SAFETY VALVES

- As per IBR requirements, there shall be atleast 2 safety valves
- The operating pressure of the safety valve shall not be more than 3% of the working pressure of the boiler.
- The safety valves must be fitted on the same valve chest so as to
- Minimum Diameter of safety valve should be more than 38mm
- Area of the safety valve,

$$Area \Rightarrow C \times A \times p = 9.81 \times H \times E$$

where, H : total heating surface, in m^2 of boiler

E : rate of evaporation of water in Kg/m^2-hr

p : Absolute working pressure of Boiler (Absolute = Gauge Pr. + 1).

A : Total area seating of v/v mm^2

C : Constant

for ordinary safety valve : C = 4.8

for high lift & spring loaded : C = 7.2

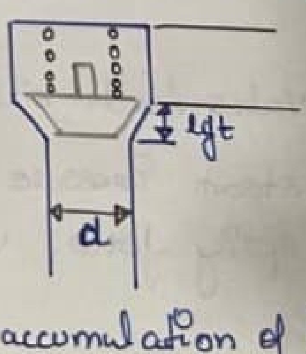
for improved high lift : C = 9.6

for full lift safety v/v : C = 19.2

for full bore safety v/v : C = 30

- More the value of C, less is the accumulation of Pressure

Suppose 'd' is the diameter of valve:



$$\frac{\pi}{4} d^2 = \pi d \times lift$$

$$\Rightarrow lift = \frac{d}{4}$$

If lift is less than $\frac{d}{4}$, there will be accumulation of Pressure

- NOTE: Accumulation of pressure is dangerous.
  - It is a scenario, where the boiler pressure increases despite the lifting of the safety valve.

To avoid accumulation of pressure, the lift shall be more than $\frac{d}{4}$.

However, spring loaded safety valve, it is difficult to achieve this lift of $\frac{d}{4}$.

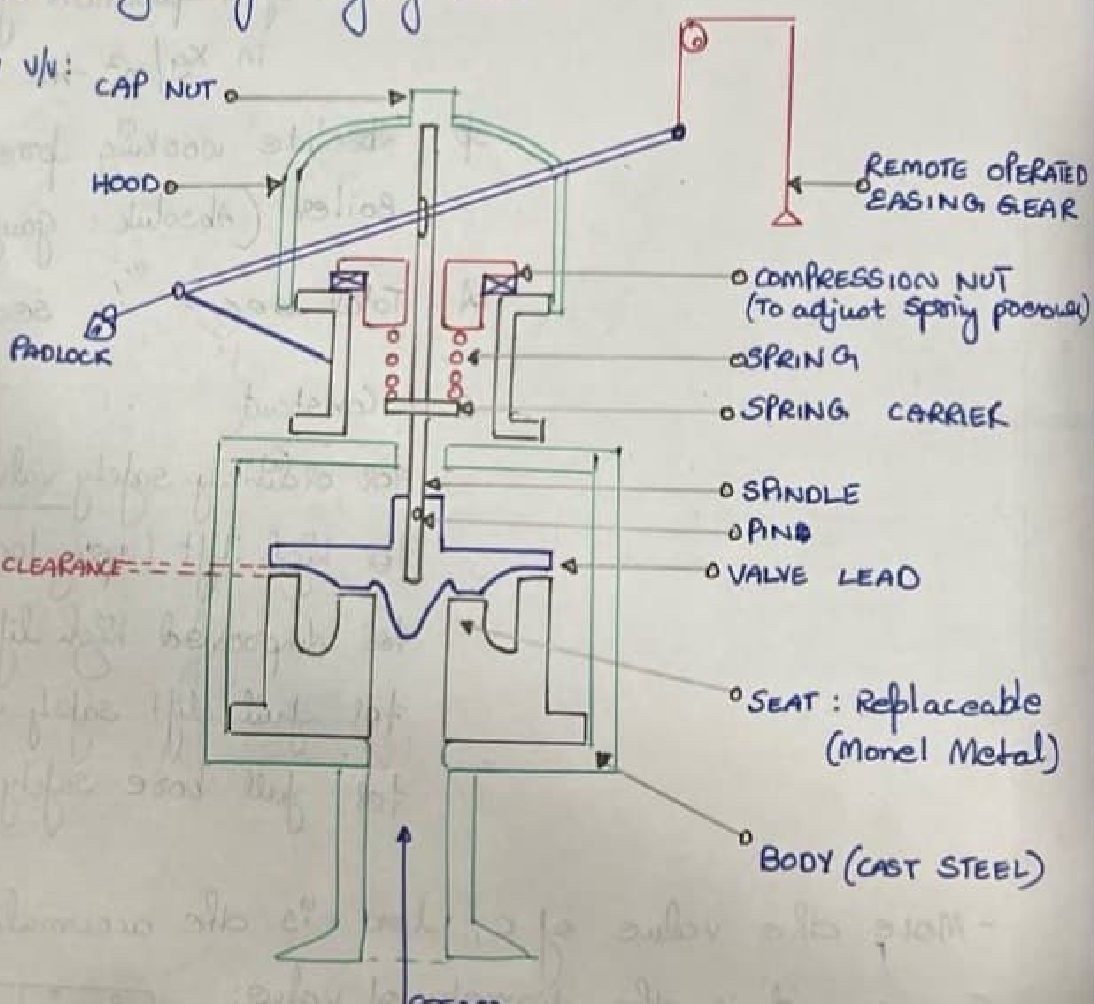
- TYPES OF SAFETY VALVE

i) Ordinary Safety Valve

ii) High lift Safety Valve

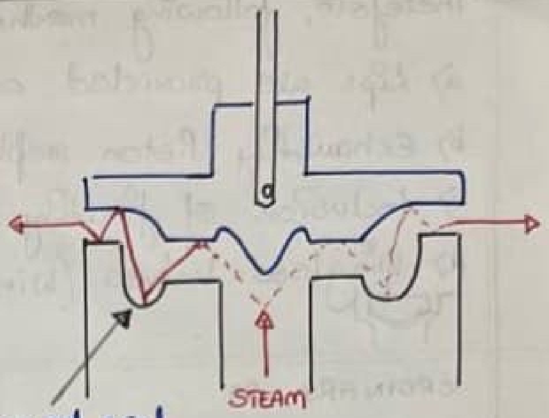
iii) Improved high lift safety Valve

i) ORDINARY V/V:



- Valve lead sits over the seat under spring pressure.
- steam Pressure acts from bottom and as it overcomes the spring force, valve will lift

- As the valve lifts, the steam has more area & eventually is relieved from the system.
- lift $= \frac{D}{24}$

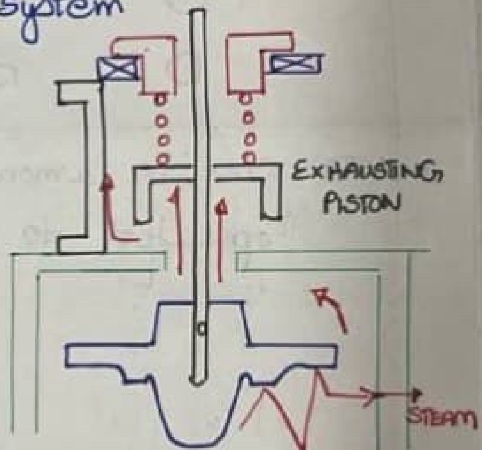


NOTE: To check lip clearance Place a wax ball at the place of clearance and manually close the valve.
The thickness of the flattened wax ball = lip clearance.

specially shaped seat deflects steam towards lip on valve & increase valve lift

ii> HIGH LIFT SAFETY VALVE

- The spring carrier is slightly modified to form an "Exhausting Piston"
- The steam being relieved out of the system is utilised to improve the lift.
- The lift $= \frac{D}{12}$
- Some steam may pass through the side of the piston ⇒ overheating & seizure ⇒ improper opening of the valve.



iii> IMPROVED HIGH LIFT SAFETY VALVE

→ To prevent lifting problems, a floating ring is added which acts as a liner (loose ring which also lifts with exhausting piston)

→ lift : $\frac{D}{8}$

Therefore, following methods are employed to improve lift:

a) Lips are provided on the valve.

