Shipbuilding in Portsmouth 2006

Since the days of the original 13th century King John dockyard, and probably before, Portsmouth has been a centre for shipbuilding. The same is still true in 2006.

Shipbuilding today is a fast moving, high technology industry which makes use of the most advanced materials and construction techniques. It pushes at the limits of what can be achieved with the available technology. In that respect it is very similar to the shipbuilding industry that Brunel would have known.

The VT Shipbuilding site in Portsmouth Naval Base
Image courtesy of VT Shipbuilding

At the forefront of this dynamic field is VT Shipbuilding. Its state-of-the-art facilities within Portsmouth Naval Base cover nearly 13.5 hectares (33 acres) and its construction and assembly halls are among the most modern in the world.

The gigantic Ship Assembly Hall measures 130 metres long by 52 metres wide and 40 metres high, with a crane capacity of some 400 tonnes. It is in this building that VT is currently constructing the bow section, masts and funnels of the Royal Navy's new Type 45 *Daring* Class destroyers.

A Type 45 bow section under construction in the VT Ship Assembly Hall in Portsmouth
Image courtesy of VT Shipbuilding

Once complete, the sections are taken by barge through the English Channel and Irish Sea to the Scotstun shipyard in Glasgow for final assembly. Transporting the bow section like this takes about a week and at this stage it is completely outfitted, right down to furniture and accessories in the cabins, including MP3 player charging points!

The six Type 45s to be built will be the largest and most powerful air defence destroyers ever operated by the Royal Navy and will have a service life of 30 years. Each one will have a complement of 190 crew and weigh in at 7350 tonnes (that's equivalent to 1880 elephants and about 1500 tonnes lighter than *HMS Warrior 1860*).

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Each Type 45 is powered by two 25 mega watt Rolls Royce WR-21 gas turbine engines. These engines are connected to alternators which transform the kinetic energy from the engines into electrical energy. This electrical energy then powers two electrical induction motors, one for each propeller.

In comparison, the *Warrior's* steam engine produced just over 4 mega watts and the 32 000 tonne *SS Great Eastern's* engines produced 6 mega watts.

A Type 45 bow unit leaving Portsmouth for final assembly in Scotstun Shipyard, Glasgow
Image courtesy of VT Shipbuilding

VT Shipbuilding is also involved in developing the next generation of Royal Navy surface ships and built the innovative *RV Triton* (*RV* stands for Research Vessel).

The Triton project created a large number of challenges for VT in the fields of naval architecture, structural design and engineering systems. These challenges needed to be met in a very short time frame and incorporated into this leading edge vessel.

Extensive use of modular construction techniques allowed the vessel to be built quickly and efficiently, in parallel with the development of the VT Diesel – Electric Propulsion System. This has been designed and installed with future technology upgrades in mind.

The experimental trimaran, *RV Triton*
Image courtesy of VT Shipbuilding

VT completed this unique project on time and within a very demanding budget, in the interests of furthering knowledge and expertise in this type of vessel.

In the century and a half since Brunel's death the materials and technology might have changed but the cutting edge nature of the shipbuilding industry certainly hasn't.

All Steamed Up

The Royal Navy's new Daring class type 45 destroyers are powered by two Rolls Royce WR-21 gas turbines, each producing enough power to light up a small town.

Unfortunately building a gas turbine in your own home is a bit difficult (but not impossible) so we are going to do the next best thing and build a small boat powered by a 'pop-pop' engine.

This is what you will need:

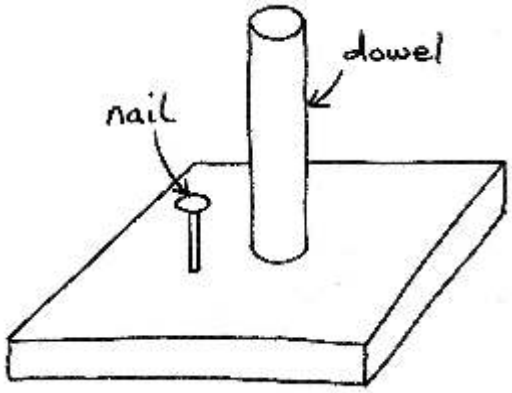
- A night light type candle
- About 50 cm of soft 3 mm bore copper tube (available from model shops)
- Two aluminium foil pie tins
- A 5 cm piece of 1 to 1.5 cm diameter wooden dowel
- A small nail
- A 10 cm by 10 cm square of 16 mm thick (or thereabouts) mdf
- An electric drill
- A hammer
- PVA wood glue
- A plumber's pipe cutter

Adult assistance may be required when using the electric drill and lighting the night light.

