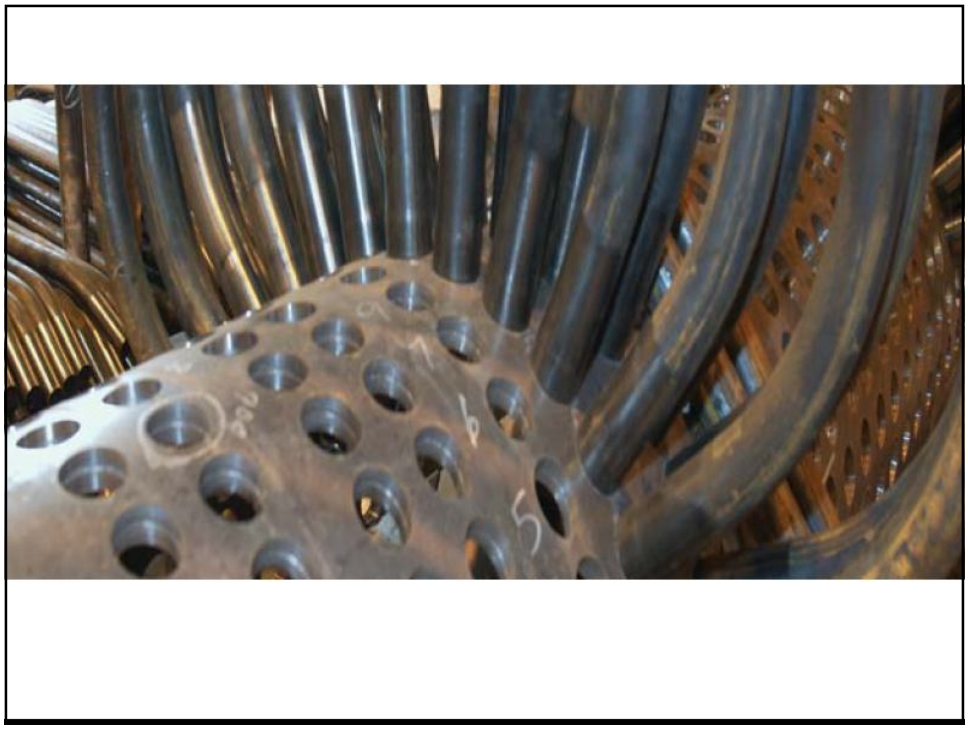
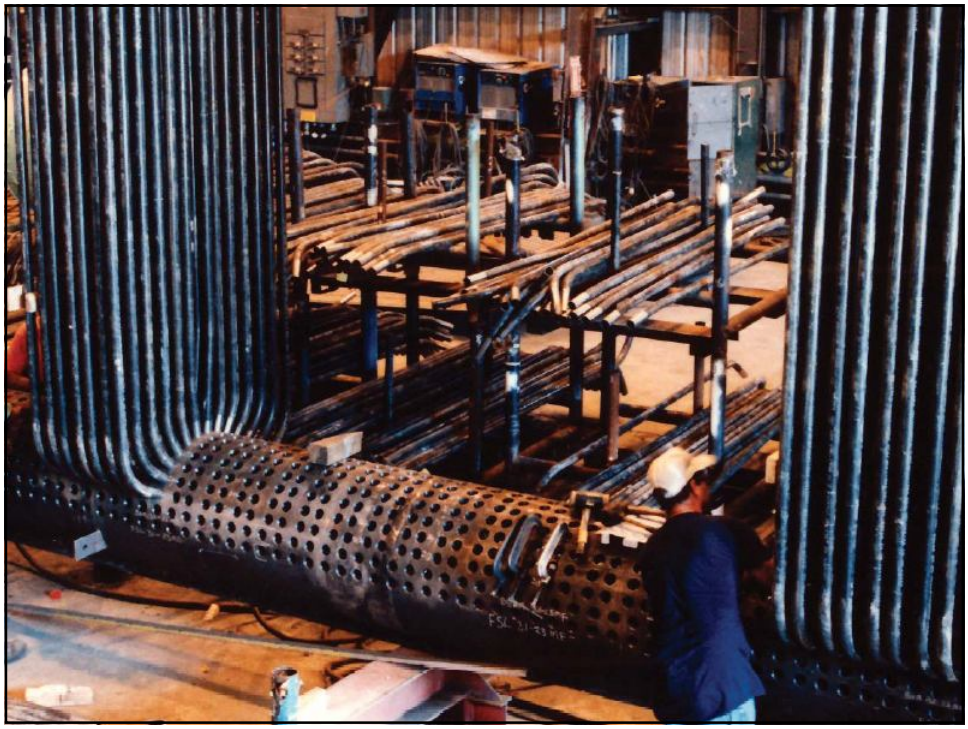
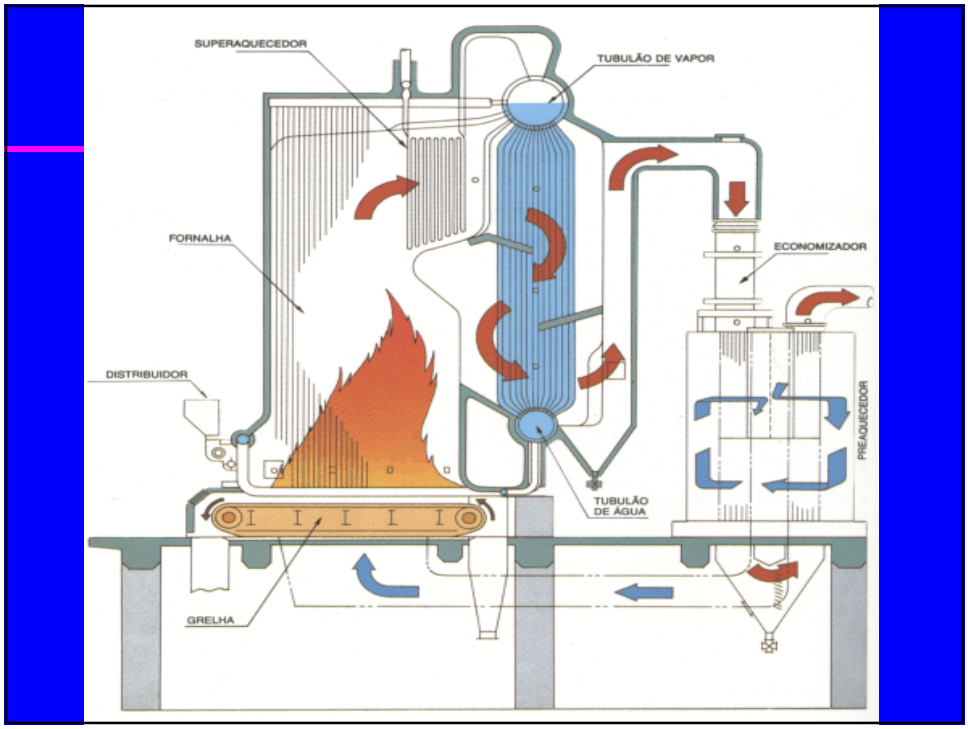


