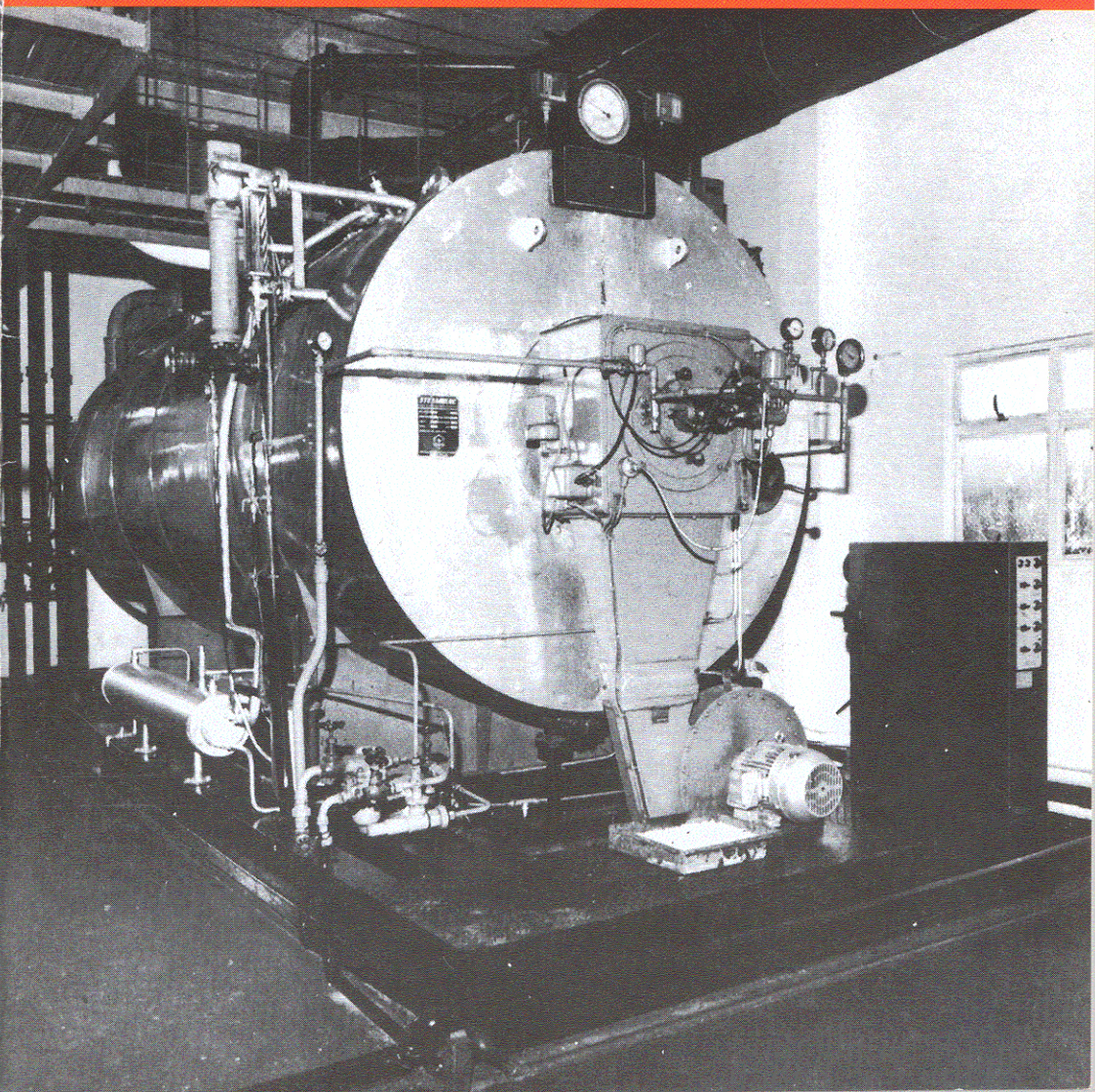


A Guide for Fire-Tube Boiler Operation



Occupational Safety and Health Branch
Labour Department



Factory owners must ensure the boiler is:—

- * Registered with the Boilers and Pressure Vessels Division, Labour Department
- * Examined by an appointed examiner and has a valid certificate of fitness
- * Supervised by a competent person whenever it is steaming
- * In safe working order
- * Properly maintained through regular periodic internal examinations every 14 months by an appointed examiner

A Guide for Fire-tube Boiler Operation

Boilers and Pressure Vessels Authority

Labour Department

May 1993

FOREWORD

This guide explains the main provisions of the Boilers and Pressure Vessels Ordinance, Chapter 56, as applicable to fire tube steam boilers. Essentials of operation are also briefly explained.

This equipment is extensively used in industry and insufficient knowledge about its operation and proper maintenance has caused serious accidents. All personnel engaged in the use of such equipment are strongly advised to familiarise themselves with the contents of this guide.

