10.1 BOILER MOUNTINGS AND THEIR FUNCTIONS

Different fittings and devices necessary for the operation and safety of a boiler are known as boiler mountings. The safety valve, water level indicator, and the fusible plug are the devices used for the safety operation of the boiler. The pressure gauge, feed check valve, blow-off cock and steam stop valve fall under the category of fittings and these are essential for the operation of the boiler.

Safety Valves. When there is a sudden drop in steam requirements, the steam pressure in the boiler will increase. The main function of a safety valve is to prevent under such a condition, an increase in the steam pressure in the boiler exceeding a predetermined maximum pressure for which the boiler is designed. This is automatically done by opening of the valve and discharging the steam to the atmosphere as soon as the pressure inside the boiler increases above the predetermined value. The safety valves are directly placed on the top of the boiler shell. The different types of the safety valves which are commonly used are discussed below.

10.2 SPRING-LOADED SAFETY VALVE

This type of safety valve is commonly used now-a-days for stationary as well as mobile boilers. It is loaded with spring instead of weights. The spring is made from a square steel rod in helical form.

A spring loaded safety valve commonly used on Locomotive boiler is shown in Fig. 10.1. It consists of two valves, each of which is placed over a valve seat fixed over a branch pipe as shown in the figure. The two branch pipes are connected to a common block which is fixed on the shell of the boiler. The lever has two pivots each of which is placed over each respective valve. The lever is attached with a spring at its middle which pulls the lever in downward direction. The lower end of the spring is attached to the back as shown in the figure. Thus the valves are held tight to their seats by the spring force.

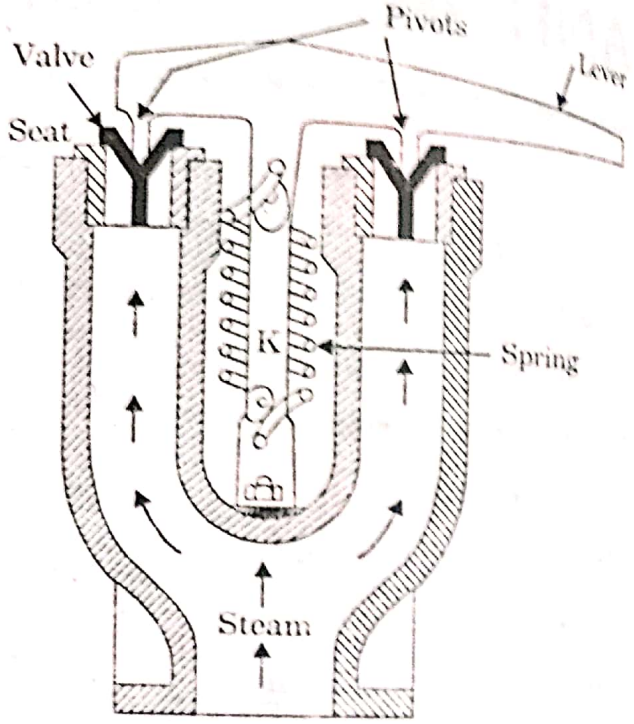


Fig. 10.1. Spring loaded safety valve.

These valves are lifted against the spring when the steam pressure is greater than the working pressure and allows the steam to escape from the boiler till the pressure in the boiler reaches its working pressure. The lever has an extension which projects into the driver's cabin. The driver can release the pressure if required just by raising the lever. The lever is connected loosely by a link to the block. This limits the valve opening and prevents the lever blowing off in case of spring failure.

The valve is much lighter and compact compared with other safety valves; therefore, they are preferred on all stationary and mobile boilers.

14.3. Water Level Indicator

It is an important fitting, which indicates the water level inside the boiler to an observer. It is a safety device, upon which the correct working of the boiler depends. This fitting may be seen in front of the boiler, and are generally two in number.

A water level indicator, mostly employed in the steam boiler is shown in Fig. 14.1. It consists of three cocks and a glass tube. Steam cock C_1 keeps the glass tube in connection with the steam space. Water cock C_2 puts the glass tube in connection with the water in the boiler. Drain cock C_3 is used at frequent intervals to ascertain that the steam and water cocks are clear.

In the working of a steam boiler and for the proper functioning of the water level indicator, the steam and water cocks are opened and the drain cock is closed. In this case, the handles are placed in a vertical position as shown in Fig. 14.1. The rectangular passage at the ends of the glass tube contains two balls.