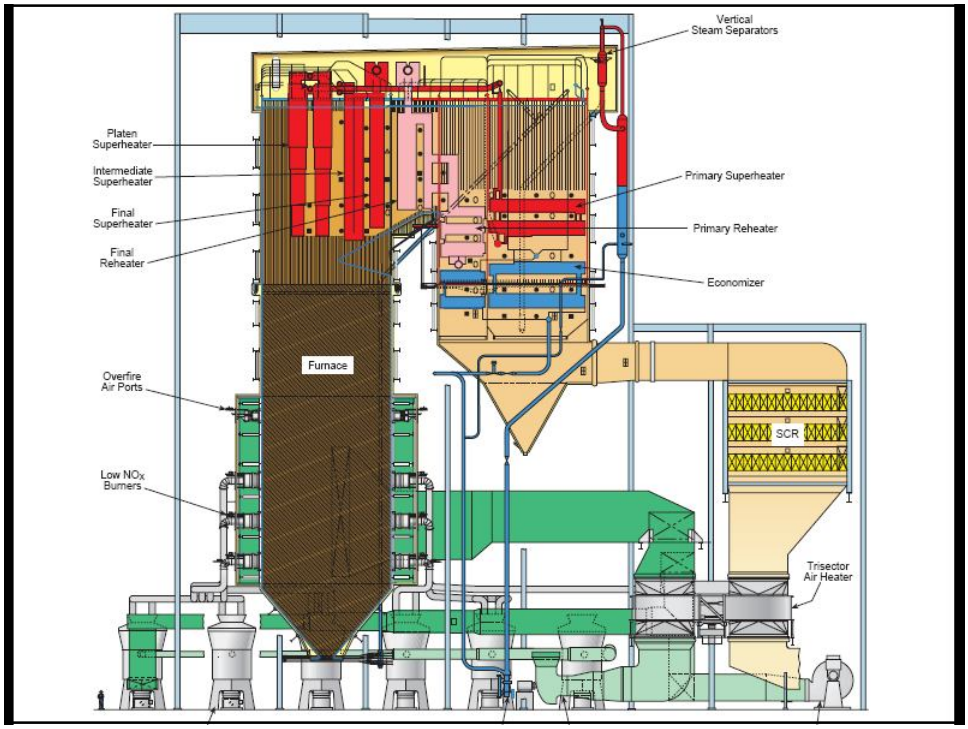
◀ *B&W's water-cooled package boilers are designed for reliable, efficient operation in a wide variety of industries.*