This guide is not meant to replace the Ordinance or the maker's manuals which remain the final authority for regulating operation of this equipment.

On request, the Labour Department will also offer further advice to owners and operators of such equipment.

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1. GENERAL

The Boilers and Pressure Vessels Ordinance, Cap.56, controls the use and operation of boilers. The responsibilities for personnel involved in its use are:—

OWNER	* apply for registration at least 30 days prior to its being put into use. * engrave the registration number allocated on the boiler in a conspicuous position.
APPOINTED EXAMINER	* examine the boiler and its auxiliary equipment. * seal the safety valve at the approved maximum permissible pressure. * issue a Certificate of Fitness.
COMPETENT PERSON	* possesses certificate of competency issued by the Authority, Labour Department, for his competence to operate the type of boiler he is employed to operate. * follows correct procedure for operation and upkeep of boilers. * supervises the boiler directly at all times when it is in operation. * ensures that the safety valve seal fixed by the appointed examiner is not broken or tampered with.

The owner of a boiler can be prosecuted and fined a maximum of \$50,000 for operating the boiler:—

- * without statutory examination or a valid certificate of fitness.
- * without direct supervision of a competent person.

2. FEATURES OF FIRE-TUBE BOILERS

The fire-tube boilers are potentially dangerous as the steam pressures are high and volume of hot water and steam content is large.

- * water surrounds the tubes through which hot combustion gases pass before venting to atmosphere through gas uptakes.
- * water converted into high pressure steam by transfer of heat from very high temperature combustion gases on water.
- * hot combustion gases produced by burning diesel oil, town gas etc. in the furnace.
- * boilers are of fully automatic design.
- * essential mountings include safety valve, steam pressure switch, pressure gauge, gauge glass, valve fittings, low-water level cut-off and alarm devices etc.

FIRE-TUBE BOILER

- | | | |
|----------------------|----------------------|-----------------------|
| 1. Smoke outlet | 9. Reversing chamber | 14. Feed water valve |
| 2. Reversing chamber | (front side) | 15. Safety valve |
| (rear side) | 10. Feed water | 16. Blow down valve |
| 3. Boiler body | control switch | 17. Water gauge glass |
| 4. Boiler frame | 11. Steam pressure | 18. Lower water level |
| 5. Furnace | switch | cut-off and alarm |
| 6. Smoke tube | 12. Main stop valve | devices |
| 7. Burner | 13. Manhole | 19. Pressure gauge |
| 8. Flame detector | | |

