

A photograph of a ship's engine room, showing a complex network of pipes, valves, and machinery. The floor is made of metal grating. The text "Inside Waverley" is overlaid in a large, bold, white font with a black outline.

Inside Waverley

Welcome to this Interactive Presentation



Waverley sailing by is a fine sight. Equally impressive is its machinery. Although its main steam engine is open to public view, much of its machinery is not. This interactive presentation takes you inside Waverley to show its machinery and how it works.

It gives an indication of the skills required to design and build the ship, as well as the expertise, and cost, needed to maintain it today. Your purchase of this disc provides much needed funds for this. Any other support you can give is always needed and would be much appreciated.

Volunteering to work on the ship during its winter maintenance in Glasgow is one way of providing support and learning more about the ship.

Phone Waverley Excursions 0845 130 4647 for further information

[Click Here to Continue](#)

Getting around

Move around this presentation as you wish.

The entire presentation can be seen by continually using the Next Page Icon.

The Site Map is a good way of finding out how much of the presentation is still to be viewed.

Options for getting around the presentation are:

1. Hyperlinks - Links are either underscored dark blue (for items not yet seen) or underscored blue (for items seen)

2. Picture or Video Icons with arrow showing the direction of view



3. Last viewed or Next Page Icons

4. Using the Hyperlinks within the Tool Bar at the bottom of page.
For example to go to the Main Menu

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



MAIN MENU

Getting around

Navigating through the presentation

Where it is

Plans of Waverley with location of all key machinery with photographs and videos

How it works

The steam engine, how steam is generated and used, auxiliary machines and steering explained

Site Map

Shows all parts of the presentation and the links between them. Use the Site Map to see parts of the presentation that have not yet been seen

Exit Presentation

<u>Where it is</u>					<u>How it works</u>				<u>Site Map</u>	<u>Main Menu</u>	<u>Exit</u>
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Where it is

Click on photos to see
Waverley's internal
layout and where its
machinery is located



[Where it is](#)

[How it works](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

[Main
Menu](#)

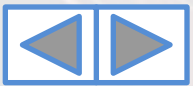
[Exit](#)



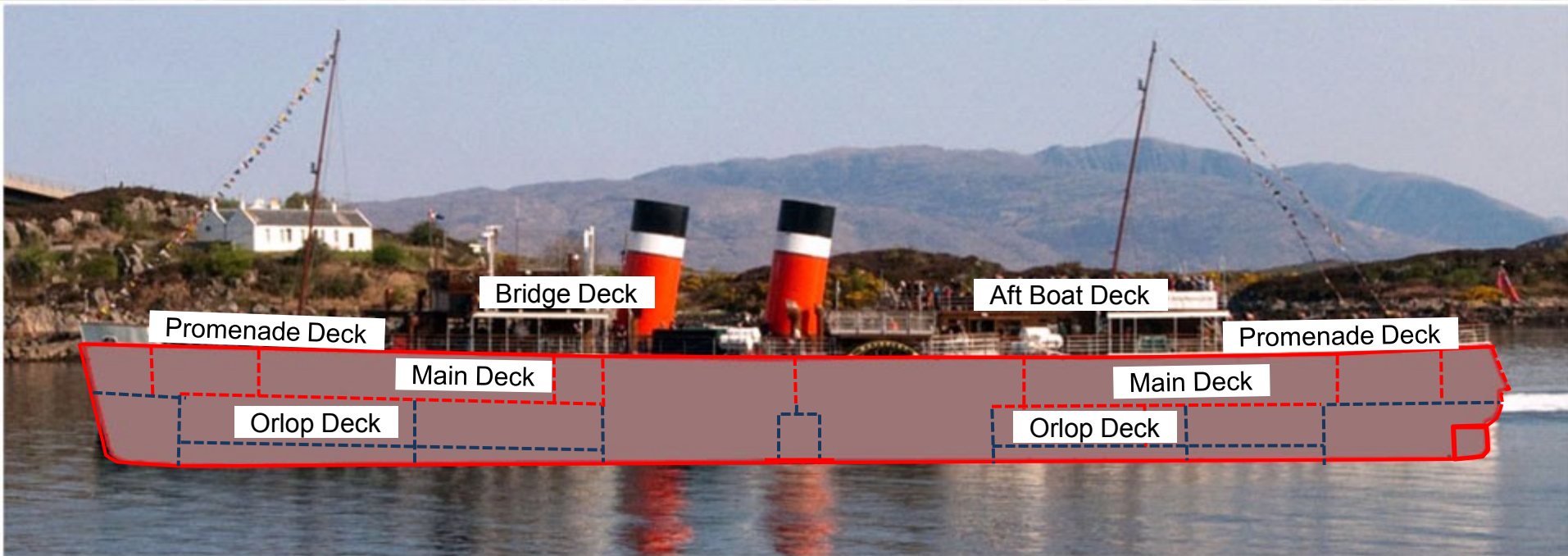


V1.0 15.7.11

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Decks



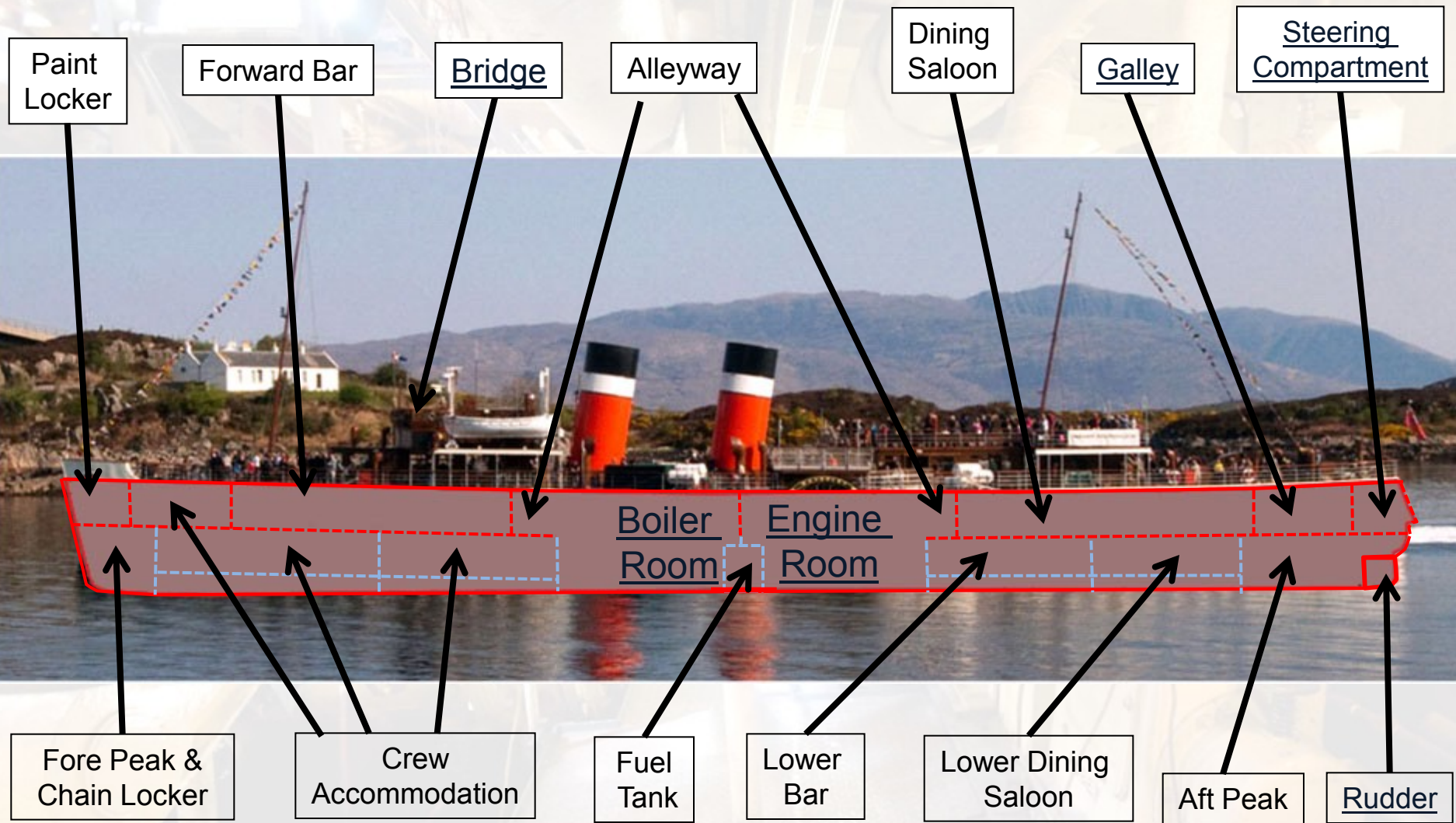
Waverley has three main decks.

There are also watertight double bottoms and bulkheads up to the height of the Main Deck as denoted by the blue lines.

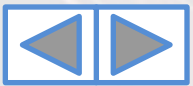
Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Centre Line Cross Section



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			





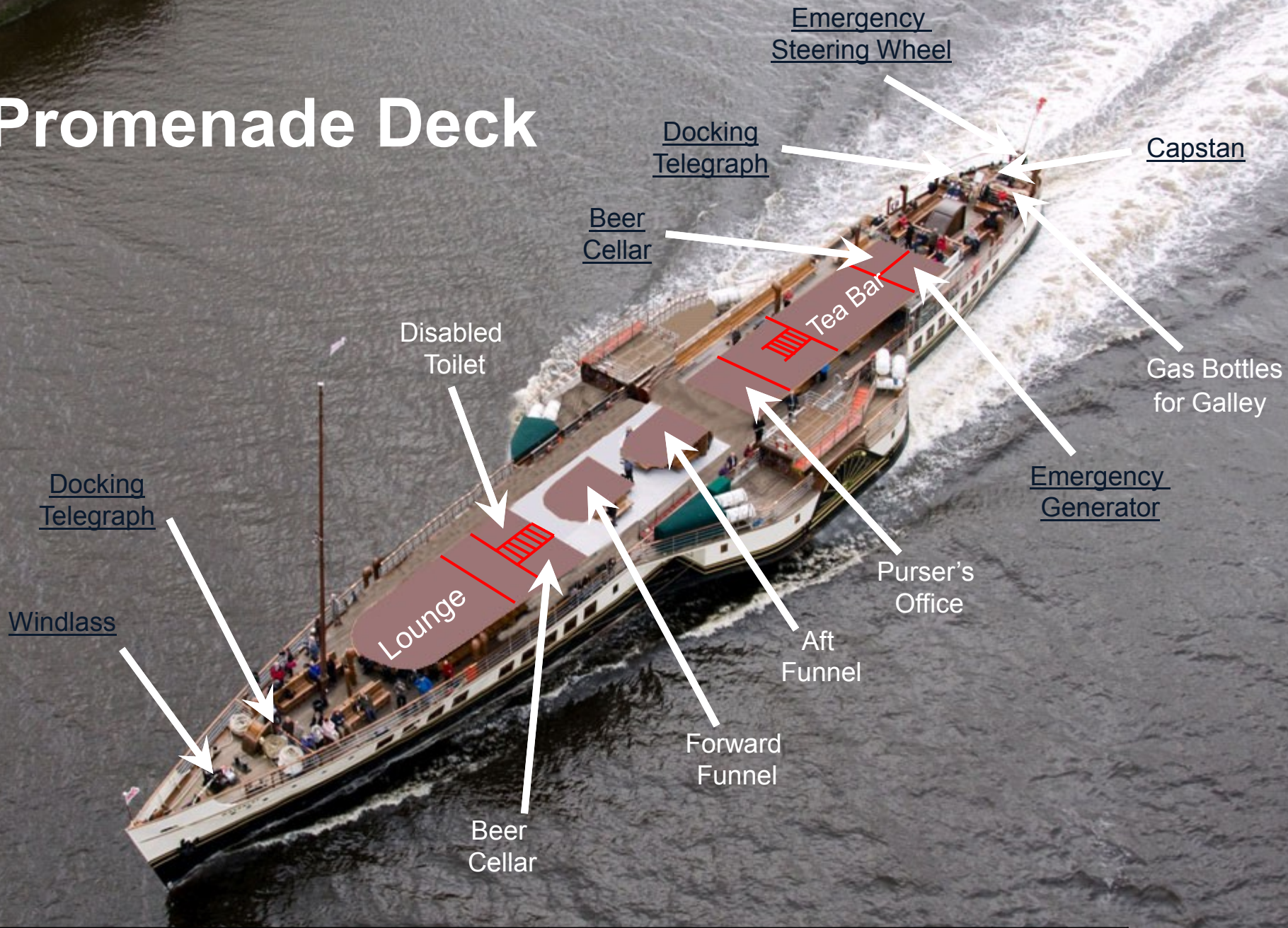
Bridge



<u>Where it is</u>					<u>How it works</u>				Site Map	Main Menu	Exit	
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles				

V1.0.15.7.1

Promenade Deck



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

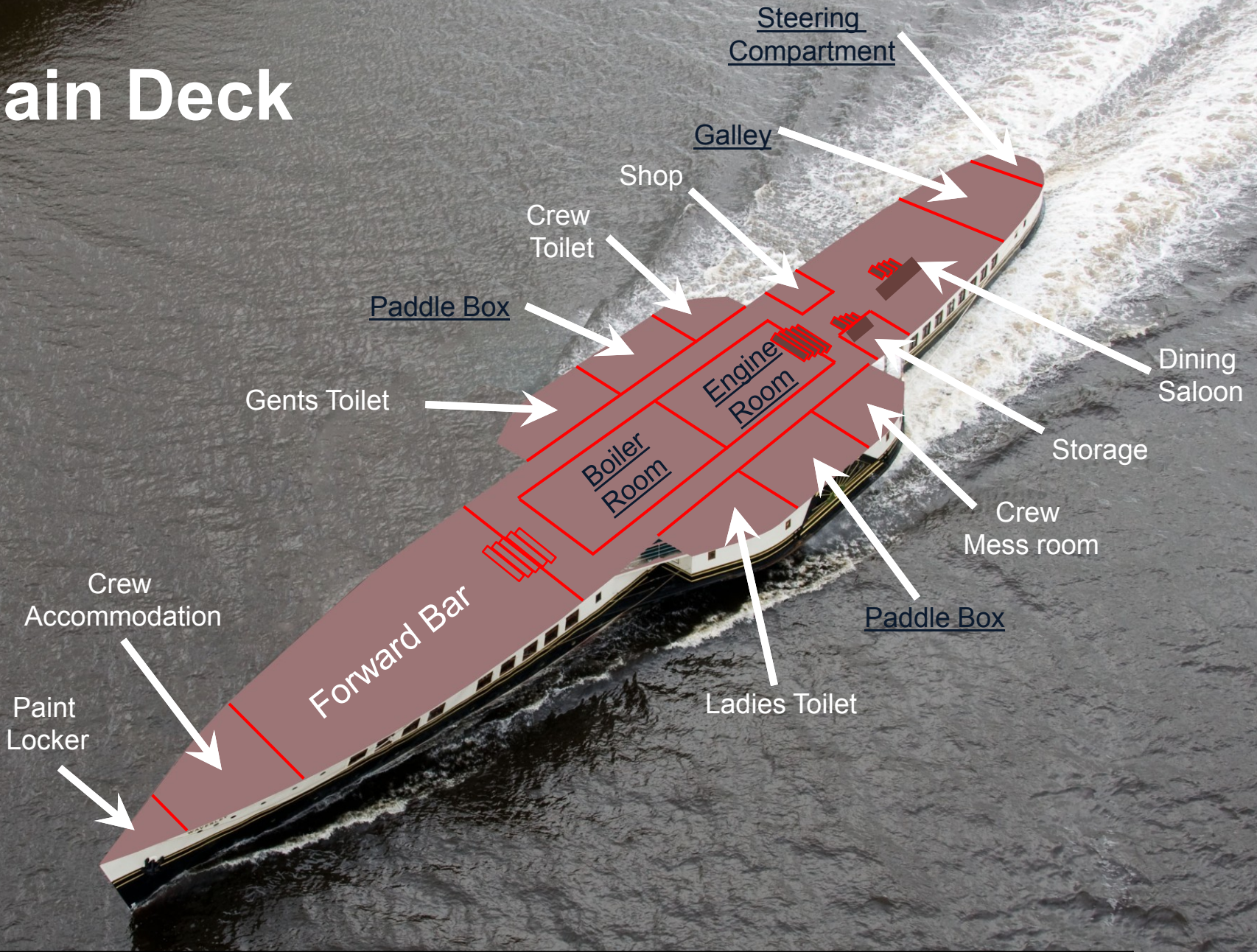
[Steam](#)

[Steering](#)

[Paddles](#)



Main Deck



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

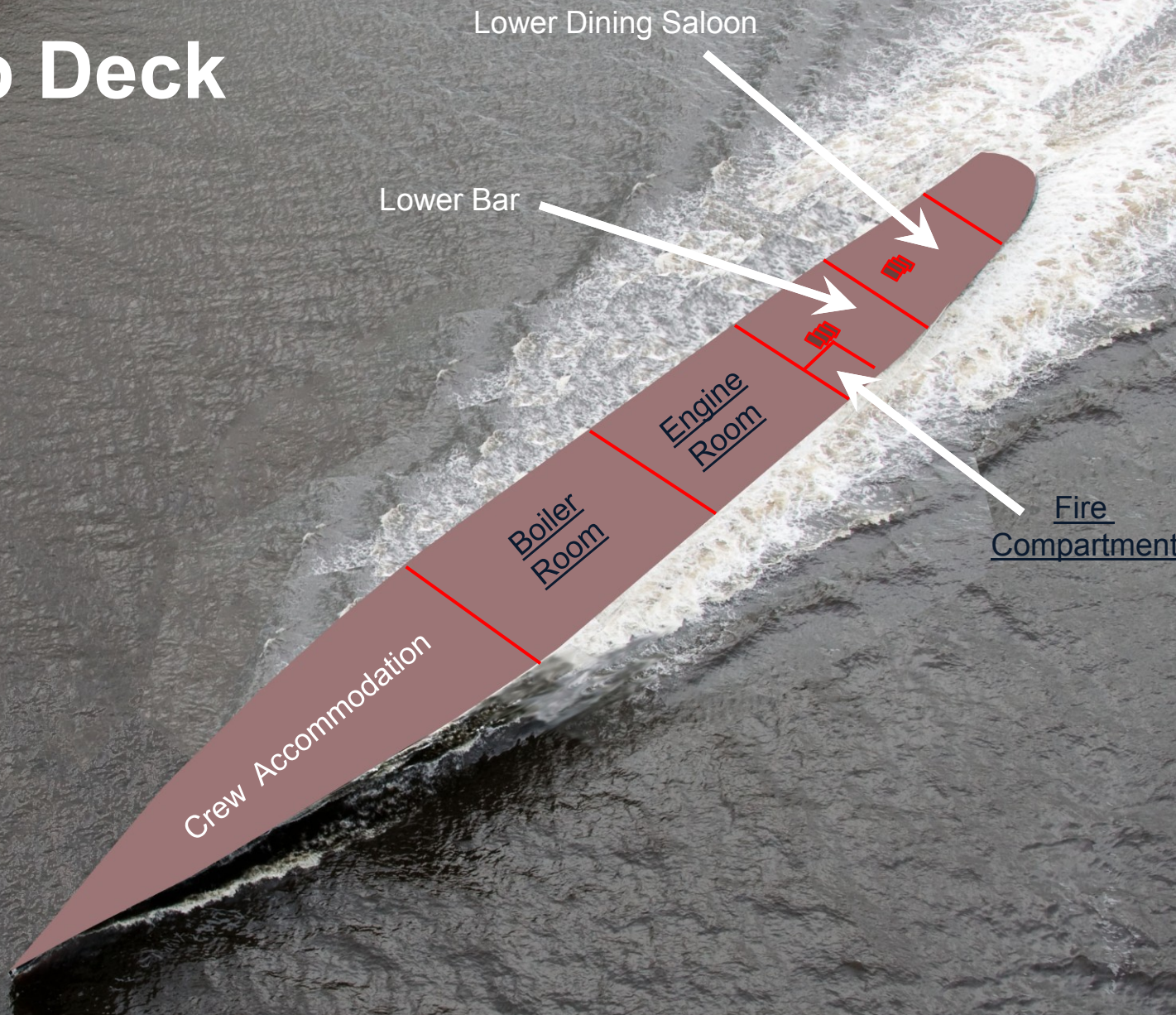
[Steam](#)

[Steering](#)

[Paddles](#)



Orlop Deck



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)



Where it is

Click on photos to see
Waverley's internal
layout and where its
machinery is located



[Where it is](#)

[How it works](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

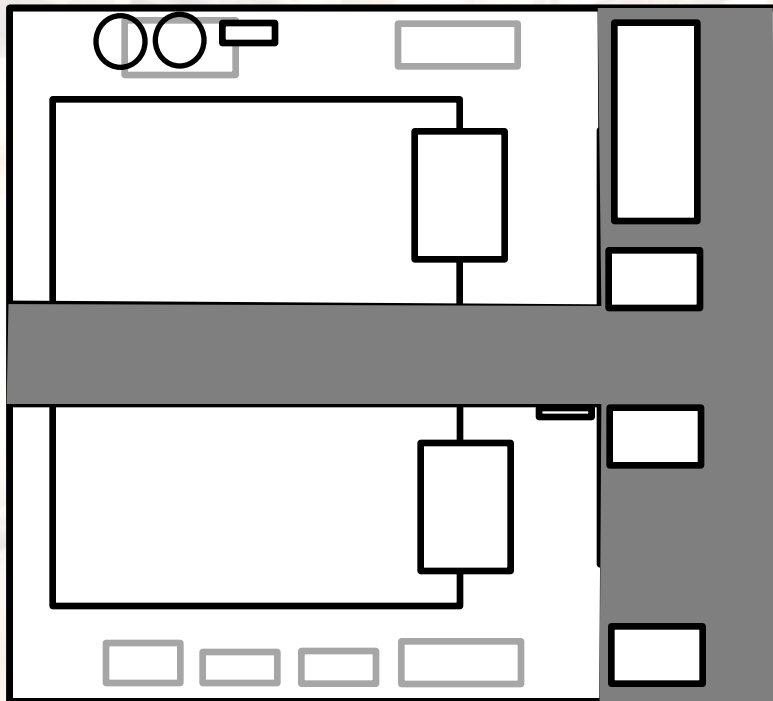
[Main
Menu](#)

[Exit](#)

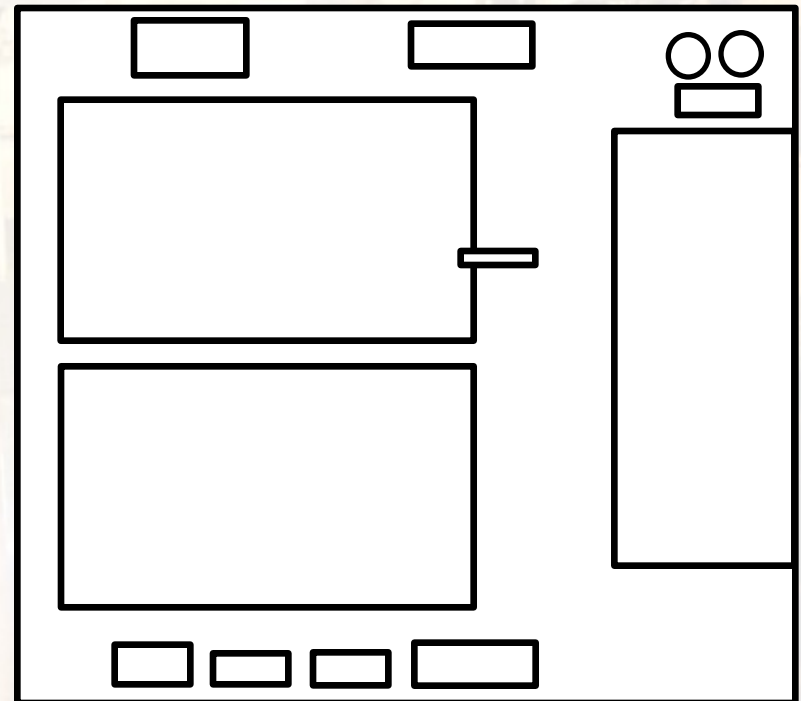


Boiler Room

Main Deck (Top)



Orlop Deck (Bottom)



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

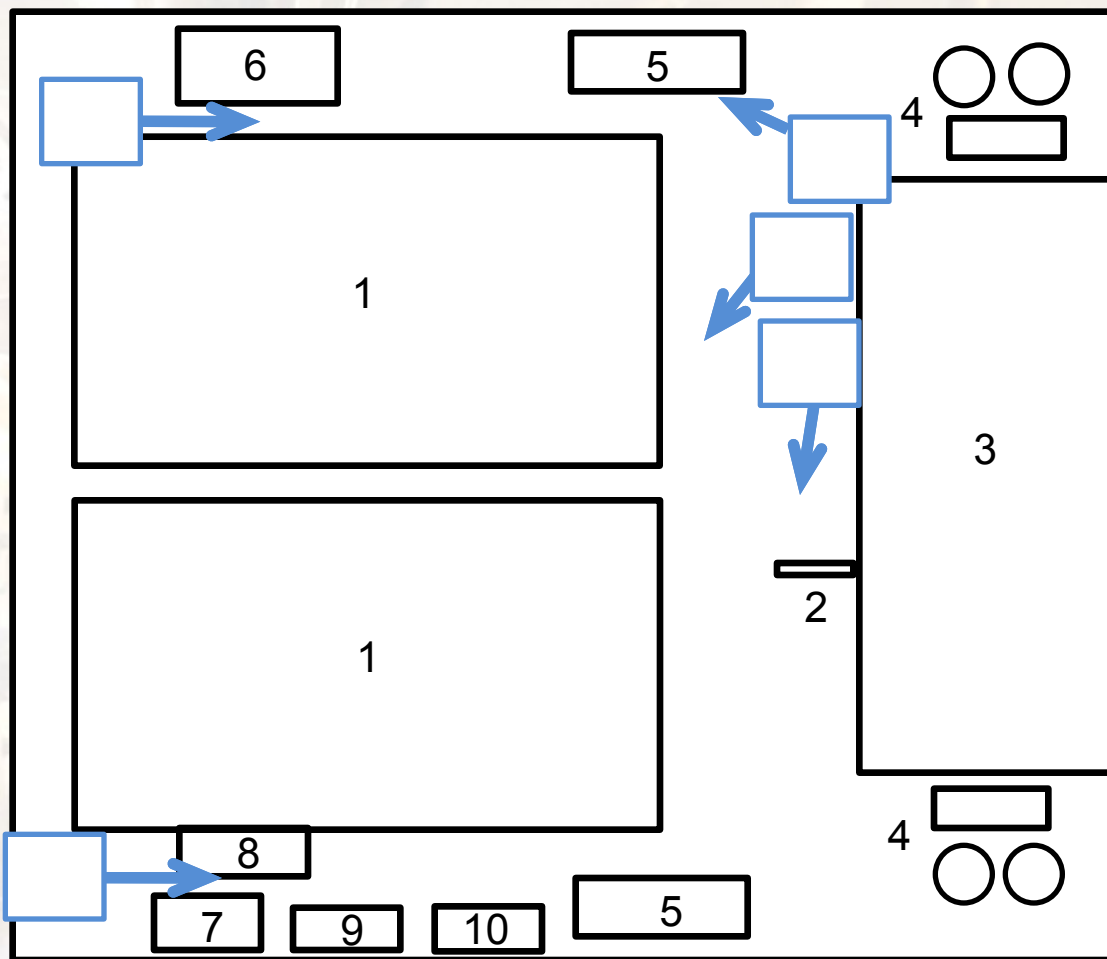
[Main Menu](#)

[Exit](#)



Boiler Room – Orlop Deck

- 1 Boiler
 - 2 Ladder
 - 3 Fuel Tank
 - 4 Fuel Pumps and Heater
 - 5 Diesel Alternator
 - 6 Sewage System
 - 7 Bilge Oil Water Separator
 - 8 Toilet Vacuumator
 - 9 Fresh Water Pump
 - 10 Salt Water Pump
 - 11. Boiler Forced Draft Fans
 - 12. Boiler Control Panel
 - 13. Tool Store
 - 14. Boiler Water Treatment
 - 15. Electric Domestic Water Heater
 - 16. Steam Domestic Water Heater
 - 17. Radiator Electric Heaters
 - 18. Toilet Vacuum Extraction Manifold
- Items in Grey are on other deck



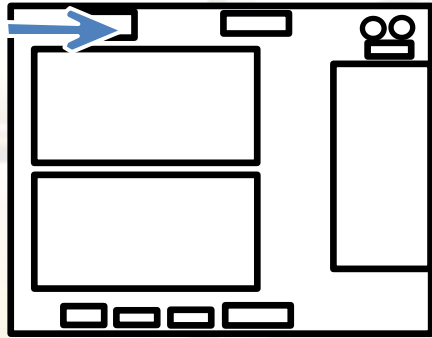
Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Boiler Room – Orlop Deck

Starboard
side
looking Aft



Starboard Boiler

Diesel Alternator

Sewage Plant



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

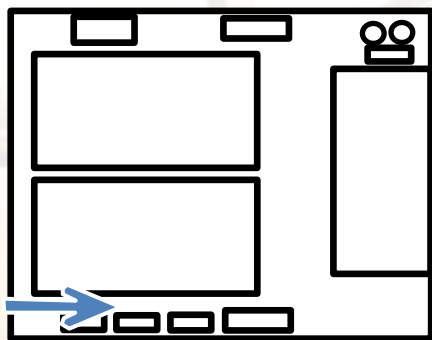
[Main Menu](#)

[Exit](#)



Boiler Room – Orlop Deck

Port side
looking Aft



Port Alternator

Port Boiler

Salt and Fresh
Water Pumps

Bilge Oil
Water Separator

Toilet
Vacuumator



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

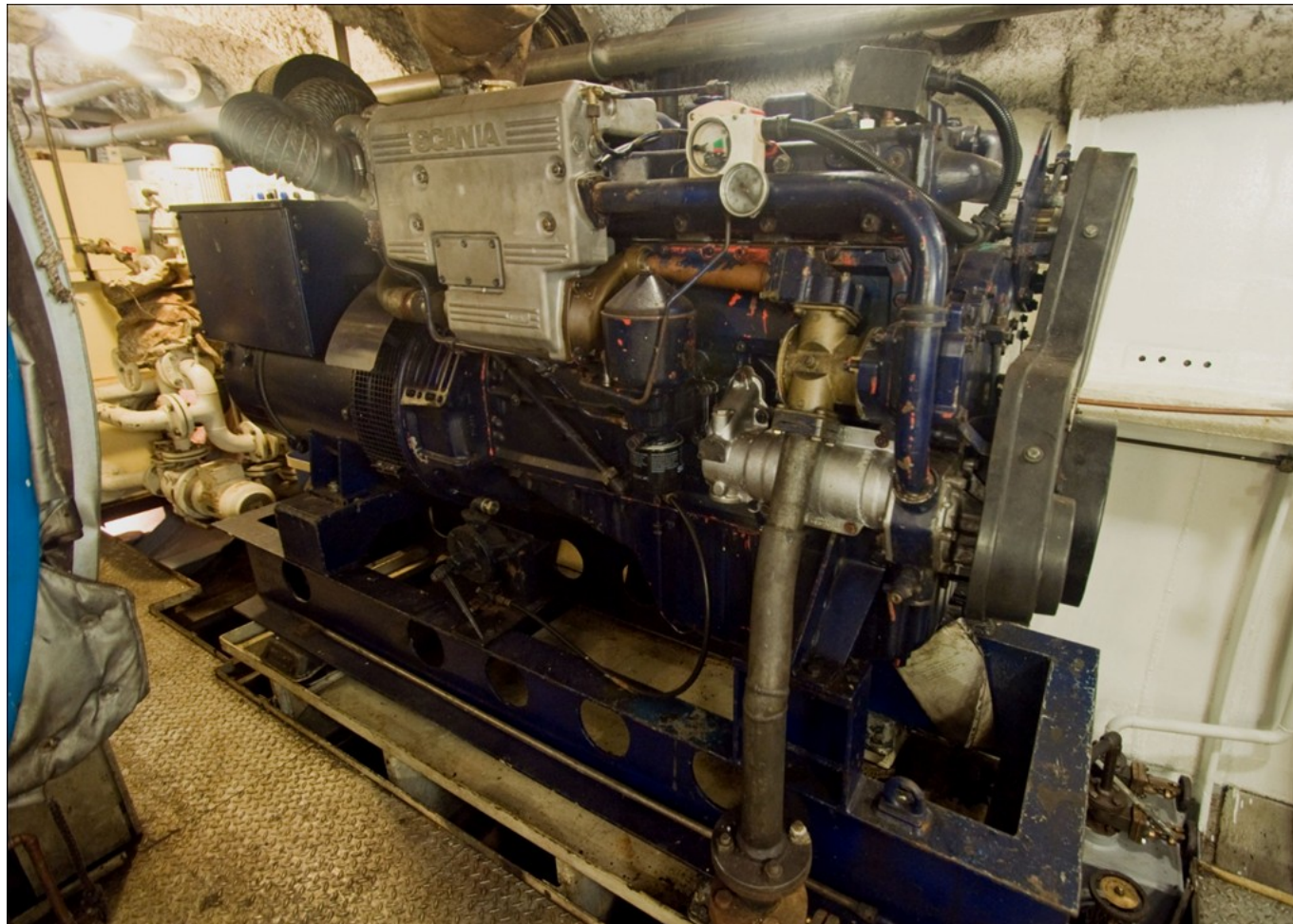
[Main
Menu](#)

[Exit](#)

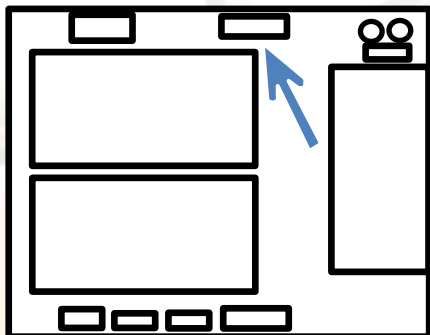


Boiler Room – Orlop Deck

By Starboard
Boiler



120 kw Diesel Alternator



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

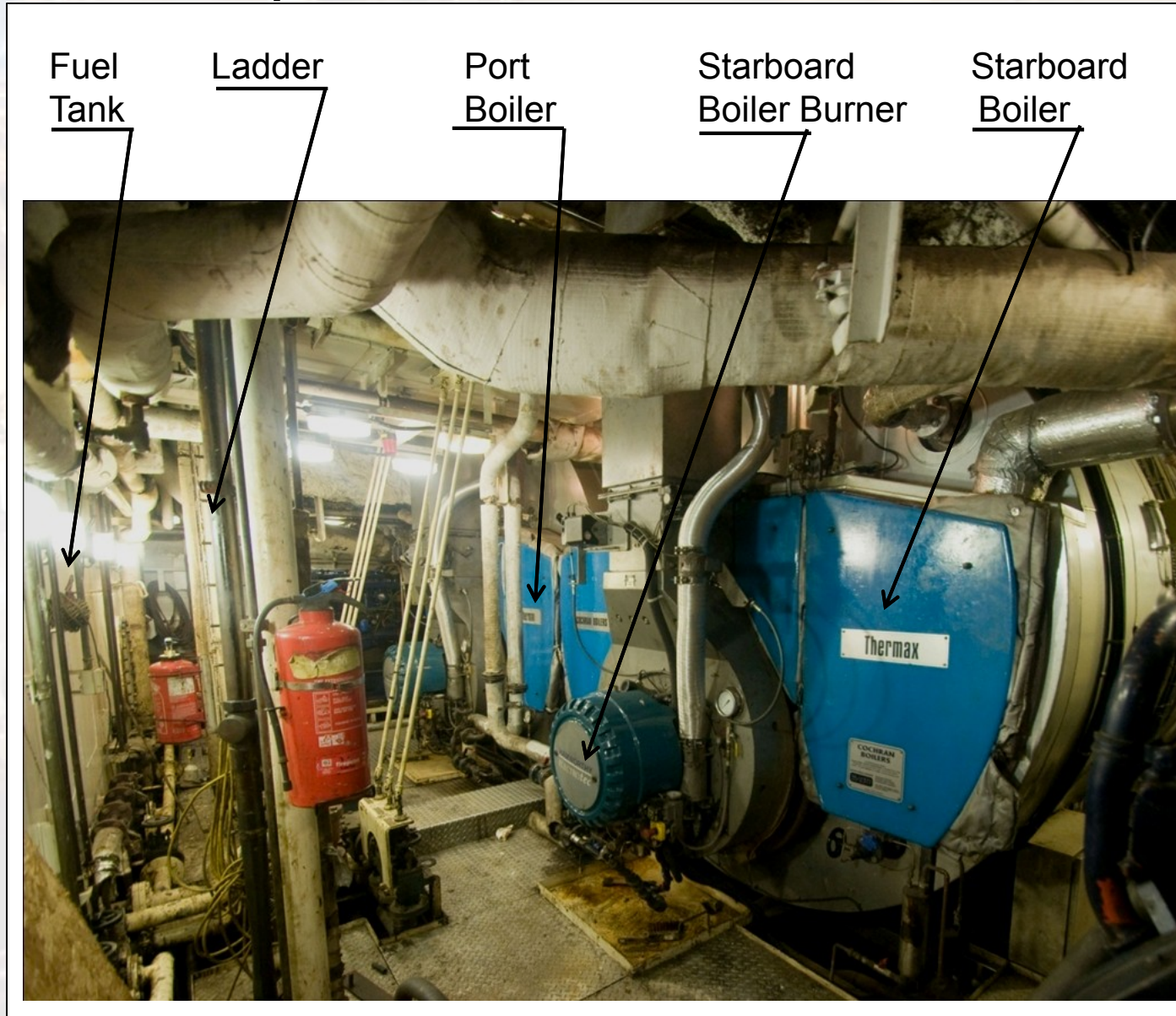
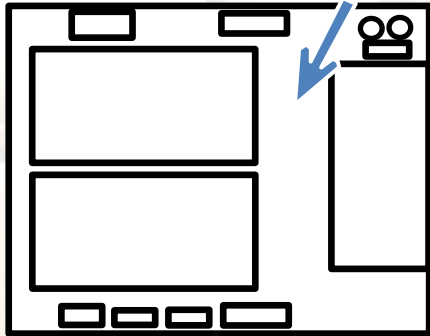
[Main
Menu](#)

[Exit](#)



Boiler Room – Orlop Deck

Aft End of
Boiler Room



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

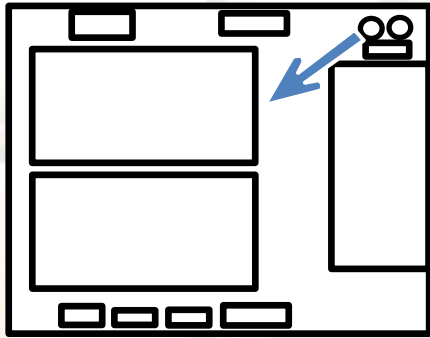
[Main Menu](#)

[Exit](#)



Boiler Room – Orlop Deck

Front of
Starboard
Boiler

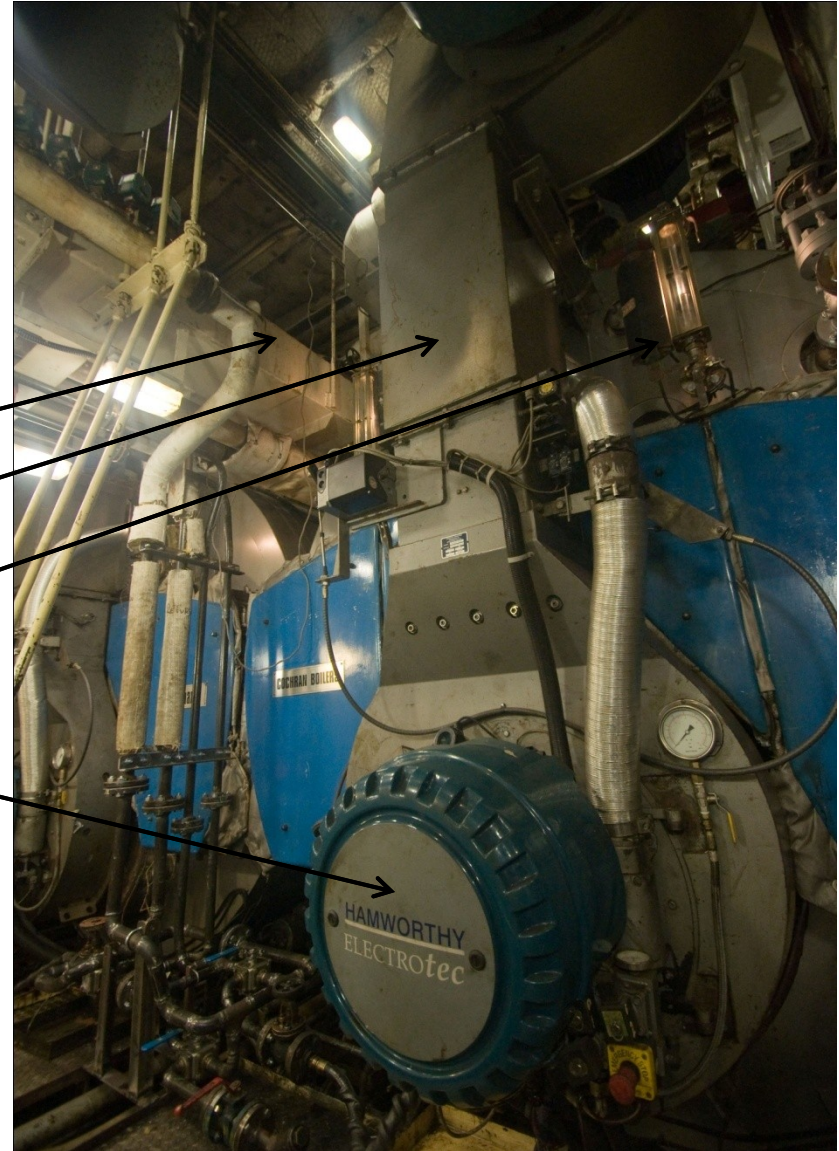


Main Deck Gantry

Fan Ducting

Gauge Glass

Burner



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

[Main
Menu](#)

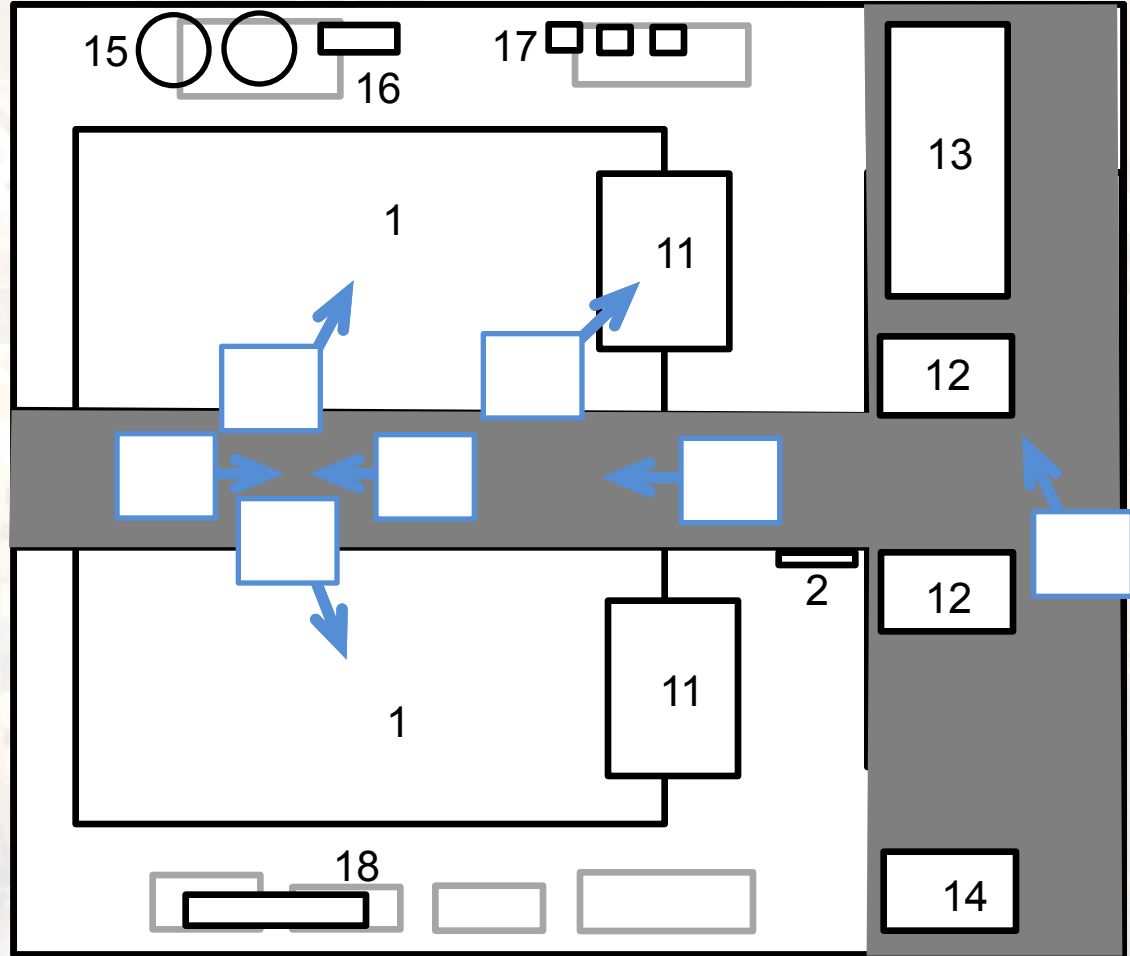
[Exit](#)



Boiler Room – Main Deck

- 1 Boiler
- 2 Ladder
- 3 Fuel Tank
- 4 Fuel Pumps and Heater
- 5 Diesel Alternator
- 6 Sewage System
- 7 Bilge Oil Water Separator
- 8 Toilet Vacuumator
- 9 Fresh Water Pump
- 10 Salt Water Pump
- 11. Boiler Forced Draft Fans
- 12. Boiler Control Panel
- 13. Tool Store
- 14. Boiler Water Treatment
- 15. Electric Domestic Water Heater
- 16. Steam Domestic Water Heater
- 17. Radiator Electric Heaters
- 18. Toilet Vacuum Extraction Manifold

Items in Grey are on other deck



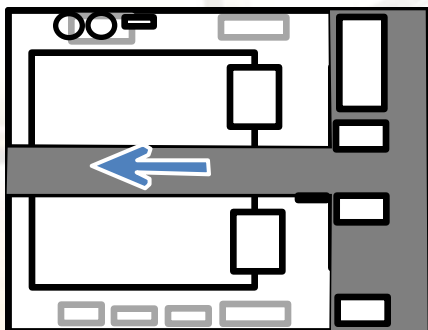
Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Boiler Room – Main Deck

Centre of Boiler Room looking Forward



Safety Valves

Safety Valve Steam Pipe

Boiler Exhaust

All boiler exhaust and safety valve steam goes up the Forward Funnel. The Aft funnel was required for the original boilers but now only takes the exhaust from the Diesel Alternators.



