Steam-powered boilers

Boilers are closed containers where a fluid is heated to generate steam above the atmospheric pressure (Steingress, 2001 5). Thus, they are often called steam-powered boilers since the steam they generate is utilized as a source of energy such as electricity. Boilers have two primary parts. These are the compartment for fuel combustion and the other compartment for evaporation of water to produce steam (Prasad). The steam produced then, leaves the water compartment and is used for various purposes (Steingress, 2003 4).

The main materials for boiler construction can be carbon steel, stainless steel, brass or cast iron. These materials are used since they are not flammable and they are good conductors of heat. Inside the boiler, combustion of fuels such as wood, coal, natural gas or oil, generates the heat needed to turn water into steam. History of Boilers Pneumatica was the first steam machine ever produced in the history of mechanics. This steam engine was the first employment of water generated into steam to produce power. It was invented in the 1st century by a Greek mathematician and inventor named Hero of Alexandria.

In the Middle Ages and Renaissance period, Italian architect and inventor Giovanni Branca designed the first boiler. The boiler discharges steam, which in turn, struck the blades of a wheel thus, causing it to rotate. Later, in the year 1785, Scottish inventor James Watt redesigned the previous boiler. He introduced the use of spherical and cylindrical vessels heated from below by open fire to generate steam. This design is what makes up the modern-day boiler (Prasad). Applications of Boilers Boilers have various purposes.

Nevertheless, most of its applications are in the field of energy generation for further functions.

One good example is the use of boiler in the first steam engine produced. Thomas Savery built this steam engine made of two copper vessels, which are alternately filled with steam from a boiler. The said engine was used for pumping water out of mines (Prasad). Other useful applications of boilers are boiler feed water deaerator, external combustion engine, fossil fuel power plant generator, and ship propeller power generator. There are still other uses of boilers especially in the industry; however, these applications are specific for each type of boiler.

There are two major types of boilers: fire-tube boilers and water-tube boilers. Fire-tube Boilers The fore-runner of a fire-tube boiler was invented by Oliver Evans in America. Evans built a boiler consisting of cylindrical casings where one is inside the other and the region between them containing water. The fire and fuel in this type of boiler are inside the cylinder thus allowing an increase in steam pressure (Prasad). Fire-tube boilers, compared to water-tube boilers, have low steam production rate. However, this type of boiler has a high steam storage capacity.

Fire-tube boilers usually utilize solid fuels; nevertheless, liquid fuels can also be used upon adaptation of the device. One hazard of fire-tube boilers is that they are sometimes explosive (Prasad). In fire-tube boilers, the boiler barrel is almost completely filled with water with a small space above to enclose the steam that is produced. The source of fuel is a furnace, which is cooled by water around it, to prevent overheating which may cause explosions. Fire-tube boilers are also known as smoke-tube or shell boiler and fire pipe.

Boilers of this type are typically used for steam locomotives and for heating buildings in stationary engineering fields. There are several kinds of fire-tube boilers that differ only in the way the flu gasses, which provide the heat, are transported in a variety of tubes. These types are Cornish boiler, Lancashire boiler, Scotch marine boiler, locomotive boiler, vertical fire-tube boiler and horizontal return tubular boiler (Shonas Wreck Guide). Water-tube Boilers This type of boiler was introduced later than its counterpart. It was invented by George Herman Babcock and Stephen Wilcox in 1867 (Prasad).

Unlike fire-tube boilers, water-tube boilers have high steam production rates. However, they have less storage capacity than fire-tube types. Water-tube boilers are characteristically used in high-pressure applications because the narrow pipes of this type can endure pressure despite their thin walls. Furthermore, water-tube boilers have less risk of explosions since the water used is only minimal. In water-tube types, the water flows through tubes, which are heated externally by gases. Steam is then collected into a drum located above the tubes.

This type is also inexpensive in a sense that the water is just circulated inside the tubes. The water is heated then turned into steam and again cooled to water upon accomplishing its purpose. Water-type boilers also have different classifications, which are D-type, O-type, A-type, flex-tube boiler, Babcock and Wilcox boiler, Stirling boiler, thornycroft boiler, and yarrow boiler (Prasad). Safety Precautions Since steam boilers are pressurized vessels, it has a risk of explosion. Boiler explosions are damaging since they are boiling liquid expanding vapor explosions.

In this case, the pressure exceeds the capacity of the vessel and thus, explodes into destructive steam, not to mention the furnace that may add to the explosion. Furnace explosions may also occur in boilers. It is thus advised that maintenance and regular inspection of the boiler be done. One well-known explosion took place in the steamer “ Eclipse” on January 27, 1865. In this disaster, 27 were killed and 78 were wounded (Hewison 1). Therefore, hazards of boiler explosion can certainly be disturbing. Maintenance and regular replacement of defective or weak parts of the boiler should be done regularly.

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