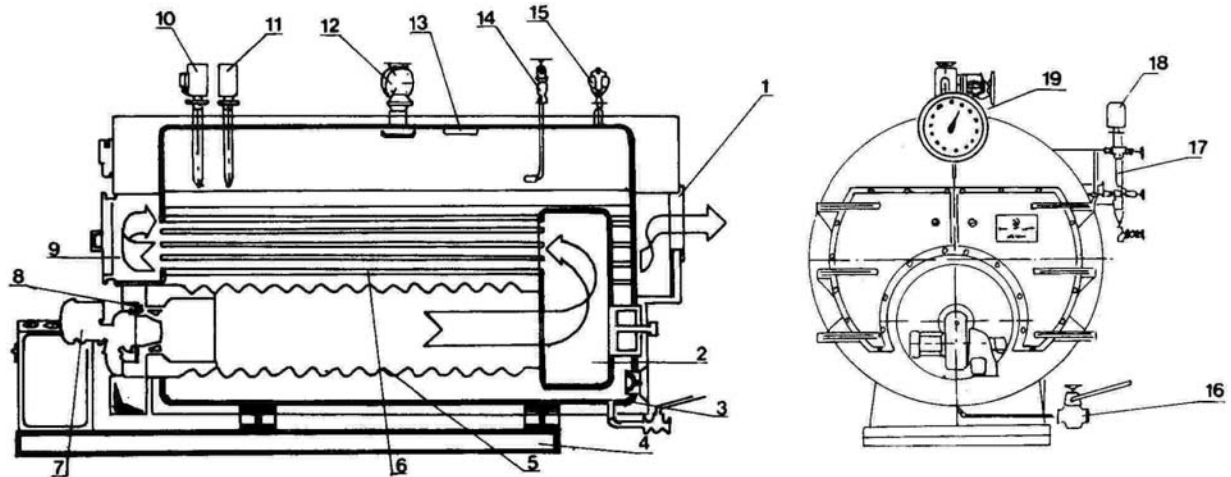


Fig. 1

3. FLASHING UP PROCEDURE

- (a) Check Certificate of Fitness and its validity date.
- (b) Check maximum permissible working pressure which is indicated by a red line on pressure gauge fitted.
- (c) Check and close drain valves.
- (d) Open water and steam cocks of water gauge glass and shut its drain cock.
- (e) Clean and examine filter in feed water system.
- (f) Open feed water tank outlet valve, and ensure water level in tank is at least half the gauge glass.
- (g) Check fuel oil daily service tank level and drain off any water present.
- (h) Clean and examine filters in fuel oil system.
- (i) Shut main steam stop valve and open air vent.
- (j) Switch on power supply. Feed water pump will automatically supply water to boiler till approximately half gauge glass.
- (k) Fuel oil pump will automatically start. Fuel oil, if heavy diesel oil, will circulate through fuel oil heater till the desired operating temperature reached.
- (l) The blower motor will start and purge furnace for at least 1-2 minutes to clear any combustible gas accumulated in the furnace and avoid a blow back.
- (m) The burner will be ignited according to an automatic sequence, initially at low fire rate.
- (n) When steam comes out from air vent, shut off air vent and switch to high fire rate. Steam pressure will gradually increase to normal working pressure.
- (o) Check gauge glass, safety valve, and all automatic safety devices to ensure they are functioning normally.
- (p) Open steam valve very slowly to permit warming through and draining of the cold steam pipes to avoid damage due to water hammer.

FEED WATER SYSTEM

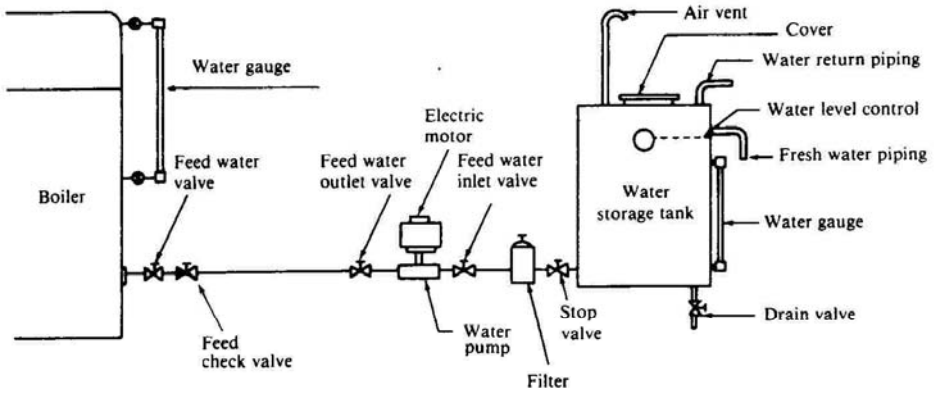


Fig. 2

FUEL OIL SYSTEM

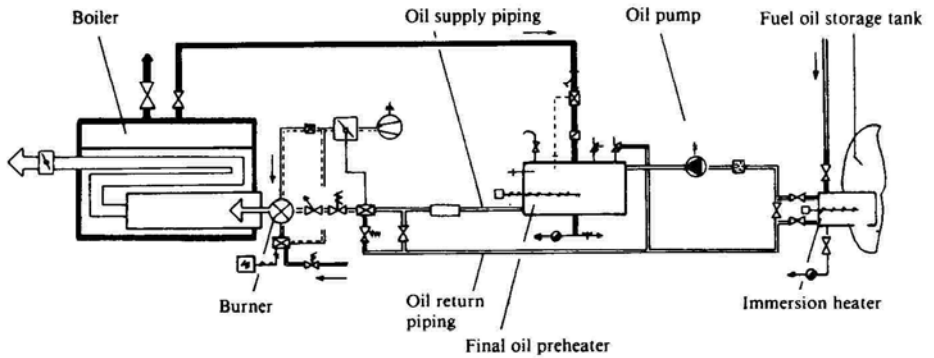


Fig. 3

4. TESTING OF GAUGE GLASS

When the boiler is in operation, the steam cocks A, D and water cocks B, E are open and drain cock C is shut. FIG. 4

- (a) First shut both steam and water cocks A, D, B and E. Open drain cock C to prove that all the gauge cocks are in order. Then, with the drain cock C still open, cocks B and E should be opened. If water blows out freely from cock C, cocks B and E are clear. FIG. 4(A).
- (b) Shut off cocks B and E and open cocks A and D with the drain cock C still open. If steam blows out freely from cock C, cocks A and D are clear. FIG. 4 (B).
- (c) To cross test, close cocks D and B, leaving E, A and C open. If water blows out from cock C, then E, A and the water-column are in order. FIG. 4(C).
- (d) Close cocks E and A leaving D, B and C open. If steam blows out from cock C, then D, B and the water-column are in order. FIG. 4(D).

