

Drawings of the U.S.S. Monitor's Steam Engine

Welcome to the drawings of the U. S. S. Monitor Ironclad Steam Engine. These drawings were created over a 20 year period by analyzing the few surviving drawings and by studying all the works of **John Ericsson**, creator of the **USS Monitor**. They represent a summation of data and information in text or drawing form acquired from the following sources:

The Science Museum- Kensington – London England

The United States National Archives-Washington DC

U.S. Navy Archives- Washington DC

Smithsonian Institution- Washington DC

Stevens Institute – Charles McCord archive material-Hoboken, New Jersey

The Mariners Museum and staff– Newport News, Virginia

The Swedish Museum – Philadelphia, Pennsylvania

The book, **Drawings of the U.S.S. Monitor** by Capt. Ernest Peterkin (Incredible piece of work!)

Historical books, papers and publications such as **The Nations Press** and **Scientific American**.

Patents of **John Ericsson**

United States **Congressional Records**

THE ENGINE

The Monitor's engine is a very unique steam engine and is properly termed as a **Half Trunk- Vibrating Lever- Back Acting Steam Engine**. ("Back Acting" and "Return Connecting Rod" are used interchangeably) It is a direct descendent and improvement of John Ericsson's 1858 patent for a "**Vibrating Lever Engine**". In the 1850s, any motion that was semicircular in nature was called a "vibration". Using a flag for instance in sending semaphore signals was called vibrations. John Ericsson identified his engine as a Vibrating Lever Engine because of this definition, but he referred to the levers as "Rock Shafts" as they rocked back and forth and created rotary motion for the propeller shaft from the linear motion of the pistons. His 1858 invention had Cross Heads (Piston rod supports) mounted outward of the cylinders and bedplate and this was not acceptable to fit within the confines of the narrow Monitor hull. The 1858 design was reconfigured for Monitor by adapting "'half trunk" pistons, a variation of a concept used by John Penn 20 years earlier. The half trunk design allowed the piston rod to be mounted to a wrist pin within the piston itself and thereby narrowing the engine width substantially. John Ericsson's design innovation fit this concept and need beautifully.

While most steam engines turn a crankshaft some distance from the cylinder, the concept of returning the power/motion back to the cylinders' centerline for propeller operation was expedient and efficient and was considered a valued improvement in designs for a narrower Marine steam engine and is thus referred to as "Back-Acting".

Some historians refer to the Monitor's engine as a "Side Lever Engine" – the confusion is understandable, but it is incorrect. A Side Lever Engine is a marine engine used for paddlewheel boats, it has a vertical steam cylinder which operates two beams (called Levers) placed low and on the side of the engines' bedplate for stability and both beams operate vertically in unison. They were not used in Screw propeller ships as the beams would have to be mounted athwartship and that would make any such ship extremely wide. The Monitor's engine cylinders are mounted horizontally, (not vertically) and are mounted athwartships. The Vibrating Lever or "Rock Shafts" operate independently from each other and are a function of the Port or Starboard Piston Rods and are parallel to the propeller shaft. The Rock Shafts oscillate in an arc and Connecting Rods mounted to it transfer motion to the Propeller Shaft.

THE DRAWINGS

The drawings presented here were done by careful study (in some cases with a calibrated microscope) since the few drawings that exist (and are in poor condition) do not have fully detailed dimensions or descriptions. Where no dimension existed, several composite drawings were made and the interface studied to determine the correct or most likely used dimension. In the mid-1800s, drawings were made in scale so the machine shop or fabrication process could scale components from the drawing with a fair amount of accuracy. The skills of the craftsman building the engine would be utilized, and as such, John Ericsson, did not call out "Fits" for his assemblies or components. He intimately knew the employees at Delameter's engine works where the engine was built in November and December of 1861 and most likely relied on verbal instructions to the staff or was familiar with the individual machinist skill levels. You will note that many dimensions are rounded numbers to one quarter of an inch which was common in that period of time. Therefore these drawings do not have tolerances or fits as they were determined by the various tradesmen during the construction of the engine and not recorded.

A word about the organization of this book of drawings.

The engine is rather complex and has some unique mechanical interactions that need to be broken down into sub-assemblies for ease of understanding and addressing these functions. The sub-assemblies have been named according to their function or are in line with the McCord drawing titles and are listed alphabetically in the book by sub-assembly title. Additionally the drawings use a **prefix** of the sub-assembly **title** for part number or component number identification. The finished sub-assemblies in each section will have their prefix and a part number of "1" (Top of the sub-assembly). Where two mirrored finished sub-assemblies exist , (for Port or Starboard application) the part number will be the "prefix" , a "1" ,and either a "P" or "S" . For example, the completed Port Valve Chest sub-assembly will be "VC-1 P ". All other parts or components to that sub-assembly will have higher numbers (i.e. VC-2, VC-3)

Fasteners and other mill related items use their own subsection prefixes but they can be used in multiple subassemblies. A Bill of Material (BOM.) for the entire engine is displayed at the end of the “Assembly” section. It lists the parts, their numbers and the fasteners used in each sub-assembly.

I am currently writing a textbook on the engine and its operation which will be published by the Mariners Museum. The book will further define and discuss the components shown in these drawings.

I wish to thank Justin Lemke and Bryan Guns, my CAD instructors, whose guidance and help made this work possible.

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2019

Green Bay Wisconsin,