And this is what you need to do:

Step 1

The copper tube needs to be carefully bent into a spiral and to do this you need to make a jig. This is quite simple. Firstly, find a drill the same size as the diameter of your dowel. Use this drill to make a hole through the centre of your square of mdf. Push the dowel into the hole. If it's a bit loose you will need to glue it with some PVA glue.



Bang the small nail in, as shown in the diagram. Leave about 1 cm of the nail sticking out.

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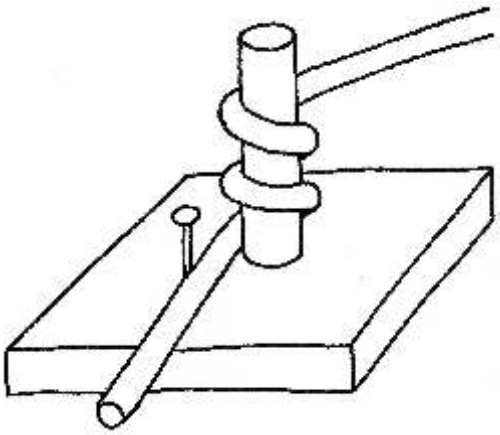
All Steamed Up

Step 2

Take your 50 cm length of copper tube and bend it around your jig, as shown in the diagram. Put three turns in the coil and make sure there is about 10 cm of straight tube left on either side of the coil. If necessary cut the tube to size with the plumber's pipe cutter



The coiling must be done carefully so that the copper tube does not collapse when bent.

Step 3

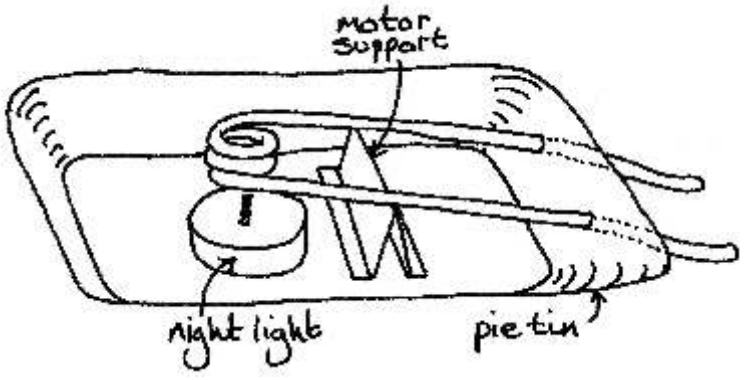
Cut a square of foil out of the base of your spare pie tin and make the motor support as shown in the diagram below. Make two holes in the rear of the pie tin for the motor tubes to poke out through. Set everything up as shown in the diagram below and your boat is ready for launching. Make sure that the ends of the motor tubes will sit below the surface of the water when your boat is floating.

Before Launching

Make sure that the motor is full of water. You can do this by sucking water through it. Light the night light, sit back and wait.

Safety

Take care when using the night light and remember the pop-pop motor will get very hot. Do not touch it until you are sure it is safe to do so.



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All Steamed Up

But How Does It Work?

When the water in the coil boils, the steam expands. This pushes the water out of the tubes. This creates a reaction force in accordance with Newton's third law of motion - for every action, there is an equal and opposite reaction. This reaction force pushes the boat forward.

As the steam continues to expand, it encounters the section of tubing that used to be full of water. This tubing is cold, and the steam condenses back into water. This causes a vacuum to form, which pulls more water back into the tubes.

You would expect that the water moving back into the tubing would cause the boat to go backwards. However, the water doesn't get very far before it hits the end of the tube (the two streams of water in the two tubes meet each other in the coil). Any motion caused by the water being sucked into the tubes is reversed by the water hitting the front of the tube (the coil) and pushing the boat forward again.

This continual boiling and condensing action is what causes the *pop-pop-pop-pop* noise of the motor