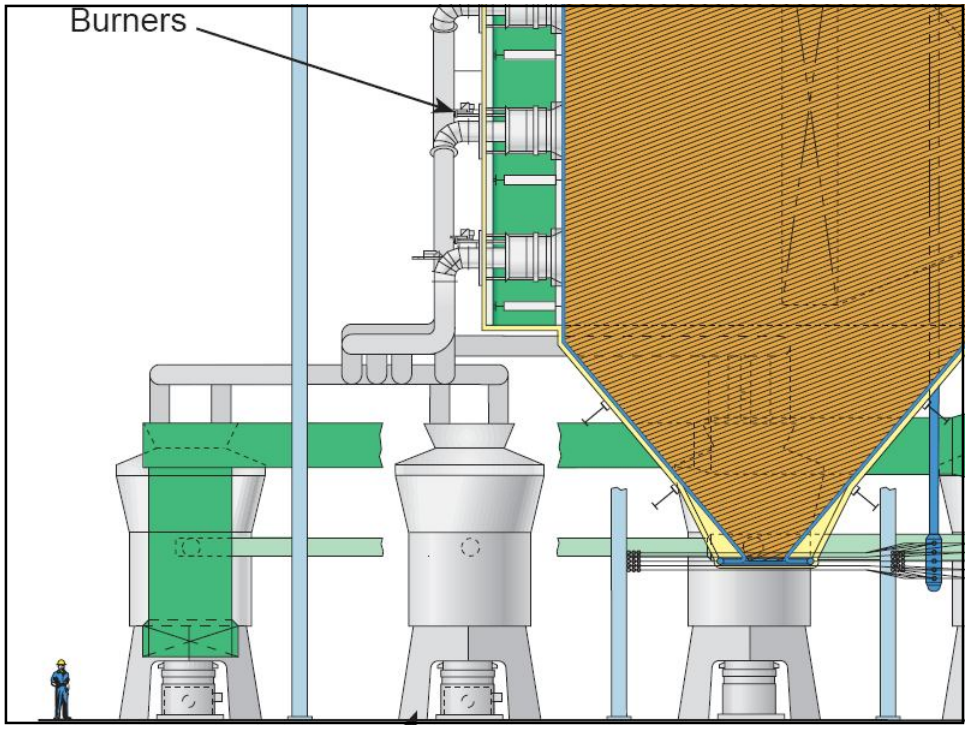

1
Furnace Rear
Wall Tubes

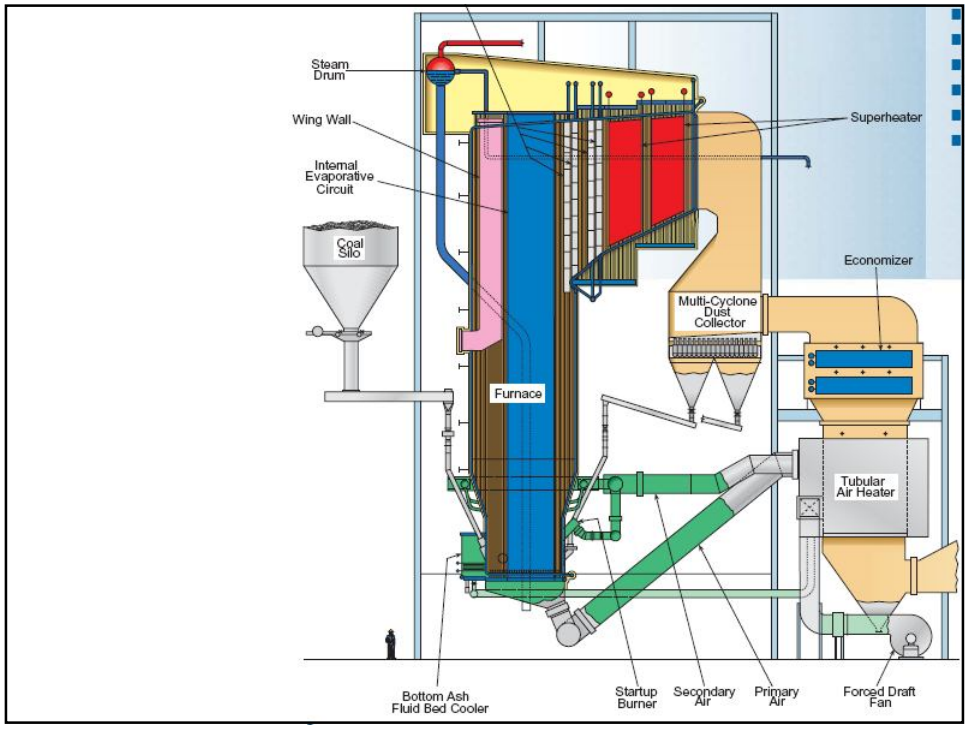


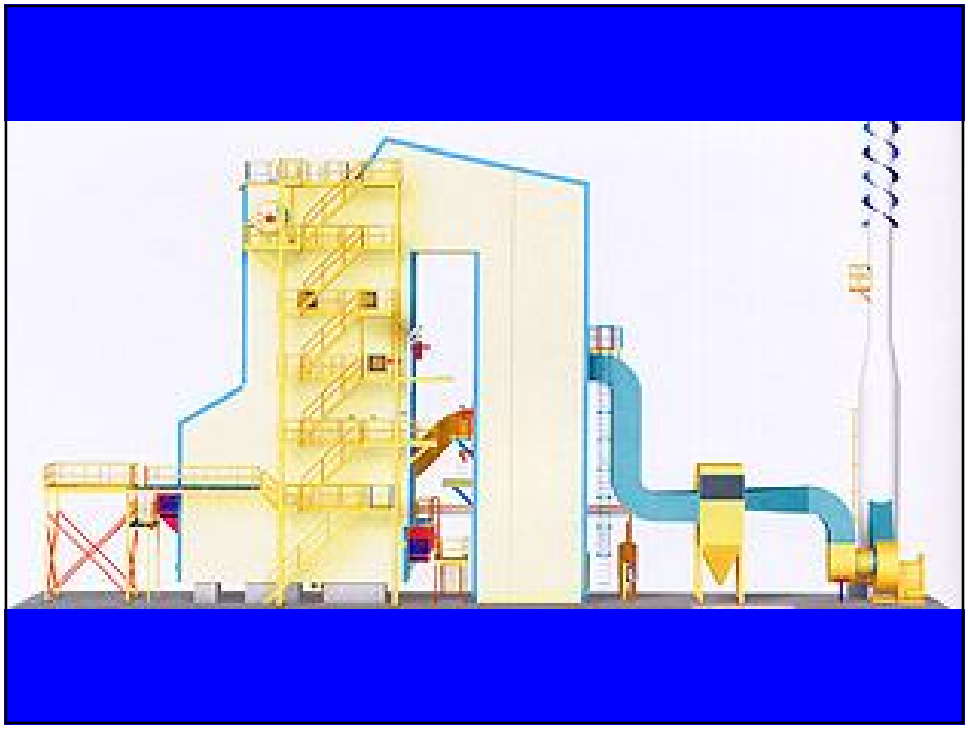


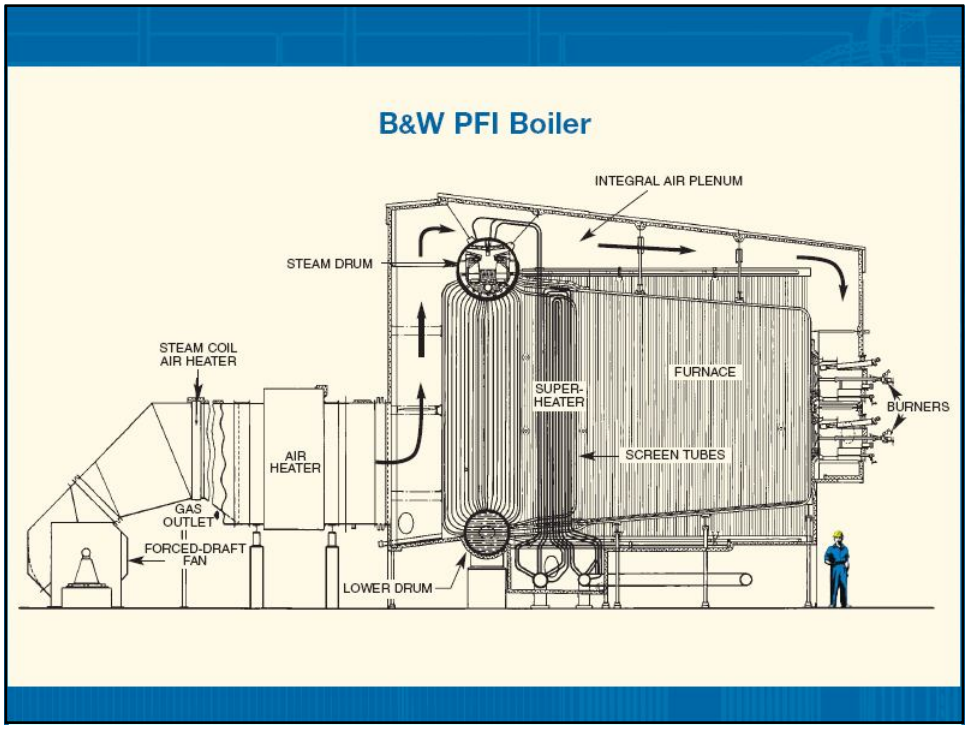

SUPERAQUECEDOR
TUBULÃO DE VAPOR
FORNALHA
ECONOMIZADOR
DISTRIBUIDOR
PREAQUECEDOR
TUBULÃO DE ÁGUA
GRELHA

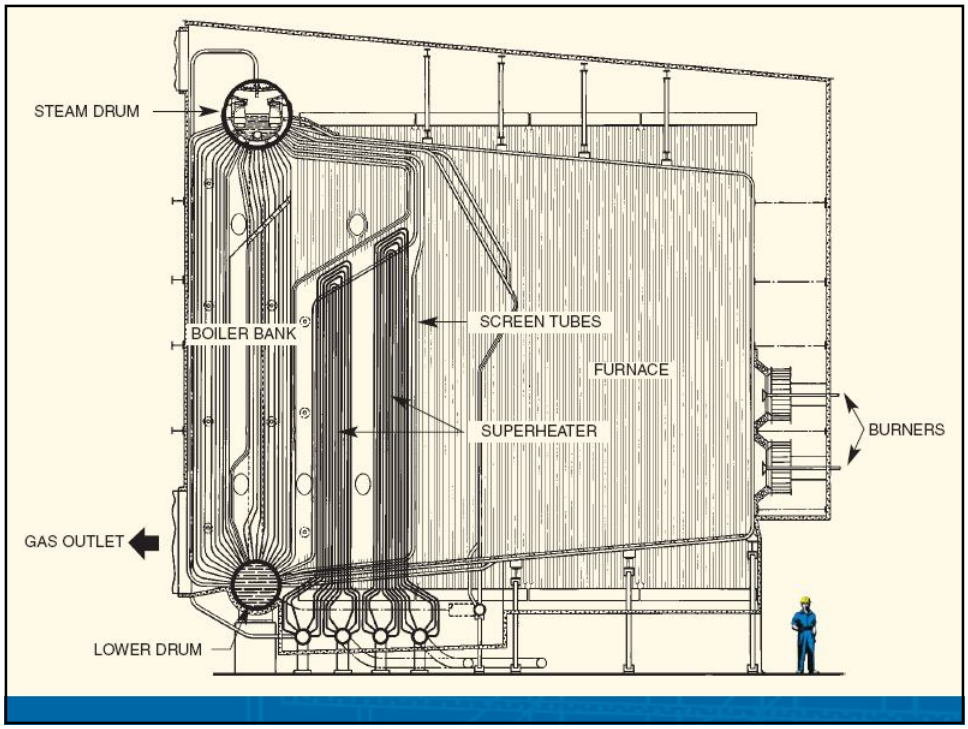

Vertical
Steam Separators
Platen
Superheater
Intermediate
Superheater
Final
Superheater
Final
Reheater
Primary Superheater
Primary Reheater
Economizer
Furnace
Overfire
Air Ports
Low NOx
Burners
SCR
Trisector
Air Heater


Burners


Steam Drum
Wing Wall
Internal Evaporative Circuit
Coal Silo
Superheater
Economizer
Multi-Cyclone Dust Collector
Furnace
Tubular Air Heater
Bottom Ash Fluid Bed Cooler
Startup Burner
Secondary Air
Primary Air
Forced Draft Fan




B&W PFI Boiler
INTEGRAL AIR PLENUM
STEAM DRUM
STEAM COIL
AIR HEATER
FURNACE
SUPER-
HEATER
BURNERS
SCREEN TUBES
AIR
HEATER
GAS
OUTLET
FORCED-DRAFT
FAN
LOWER DRUM