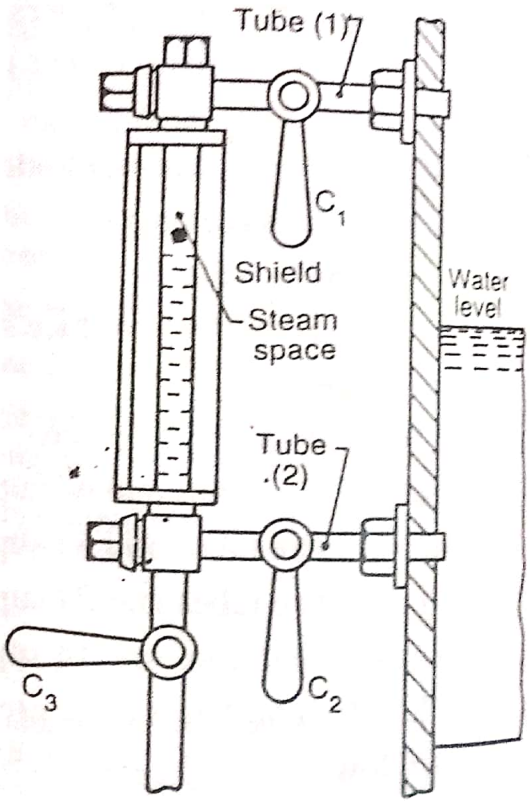


Fig. 14.1. Water level indicator.

is kept free from ...

14.4. Pressure Gauge

A pressure gauge is used to measure the pressure of the steam inside the steam boiler. It is fixed in front of the steam boiler. The pressure gauges generally used are of Bourden type.

A Bourden pressure gauge, in its simplest form, consists of an elliptical elastic tube ABC bent into an arc of a circle, as shown in Fig. 14.2. This bent up tube is called Bourden's tube.

One end of the tube gauge is fixed and connected to the steam space in the boiler. The other end is connected to a sector through a link. The steam, under pressure, flows into the tube. As a result of this increased pressure, the Bourden's tube tends to straighten itself. Since the tube is encased in a circular curve, therefore it tends to become circular instead of straight. With the help of a simple pinion and sector arrangement, the elastic deformation of the Bourden's tube rotates the pointer. This pointer moves over a calibrated scale, which directly gives the gauge pressure.

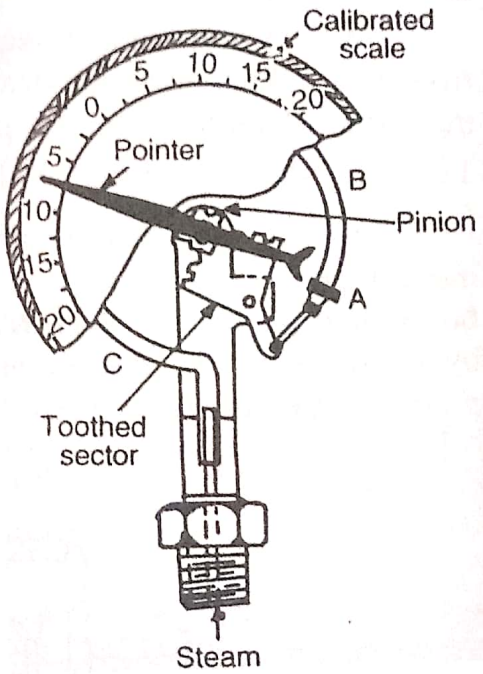


Fig. 14.2. Bourden type pressure gauge.

14.5. Safety Valves

14.10. Steam Stop Valve

It is the largest valve on the steam boiler. It is, usually, fitted to the highest part of the shell by means of a flange as shown in Fig. 14.7. The principal functions of a stop valve are :

1. To control the flow of steam from the boiler to the main steam pipe.
2. To shut off the steam completely when required.

The body of the stop valve is made of cast iron or cast steel. The valve, valve seat and the nut through which the valve spindle works, are made of brass or gun metal.

The spindle passes through a gland and stuffing box. The spindle is rotated by means of a hand wheel. The upper portion of the spindle is screwed and made to pass through a nut in a cross head carried by two pillars. The pillars are screwed in the cover of the body as shown in the figure. The boiler pressure acts under the valve, so that the valve must be closed against the pressure. The valve is, generally, fastened to the spindle which lifts it up.