Port Boiler

Starboard Boiler

Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

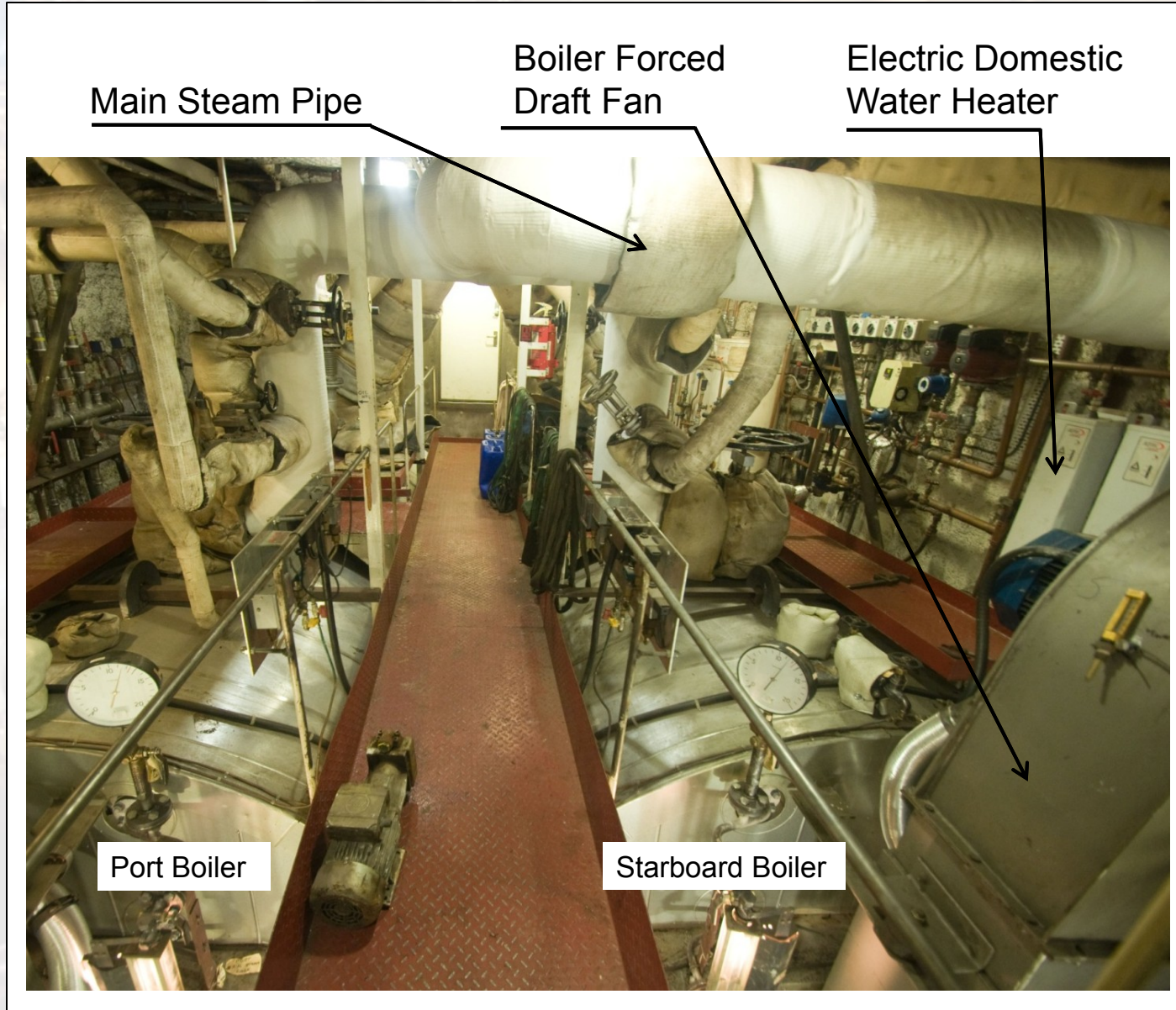
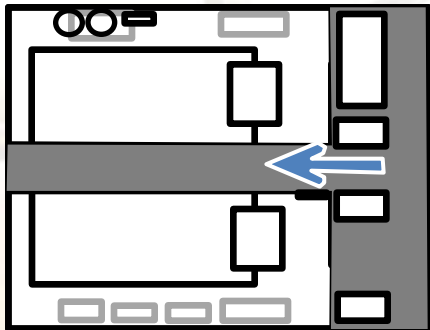
[Main Menu](#)

[Exit](#)



Boiler Room – Main Deck

Looking Forward



Main Steam Pipe

Boiler Forced Draft Fan

Electric Domestic Water Heater

Port Boiler

Starboard Boiler

Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

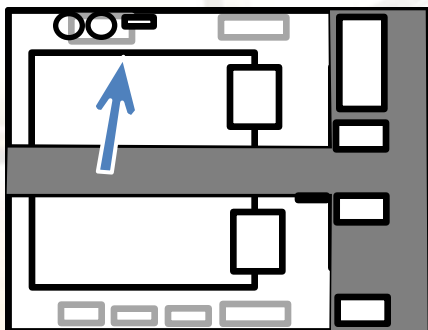
[Main Menu](#)

[Exit](#)



Boiler Room – Main Deck

Centre of Boiler Room looking Starboard

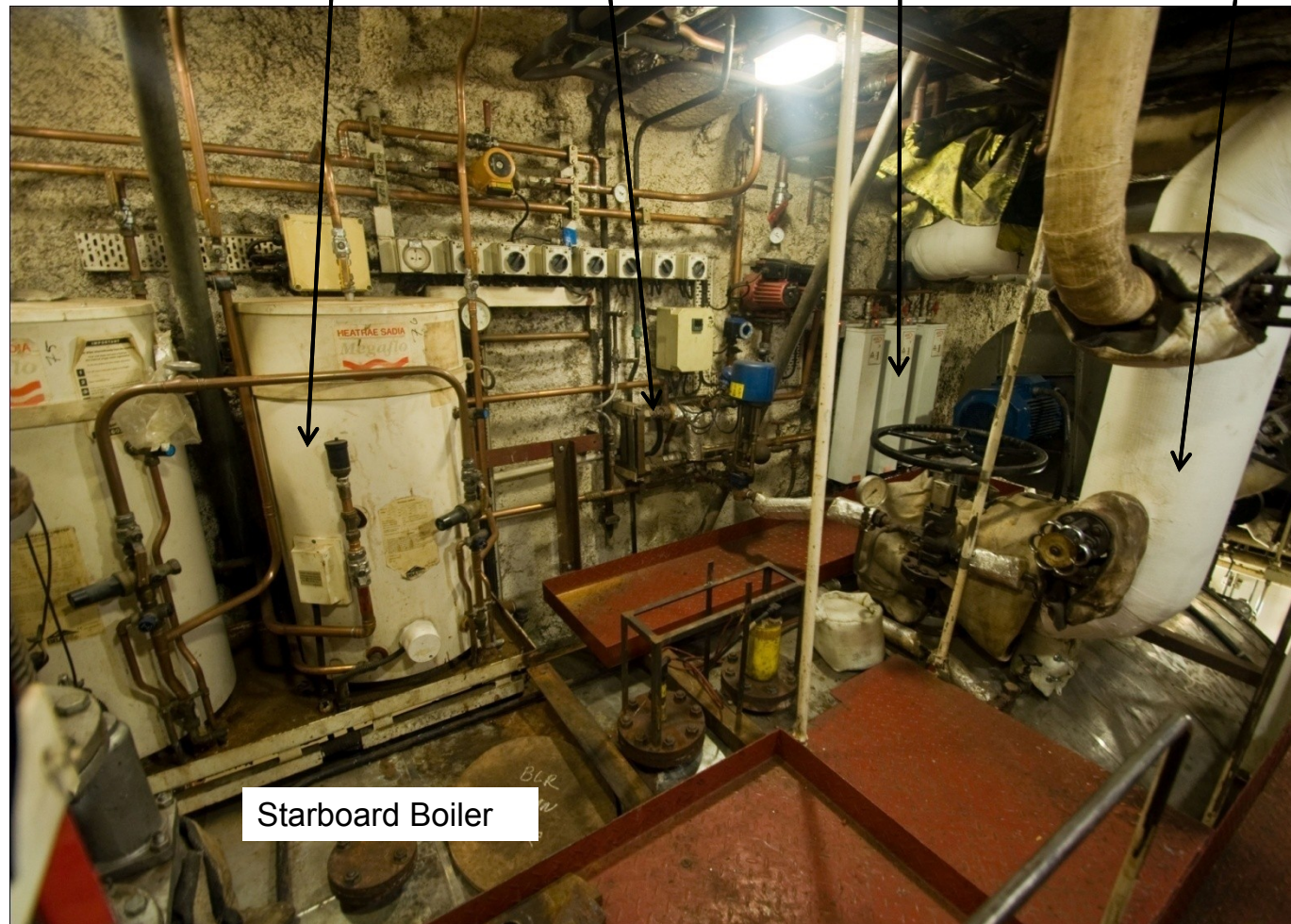


Electric Hot Water Cylinders

Steam Hot Water Heater

Electric Heaters for Radiators

Main Boiler Steam Pipe



Starboard Boiler

Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

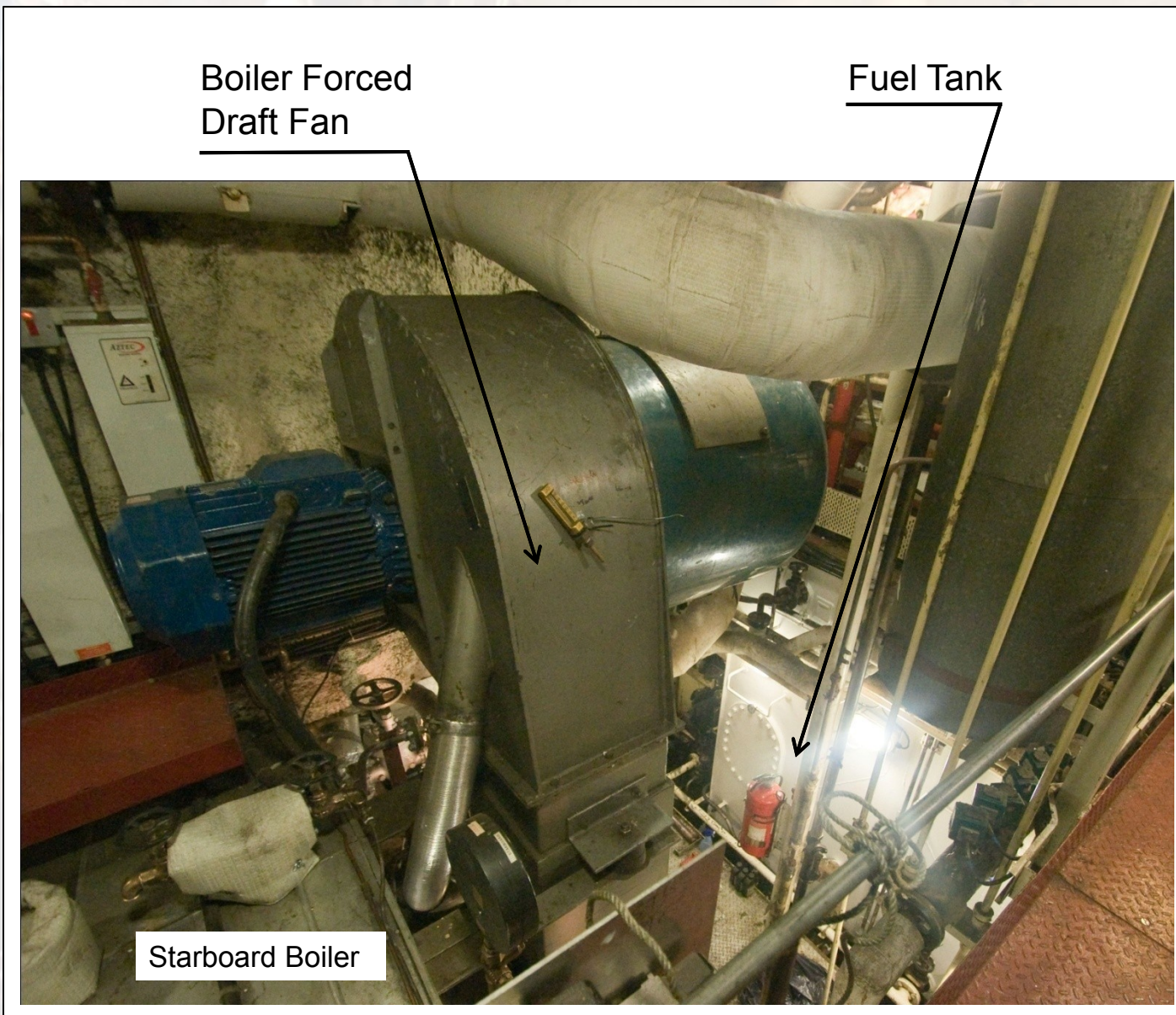
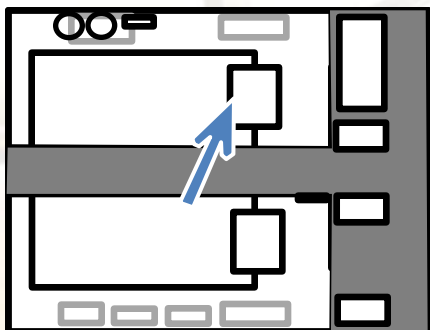
[Main Menu](#)

[Exit](#)



Boiler Room – Main Deck

Centre of Boiler Room looking Aft and Starboard



Starboard Boiler

Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

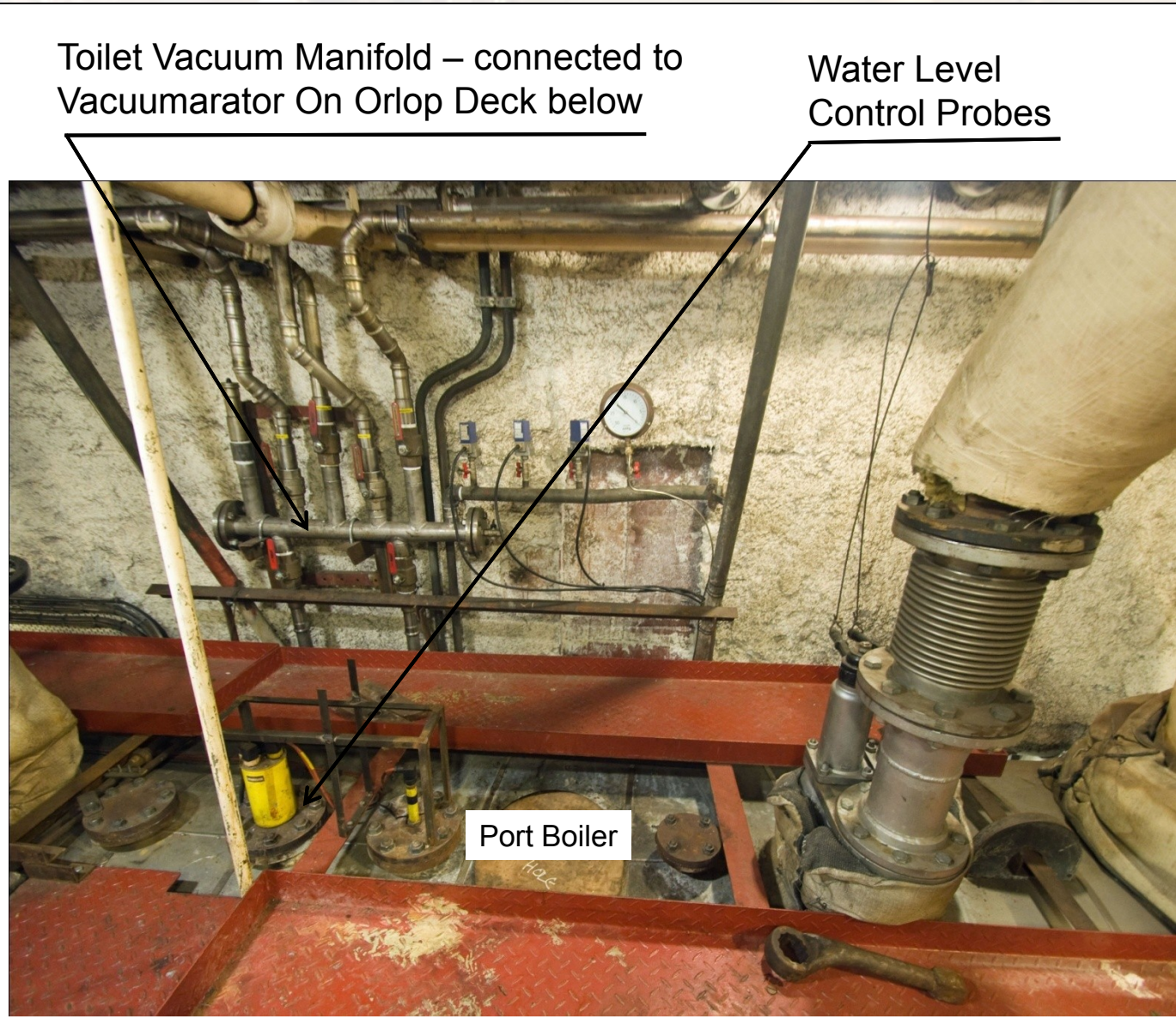
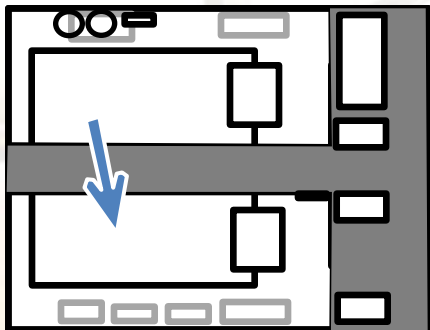
[Main Menu](#)

[Exit](#)



Boiler Room – Main Deck

Centre of Boiler Room looking to Port



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

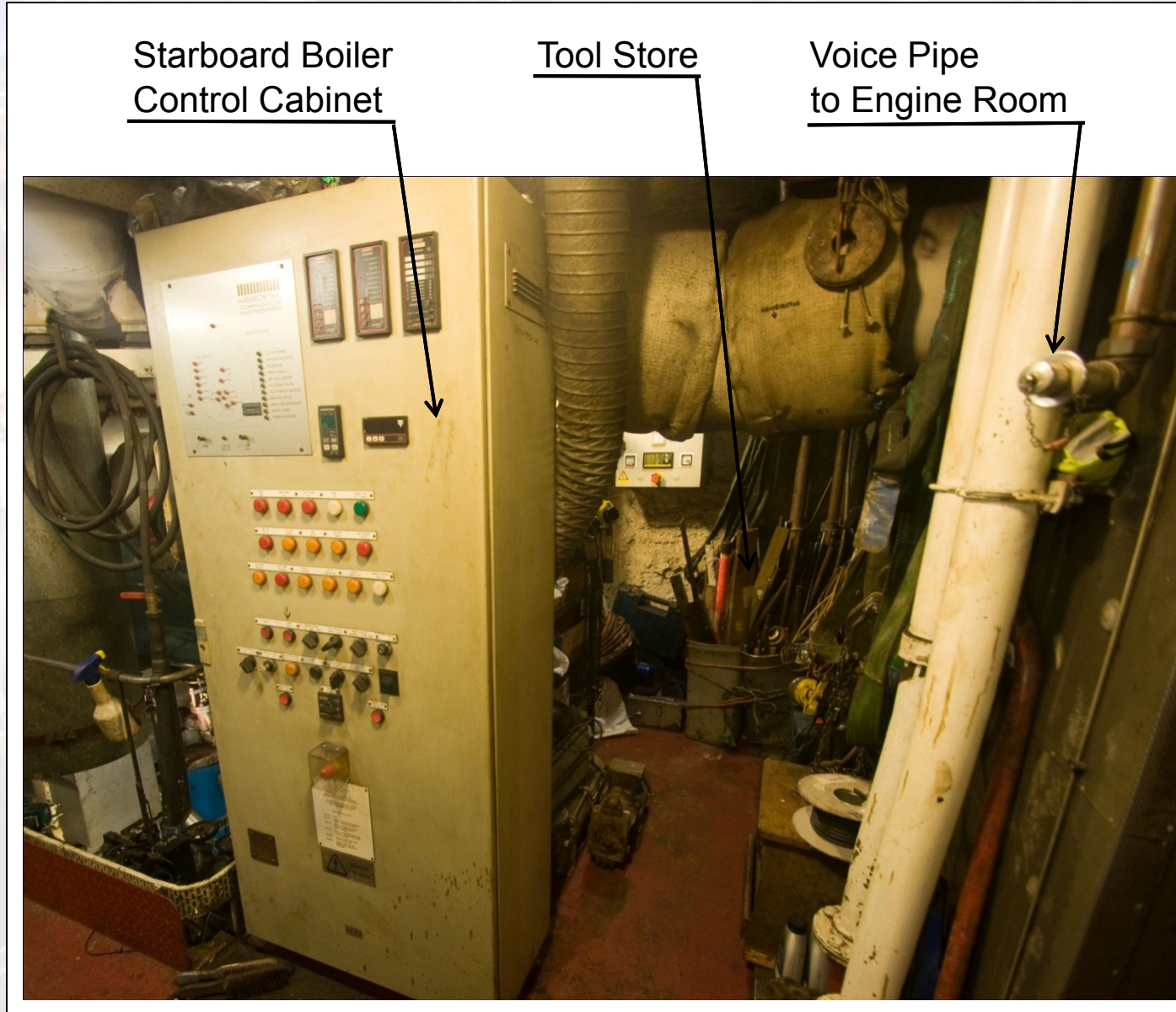
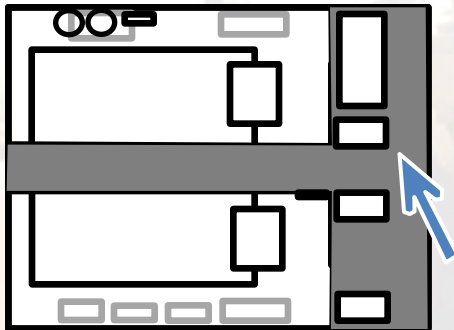
[Main Menu](#)

[Exit](#)



Boiler Room – Main Deck

Aft of Boiler Room Front looking to Starboard



Starboard Boiler Control Cabinet

Tool Store

Voice Pipe to Engine Room

Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

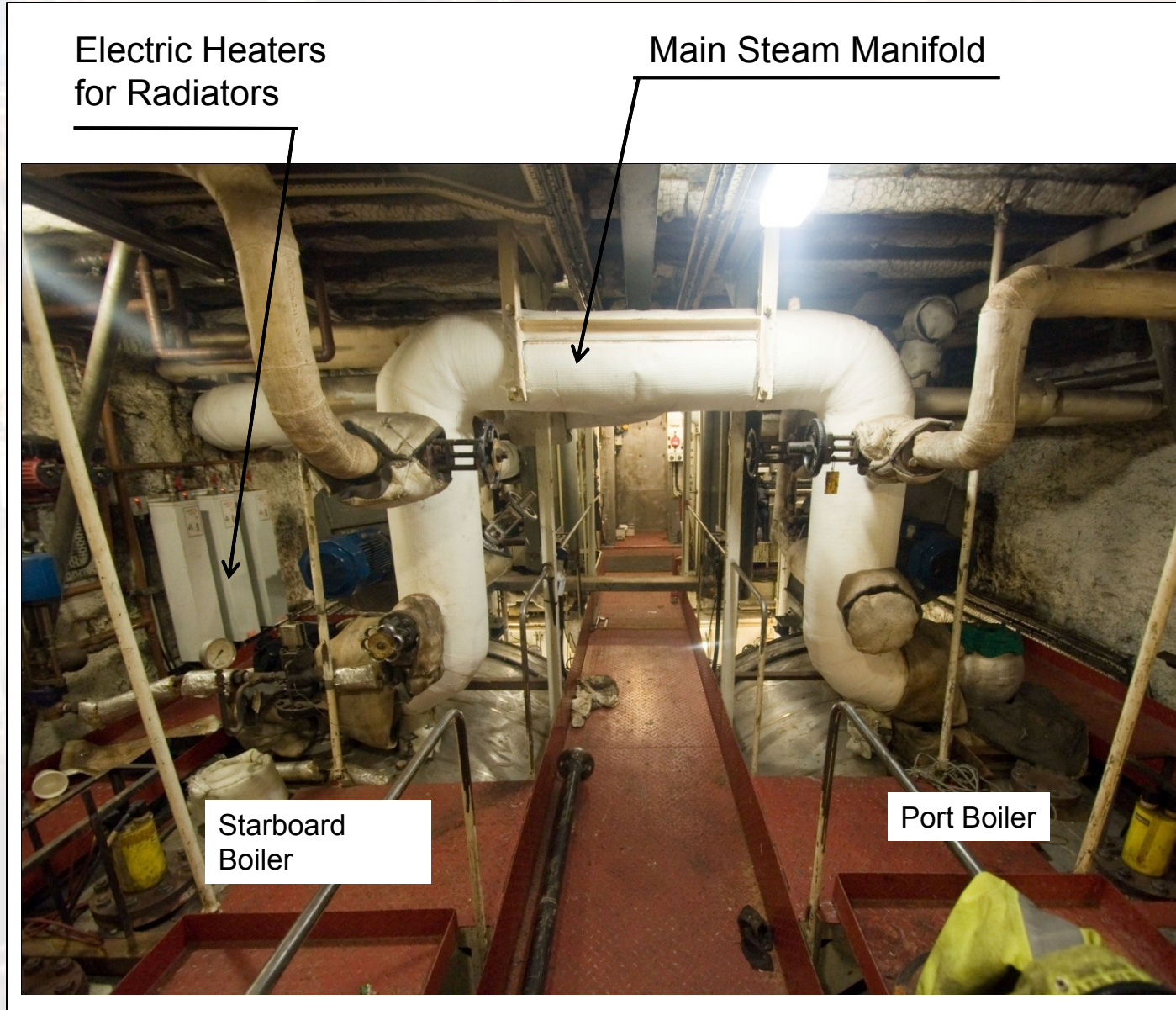
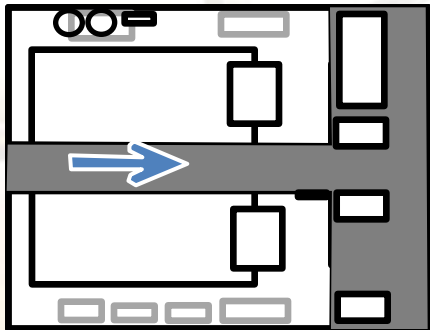
[Main Menu](#)

[Exit](#)



Boiler Room – Main Deck

Looking Aft



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

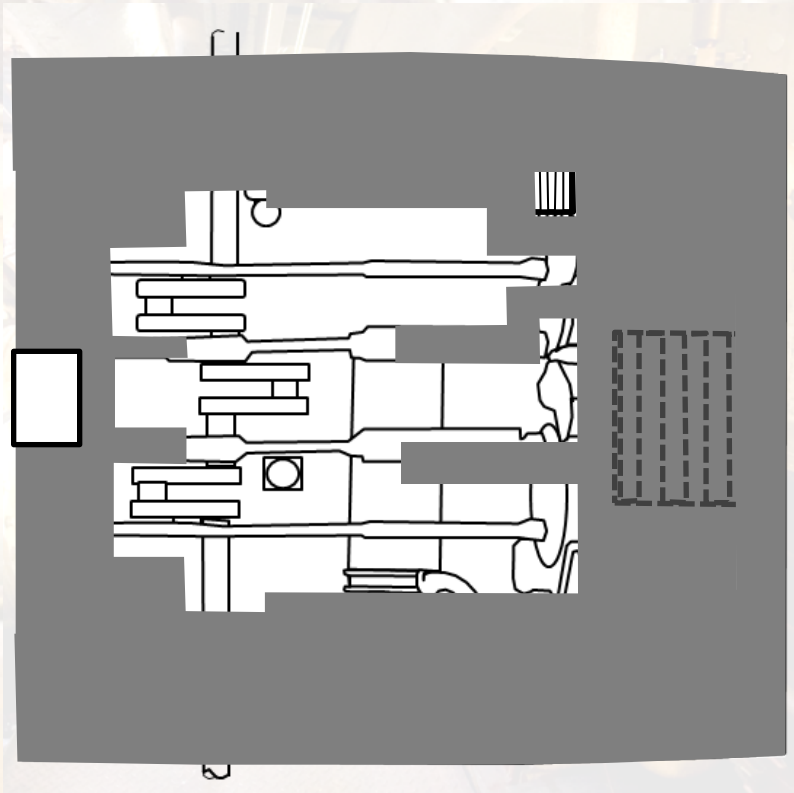
[Main Menu](#)

[Exit](#)

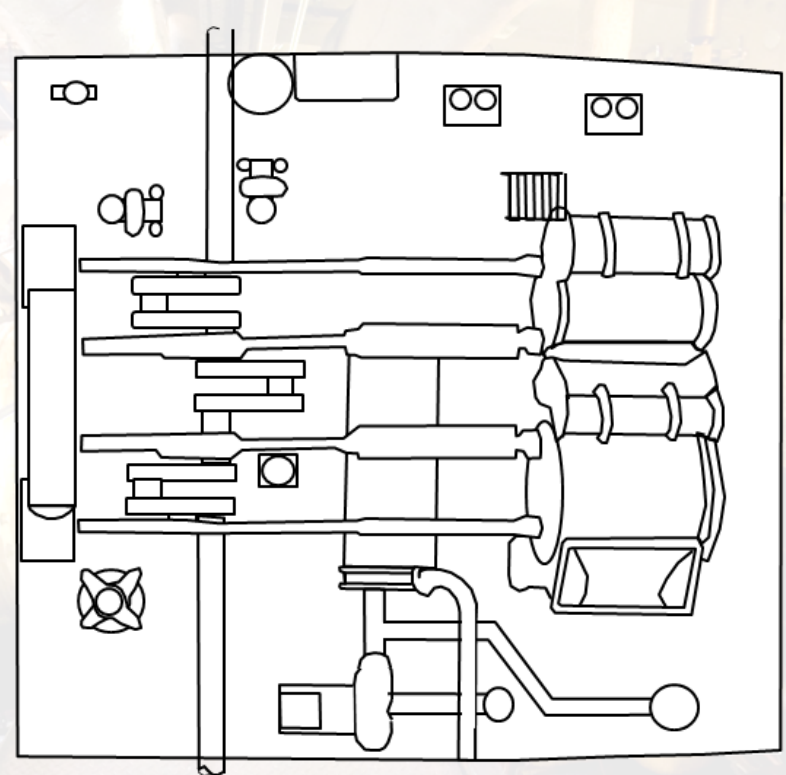


Engine Room

Main Deck (Top)



Orlop Deck (Bottom)



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

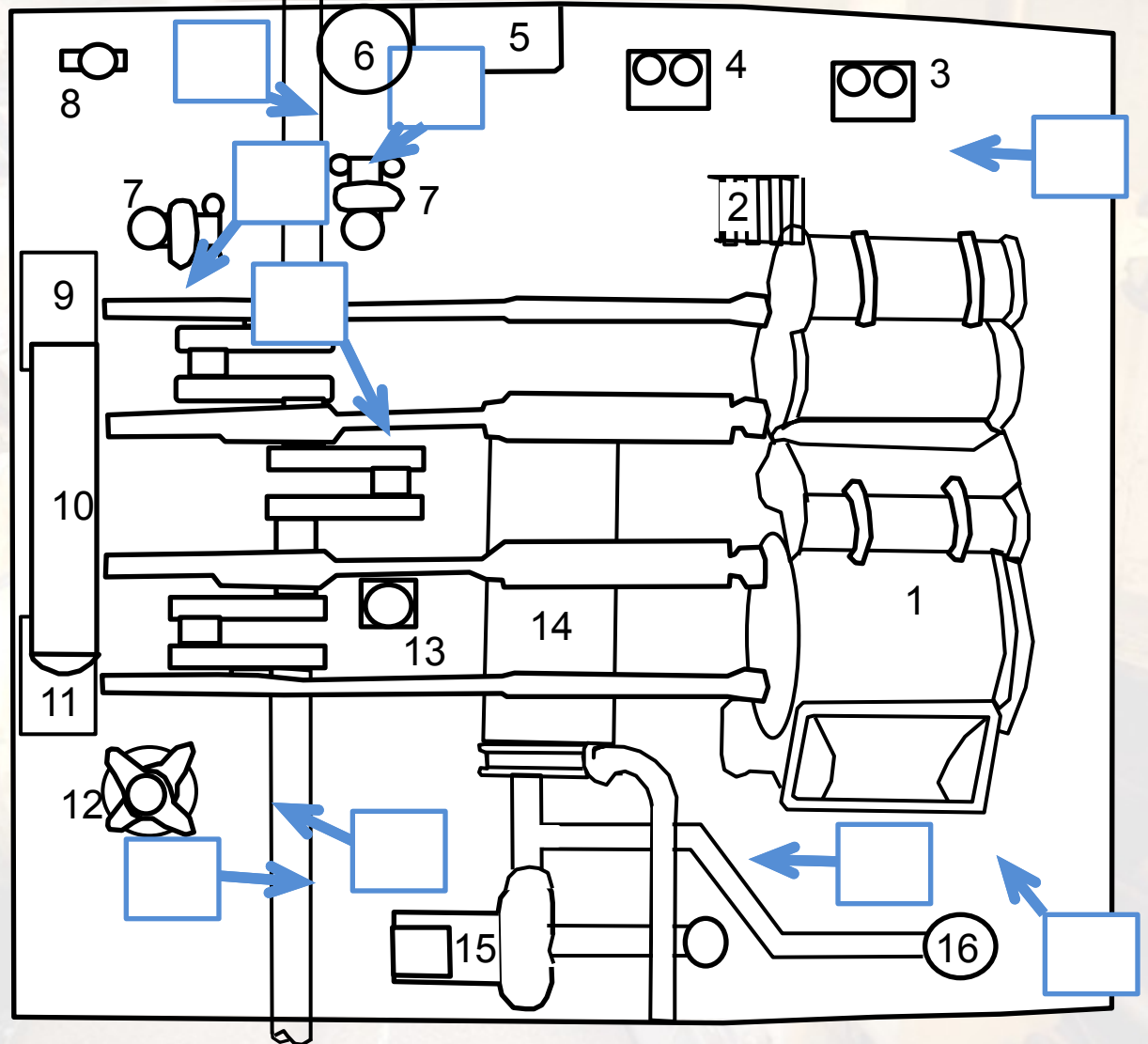
[Main Menu](#)

[Exit](#)



Engine Room – Orlop Deck

- 1 Main Steam Engine
 - 2 Ladder
 - 3 General Service Pump
 - 4 Fire & Bilge Pump
 - 5 Workbench
 - 6 Electric Standby Boiler Feed Pump
 - 7 Boiler Feed Pump
 - 8 HP Feed Water Filter
 - 9 Hot Well
 - 10 Feed Heater
 - 11 Feed Water Filter Tank
 - 12 Air Pump
 - 13 Reversing Engine
 - 14 Condenser
 - 15 Steam Condenser Cooling Water Pump
 - 16 Electric Condenser Cooling Water Pump
 - 17 Main Switchboard
 - 18 Control Table
 - 19 To Boiler Room
- Items in Grey are on other deck



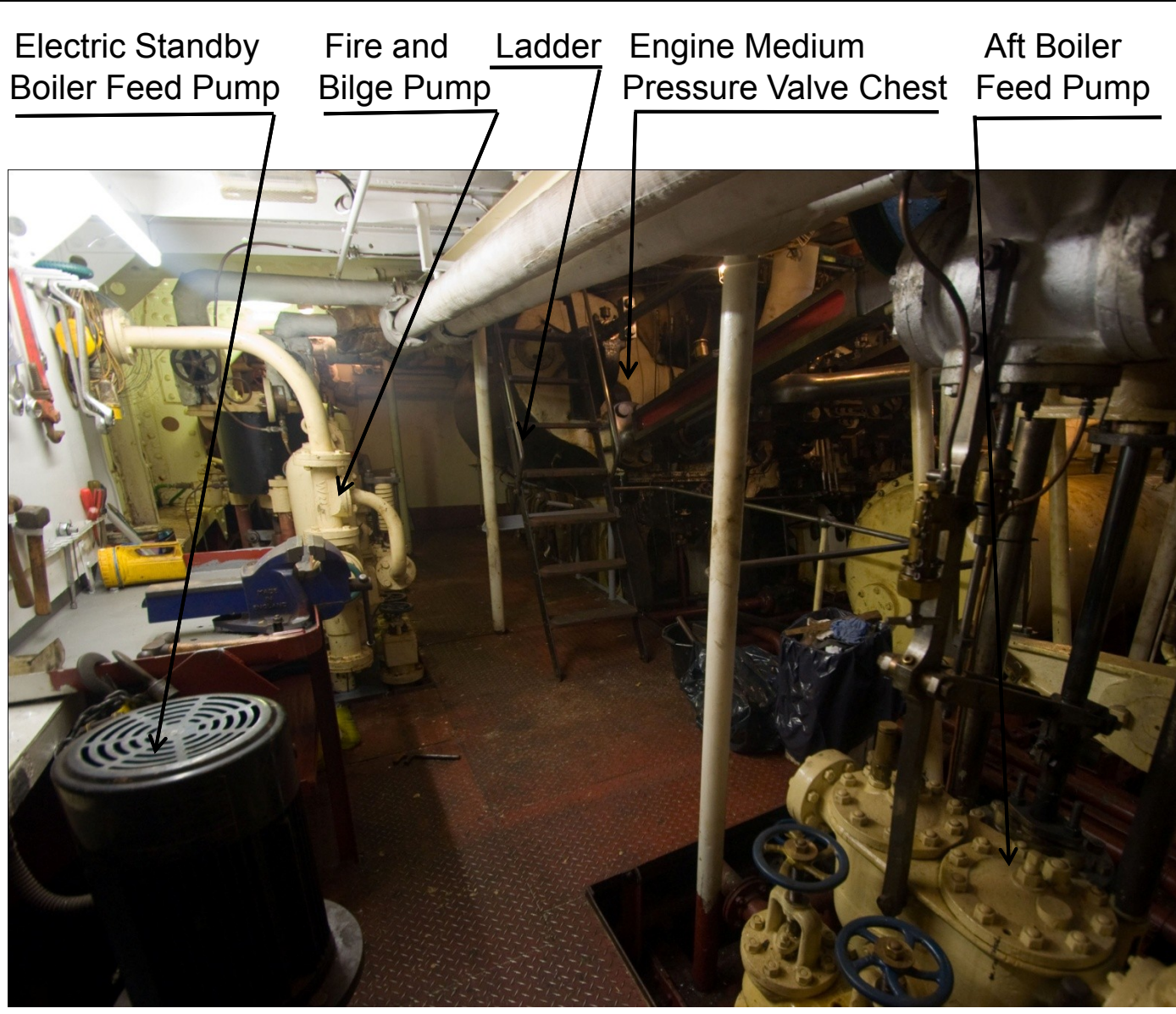
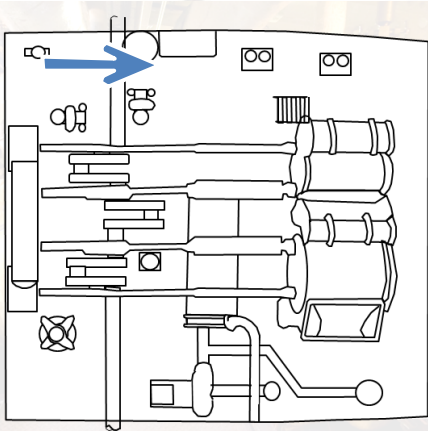
Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Engine Room – Orlop Deck