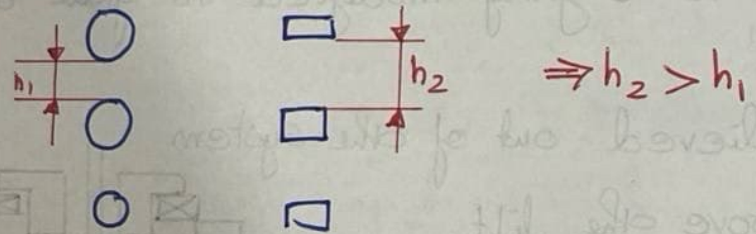
b) Exhausting Piston replace the spring carrier. (Exhaust Steam Piston)

c) Inclusion of floating rings

d) Wingless Valves. (Winged Valves:  Act as guide but hinder steam pressure
- Lapping is difficult & req. spl template

ORDINARY SA	HIGH LIFT SAFETY V/V	IMPROVED HIGH LIFT
i) Winged Valves	i) Winged Valve	i) Wingless Valve
ii) No waste steam Piston	ii) Exhausting Piston	ii) Exh. steam Piston
iii) Lift $= \frac{D}{24}$	iii) No floating Ring	iii) floating ring
iv) No floating ring	iv) Lift : $\frac{D}{12}$	iv) Lift : $\frac{D}{8}$

Also, the spring has a square cross-section to provide for more lift:, unlike conventional round surfaces.

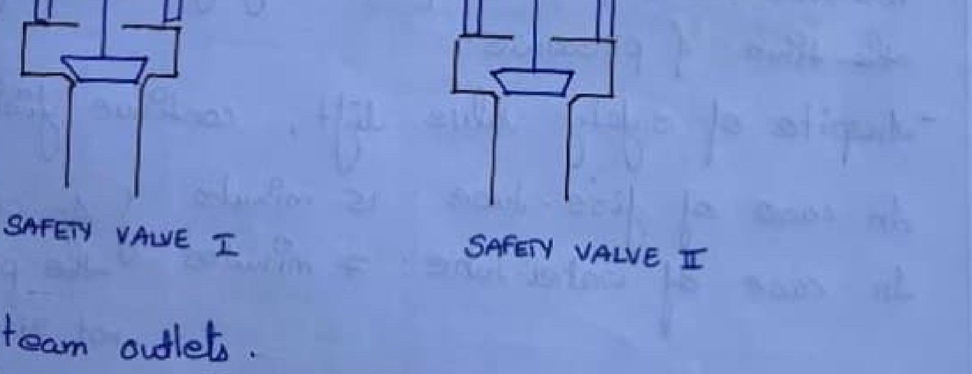


- NOTE: Once in a month, or as specified, the easing gear is operated to ensure proper lifting of safety valve.

- OVERHAULING

i) Remove Cap
ii) Remove hood
iii) Remove Easing gear
iv) slacken compressionnut
v) Open spring Casing
vi) Remove spindle valve & spring carrier
vii) check the condition of valve & valve seat for signs of pitting, corrosion, erosion. Carry out Lapping if required.
viii) Trueness of the shaft is checked by placing on a Lathe
ix) Check casing for corrosion
x) check spring compression
xi) Blow through the drain holes.
xii) Apply persian glue, & check the point of contact b/w Valve & seat
xiii) check all clearances
xiv) Hang the spindle and hammer it. "Ringing Sound"
xv) drop the spring & it should bounce 2-3 times: "Good quality"

- SETTING THE OPERATING PRESSURE OF SAFETY VALVES:



- shut all steam outlets.
- Take sufficient amount of water & then slowly raise the pressure.
- Gag one of the safety valves using Gagging tool

- Bypass the HP cut out to avoid boiler trip
- When the required pressure is reached, adjust the compression nut on the ungagged safety valve. to lift the valve. Note the pressure at which it lifts

  Note:– Tighten nut → if lifting at lower pressure
  Loosen nut → if lifting at higher pressure.

- Now, gag the other safety valve which is set and follow the same procedure for the 2nd valve.

Once, the pressure is set, remove the gagging tool.

- Make a steel plate and cut it into 2 pieces and place it under the compression nut to avoid intentional change of setting of pressure to injure personnel or compromise the system.

- ACCUMULATION OF PRESSURE: TEST:

- Take sufficient water in the boiler
- Shut all the valves
- Fire the boiler on full load. Bypass HP Cut out.
- Pressure rises & at a point: safety valve lifts. Note down the time & pressure.
- Inspite of safety valve lift, continue firing.

  In case of fire-tube : 15 minutes
  In case of water-tube : 7 minutes
  } In this period, the pressure should not rise above 10%. of Max. working pressure of the boiler.

- This is carried out only when the setting of safety valves are changed, or when a new safety valve is fitted.

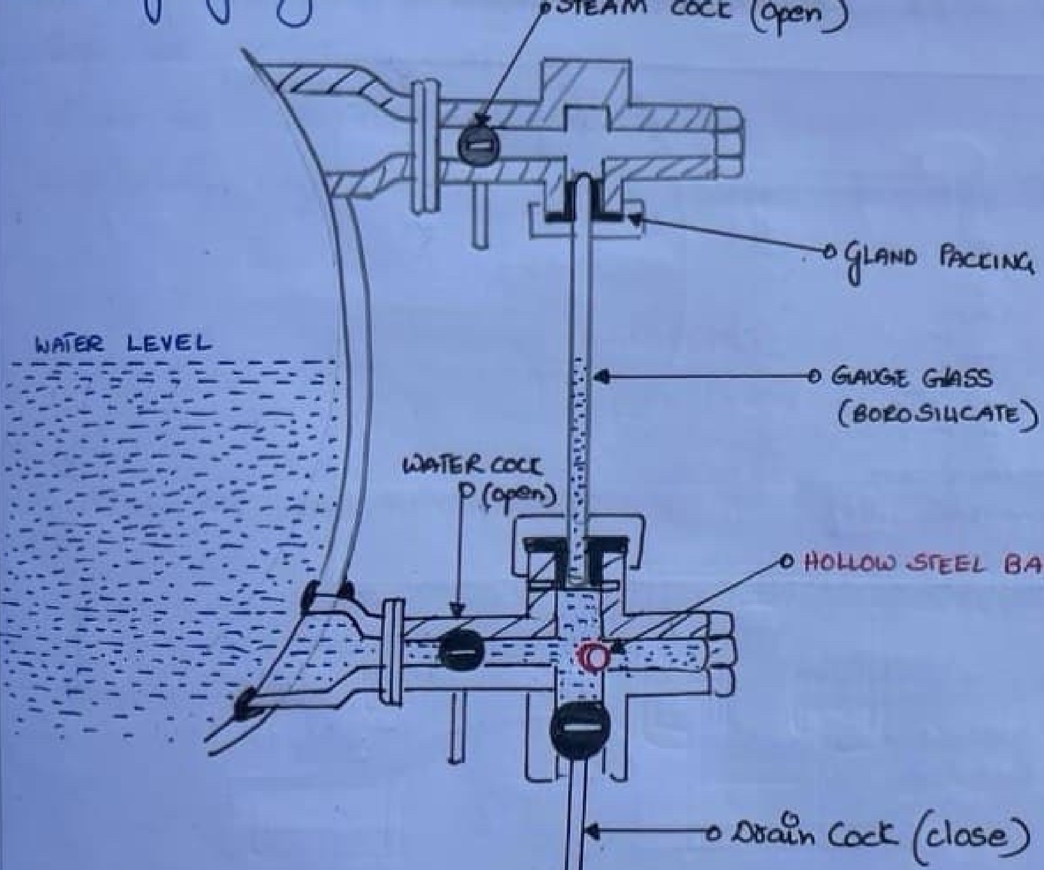
Blowdown of Safety Valve: Difference b/w lifting pressure & Seating pressure of the valve.

- Lifting Pressure is adjusted using compression nut
- Seating Pressure can be adjusted using blow down ring fitted on valve seat.

• GAUGE GLASS:

- a means of water level measurement on a boiler

a) Tubular Gauge Glass



Q: Suppose, in case of 2 Gauge glasses.

a) One may not show
b) And one is showing

Ans Stop the firing.

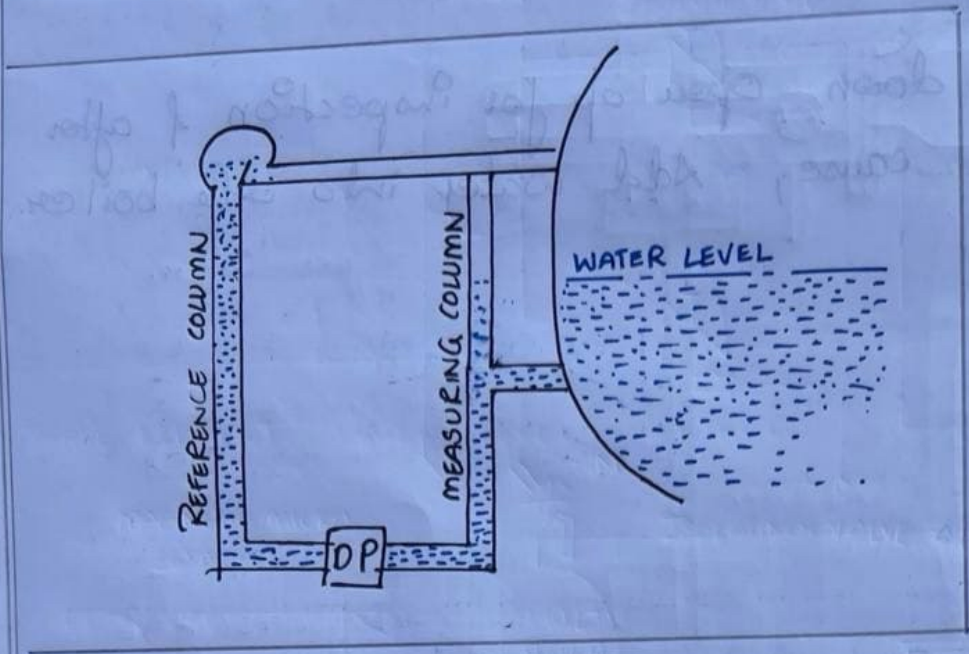
- Blow through the gauge glass.