A non-return valve is, sometimes, fitted near the stop valve to prevent the accidental admission of steam from other boilers. This happens when a number of boilers are connected to the same pipe, and when one is empty and under repair.

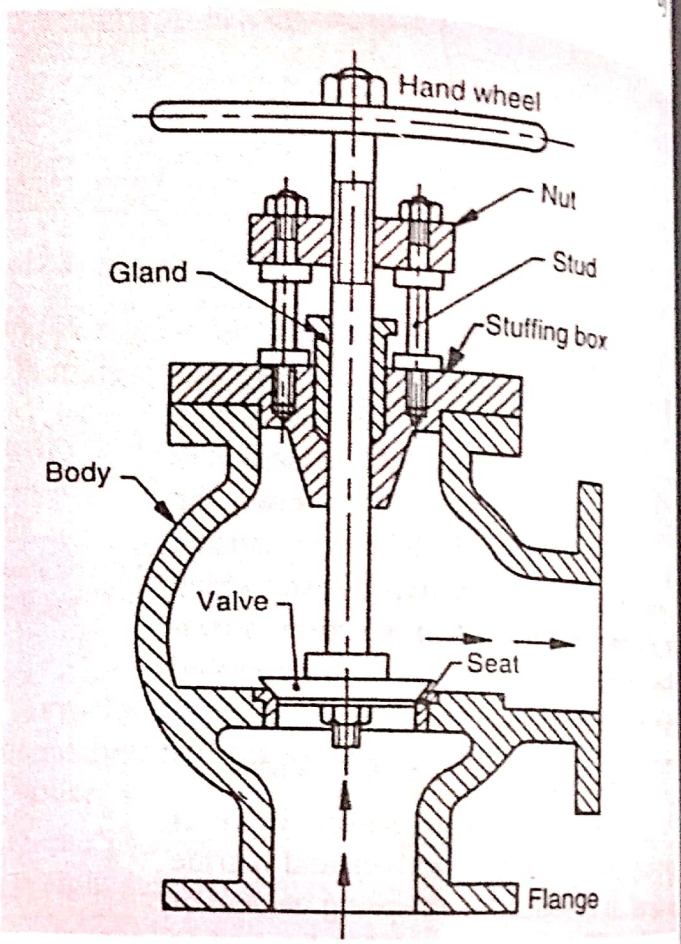


Fig. 14.7. Steam stop valve.

14.11. Blow off Cock

The principal functions of a blow-off cock are :

1. To empty the boiler whenever required.
2. To discharge the mud, scale or sediments which are accumulated at the bottom of the boiler.

The blow-off cock, as shown in Fig. 14.8, is fitted to the bottom of a boiler drum and consists of a conical plug fitted to the body or casing. The casing is packed, with asbestos packing, in grooves round the top and bottom of the plug. The asbestos packing is made tight and plug bears on the packing. It may be noted that the cocks packed in this way keep the grip better under high pressure and easily operated than unpacked.

The shank of plug passes through a gland and stuffing box in the cover. The plug is held down by a yoke and two stud bolts (not shown in the figure). The yoke forms a guard on it. There are two vertical slots on the inside of a guard for the box spanner to be used for operating the cock.

