Portable Boiler Steam Engine

As the charter item for this series of writings, the "Portable Boiler and Ajax Steam Engine" is featured – courtesy of a little town in west Georgia. Estimated to be built in the 1,800's (or early 1,900's), this power-plant is obviously well-beyond its useful life; indeed, it is a centerpiece for the town as displayed below.

According to the placard displayed along side the unit, the manufacturer was A. B. Forquhar, located in York, Pennsylvania "A Short History of the A. B. Forquhar Company" is provided by www.steamtraction.com.
The man, "Forquhar", was somewhat of a self-made inventor or engineer; for at an early age, he developed a keen interest in agricultural equipment. The portable engine pictured at the right was developed sometime in the early 1,900's. With a spotless safety record – of not exploding – the boilers and accompanied farm implements continued to grow in demand in both domestic and international markets. By the 1920's, he had not only established a international company, but was personally recognized as an authority on political economy, finance and tariff legislation.

On a technical matter is (or was) the risk of a boiler explosion. Early development of the steam engine (or boiler) presented such potential if not certainty; and obviously, such risk of explosion could be a consideration in the purchase and use of such equipment. Other than the obvious pressure that causes the boiler to give-way or explode, why were these engines susceptible to explosion?

From Wikipedia, boiler explosions occur for two reasons:

1. Over-pressure in the boiler, the steam or water parts
2. Over-combustion in the furnace or heat-generating parts

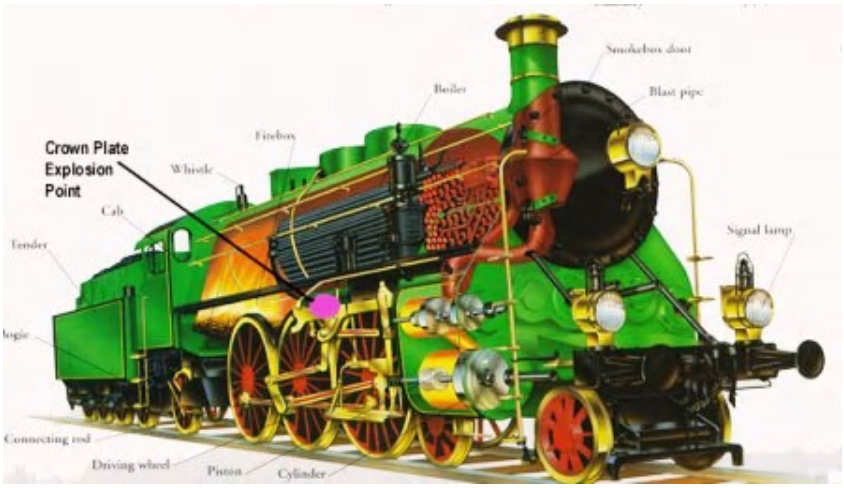
Common cause(s) for early boilers was corrosion in the lap joints – or the seams marked by rivets and joints. As far as historical accounts of such explosions, a steamship exploded in 1865 while transporting Union soldiers near Memphis Tennessee (on the Mississippi River). In this single explosion – involving four boilers aboard the Sultana – and estimated 1,200 were killed. With the re-occurring accidents came early design and development to bolster the boiler design in high-stress areas; and whether

shipboard, land-based stationary or mobile units (as above), the accidents continued to decrease (or the design improved) into the end of the 19th century.

With the early problems of explosions and the growing use of boilers came such organizations as the Hartford Steam Boiler Inspection and Insurance Company. As with any insurance company, investigations included some attempt to identify the cause or causes – with the intention of reducing the frequency as well as processing claims. Beginning in 1866, and with over 140 years of experience, this company continues even today.

Even as recent as 1999, boiler accidents continued to occur. From the Web, the historic Ford River Rouge plant in Michigan incurred a boiler explosion. According to an investigation, the cause could have been (or was) a combination of a valve failure and the leaking of natural gas. Of course, natural gas explosions are another matter that transcends actual failure of the boiler.

Surfing the Web enabled another account of accident; this time, involving a train engine in San Antonia Texas at a much earlier time, 1912. With the excellent illustration to the right, the cause of the accident is shown to have occurred on a similar type engine of the Southern Pacific Rail.



The "crown plate" actually fractured due to excessive pressure increase; and the pressure (or explosion) being so enormous that sections of the boiler weighing up to 15,000 lbs. were blown a quarter mile away!

Leaving the matter of accidents and explosions behind – though not without some understanding of the cause and effect – the construction of the earlier, mobile boiler reminded me of something else; this time, in Charleston South Carolina.

The use of the large, rounded rivets was common for all applications of metal assembly from bridges to submarines; yes, you read correctly, "submarines". What I was reminded of (in Charleston) was that the now-recovered CSS Hunley was similar in construction; indeed, this single-production submarine was constructed from boiler(s). Both a full-size replica (seen in Charleston) and the first rendering by Conrad Chapman, show the similar construction using rivets. Therefore, submarines and boilers have something in common. Thanks www.charlestonillustrated.com.

What has not been mentioned is any detail is how steam engines (or boilers) work; expressed another way, "How does steam power?"
From "The History of Engines – How Engines Work" (inventors.about.com), the following: With the simple description of a steam engine converting potential energy (steam in boiler) to a mechanical force, a fuel (wood, oil, etc.) is used to heat liquid water to vapor; and the heat energy is transferred to the vapor water or steam. With the steam containing much energy (kinetic energy), it can then fuel mechanical force or kinetic energy. Honestly, I use to know this stuff back in high-school and college but, thanks to the Web, can at least spit out a brief overview.

If you've ever come in contact with steam, to include boiling water on the stove, you know that it is ultra-hot. This heat is potential energy; and if you boil the water on a tea kettle, you know that the steam will generate a whistle as in blows out of the small hole or whistle valve. The steam, having captured the energy from the stovetop element (gas or electric) is hot, expanded water – full of energy to do much more than whistle.

Steam can be dangerous because of the intense energy. At the same time, it has been used to power many things from ships to farm equipment. Even to this day, steam is used to generate electricity. Though the old "Forquhar" has long been retired, the basic output of steam continues on.

Several years ago, while visiting a machine shop, the owner and operator took to his hobby shop on one side of the machine shop. There, he proudly showed-off his miniature steam engines – and I must say – that it was fascinating. As he explained, these miniatures have a following to include shows and other gatherings. Whether a miniature or a full-scale engine, the same principles apply.