The gauge glass that wasn't showing: If it shows after blow through ⇒ it was clogged.

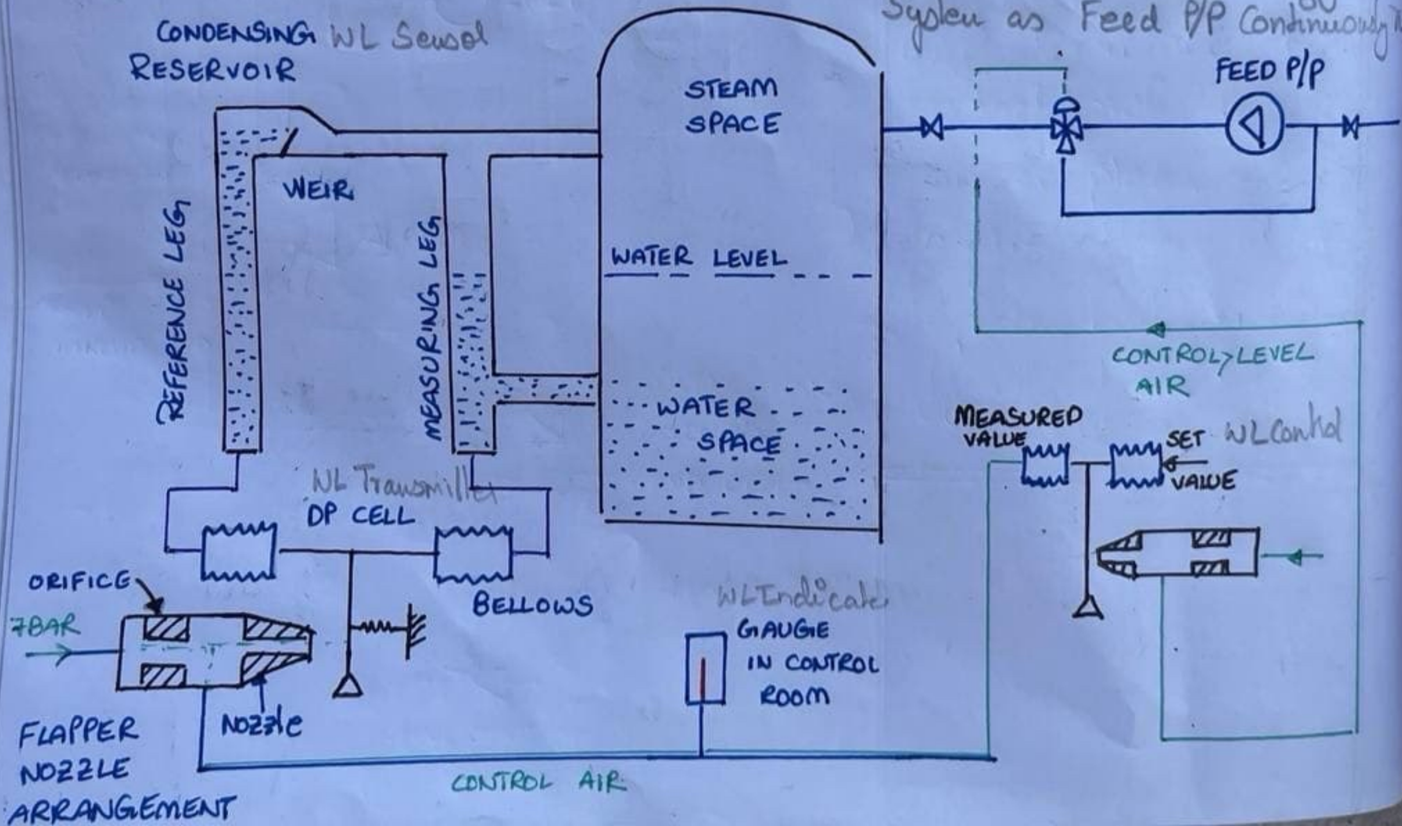
If it still doesn't show, actual boiler water level may be too low. ⇒ Dangerous situation.

- Stop the boiler.
- Allow to cool down. Open up for inspection & after ascertaining the cause, Add water into the boiler.

• REMOTE GAUGE GLASS:



(This is a Modulating Control System as Feed P/P Continuously ru



REMOTE INDICATION OF BOILER WATER LEVEL:

- On UMS ships, where most of the processes are automated, including water level control, a remote means of indication is a requirement.

a) - Differential Pressure method of Remote Indication involves remotely determining Boiler Water Level using a differential pressure transmitter connected to 2 columns (Measuring & Reference) as shown.

COLUMN ①: REFERENCE LEG
- Connected to the steam space
- It has a condensing reservoir at the top. It is not insulated & hence, steam will condense
- A weir allows excess condensed water to drain off into measuring leg.
- Thus, the water in reference leg always remains at a constant height at all times.

COLUMN ②: MEASURING LEG
- Connected to water space of steam drum & also to condensing reservoir.
- Height of water in this leg is equal to the height of BW in the drum from the DP transmitter

We have, pressure exerted by a liquid, $P = \rho g h$

i.e, Pressure at the bottom of Ref Leg $\propto$ Height of water in Leg.

Similarly, Pressure at the bottom of the Measuring Leg is due to the the height of water in that leg, which is the height of Boiler Water level & will change as Boiler Water level changes

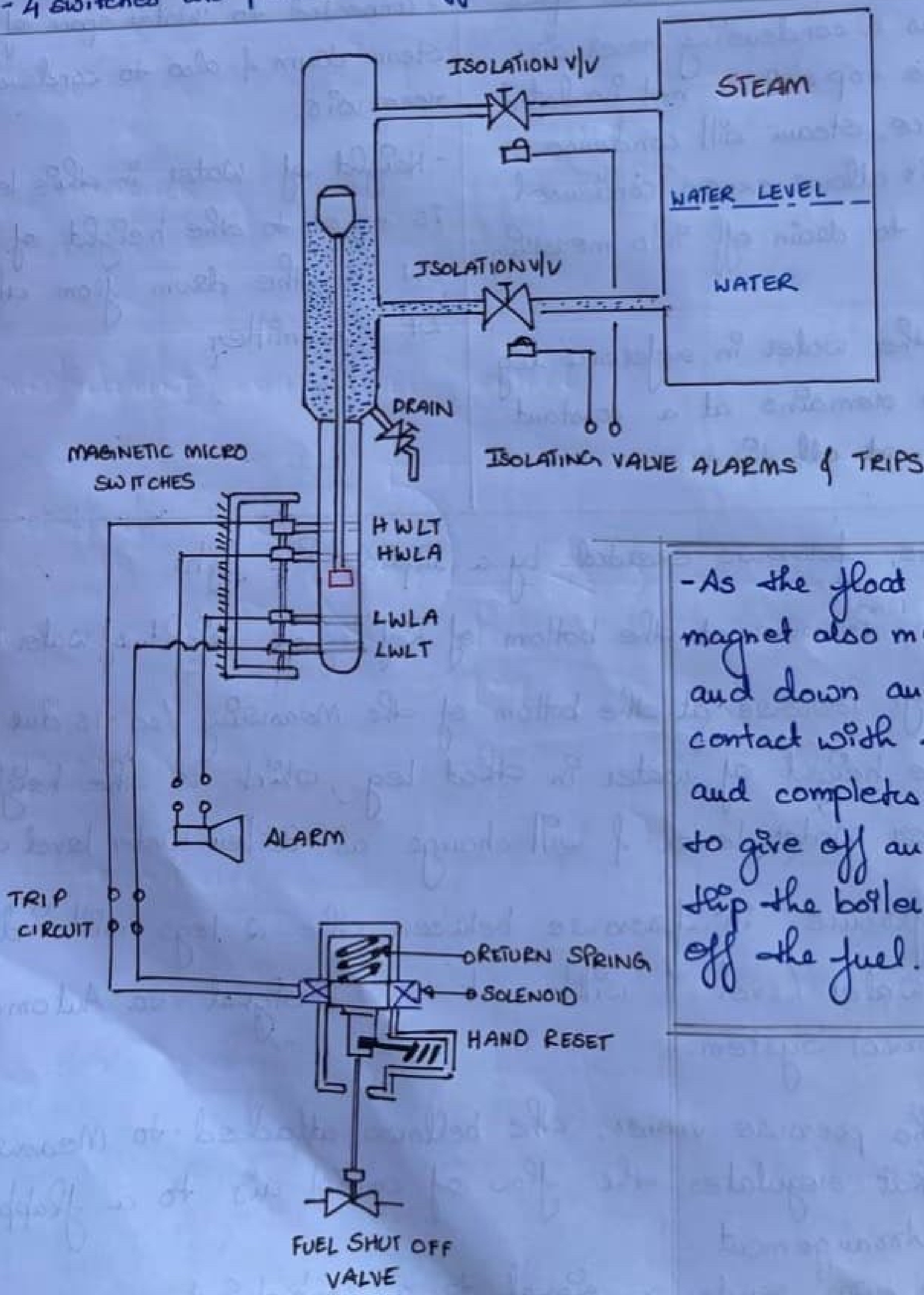
The difference in pressure between the 2 legs will indicate Boiler Water Level & will be sent as a signal to Automatic Level Control System. %

