BASICS OF MECHANICAL ENGG. LAB ME-107-F

Sr. No	Experiment Title
1	To study the Cochran Boilers.
2	To study the Babcock & Wilcox Boilers.
3	To study the working & function of mountings and accessories in Boilers.
4	To study the two strokes & four stroke diesel engine.
5	To study the two stroke & four stroke petrol engine.
6	To determine Mechanical Advantage, V.R. and Efficiency of worm and worm gear of single, double and triple start.
7	To prepare stress-strain diagram for mild steel and cast iron specimens under tension and compression respectively on a U.T.M.
8	To study the constructional features & working of Pelton, Kaplan and Francis turbine.
9	To study construction details and working of a simple screw jack.
10	To study construction details and working of a single purchase winch crab machine & find its efficiency.
11	To study construction details and working of a double purchase winch crab machine & find its efficiency.

EXPERIMENT No. - 1

TITLE: To study the Cochran Boilers.

OBECTIVE: The objective of the study is to know about the working procedure & parts of the Cochran boiler with the help of model.

APPARATUS USED: Model of Cochran Boiler.

THEORY: A boiler is a closed vessel in which steam is produced from water by combustion of fuel. The primary requirements of steam generator or boiler are:

1. Water
2. Water drum
3. Fuel for heating

TYPES OF BOILERS:-

a. Water tube boiler
b. Fire tube boiler

In the water tube boilers, the water are inside the tube & hot gases surrounds the tubes.
The various water tube boiler are following:

(i) Babcock & Wilcox boiler
(ii) Sterling boiler
(iii) Lamont boiler
(iv) Loeffler boiler
(v) Benson boiler
(vi) Velox boiler

The various fire tube boiler are following :

(i) Lancashire boiler
(ii) Locomotive boiler
(iii) Scotch marine
(iv) Cochran boiler
(v) Cornish boiler

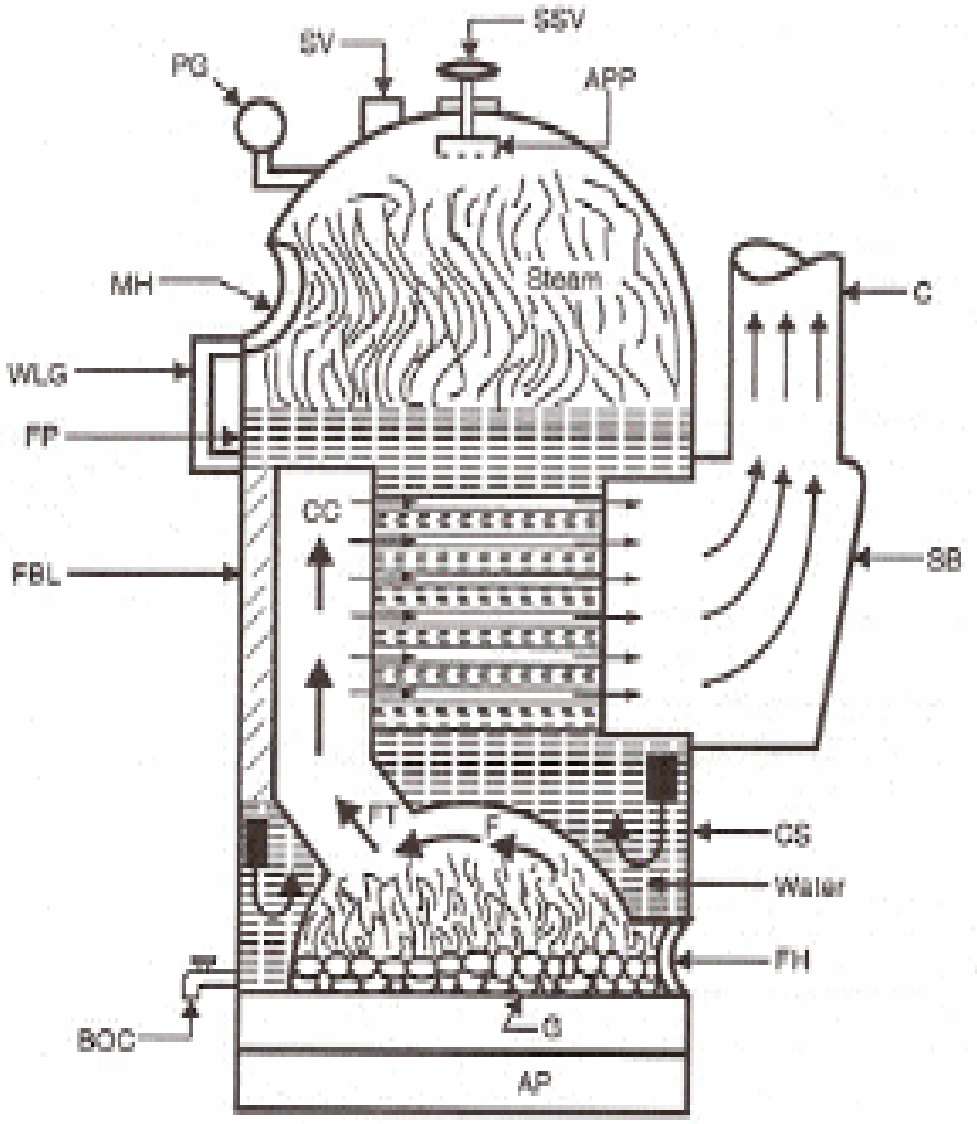
CONSTRUCTION AND WORKING:

