

جهاز شؤون البيئة
المشروع المصرى للحد من التلوث

دليل الرصد الذاتى
وحدات توليد الطاقة

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(EPAP)

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○ (GIM EPAP,)

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○ :

○ ○ ()
○ ○ ○ (Shell-type boiler)

○ ○

○ ○ ○ ○ ○
(hot water heating boilers)

○ ○

○) ○

○ ○ (hot-water boiler) " "

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○ (steam generator) " "

$$\tilde{O} \quad (\tilde{O} \quad \tilde{O})$$
$$\tilde{O} \quad \tilde{O} \quad \tilde{O}$$

(A-)

$$\tilde{O} \quad \tilde{O}$$
$$\tilde{O} \quad \tilde{O}$$

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Load flow for heat

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$$\tilde{O} \quad \tilde{O} \quad \tilde{O}$$

(A-)

(A-)

(B)



\bar{O}

\bar{O} \bar{O} \bar{O} (mass transfer)
 \bar{O}

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\bar{O} \bar{O}
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(Fire tube or shell)

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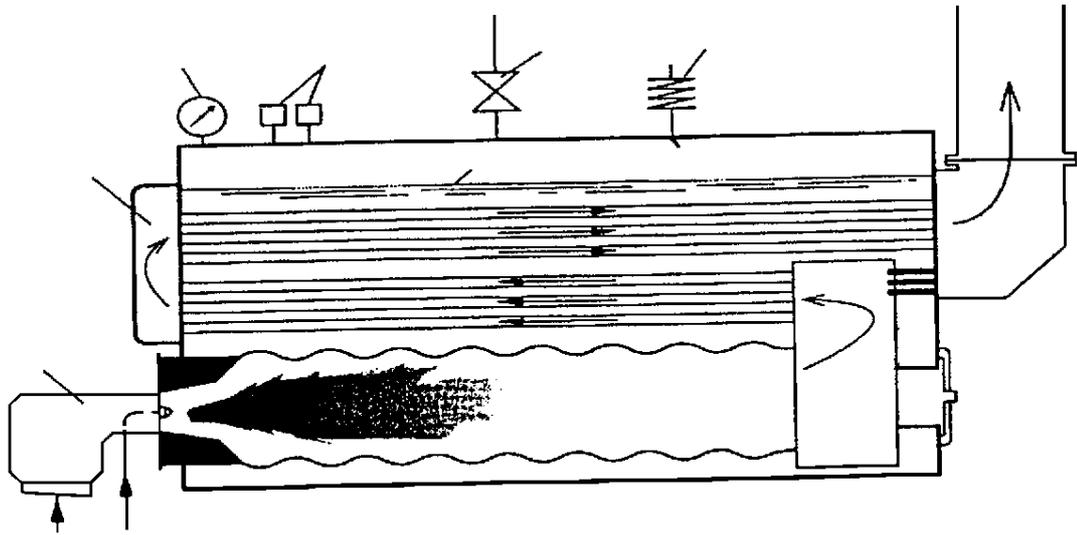


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- :
- (shop-assembled) () •
 - (modular) •
 - (site assembled) •
-

: (Fire-tube boiler)

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○ ()
 (flame tube)
 ○ ○ ○ ○ ○ ○
 ○ ○ ○ ○ ○ ○
 ○ ○ ○ ○ ○ ○



(-)

(Three-P Fire-Tube Boiler)

○ ○ ○

(Horizontal-return-tubular)

(locomotive firebox-

(fire box)

○ ○

(type

(Scotch-marine) ()

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Ö (pressure vessel)

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Ö Ö Ö (Babcock & Wilcox)

Ö :

(wet and dry- back furnace) Ö Ö

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Ö (three-pass boilers) () :

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(corrugating) (

(stiffening flanges) (

(stay bolts) (

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Ö (heat-release) Ö

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○ ○ . (T)

(S) (P)
○ ○ ○ . (T) (D)
○ ○ .

(○ ○) ○ . (-)

○ ○ (Baffles)
○
○

(working pressure)

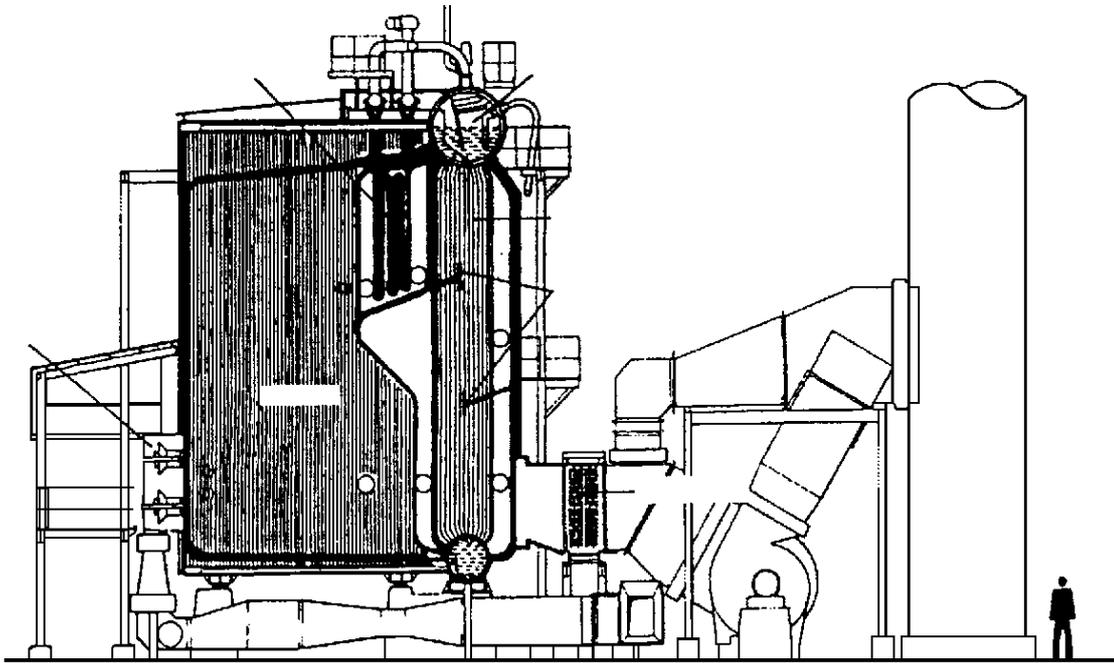
○ ○ ○
○
○ ○ ○
○ ○ ○
○ ○ ○
○ (multi-drum boilers)