→ As the pressure varies, the bellows attached to Measuring Leg that regulates the flow of control air to a flapper/ Nozzle Arrangement.

→ This in turn sends a signal to a Control System to actuate a 3way valve ahead of the feed pump to control WL and flow into the boiler.

b) FLOAT MEANS OF REMOTE WATER LEVEL INDICATION.

- An external float chamber is made balanced connections to steam & water spaces of the steam drum.
- Float (a float) attached to a rod with a magnet on the other end, floats with relative to Boiler Water Level
- Any change in Water Level causes the float to move up & down in the chamber.
- 4 switches are placed at different Locations/Positions as shown.



- As the float moves, the magnet also moves up and down and it makes contact with the switches and completes the circuit to give off an alarm or trip the boiler by cutting off the fuel.

4 SWITCHES FOR FOLLOWING INDICATIONS/ ACTIONS:

i> LOW WATER LEVEL ALARM (LWLA):

- It gives an alarm and if unattended, it activates the trip

ii> LOW WATER LEVEL TRIP (LWLT): when LWLA is left unattended

- It shuts off the fuel shut/cut off valve.

iii> HIGH WATER LEVEL ALARM (HWLA):

- It gives an alarm if the boiler water level is too high.
- If unattended, it leads to the formation & activation of HWLT.

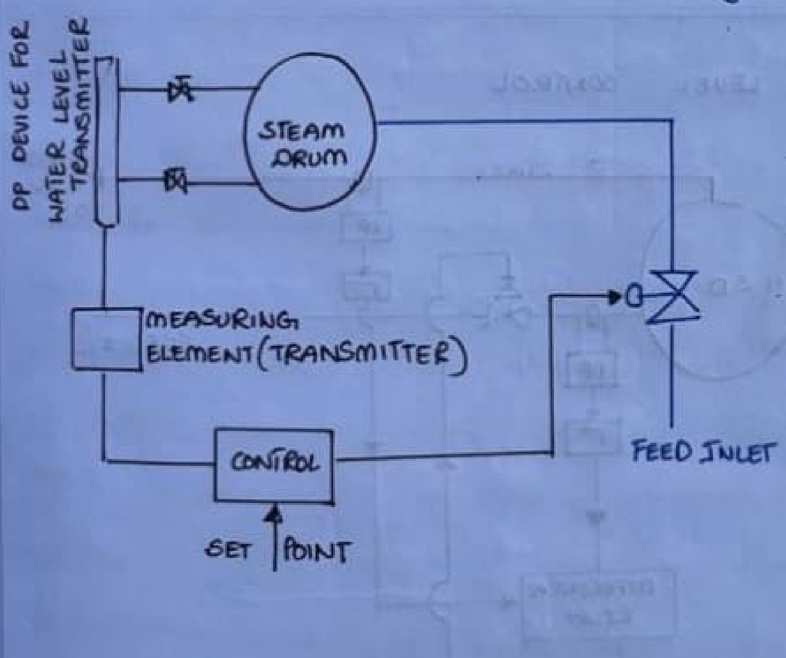
iv> HIGH WATER LEVEL TRIP (HWLT):

- It shuts off the fuel shut off valve & also feed check valve.

• NOTE: To try out alarms, shut isolating valves and then open drain valve to carry out LWLA & LWLT.

• BOILER WATER LEVEL CONTROL:

i> SINGLE ELEMENT CONTROL: Not suitable for boilers with fluctuating steam demand

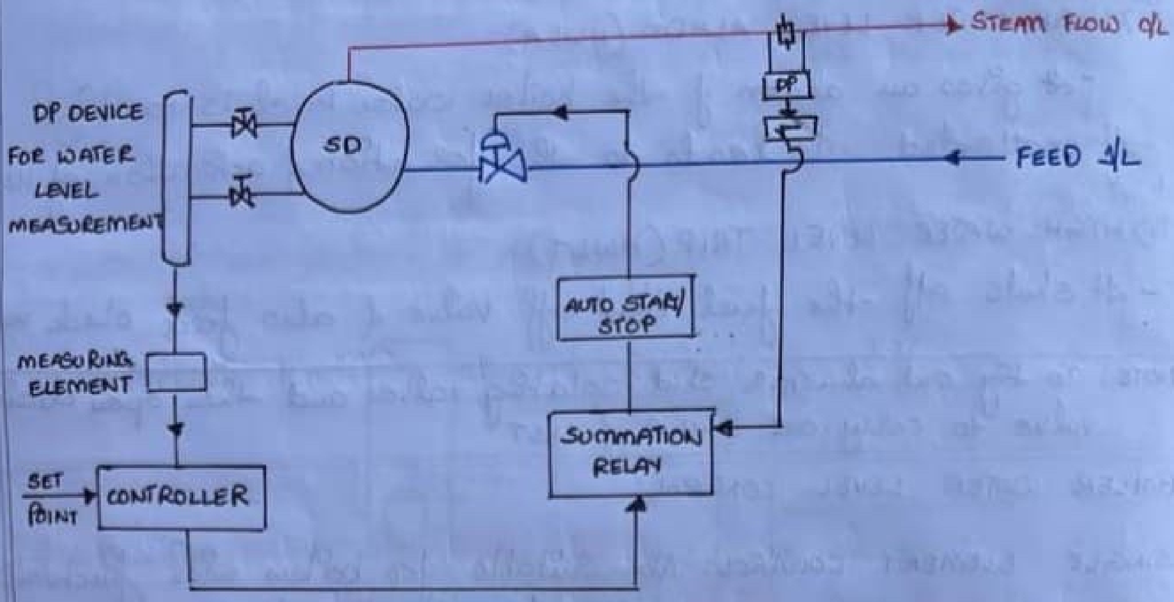


- Effect of shrink & swell led to operational issues

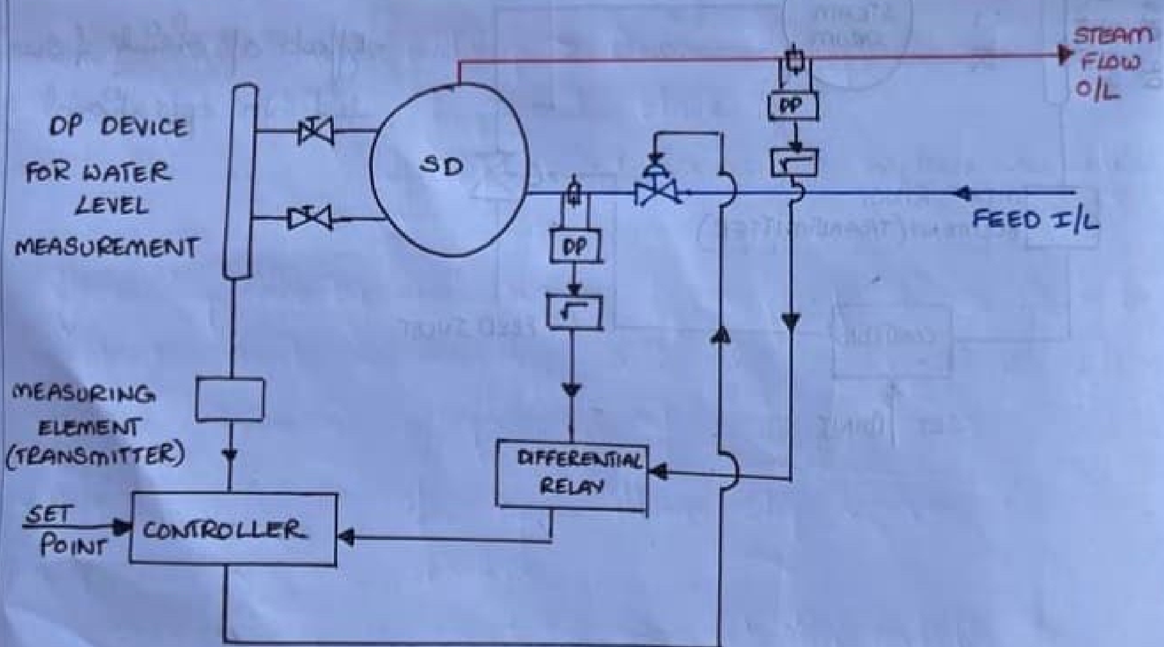
ii) TWO ELEMENT WATER LEVEL CONTROL

- As the name suggests, it measures 2 elements
  - a) steam flow out of the boiler
  - b) Actual BWL

to maintain a constant Boiler Water Level.



iii) THREE ELEMENT WATER LEVEL CONTROL



- Here, three elements : a) steam flow
  - b) Actual BWL, &
  - c) Feed flow , are measured for

efficient operation & accuracy.