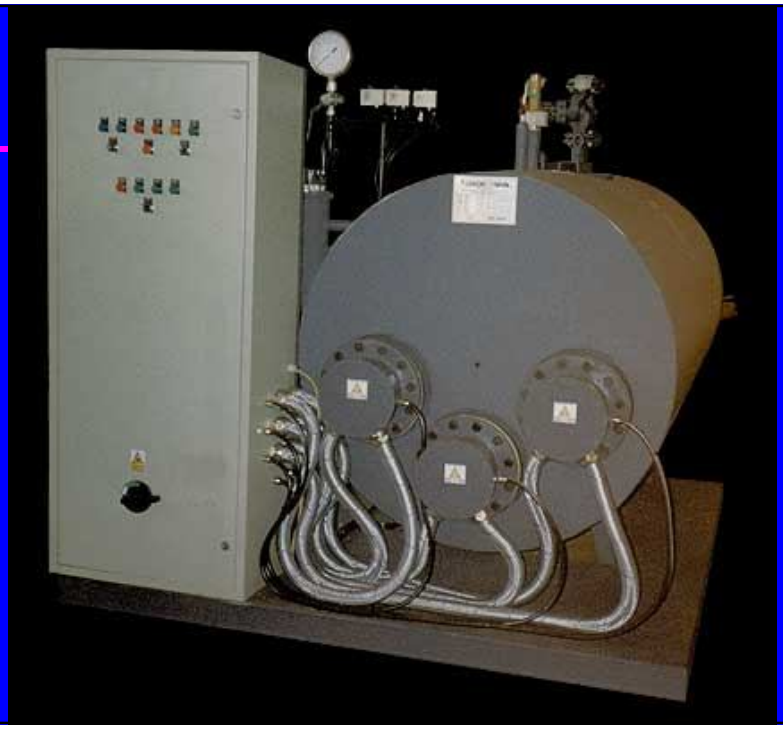

STEAM DRUM
BOILER BANK
SCREEN TUBES
FURNACE
SUPERHEATER
BURNERS
GAS OUTLET
LOWER DRUM

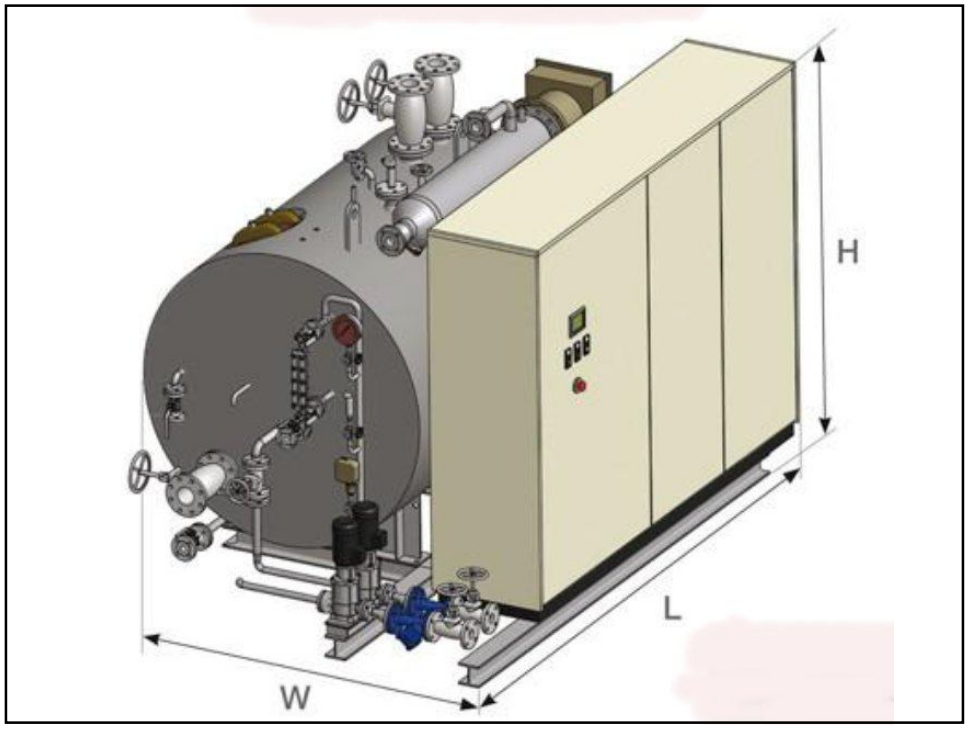
Caldeiras Elétricas

Funcionam por efeito Joule: conversão de energia elétrica em calor por circulação de corrente em um meio condutor de eletricidade

Tipos:

- Resistência
- Eletrodo submerso
- Jato de água (ou cascata)




H
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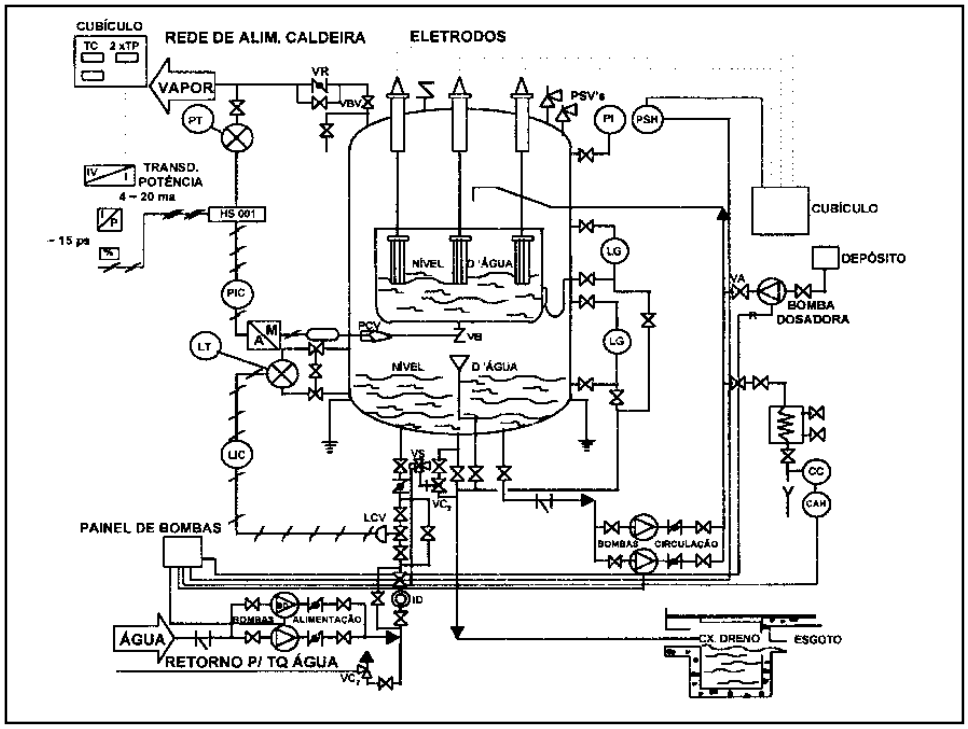
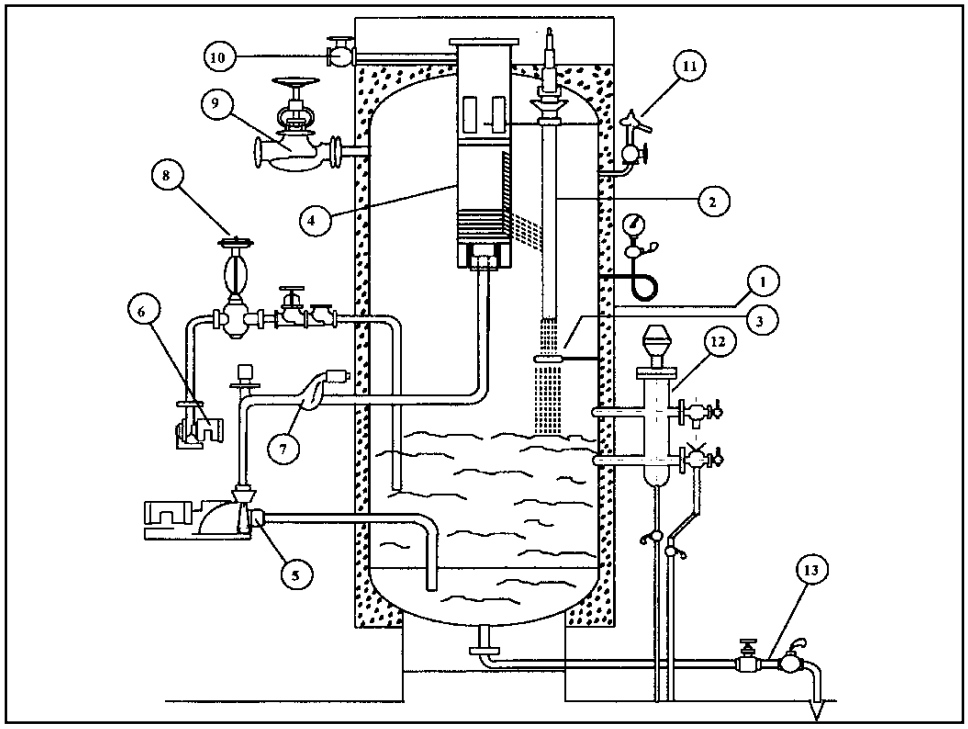