Starboard
side
Looking Aft



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Engine Room – Orlop Deck

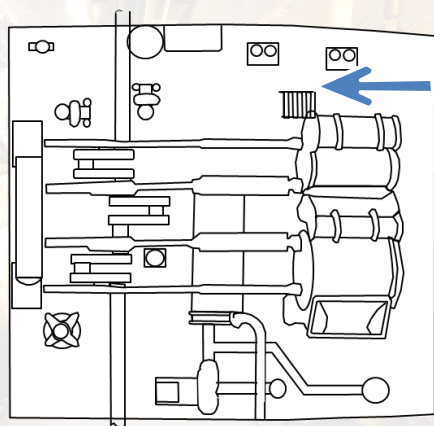
Starboard side
looking
Forward

Engine Medium
Pressure Valve Chest

Ladder

Fire and
Bilge Pump

General Service
Pump



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

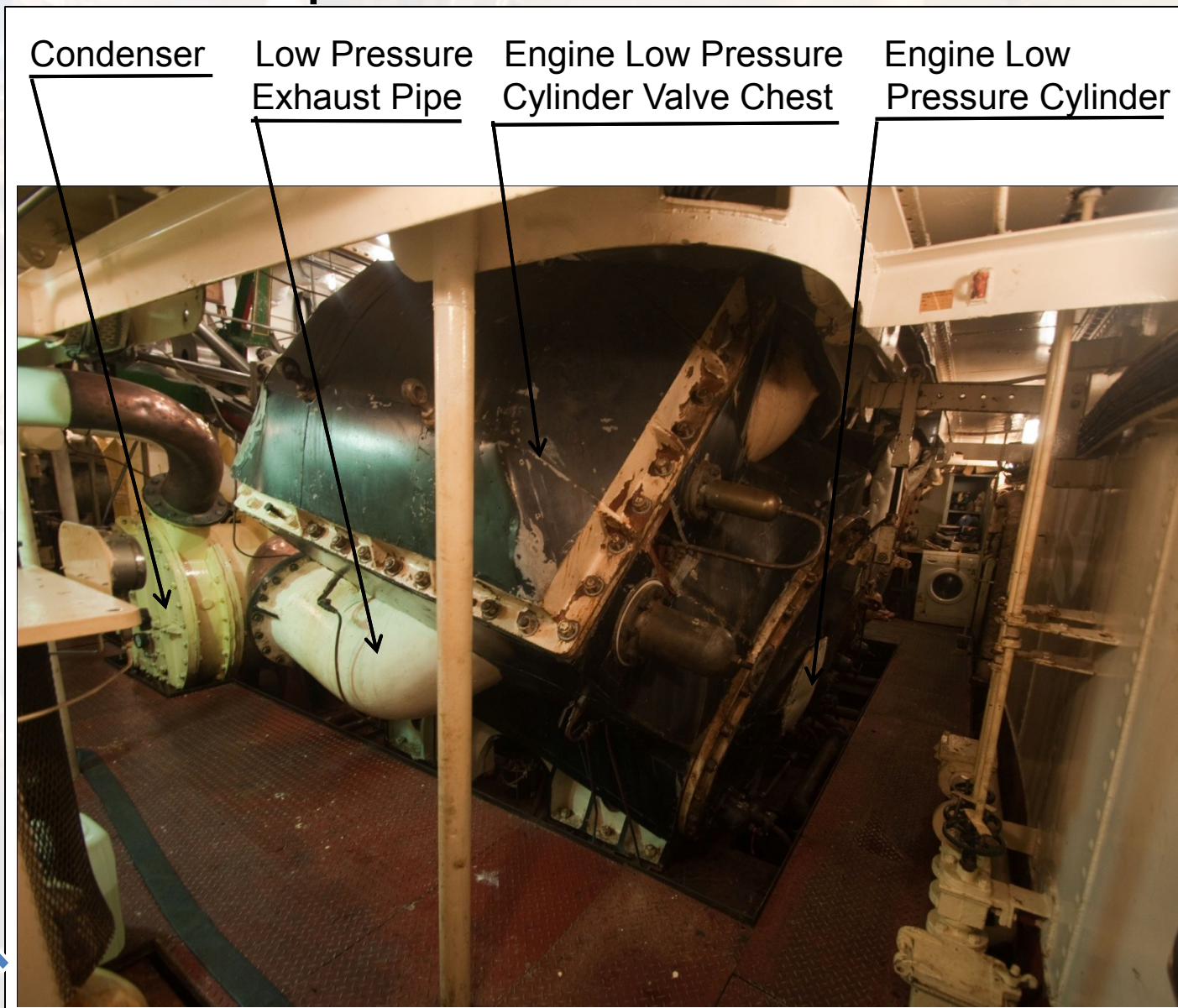
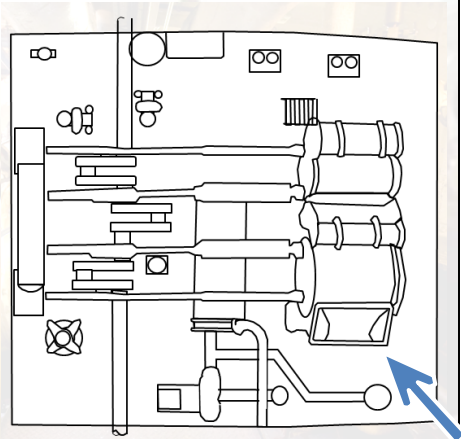
[Main
Menu](#)

[Exit](#)



Engine Room – Orlop Deck

Behind Engine
looking to
Starboard



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

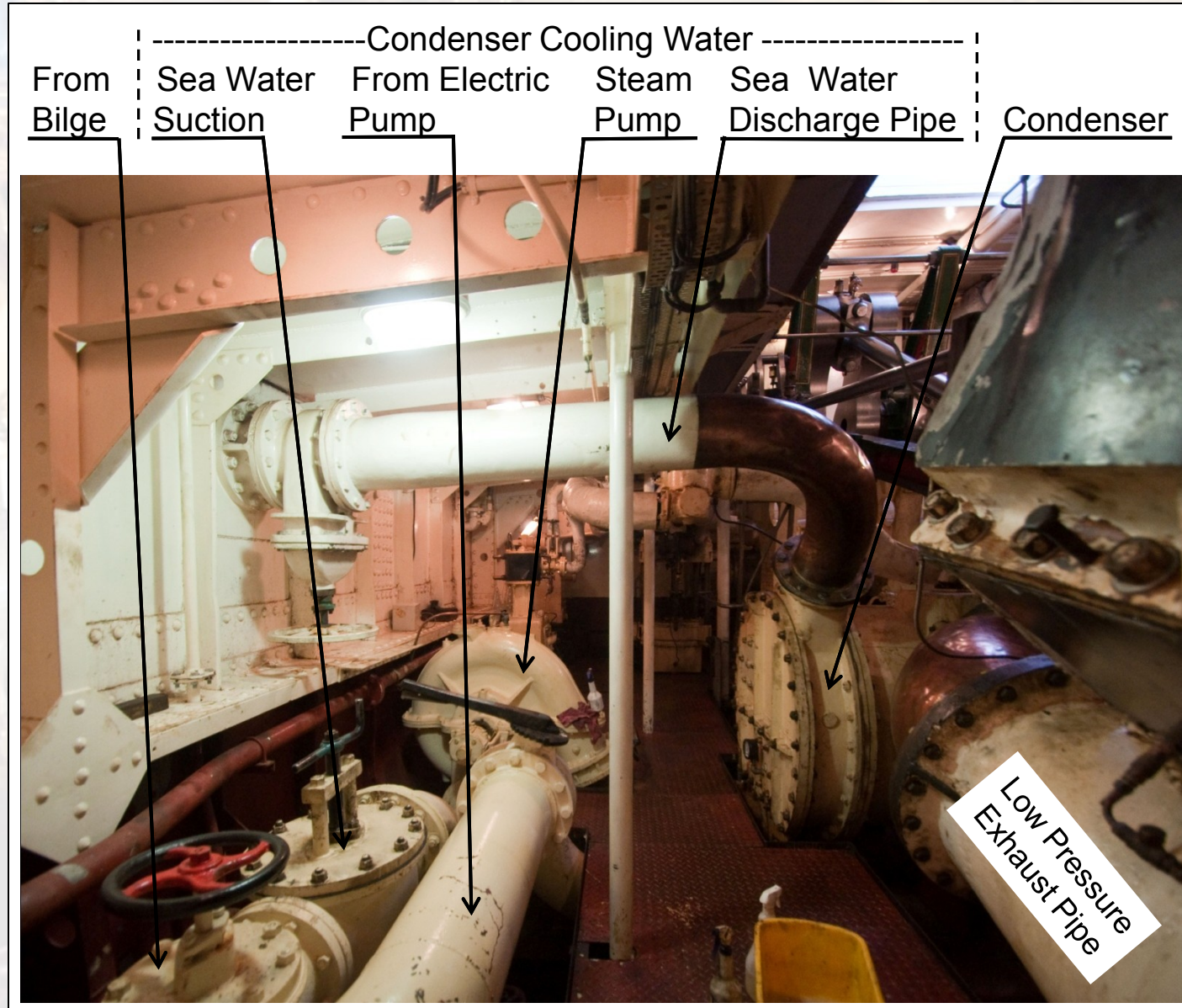
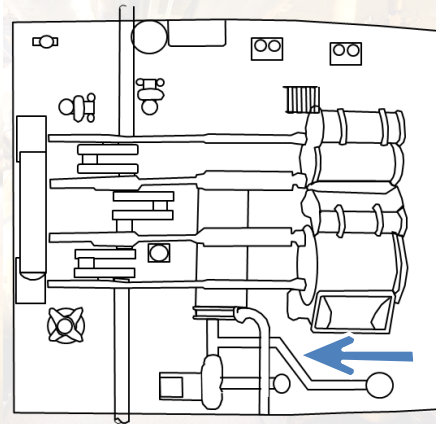
[Exit](#)



Engine Room – Orlop Deck

Port Side
looking
Forward

Note:
The Condenser
Cooling Water Pump is
also an emergency
Bilge Pump



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

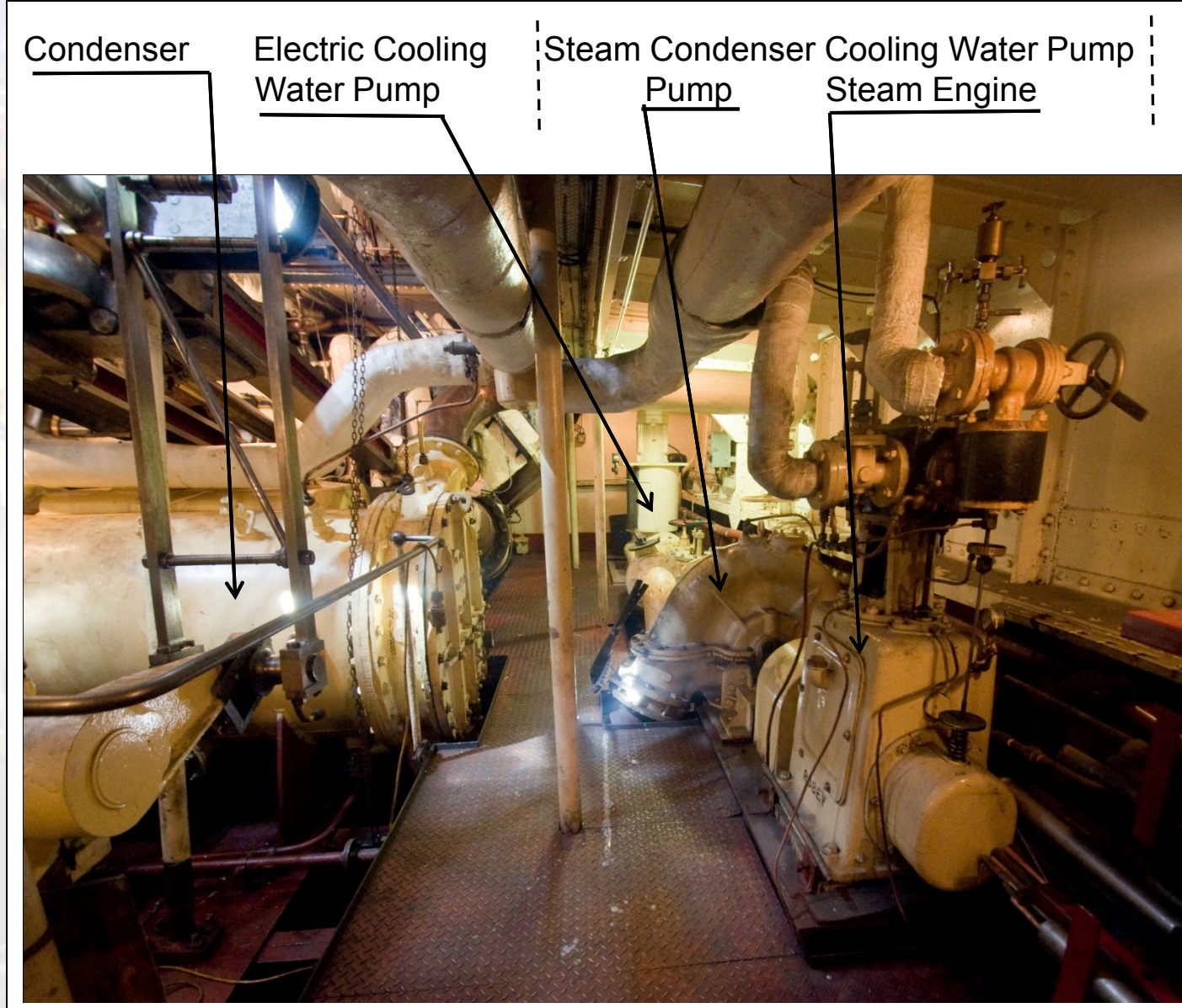
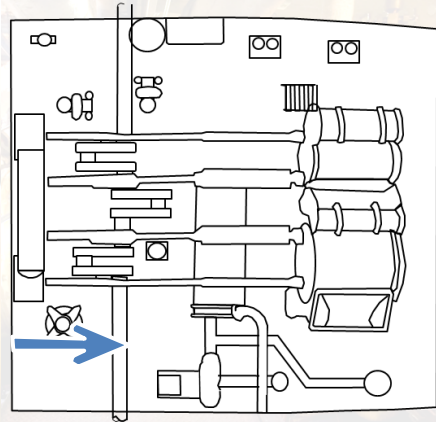
[Main Menu](#)

[Exit](#)



Engine Room – Orlop Deck

Port Side
looking Aft



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Engine Room – Orlop Deck

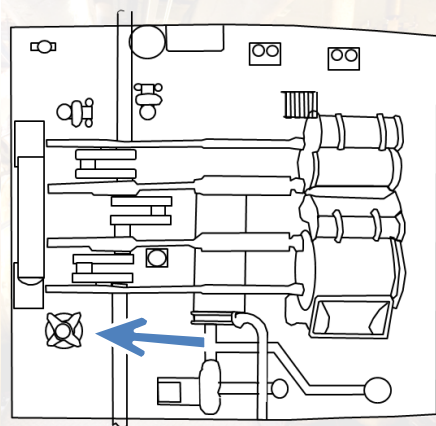
Looking Forward on Port side at front of engine room



Feed Water Heater

Feed Water Filter Tank

Air Pump



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



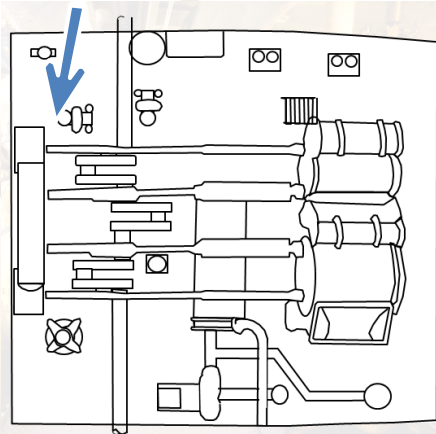
Engine Room – Orlop Deck

By the Boiler Room bulkhead looking to Port

Air Pump Crankshaft Guard Feed Water Filter Tank Feed Water Heater Hot Well Feed Water Pump Control Spindle - see insert



Hotwell Float controls Feed Water Pump Control Spindle



Float Counterweight

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

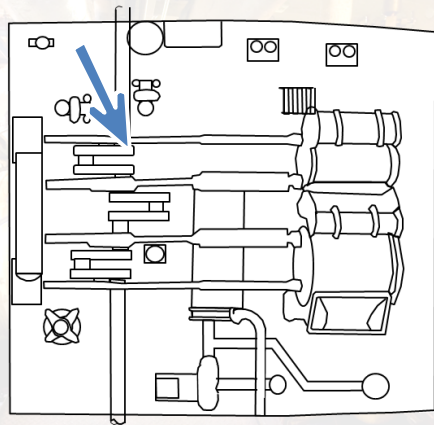
[Exit](#)



Engine Room – Orlop Deck

Looking Aft and to Port from underneath crankshaft

Condenser Wyper Shaft Reversing Engine Counter Weight for Eccentrics & Drag Links



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

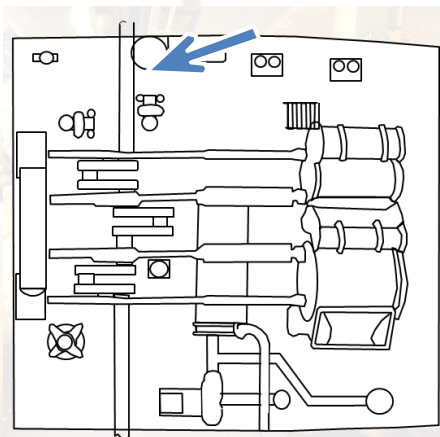
[Main Menu](#)

[Exit](#)



Engine Room – Orlop Deck

Starboard
Centre Engine
Room Looking
Forward



Boiler
Feed
Pumps

Steam
Cylinders

Water
Pumps



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

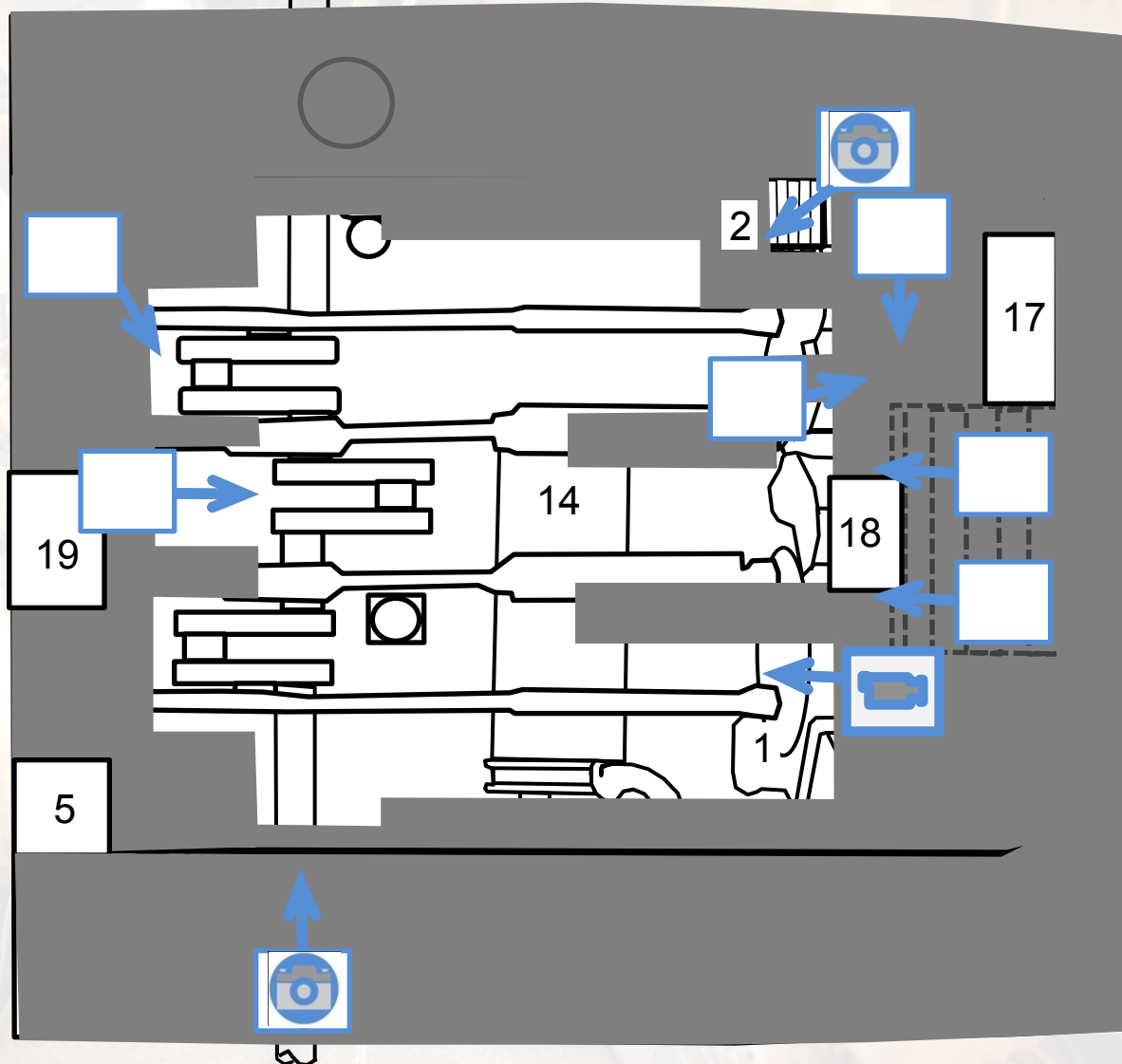
[Main
Menu](#)

[Exit](#)



Engine Room – Main Deck

- 1 Main Steam Engine
- 2 Ladder
- 3 General Service Pump
- 4 Fire & Bilge Pump
- 5 Workbench
- 6 Electric Standby Boiler Feed Pump
- 7 Boiler Feed Pump
- 8 HP Feed Water Filter
- 9 Hot Well
- 10 Feed Heater
- 11 Feed Water Filter Tank
- 12 Air Pump
- 13 Reversing Engine
- 14 Condenser
- 15 Steam Condenser Cooling Water Pump
- 16 Electric Condenser Cooling Water Pump
- 17 Main Switchboard
- 18 Control Table
- 19 To Boiler Room



Items in Grey are on other deck

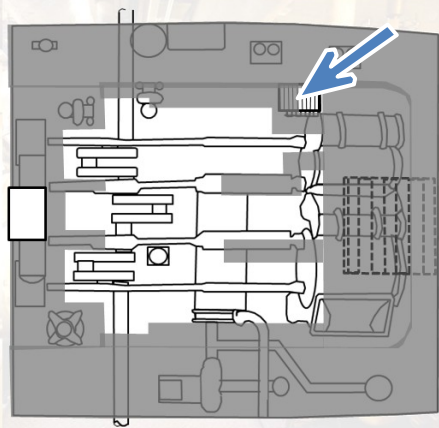
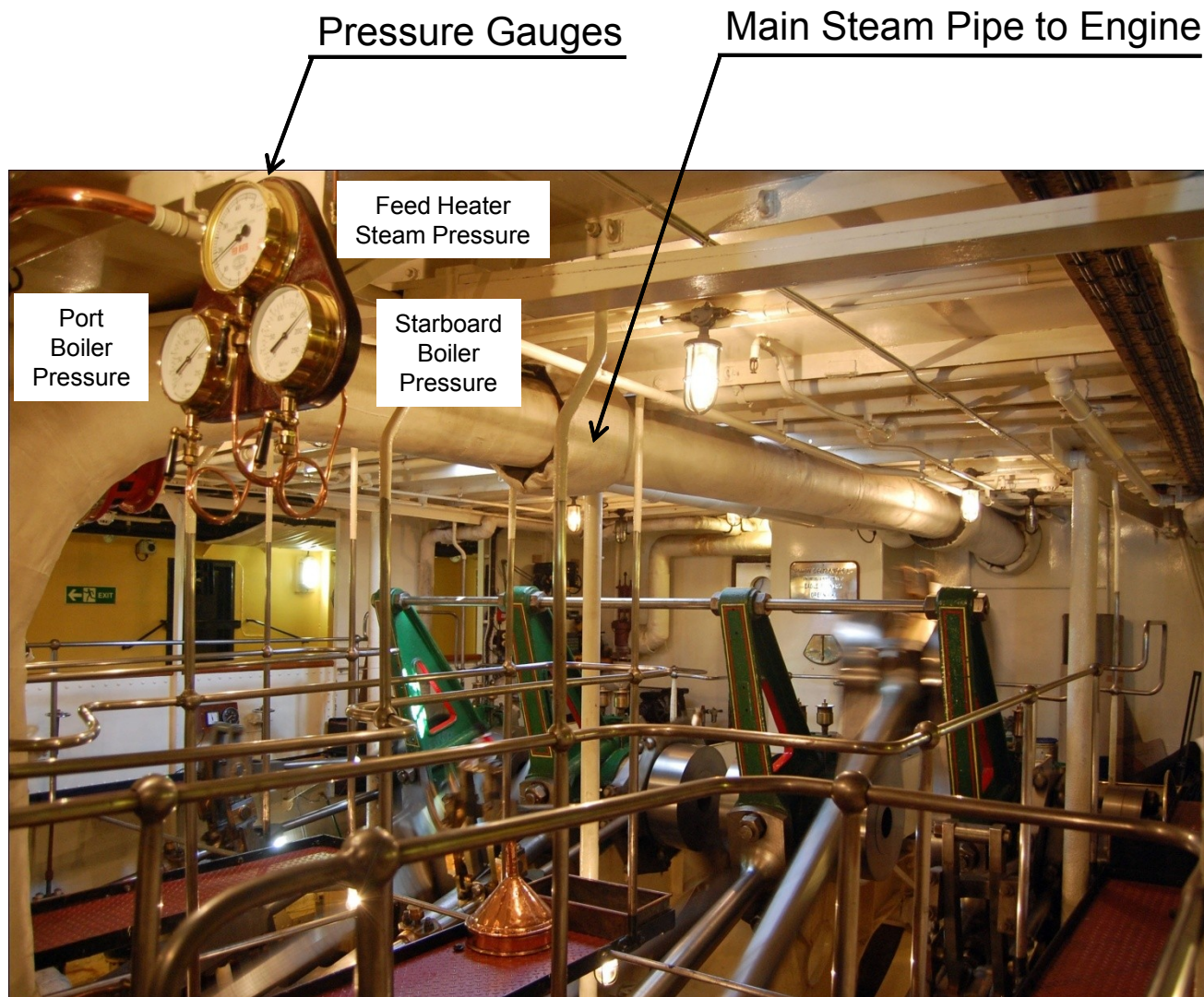
Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Engine Room – Main Deck

From Starboard side looking Forward



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

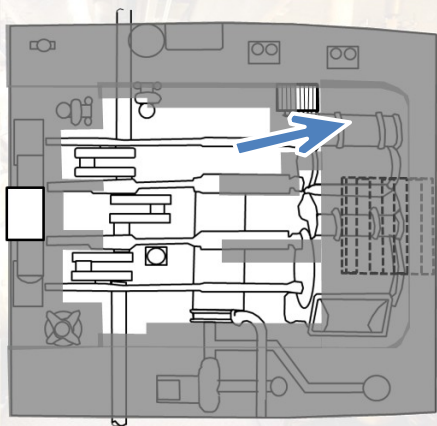
[Main Menu](#)

[Exit](#)



Engine Room – Main Deck

Main Switchboard



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

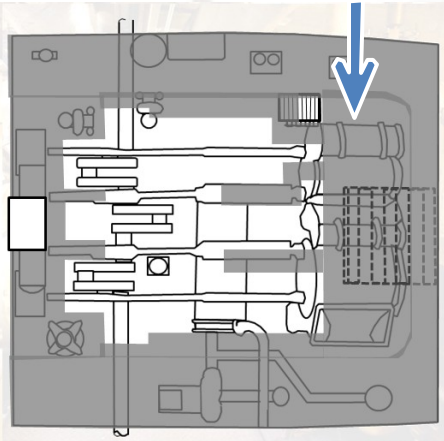
[Main Menu](#)

[Exit](#)



Engine Room – Main Deck

Engineer at the Controls



Voice Pipes

Control Table

Boiler Control Panel

Emergency Main Engine Steam Shut Off



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

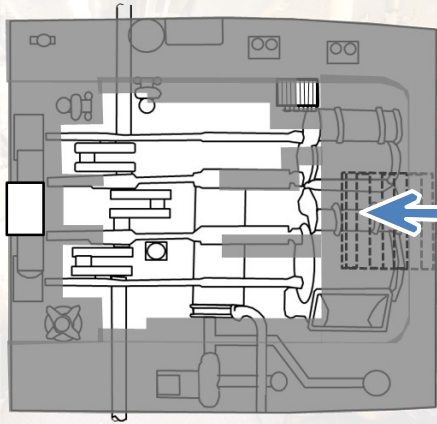
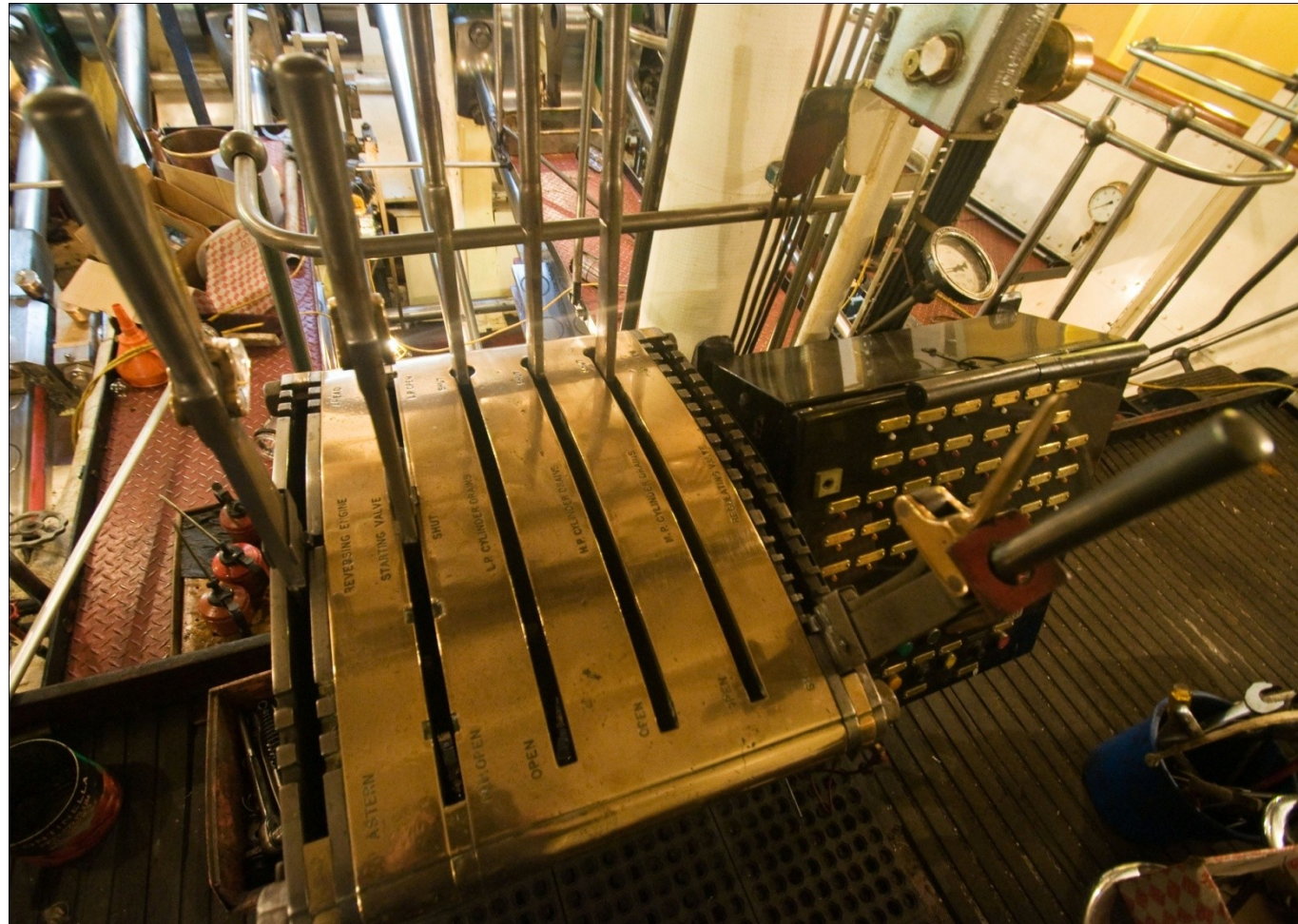
[Main Menu](#)

[Exit](#)



Engine Room – Main Deck

Control Table



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

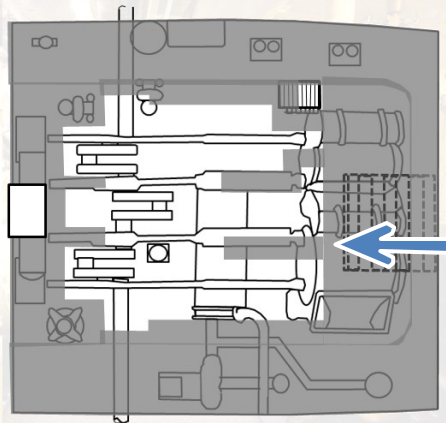
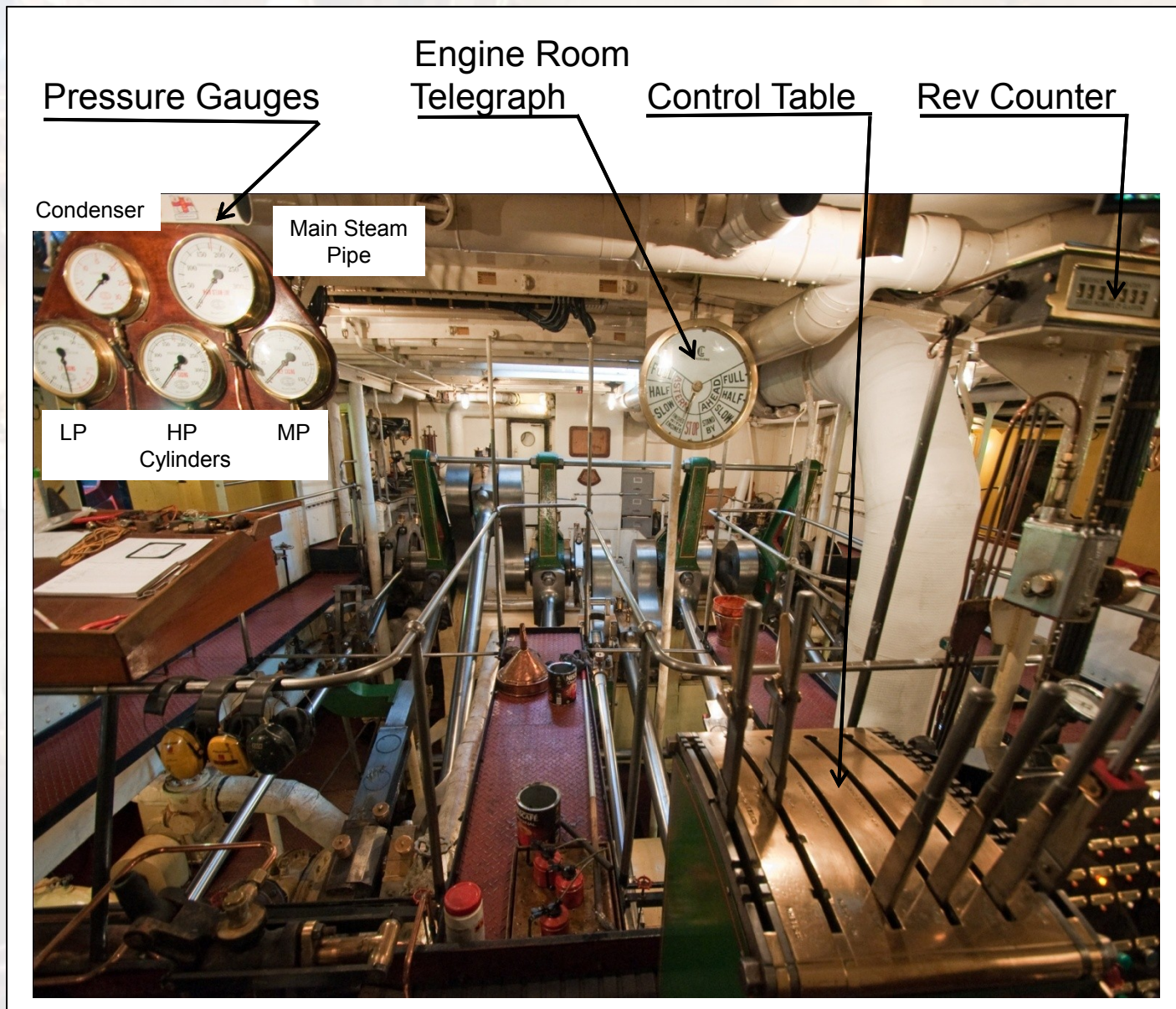
[Exit](#)



V1.0 15.7.11

Engine Room – Main Deck

Engineer's view



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

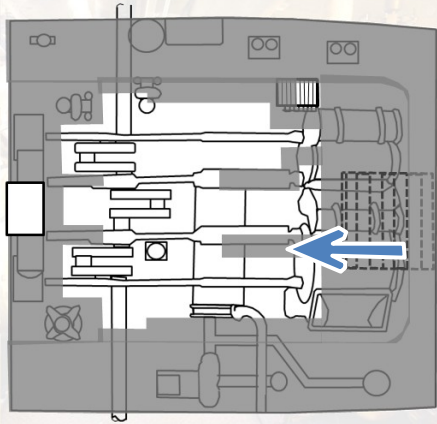
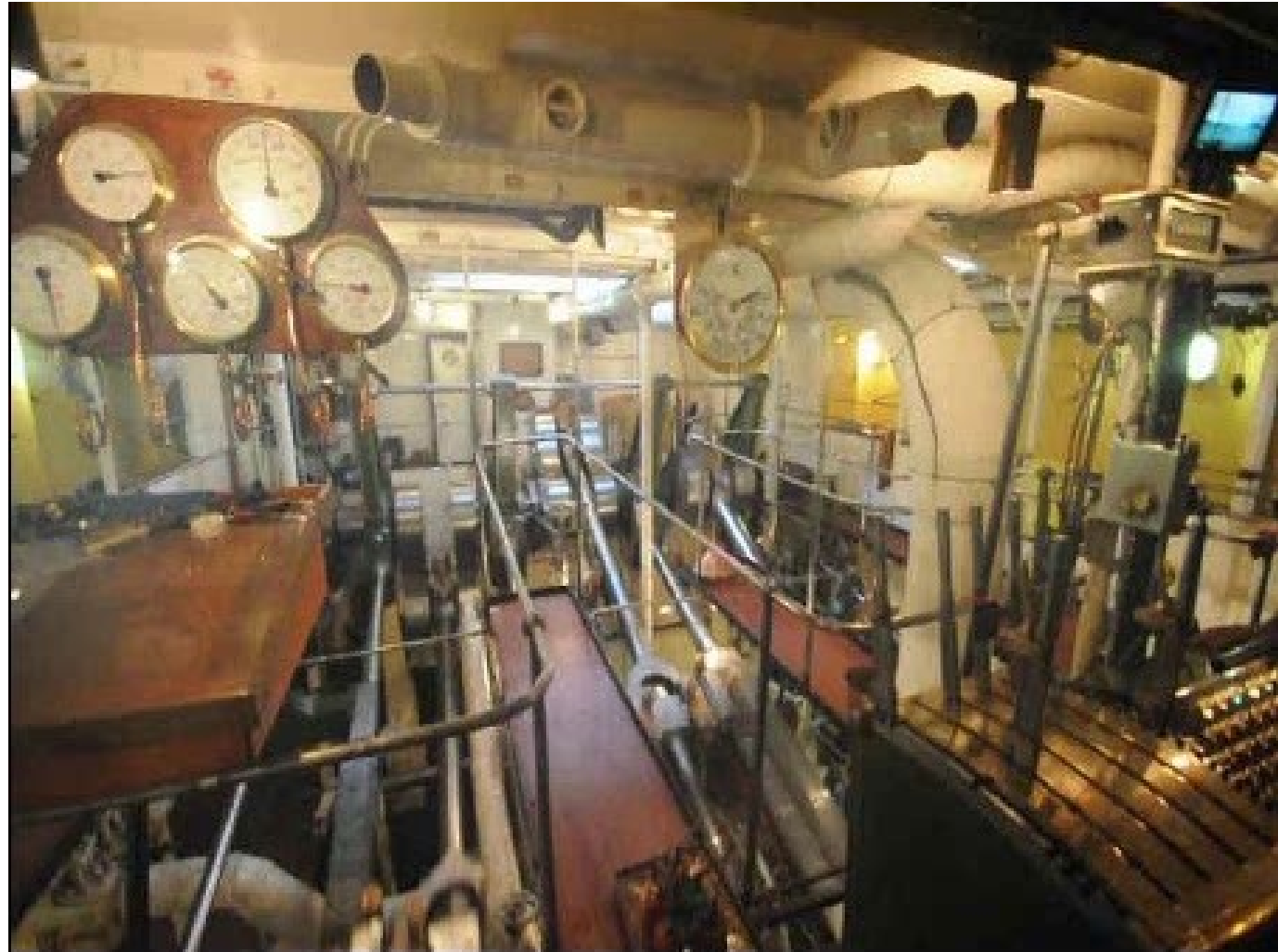
[Main Menu](#)

[Exit](#)



Engine Room – Main Deck

Full Ahead



Click on picture to play video

Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

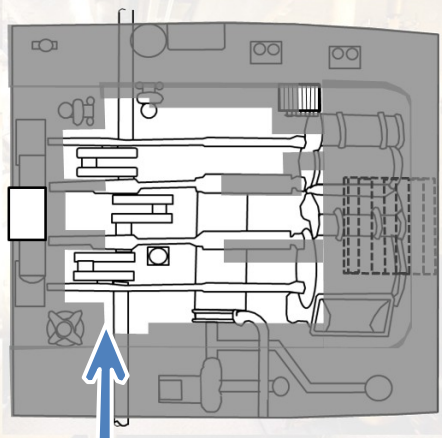
[Main Menu](#)

[Exit](#)



Engine Room – Main Deck

Looking to
Starboard
along the
Crankshaft



Grease Cups

Bottom End Bearing

Crank Web

Connecting Rod

Main Bearing

Eccentrics

Paddle Shaft Coupling



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

[Main
Menu](#)

[Exit](#)