BOILER SURVEY:

- Inspection of the water side, steam side & gas side of the boiler by competent authorities to ensure safe operation & integrity of the boiler.
- Upon installation, upto the first/initial eight years, surveys are conducted every 2 years ± 6 months.
- After 8 years in commission,

HOW SURVEY IS CONDUCTED?

- Ensure all materials/components are available (Lapping paste, gaskets, etc).
- change over to Diesel oil for firing as well as for use in Main Engine.
- Carry out proper blow down/scum blow down. to remove imp
- Stop firing & stop Boiler feed water supply p/p.
- start Boiler Blow down to depressurise the boiler gradually.
- Ensure Maximum blow down is carried out as blowdown rate depends on the steam pressure.
- Steam pressure as it gradually decreases and approaches to 1 Bar, stop blow down & open the vents (this is done to ensure no vacuum is formed inside the boiler & also to check if the valve is clear).
- Water is not completely expelled. Some ships have tanks to remove water after steam pressure has fallen below 1 Bar. Do not blow down into bilges as it can damage & scrap off the paint, water being red in colour (due to mud) can clog.
- After Venting & Blowdown, prepare for unmounting valves and Mountings.
- Tag the removed valves & fittings.
- Check the condition: for scratch, pitting.
- Lap the valves on valve seat
- Check valve body: for cracks & corrosion.

- Hang the valve spindle on railings & slowly tap with a hammer
"Ringing Sound" ⇒ Good Condition.
- check the bending of the spindle : on a Lathe.
- open up the Manhole Door on both "steam" side & "Water Side"
  i> check for scale formations in the drum & tubes.
    - Circulate the descaling compound.
      Older Days: Cut a tube & check for its condition
      Now: Scale formation is checked using a camera &
      Scale formation on drum surface also ascertains
      scaling of tubes.

  ii> check condition of the drum if welding is required

- Intensive checks are done at blow down valves.
  In case of fire tube boiler, check around OGEE Ring.
- safety valves overhaul & other mountings to be checked.
- smoke side: Carbon buildup ⇒ Broom the space.
  check for buckling: If present, blank it.
  If replacement available, replace the affected tube

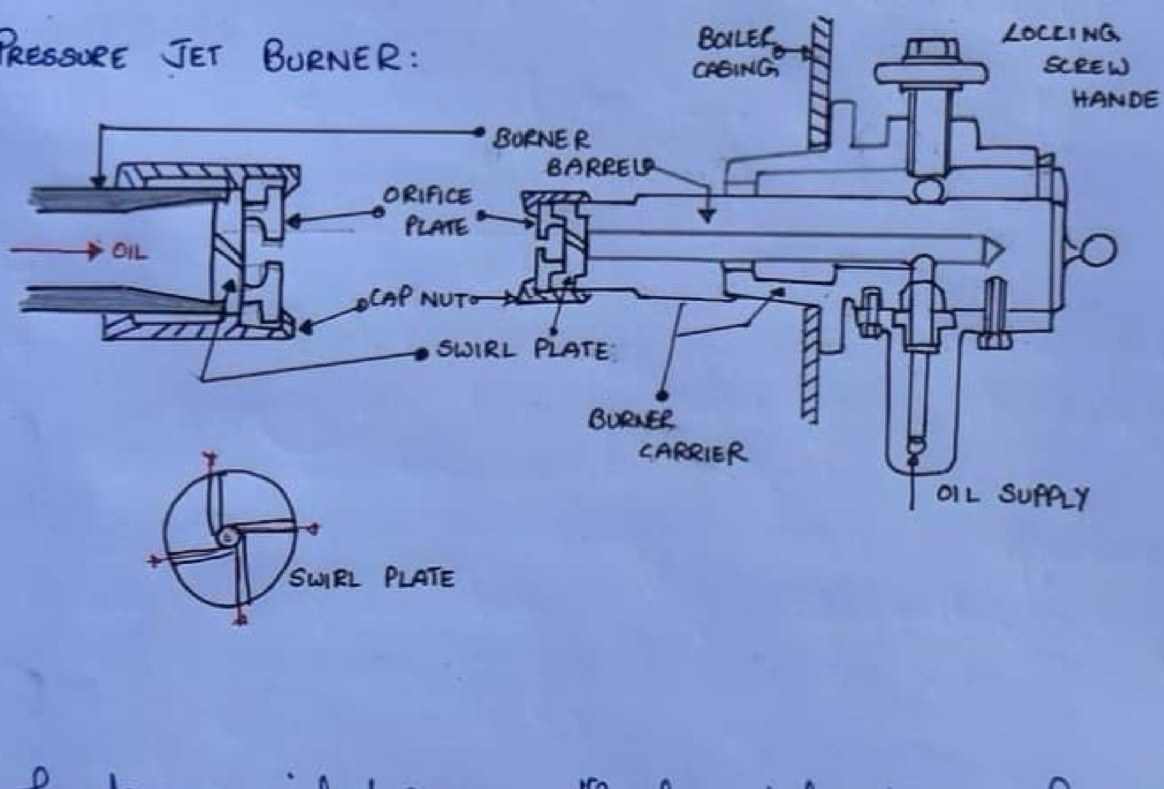
- After inspection by the surveyor & necessary observations being rectified, attach the mountings and also carry out the lifting of safety valves in the presence of surveyor.
- Once pressure is up, open Main stop valve & all alarms and leakages are checked.
  - Once survey is completed ⇒ "Interim Certificate"
    Main Certificate ⇒ from Head office.
- Upon completion: Check operation of Easing Gear

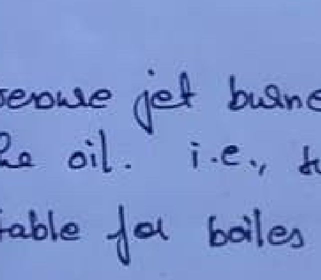
- BOILER BURNERS

3 Types: a) Pressure Jet
b) Steam assisted Pressure Jet
c) Rotary Cup

- Primary function of the burner is to produce a hollow rotating cone of oil droplets for efficient atomisation.
- Sufficient Combustion depends on the correct atomisation, penetration & swirling. (Swirl Plates attached behind the burner guide the air & also provide them with a motion to ensure efficient mixing of air & fuel).

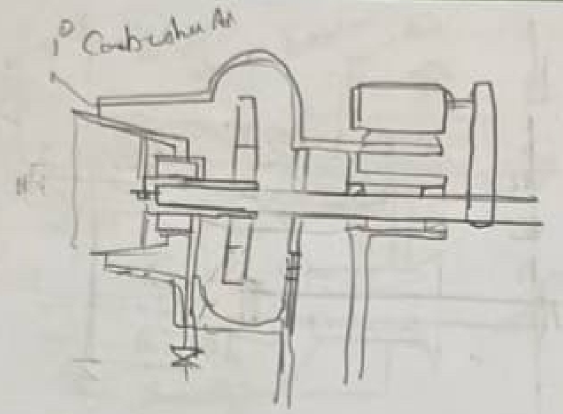
i) PRESSURE JET BURNER:





- The pressure jet burner entirely depends on the pressure of the oil. i.e., turndown ratio = $\sqrt{\frac{\text{max oil Pr}}{\text{min oil Pr}}}$ = is less.
- Not suitable for boilers with high evaporation rates.