CUBÍCULO
TC 2 xTP
REDE DE ALIM. CALDEIRA
ELETRODOS
VAPOR
VR
VBV
PT
PSV's
PI
PSH
TRANSD. POTÊNCIA
4 – 20 ma
HS 001
- 15 ps
CUBÍCULO
DEPÓSITO
NÍVEL D 'ÁGUA
LG
VA
BOMBA DOSADORA
PIC
M
A
PCV
VB
LT
NÍVEL D 'ÁGUA
LIC
VS
CC
CAH
PAINEL DE BOMBAS
LCV
BOMBAS CIRCULAÇÃO
ID
BOMBAS ALIMENTAÇÃO
ÁGUA
RETORNO P/ TQ ÁGUA
CX DRENO
ESGOTO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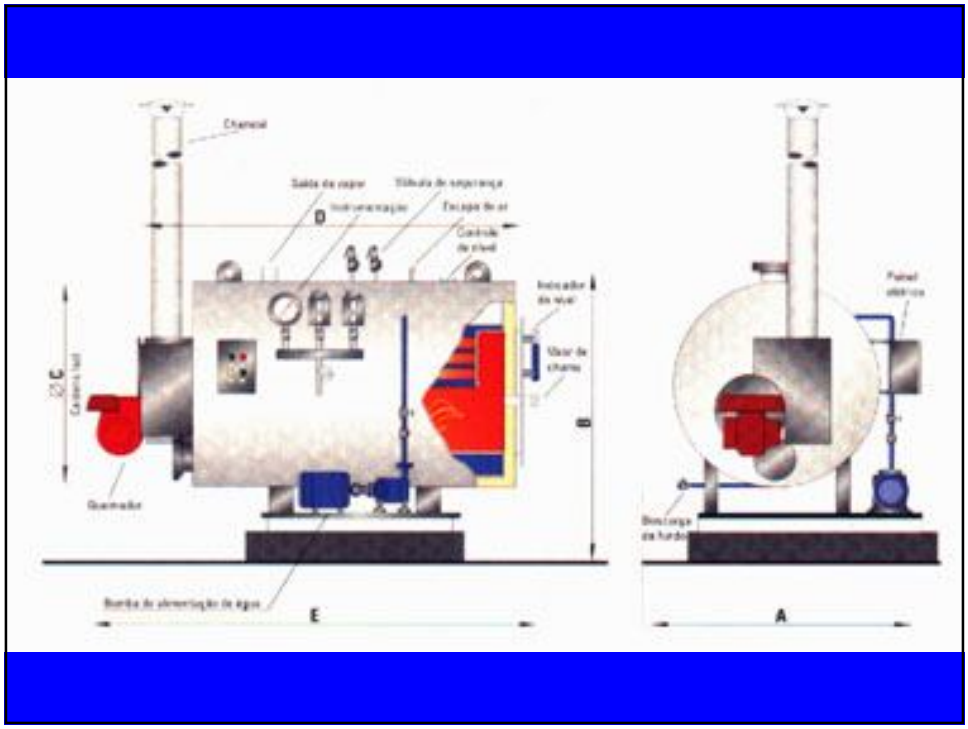
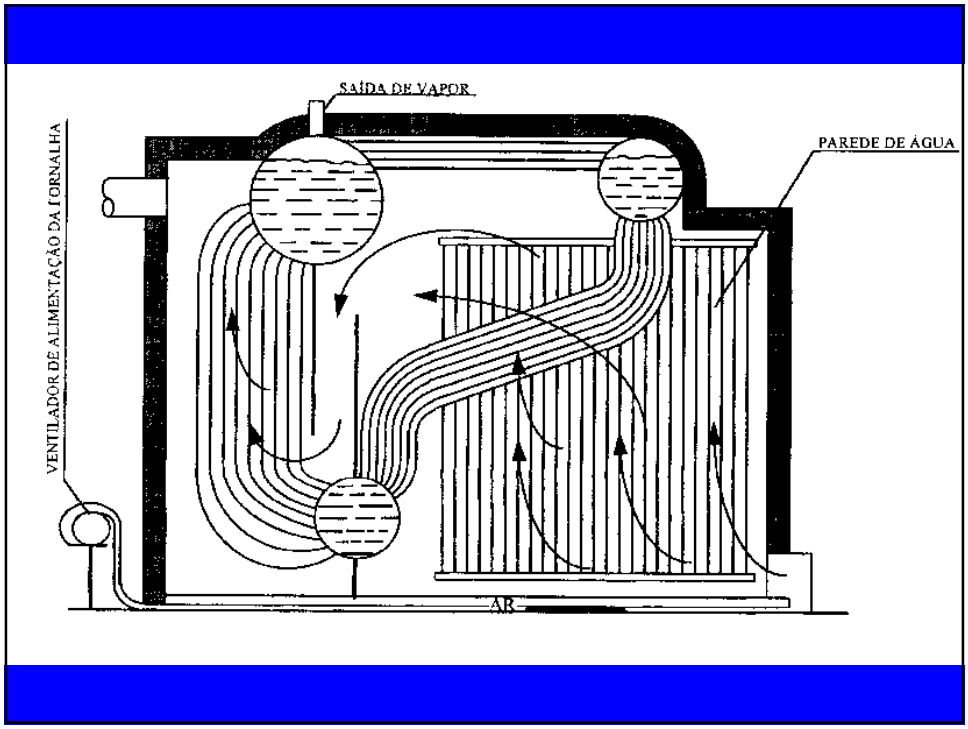
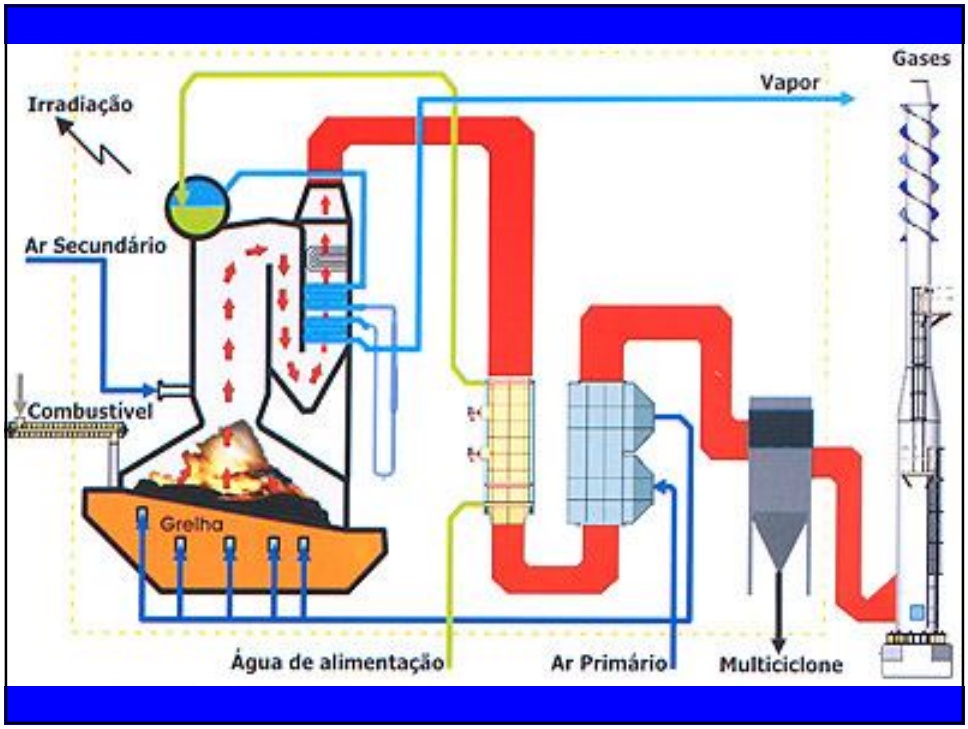
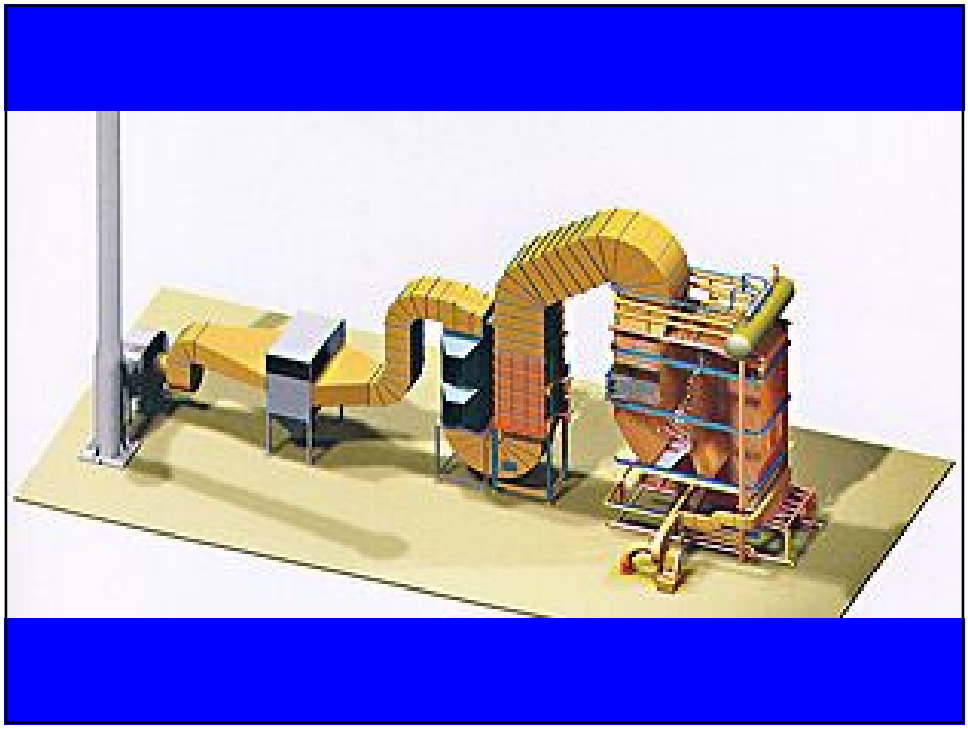
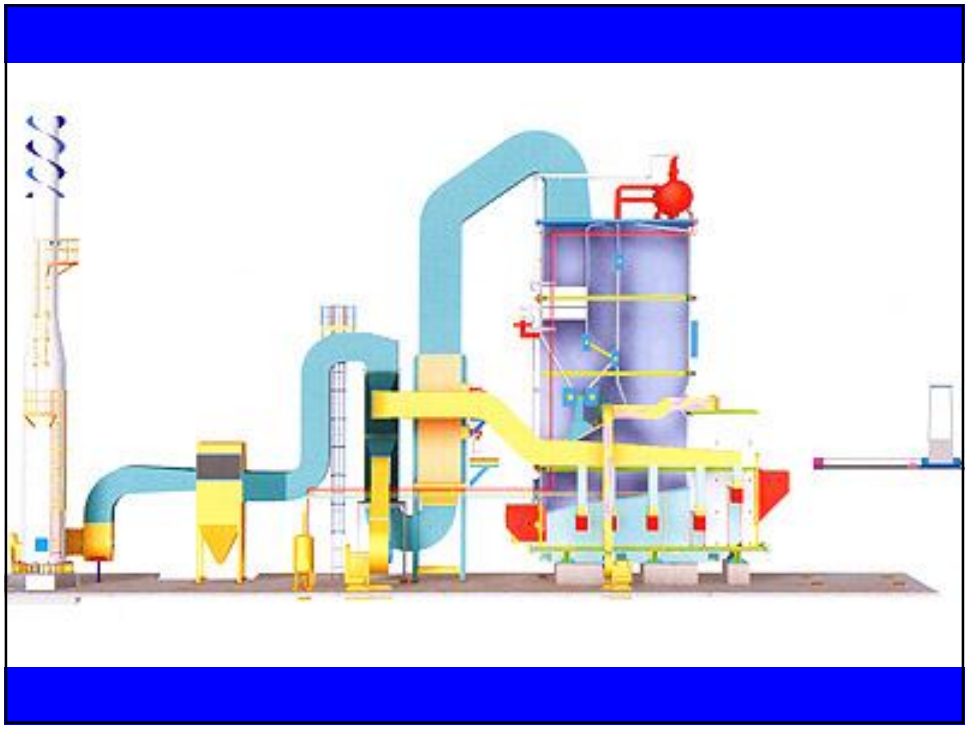