Engine Room – Main Deck

Looking
Aft



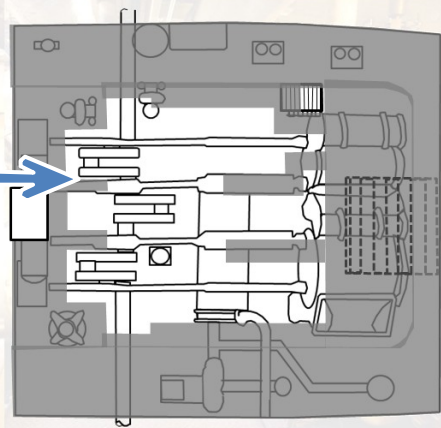
Crank Web

No 2 Main Bearing
incorporates
Thrust Bearing

Con Rod
Bottom End

Eccentrics

No 3 Main
Bearing



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

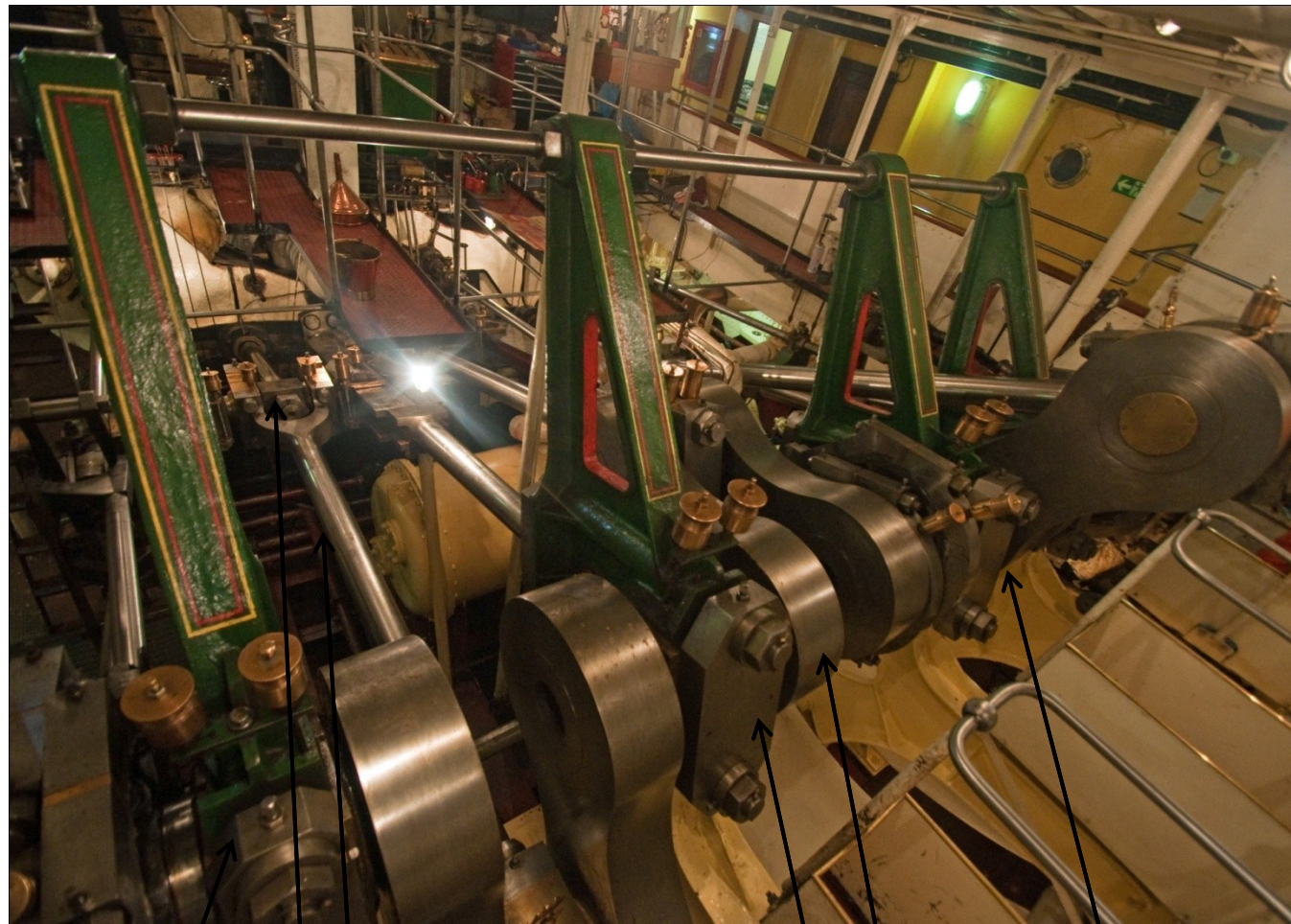
[Main
Menu](#)

[Exit](#)



Engine Room – Main Deck

Looking Aft
and to Port



No 1 Main
Bearing

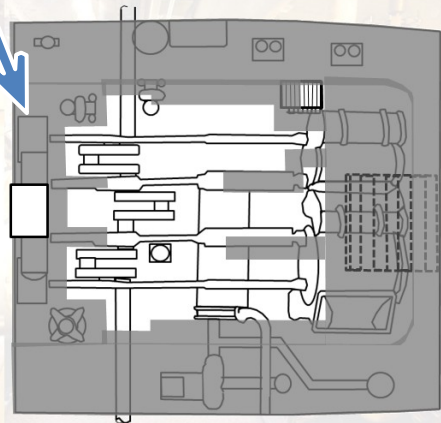
Cross
Head

Connecting
Rod

No2 Main &
Thrust Bearing

Crank Web

Eccentrics



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

[Main
Menu](#)

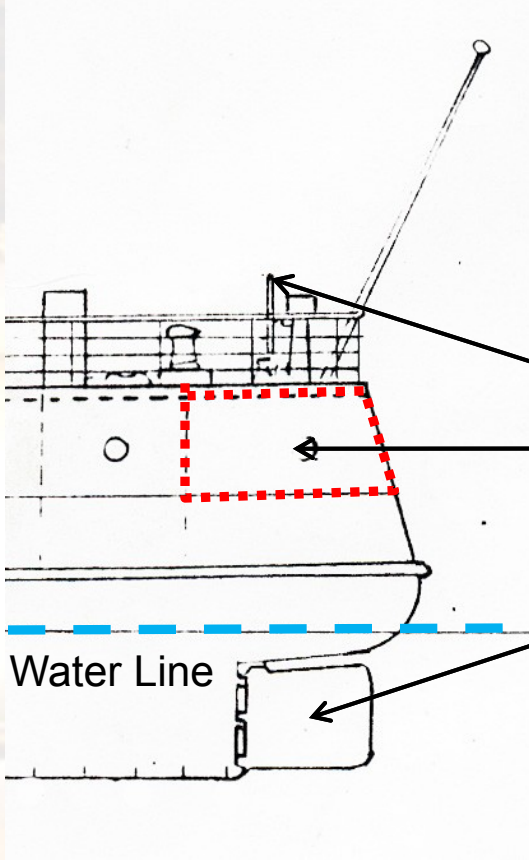
[Exit](#)



Steering



Emergency Hand Steering Wheel



Water Line



Rudder



Steam Tiller in Steering Compartment

Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

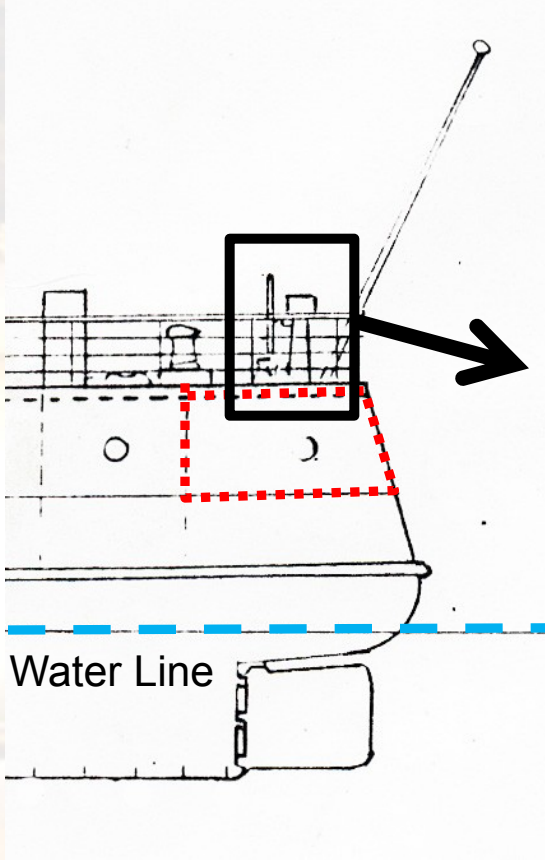
[Main Menu](#)

[Exit](#)



Steering

Emergency Wheel



Stern Navigation Lights

Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

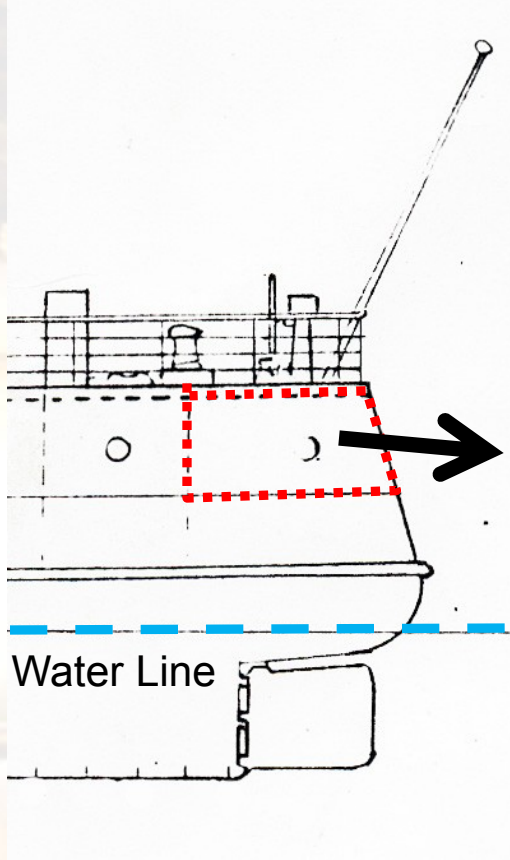
[Main Menu](#)

[Exit](#)



Steering

Steam Tiller



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

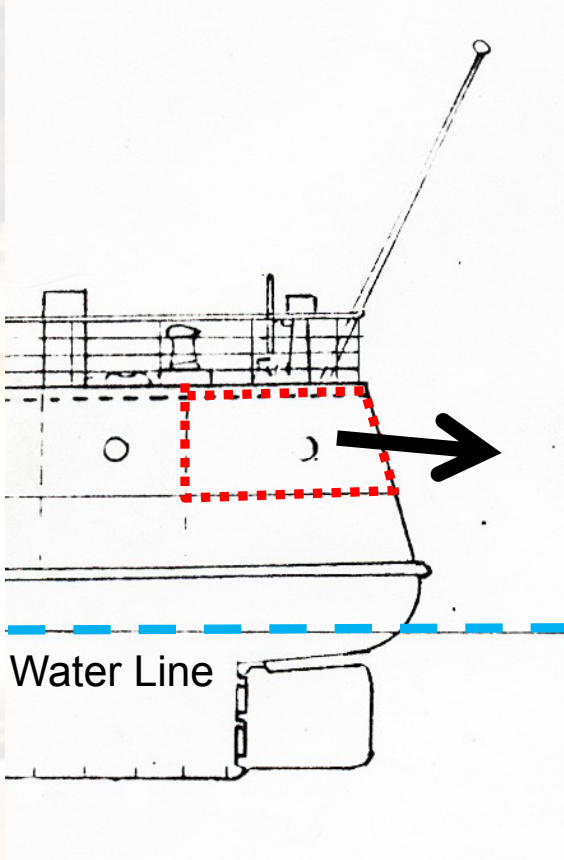
[Main Menu](#)

[Exit](#)



Steering

Steam Tiller



Click on picture to play video

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

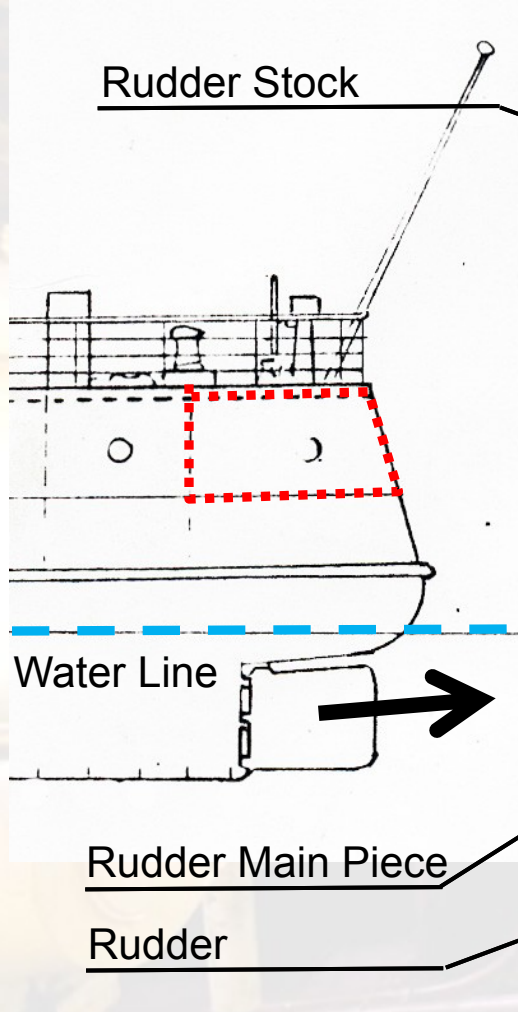
[Main Menu](#)

[Exit](#)



Steering

Rudder



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Galley



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Emergency Generator



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)



Beer Cellar



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)



Docking Telegraph (aft Telegraph shown)

Docking Telegraphs communicate orders to the deck crew from the Bridge.

Orders are transmitted from Docking Telegraphs on the Bridge Wings



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

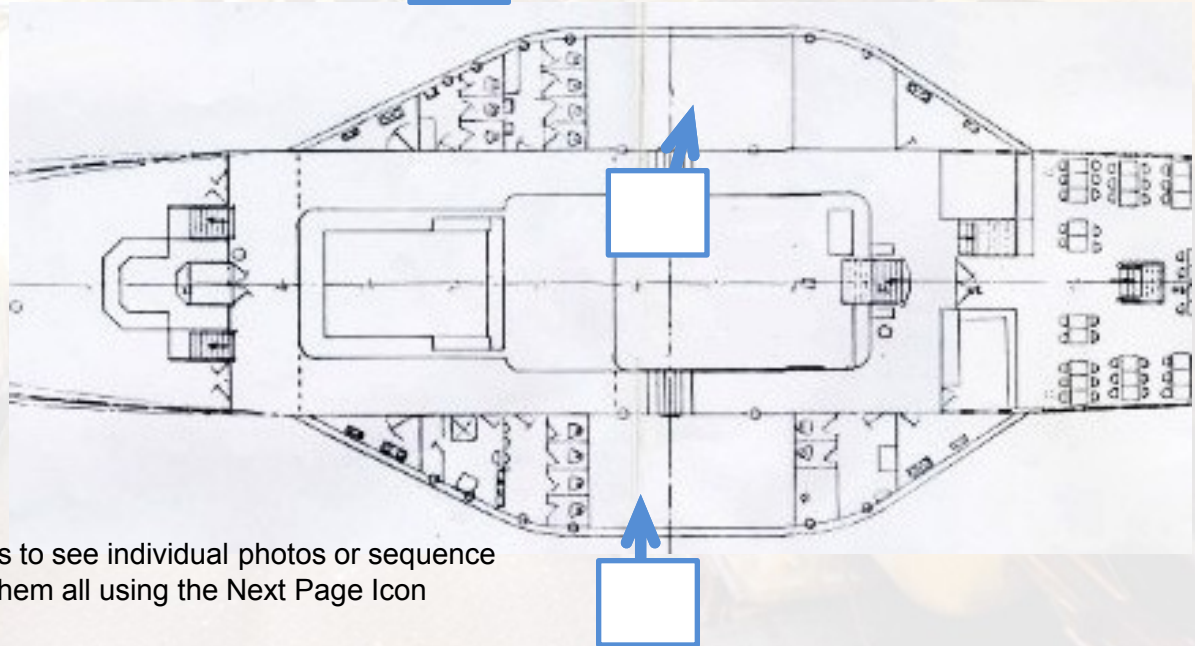
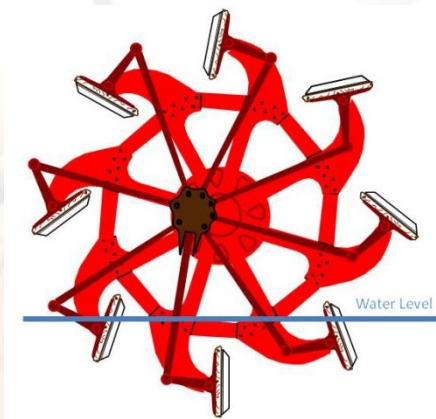
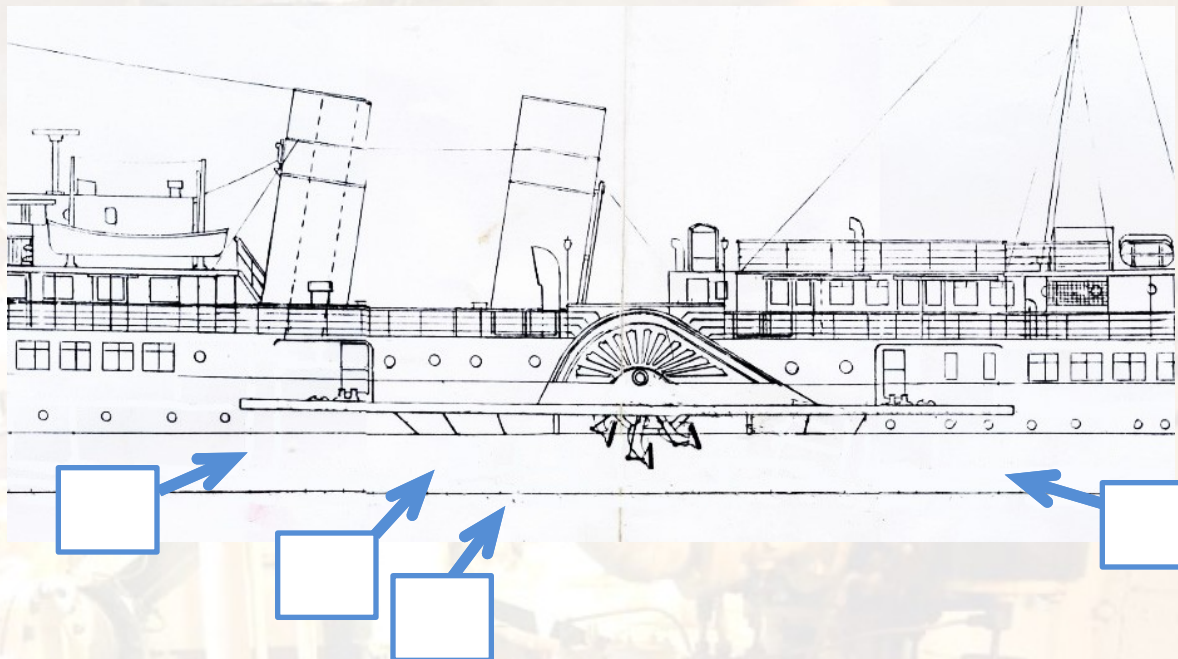
[Site Map](#)

[Main Menu](#)

[Exit](#)



Paddle Wheel

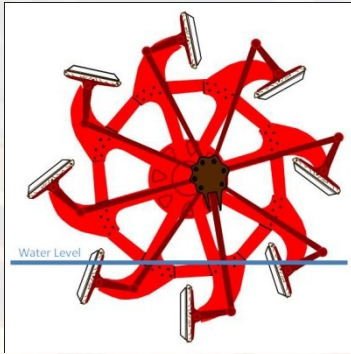


Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



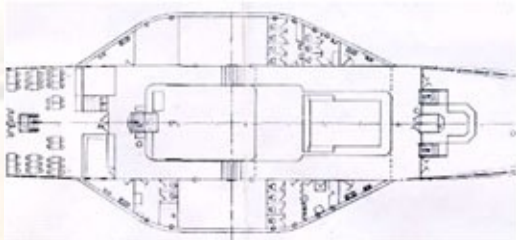
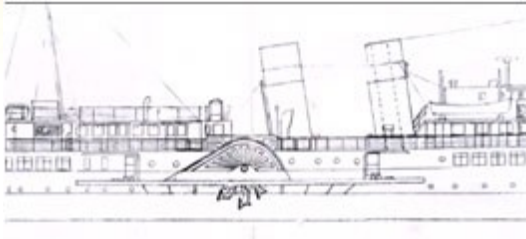
Paddle Wheel



11ft x 3 ft
Paddle Float

Star Centre

Plimsoll Line



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

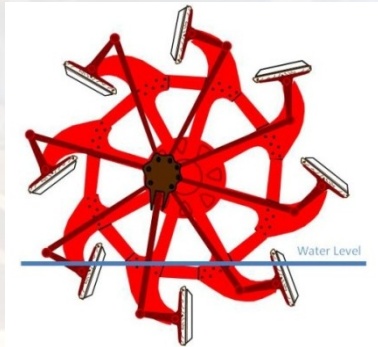
[Steam](#)

[Steering](#)

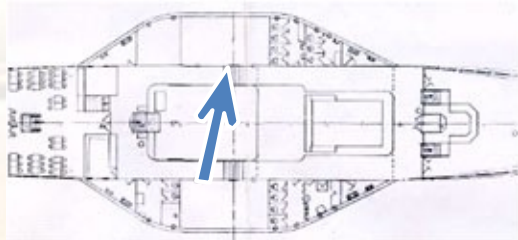
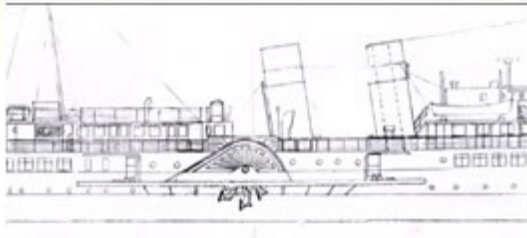
[Paddles](#)



Paddle Wheel



Pedestal Bearing



Crows Nest



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

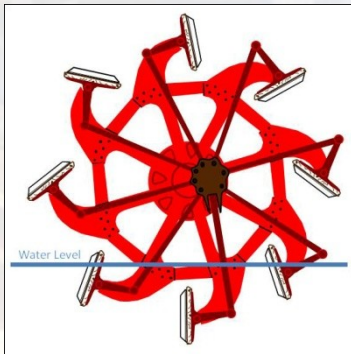
[Site Map](#)

[Main Menu](#)

[Exit](#)

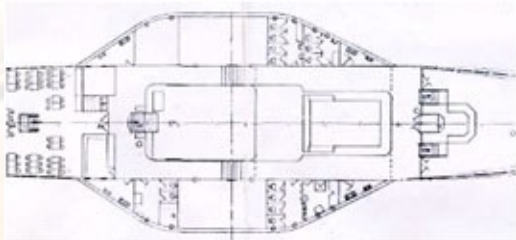
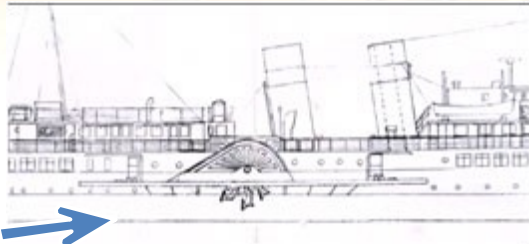


Paddle Wheel



Lower Bar Portholes

Sponson House



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

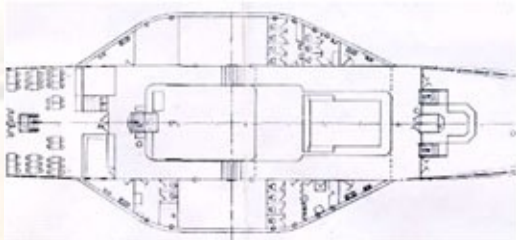
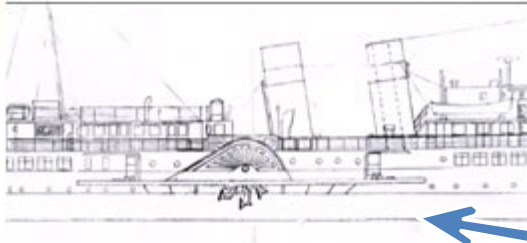
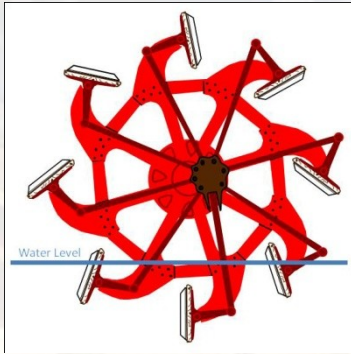
[Site Map](#)

[Main Menu](#)

[Exit](#)



Paddle Wheel



Spring Beam
on which Star Centre pin is mounted
absorbs docking force

Crows Nest



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

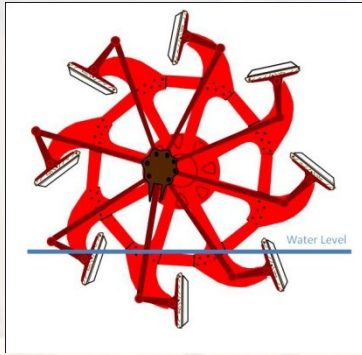
[Steam](#)

[Steering](#)

[Paddles](#)



Paddle Wheel

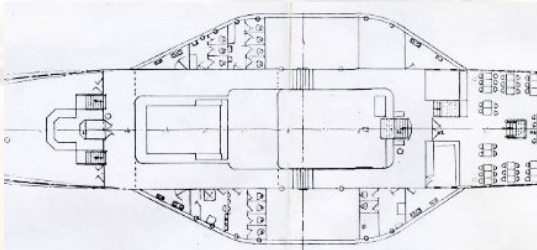
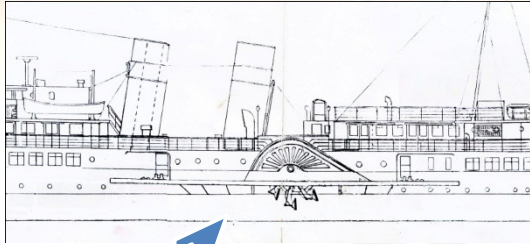


Crows Nest

Pedestal
Bearing

Paddle
Bobbin

Star Centre



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

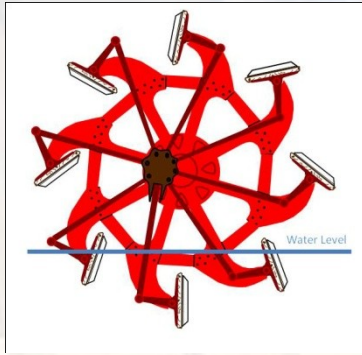
[Site
Map](#)

[Main
Menu](#)

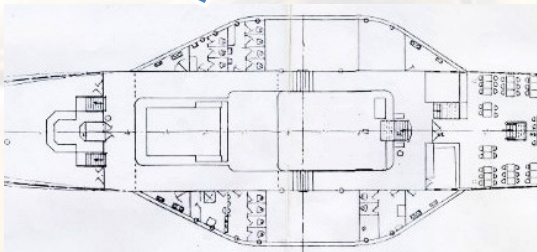
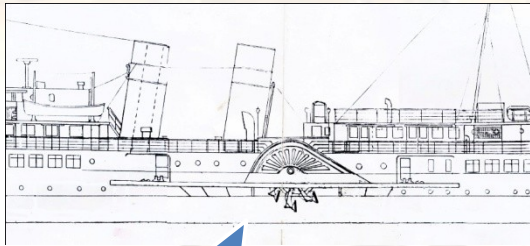
[Exit](#)



Paddle Wheel



- Crows
Nest
- Paddle
Float
- Inner
Arm
- Lazy
Brackets
- Paddle
Frame Arm
- Driving
Arm



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

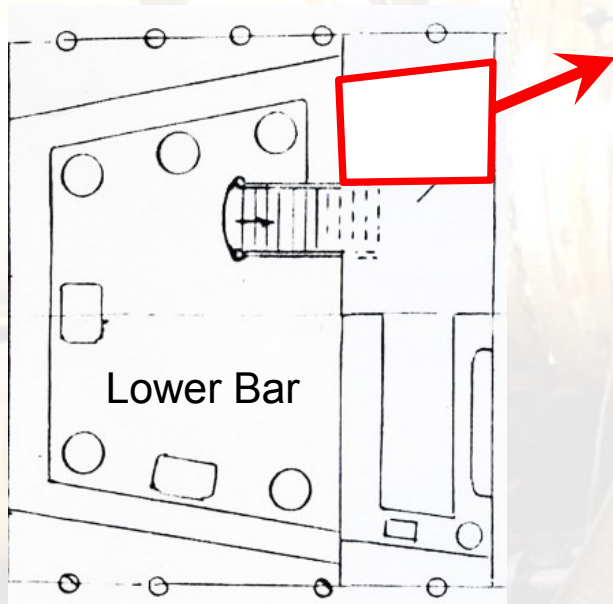
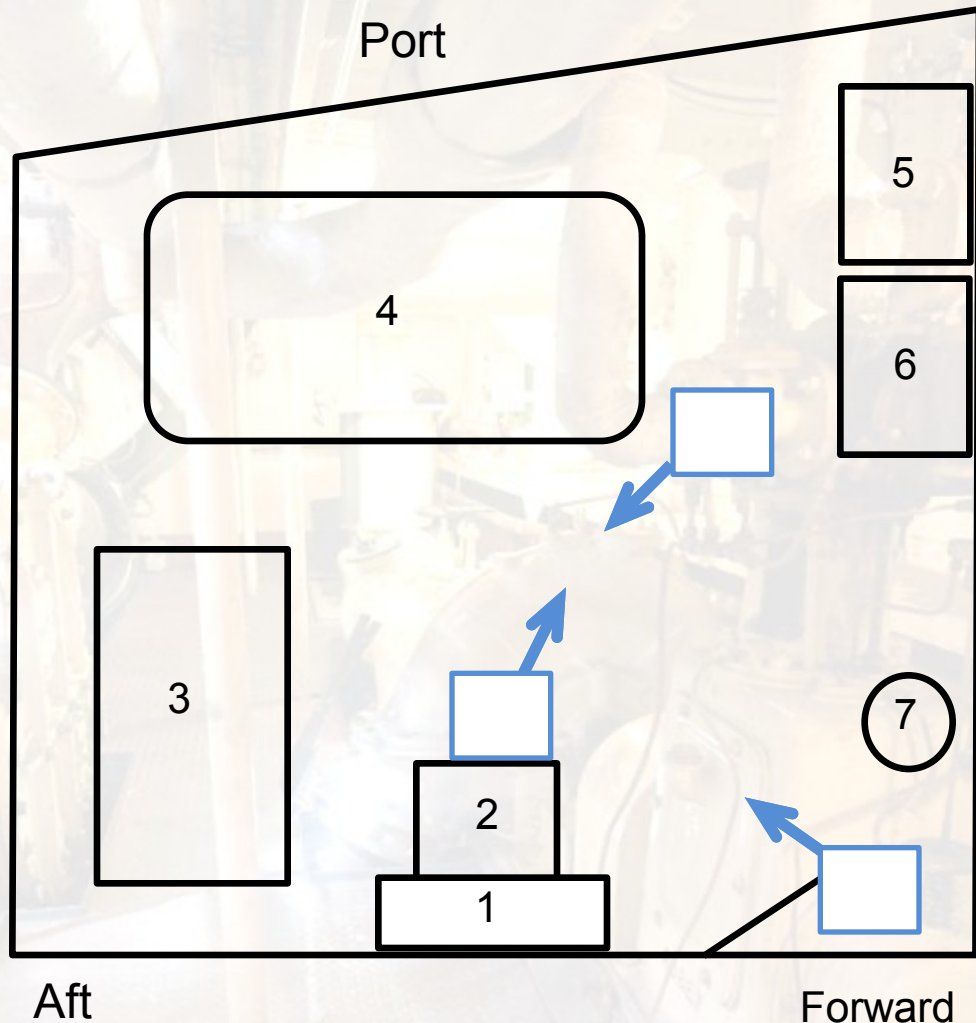
[Steering](#)

[Paddles](#)



Fire Compartment (Citadel)

- 1 Sprinkler Pump Control Panel
- 2 Fuel Tank
- 3 Diesel Sprinkler Pump
- 4 Pressurised Sprinkler Tank
- 5 Foam Tank
- 6 Compressor
- 7 Emergency Fire & Bilge Pump



Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is

How it works

Boiler Room

Engine Room

Steering

Paddles

Bridge

Engine

Steam

Steering

Paddles

Site
Map

Main
Menu

Exit

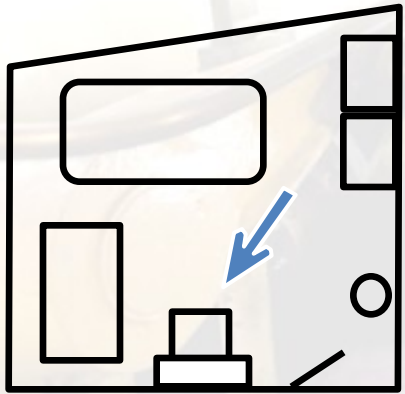
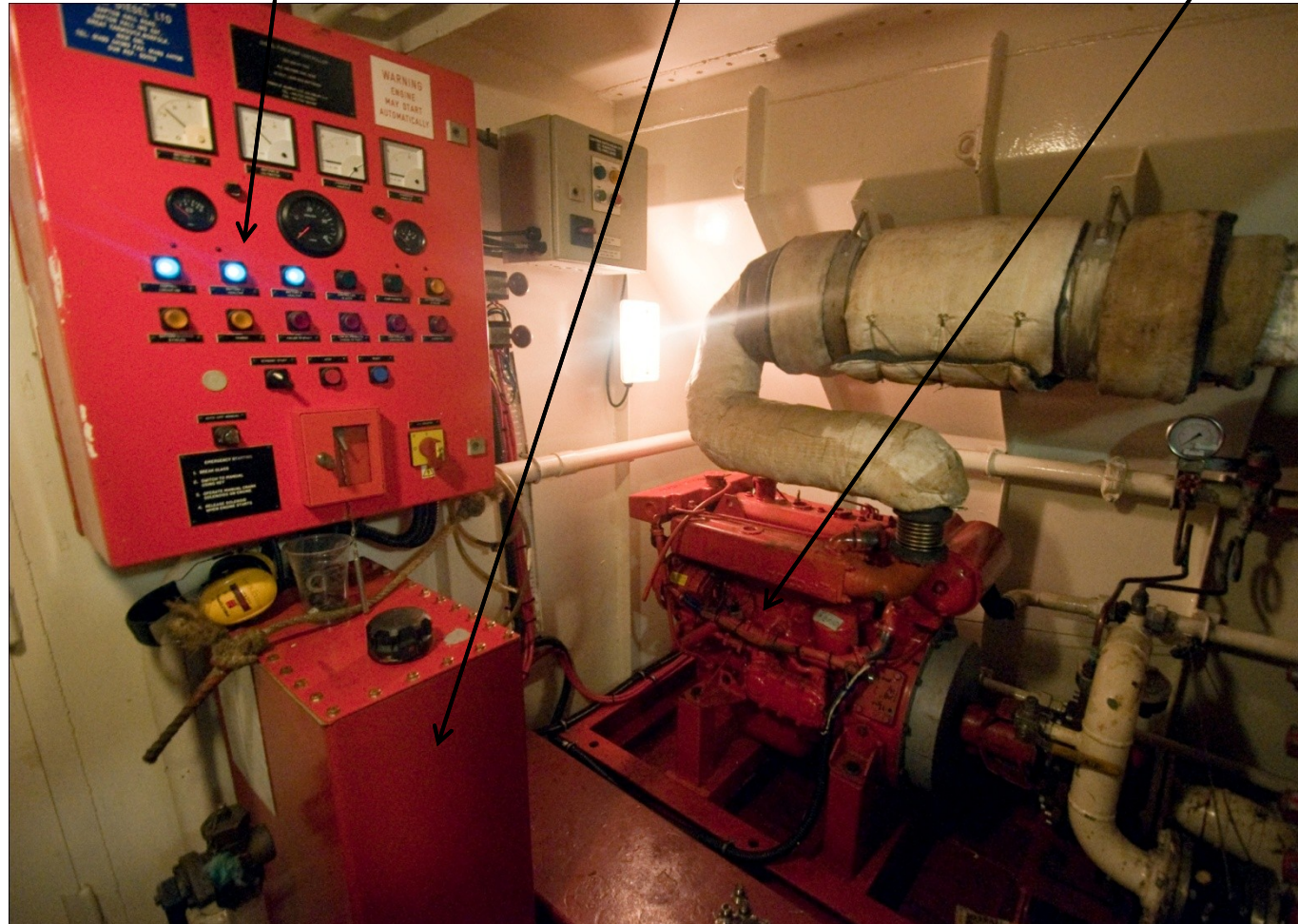


Fire Compartment (Citadel)

Control Panel

Fuel Tank

Diesel Sprinkler Pump



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)

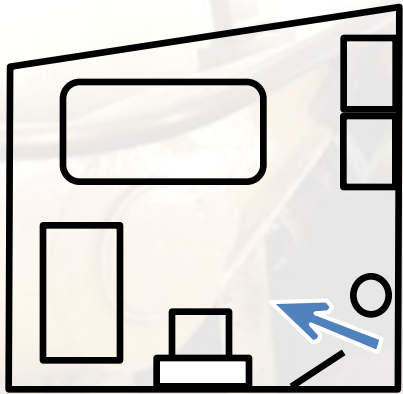


Fire Compartment (Citadel)

Diesel Sprinkler Pump

Fuel Tank

Pressurised Sprinkler Tank



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



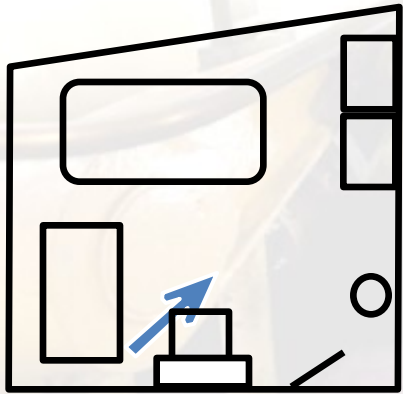
Fire Compartment (Citadel)

Pressurised
Sprinkler Tank

Foam Tank

Compressor

Emergency Fire
& Bilge Pump



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

[Main
Menu](#)

[Exit](#)



Capstan



Steering Compartment Hatch

Direction Control Valve

Steam Engine

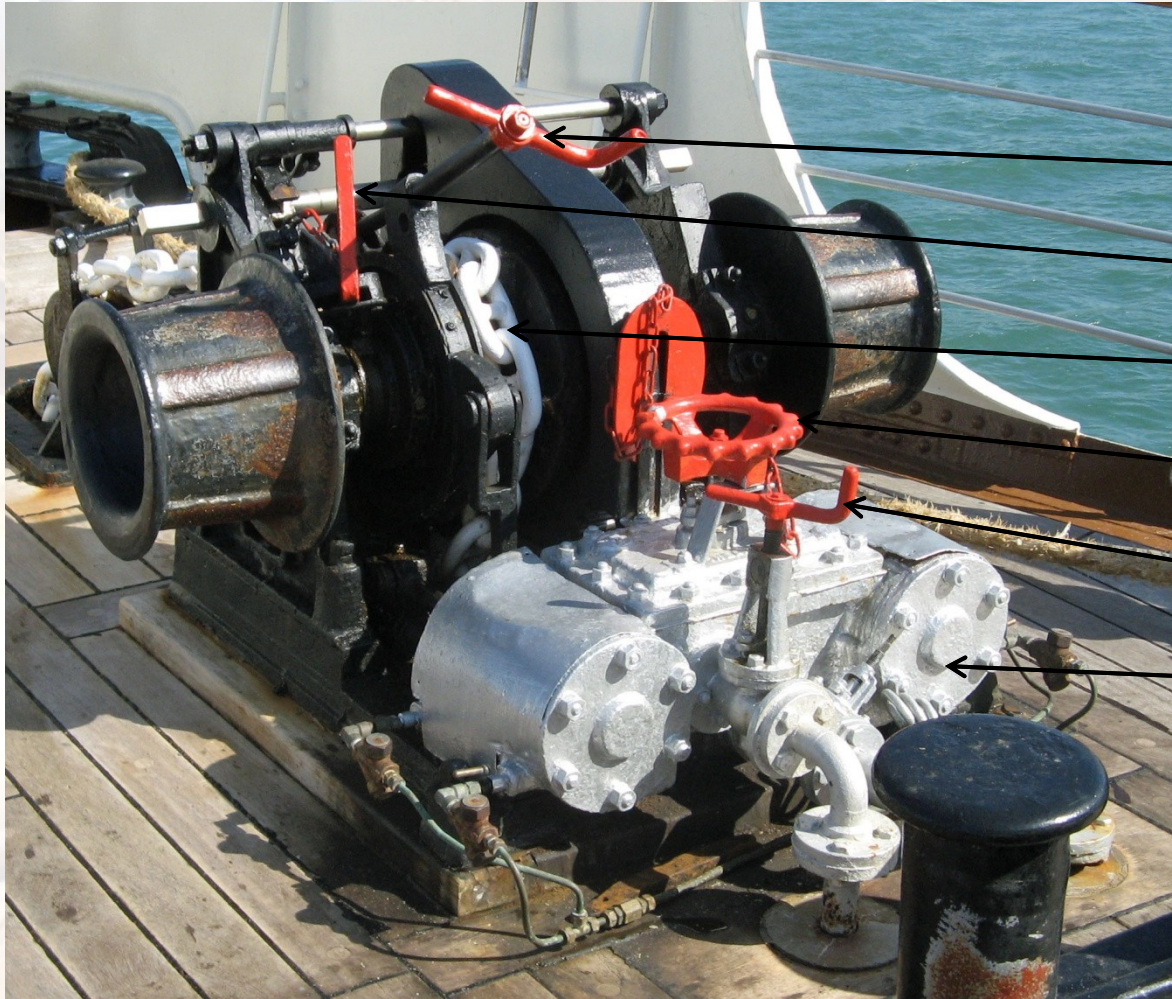
Steam Control Valve

The Capstan is a rotating vertical drum that hauls in rope and applies force to it. Waverley's Capstan is steam powered and rotates in both directions

<u>Where it is</u>					<u>How it works</u>				<u>Site Map</u>	<u>Main Menu</u>	<u>Exit</u>
<u>Boiler Room</u>	<u>Engine Room</u>	<u>Steering</u>	<u>Paddles</u>	<u>Bridge</u>	<u>Engine</u>	<u>Steam</u>	<u>Steering</u>	<u>Paddles</u>			



Windlass



Anchor Brake Handle

Anchor Clutch Handle

Anchor Chain

Direction Control Valve

Steam Control Valve

Steam Engine

The Windlass has two rotating horizontal drums that haul in rope and apply force to it. It can also raise and lower the anchor. Waverley's Windlass is steam powered and rotates in both directions

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

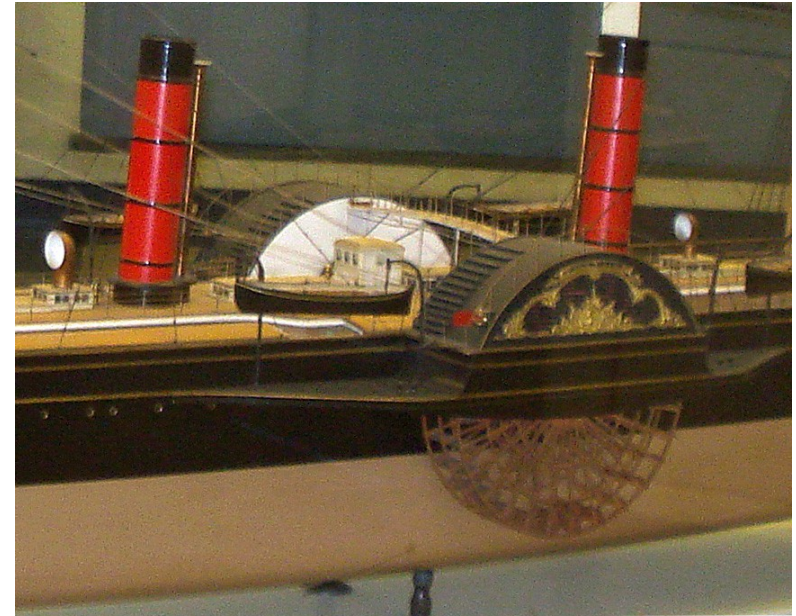
[Exit](#)



The Bridge



It is because of Paddle Ships that the area commanding the ship is known as the bridge. In the days of sail the Wheel was on the open rear deck. As this was not practicable with Funnels and large Paddle Boxes obstructing the view, Paddle Ships were commanded from a walkway between the Paddle Boxes which became known as the “Bridge”



Model of 3871 ton paddle ship RMS Scotia launched in 1861 showing the “bridge” between the Paddle Wheels.