. (mud drums)

○ ○
○
○ ○ ○ (water-walls)
○ (header)

○ ○ ○ ○ ○
○ (convection bank)

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(tangent tubes) " " :

. (welded walls) " " :

(economizers)

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0 0
0 0

(-)

(Composite Boiler)

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(convection bank)

(bore tube)

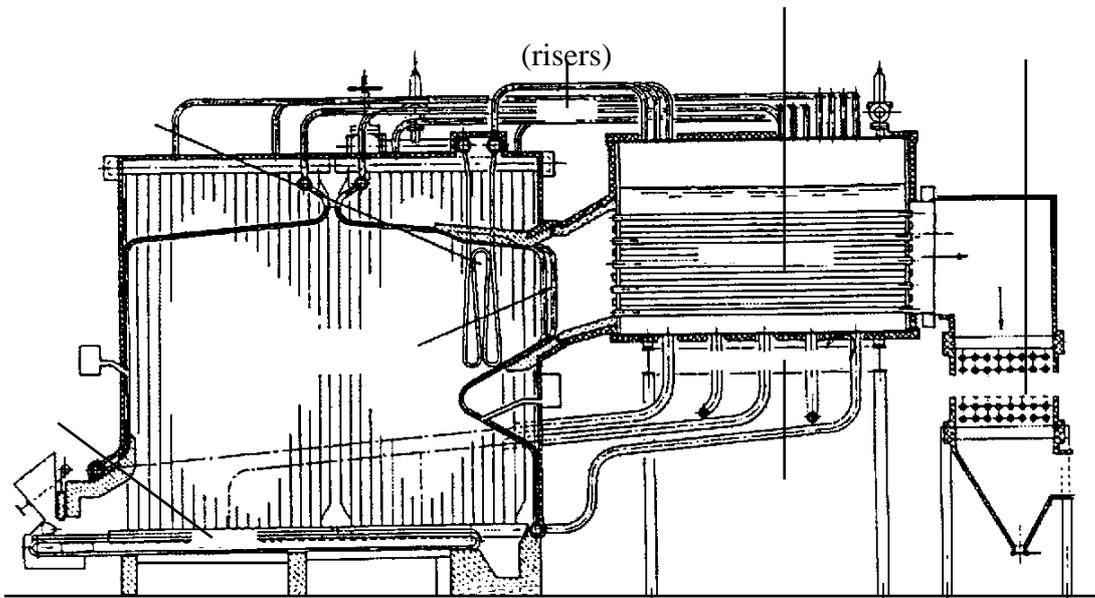
(water walles)

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(steam (disengagement velocity



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:(-)

	ō) - (
ō ō ō	ō ō	
ōō ōō)% - (ō ō ōō (preheater) ōō ō	ōō ōō)% - ō (ō (economizer)	
ō ō ō - ō -	ō ō	

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̃ ̃) ̃ - ((dowtherm

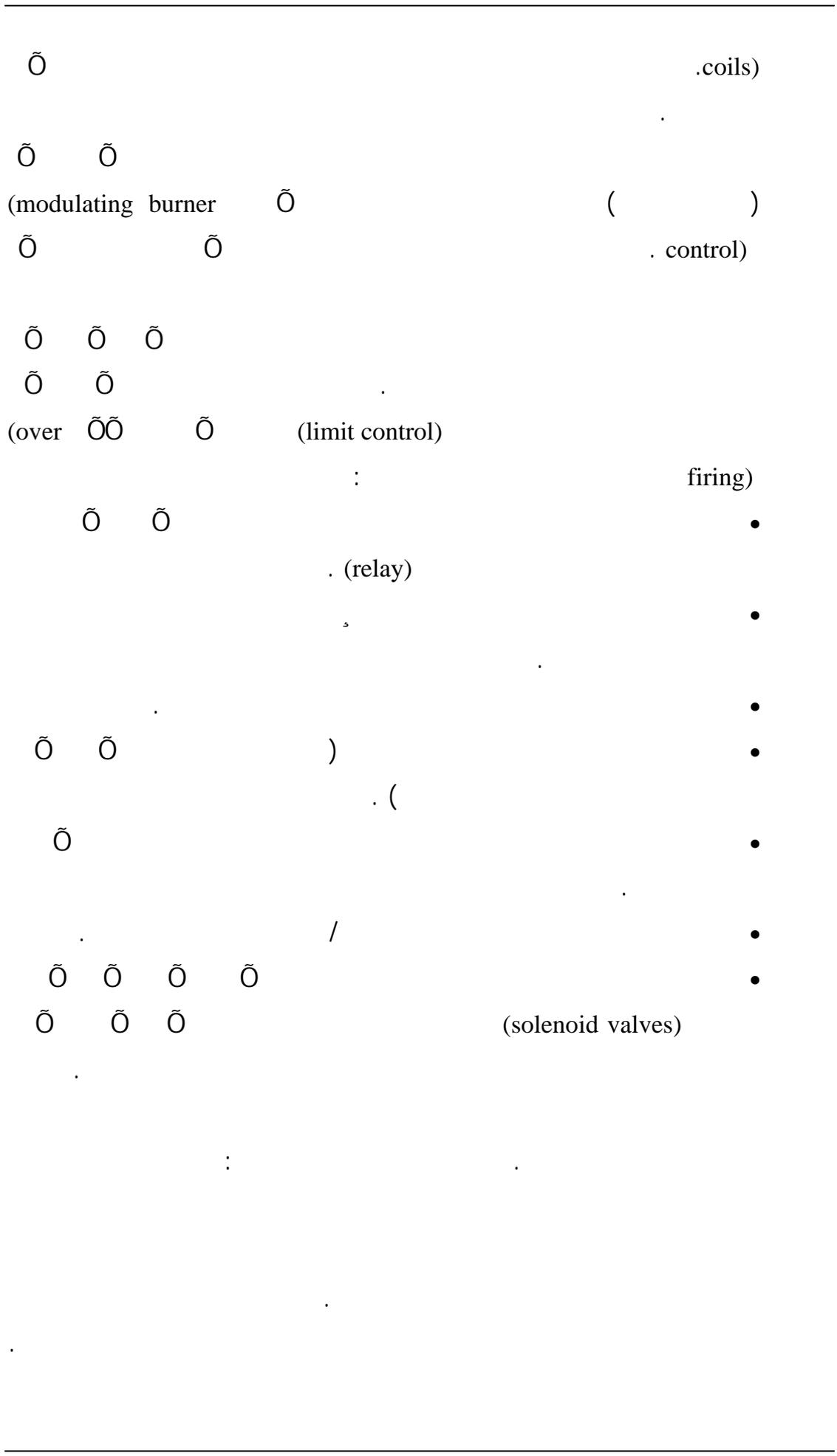
̃ (sub-critical pressure) ̃ ̃
̃ ̃ ̃ ̃
(super-critical pressure)
̃ : ̃ ̃
(reheaters) (superheaters)
(preheaters)