→ TURN DOWN RATIO: Ratio of Maximum throughput of the oil to the Minimum throughput of the oil is called "Turn down Ratio". Under this, Boiler burner works satisfactorily.
- Higher the turn down, better the burner



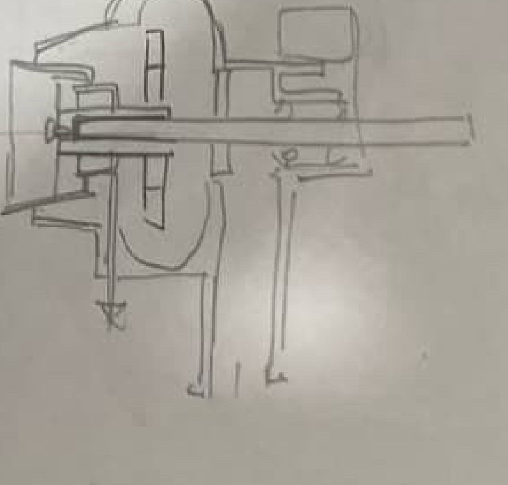
- Rotating cup burner atomises the oil by throwing it off the edge of a tapered cup being rotated at high speeds (2000 - 7000 rpm) either by an air turbine driven by 1° Combustion air or by an electric motor through drive mechanism

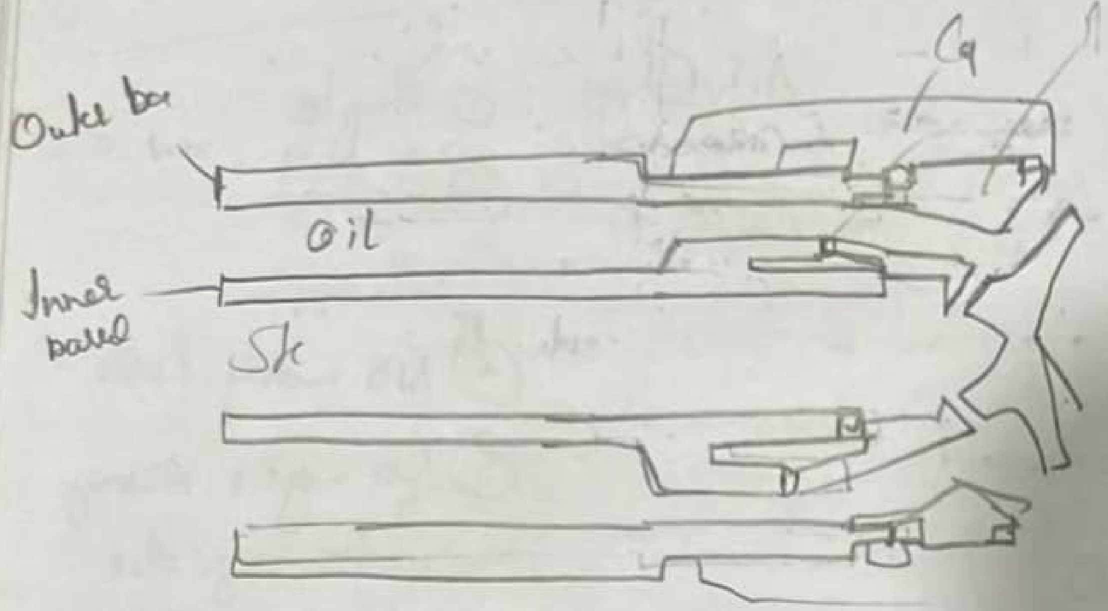
- construction: Consists of a tapered cup at the end of a rotating spindle mounted on bearings
  - F O is supplied to the inner surface of the cup surface through hollow end of the spindle

- As the cup rotates, centrifugal force causes the fuel oil to form a very thin layer and as it reaches the edge of the cup, the radial components of velocity breakdown the oil into fine droplets thus forming a hollow rotating cone of oil droplets.

fuel ? rate ?
2° air ? fuel
switch lower ?
a

Advantages
→ Wider TD Ratio (Can operate at low firing rates)
→ High Comb η →
→ Lower emissions
→ Reduced Maintenance
→ Quick operation
→ fuel flexibility



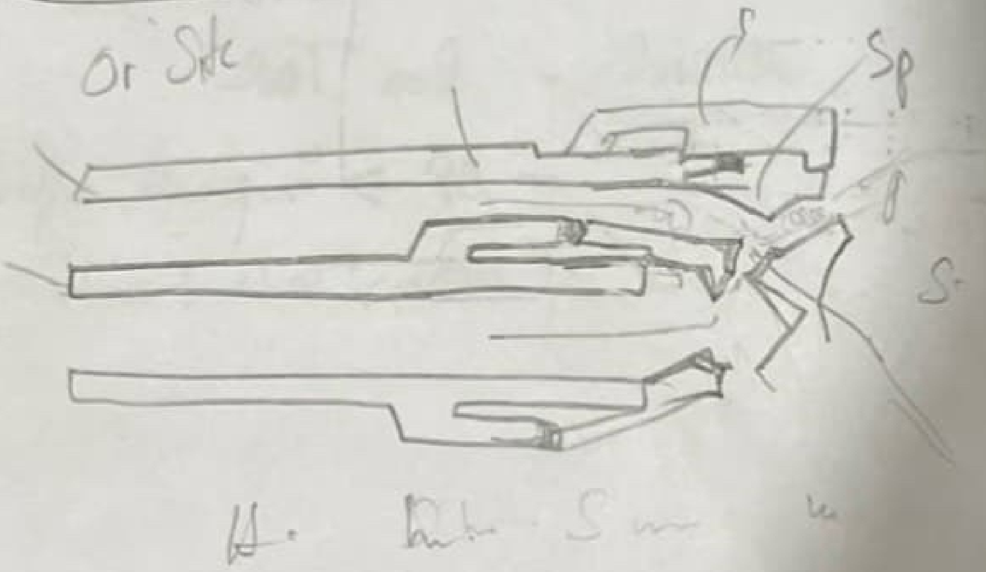


oil is atomised by spraying it into the high velocity jet of steam.

20 Atom ray

Complex

Ste (h



Advantages

→ Improved TD ratio

→ Atomisation is excellent throughout Through put range (Lower firing rates)

→ Improved η_{Boil} equire

→ Improved combustion

Disadvantages

→ Steam consumption

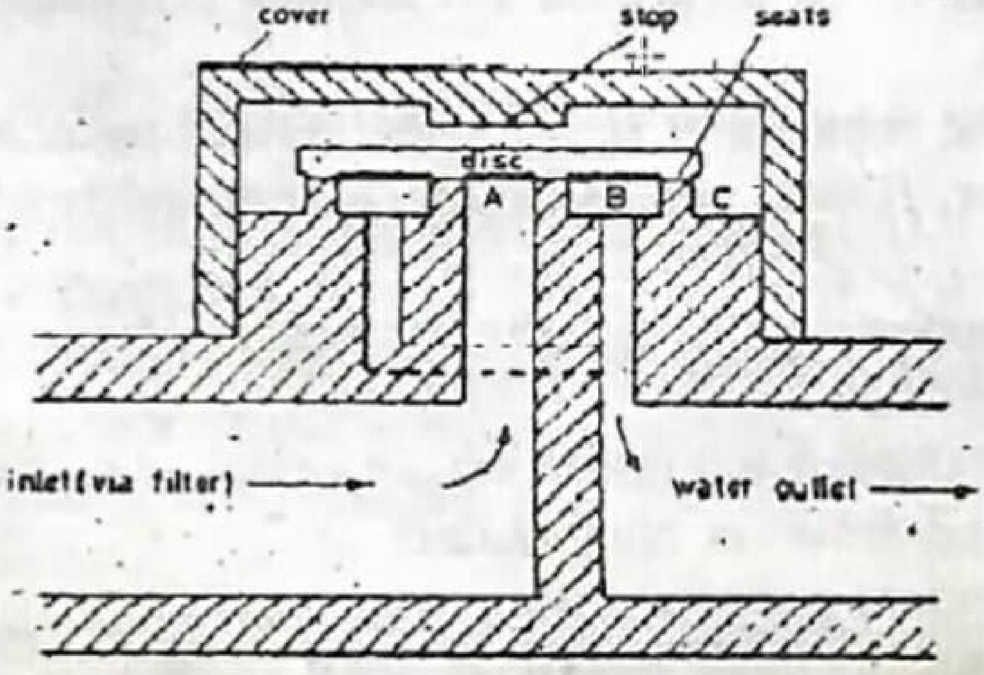
→ Complex burner, E

→ Suitable for Large burne

to close on the inlet. Because of the build-up of static pressure in the space above the disc in this way, and the differential area on which the pressures are acting, the disc is held firmly closed. It will remain so unless the pressure in the space above the disc falls.