In 1863 Scotia became the last paddle ship to win the Atlantic Blue Riband with an average crossing speed of 14.46 knots

[Where it is](#)

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

[How it works](#)

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

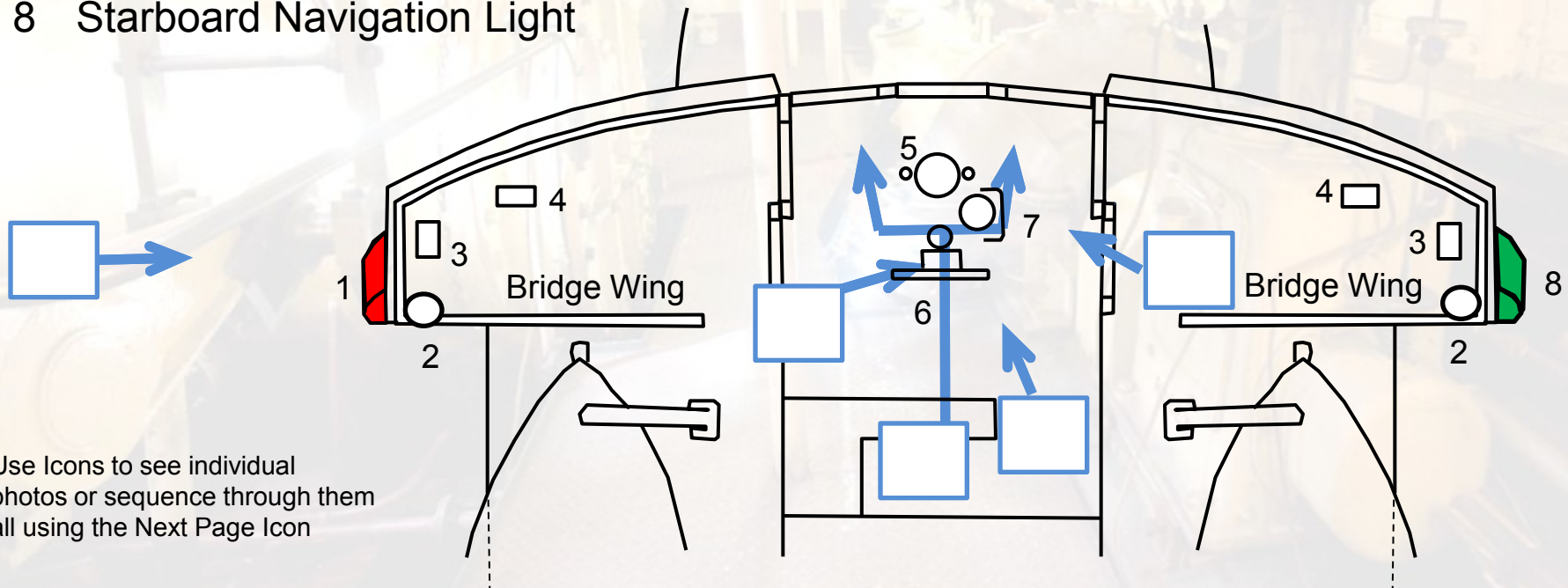
[Main Menu](#)

[Exit](#)



The Bridge

- 1 Port Navigation Light
- 2 Searchlight
- 3 Bridge Wing Engine Room Telegraph
- 4 Docking Telegraph
- 5 Binnacle
- 6 Wheel
- 7 Wheelhouse Engine Room Telegraph
- 8 Starboard Navigation Light



Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Bridge



Aft Docking Telegraph on Promenade Deck

Bridge Wing Engine Room Telegraph

Docking Telegraph



Binnacle

Wheelhouse Engine Room Telegraph

Searchlight



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



The Bridge



Electronic Chart

Radar

AIS (1)

Depth Sounder

1 - Automatic Identification System



Autopilot Joystick

Autopilot

Rudder Angle Indicator



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)

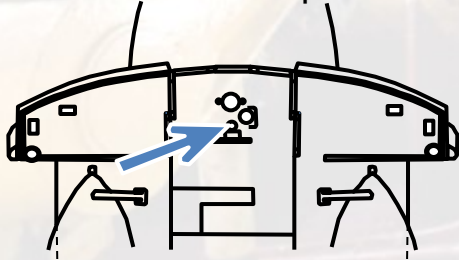


The Bridge

The Binnacle houses the ship's compass which is mounted in gimbals to keep it level. It is positioned in front of the helmsman.

An accurate compass requires compensation for the way metal in the ship affects the magnetic field. This is done by adjustable compensating magnets which were invented by 19th century physicist Lord Kelvin and are colloquially known as Kelvin's Balls.

The Ship's Wheel housing is made of gunmetal to minimise its effect on the compass



Binnacle

Compass

Engine Room Telegraph

Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



The Bridge

Electronic Chart

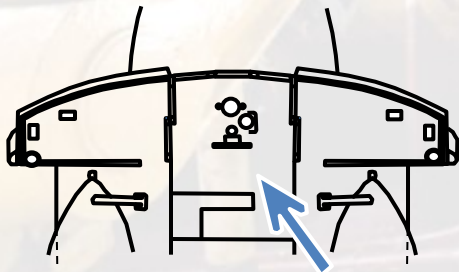
Radar

Voice Pipe to
Engine Room

Wheel

Rudder Angle
Indicator

Binnacle



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site
Map](#)

[Main
Menu](#)

[Exit](#)



The Bridge

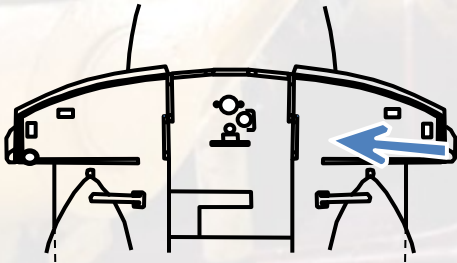


Wheel

Binnacle

Engine Room Telegraph

Rudder Angle Indicator



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



How it works

Main Steam Engine

Description, Component parts, How steam flows through the engine, Reversing the Engine

Steam

How the Boiler produces steam and how steam is circulated and used

Steering

The steering system and its steam tiller

Paddles

Description, efficiency and feathering gear

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

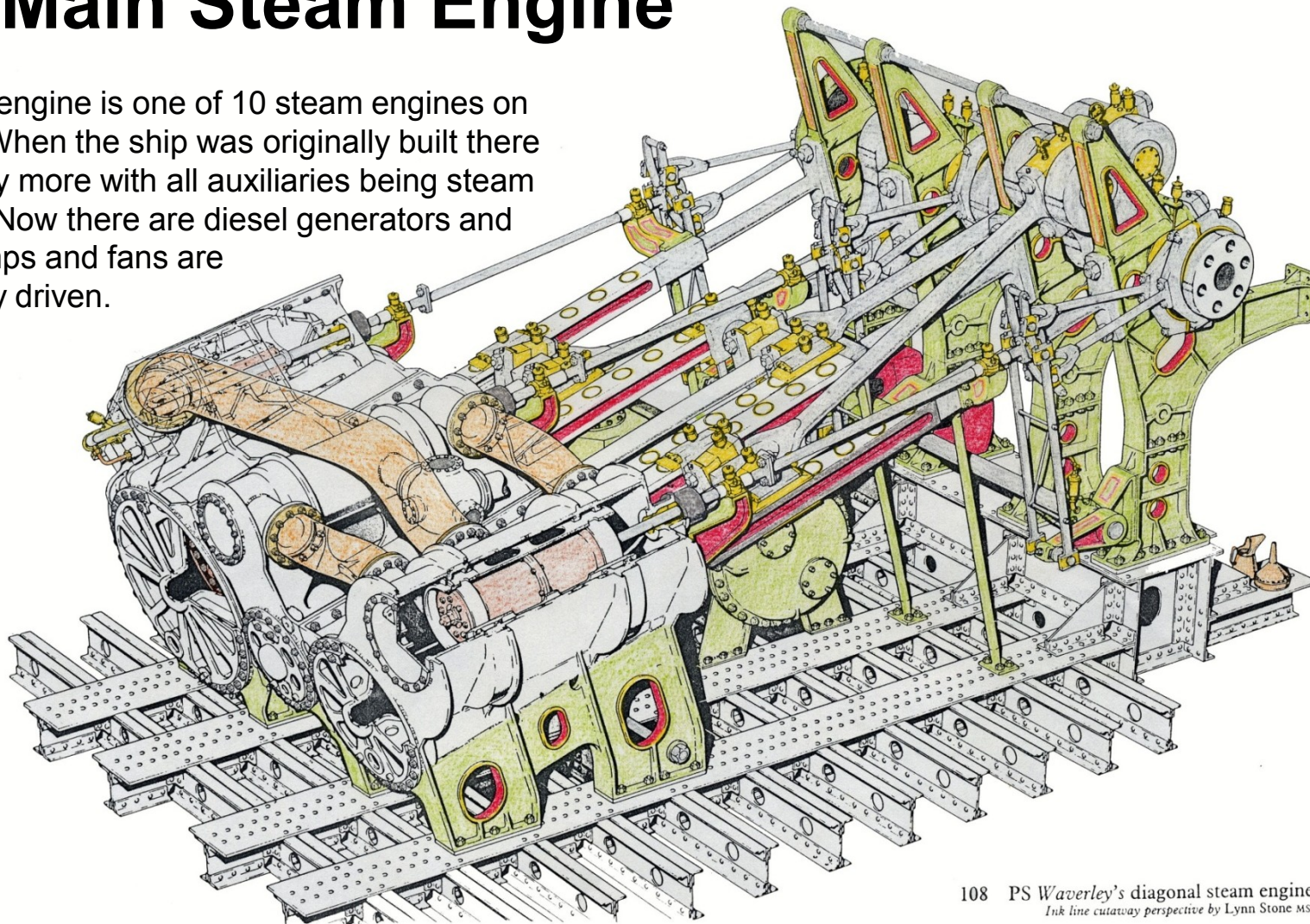
[Main Menu](#)

[Exit](#)



The Main Steam Engine

The main engine is one of 10 steam engines on the ship. When the ship was originally built there were many more with all auxiliaries being steam powered. Now there are diesel generators and some pumps and fans are Electrically driven.



108 PS Waverley's diagonal steam engines
Ink line cutaway perspective by Lynn Stone MSAI

Waverley's Steam Engine was built and installed by Rankin and Blackmore, Eagle Foundry, Greenock. It can deliver 2,100 horsepower which enabled Waverley to achieve 18.37 knots during its trials at an engine speed of 57.8 rpm.

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			

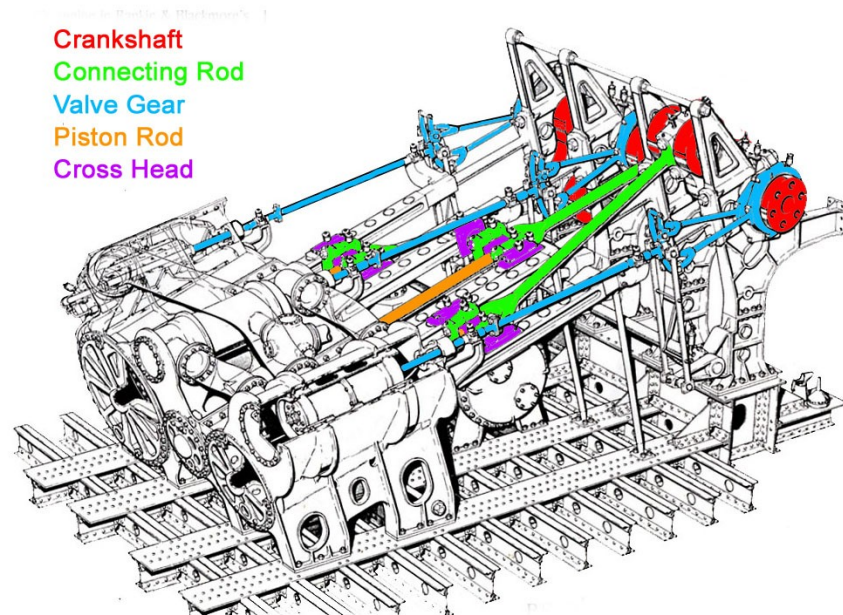
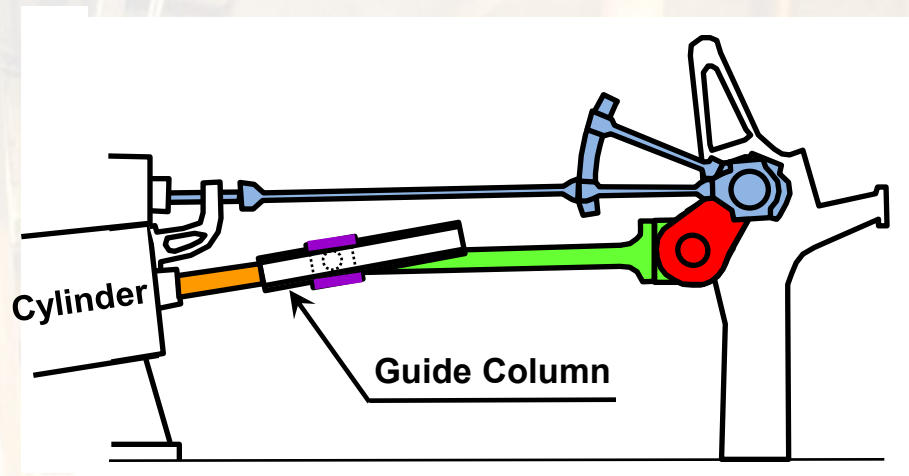


The Steam Engine – Component Parts

A steam engine uses the pressure of steam inside a cylinder to drive a piston and its associated **Piston Rod** backwards and forwards. This linear motion is converted into rotary motion by a **Connecting Rod (Con Rod)** and **Crankshaft**. The **Piston Rod** is connected to the **Con Rod** by a **CrossHead** which slides along a **Guide Column**.

Valve gear controls how steam enters and leaves the Cylinders.

Technically Waverley's steam engine is three different engines that operate together to drive the **Crankshaft** which is directly coupled to the Paddle Wheels. Therefore the Paddle Wheels cannot turn at different speeds or in different directions



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Steam Engine – Component Parts

Click on the picture below to see how the linear motion of the Piston Rod is converted to rotary motion by the Connecting Rod and Crankshaft



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

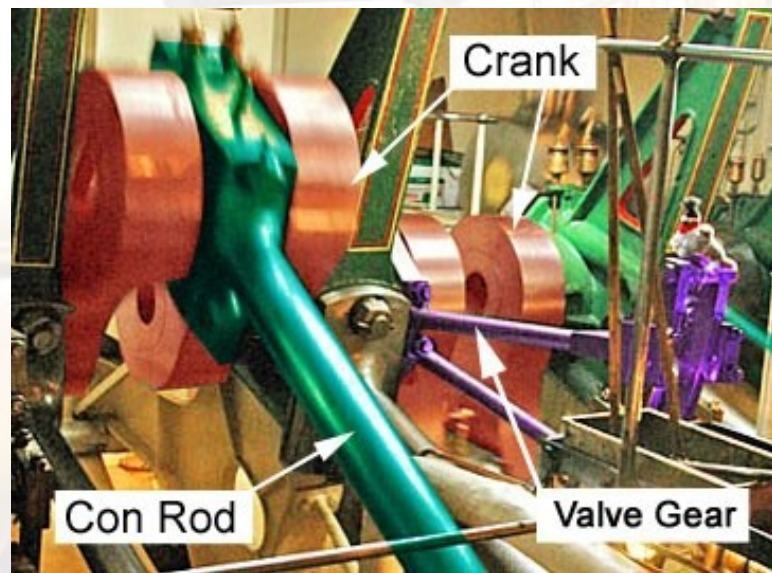
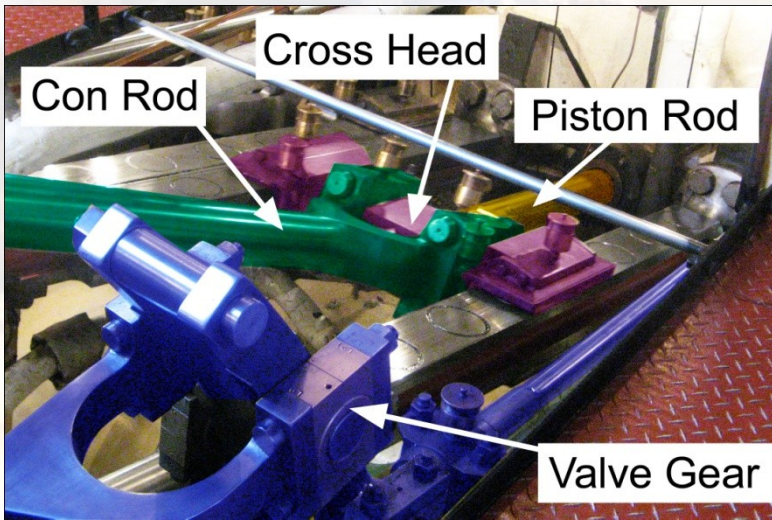
[Site Map](#)

[Main Menu](#)

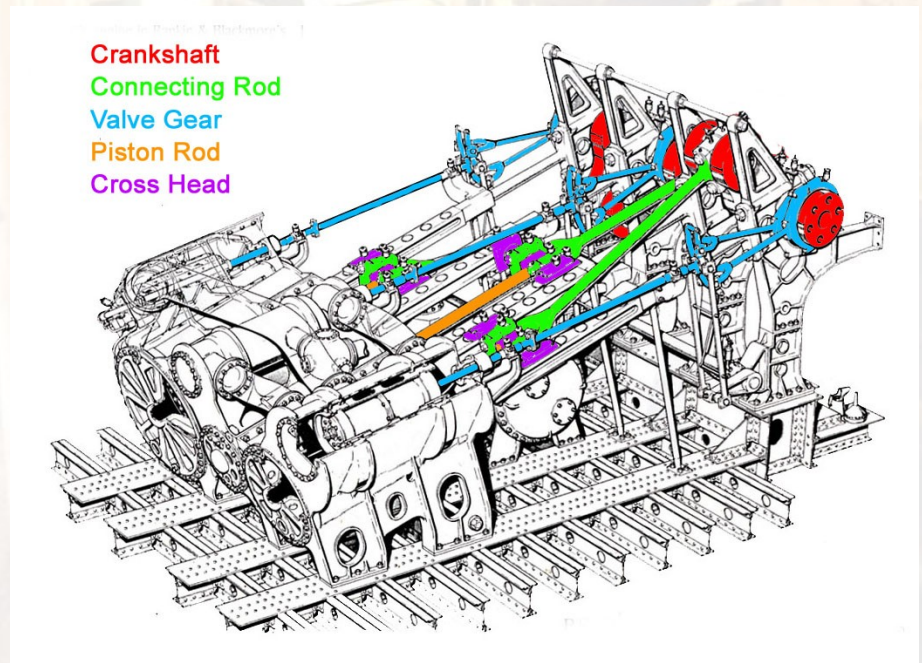
[Exit](#)



The Steam Engine – Component Parts



Pictures with colour tinted parts to aid identification



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)



The Steam Engine – Steam Flow

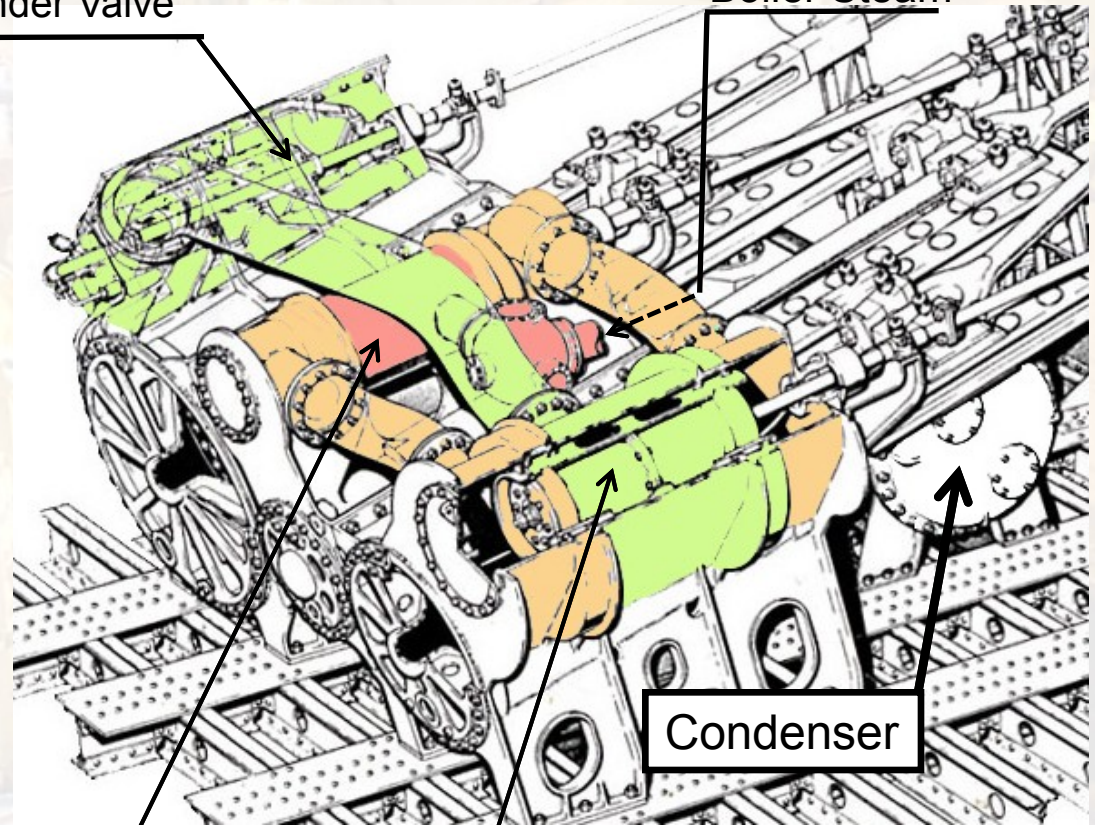
The steam engine is a triple expansion engine, so called because the steam is used three times.

It goes from the High Pressure (HP) Cylinder to the Medium Pressure (MP) Cylinder and then to the Low Pressure (LP) Cylinder before its energy is exhausted.

Exhaust steam then enters a Condenser which uses seawater to cool the exhaust steam into water to be fed back into the boiler. Thus, unlike a railway locomotive, the steam is re-used.

Low Pressure
Cylinder Valve

Boiler Steam



High Pressure
Cylinder Valve

Medium Pressure
Cylinder Valve

Condenser

- High Pressure Steam
- Medium Pressure Steam
- Low Pressure Steam

Where it is

How it works

Boiler Room

Engine Room

Steering

Paddles

Bridge

Engine

Steam

Steering

Paddles

Site
Map

Main
Menu

Exit



The Steam Engine – Steam Flow

As steam is used within the engine its pressure decreases. To ensure each Cylinder delivers the same power the High Pressure, Medium Pressure and Low Pressure Cylinders are of increasing size and are respectively 24, 39 and 62 inches in diameter.

This is because the force on the Piston in each Cylinder is: -

$$F = P \times A$$

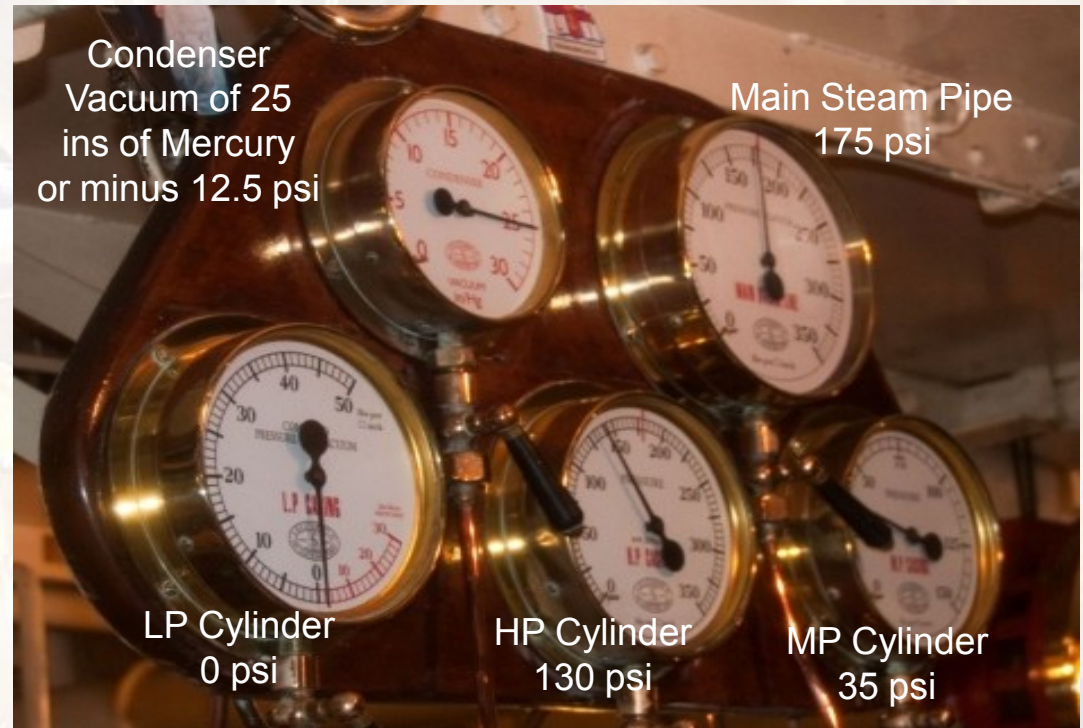
with

F= Force on the Piston

P = Steam pressure

A = Area of the Piston

So for a low pressure cylinder to have the same piston force as a high pressure cylinder, its cylinder diameter must be correspondingly larger.



Pressures in each Cylinder and in the Condenser can be seen in the gauges on the port side of the engine platform. (psi = Pounds per Square Inch)

The lowest pressure in the steam circuit is the vacuum in the condenser. Also note that the steam in the Low Pressure Cylinder is actually at atmospheric pressure.

Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

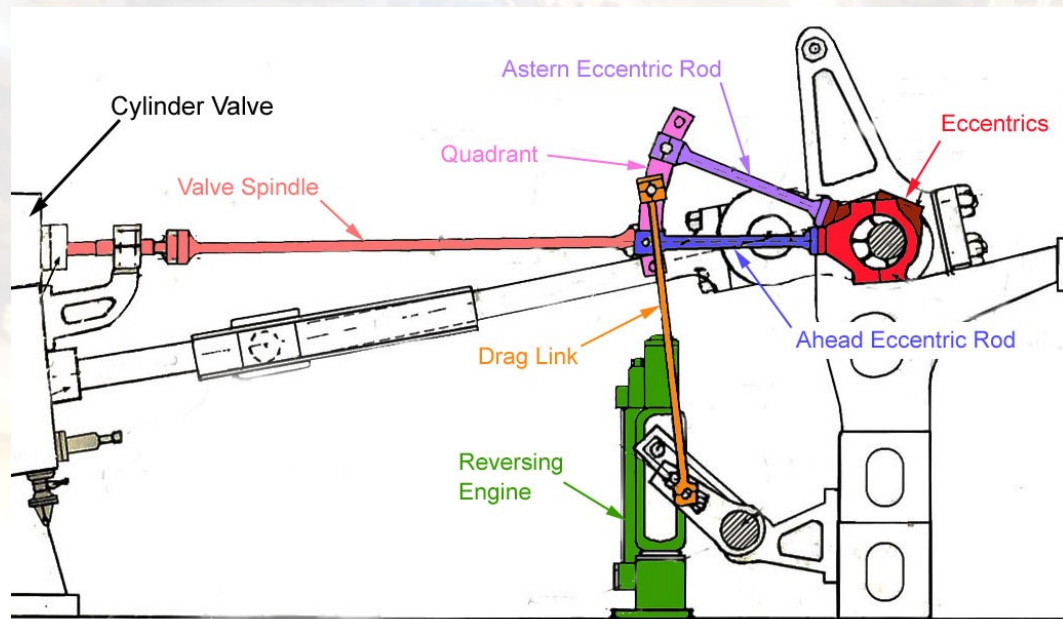
[Site Map](#)

[Main Menu](#)

[Exit](#)



The Steam Engine – Reversing



Low Pressure Valve Spindle

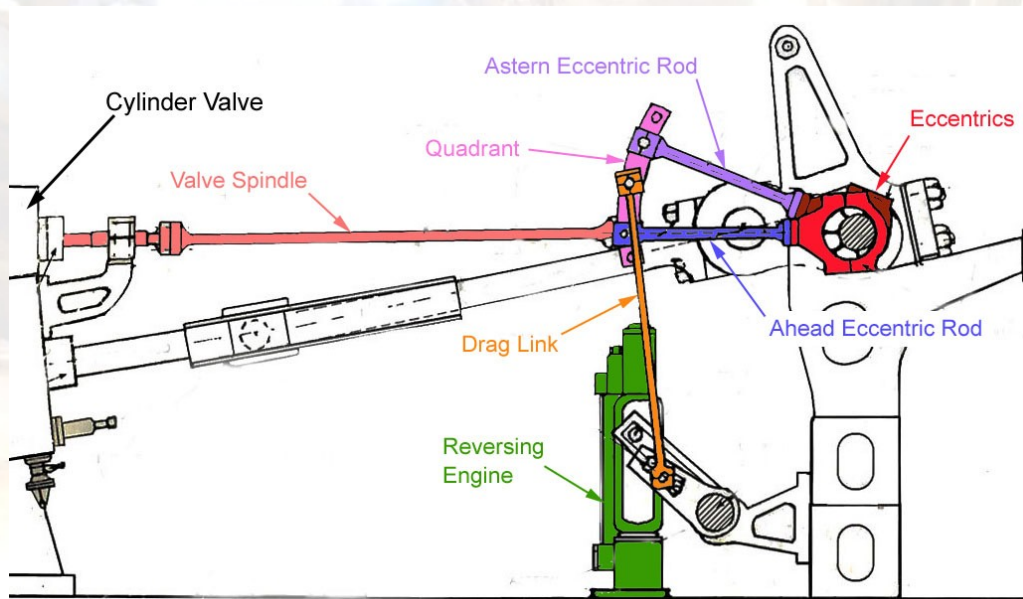
Steam enters and leaves each Cylinder through its dedicated Cylinder Valve. The direction of the engine depends on when, during the rotation of the engine, the Valve admits steam to the Cylinder and allows steam to exhaust from it.

This timing is controlled by the valve gear whose component parts are shown above

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Steam Engine – Reversing



The point at which the Valve admits steam into the cylinder is controlled by an Eccentric. This is an offset disc on the crankshaft that moves the Eccentric Rod to and fro to drive the Valve Spindle and its valve as shown in the diagram.

Each Cylinder has two Eccentrics (each approx 180° apart) and Rods, one for Ahead and one for Astern. In the Ahead position shown above the Ahead Eccentric Rod drives the Valve Spindle.

- Valve Spindle
- Ahead Eccentric Rod
- Astern Eccentric Rod
- Quadrant
- Drag Link
- Ahead Eccentric
- Astern Eccentric

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

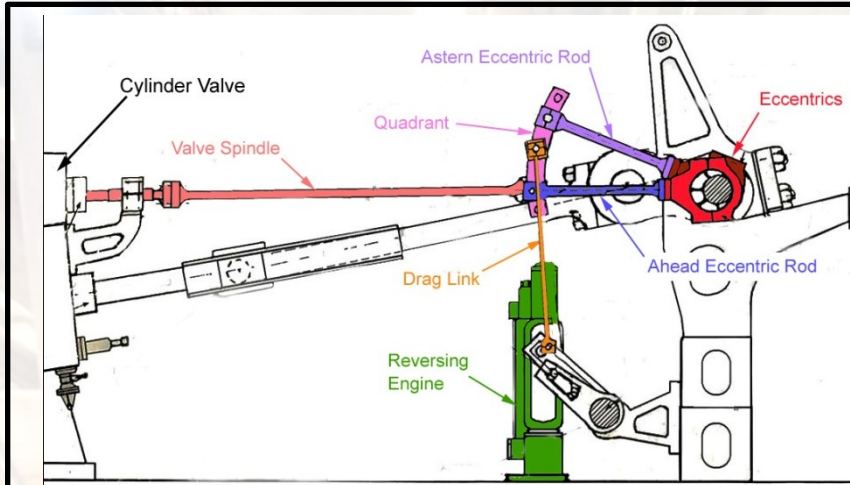
[Main Menu](#)

[Exit](#)

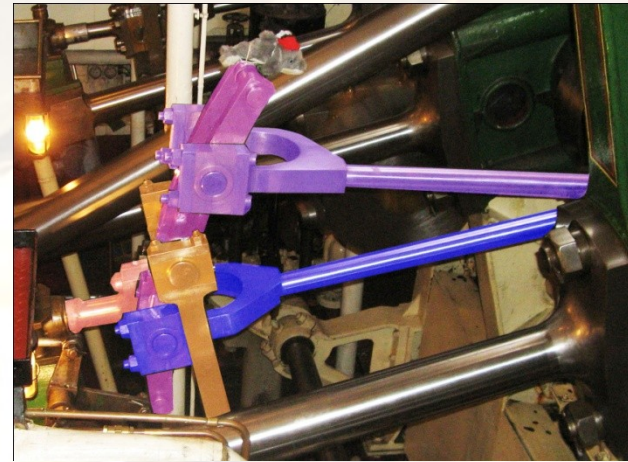


The Steam Engine – Reversing

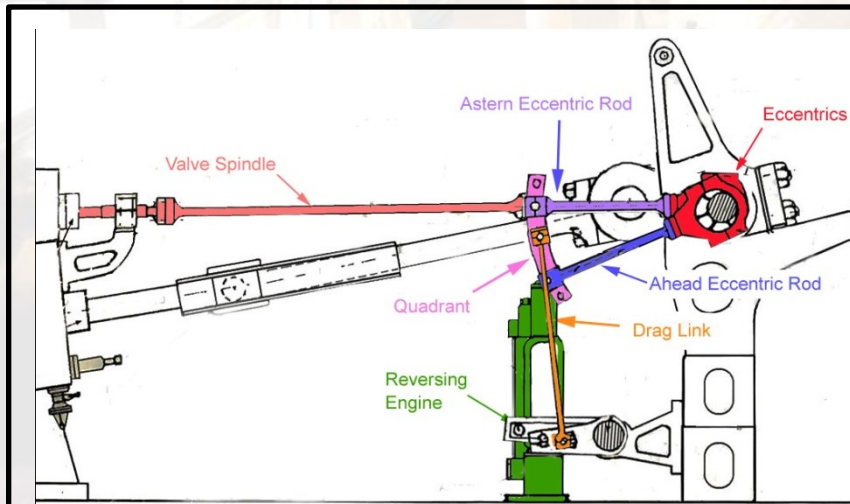
To put the engine Astern, the Eccentric Rods need to be lowered so that the Astern Rod drives the Valve Spindle as shown in the diagram.



Ahead



To do this a Drag Link pulls down the Quadrant to which both Eccentric Rods are attached. The end of the valve spindle slides within the Quadrant to permit this movement



Astern



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

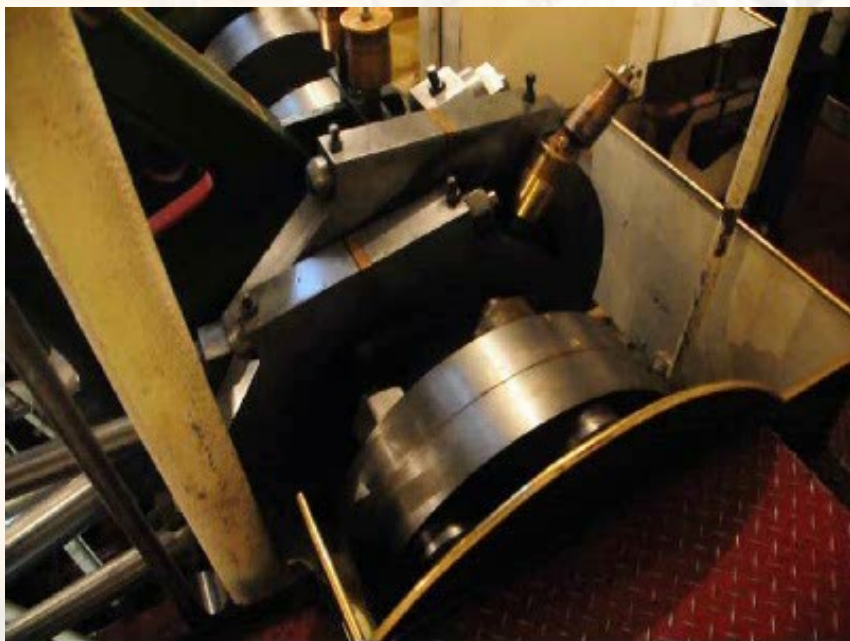
[Main Menu](#)

[Exit](#)



The Steam Engine – Reversing

Click on the video below to see how the Eccentrics move the Eccentric Rods and their Quadrant



Click on the video above to see the engine being reversed when the Quadrant is lowered

The video also shows the Air Pump on the Orlop deck below (refer How it works – Steam)

[Where it is](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[How it works](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



The Steam Engine – Reversing

The three sets of Eccentric Rods are moved by their Drag Links which are attached to the Wyper shaft which is driven by a Reversing Engine. This shaft has balance weights to counter the weight of the Quadrant and its Eccentric Rods.

In this way the engine can quickly change its direction which, for a Paddle Steamer, is essential.

To better understand reversing of the engine, watch it being reversed as Waverley approaches or leaves a pier.



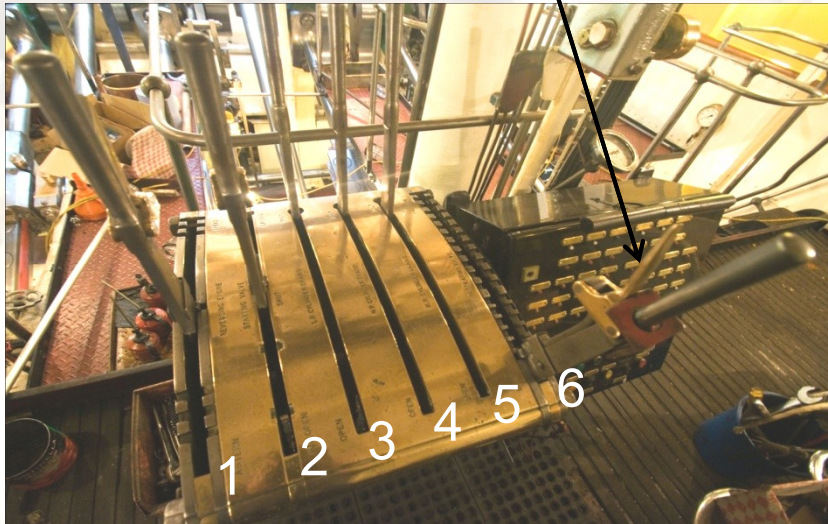
Click the video above to see the three Quadrants and their Rods moving together. The Reversing Engine can also be seen below.

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Steam Engine – Controls

Boiler Control Panel



The Control Table

- 1 **Reversing** – controls the Reversing Engine to put the Eccentric Rods into the Ahead , Astern or the mid (Neutral) position. Shown in mid position
- 2 **Starting Valve** – Steam first enters the High Pressure (HP) Cylinder. With engine stopped in certain positions, it is not possible to start the engine with the High Pressure Cylinder. The starting valve is then used to allow High Pressure steam to either the Medium Pressure or Low Pressure Cylinders. It is shown in the shut position.
- 3 **Low Pressure Cylinder Drain Valve** – The drain valves are opened when the engine is first started to avoid damage to the engine from water accumulating in the cylinders. Shown in shut position
- 4 **High Pressure Cylinder Drain Valve** – Shown in the shut position
- 5 **Medium Pressure Cylinder Drain Valve** – Shown in the shut position
- 6 **Regulating Valve** - Controls the amount of steam through the engine and therefore the speed of the engine – Shown in the shut position

Where it is

Boiler Room Engine Room Steering Paddles Bridge

How it works

Engine Steam Steering Paddles

[Site Map](#)

[Main Menu](#)

[Exit](#)

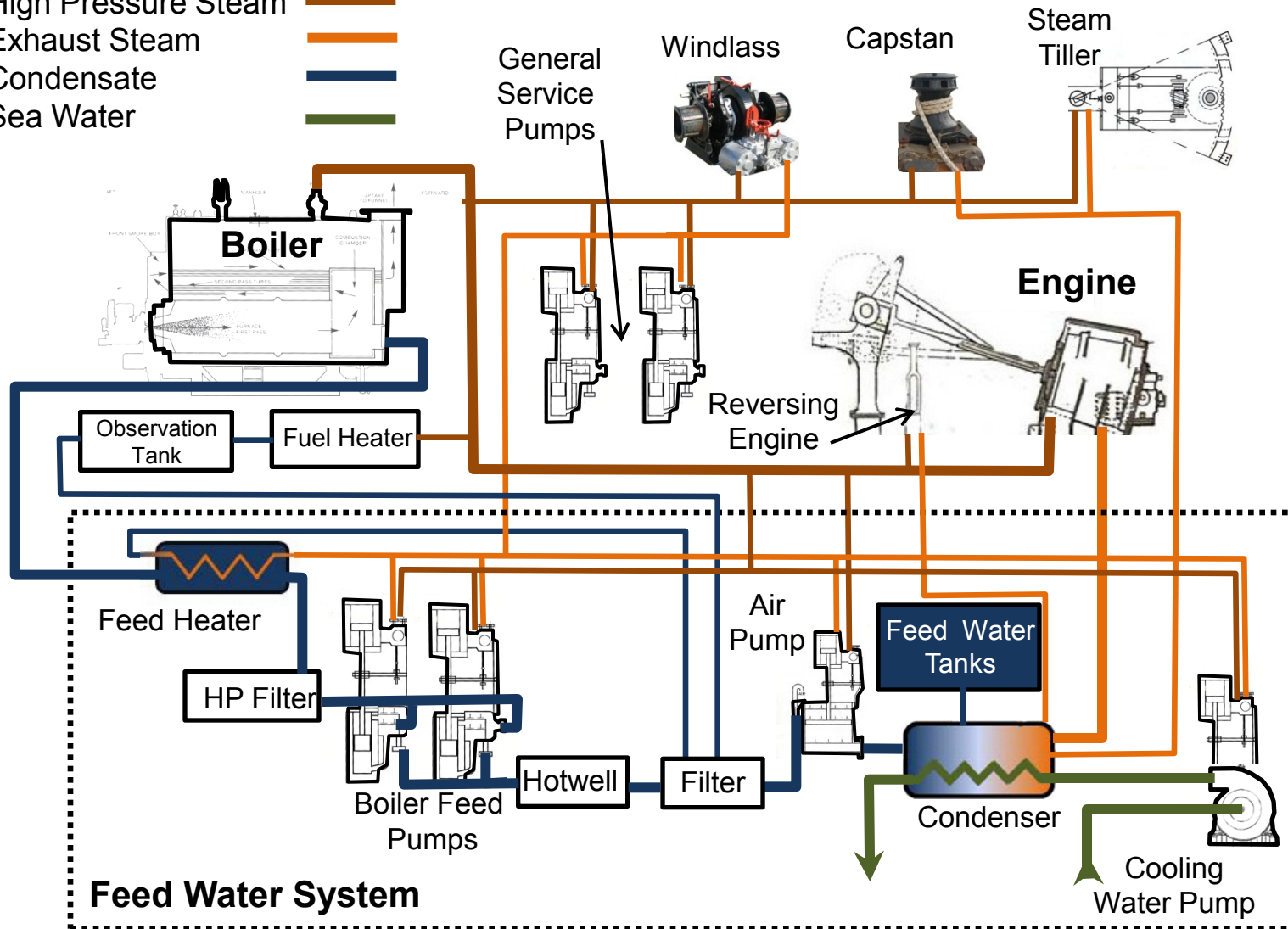


Production, circulation and use of Steam

This basic steam circuit shows how steam is produced, used and re-circulated.

