

Marine Engineering Steam Power

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August 21, 2021

Overview

- Introduction
- History of steam power
- How steam engines work
- Types of steam engines
- Steam Engines on the lakes

Introduction

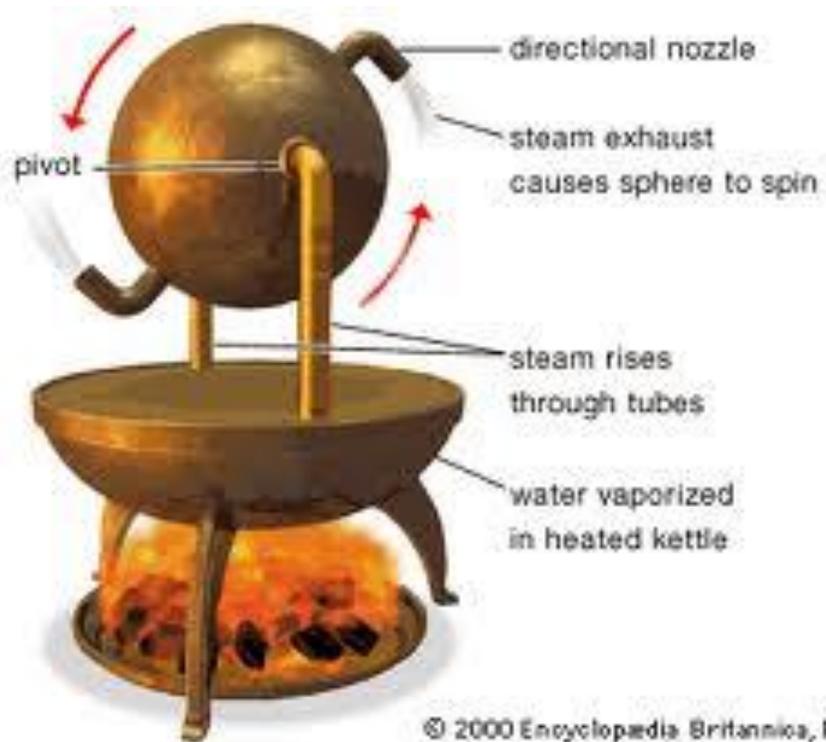
- Principle:
 - Heat x Water = Steam
 - Steam expands exerts pressure causing movement

Introduction

- Principle:
 - Heat x Water = Steam
 - Steam expands exerts pressure causing movement
- Steam Engine:
 - Any machine that generates steam and converts the steam pressure into mechanical motion

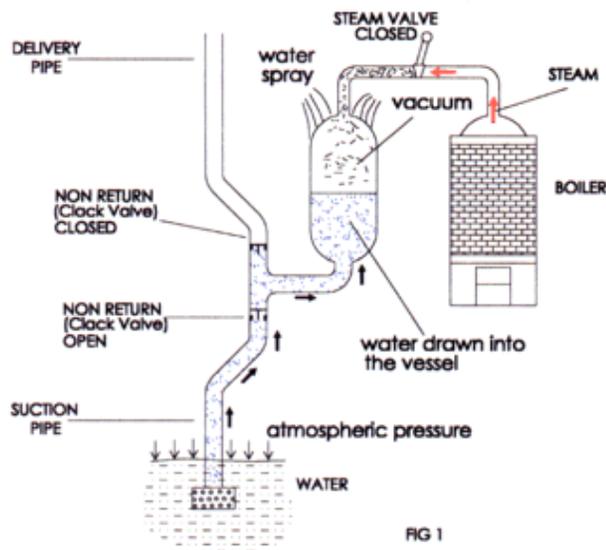
History

- First known steam engine
 - Toy made by Hero of Alexandria – 2000 years ago



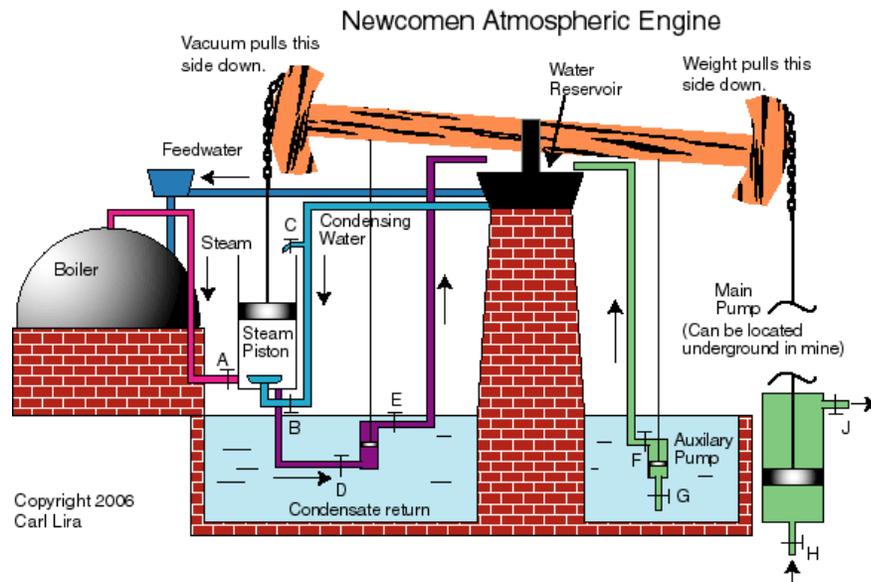
History

- Problem: how to remove water from coal mines?
 - 1698 – Thomas Savery
 - Using valves, atmospheric pressure and condensation to create a partial vacuum – water was **pulled** out of the mines.