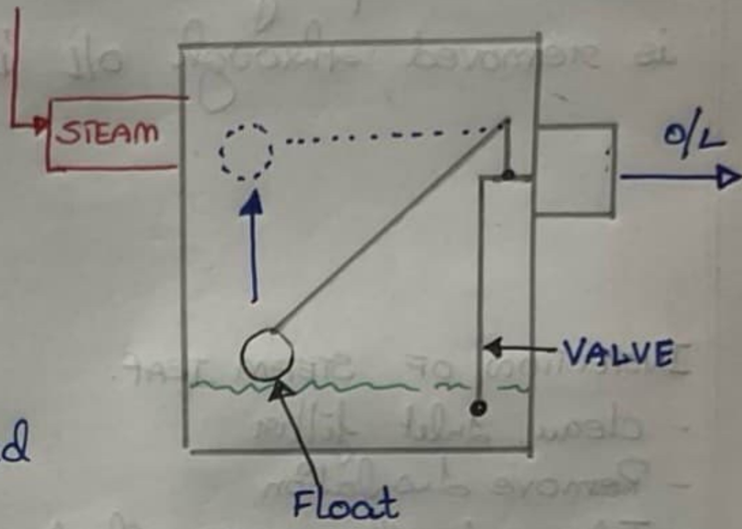
In order that this pressure can fall, and the trap re-open, a small groove is cut across the face of the disc communicating B and C

FIG 128
AIR DRAIN TRAP



i) Float type Steam Traps:

- Normally used in steam turbine Inlet (to remove water droplets)
- Water condensed at the bottom rises as steam condenses which in turn activates a float controlled valve

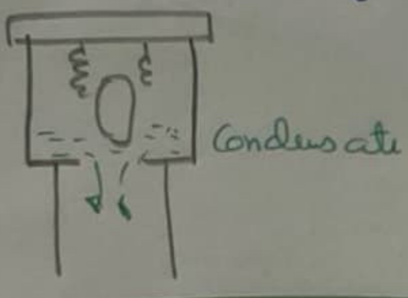


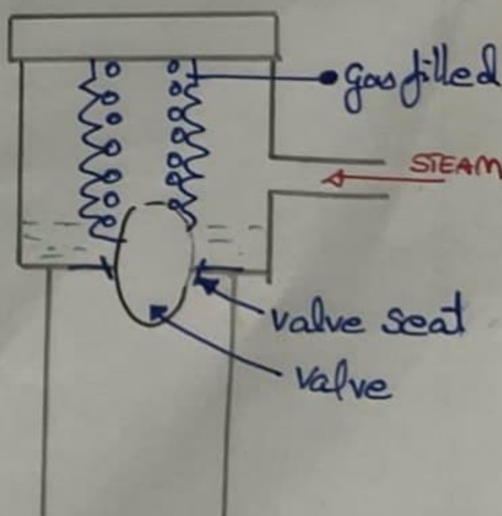
- As the float reaches a maximum position, it opens the valve to remove condensate.

ii) Thermostatic steam Trap:

- A gas filled below expands when steam comes in & steam condenses ⇒ bellow contracts to remove condensate

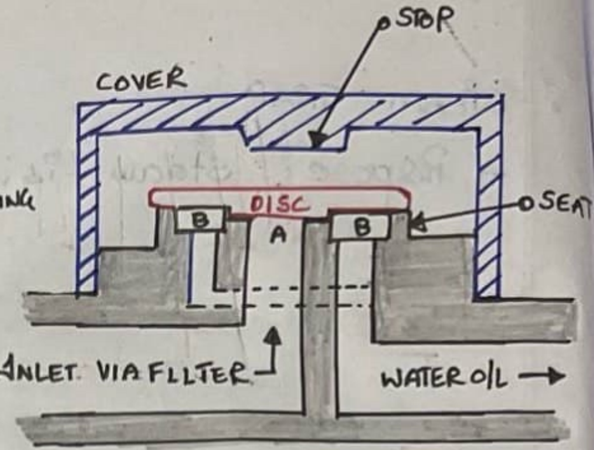
Disadvantage: Bellow may rupture





iii) Thermodynamic Steam Traps:

- Most widely used.
- Should be properly insulated.
- steam is introduced through A ⇒ lifting the disc Some steam passes through B : Water outlet & some steam goes above the disc. and gets trapped closing the disc.



- As water condenses in the inlet side, as it reaches the disc, it lifts the disc as its temperature lowers ⇒ the steam on top of the disc condenses and the condensate is removed through O/L 'B' as shown.

INSPECTION OF STEAM TRAP.

- clean inlet filter
- Remove insulation
- Take out the cover. Check condition, also of
- Lap the disc with the seat

Soot may get collected around the fins
- soot (dry) may get accumulated due to carbon buildup.

There are 3 types of fire in Economizer fire.
a) Minor fire (sparks : always taking place)
b) Soot fire
c) Metal fire

In case of wrong action in case of Minor fires, i.e., carrying out soot blowing, i.e. assuming soot build up steam inducted leads to the formation of Hydrogen
→ highly combustible gas.

i.e., $2H_2O \longrightarrow 2H_2 + O_2 \rightarrow$ support fire

- when Minor fire occurs : a) steam production increases as there is heat transferred to the tubes. & may require to dump the excess steam
b) Economiser outlet temperature is very high
c) Sparks in the funnel.

- Hydrogen fire causes excess heat generation which may result in Metal fire.

Minor fire $\xrightarrow{\text{Wrong Action}}$ Hydrogen fire $\longrightarrow$ Metal

• NOTE : If there is continuous sparks from the funnel, assuming economiser fire, do not carry out steam/air soot blow

- Increase the load (Do not decrease the load as it leads to ineffective combustion ⇒ fire
On increasing the load, gas flow rate will increase and

will provide soot blowing action.

- In an event, if the fire still persists, carry out boundary cooling

Some ships are equipped with fixed fire fighting system supplied by fire line.

- Water will drain into seal pot of drain overflow.

- If still persists, fast stop the engine.

- CORROSION IN BOILERS:
  - Wastage of material due to chemical or Electrochemical reaction is called "Corrossion"
  - Wastage of material due to mechanical reasons, is called "Erosion"

i) OXIDATION CORROSION:
- Air may enter due to leaks in the condensate system
- Dissolved oxygen may enter the boiler.

i.e. $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$ Ferrous Oxide (Red Oxide / Iron Oxide) "Haematite"

Metal starts thinning down. ⇒ "Corrosion"

- To prevent oxygen: Mechanical Methods
  - a) Maintain the feed water temperature or temperature of Hot Well above 70°C.
  - b) Keep the Hot well / cascade tank closed
  - c) Use of Vacuum Condenser: Dissolved gases will be removed.
  - d) Use of De-aerator (Water is sprayed)
  - e) Warming / Cold Starting = Air Vent open to expel air

Chemical Methods:

a) Use of Oxygen Scavengers: Hydrazine (0.2 ppm): HP Boiler

$$N_2H_4 + O_2 \longrightarrow N_2 + 2H_2O$$

- Advantages: i) Hydrazine is a volatile substance
  - Hydrazine vapour gets carried away from with steam & provide corrosion protection in pipings
  - ii) No precipitation or sediments left.
- Disadvantage: Too much hydrazine ⇒ formation of NH_3 ⇒ Ammonium Corrosion.

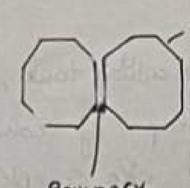
b) Use of Sodium Sulphide: Na_2SO_3 (Used in LP Boiler)

$$2Na_2SO_3 + O_2 \rightarrow 2Na_2SO_4 \text{ (Sodium Sulphate)}$$

- Advantages: a) Safe chemical, b) Caustic Embrittlement is reduced. "Caustic Cracking"
- Disadvantages: a) Increases dissolved solid content.

To much alkalinity
NaOH ⟶ Corrosion
material becomes hard & results in cracking.

→ NOTE: Caustic Embrittlement: Alkanity is too high.