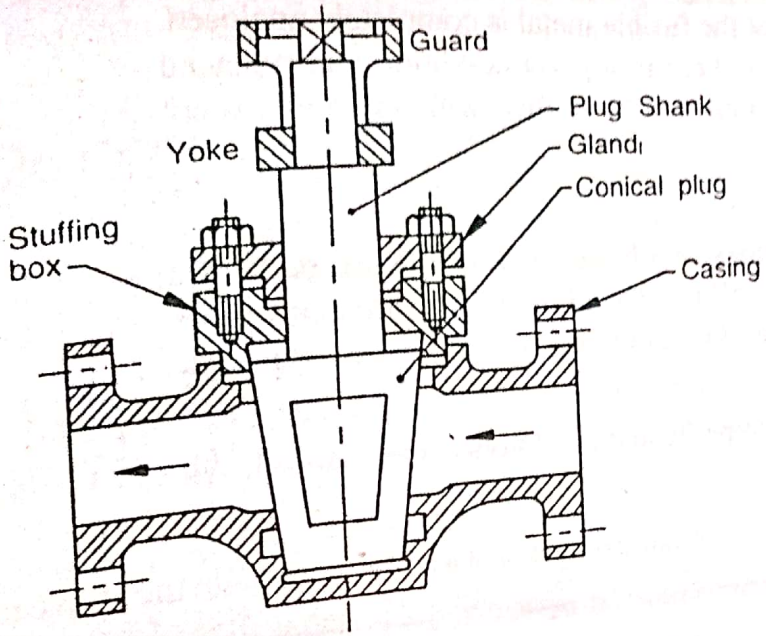
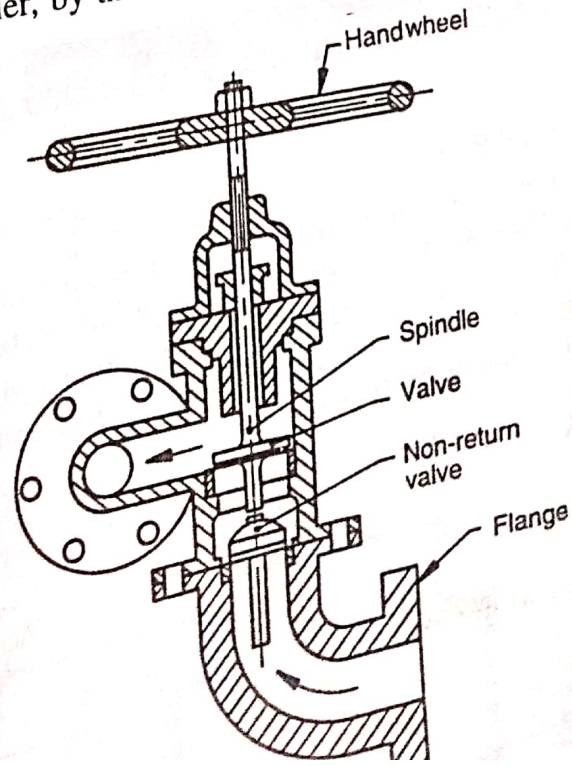


Fig. 14.8. Blow off cock.

14.12. Feed Check Valve

It is a non-return valve, fitted to a screwed spindle to regulate the lift. Its function is to regulate the supply of water, which is pumped into the boiler, by the feed pump. This valve must have its spindle lifted before the pump is started. It is fitted to the shell slightly below the normal water level of the boiler.



A feed check valve for marine boilers is shown in Fig. 14.9. It consists of a valve whose lift is controlled by a spindle and hand wheel. The body of the valve is made of brass casting and except spindle, its every part is made of brass. The spindle is made of muntz metal. A flange is bolted to the end of boiler at a point from which perforated pipe leads the feed water. This pipe distributes the water in the boiler uniformly.

14.13. Feed Plug ... of the

10.6 FUSIBLE PLUG

The main object of the fusible plug is to put off the fire in the furnace of the boiler when the water level in the boiler falls below an unsafe level and thus avoids the explosion which may take place due to overheating of the tubes and shell. This plug is generally fitted over the crown of the furnace or over the combustion chamber.

A fusible plug which is commonly used is shown in Fig. 10.5. *A* is a hollow gun metal body screwed into the crown of the boiler grate. *B* is a second hollow gunmetal plug screwed into the plug *A*. The third plug *C* is locked with plug *B* by pouring a low melting point metal into groove provided for the same.

Under normal water level condition in the boiler, this plug is covered with water which keeps the temperature of the fusible metal below its melting point. But when the water level in the boiler falls low enough to uncover the plug; the fusible metal between the plugs *B* and *C* quickly melts and the plug *C* drops out. The opening so made allows the steam to rush the water into the furnace and extinguish the fire. The steam rushing out puts out the fire and gives warning that the crown of the furnace is in danger of being overheated.

10.7 FEED CHECK VALVE

fusible metal.

14.14. Boiler Accessories

These are the devices which are used as integral parts of a boiler, and help in running efficiently. Though there are many types of boiler accessories, yet the following are important from the subject point of view :

1. Feet pump ; 2. Superheater ; 3. Economiser ; and 4. Air preheater.

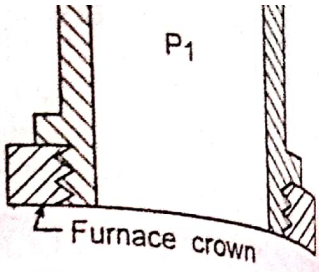


Fig. 14.10. Fusible plug.