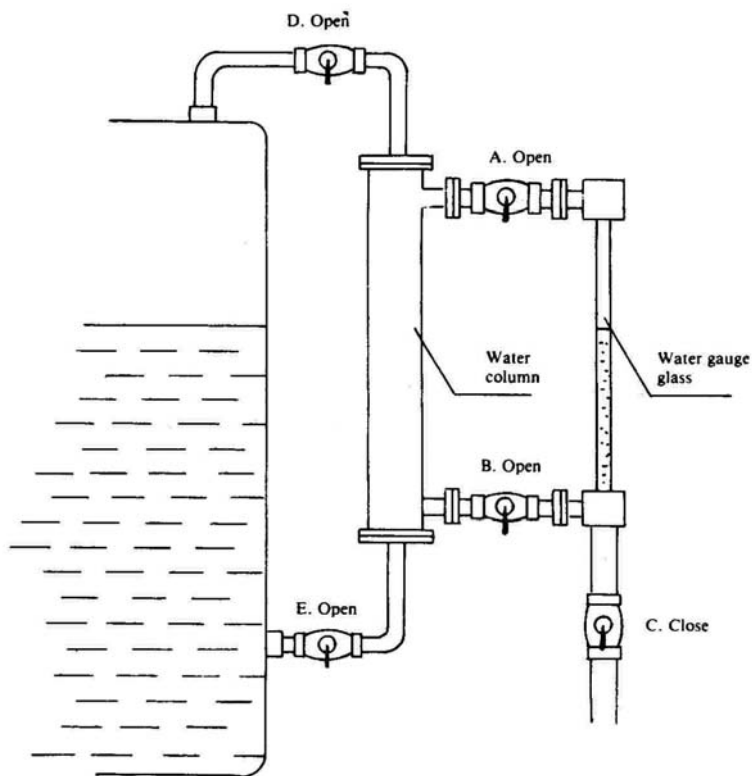


Fig. 4

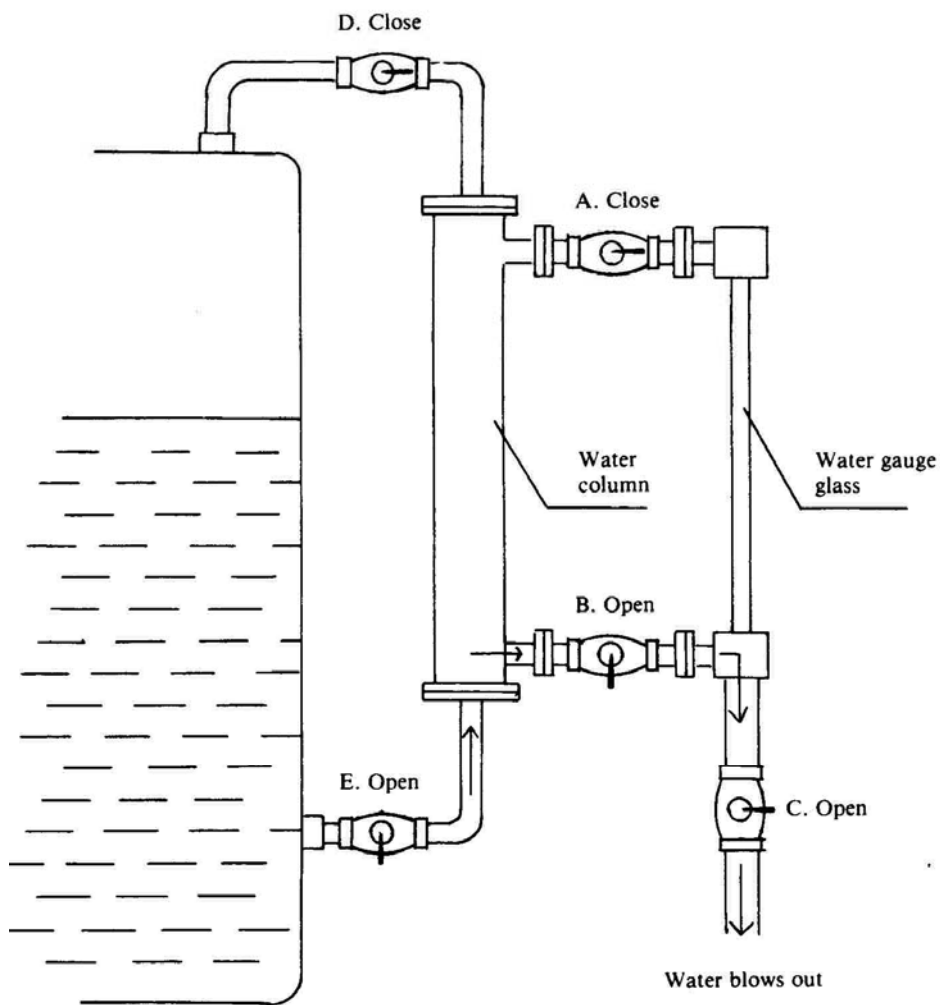


Fig. 4(A)