KEY

- High Pressure Steam —
- Exhaust Steam —
- Condensate —
- Sea Water —

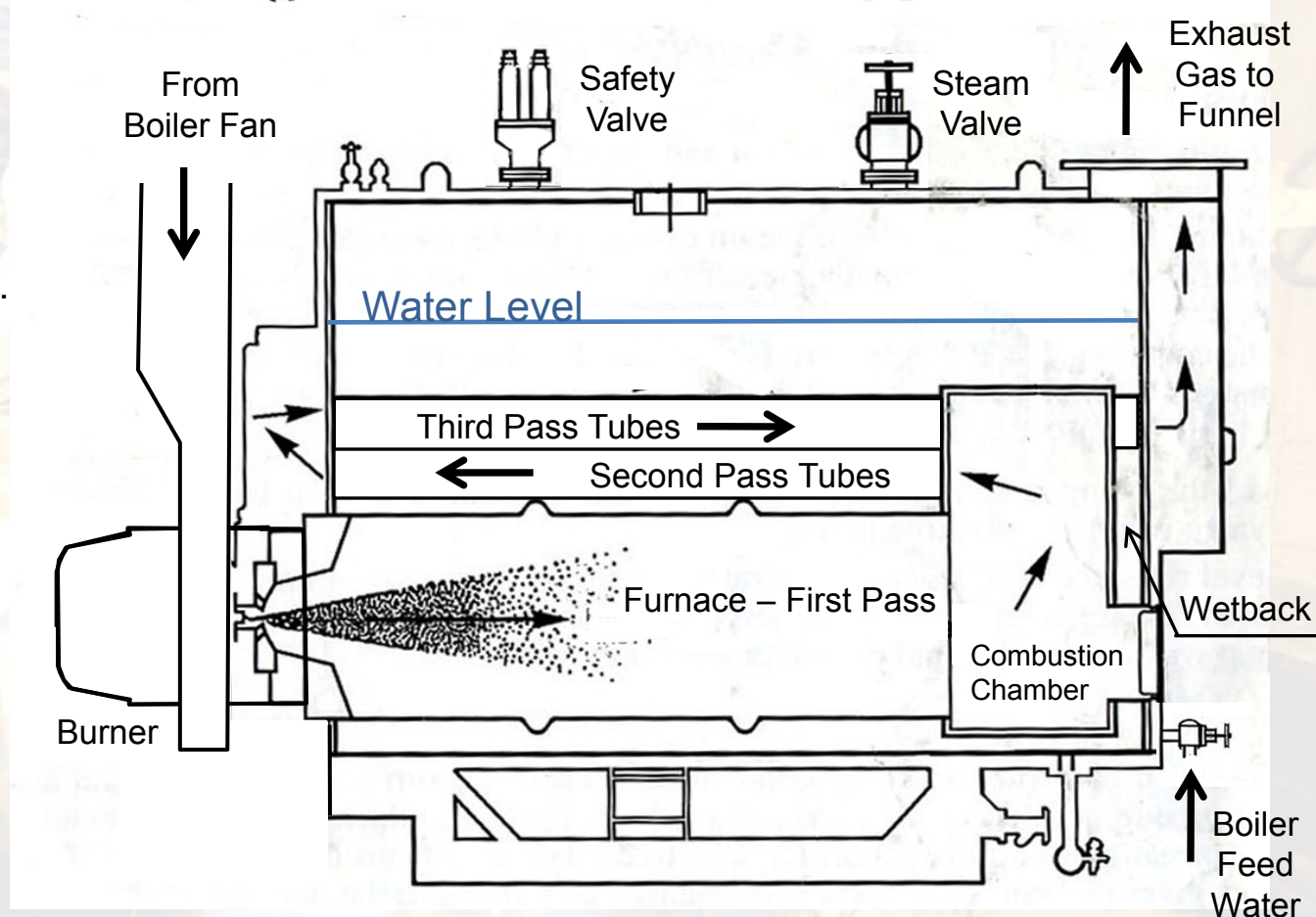


Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			

The Boiler

Waverley was fitted with two Cochran Thermax Boilers during its Millennium rebuild in 2000. It was originally fitted with a double ended Scotch Boiler which used both Funnels for Exhaust Gas whereas the Thermax Boilers only use the Forward Funnel.

Each boiler contains 20 tonnes of water, and, each hour, normally burns 350 litres of fuel per hour to produce 5.5 tonnes of steam at 180 pounds per square inch (12.4 bar).



After the combustion chamber fuel is no longer burnt so only exhaust gases pass through the boiler tubes

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



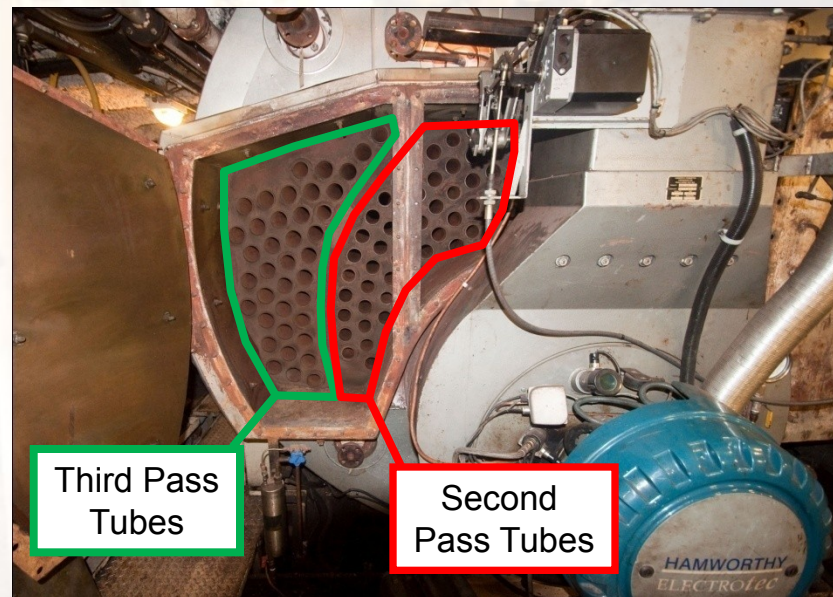
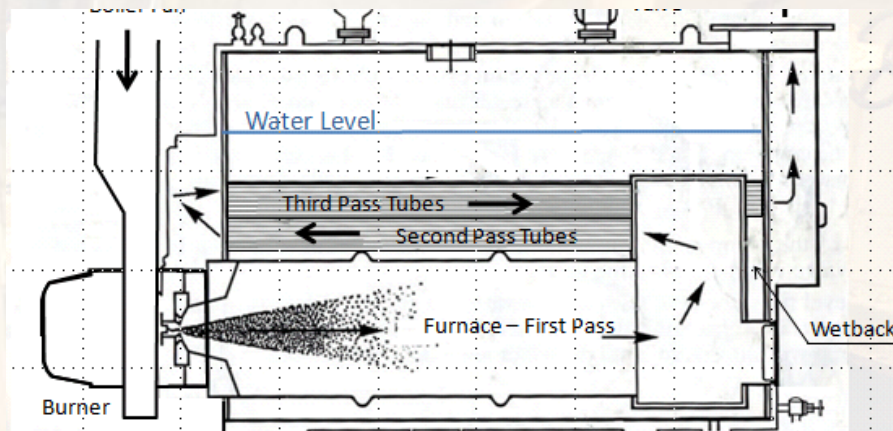
The Boiler

The Thermax Boilers are 3 pass wetback fire tube boilers. After fuel is burnt in a furnace tube exhaust gases then pass through the second and third pass tubes. The chamber between the furnace and second pass tubes is enclosed in water, hence this is a “wetback” boiler.

Before it can be used in the burners, the heavy fuel oil needs to be heated in a steam heat exchanger.

Condensed steam from this heat exchanger passes through an observation tank before being returned to the feed water system. This tank has a sight glass to confirm that there is no oil in the feed water from a defective steam heating coil.

When steam is raised from cold diesel fuel is used.

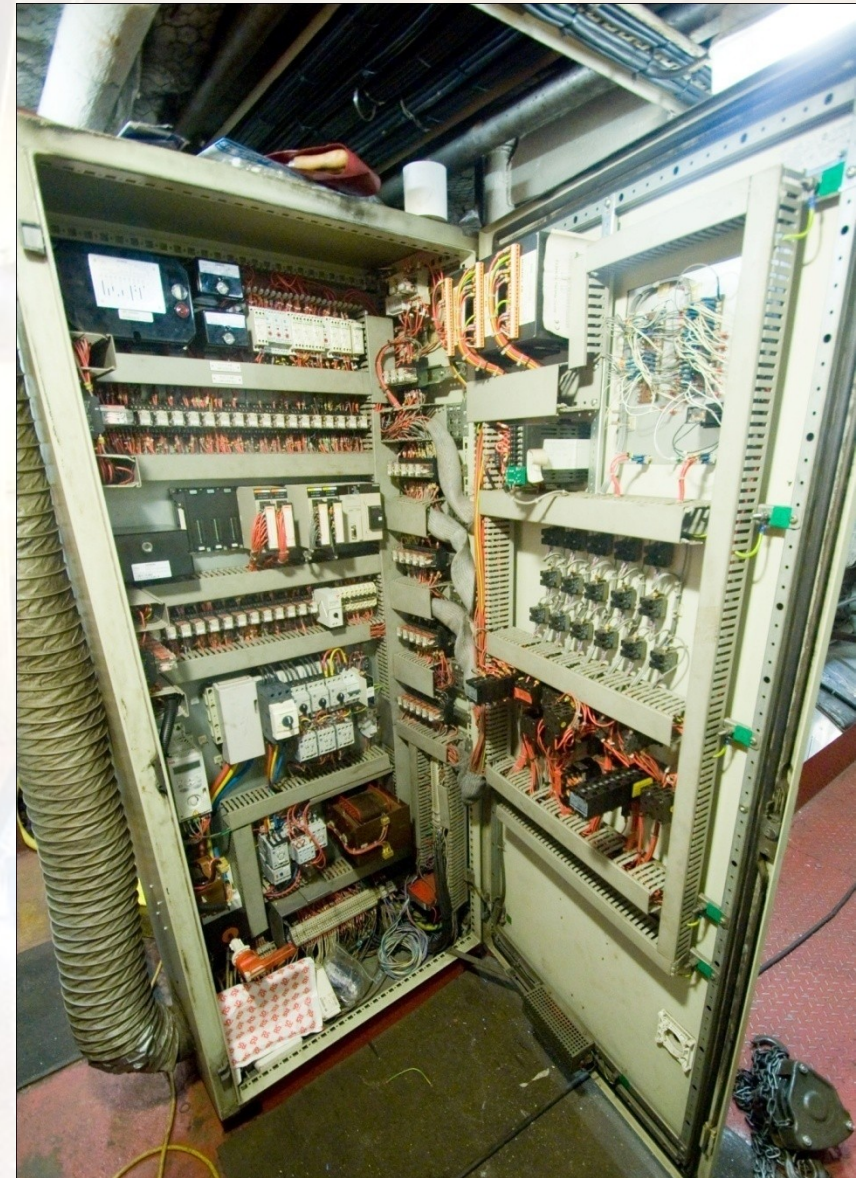
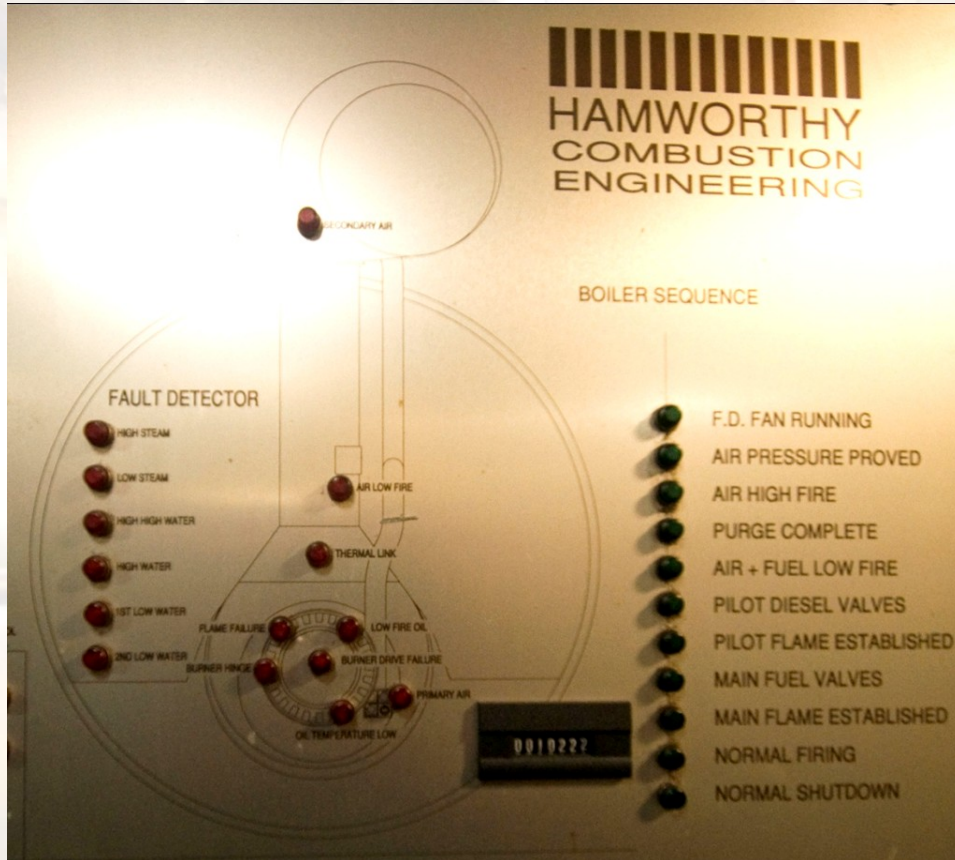


Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Boiler

Photographs showing the complexity of the boiler control system



Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

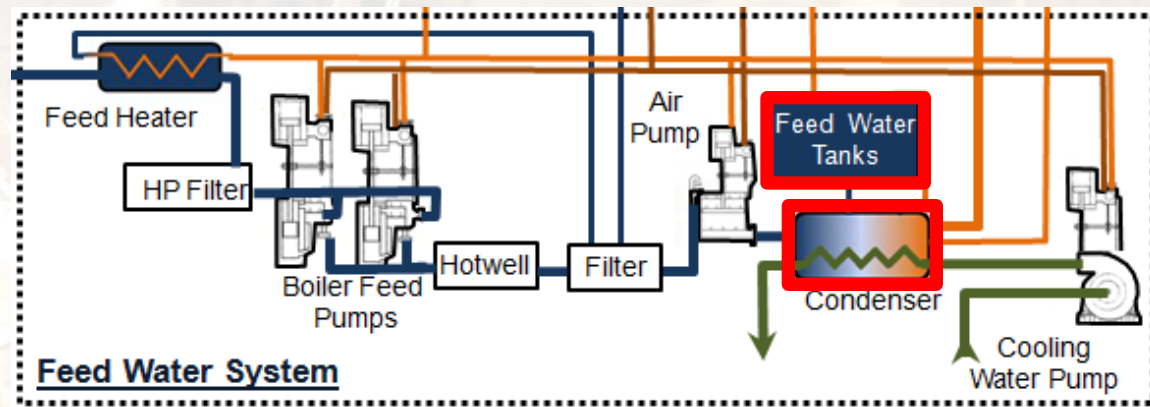
[Paddles](#)



Feed Water System

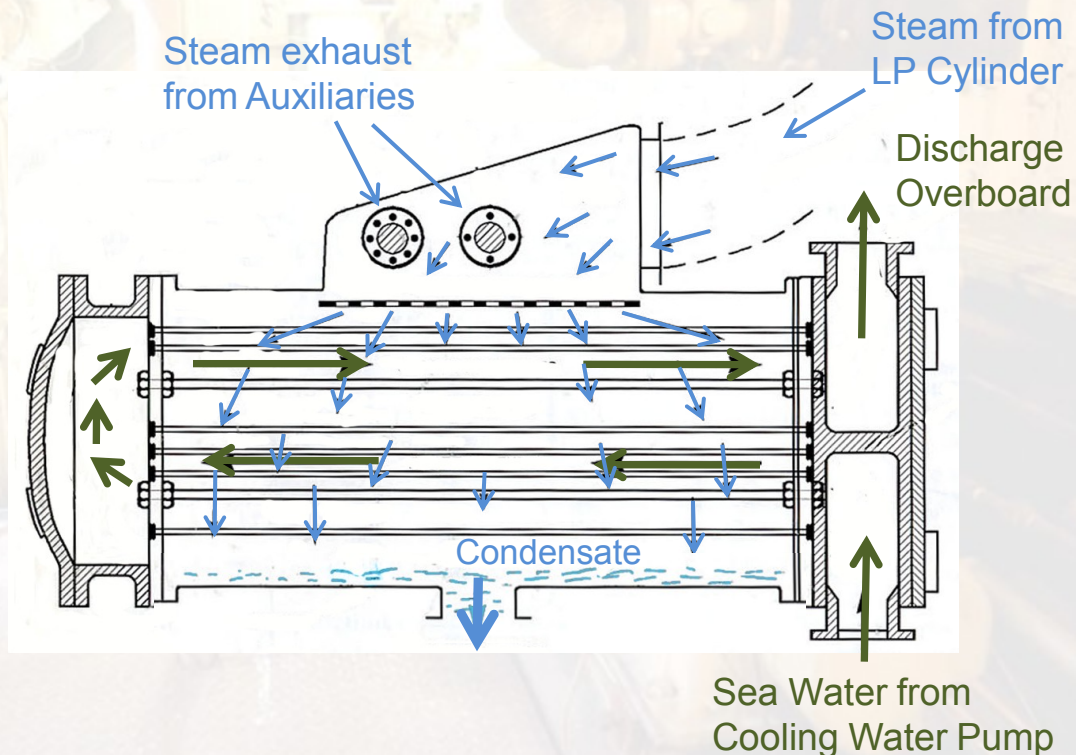
Feed Water Tanks

Tanks containing fresh water to top up feed water are located within the ships double bottom and holds 7 tonnes of water, a small percentage of the 40 tonnes in both boilers. Each day typically 0.5 tonnes of fresh water is used.



Condenser

The exhaust steam is cooled as it passes over tubes in the Condenser through which sea water is circulated. As it cools it condenses into water and a partial vacuum is created.

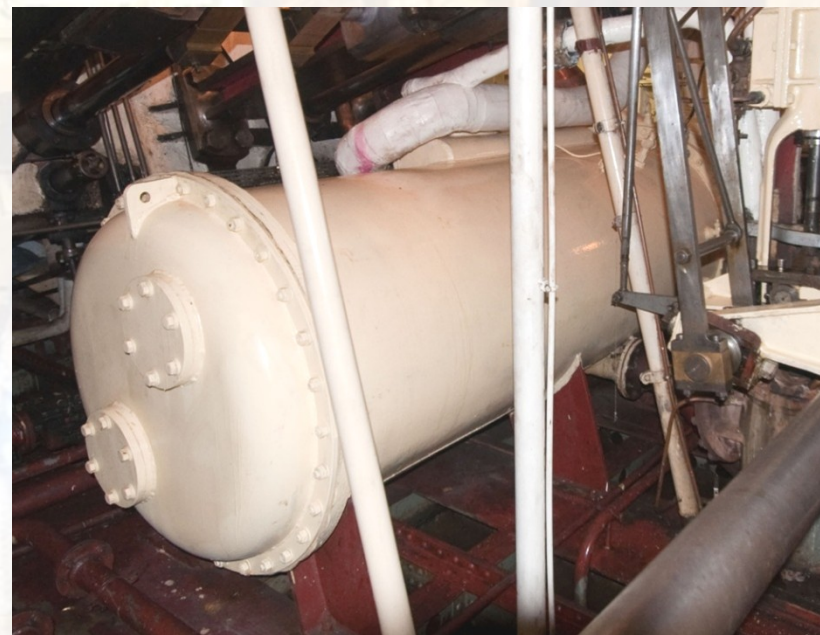
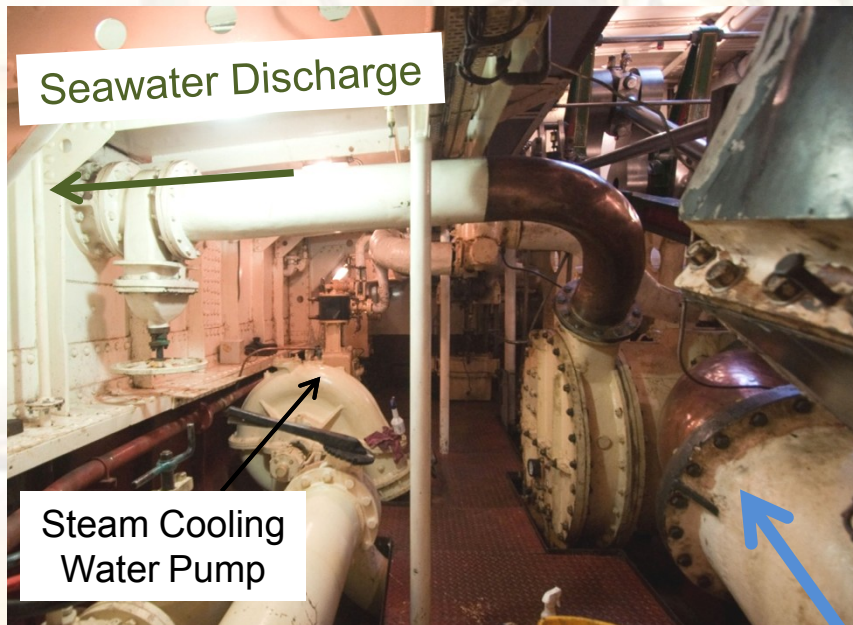
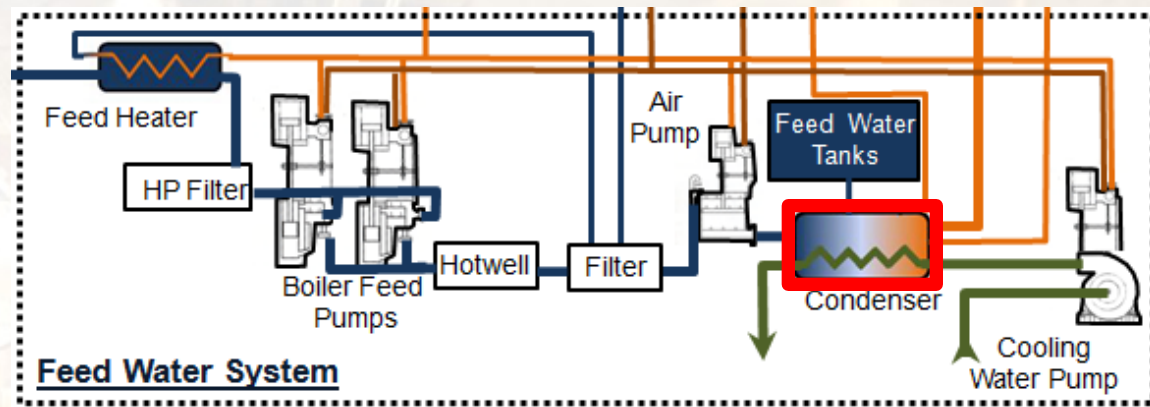


Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Feed Water System

Condenser



Steam from LP Cylinder

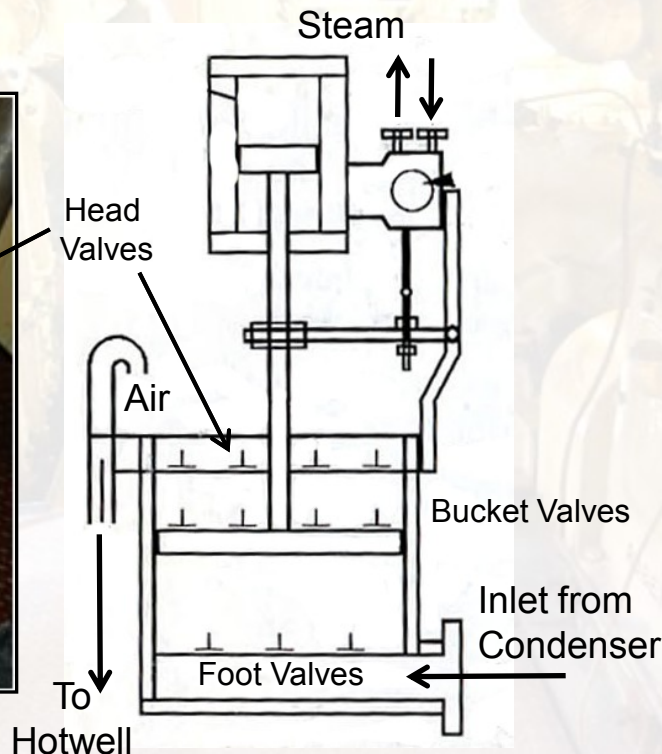
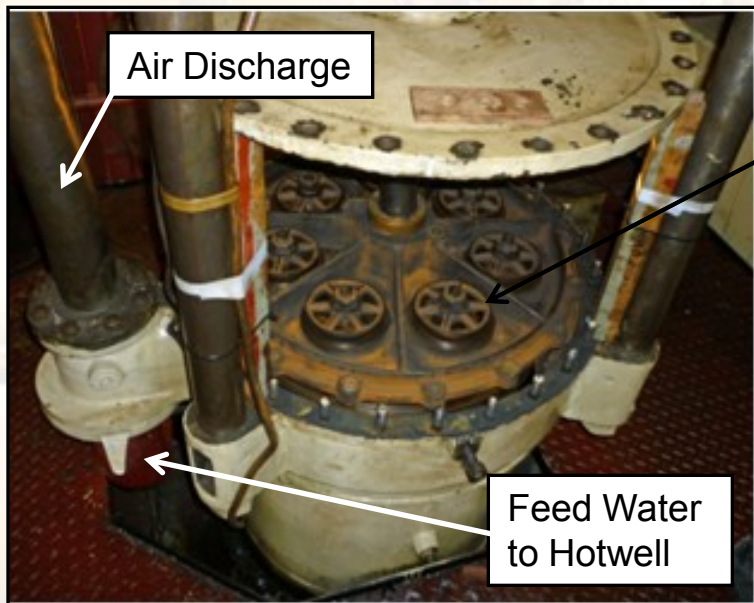
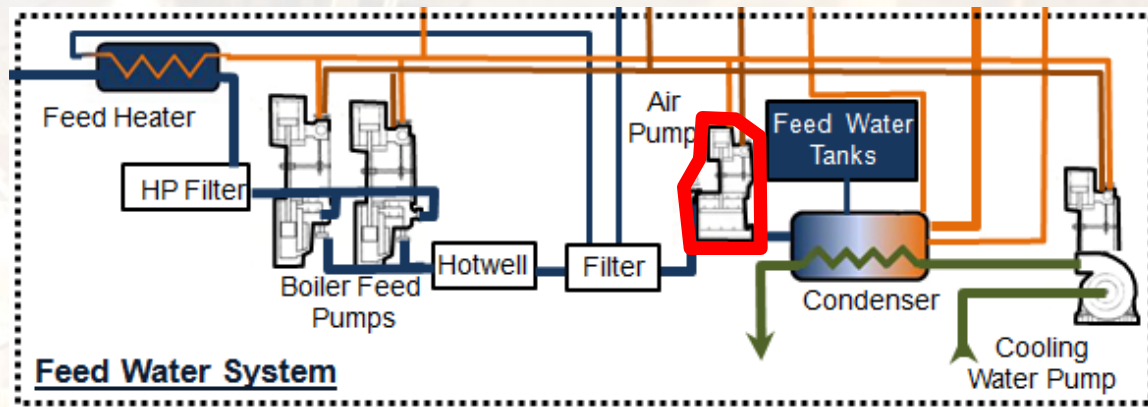
Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Feed Water System

Air Pump

A steam driven Air Pump removes condensed steam (condensate) from the Condenser and also creates a vacuum in the Condenser. It does so by pumping the condensate through a series of non-return valves.



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			

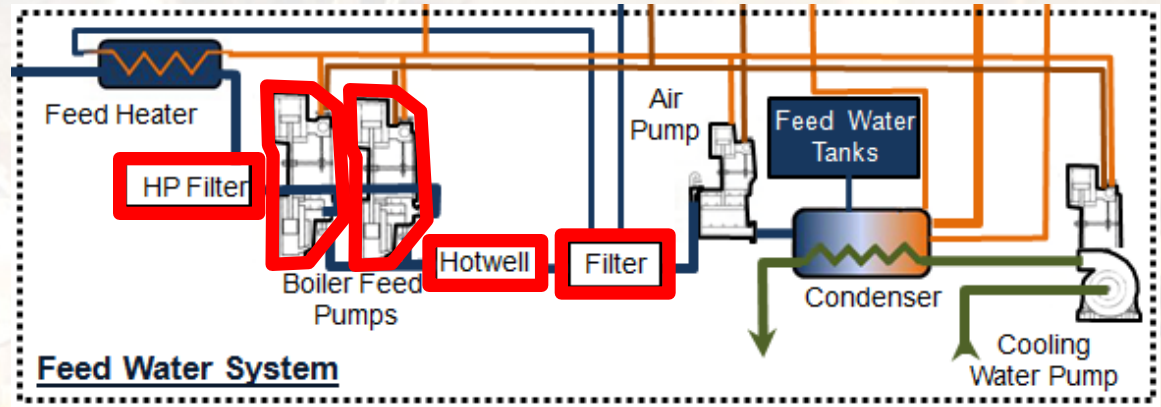


Feed Water System

Hotwell, Feed Pumps and Filters

The **Hotwell** is a holding tank for the feed water.

The feed water system has two filters, a baffle filter in the **Filter Tank** and a **High Pressure Filter** after the **Boiler Feed Pump**.



Feed Water Heater

Filter Tank

Hotwell

HP Filter



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Feed Water System

Feed Pumps

There are two Boiler Feed Pumps, one working and one standby. These pumps force feed water into the Boiler by raising its pressure above that in the Boiler.

The way that the pump can pressurise feed water above the pump's steam pressure is explained by the following equations.

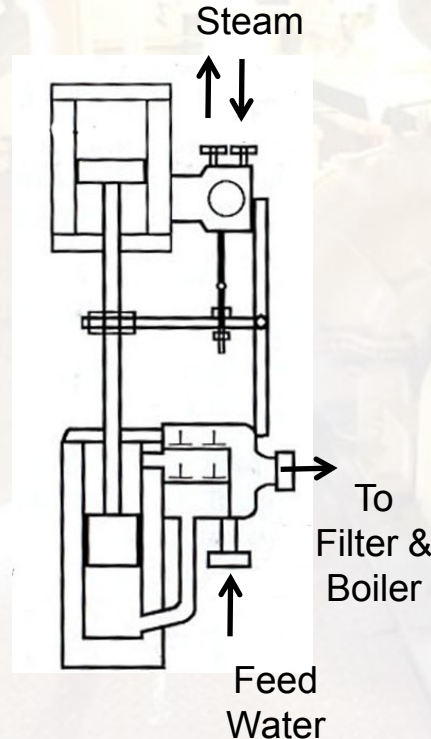
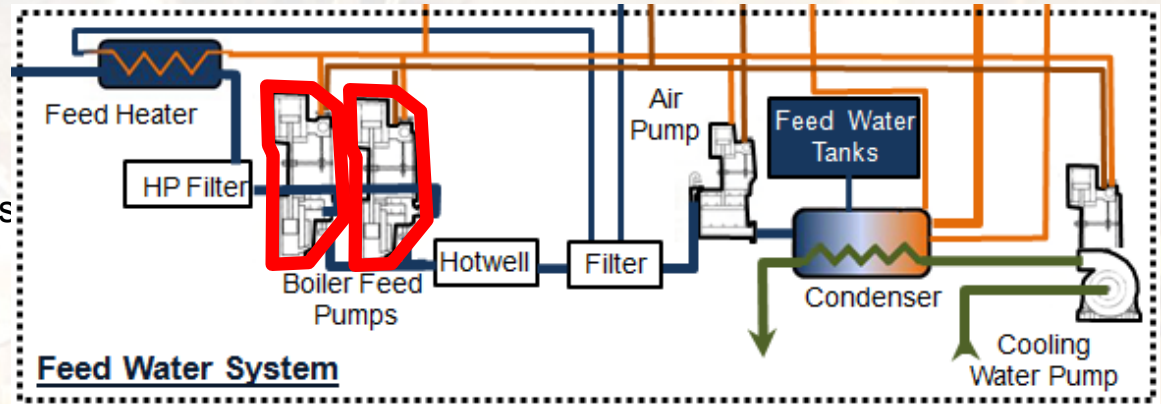
$$F = P_1 \times A_1 \quad \text{for the pump's steam piston}$$

$$F = P_2 \times A_2 \quad \text{for the pump's water piston}$$

The Force (F) from the steam piston is the same as that exerted on the water piston therefore

$$P_1 \times A_1 = P_2 \times A_2$$

The Area (A_1) of the steam piston is greater than the Area (A_2) of the water piston. As a result the feed water Pressure (P_2) is greater than the pump's steam Pressure (P_1)



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

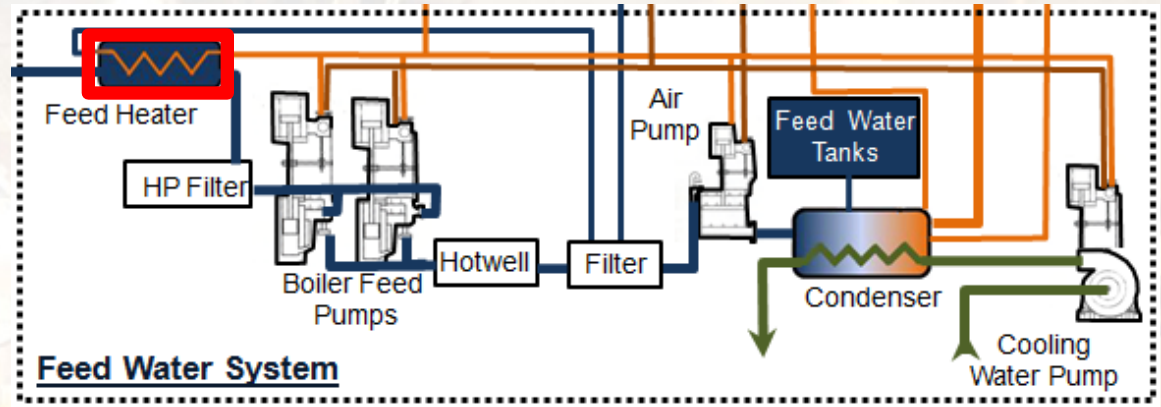
[Exit](#)



Feed Water System

Feed Water Heater

The Feed Water Heater is a heat exchanger that uses exhaust steam from auxiliary machines to heat the Feed Water before it enters the Boiler.

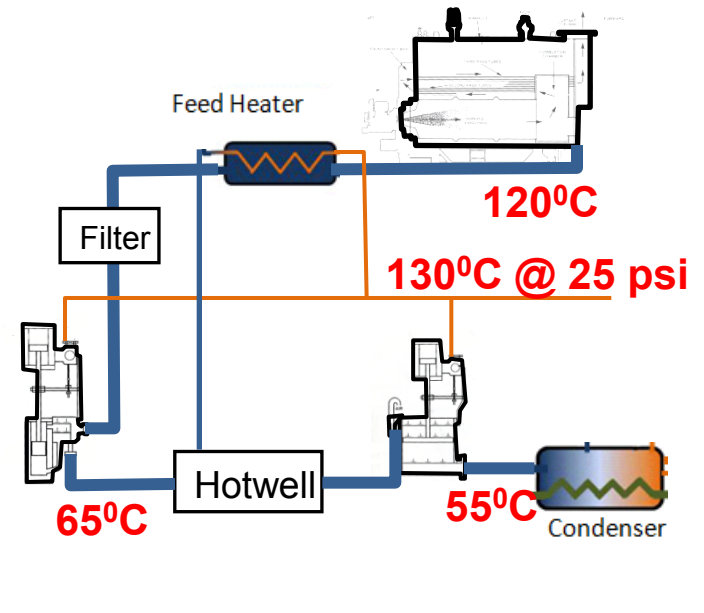


Feed Water Heater

Filter Tank

Hotwell

Hotwell Float Arm controls Feed Pump speed



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Steering

Waverley's Rudder and its Rudder Stock is moved by a steam powered tiller.

This Steam Tiller is controlled by a Telemotor which comprises of a Transmitter and Receiver.

The Telemotor Transmitter is on the Bridge within the housing for the ship's Wheel. It is connected by pipes to the Telemotor Receiver, a spring loaded hydraulic cylinder in the Steering Compartment.

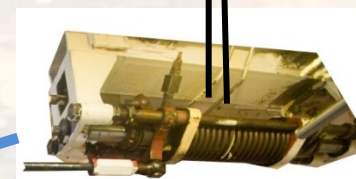
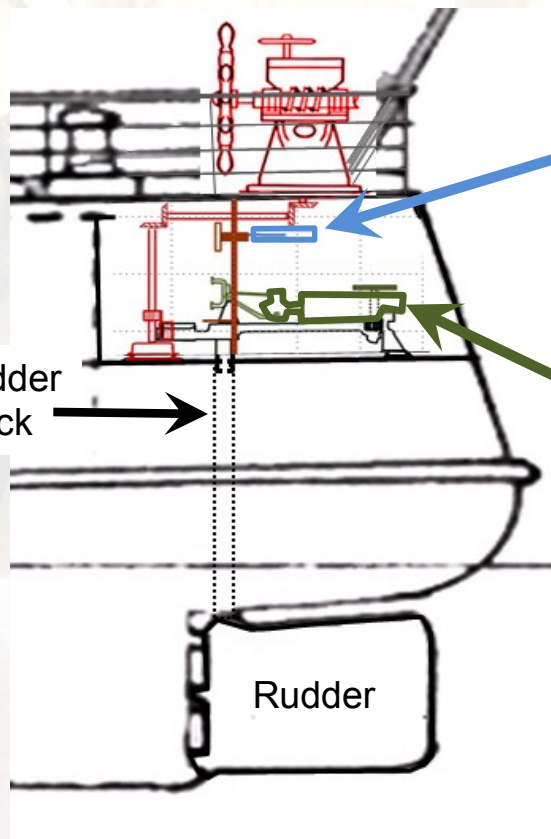
The Telemotor Receiver controls the operation of the Steam Tiller's steam engine.

In this way the Rudder moves as required by the Ship's Wheel

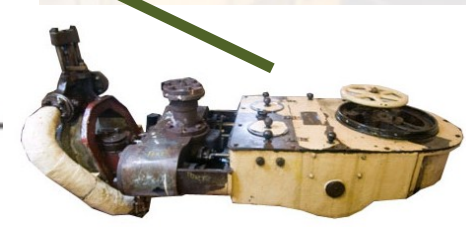


Telemotor Transmitter

Hydraulic lines filled with water



Telemotor Receiver



Steam Tiller

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

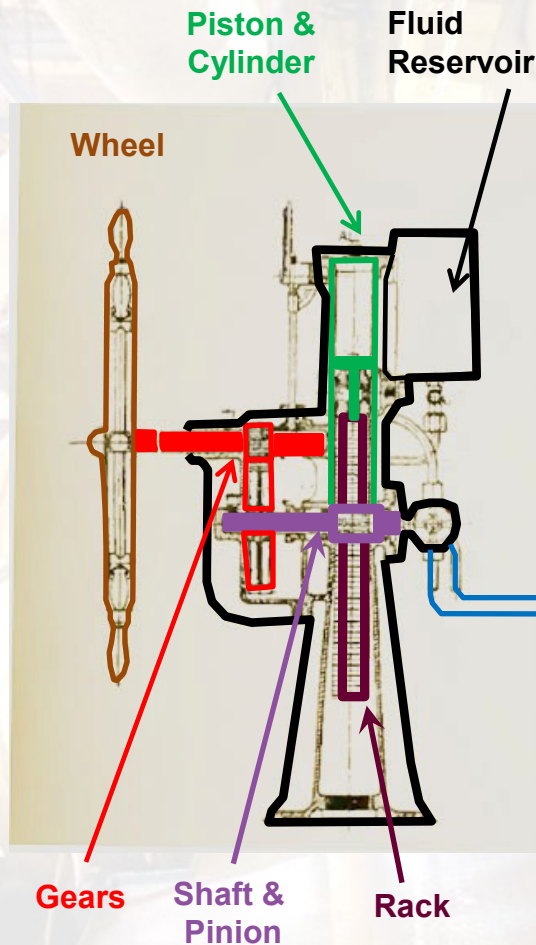
[Exit](#)



Steering – The Telemotor

Telemotor Transmitter

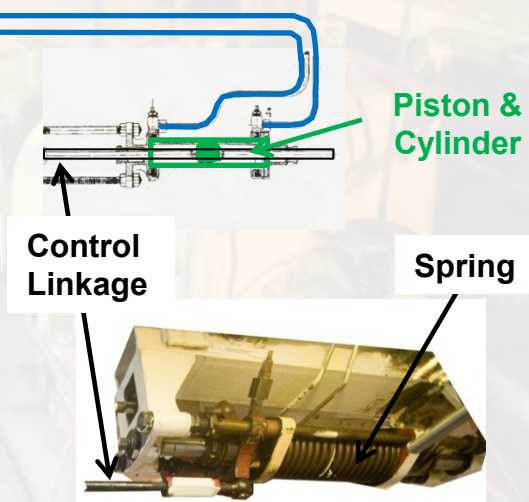
The Ship's **Wheel** rotates **Gears** that drive a **Shaft and Pinion** that moves a **Rack** up and down. The **Rack** is connected to a **Piston** so that when the **Wheel** is rotated a corresponding amount of hydraulic fluid is sent to the Telemotor Receiver.



Telemotor Receiver

The transfer of hydraulic fluid from the Telemotor Transmitter to its Receiver moves a Piston and the linkage to which it is attached. This linkage controls the Steam Tiller.