Fig. 14.11 shows the schematic diagram of a boiler plant with the above mentioned accessories.

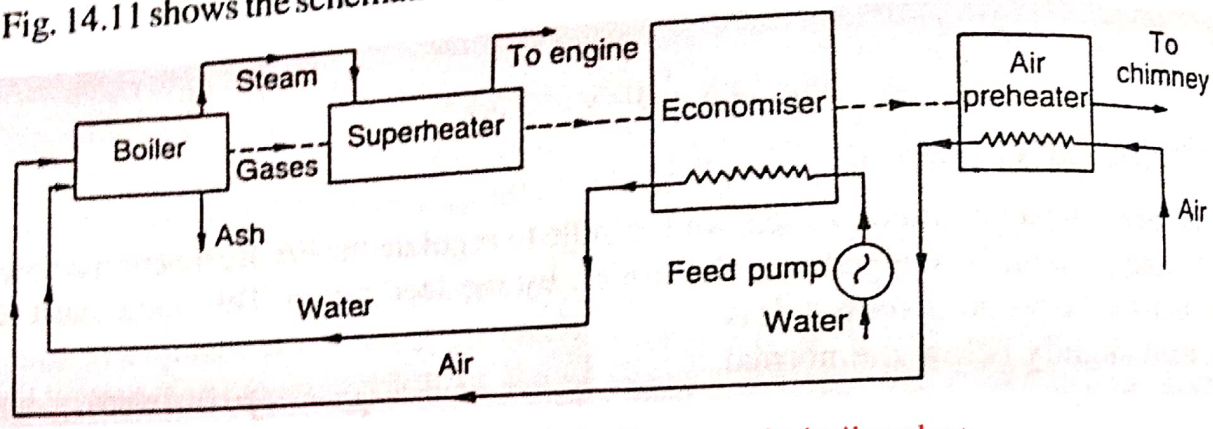


Fig. 14.11. Schematic diagram of a boiler plant.

14.15. Feed Pump

We know that water, in a boiler, is continuously converted into steam, which is used by the engine. Thus we need a feed pump to deliver water to the boiler.

The pressure of steam inside a boiler is high. So the pressure of feed water has to be increased proportionately before it is made to enter the boiler. Generally, the pressure of feed water is 20% more than that in the boiler.

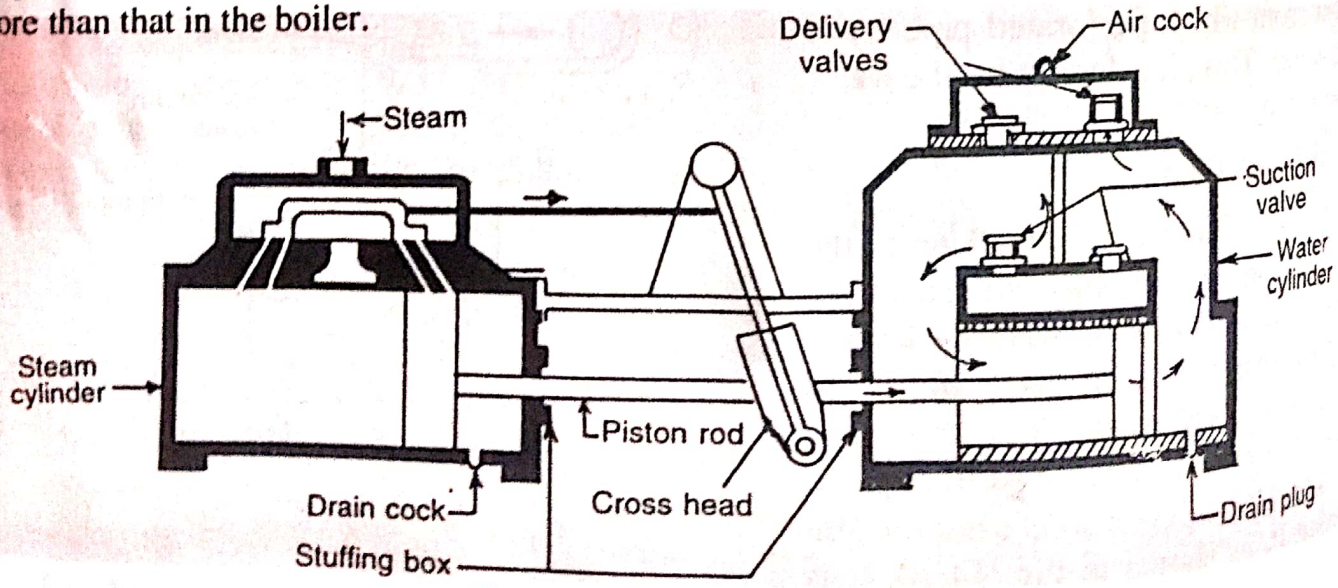


Fig. 14.12. Duplex feed pump.