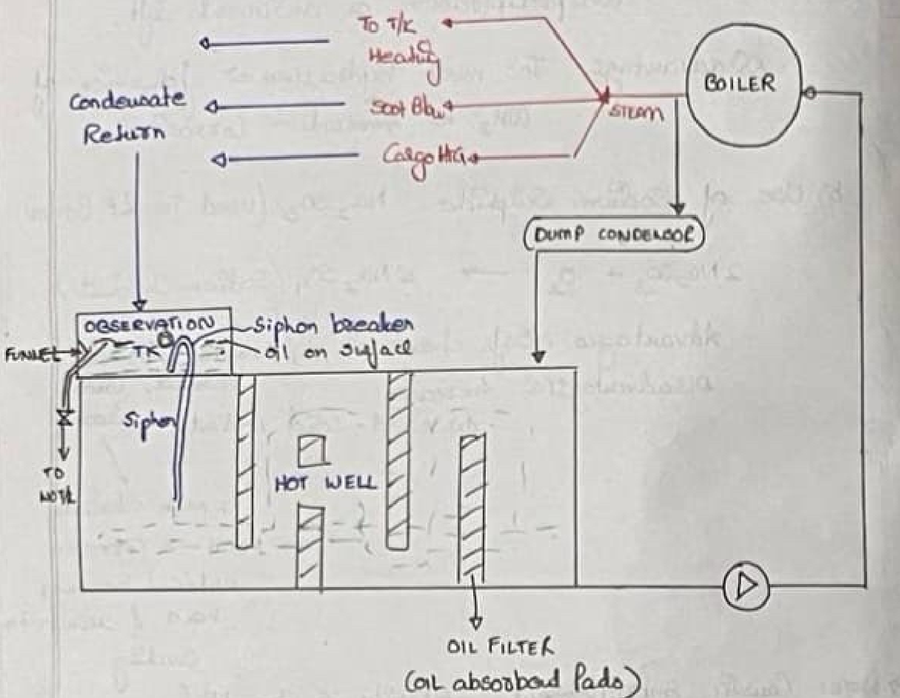


Due to high concentration of alkaline substances, high stresses act at the boundary as too much etching of the boundary takes place leading to cracks.

- In case of high Acidic Nature: Hydrogen Cracking takes place  H + Carbon ⟶ HC ii> ACIDIC CORROSION:

- Oil in water ⇒ formation of acid.

% How to prevent oil being carried over into the boiler?



- If oil is detected in observation tank, identify source of contamination:
  → Check the steam trap of condensate return lines which has a drain. Collect the sample & identify.
- Permanent repairs at Drydock : Replace leaking tube.
- Carry out scum blowdown, maintain pH @ 12 to 13.
- Boil out with caustic solution

• ACIDIC CORROSION:

- Presence of chloride & Sulphates
  ↓ Formation of HCl   ↓ Formation of H_2SO_4

- Addition of Alkaline solution : Sodium Sulphide, NaOH, Na_2CO_3

$$MgCl_2 + 2NaOH \longrightarrow Mg(OH)_2 + 2NaCl.$$

$$CO_2 + H_2O \longrightarrow H_2CO_3 \text{ (Carbonic Acid)}$$

then, $H_2CO_3 + 2NaOH \rightarrow Na_2CO_3 + 2H_2O$

2 TYPES OF HARDNESS:

Permanent Hardness & Temporary hardness.

i) Temporary hardness : $Ca(HCO_3)_2$ ∴ Alkaline Salts / Basic Salts

- Temporary hardness salts do not form hard scales
- Are alkaline salts : $Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2 + H_2O$ (↘ Blowdown)
- On heating water, they decompose & form sludge. Can be removed by blowdown

ii) Permanent Hardness : $MgSO_4$, $CaSO_4$ ⇒ Form hard scales "Acidic Salts" - Cause overheating & rupture "Phosphate treatment"

$$3CaSO_4 + 2Na_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 3Na_2SO_4$$

Sodium Phosphate → Calcium Phosphate

- This Calcium phosphate shall not settle down on heating surface
- So Coagulant is added to trap it & prevent it from settling.

- BOILER WATER TESTS

Purpose: a) To verify & ensure the quality and safety of BLR FW.

b) To detect the ingress of foreign matter & contaminants which may cause scale formation, corrosion & foam carry over.

① pH Test : Using pH meter / litmus paper

- 9.5 to 10

② Alkalinity Test : a) P-Alkalinity

→ Procedure : i) 100ml of BLR Sample + 10 drops (1ml) of phenophthalein

⇒ "Pink Colouration"

Phenophthalein is less alkaline than hydroxyls ($OH^{\ominus}$) & carbonates (CO_3^{-2}), and when it is added to a sample containing ($OH^{\ominus}$) & CO_3^{-2}, it changes colour of the sample to "pink"

ii) Add ml/drops of $\frac{N}{50}$ H_2SO_4

⇒ "clear Solution" (⇒ "Alkalinity Sample to Phenophthalein")

i.e, the acid added will first neutralize $OH^{\ominus}$, forming salts and then react with carbonates to form bicarbonates. One Bicarbonates is formed from 2 molecules of carbonates. Hence, the quantity of acid used is a measure of alkalinity due to $OH^{\ominus}$ and one half of carbonates.

iii) ∴ ml/drops of $\frac{N}{50}$ H_2SO_4 added × 10 = ppm of $CaCO_3$

(2 - 10 ppm)

b) Total Alkalinity

- The p- alkalinity sample is added with Methyl orange (ie, 100 ml BLR FW Sample + 10 drops of phenopthalein

⇓

Pink

- Add drops of $\frac{N}{50}$ H_2SO_4

⇓

clear Solution

+

- Add ⟶ Methyl orange (10 drops)

⇓

Yellow

- Add $\frac{N}{50}$ H_2SO_4 in drops ⟶ Pink

Here, Methyl Orange is less alkaline than $OH^{\ominus}$, & carbonates

bicarbonates are indicated if colour is yellow

- If No yellow colour : No bicarbonates ⇒ No Carbonates

ie, Alkalinity is Only due to $OH^{\ominus}$

⇒ 5 to 15 ppm

i.e, $\frac{N}{50}$ H_2SO_4 in both tests × 10 = ppm of $CaCO_3$

③ Chloride Test : Alkalinity sample to phenophthalein

($Cl^{\ominus}$ due to SW ingress from condenser, leading to scale, acidity & foaming)

+ 2ml H_2SO_4 (To make it fastly react)

+ 20ml Potassium Chromate ($KCrO_3$)

+ $\frac{N}{35.5}$ mL/drops of silver Nitrate ($AgNO_3$)

= Brown Colour

∴ mL/drops of $\frac{N}{35.5}$ $AgNO_3$ × 10 = ppm of $Cl^{\ominus}$

for HP Boilers : 10 - 20 ppm (≤ 50ppm)

④ Conductivity Tests : for Total Dissolved Salts (SW ingress & chemicals)

- Can Cause Scaling, corrosion & foaming

Use Conductivity Meter : 1500 - 3000 μS/cm

⑤ PHOSPHATE TEST:

- To ensure minimum reserve of phosphate to neutralize hardness salts (Ca & Mg salts) which would otherwise cause scale, foam carry over.
- Too less phosphate reserve: Scales ⇒ Overheating
- Too high phosphate reserve: foaming & carry over
  excess sludge deposits
  (Act as insulating layer)

Procedure: Comparator Disc is used

Right Hand: 25 ml of BLR Sample + 25 ml Vanadomolybdate Reagent

Left Hand: 25 ml of equal volume of Vanadomolybdate Reagent + de-ionized water

Place on both compartments: Allow for colouration.

∴ Disc reading = phosphate reserve in ppm (mg/L)

For HP Boiler: 10 - 20 ppm

⑥ HYDRAZINE TEST: Reserve of NH_4 which acts as O_2 Scavenger

Procedure: obtain 250 mL BLR FW Sample + 5 ml HCl

- 2 Nessler Cylinder:
  ① 1st Cylinder: 25 ml above sample + 10 ml 4-dimethyl amino benzaldehyde
  ② 2nd cylinder: 25 ml above sample
- Place in Comparator
- $\frac{\text{Disc Reading}}{25}$ = NH_4 reserve in ppm
- For HP Boiler: 0.05 - 0.1 ppm

BOILER WATER TREATMENT

- The conditioning and treatment of Boiler feed water to ensure efficient & safe heat exchange, quality and quantity of steam and feed water, and to protect from Corrosion

PURPOSE:

i) To prevent scale formation

ii) To prevent corrosion

iii) To detect & prevent foreign particles/contaminants (sludge, oil, rust, mud)

iv) To condition & control sludge formation

following table depicts the recommendations for efficient treatment of Boiler Water

PURPOSE	CHEMICAL	TYPE OF BOILER
To prevent Scale formation	Sodium Phosphate (Na_3PO_4)	All, upto 84 Bar
To give alkalinity & prevent corrosion	Sodium Hydroxide ($NaOH$) Sodium Carbonate (Na_2CO_3)	upto 84 Bar (or) upto 60 Bar
To condition sludge	Polyelectrolytes + Starch (or) sodium Aluminate	upto 84 Bar (or) upto 60 Bar
To remove traces of oxygen	- Sodium Sulphite - Hydrazine (NH_4)	upto 42.0 Bar 31.5 to 84 Bar
To prevent risk of Caustic cracking	. Sodium Sulphate . Sodium Nitrate	upto 31.5 Bar
To prevent risk of carry over of foam	Antifoams	upto 42 Bar
To protect feed water & condensate systems from corrosion	- Filling Amines - Neutralizing Amines	upto 60 Bar from 31.5 to 84 Bar