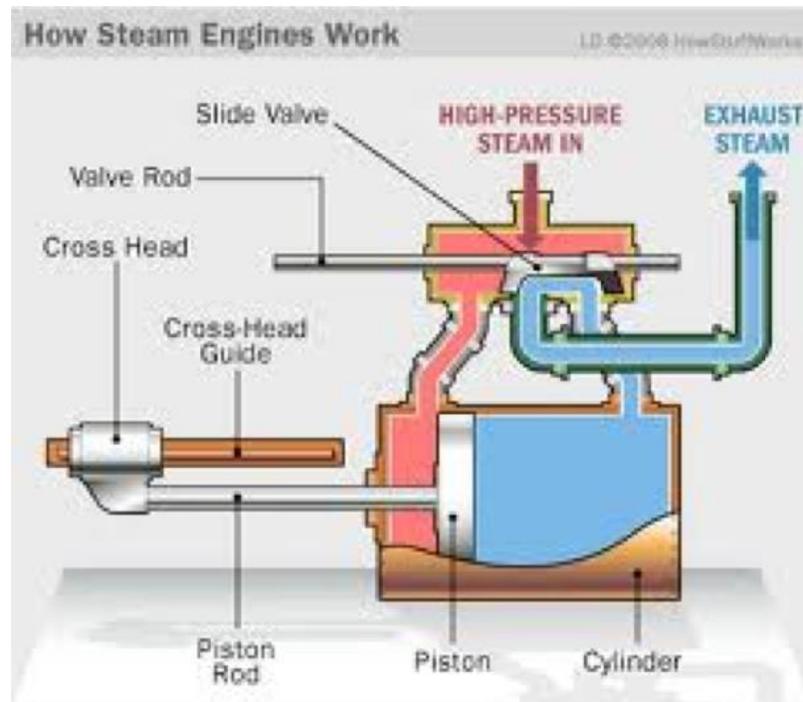
History

- 1712 – Thomas Newcomen
 - Used condensation to create a partial vacuum and atmospheric pressure to push the mine water into a partial vacuum.
 - Added a piston & rocking arm



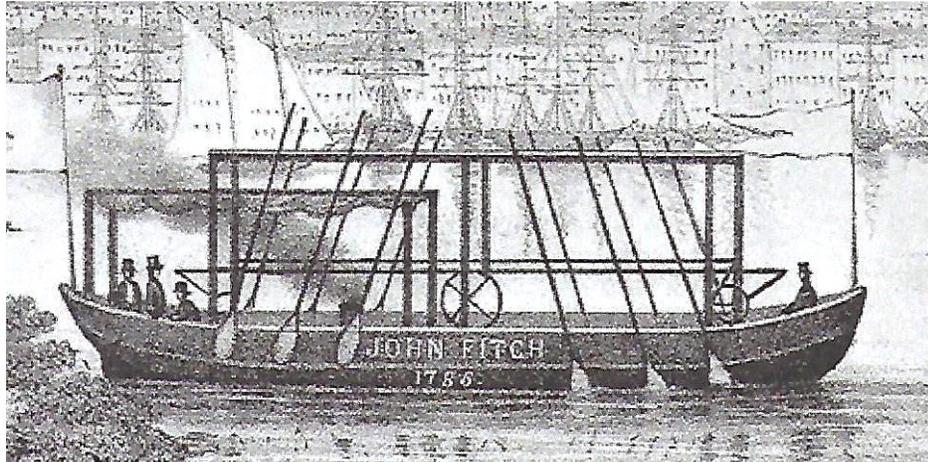
History

- 1796 – James Watt
 - Used steam pressure to push a piston in both directions
 - Piston & cylinder remained hot, eliminating the damage caused by constant heating and cooling of the mechanisms



History

- 1787 – John Fitch
 - Built the first steamboat in the U.S.
 - 45-foot craft – successfully navigated the Delaware River