A feed pump may be of centrifugal type or reciprocating type. But a double acting reciprocating pump is commonly used as a feed pump these days. The reciprocating pumps are run by the steam

from the same boiler in which water is to be fed. These pumps may be classified as simplex, duplex and triplex pumps according to the number of pump cylinders. The common type of pump used is a duplex feed pump, as shown in Fig. 14.12. This pump has two sets of suction and delivery valves for forward and backward stroke. The two pumps work alternately so as to ensure continuous supply of feed water.

14.16. Superheater

A superheater is an important device of a steam generating unit. Its purpose is to increase the temperature of saturated steam without raising its pressure. It is generally an integral part of a boiler, and is placed in the path of hot flue gases from the furnace. The heat, given up by these flue gases, is used in superheating the steam. Such superheaters, which are installed within the boiler, are known as integral superheaters.

A Sudgen's superheater commonly employed with Lancashire boilers is shown in Fig. 14.13. It consists of two mild steel boxes or heaters from which hangs a group of solid drawn tubes bent to U-form. The ends of these tubes are expanded into the headers. The tubes are arranged in groups of four and one pair of headers generally carries ten of these groups or forty tubes in all. The outside of the tubes can be cleaned through the space between the headers. This space is closed by covers.

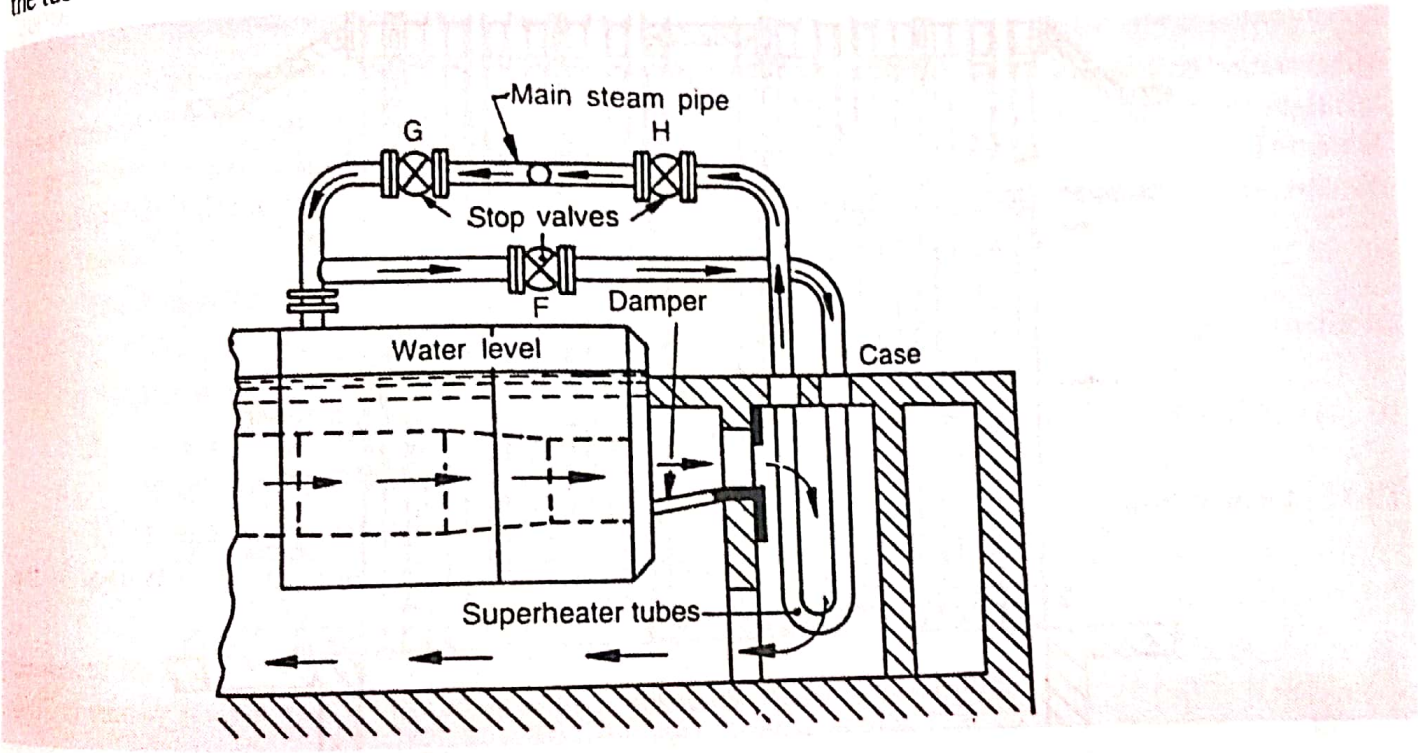


Fig. 14.13. Superheater.

The steam enters at one end of the rear header and leaves at the opposite end of the front header. The overheating of superheater tubes is prevented by the use of a balanced damper which is operated by the handle. The superheater is in action when the damper is in a position as shown in the figure. If the damper is in vertical position, the gases pass directly into the bottom flue without passing over the superheater tubes. In this way, the superheater is out of action. By placing the damper in intermediate position, some of the gases will pass over the superheater tubes and the remainder will pass directly to the bottom flue. It is thus obvious, that required degree of heat for superheating may be obtained by altering the position of the damper.

It may be noted that when the superheater is in action, the stop valves *G* and *H* are opened and *F* is closed. When the steam is taken directly from the boiler, the valves *G* and *H* are closed and *F* is open.

14.17. Economiser

An economiser is a device used to heat feed water by utilising the heat in the exhaust flue gases before leaving through the chimney. As the name indicates, the economiser improves the economy of the steam boiler.

A well known type of economiser is Greens economiser. It is extensively used for stationary boilers, especially those of Lancashire type. It consists of a large number of vertical pipes or tubes placed in an enlargement of the flue gases between the boiler and chimney as shown in Fig. 14.14. These tubes are 2.75 metres long, 114 mm in external diameter and 11.5 mm thick and are made of cast iron.