(High-Pressure Process Systems)

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/
(Low-Pressure Steam Systems / Hot-Water Systems)
(bar) ̃ ̃

(Steam-Heating Boiler)

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̃ ̃ ()
(steam ̃ (convectors) (radiators)



(vacuum pump)

(vacuum tank)

(Hot-Water Systems)

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(hot-water-heating system) Ö Ö Ö

Ö (high-temperature hot-water system) Ö

Ö (expansion tanks)

(air Ö

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cushion)

Ö (relief valve) ÖÖ ()

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(dowtherm oils)

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(diphenyl and diphenyl-oxide)

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0 0

(luminosity)

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(rotational speeds)

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(methane)

(heptane)

(ethane)

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(H S)

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% ,

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(pentane)

(butane and propane)

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(refinery gas)

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ō ō (pile burning)

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.(dumping grates)

(static pinhole grates)

.(pneumatic)

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(hoppers)

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ō ō ō

ō (draught fan)

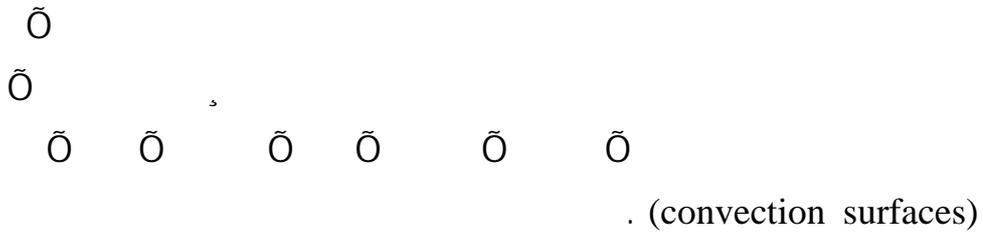
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single-pass convection bank



(soot blowers)

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 : (make up water)

0 0 (scales) •

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(C)

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(ion exchange)
 . (demineralization) (dearation)

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.(water test kits)

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.(conductivity meters)

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Ö (anions)

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Ö (zeolites)
Ö Ö . (sodium (aluminium silicates
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• (brine)
• (resins) •
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• (polysterene) •
• (carboxylic resins)

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• (coagulants) •
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(deaeration) (

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• • • •
• • (operating pressure)

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• (steam deaerators)
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(conditioning of boiler feed (water

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(glassy

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phosphates)

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: (chelating agents) _____ (

: (Anti-foams) _____ (

: (neutralizing amines) _____ (

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o : (sodium sulfite) _____ (

o o o o . o o o o
o o
(compounded sodium sulfite)

0 (uncompounded sodium sulfite)

(stand- 0

.by)

0 0
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: (hydrazine) (

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:(sodium sulfite) (

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:(sludge mobilizers) (

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0 0

(Blowdown) - -

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$$\% \quad X \quad \frac{B_f}{B_f - B_b} = \quad \%$$

(/) = B_f

0 0 = B_b

(/)



\tilde{O} \tilde{O} (package boilers) \tilde{O} :

:
= B_b
= B_f

% , = % $X \frac{\quad}{\tilde{O}} =$ % :

:

(blasts)

(drift)

- . (shell boilers)
- (continuous bleed)
- . (nominal water level)

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(bleed valve)

. (electrical (conductivity



0 0
0 0

.(electrostatic precipitator filters)

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(waste-heat boilers)

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/ (dip-stick) 0

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. (load)

(shaft power)

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(leaving temperature)

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.()

.(evaporative coolers)

(spray ponds)

(lime-soda-ash)

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(bearings)

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Õ ... (pour-point depressant) Õ

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(Engine starting system)

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(starting tanks) . Ö

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Ö . (rotary air compressor)
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(rotor) (moving blades)
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(turbine rotor)

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0 (starting motor)
(set-up 0 (clutch) ()

gear)