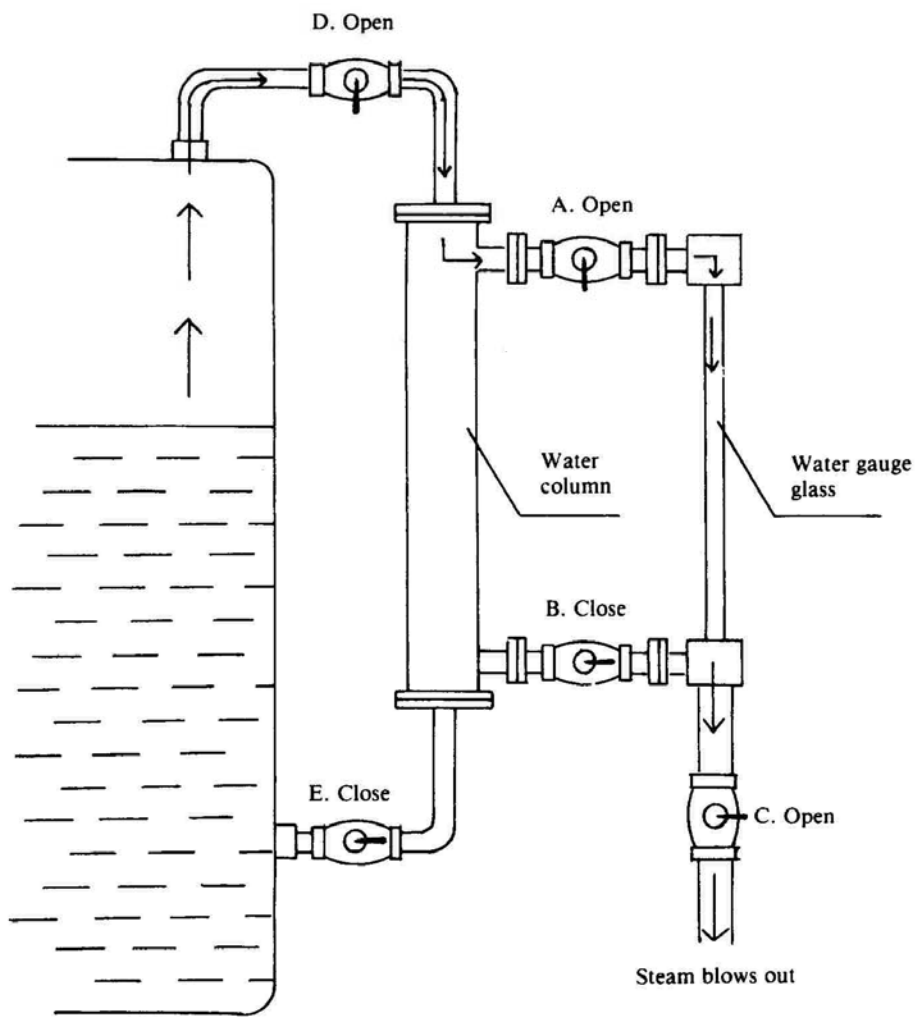


Fig. 4(B)