Simply vertical boilers of the fire tube type find favour in small plats requiring small quantities of Steam and where the floor area is limited. The most common application are steam rollers, pile drivers, steam shovels, portable hoisting rigs and certain other mobile applications. The coal is fed through the fire door to the grate with fire bars on it. The boiler can also work as oil Fired unit by fitting an oil burner at fire door. The grate is then dispensed with and a lining of fire bricks are Provided beneath the furnace. The furnace has no riveted seams exposed to flame and is pressed hydraulically from one plate to finished shape. This makes the furnace suitable to resist the intense heat produced by the Combustion of fuel. The coal, on burning, produces hot flue gases and these hot products of combustion from the fire box Enter through the small flue pipe into the combustion chamber which is lined with fire bricks on the outer wall of the boiler. The dome shaped furnace and the combustion chamber prevent the loss which could otherwise occur because of combustion being retarded and much unburnt and combustible matter leaving the furnace. The unburnt fuel is deflected back to the grate and complete combustion is achieved in combustion chamber where high temperatures are maintained. The hot gases passing through the horizontal smoke tubes give their heat to the water and in doing so convert water into steam which gets accumulated in the upper portion of the shell from where it can be supplied to the user. The flue tubes are generally of 62.5 mm. external dia. And are 165 in number. The crown of the shell is made hemispherical in shape which gives the maximum space and strength for a certain weight of material in the form of plates. Finally the flue gases are discharged to the atmosphere through the smoke box and the chimney.

APPLICATIONS:

The steam generated is employed for the following purpose:

1. For generating power in steam engines or steam turbines.
2. In the textile industries for sizing & bleaching etc. & many other industries like sugar mills, chemical industries.
3. For heating the building in cold weather & for producing hot water supply.
4. Steam turbine propelled ships & other marine vessels.
5. Agriculture field machineries saw mills etc.
6. Steam locomotives
7. To study steam to the steam engines for driving industry hoists, road rollers in road constructions & pumps in coal mines.



CS = Cylindrical shell
CC = Combustion chamber
FBL = Fir brick lining
F = Furnace (dome shaped)
BOC = Blow off cock
SSV = Steam stop valve
APP = Antipriming pipe
PG = Pressure gauge

FT = Flue tube
SB = Smoke box
C = Chimney
FH = Fire hole
G = Grate
AP = Ash pit
SV = Safety valve
MH = Man hole
WLG = Water level gauge

EXPERIMENT No.- 2

TITLE: To study the Babcock & Wilcox Boilers.

OBECTIVE: The objective of the study is to know about the working procedure & parts of the Babcock & Wilcox Boiler with the help of model.

APPARATUS USED: Model of Babcock & Wilcox Boilers.

THEORY: A boiler is a closed vessel in which steam is produced from water by combustion of fuel.
The primary requirements of steam generator or boiler are:

1. Water
2. Water drum
3. Fuel for heating

TYPES OF BOILERS:-

a. Water tube boiler
b. Fire tube boiler

In the water tube boilers, the water are inside the tube & hot gases surrounds the tubes.
The various water tube boiler are following:

(i) Babcock & Wilcox boiler
(ii) Sterling boiler
(iii) Lamont boiler
(iv) Loeffler boiler
(v) Benson boiler
(vi) Velox boiler

The various fire tube boilers are following:

(i) Lancashire boiler
(ii) Locomotive boiler
(iii) Scotch marine
(iv) Cochran boiler
(v) Cornish boiler