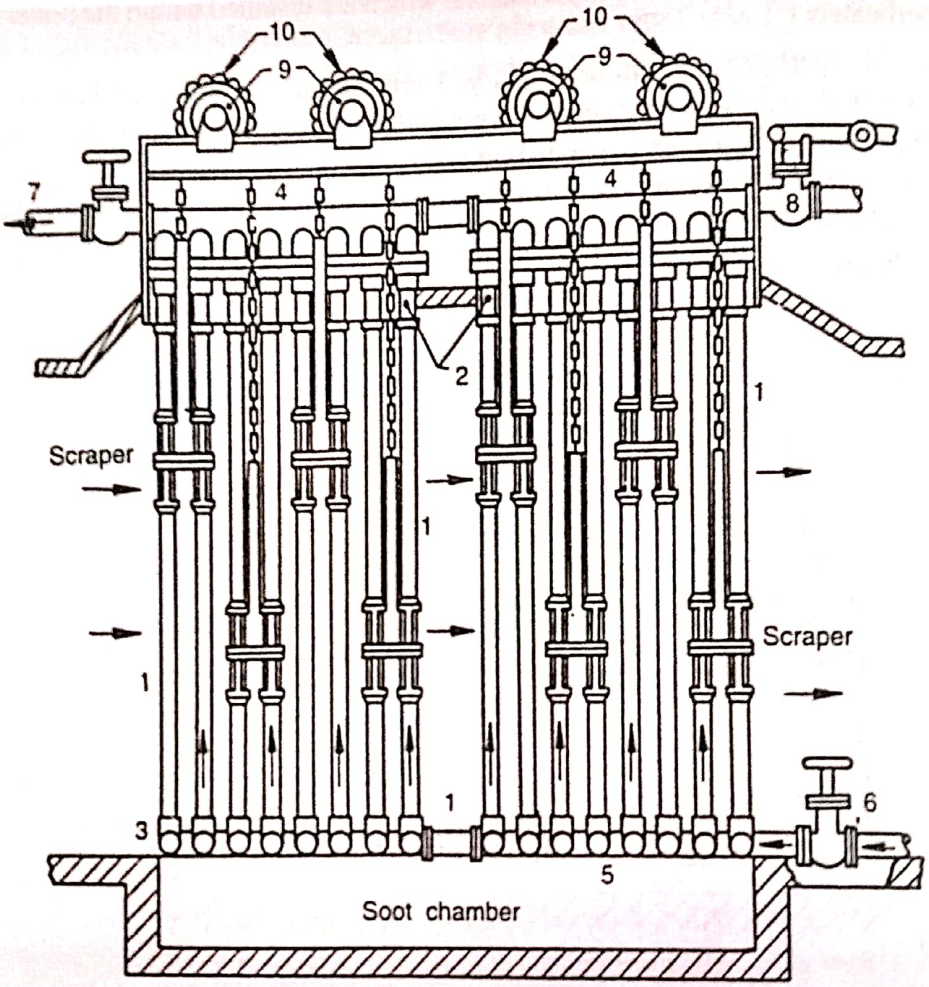


Fig. 14.14. Economiser.

The economiser is built-up of transverse section. Each section consists of generally six or eight vertical tubes (1). These tubes are joined to horizontal pipes or boxes (2) and (3) at the top and bottom respectively. The top boxes (2) of the different sections are connected to the pipe (4), while the bottom boxes are connected to pipe (5). The pipes (4) and (5) are on opposite sides, which are outside the brickwork enclosing the economiser.

The feed water is pumped into the economiser at (6) and enters the pipe (5). It then passes into the bottom boxes (3) and then into the top boxes (2) through the tubes (1). It is now led by the pipe (4) to the pipe (7) and then to the boiler. There is a blow-off cock at the end of the pipe (5) opposite to the feed inlet (6). The purpose of this valve is to remove mud or sediment deposited in the bottom boxes. At the end of pipe (4) (opposite to the feed outlet) there is a safety valve.

It is essential that the vertical tubes may be kept free from deposits of soot, which greatly reduce the efficiency of the economicser. Each tube is provided with scraper for this purpose. The

scrapers of two adjoining sections of tubes are grouped together, and coupled by rods and chains to the adjacent group of scrapers. The chain passes over a pulley (9) so that one group of scrapers balance the adjacent group. The pulley (9) of each chain is connected to a worm wheel (10) which is driven by a worm on a longitudinal shaft (not shown in the figure). The scrapers automatically reverse when they reach the top or bottom end of the tubes. These are kept in motion continuously when the economiser is in use. The speed of scraper is about 46 m/h.

It may be noted that the temperature of feed should not be less than about 35° C, otherwise there is a danger of corrosion due to the moisture in the flue gases being deposited in cold tubes. Following are the advantages of using an economiser :-