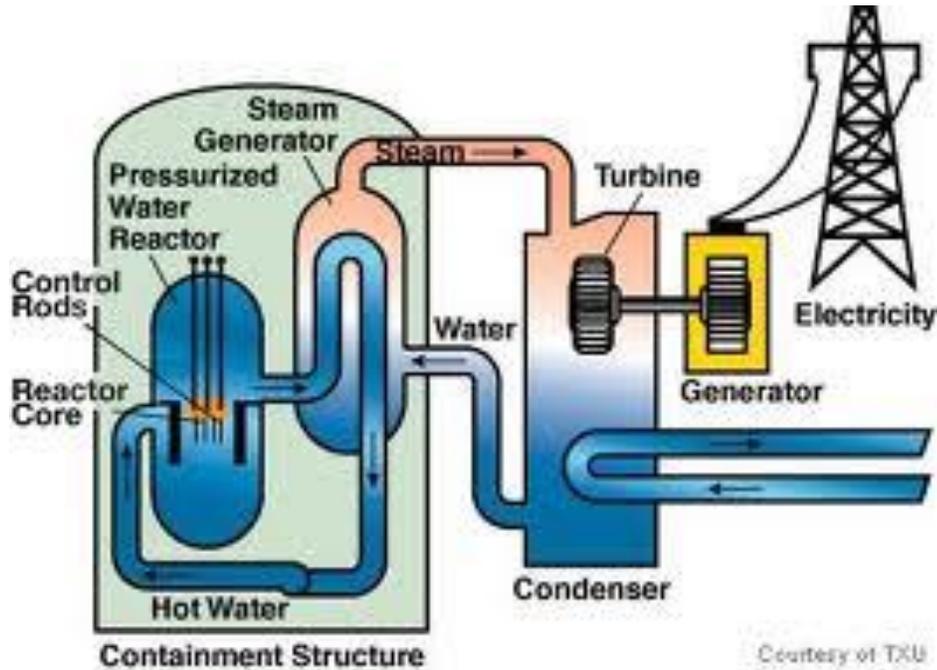


History

- 1802 – Robert Fulton
 - Constructed a steamboat for use on the Hudson River
 - 1807 – *Clermont*, steamed from New York to Albany on the Hudson River
 - 150-mile trip, in 32 hours. Average speed about 5 miles per hour
 - 1811 – *New Orleans* passenger, package freight on the lower Mississippi
 - 1814 – between New Orleans, LA and Natchez, MS.
- 1816 – *Frontenac*, Canadian sidewheel steamer, Lake Ontario
- 1817 – *Ontario*, U.S. sidewheel steamer, Lake Ontario

History

- Today - Modern Steam Turbines
 - Turbine engines use curved blades attached to a central shaft that turns
 - Steam pressure turns the blades, turning the central axle
 -



How Steam Engines Work

- Four Parts
 - **Boiler:** Using heat to convert water into steam
 - Two types: Fire Tube & Water Tube

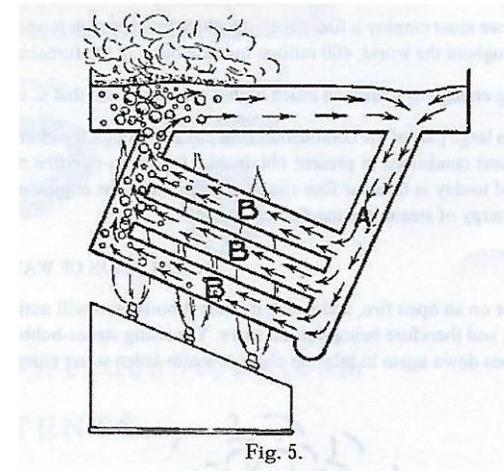
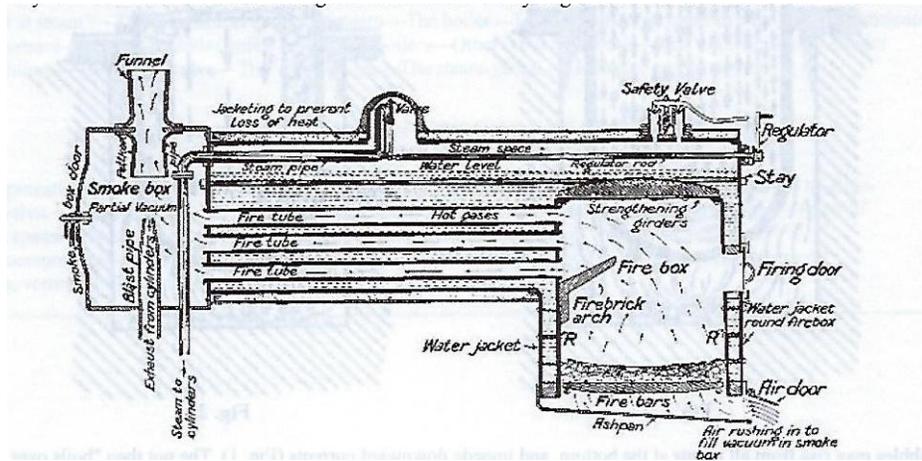
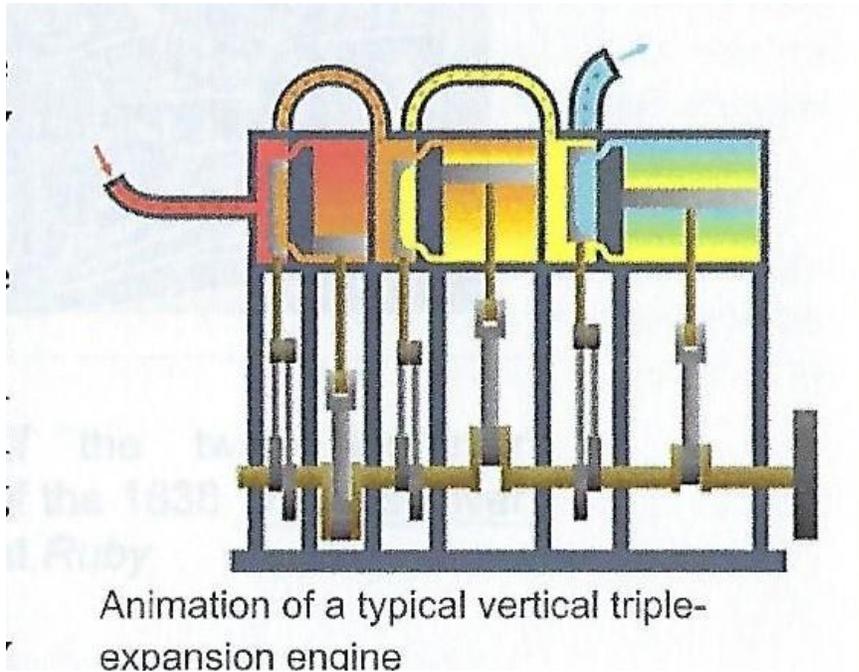