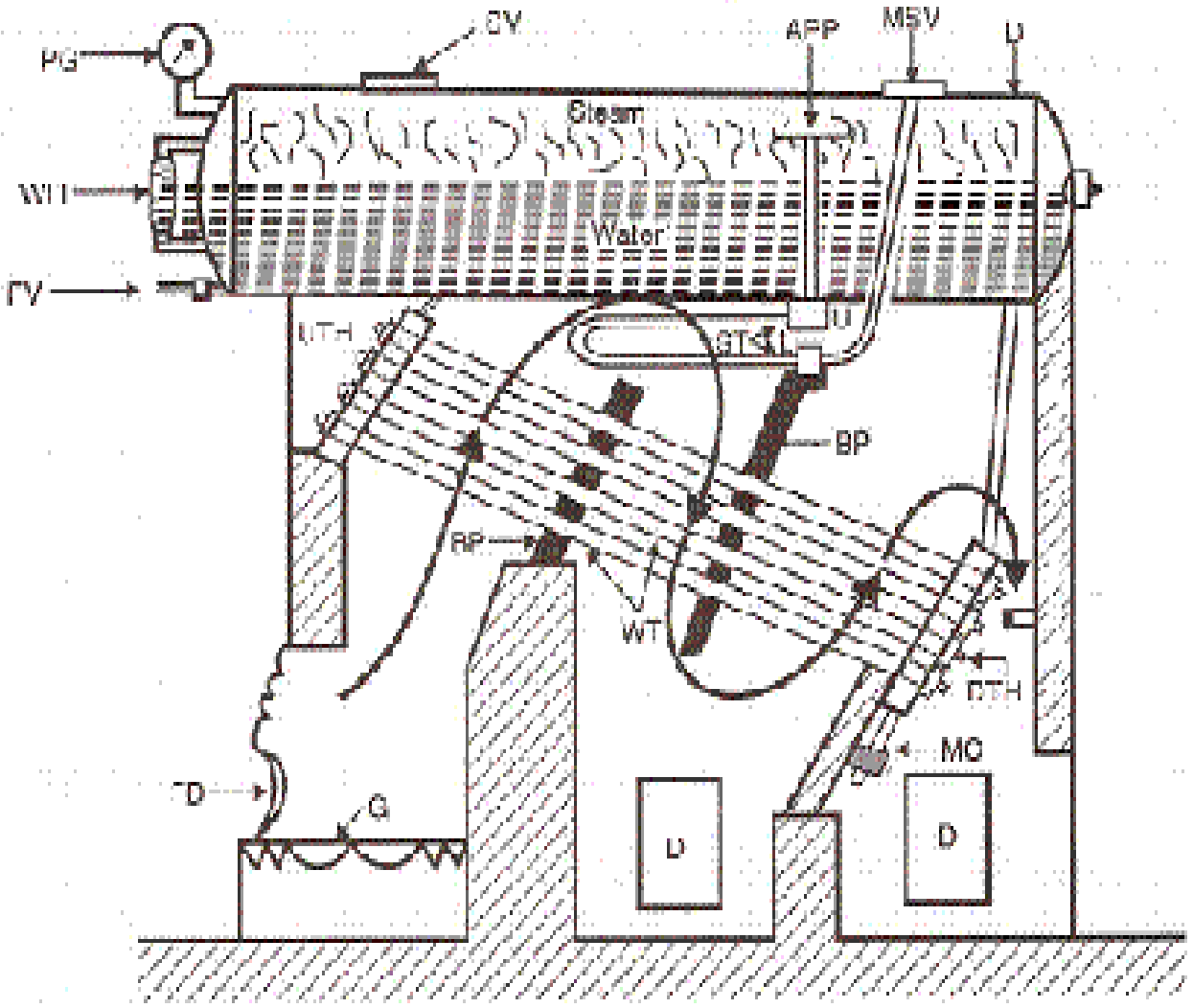
BABCOCK & WILCOX BOILER:
The water tube boilers are used exclusively, when pressure above 10bar and capacity in excess of 7000kg./hr. is required.
Babcock & Wilcox boiler with longitudinal drum: It consists of a drum connected to a series of front end and rear end header by short riser tubes. To these headers are connected a series of inclined water tubes of solid drawn mild steel.The inclination of tubes to the horizontal is about 15 degree or more. A hand hole is provided in the header in front of each tube for cleaning & inspection of tubes. A feed valve is provided to fill the drum and level of water indicates by water level indicator. Fire is burnt on the grate. The hot gases are forced to move upwards between the tubes by baffle plates provided. The water from the drum flows through the inclined tubes via down take header & goes back into the steam the steam space of the drum. The steam then enters through the anti-priming pipe and flows in the super heater tubes where it

is further heated and is finally taken out through the main stop valve and supplied to the engine when needed.