1. There is about 15 to 20% of coal saving.
2. It increases the steam raising capacity of a boiler because it shortens the time required to convert water into steam.
3. It prevents formation of scale in boiler water tubes, because the scale formed in the economiser tubes, can be cleaned easily.
4. Since the feed water entering the boiler is hot, therefore strains due to unequal expansion are minimised.

14.18. Air Preheater

An air preheater is used to recover heat from the exhaust flue gases. It is installed between the economiser and the chimney. The air required for the purpose of combustion is drawn through the air preheater where its temperature is raised. It is then passed through ducts to the furnace. The air is passed through the tubes of the heater internally while the hot flue gases are passed over the outside of the tubes.

The following advantages are obtained by using an air preheater :

1. The preheated air gives higher furnace temperature which results in more heat transfer to the water and thus increases the evaporative capacity per kg of fuel.
2. There is an increase of about 2% in the boiler efficiency for each 35-40° C rise in temperature of air.
3. It results in better combustion with less soot, smoke and ash.
4. It enables a low grade fuel to be burnt with less excess air.

QUESTIONS

1. Describe with a neat sketch, water level indicator for a boiler.
2. Explain how the flow of steam of water is automatically stopped when the glass tube breaks.
3. Why the safety valves are needed in a boiler ? Sketch and describe a Ramsbottom spring loaded safety valve.
4. Differentiate between lever safety valve and dead weight safety valve.
5. What is the purpose of a steam stop valve ? Explain its working.
6. Explain the functions of blow off cock and feed check valve.
7. What is the function of a superheater ? Describe Sugden's superheater.
8. Discuss, briefly, the working of an economiser in a boiler plant giving a neat sketch.
9. Explain why air preheaters are used in a high pressure boiler.