Fig. 5.

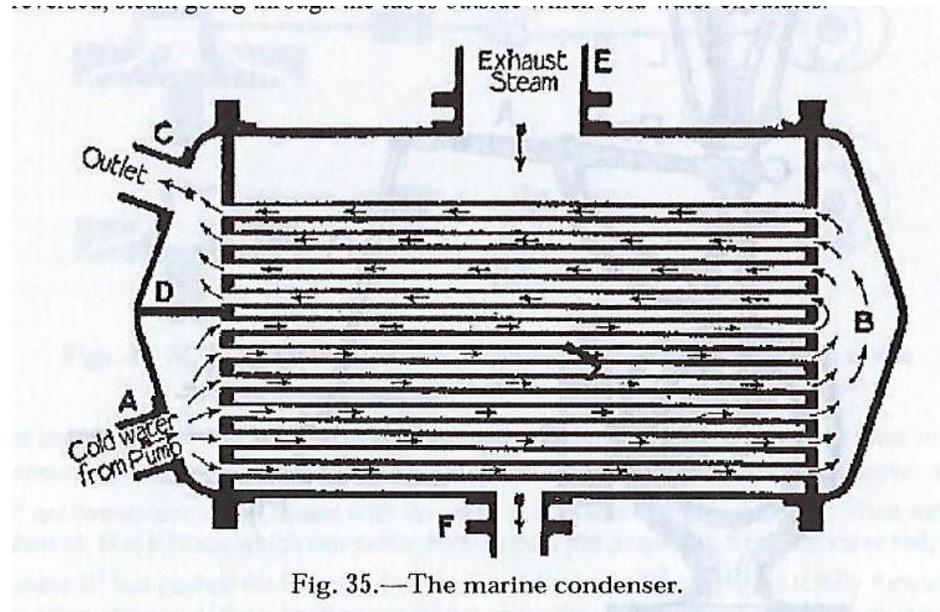
How Steam Engines Work

- Four Parts
 - Boiler: Using heat to convert water into steam
 - **Marine Engine:** Converts heat energy into mechanical motion



How Steam Engines Work

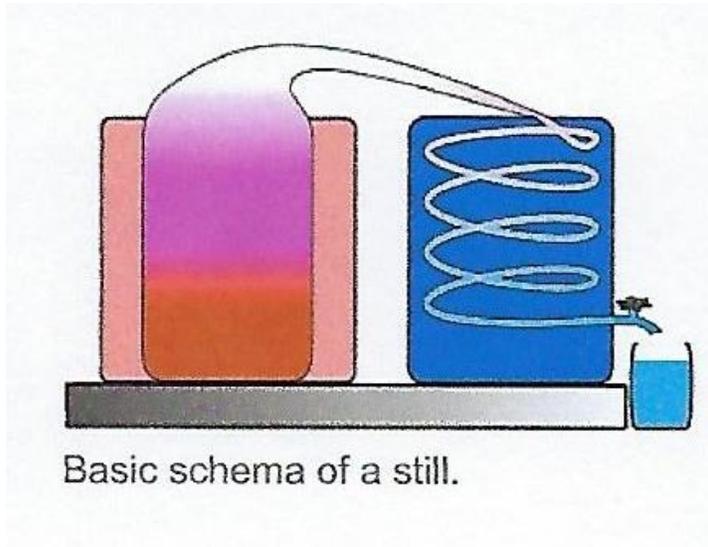
- Four Parts
 - Boiler: Using heat to convert water into steam
 - Engine: Converts heat energy into mechanical motion
 - **Condenser**: Converts waste steam back to water; returns to boiler