It also compresses a Receiver spring which creates a back pressure in the hydraulic fluid giving the Bridge Wheel its feel. If released this would turn the Wheel back to its mid position



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)

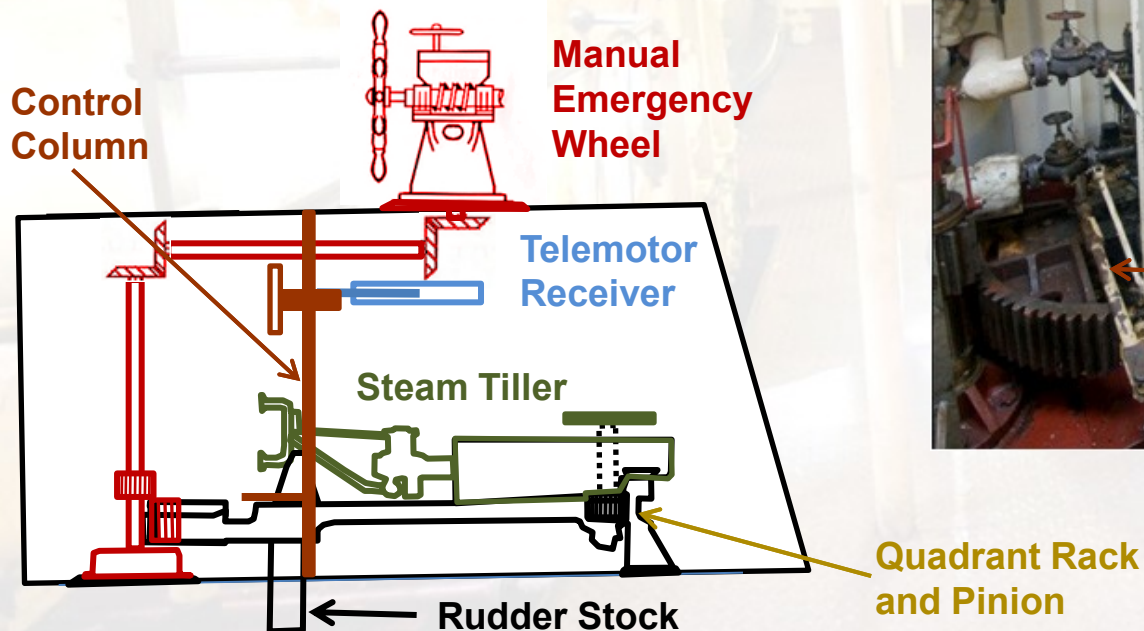


Steering Compartment

The **Telemotor Receiver** operates the **Steam Tiller** via its control valve which is connected to the **Control Column** and a **Control Valve Linkage**.

The **Steam Tiller** then turns its **Pinion** which is engaged in the **Quadrant Rack** (tinted for identification). This rotates the **Steam Tiller** along the **Quadrant Rack** and so turns the Rudder Stock.

Also within the Steering Compartment are Emergency Steering mechanisms and an Autopilot hydraulic cylinder (not shown for clarity) which operates in a similar manner to the Telemotor Receiver.



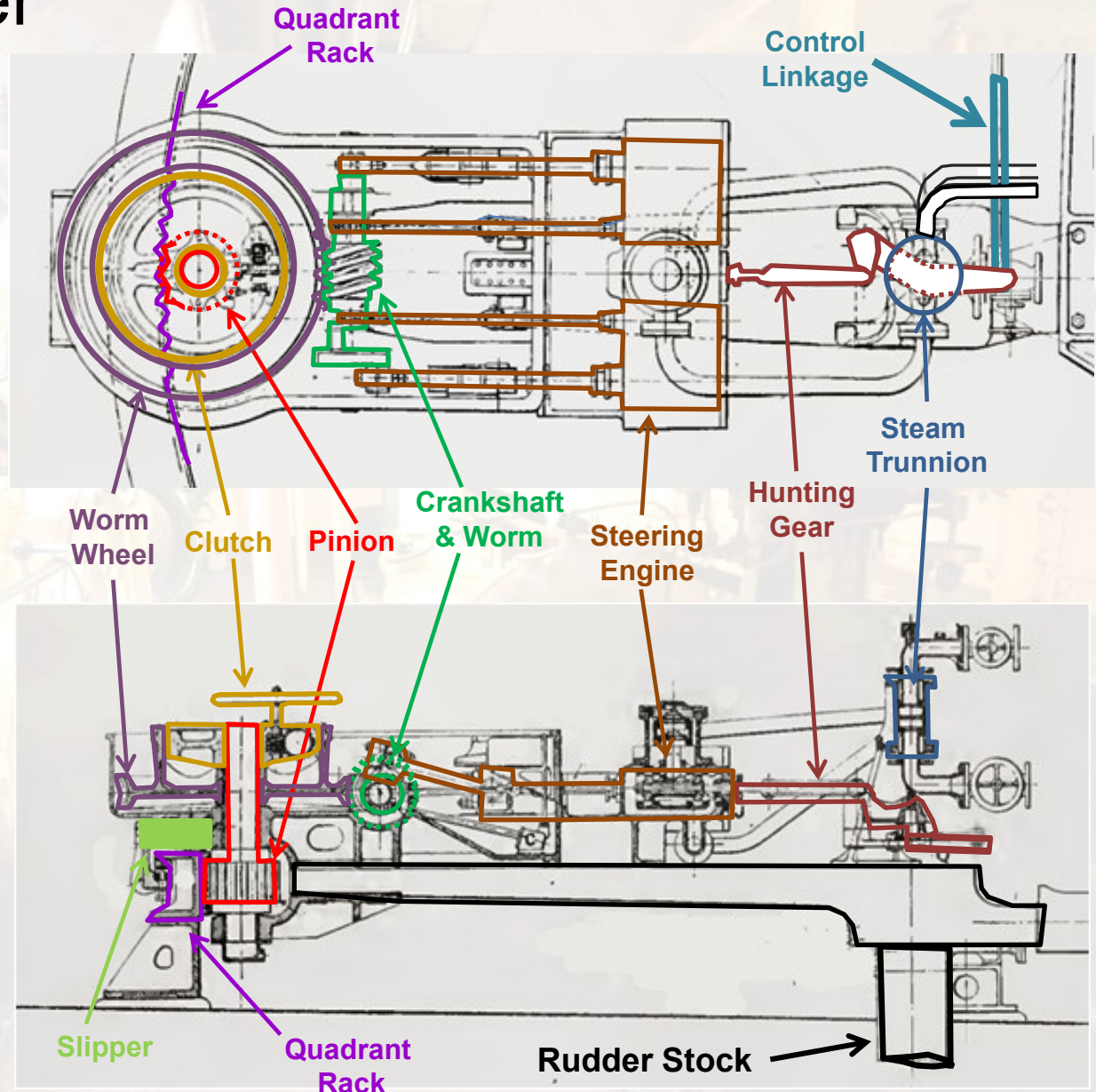
- Telemotor Receiver
- Control Column
- Steam Tiller
- Quadrant Rack
- Control Valve Linkage

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Steam Tiller

1. The Steam Tiller is powered by a **Steering Engine** that operates in the required direction when its control valve is moved by the **Hunting Gear** which is connected to the Telemotor Receiver's **Control Linkage**.
2. When the Steering Engine operates its **Worm** on the Engine's **Crankshaft** turns the **Worm Wheel** which drives a **Pinion** via a **Clutch**. This **Pinion** is engaged in the **Quadrant Rack** so that as it turns, the Steam Tiller rotates along the **Quadrant Rack** to turn the Rudder Stock. As it does so the Steam Tiller slides on its **Slipper** along the top of the **Quadrant Rack**.
3. When the Tiller has rotated to the angle set by the **Hunting Gear**, the **Steering Engine's** control valve closes and stops the Steam Tiller



Where it is

Boiler Room Engine Room Steering Paddles Bridge

How it works

Engine Steam Steering Paddles

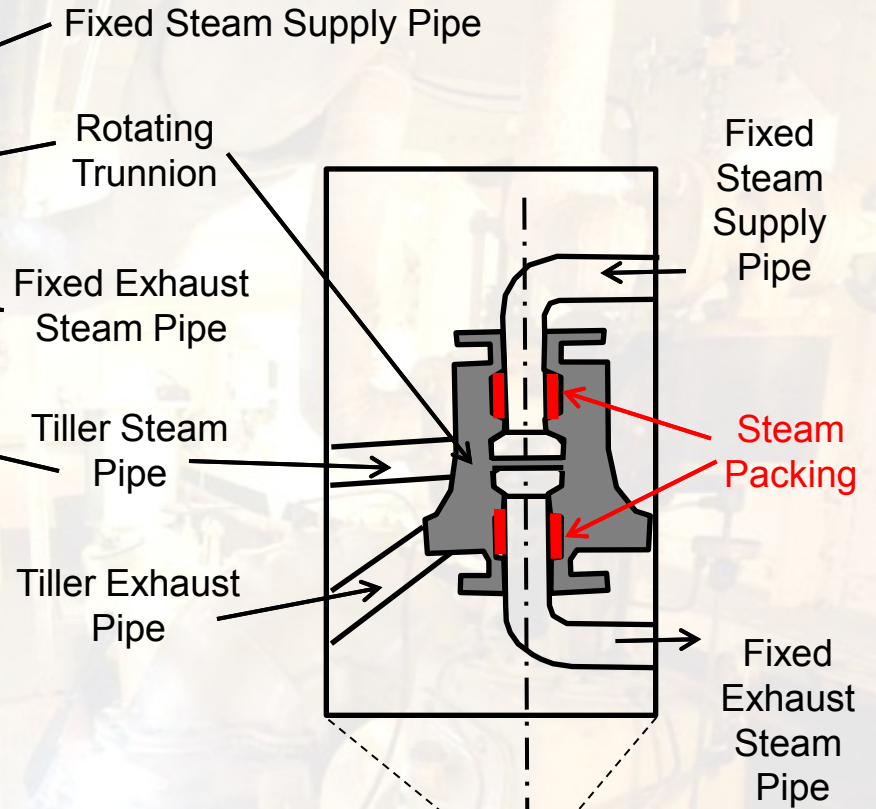
Site
Map

Main
Menu

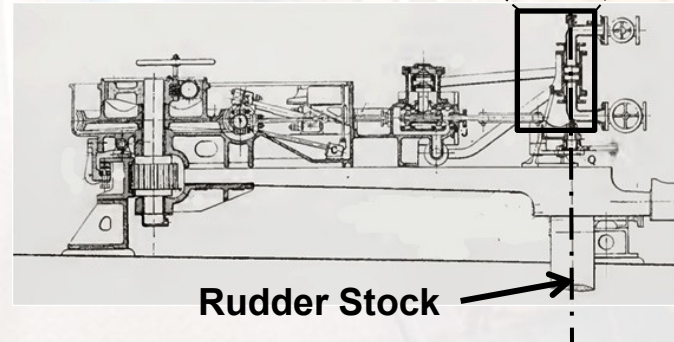
Exit



Steam Tiller's Steam and Exhaust connection



Steam enters and leaves the Tiller via a Steam Trunnion that can rotate with its Steam and Exhaust pipes on the Tiller. It can do so because it is in line with the Rudder Stock. Within the Trunnion steam packing ensures no leakage of steam as the Trunnions rotates.



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



The Steam Tiller's Steering Engine



Hunting Gear
connection
to Control Valve

Steering Engine
Cylinders

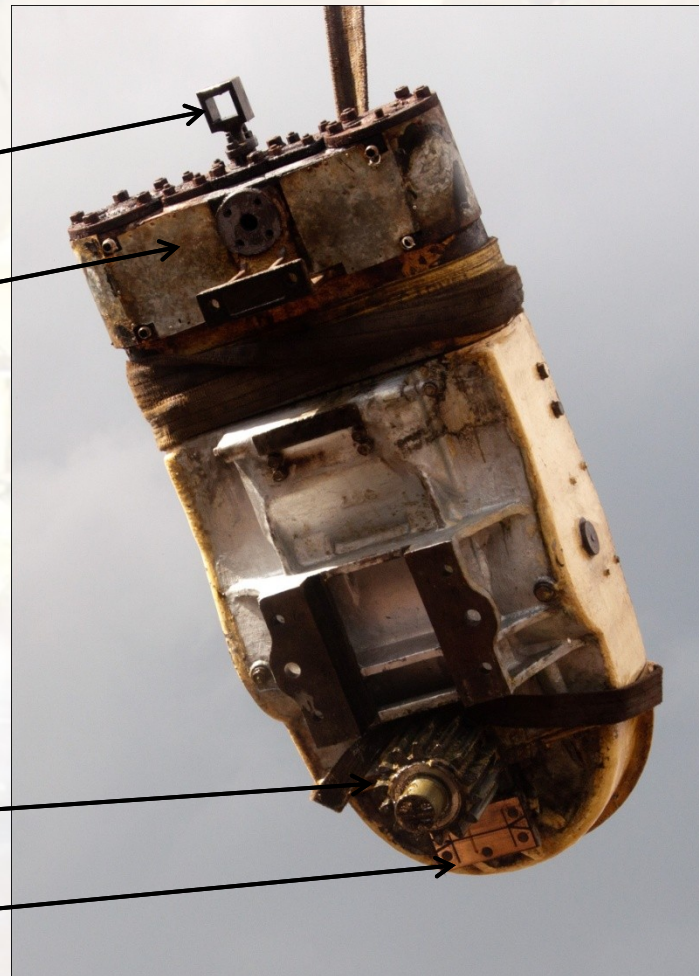
Crankshaft
with Worm

Clutch Drum &
Worm Wheel

Clutch Assembly

Pinion

Slipper



Photographs taken as the Steering Engine was removed during Waverley's May 2011 Dry Docking

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site
Map](#)

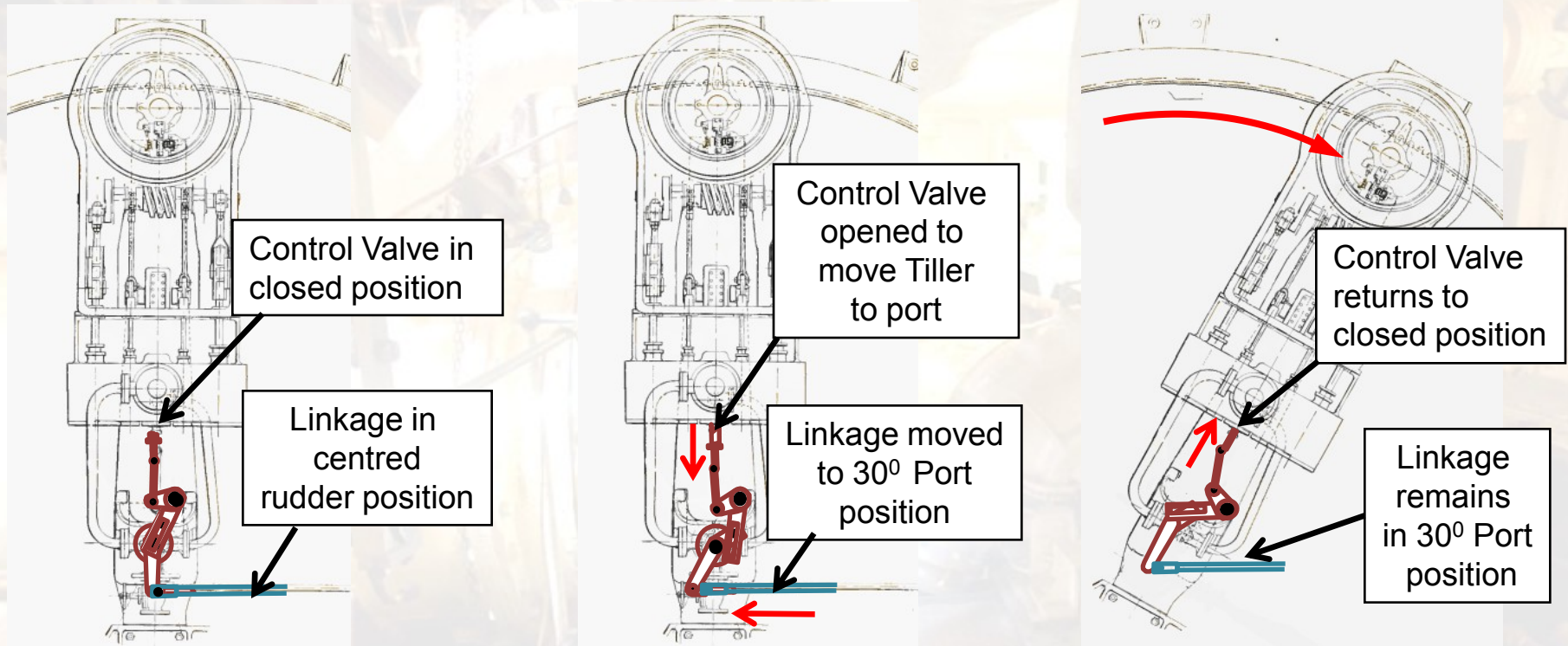
[Main
Menu](#)

[Exit](#)



The Steam Tiller – Operation of Hunting Gear

The Steam Tiller is controlled by the Hunting Gear which sets the Tiller's neutral position in response to a command from the Wheel via the Telemotor and Control Linkage. The Tiller will always move towards this neutral position and will stop once it is reached. An example of this is shown in the diagrams below.



1. The **Hunting Gear** moves the control valve in or out of the Steering Engine according to the position of the **Control Linkage**. Moving the valve into or out of the Engine moves the Tiller respectively to Starboard or Port

2. When a 30° Port rudder is called for, the **Control Linkage** moves as required in the direction shown. This moves the control valve out of the Engine which starts to move the Tiller to Port

3. The arrangement of the **Hunting Gear** is such that as the Tiller rotates to Port the control valve moves back into the Steering Engine. At 30° to port the valve closes and the Tiller stops

Where it is

Boiler Room Engine Room Steering Paddles Bridge

How it works

Engine Steam Steering Paddles

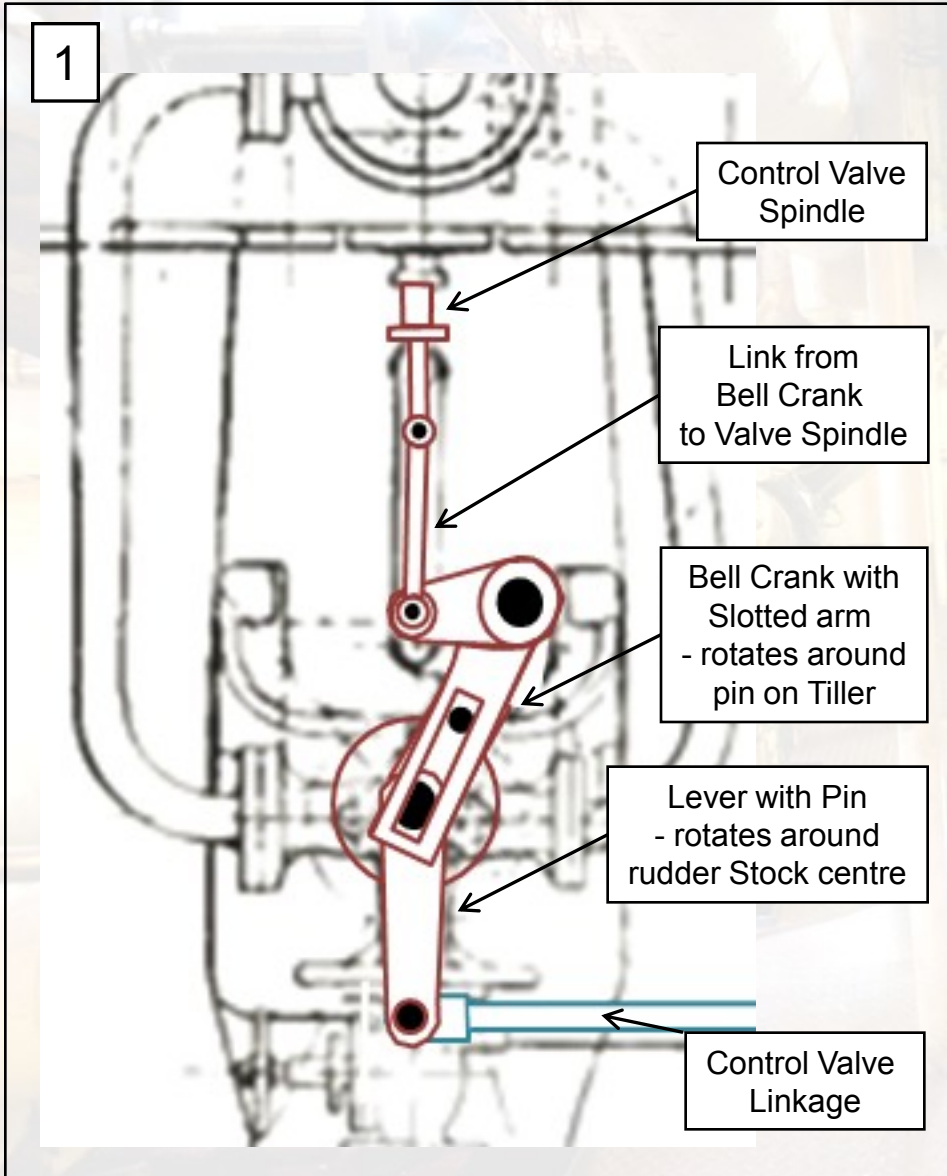
Site
Map

Main
Menu

Exit

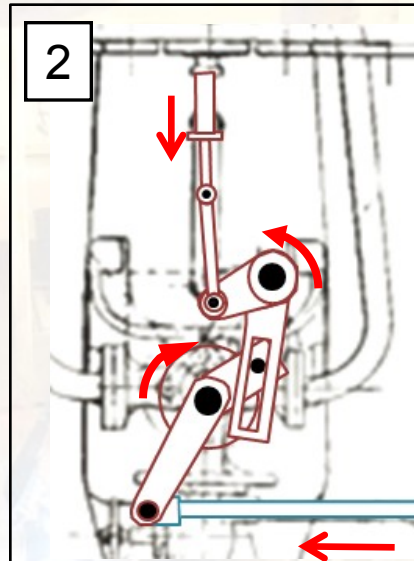


The Steam Tiller – Operation of Hunting Gear

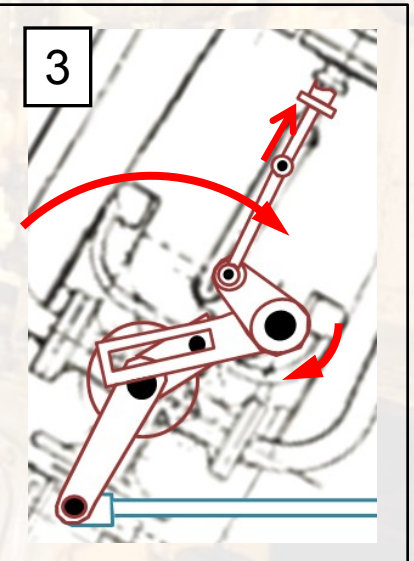


The main diagram shows the Hunting Gear and its component parts in more detail in the position when rudder is centred and control linkage is in the centred rudder position.

This is stage one in the previous example. Stages two and three are shown below.



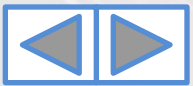
30° Port called for, The Control Valve Linkage moves the Lever clockwise. As it does so its pin engages in Bell Crank's slotted arm causing it to rotate anti-clockwise and move valve spindle out of Steering Engine



As the Tiller moves to Port, the Bell Crank is rotated clockwise by the Lever's pin is in its slotted arm. This pushes the valve spindle back into the Steering Engine until it stops at 30° Port

Where it is					How it works			
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles

Site Map	Main Menu	Exit
--------------------------	---------------------------	----------------------

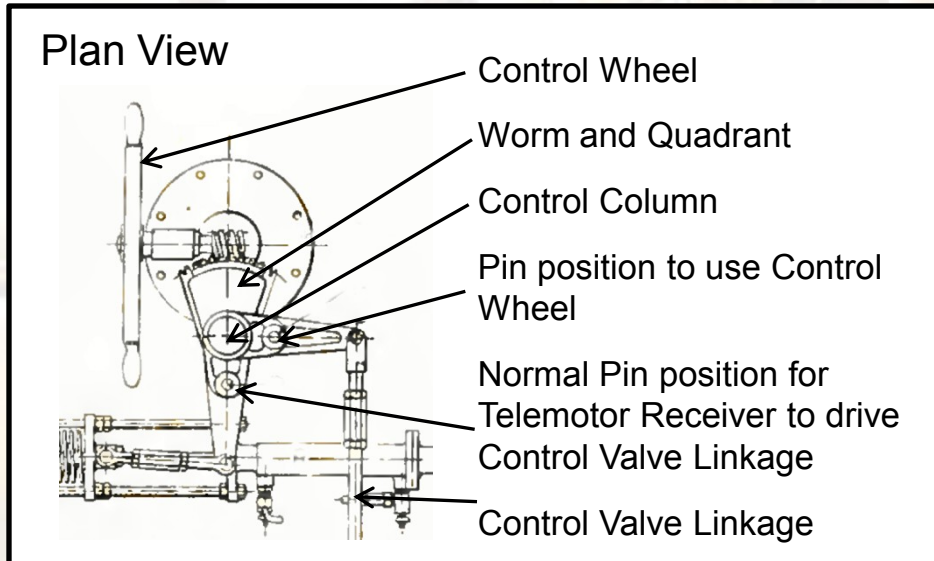


Emergency Steering

There are Emergency Steering arrangements for a failure of the Telemotor or of the Steam Tiller.

If the Telemotor fails, a Control Wheel can be used to directly control the Steam Tiller. This wheel moves the Control Column by a worm and quadrant to directly operate the Steam Tiller's Control Valve.

To do this, a pin has to be removed from its normal position and inserted into the position so the Control Wheel can be used as shown below.

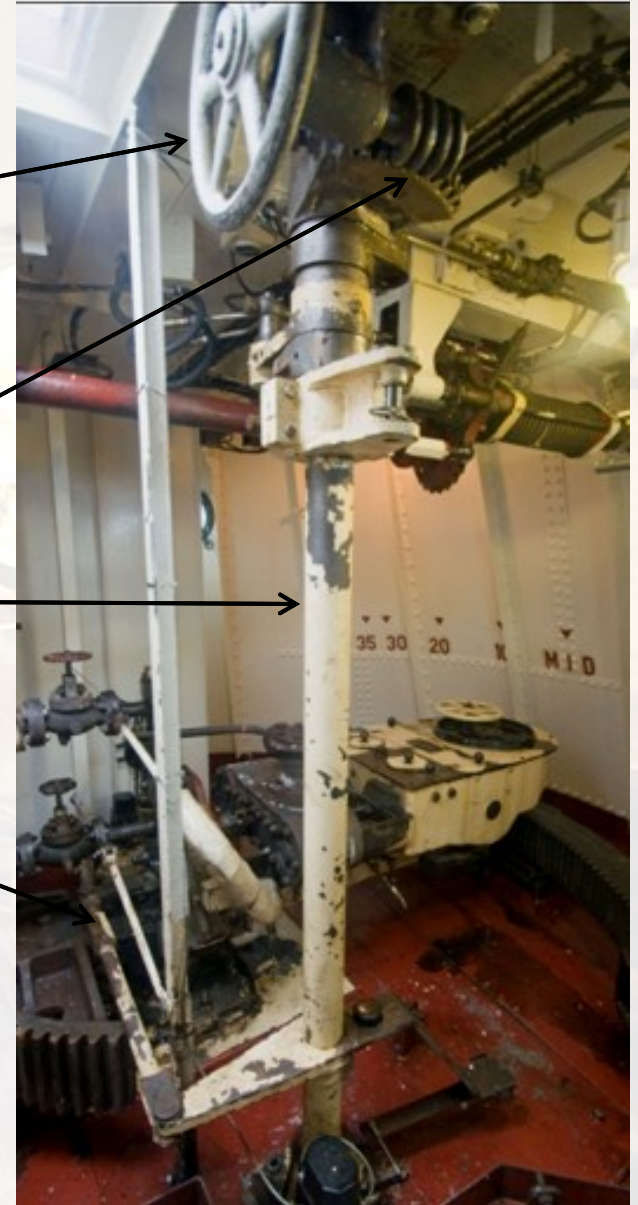


Control Wheel

Worm & Quadrant

Control Column

Control Valve Linkage



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

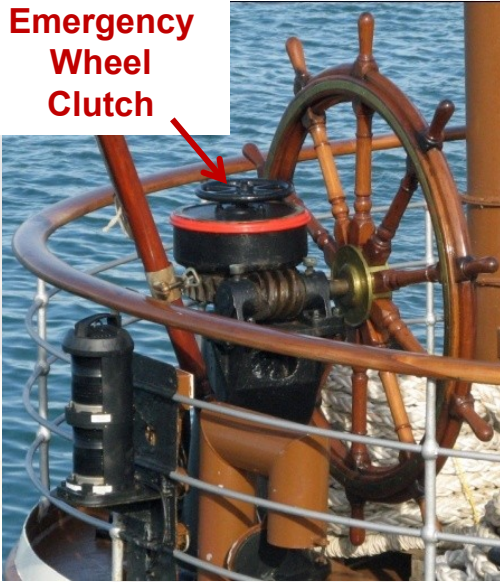
[Site Map](#)

[Main Menu](#)

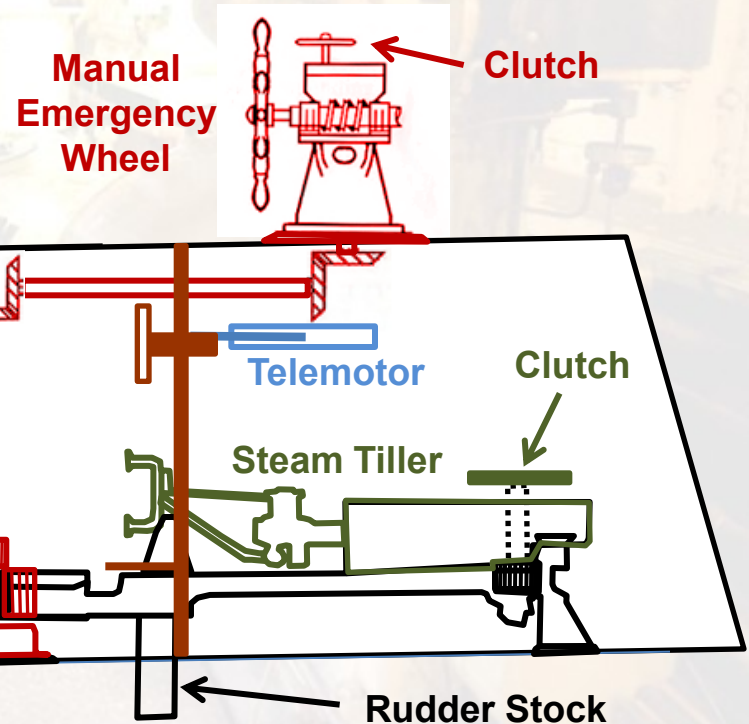
[Exit](#)



Emergency Steering



If the Steam Tiller fails, the ship can be steered directly by the Manual Emergency Wheel. This requires the Emergency Pinion to be engaged into its Quadrant; the Tiller Engine's Clutch to be disengaged and the Emergency Wheel's Clutch to be engaged.



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

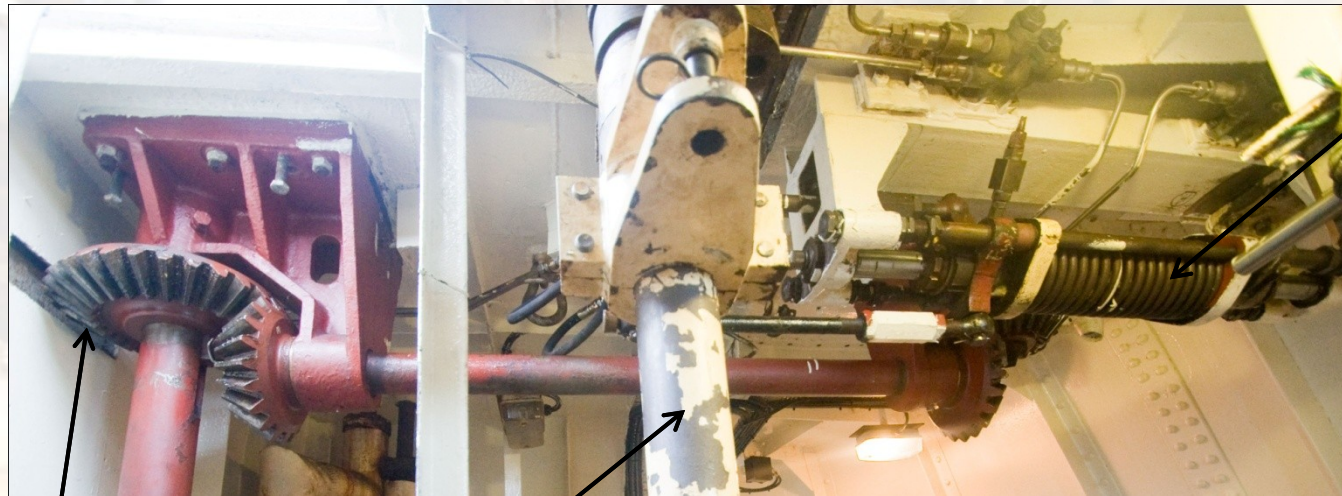
[Site Map](#)

[Main Menu](#)

[Exit](#)



Waverley's Steering Gear



Telemotor Receiver

Steam Tiller

Quadrant Rack

Clutch

Control Column

Shafts & Bevel Gears for
Emergency Wheel

Trunnion for Steam
& Exhaust



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Waverley's Steering Gear



Steam & Exhaust Trunnion

Control Valve Linkage

Emergency Pinion and Quadrant

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Waverley's Steering Gear

Note how the Tiller Steam Pipe rotates around its Trunnion and how the Tiller moves in response to the movement of the Control Linkage



Tiller Steam Pipe

Movement of Control Linkage

Click on Picture for Video of Steam Tiller

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)

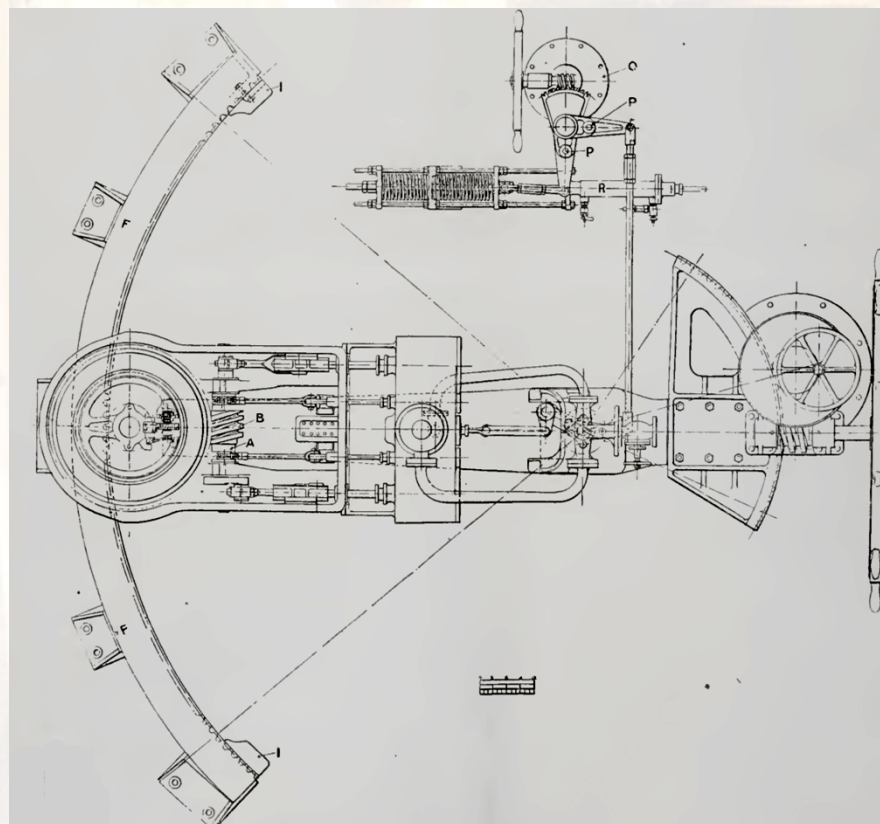
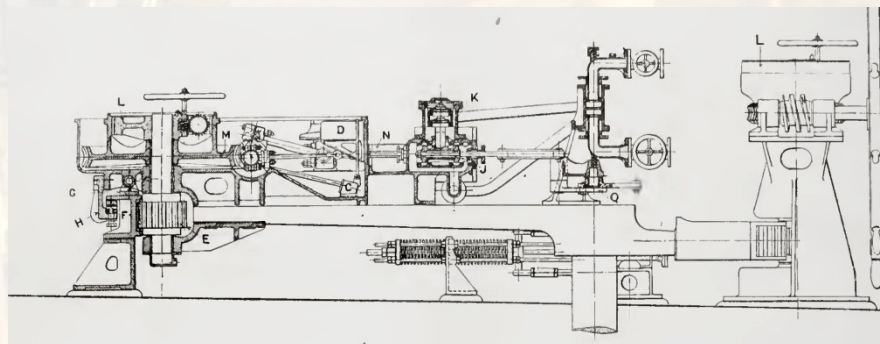


Brown's Patent Telemotor and Steam Tiller

Waverley's Steam Tiller Steering Gear was manufactured by Brown Bros of Edinburgh to a design that was originally patented in 1883-9 and later improved.

The Science Museum in London has a model of a Brown's Steam Tiller which is almost identical to Waverley's Steering Gear. The model is the after part of S.S. Ballarat, 11,120 tons, built in Greenock in 1911.

This system was widely used at that time. Indeed Waverley's Telemotor Control and its Hunting Gear is almost identical to that used in the Titanic.



Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Science Museum Model

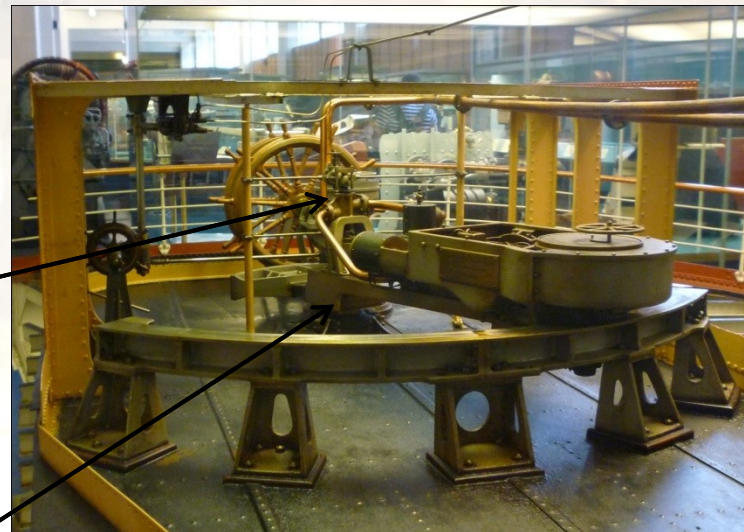


Steam Tiller
Clutch

Steam &
Exhaust
Trunnion

Crankshaft
& Worm

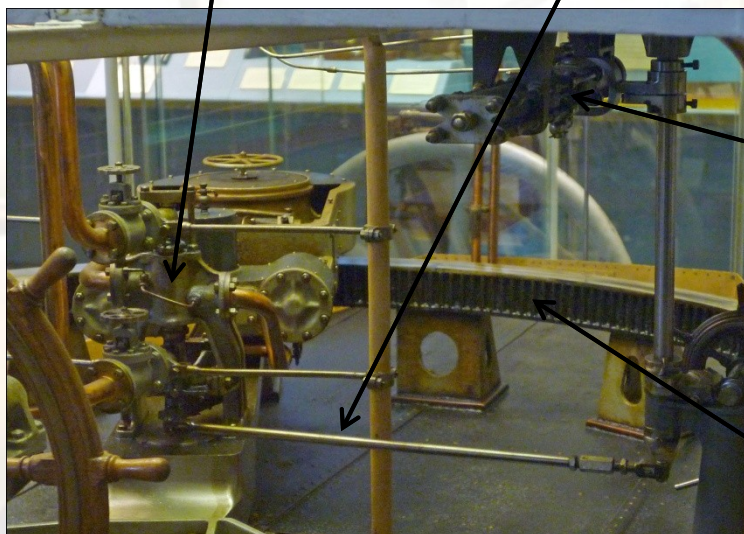
Rudder Stock



Hunting
Gear

Steam & Exhaust
Trunnion

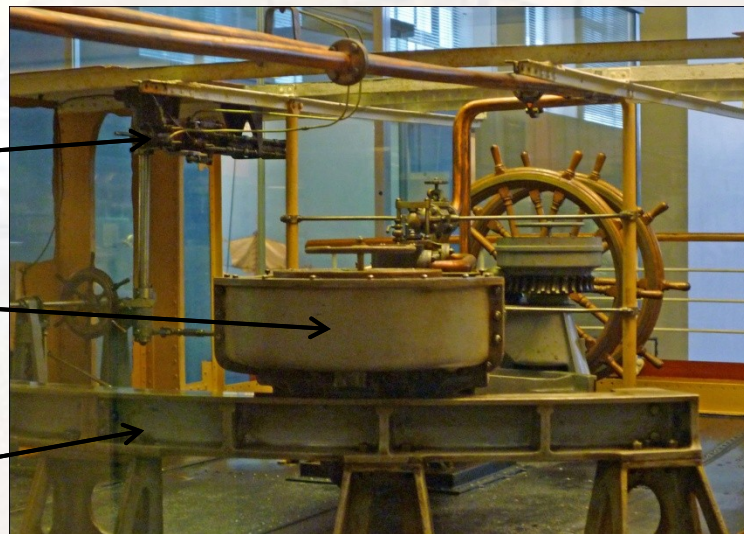
Control Valve
Linkage



Telemotor
Receiver

Steam Tiller

Quadrant Rack



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

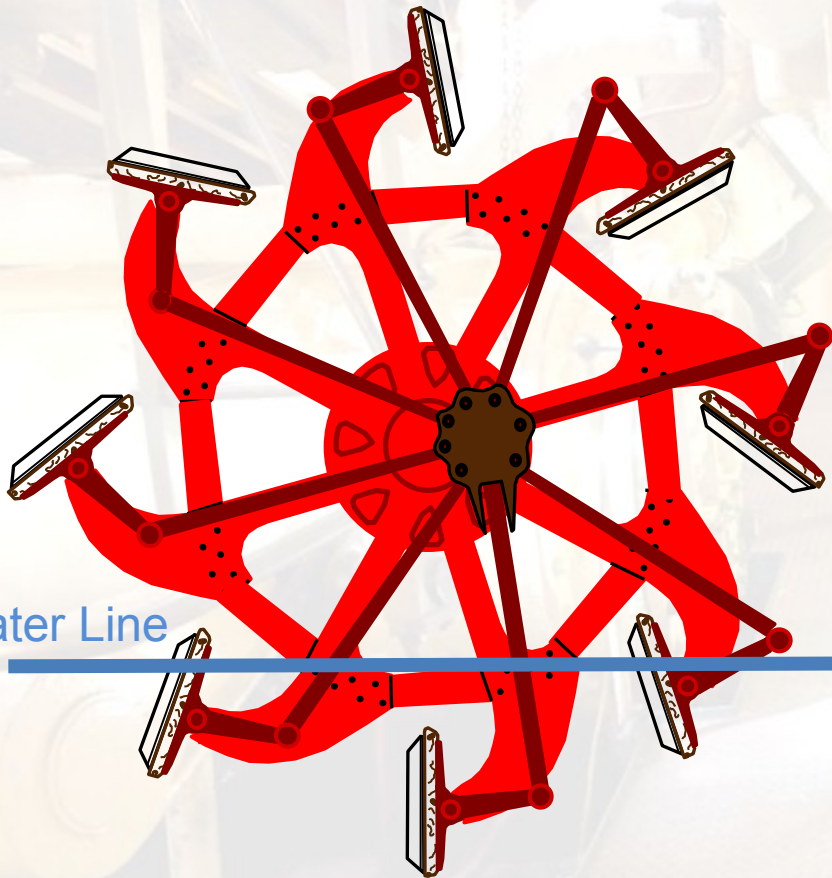
[Main Menu](#)

[Exit](#)

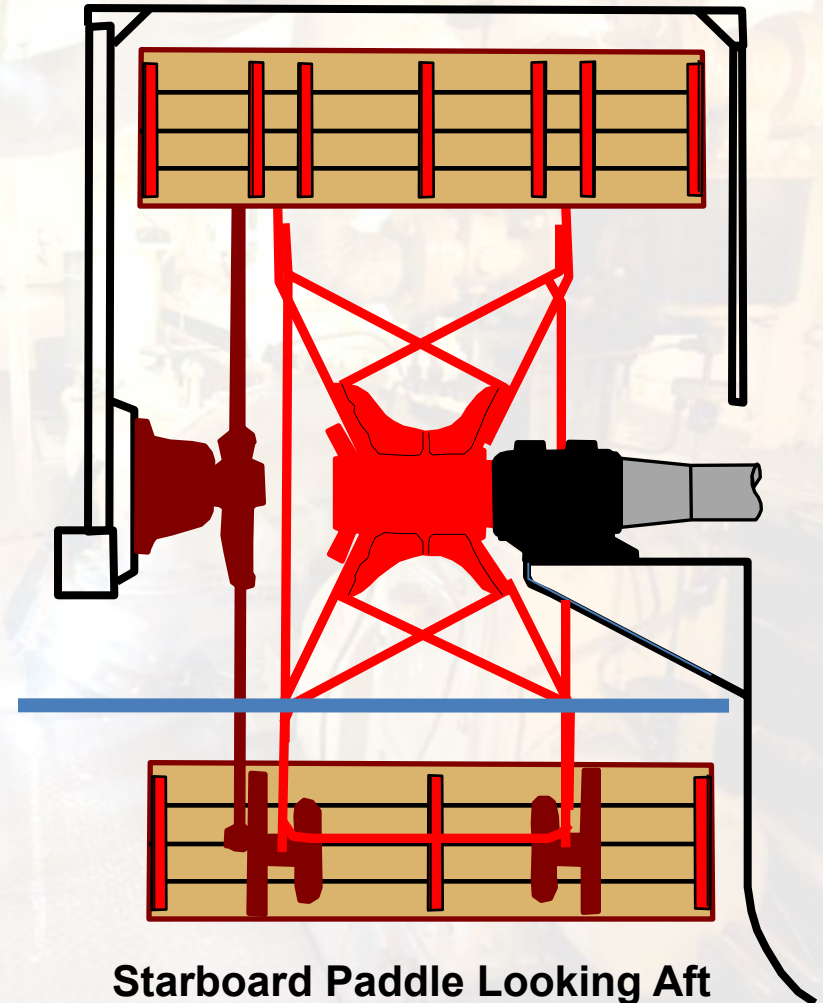


Paddles - Description

Each Paddle Wheel has 8 timber paddle floats, 11 feet wide by 3 feet deep. The Paddle Wheel is 13 ft 10 ins in diameter to the centre of the floats and weighs 8.5 tons.