APPLICATIONS:

The steam generated is employed for the following purpose :

1. For generating power in steam engines or steam turbines.
2. In the textile industries for sizing & bleaching etc. & many other industries like sugar mills, chemical industries.
3. For heating the building in cold weather & for producing hot water supply.
4. Steam turbine propelled ships & other marine vessels.
5. Agriculture field machineries, saw mills etc.
6. Steam locomotives
7. To study steam to the steam engines for driving industry hoists, road rollers in road constructions & pumps in coal mines.



D = Drum
DTH = Down take header
WT = Water tubes
BP = Baffle plates
D = Doors
G = Grate
FD = Fire door
MC = Mud collector
WLI = Water level indicator
PG = Pressure gauge
ST = Superheater tube
SV = Safety valve
MSV = Main stop valve
APP = Antipriming pipe
L = Lower junction box
U = Upper junction box
FV = Feed valve

EXPERIMENT NO. 3

Aim: To study the construction and working of various boiler mountings and accessories.

Theory: A boiler is defined as a closed vessel in which steam is produced from water by combustion of fuel. Also defined as "A combination of apparatus for producing, furnishing, or recovering heat together with the apparatus for transporting the heat so made available to the fluid being heated and vaporized."

Classification of Boilers:
The boilers may be classified according to following criteria:

1. According to relative position of water and hot gases.

(a) Water tube boiler: A boiler in which the water flows through the tubes which are surrounded by hot combustion gases i.e. Babcock and Wilcox, Stirling, Benson boilers etc.

(b)Fire tube boiler: The hot combustion gases pass through the boiler tubes, which are surrounded by water i.e. Lancashire, Cochran, Locomotive boilers etc.

2.According to water circulation arrangement

(a) Natural circulation: Water circulates in the boiler due to density difference of hot and cold water e.g., Babcock and Wilcox boiler, Lancashire boiler, Locomotive boiler etc.
(b) Forced circulation: A water pump forces the water along its path, therefore, the steam generation rate increases e.g.. Benson, La Mont, Velox boilers etc.

3. According to position of furnaces:

(a) Internally fired: The furnace is located inside the shell e.g., Cochran, Lancashire boilers etc.

(b) Externally fired: The furnace is located outside the boiler shell i.e. Babcock and Wilcox, Stirling boilers etc.

4. According to the use: Stationary, Portable, Locomotive or marine boiler.

5. According to position of the boilers: horizontal, inclined or vertical boilers.

Boiler Mountings:

The boiler mountings are the part of the boiler and are required for proper functioning. In accordance with the Indian Boiler regulations, of the boiler mountings is essential fitting for safe working of a boiler. Some of the important mountings are:

Water level Indicator

Water level indicator is located in front of boiler in such a position that the level of water can easily be seen by attendant. Two water level indicators are used on all boilers.

Pressure Gauge

A pressure gauge is fitted in front of boiler in such a position that the operator can conveniently read it. It reads the pressure of steam in the boiler and is connected to steam space by a siphon tube.

The most commonly, the Bourdon pressure gauge is used.

Safety Valve

Safety valves are located on the top of the boiler. They guard the boiler against the excessive high pressure of steam inside the drum. If the pressure of steam in the boiler drum exceeds the working pressure then the safety valve allows blow-off the excess quantity of steam to atmosphere. Thus the pressure of steam in the drum falls. The escape of steam makes a audio noise to warm the boiler attendant.

There are four types of safety valve.

1. Dead weight safety valve.
2. Spring loaded safety valve
3. Lever loaded safety valve
4. High steam and low water safety valve.

Fusible Plug

It is very important safety device, which protects the fire tube boiler against overheating. It is located just above the furnace in the boiler. It consists of gun metal plug fixed in a gun metal body with fusible molten metal.

During the normal boiler operation, the fusible plug is covered by water and its temperature does not rise to its melting state. But when the water level falls too low in the boiler, it uncovers the fusible plug. The furnace gases heat up the plug and fusible metal of plug melts, the inner plug falls down The water and steam then rush through the hole and extinguish the fire before any major damage occurs to the boiler due to overheating.