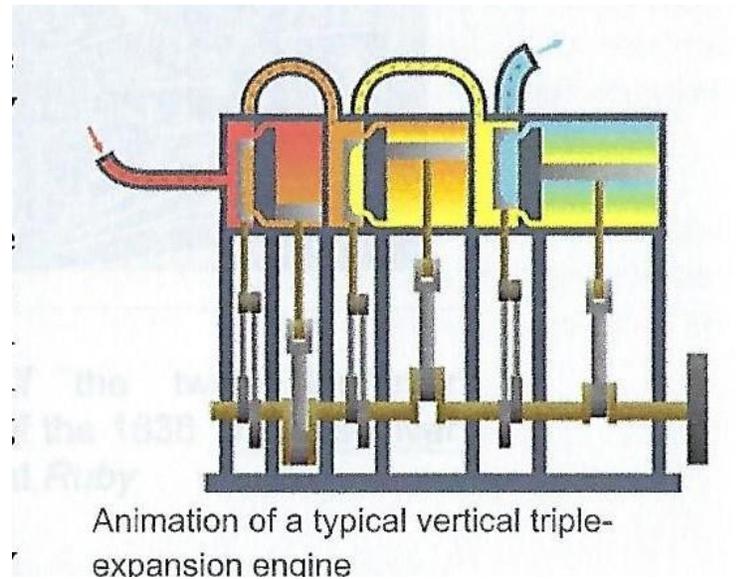
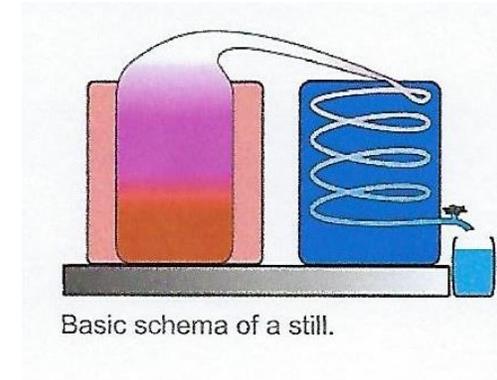
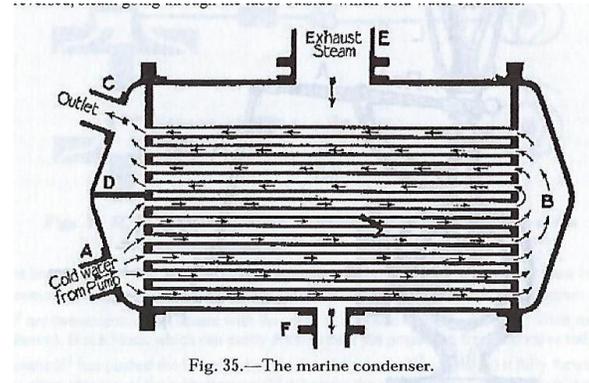
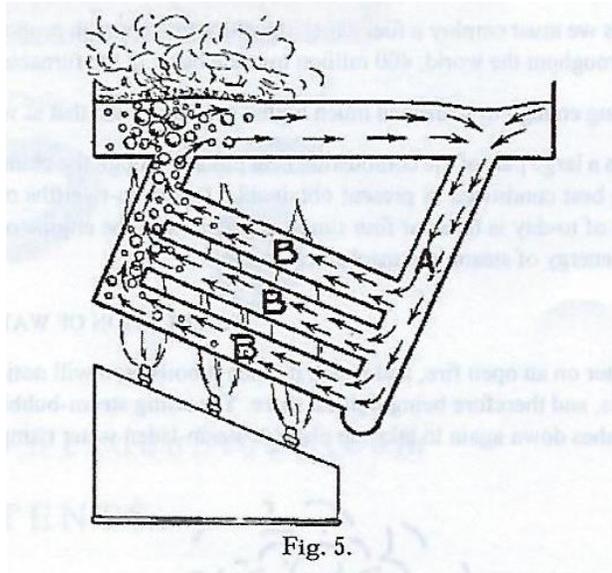
How Steam Engines Work

- Final Part

- Boiler: Using heat to convert water into steam
- Engine: Converts heat energy into mechanical motion
- Condenser: Converts waste steam back to water; returns to boiler
- **Evaporator**: Converts salt water to fresh water



How Steam Engines Work

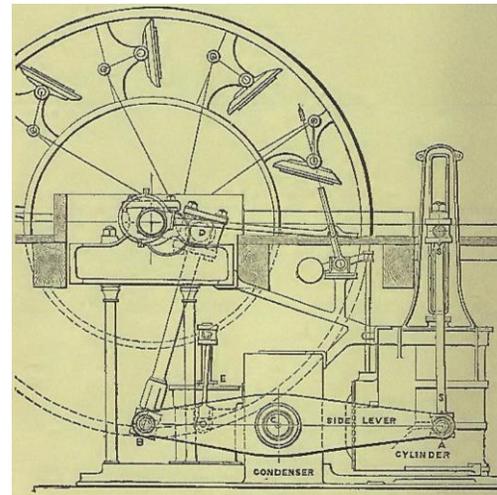


Types of Steam Engines

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 - Cylinder Technology
 - Connection mechanism

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- Low Pressure, Side Lever Beam Engine