Side View



Starboard Paddle Looking Aft

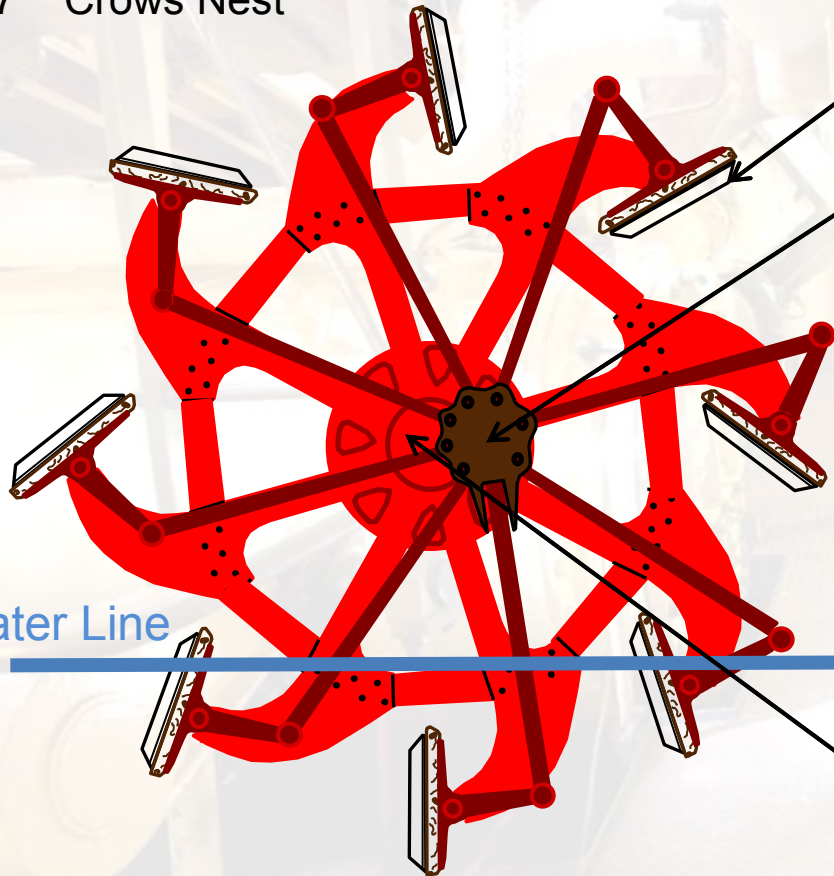
Water Line

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			

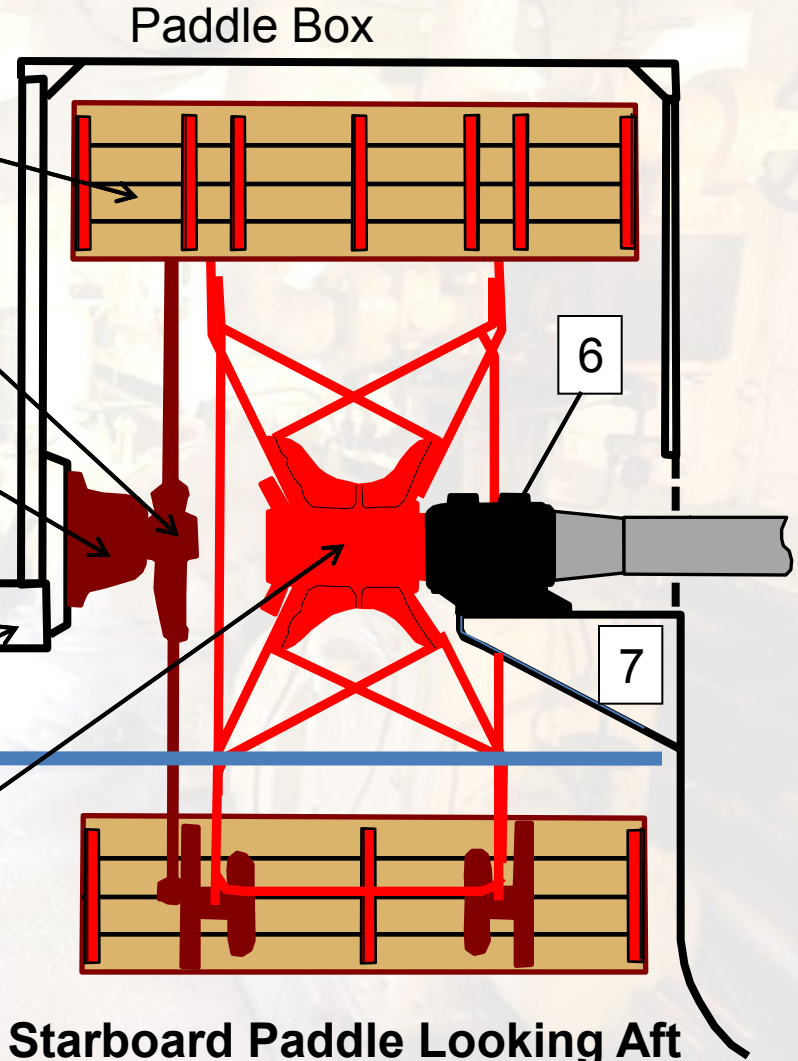


Paddles - Description

- 1 Paddle Float
- 2 Star Centre
- 3 Star Centre Pin
- 4 Spring Beam
- 5 Paddle Bobbin
- 6 Pedestal Bearing
- 7 Crows Nest



Side View



Starboard Paddle Looking Aft

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			

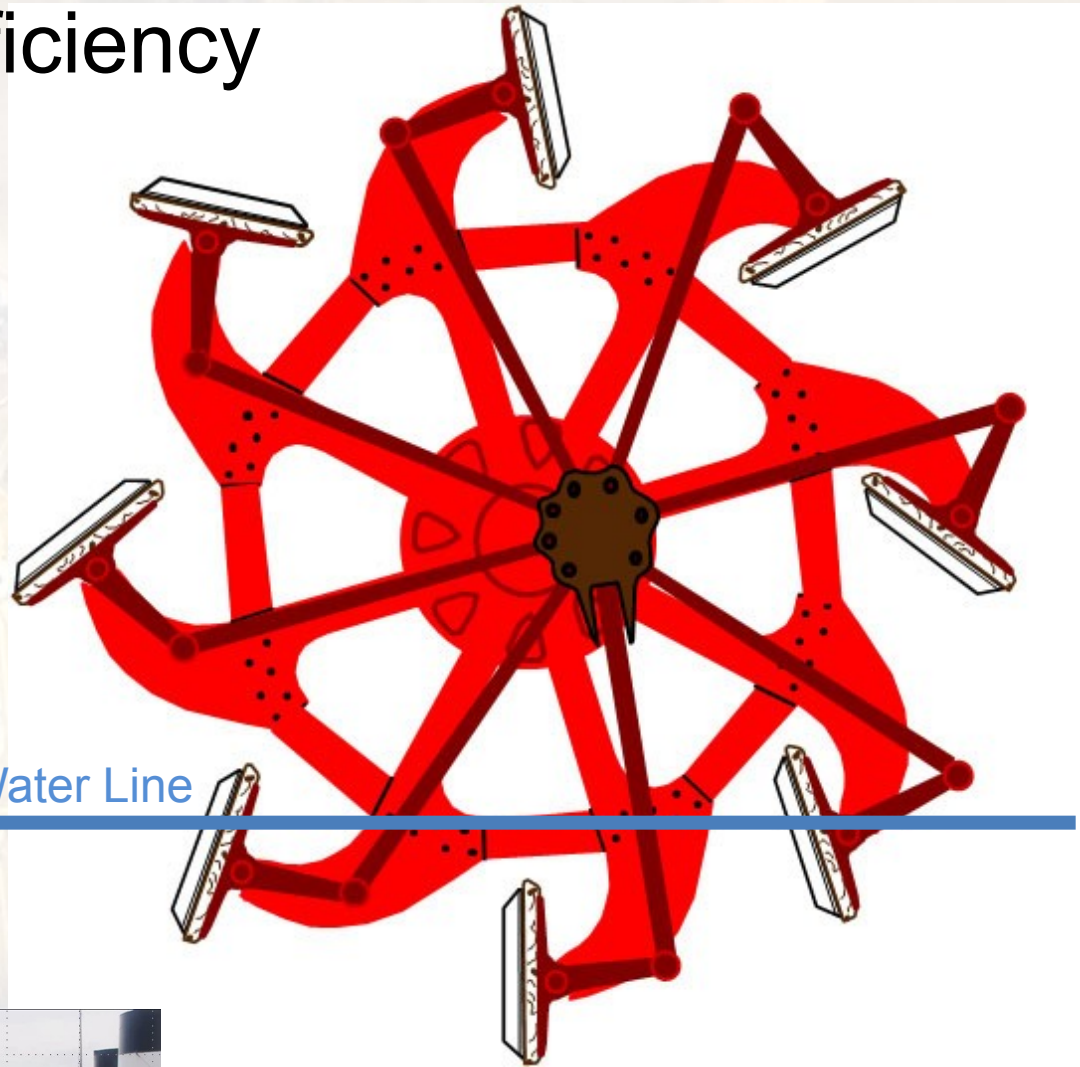


Paddle Wheel - Efficiency

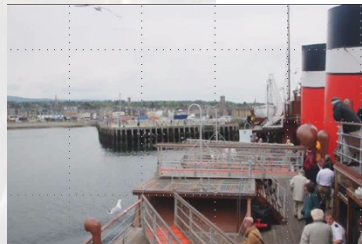
At typical engine revolutions of 42 rpm, each Paddle Float moves at 30 ft per second. Waverley's typical cruising speed of 14 knots is 24 ft per second.

The force of the Paddle Wheels is proportional to the speed difference between the Float and that of Waverley's speed through the water.

At 14 knots this speed difference is $30 - 24 = 6$ feet per second. At rest it is 30 feet per second so when stopped this force is five times greater than at cruising speed. This explains Waverley's high initial acceleration.



Click on Picture to see Waverley's high deceleration



[Where it is](#)

[How it works](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

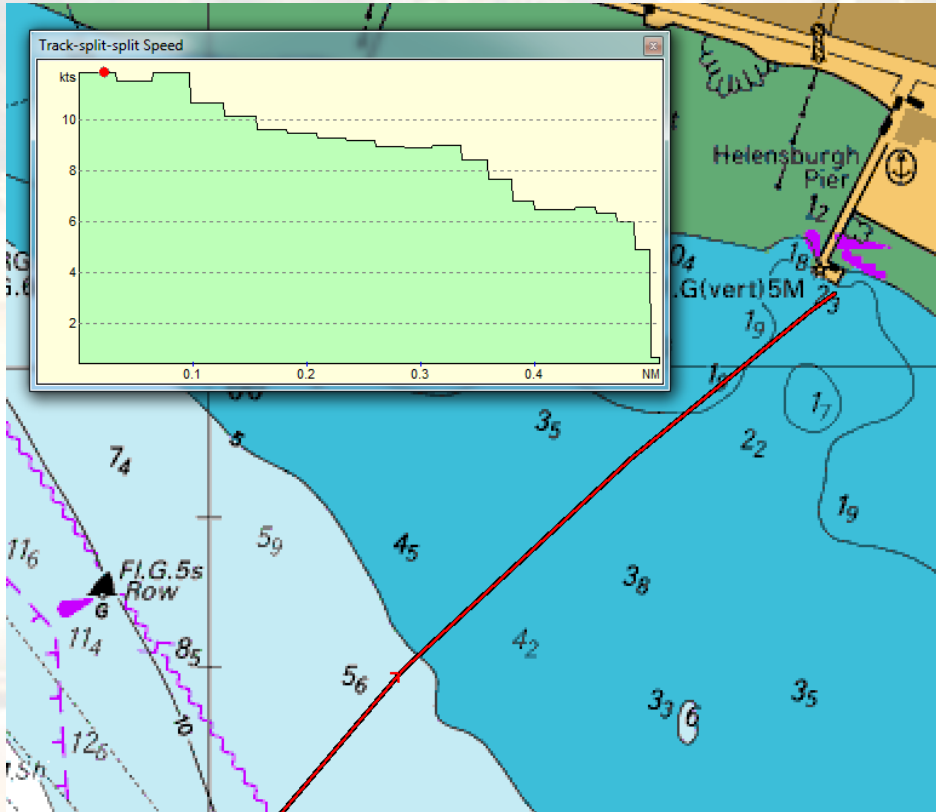


V1.0 15.7.11

Paddle Wheel - Efficiency

Waverley's high initial acceleration and deceleration is shown by the video and chart of Waverley approaching Helensburgh Pier. The GPS trace is updated every 10 seconds.

It shows how the 693 ton Waverley decelerates from 5 knots to rest within 10 seconds.



Click on picture to play video

Where it is

How it works

[Site Map](#)

[Main Menu](#)

[Exit](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

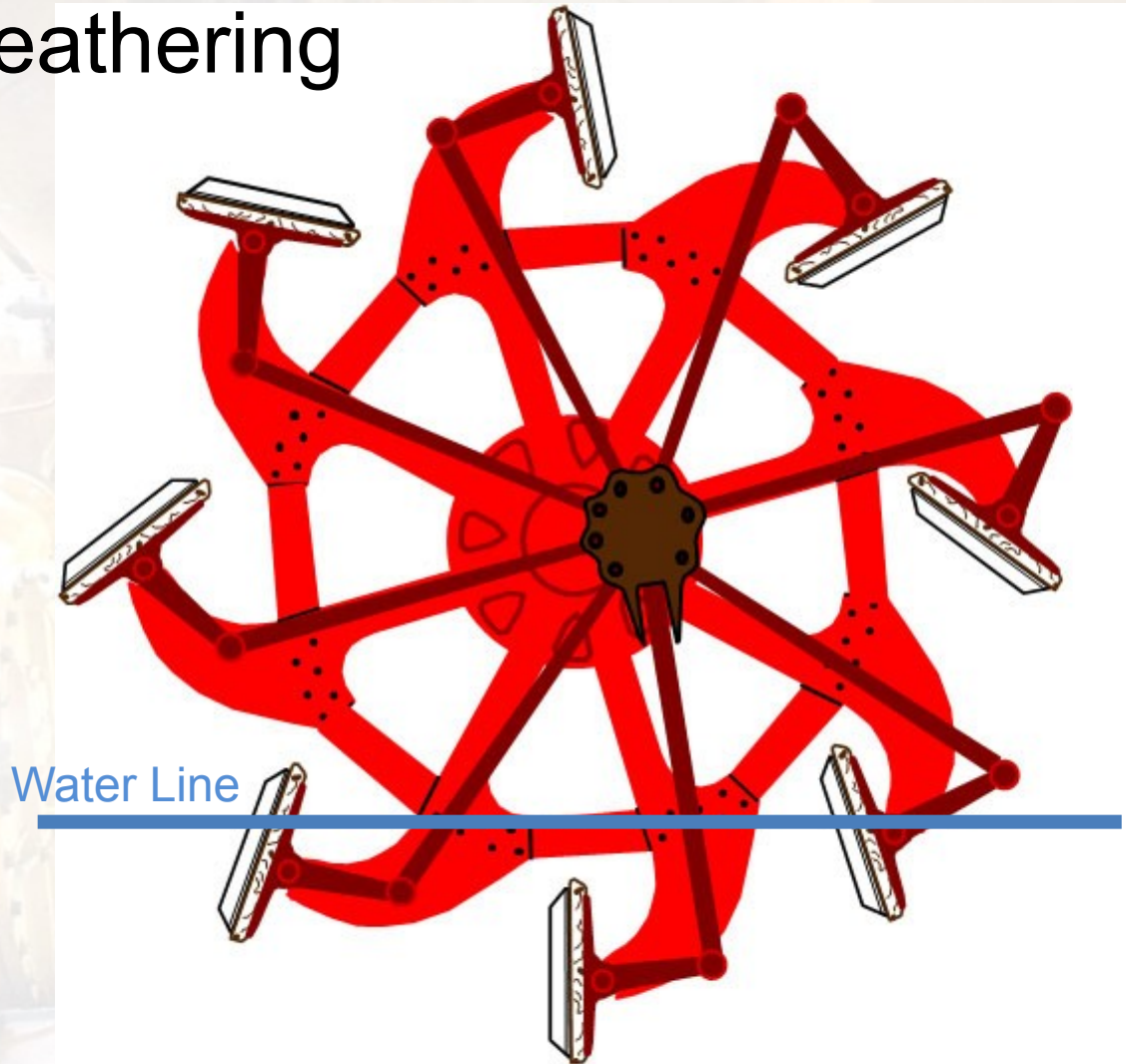
[Paddles](#)



Paddle Wheel - Feathering

Although the 33 sq ft Paddle Float moving at 30 ft per second through the water exerts a high force, much power is lost as water flows around the Paddles. Propellers, having a smooth water flow, are more efficient than Paddle Wheels.

To make Paddle Wheel as efficient as possible the floats are “feathered”. This makes them almost vertical when under the water and so reduces resistance when the float enters the water and gives the maximum possible force.



[Where it is](#)

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

[How it works](#)

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

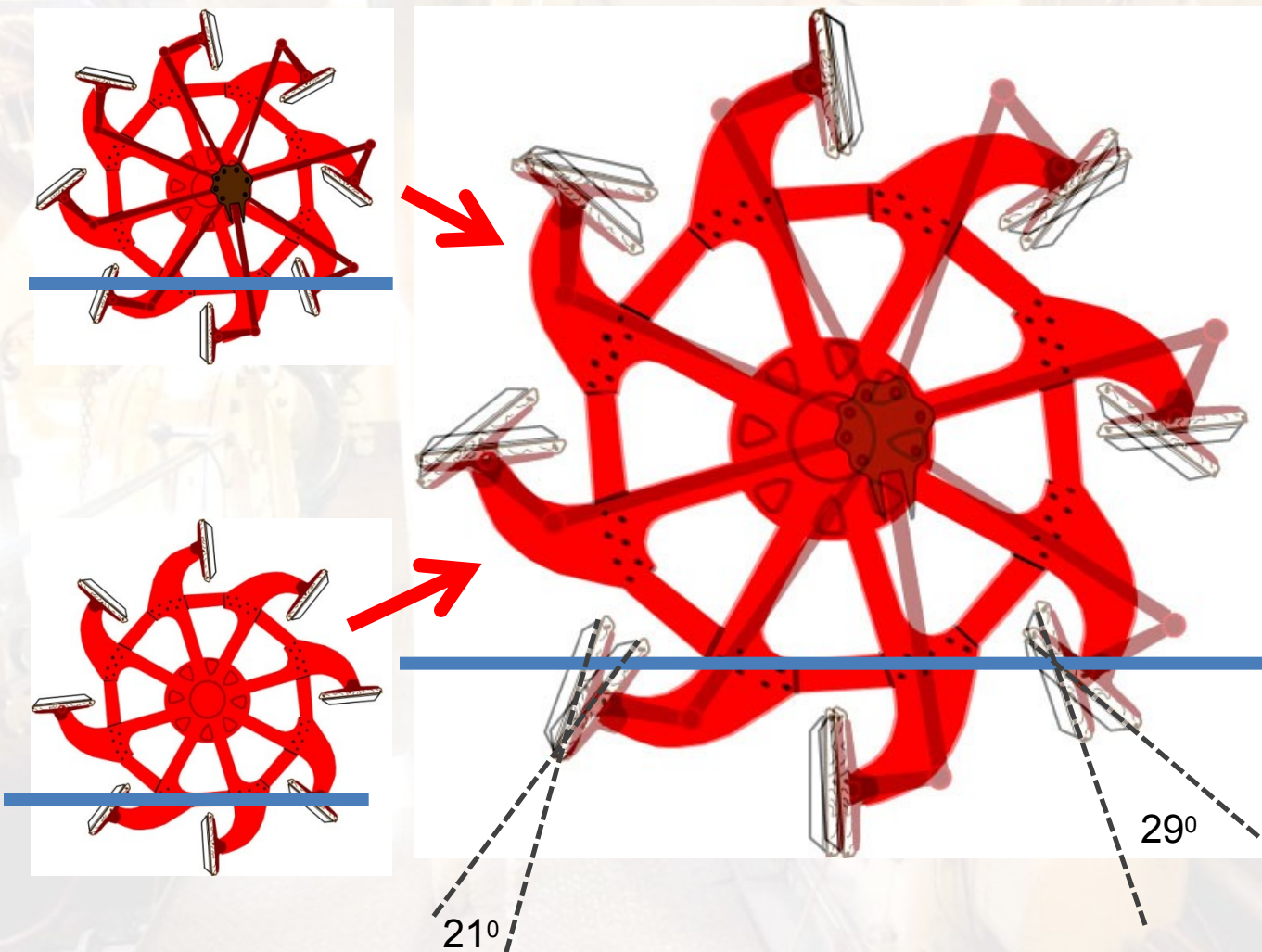
[Exit](#)



Paddle Wheel - Feathering

The effect of feathering can be seen by overlaying Waverley's Paddle Wheel on top of a Paddle Wheel with no feathering gear.

From this it can be seen that when entering and leaving the water Waverley's feathered paddle floats are respectively 29° and 21° closer to vertical than a Paddle Wheel without feathering.



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			

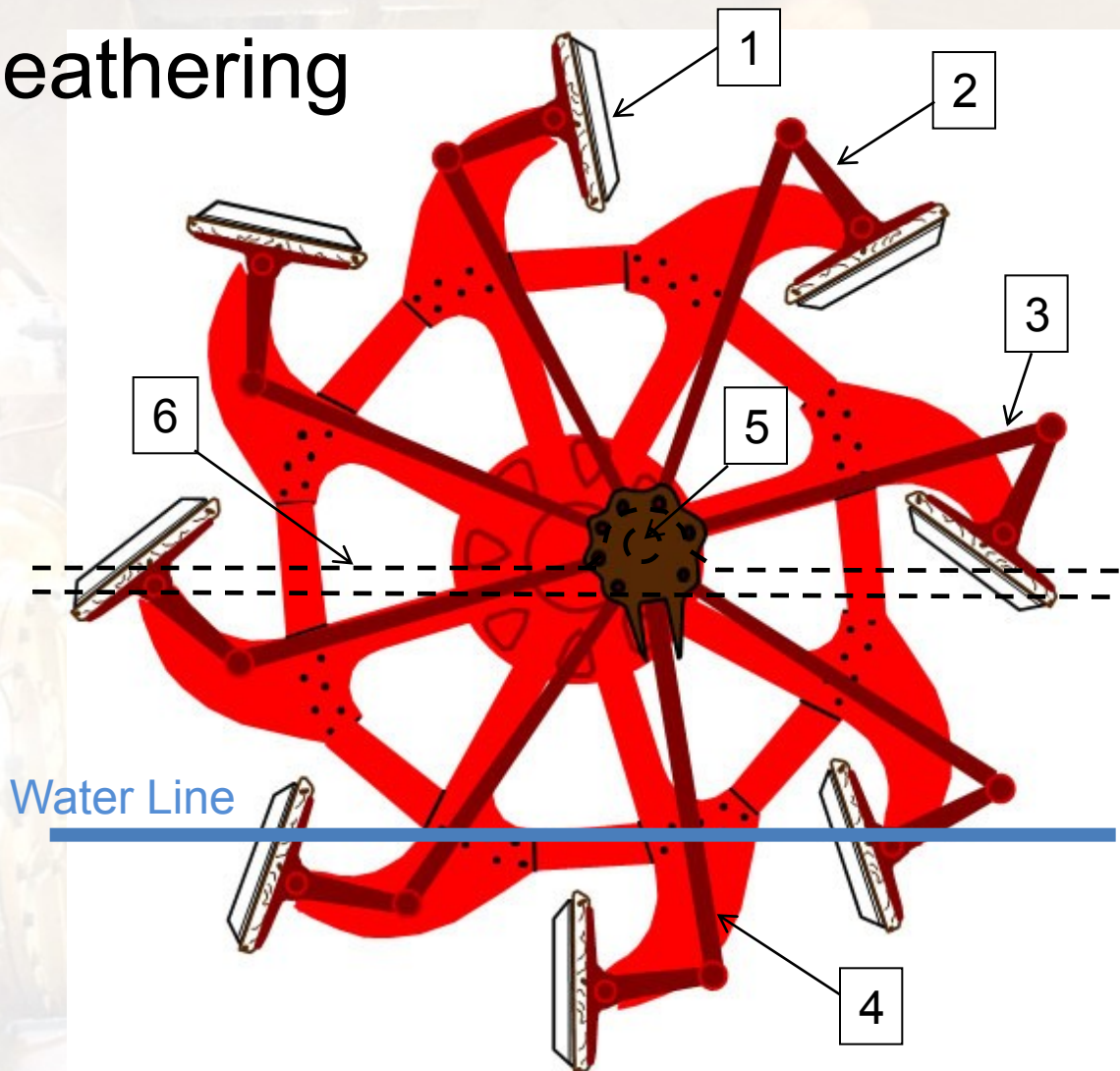


Paddle Wheel - Feathering

Paddle Wheel feathering is controlled by Feathering Gear which consists of a rotating Star Centre, Radius Rods and Driving Arms.

The Star Centre is attached to the Paddle Box's Spring Beam and is offset from the centre of the Paddle Wheel. It is driven by No 1 Radius Rod to make it rotate with the Paddle Wheel. As it does so Radius Rods connected to Driving Arms change the angle of the Paddle Float relative to the Paddle Wheel.

Because it drives the Star Centre, No 1 Radius Rod differs from the other Radius Rods.



- | | | | |
|---|--------------|---|-----------------|
| 1 | Paddle Float | 2 | Driving Arm |
| 3 | Radius Rod | 4 | No 1 Radius Rod |
| 5 | Star Centre | 6 | Spring Beam |

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

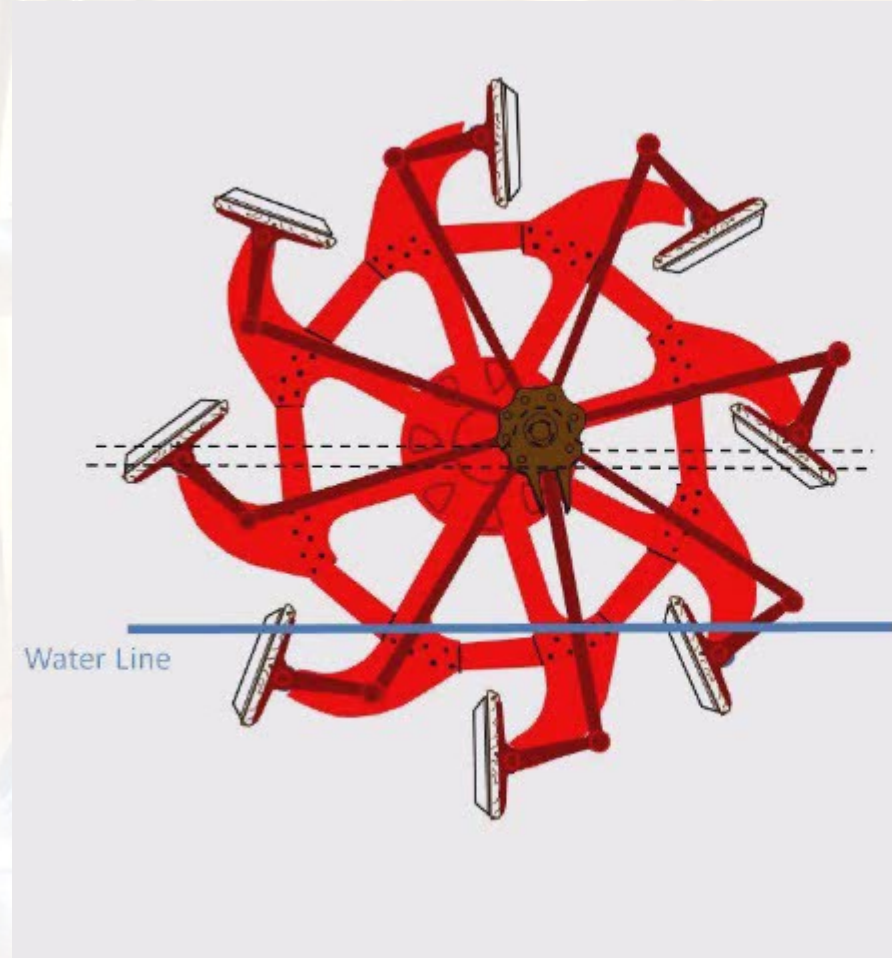
[Exit](#)



Paddle Wheel - Feathering



Click on the picture for a video of the Paddle Wheel slowed to half speed. The estimated actual speed of the ship is 10 knots



Click on the Paddle Wheel for an animation of the Feathering Mechanism

Where it is

[Boiler Room](#) [Engine Room](#) [Steering](#) [Paddles](#) [Bridge](#)

How it works

[Engine](#) [Steam](#) [Steering](#) [Paddles](#)

[Site Map](#)

[Main Menu](#)

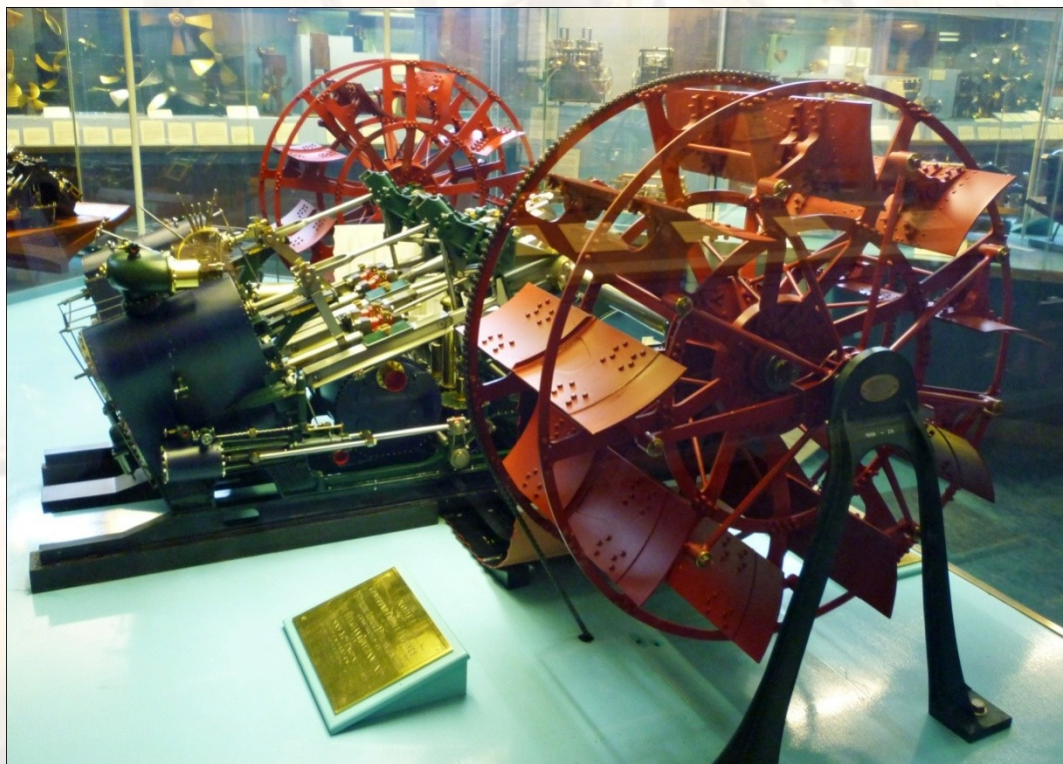
[Exit](#)



The Age of the Paddle Wheel

Waverley's Paddle Wheel arrangement has been in use for some time.

The Science Museum in London has a working model of the engine and paddle wheels of the 1099 ton P.S. Princesse Henriette, built by Dennys of Dumbarton in 1888 which, other than the outer rim, has feathering gear identical to that on Waverley.



Click on picture for video of working model

[Where it is](#)

[How it works](#)

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

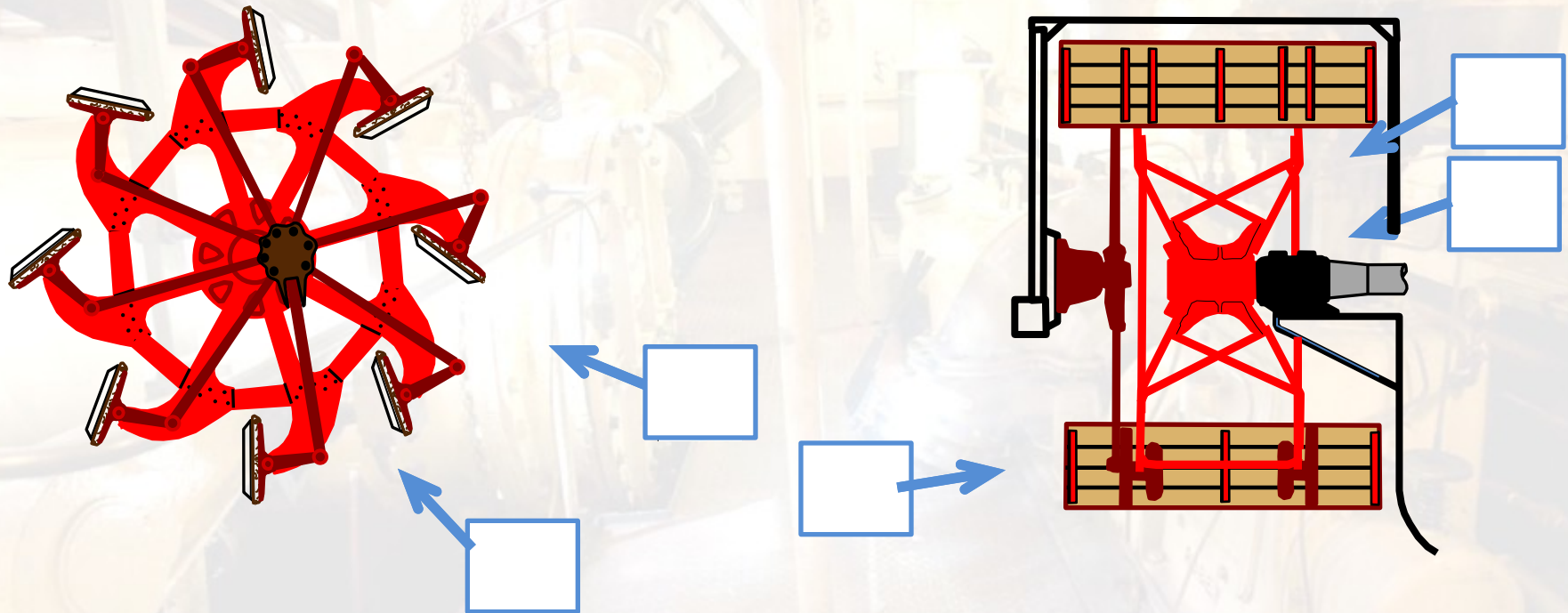
[Main Menu](#)

[Exit](#)



Paddle Wheel - Photographs

Photographs taken during Waverley's annual dry docking showing component parts of the Paddle Wheels



Use Icons to see individual photos or sequence through them all using the Next Page Icon

Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Paddle Wheel - Photographs

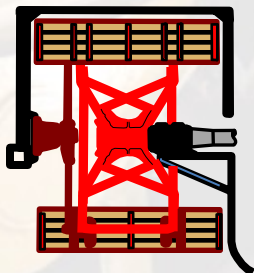
Star Centre

Paddle Bobbin

Radius Rod

Driving Arm

Paddle Float



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Paddle Wheel - Photographs

Spring Beam

Star Centre

Radius Rod

Paddle Bobbin

Driving Arm

Paddle Frame Arm

Paddle Float

Lazy Bracket



Where it is

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

How it works

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



Paddle Wheel - Photographs

Crows Nest

Paddle Bobbin

Star Centre Pin

Star Centre

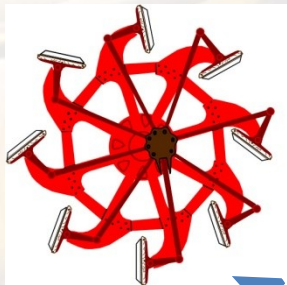
Radius Rod

Paddle Frame Arm

Lazy Bracket

Driving Arm

Inner Arm



<u>Where it is</u>					<u>How it works</u>				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Paddle Wheel - Photographs

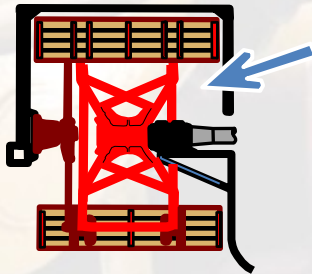
No 1 Radius Rod

Star Centre Pin

Radius Rod

Star Centre

Paddle Bobbin



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

[Site Map](#)

[Main Menu](#)

[Exit](#)



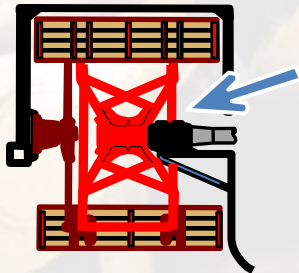
Paddle Wheel - Photographs



Paddle Bobbin

Crows Nest

Pedestal Bearing



Where it is

How it works

[Boiler Room](#)

[Engine Room](#)

[Steering](#)

[Paddles](#)

[Bridge](#)

[Engine](#)

[Steam](#)

[Steering](#)

[Paddles](#)

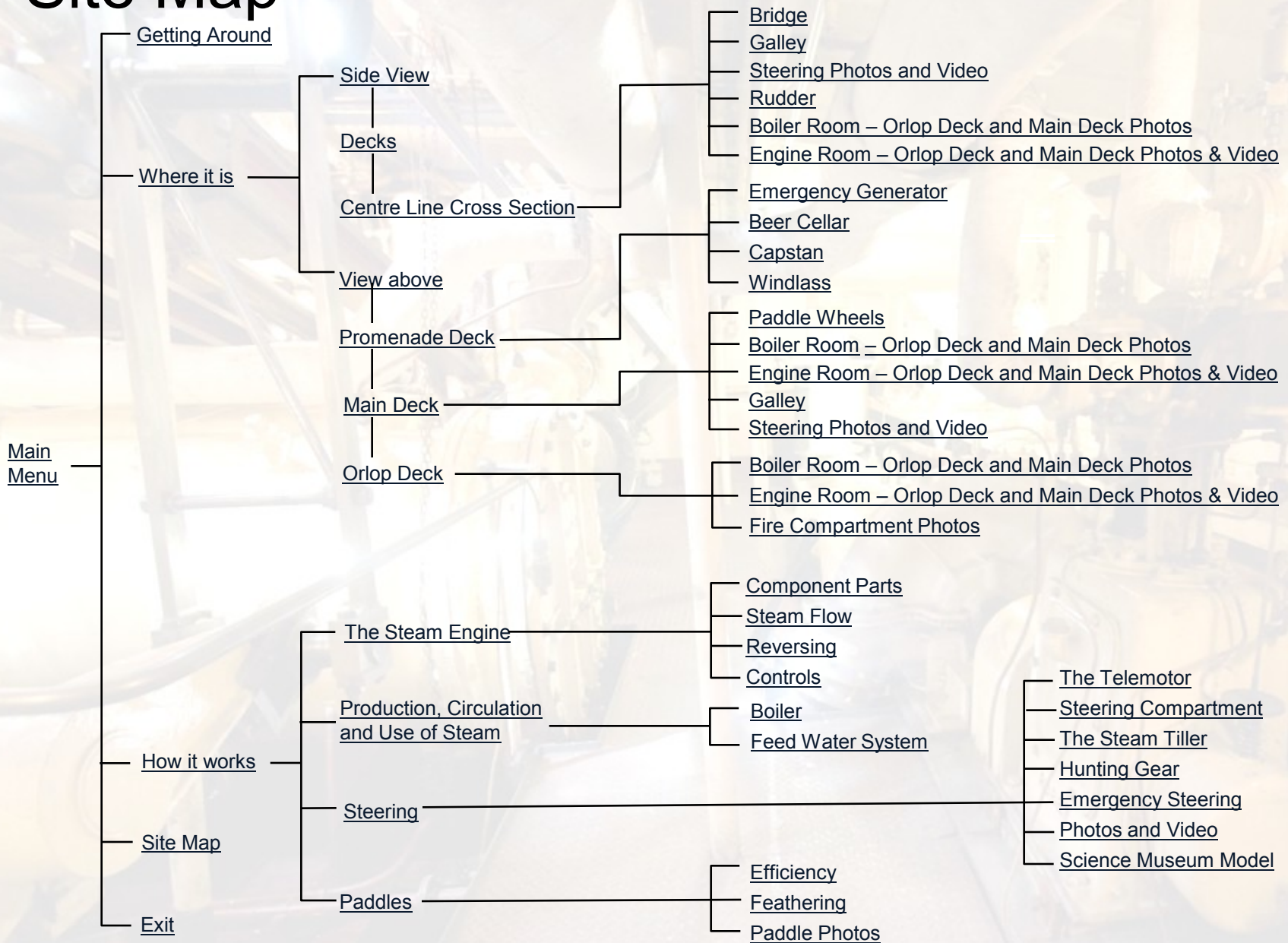
[Site Map](#)

[Main Menu](#)

[Exit](#)



Site Map



Where it is					How it works				Site Map	Main Menu	Exit
Boiler Room	Engine Room	Steering	Paddles	Bridge	Engine	Steam	Steering	Paddles			



Thanks for purchasing this presentation which Waverley Excursions hopes you have enjoyed.



To leave the presentation click Exit, otherwise click on Main Menu