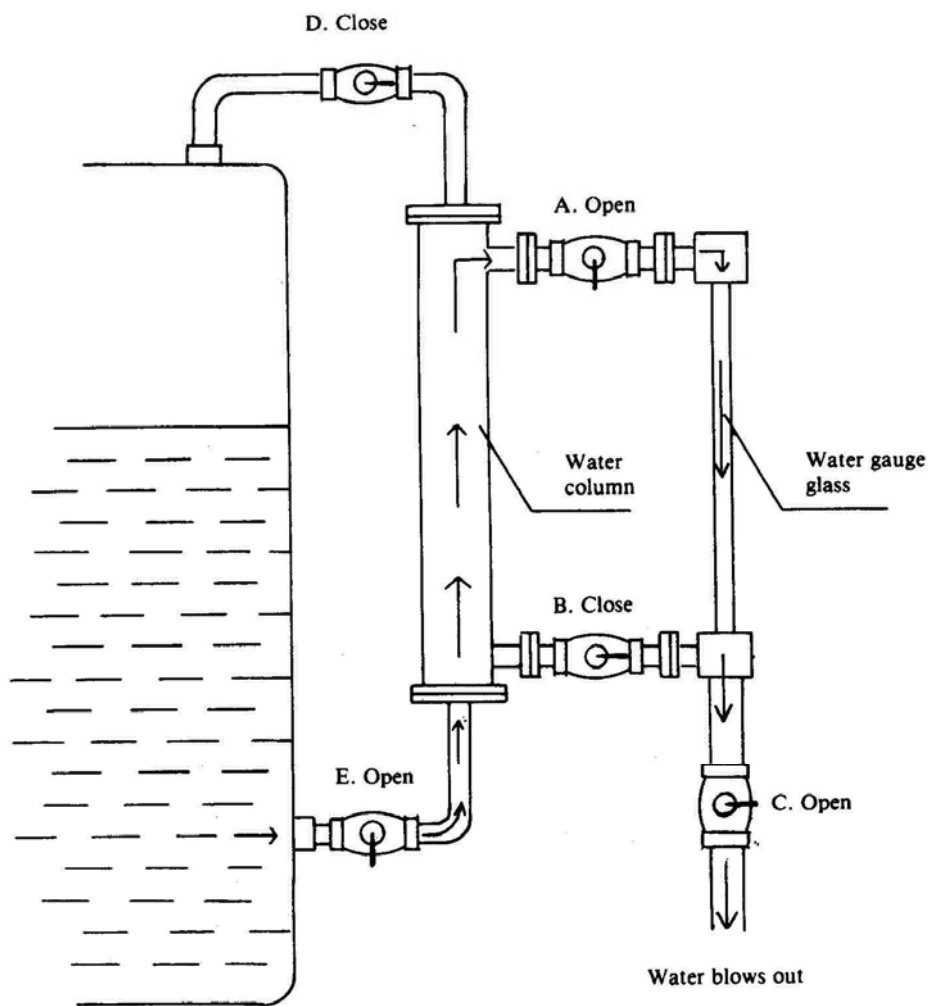


Fig. 4(C)

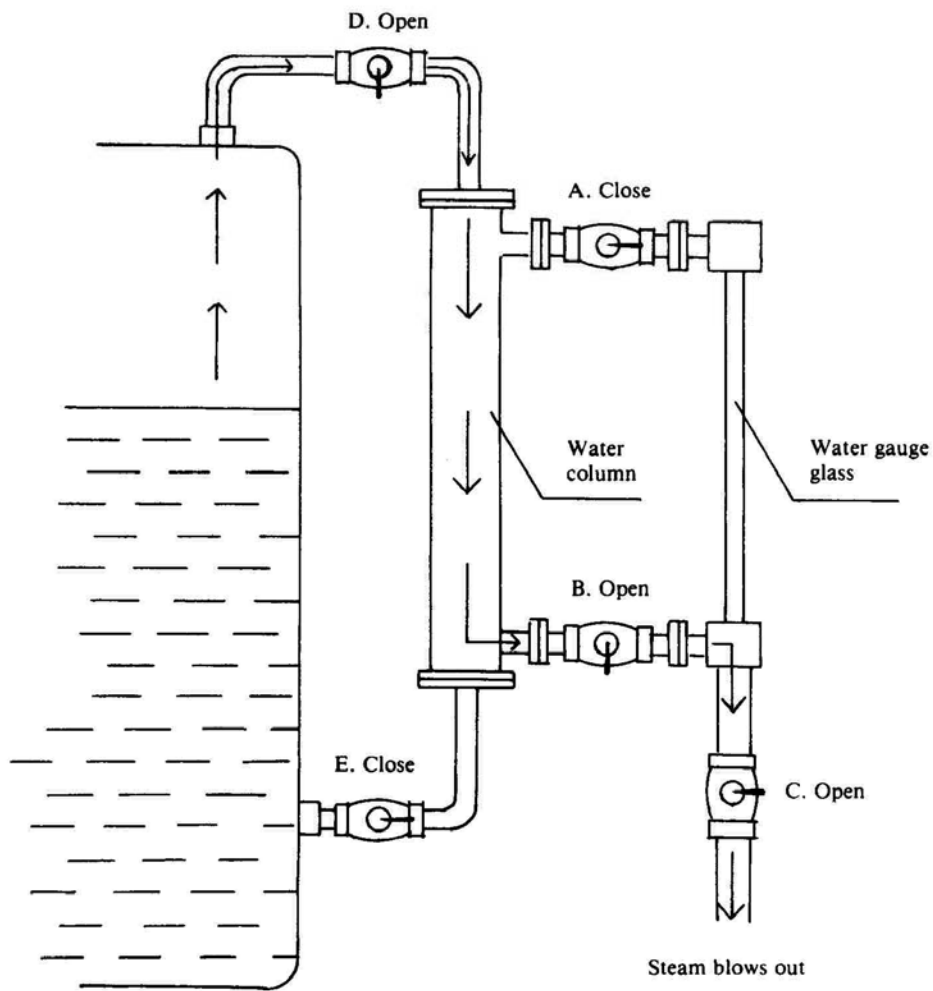


Fig. 4(D)

Possible causes of gauge glass indicating incorrect level

- (a) If cocks A and D or steam passage is shut or choked, boiler pressure will press the water level in the glass higher than the real water level of the boiler. The water level indication in glass will, therefore, be incorrect.
- (b) If cocks B and E or water passage is shut or choked, steam will condense on upper column of glass and accumulate. The apparent water level shown can be higher than the actual water level, causing false reading.

Water gauge glass should be tested daily at least at every change of attendant. The safety of boiler operation relies greatly on proper functioning of the water gauge glass.

5. LOW-WATER LEVEL CUT-OFF SWITCH

This device should be checked daily to ensure it is in normal working order. Switch off the feed water pump, drain the float control water chamber. If boiler is tripped off automatically, the device is in good order.