(rpm)

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0 0 0 0
0)

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0 0 (impeller)

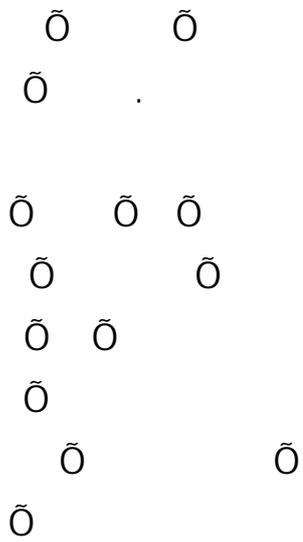
(over speed trip)

0

(speed

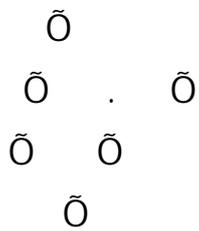
governor)

(thermal switches)



(regenerative gas turbine)

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(blast furnace gas)

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.(Air atomizing)

Ö (Vanadium) Ö
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.(blading) Ö
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(inhibiting

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(waste heat boiler)

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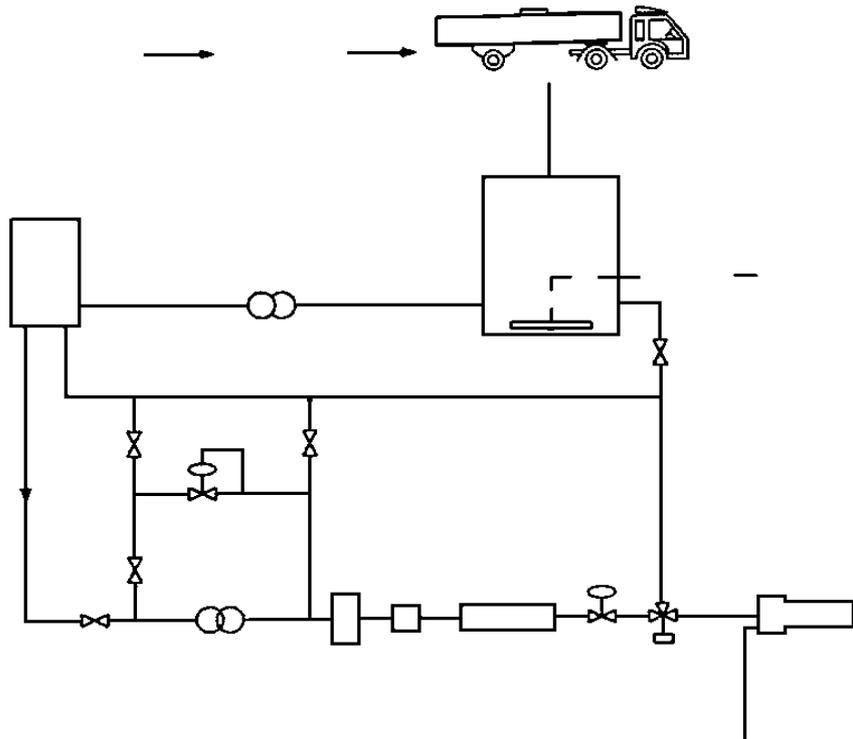
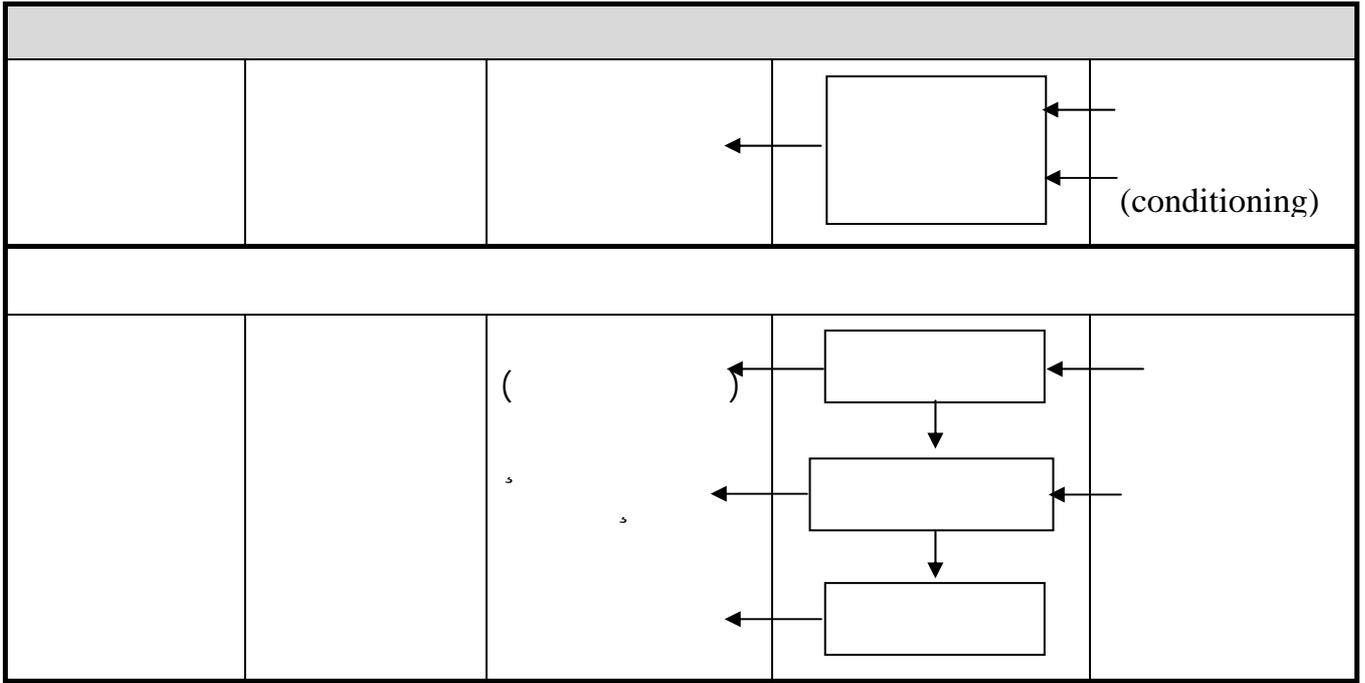
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\tilde{O}
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 $\tilde{O} \quad \tilde{O} \quad \tilde{O}$
(feedback signals) ()
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0 0 (gas train) 0