Chaminé
Saída de vapor
Válvula de segurança
Instrumentação
Escape de ar
Comando de nível
Indicador de nível
Visor de chama
Painel elétrico
Queimador
Descarga de fundo
Bomba de alimentação de água
D
E
A

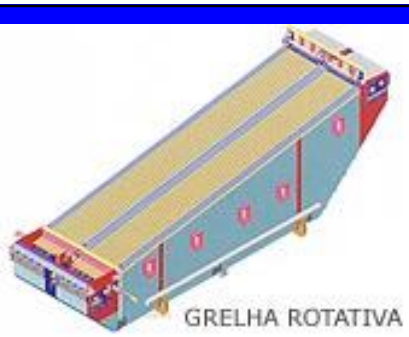

SAÍDA DE VAPOR
PAREDE DE ÁGUA
VENTILADOR DE ALIMENTAÇÃO DA FORNALHA
AR


Gases
Vapor
Irradiação
Ar Secundário
Combustivel
Grelha
Água de alimentação
Ar Primário
Multiciclone

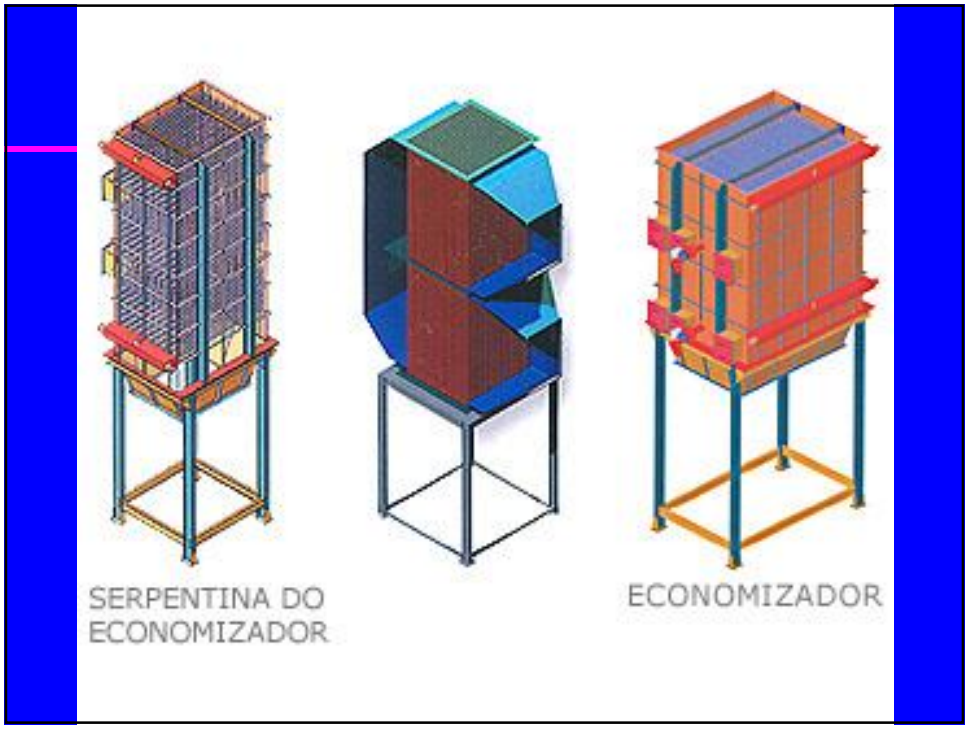


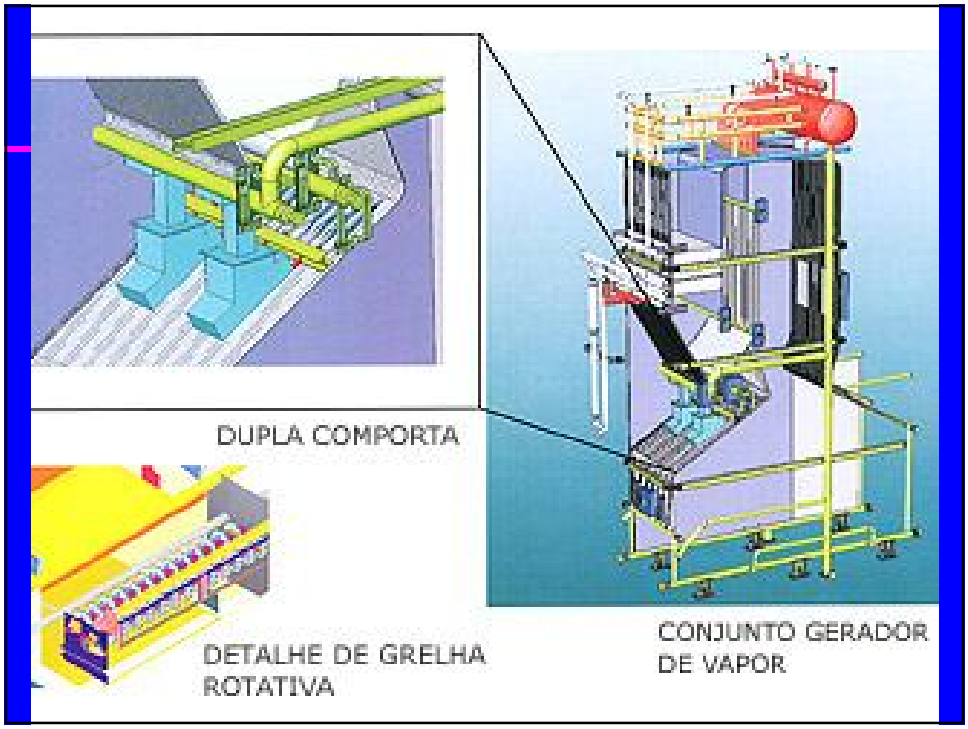


CONJUNTO DE ALIMENTAÇÃO
AUTOMÁTICA DE CAVACO E SERRAGEM.



GRELHA ROTATIVA


SERPENTINA DO
ECONOMIZADOR
ECONOMIZADOR


DUPLA COMPORTA
DETALHE DE GRELHA
ROTATIVA
CONJUNTO GERADOR
DE VAPOR


Desaerador


BREMER