Types of Steam Engines – Cylinder Technology

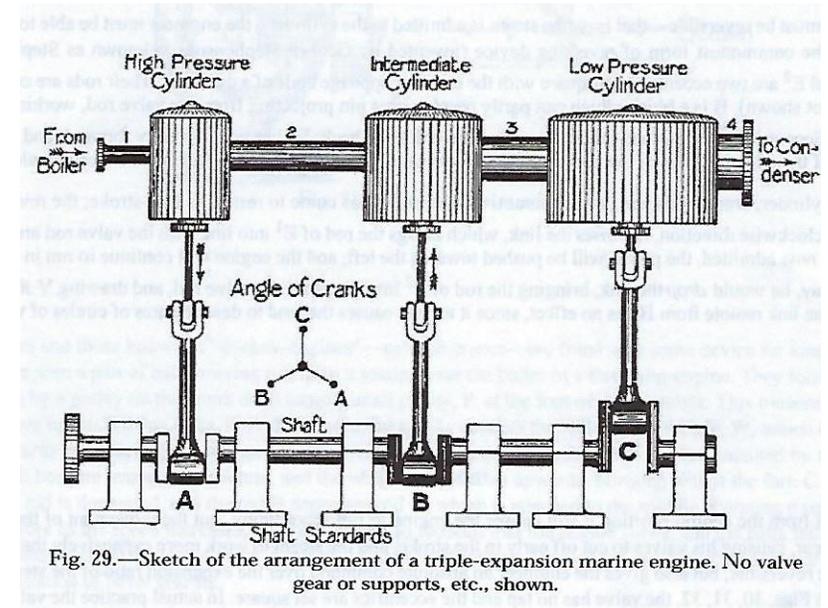
- Simple expansion
 - Expands steam through one stage
 - Cylinder operates at either Low, Intermediate, High pressure
 - Depends on PSI from boiler & size of cylinder

Types of Steam Engines – Cylinder Technology

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- Compound expansion
 - Expands steam through more than one stage
 - Cylinder operates at more than one pressure

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- Compound expansion
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 - Cylinder operates at more than one pressure
- Triple expansion or Multiple expansion

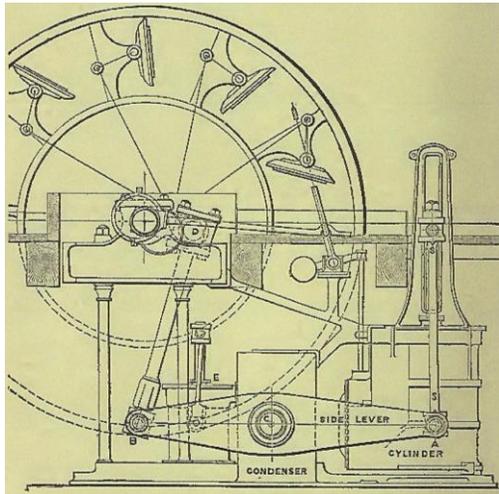


Types of Steam Engines – Connection Mechanism

- Steam Engines are classified by:
 - Cylinder Technology
 - Connection mechanism
 - Side-lever*
 - Grasshopper
 - Walking Beam*
 - Steeple*
 - Direct-acting
 - Oscillating*
 - Trunk
 - Vibrating lever
 - Back acting
 - Vertical

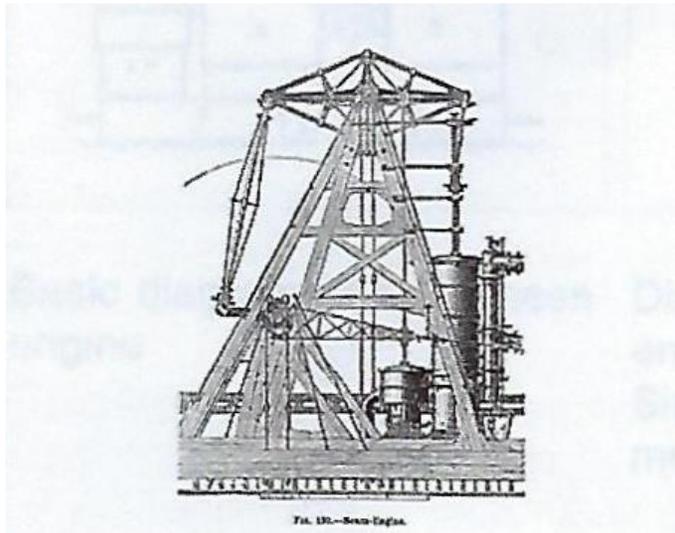
Types of Steam Engines – Connection Mechanism

- Steam Engines are classified by Connection Mechanism:
 - Side-lever:
 - First connection mechanism widely adopted for marine use in Europe (1815)
 - Most common for inland waterway and coastal service
 - Side lever connects the steam piston to the crank that turns the bucket wheel