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(0) 0 0

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(leachate)

(BOD & COD)

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(D-)

(excess air) •

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(aldehydes)

NO , NO , N O

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(SO)

(No_x)

(CO)

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(D-)

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Õ (softening)

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(Back Wash)

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. (steam traps)

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Õ Õ Õ (once-through) ()

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(PM ,)

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*(particulate
matter)*

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0 0 0 0 (acidification)

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$\text{O} : \text{O} \quad \text{O} \quad \text{O}$
 $\text{O} \text{ } _2 \text{ (NO)} \quad \text{O} \text{ } _2 \text{ (NO)}$
 $\text{O} \quad \text{O} \quad \text{O} \quad \text{O} \text{ } _2 \text{ (NO)}$
 $\text{O} \text{O} \quad \text{O} \text{O} \text{ } _2 \text{ (NO)} \text{ (nitrogen sesquioxide)}$
 $\text{O} \text{ } _2 \text{ (NO)} \quad \text{O} \text{ } _2 \text{ (NO)}$
 $\text{O} \quad \text{O} \quad \text{O}$
 $\text{O} \quad \text{O}$
 $\text{O} \quad \text{O} \quad \text{O}$
 $\text{O} \text{ (nitrous acid)} \quad \text{O} \quad \text{O}$

:

$\text{NO} + \text{H}_2\text{O} \longrightarrow \text{HNO}_2 + \text{HNO} \text{ ()}$
 $\text{NO} + \text{H}_2\text{O} \longrightarrow \text{HNO}_3 + \text{NO} \text{ ()}$
 $\text{O} \quad \text{O}$

(NH)

(NH NO)

$\text{O} \text{ } _2 \text{ (NO)}$
 $\text{O} \quad \text{O} \quad \text{O}$

(secondary air contaminants) O

(O)

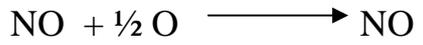
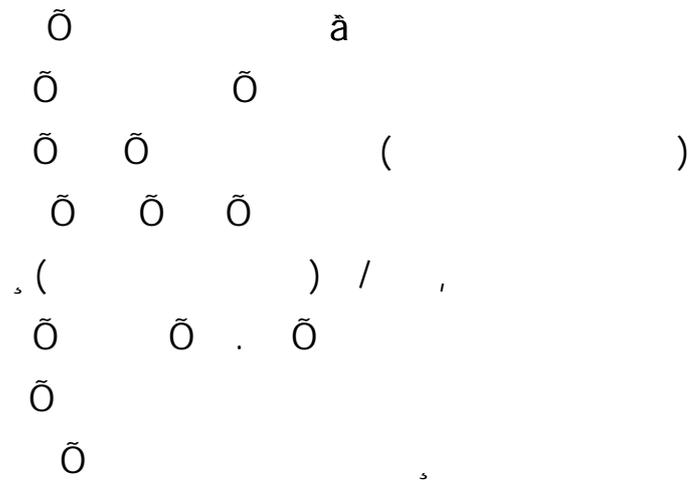
O

$\text{O} \quad \text{O}$

$\text{O} \quad \text{O} \quad \text{O} \quad \text{O}$

:

$\text{N} + \text{O} \longrightarrow \text{NO}$



$\text{O} \quad \text{O}$
 $\text{O} \quad \text{O} \quad \text{O} \quad (\text{fossil fuel})$
 $(\text{green house effect}) \quad \text{O}$

$\text{O} \quad \text{O}$

$\text{O} \quad \text{O} \quad \text{O} \quad \text{O}$
 $\dots \text{HCl} , \text{HF} , \text{PAH}) \quad \text{O}$

$\text{O} \quad (\quad)$
(Dioxan, Furans)

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$\text{O} \quad \text{O}$



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(eutrophication)

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(clarifier sludge)

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ō ō ō ō ō ō ō

(bag filters)

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(Boilers tune-up)

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(flame out condition) ō

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(Low NO_x Burners)

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0 0
0 0 0 % - %

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0 0 0
% -
0 0 0 % -
0 (wet gas scrubbers)
()

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0 (cyclones =)
(bag filters)
0 (electrostatic precipitators)

0) (PM) %
0 0 .(
% ,
% ,

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 Õ (water conditioning)
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(cleaner production)

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(diagnostic equipment)

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(low water Õ Õ Õ

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Õ Õ Õ cutoff)

Õ (float chamber) Õ

(sensor)

		(gauge cocks)	•
○	○		
(water column,	○		
		water glass)	•
○	○		
○		(burners)	•
○	○	○	○
		(flame detectors or safeguards)	
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		(damper)	•
○	○		
		(fireside)	

(handholes)

○ ○ ○
○

(manholes)

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○ ○ (purging)

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(pittings)

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(rivets)

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 / (wrought iron)
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operating- 0 0 0 0) 0
 . (pressure cutout



Ö) , -

. (upper-limit control

Ö •
Ö Ö

.(low-water fuel cutoff)

(spring- Ö •
loaded (pop valve

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Ö Ö Ö . /
(/)

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Ö Ö •

. (flame safeguard safety controls)