LOWER WATER LEVEL CUT-OFF

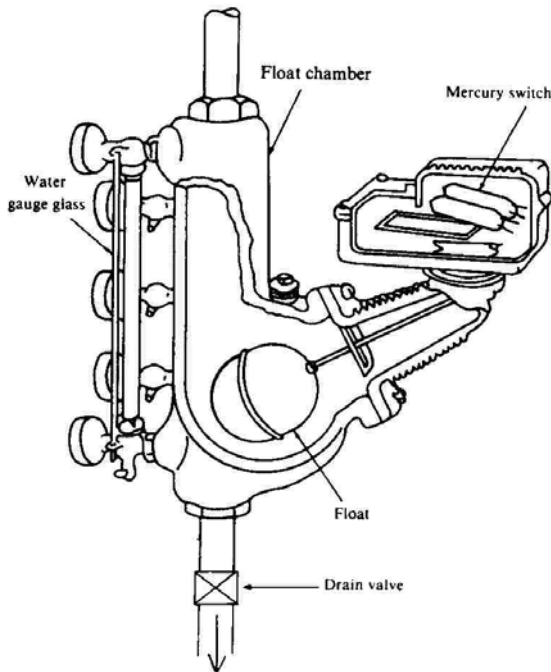


Fig. 5

6. STEAM PRESSURE TESTING OF SAFETY VALVE

The safe operation of steam boiler depends on the correct functioning of the safety valve. The safety valve should be lifted daily with the easing gear to prevent sticking of valve seat and it should be pressure tested weekly as follows:-

- (a) Shut off main steam stop valve.
- (b) Adjust steam pressure switch to a setting slightly higher than maximum permissible working pressure.
- (c) With boiler on maximum firing rate, observe the pressure gauge. When steam pressure reaches m.p.w.p., safety valve will automatically open to release steam pressure. That means safety valve is set correctly and working. Maximum permissible working pressure can be obtained from the Certificate of Fitness.
- (d) If the safety valve does not open when the steam pressure reaches the m.p.w.p., boiler should be stopped immediately, and the easing gear operated to release steam and lower the boiler pressure. Call the Appointed Examiner for examination immediately.

SAFETY VALVE

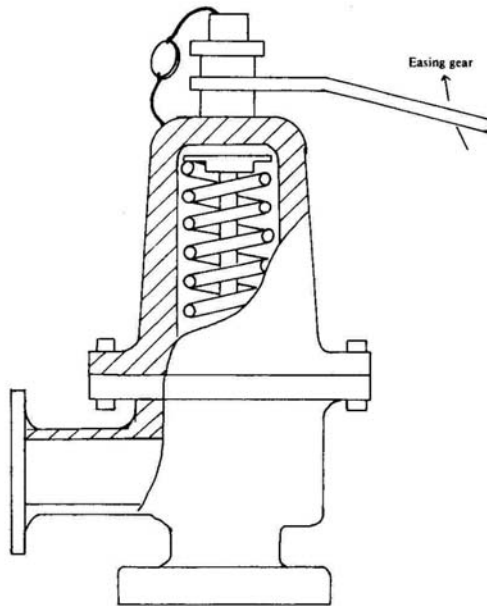


Fig. 6

7. TESTING OF STEAM PRESSURE SWITCH

This switch should be checked daily to ensure it is functioning properly. During the initial start, make sure the boiler can be tripped off automatically when boiler pressure attains the cut-off value of the pressure switch. Cut off pressure and differential pressure can be adjusted with the adjusting screw on top of the switch to suit the requirement of the factory.