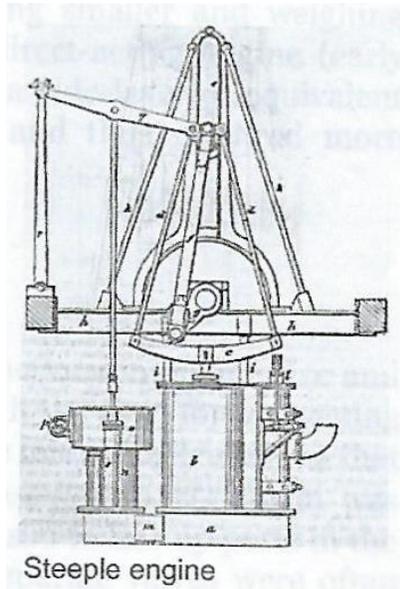
Types of Steam Engines – Connection Mechanism

- Steam Engines are classified by Connection Mechanism:
 - Walking Beam
 - Also known as “vertical beam”, “overhead beam”, or simple “beam”.
 - Primarily a U.S. adaption
 - “Beam” connection were used as a paddlewheel engine for inland waters.
 - Rarely used for powering propellers
 - Height of the beam made the vessel “less” stable in heavy seas.



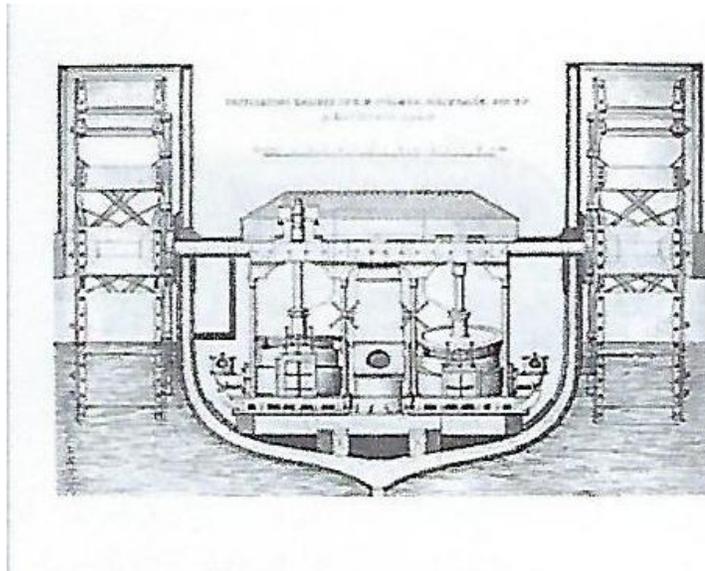
Types of Steam Engines – Connection Mechanism

- Steam Engines are classified by Connection Mechanism:
 - Steeple
 - Referred as a “crosshead”
 - Attempt to come up with a smaller, lighter, more efficient design
 - The vertical oscillation of the piston is used to move an assembly, composed of crosshead and guides to rotate a crankshaft



Types of Steam Engines – Connection Mechanism

- Steam Engines are classified by Connection Mechanism:
 - Direct-acting
 - Applies power directly to the crank-shaft via a piston rod or connecting rod
 - Could be adapted to sidewheel and propeller
 - Advantage: smaller, less weight, smaller engine rooms
 - Disadvantage: more prone to wear & tear, requiring more maintenance
 - Oscillating Engine reduce engine size and weight



Propeller

- Defects of paddle-wheel vessels
 - Performance was affected by variation draft as coal and stores were used
 - Paddle-box offered resistance to progress
 - For fighting ships paddle-wheels were a detriment if damaged
 - Engine, beam and paddlewheels were all above the waterline
- Propeller resolved those defects

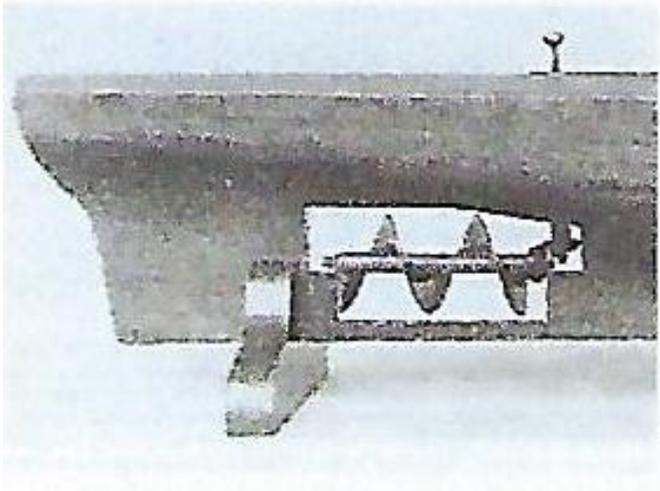
Propeller History

- First propeller to drive a vessel - 1804
 - Tested in New York harbor in 1804
 - Developed by Col. John Stevens
 - A small twin-screwed steam launch

- First screw propeller applied to a ship in 1837 in England & U.S.