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(ASME)

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. (relief valve)

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operating limit 0 0)

. (control

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(pilot proving)

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. (electric contacts)

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(EEAA)

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(dampers)

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(balanced- ō ō

draught (boilers

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(Bourdon gauge)

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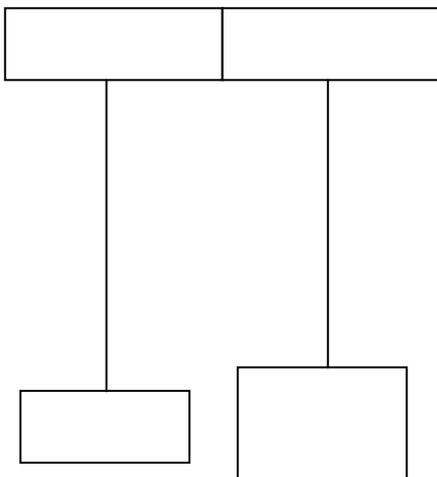
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(positional control)

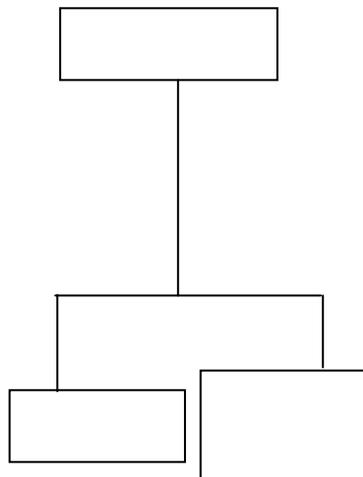
(parallel)

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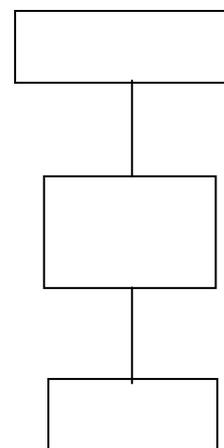
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Õ (positioning) Õ (on/off) /
(metering)
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(high/low/off)

(positioning control system) (

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Õ Õ (cam)

(commissioning)
(dampers)

(open-loop) " " .





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 Õ Õ (servomotor)
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/ (
(metering/modulating control systems)

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 (ratio controller) ()
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(Soot Blowers) - -



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 (\bar{O})
 \bar{O} \bar{O} (waste heat boilers) \bar{O}

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 \bar{O} \bar{O} ()

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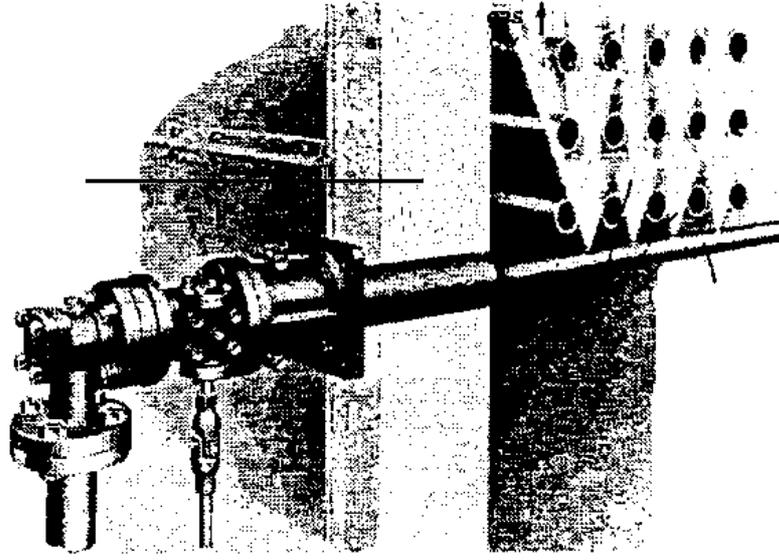
\bar{O} \bar{O} \bar{O} (effective radius of cleaning) \bar{O}
 \bar{O} \bar{O})

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\bar{O} \bar{O} \bar{O} Ç
 \bar{O} \bar{O} \bar{O} \bar{O} \bar{O}
 \bar{O} (economizers) \bar{O} \bar{O}

(evaporative \bar{O} \bar{O} \bar{O} \bar{O} \bar{O} \bar{O}

. convection)



شكل (٢-١٠): نفاثات السناج الدوارة متعددة الفونيات

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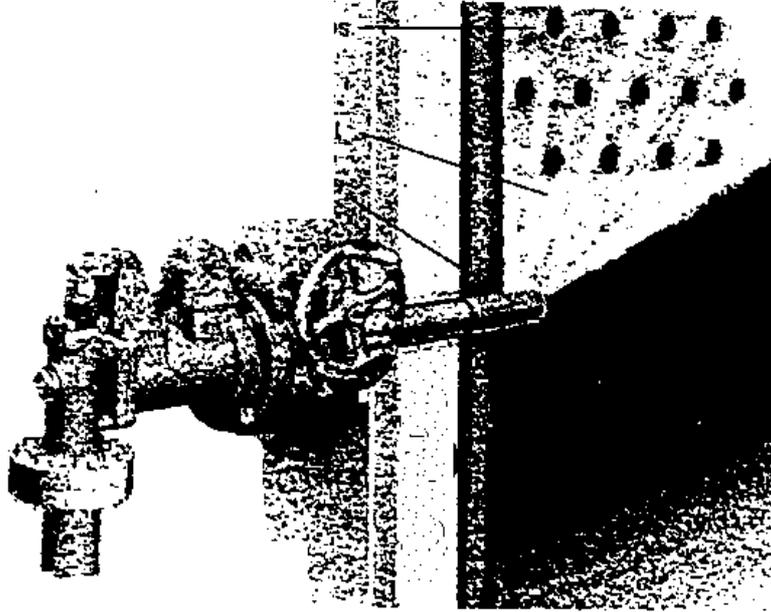
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شكل (١٠-٣): نفاثات السناج الانسحابية القصيرة