STEAM PRESSURE SWITCH

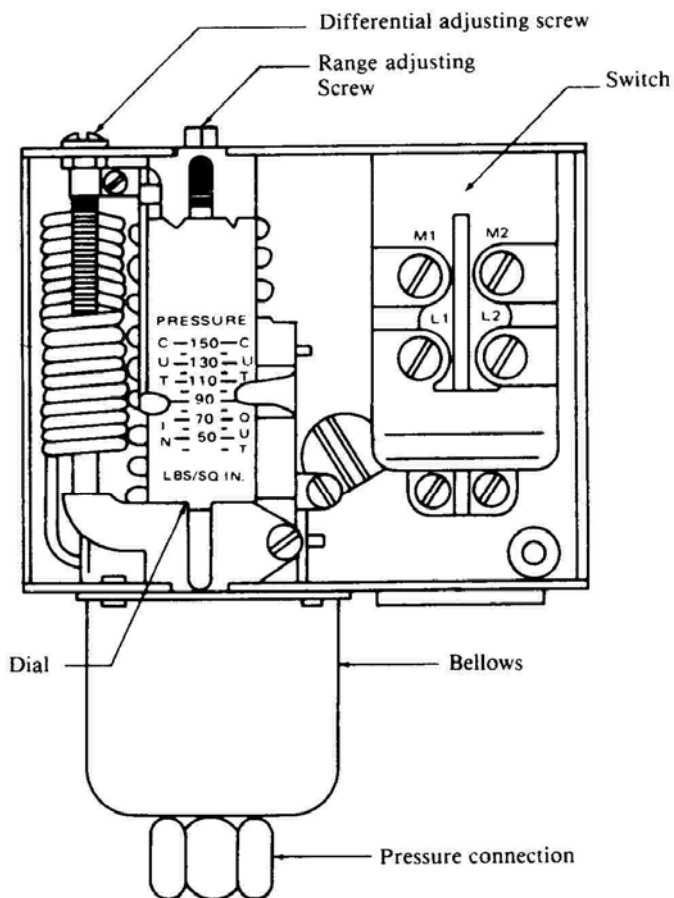


Fig. 7

8. TESTING OF FLAME DETECTOR

The detector should be tested weekly to ensure it is in normal working order. An easy method of testing is by removing the detector head from the boiler and shielding the sensing head with hand. If boiler trips off automatically, the flame detector is in satisfactory condition.

FLAME DETECTOR (FLAME EYE)

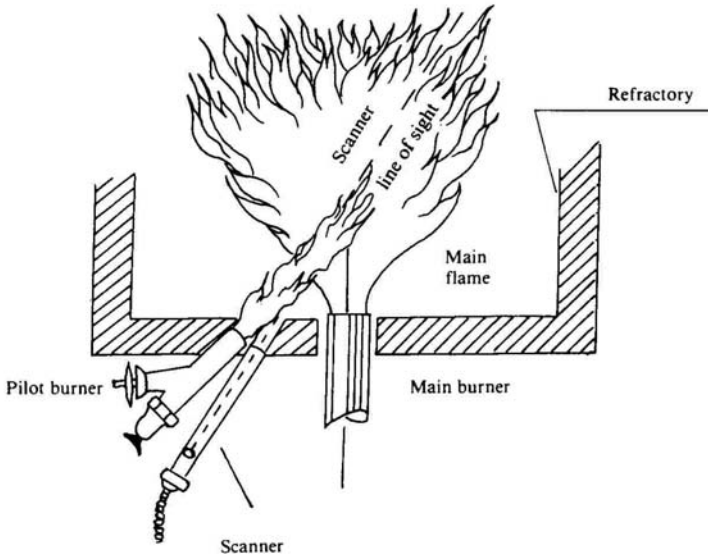


Fig. 8

9. FIRE-TUBE BOILER EMERGENCIES

- (a) When the boiler is steaming with water level not visible in the gauge glass, *shut off the burner immediately*. Test the gauge glass or test cocks. If low water level established in the boiler *NEVER* add water into the boiler right away. Locate and rectify the fault, wait until the boiler has cooled down, seek advice of an Appointed Examiner for identifying defect or damage before flashing the boiler again.
- (b) If the steam pressure exceeds the maximum permissible working pressure without lifting of safety valve, *shut off the boiler immediately*. Operate the easing gear to release steam. If safety valve still does not open automatically, release steam from air vent valve and contact an Appointed Examiner for examination and advice on repair.

- (c) Boiler water should be tested and chemically treated according to manufacturer's schedule or on the advice of an Appointed Examiner. This will avoid corrosion and scale formation on heating surfaces. Wastage of furnace, fire tubes or boiler shell can develop and cause boiler explosion. Consult an Appointed Examiner for advice.

10. HANDLING OF BOILER FIRES

- (a) First raise fire alarm or shout to let all workers in the factory know of the fire.
- (b) Shut off the main power supply for boiler room. Shut off the fuel oil isolating valve. Stop the boiler, and switch off the ventilation fan.
- (c) Locate the site of fire, and check the cause and nature of fire. Use appropriate fire extinguishers for different type of fires:—

Oil fire : foam, dry powder etc.

Electric fire : CO₂, dry powder etc.

11. IMPORTANT POINTS FOR COMPLIANCE BY WORKERS AND FACTORY OWNERS

- * Don't break the seal of the safety valve, or try to adjust its setting to increase the boiler pressure. This endangers the safety, will cause over-pressure of the boiler and may cause boiler explosion with consequent injuries to personnel.
- * All automatic safety devices such as safety valve, pressure switch and low-water cut-off switches should be tested periodically to ensure they are in good working condition at all times.
- * If accident happens to a boiler or its auxiliary, owner must immediately stop using the boiler and report the accident to the Authority of Boilers and Pressure Vessels within 24 hours. The owner can be prosecuted and fined a maximum of \$10,000 for not complying this requirement.

12. ENQUIRIES

- * For all enquiries please contact the BOILERS AND PRESSURE VESSELS DIVISION of the Labour Department. The address is as follows:—

Unit 01-02, 20/F, Millennium City 6,
392 Kwun Tong Road, Kwun Tong, Kowloon
Telephone: 3107 3458



Occupational Safety and Health Branch
Labour Department

Contact Information Updated - 2015

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