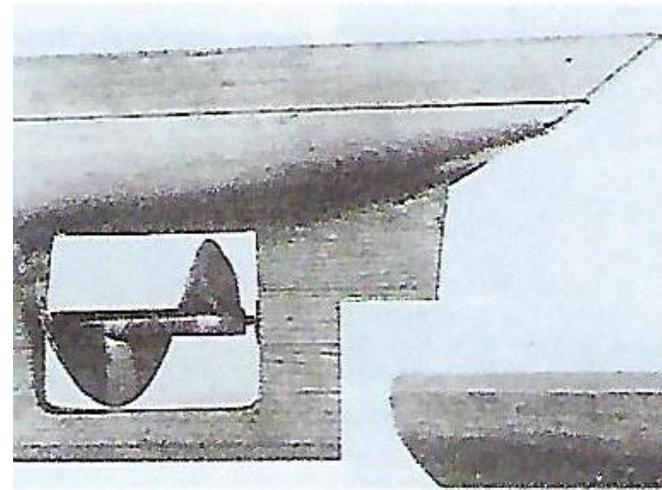
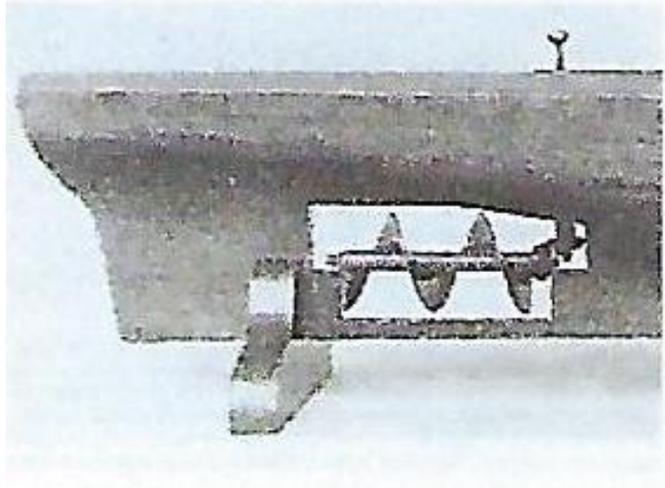
Propeller History

- First propeller to drive a vessel was 1804
- First screw propeller applied to a ship in 1837 in England & U.S.
- England: Francis Smith patented a screw propeller



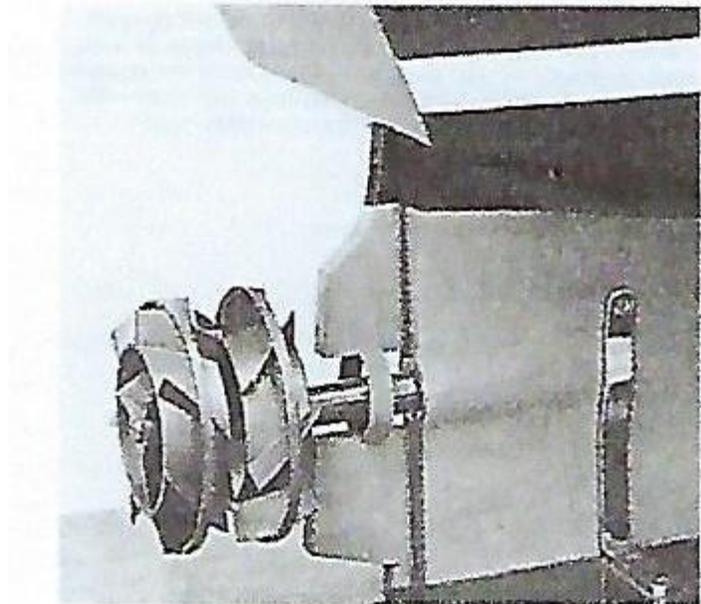
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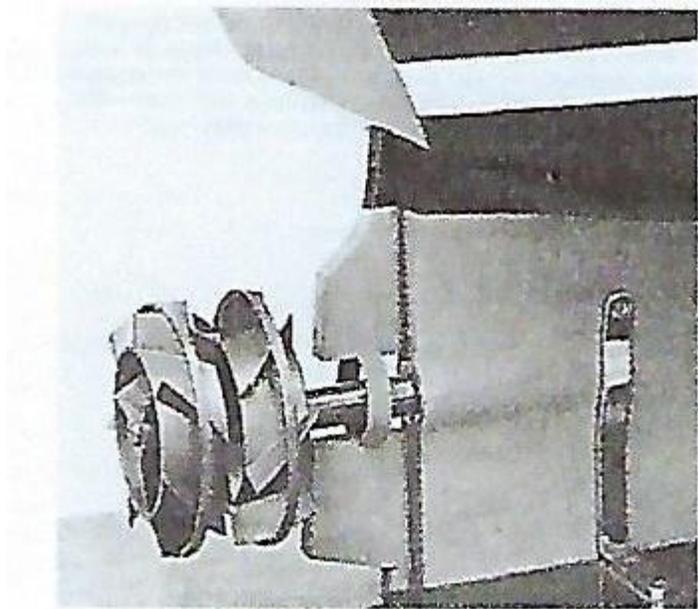
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- England: Francis Smith patented a screw propeller
- John Ericsson, patented a screw propeller consisting of 2-drums on a shaft.



Propeller History

- John Ericsson, patented a screw propeller consisting of 2-drums on a shaft.
- Basis for the modern torpedo



Propeller History

- 1839 – propeller *Robert F. Stockton*



Questions or Comments