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(brushes)

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Õ (sonic blowers)

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(conductivity)

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(capacitance)

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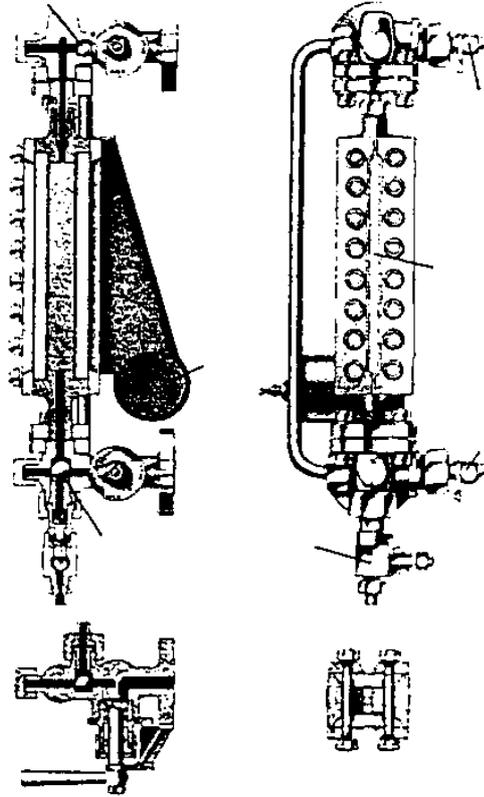
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(full-bore (valve

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. (sample cooler)

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. (norm)

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(interlocks)

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Õ Õ (scanner)

Õ Õ (pulverized fuel)

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 (hydraulic) Õ Õ
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 (CMS) (local meters)

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		/(RPM) (Hz-meter)	/	(...)
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(dumping sites)					
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الملاحق

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(Tiny Boilers)

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. (ASME)

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(High Pressure Steam Boilers)

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(Hot- Water-Supply Boilers)

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(Low- Pressure Boilers)

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(Packaged Boilers)

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(Power Boilers)

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(Supercritical Boilers)

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Ö Ö Ö (,)

(Waste Heat Boilers)

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(Safety Valve)

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(Stop Valve)

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(Pressure Gauge)

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(/)

(steam gauge siphon)

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(Inspector's test gauge connection and cock)

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(water column)

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(Water Level Indicator)

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(water test gauges or try cocks)

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(Drain valve)

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\bar{O} \bar{O} (horse power) \bar{O}
 \bar{O} (Btu) \bar{O} \bar{O} \bar{O}
 (MW)

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 \bar{O} \bar{O} \bar{O} \bar{O} /
 \bar{O} \bar{O} \bar{O} \bar{O} /Btu
 \bar{O} \bar{O}
 \bar{O} /
/ \bar{O} \bar{O}
 /Btu

Boiler turndown Ratios

\bar{O} \bar{O} \bar{O}
 \bar{O}
— : (Turndown Ratio)

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(draft)

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(forced draft fan) ()

ō (induced draft fans)

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$$(\Delta P) = H \cdot \frac{P_o g}{R_{air}} \cdot \left[\frac{1}{T_o} - \frac{1}{T_{gas}} \right] \approx H \left[\frac{1}{T_o} - \frac{1}{T_{gas}} \right]$$

:

(cm H O)

= ΔP

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H

(kPa)

= P_o

(K)

= T_o

(K)

= T_{gas}

(K 0 / ,)

= R_{air}

(/ ,)

= g

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(O scavengers)

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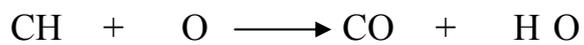
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- Methane , ò by volume



Multiplying through by ,



- Ethane , ò



Multiplying through by ,



- Propane , ò



Multiplying through by ,



- Butane , ò



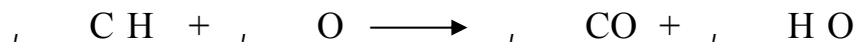
Multiplying through by ,



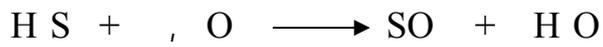
- Pentane , ò



Multiplying through by ,



- Hydrogen sulfide , ò



Multiplying through by ,



(stoichiometric quantity)

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(kmoles)

$$\begin{aligned}
 & : \\
 & , X \frac{100}{21} = , \text{ kmoles} \\
 & , = \frac{10,05}{1} = \frac{\text{حجم الهواء}}{\text{حجم الوقود}} \\
 & = /
 \end{aligned}$$



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:(,) % ,



:(,) %



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$$(\text{ , } + \text{ , } + \text{ , }) - \text{ , } = \text{ , } \text{ kg O /kg fuel}$$

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% ,
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, X $\frac{100}{23,3} =$, kg

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$$\text{mass} \left\{ \begin{array}{l} \text{A} \\ \text{F} \end{array} \right. = \frac{\quad}{\quad} = \frac{\quad}{\quad} = 13,57 \text{ kg air/kg fuel}$$

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$$\left\{ \begin{array}{l} \text{A} \\ \text{F} \end{array} \right. = \quad , \quad X \quad , = \quad , \quad \text{kg air/kg fuel}$$

%

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$$\text{A/F} = \quad , \quad X \quad , = \quad , \quad \text{kg air/kg fuel}$$

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-		
-	(register burner)	
-	(dual-fuel burner)	
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(/)

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(/)

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$$X \left[\frac{\quad}{\tilde{O}} \right] =$$