Blow-Off Cock

The function of blow-off cock is to discharge mud and other sediments deposited in the bottom most part of the water space in the boiler, while boiler is in operation. It can also be used to drain-off boiler water. Hence it is mounted at the lowest part of the boiler. When it is open, water under the pressure rushes out, thus carrying sediments and mud.

Feed Check Valve

The feed check valve is fitted to the boiler, slightly below the working level in the boiler. It is used to supply high pressure feed water to boiler. It also prevents the returning of feed water from the boiler if feed pump fails to work.

Steam Stop Valve

The steam stop valve is located on the highest part of the steam space. It regulates the steam supply to use. The steam stop valve can be operated manually or automatically.

Boiler Accessories

The accessories are mounted on the boiler to increase its efficiency. These units are optional on an efficient boiler. With addition of accessories on the boiler, the plant efficiency also increases. The following accessories are normally used on a modern boiler:

(i) Economizer (ii) Super heater (iii) Air pre heater (iv) Feed water pump (v) Steam injector.

Economizer

An economizer is a heat exchanger, used for heating the feed water before it enters the boiler. The economizer recovers some of waste heat of hot flue gases going to chimney. It helps in improving the boiler efficiency. It is placed in the path of flue gases at the rear end of the boiler just before air pre-heater.

Super heater

It is a heat exchanger in which heat of combustion products is used to dry the wet steam, pressure remains constant, its volume and temperature increase. Basically, a super heater consists of a set of small diameter U tubes in which steam flows and takes up the heat from hot flue gases.

Air Pre-heater

The function of an air pre-heater is similar to that of an economizer. It recovers some portion of the waste heat of hot flue gases going to chimney, and transfers same to the fresh air before it enters the combustion chamber.

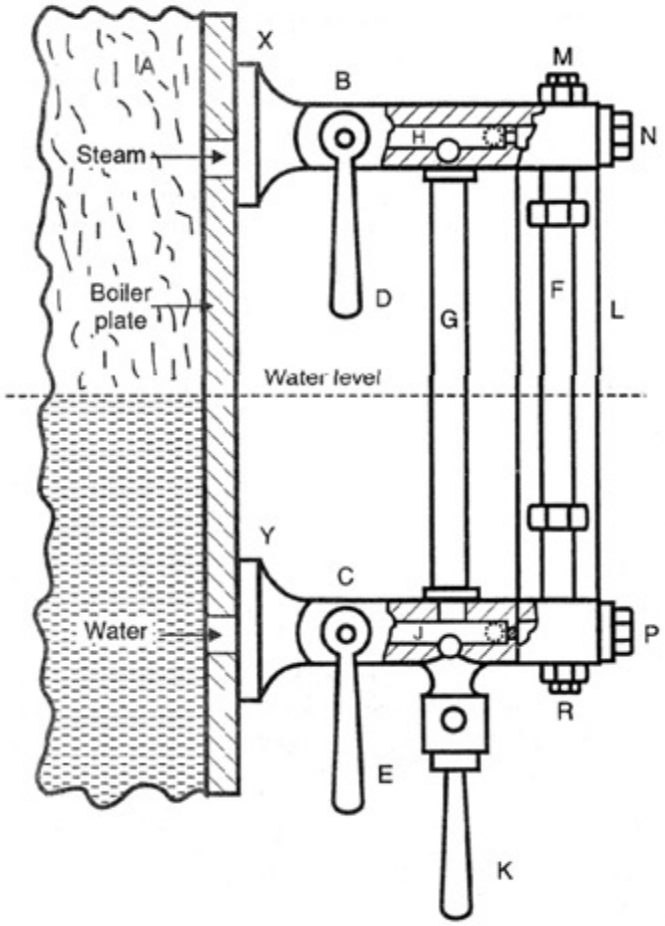
Due to preheating of air, the furnace temperature increases. It results in rapid combustion of fuel with less soot, smoke and ash. The high furnace temperature can permit low grade fuel with less atmospheric pollution. The air pre-heater is placed between economizer and chimney.

Feed Water Pump

It is used to feed the water at a high pressure against the high pressure of steam already existing inside the boiler.

Steam Injector

A steam injector lifts and forces the feed water into the boiler. It is usually used for vertical and locomotive boilers and can be accommodated in small space. It is less costly. It does not have any moving parts thus operation is salient.



A = End plate of boiler
B and C = Hollow gun metal castings
D and E = Cocks
F = Gauge glass
G = Hollow metal column
H and J = Two balls
K = Drain cock
L = Guard glass
M, N, P, R = Screwed caps
X, Y = Flanges

Fig.3.1-water level indicator