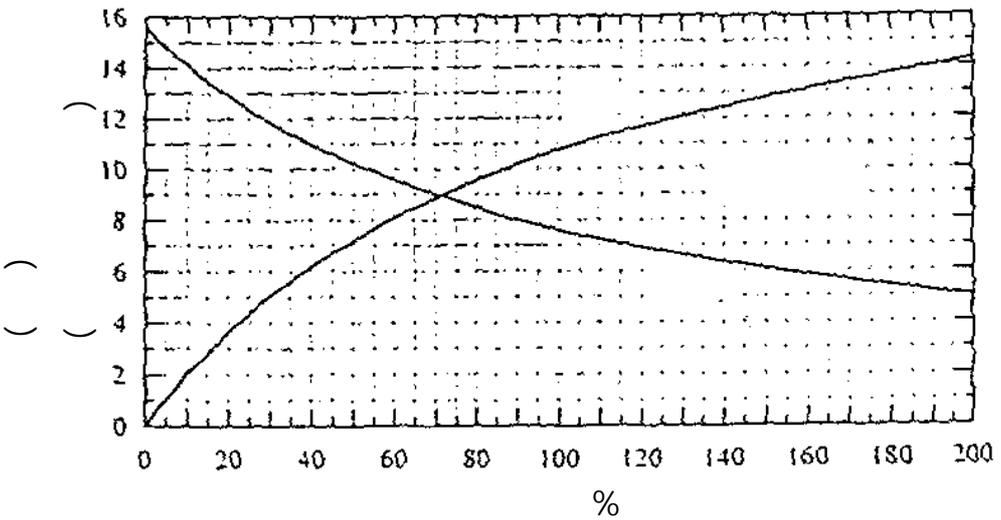
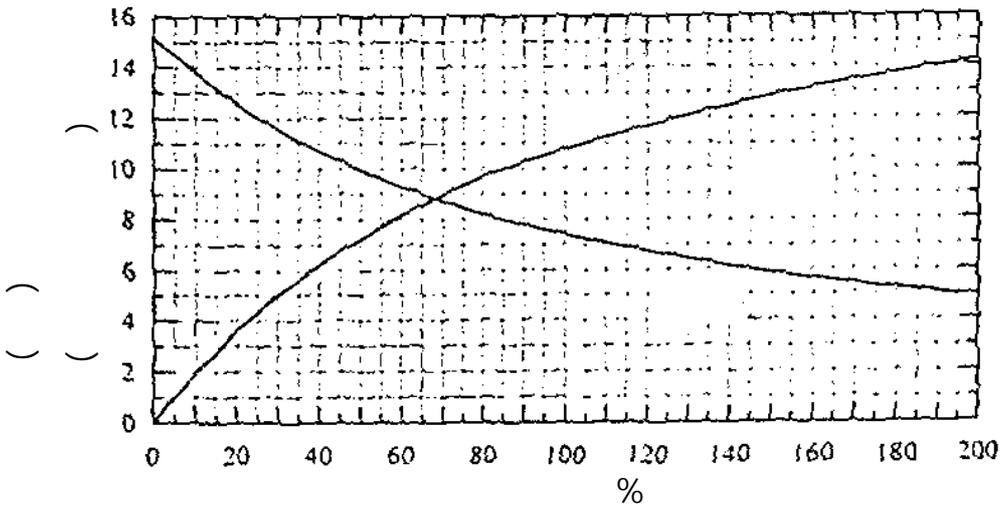
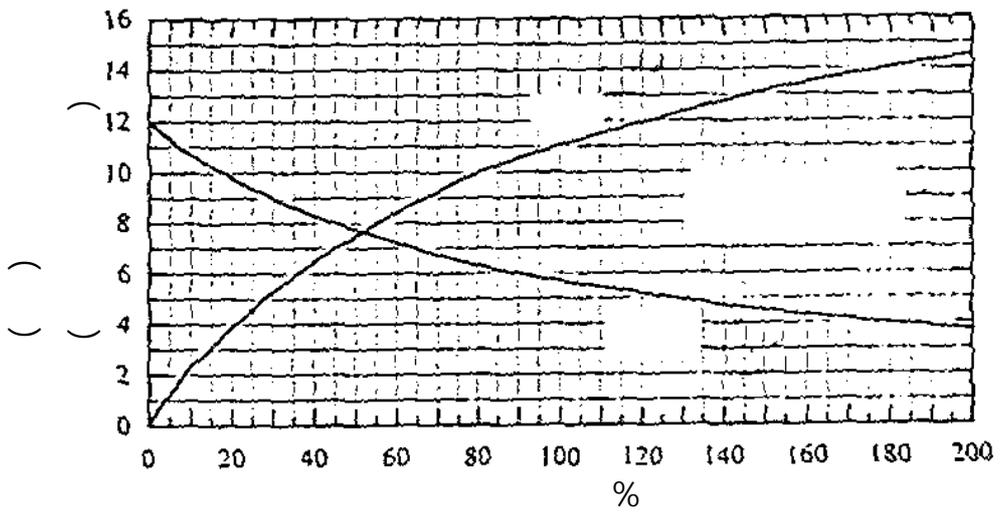
$$X \left[- \frac{(\quad)}{\quad} \right] =$$

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$$\left[\frac{\quad}{\quad} \tilde{O} \right] (\quad) =$$

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(volumetric rate)

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X

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\bar{O} \bar{O}

(return chamber)

. (refractory appliance)

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\bar{O} \bar{O}

(geometric projection)

. / , \bar{O}

(Effective projected radiant surface)

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(heat flux)

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\bar{O}

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(one furnace \bar{O} \bar{O} \bar{O})

\bar{O} \bar{O} \bar{O} / \bar{O}

. diameter)

(peak

\bar{O} \bar{O})

(cross-sectional area)

heat flux)

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(maximum heat input)

(net calorific value)

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(local convection)

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(life expectancy)

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