STEAM-POWERED BOATS

Image of a homemade pop-pop boat

For my science fair project, I built a steam powered toy boat, or put-put boat. In the design, I varied the amount of area of copper tubing hit by the candle, to test its speed. Turns out that two coils is the best. Then, I tested it to see if it would fit to scale. Unfortunately, the boat I made was too big and couldn't float.

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You may not know what pop-pop boats are. If you do, good for you! Pop-pop boats are small steam powered boats. They have a very simple design (see image on title page), and work very well. They run off of steam power, which is very important to the modern world. Being used in anything from pop-pop boats to trains to even nuclear power plants! Though it may sound old-fashioned, some people think it's the key to modern technology. A pop pop boat is a simple example of how these work, and by testing speed, I could help people figure out how to amplify the power of this new modern power source.

Research

In 1891, a frenchman named Thomas Poit filed a patent application in the United Kingdom for a simple pop-pop boat. A pop-pop boat got its name from the popping sound it makes when it runs. Pop-pop boats were popular, especially in the 1940s and 1950s. They eventually declined in popularity though in the 20th century. A pop-pop boat has a simple steam engine with a candle. The candle heats up the copper tubing until it reaches a steam explosion(not as crazy as you think).

Image of how a pop-pop boat works:

Then it enters a series of pushing out and sucking in water and out, propelling the boat further forward. Pop-pop boats were originally made with one exhaust pipe(where the water goes in and out), but two were found to be more efficient so they switched. As I said, the pop-pop boat sucks in water at the same rate as it pushes it out, so why doesn't it propel itself backwards too, and just stay put, going back and forth forever? Well, as the water starts to move toward the back of the boat, it accelerates, adding force as the boat is propelled backward. The water reentering the tubing does de-accelerate the boat, but it doesn't leave the tubing, and slows

itself down as it gets closer to where it will start to exit. Therefore, more force is pushing the boat forward rather than backward, so the boat slowly moves forward.

diagram:

Procedure

My experiment is to vary the amount of coils in my pop pop boat design. I had one with four coils, one with two coils, and one with no coils. I then tested how long it would take for them to prime, and then I had them do 3 laps, and calculated the average time. My hypothesis was that the more coils there were, the longer it would take to prime, but the faster it would go. It was hard to find a good pop pop boat design. After a lot of trial and error, I finally got a design that works, and continued on with my experiment. First, I made the boat with four coils. This one took the longest to prime, but had a pretty good lap time. I then made the boat with two coils, which had the best lap time and had a better time to prime. The boat with no coils had a good time to prime, but had a very bad track record. For each of my pop pop boats I put one or two candles in, and tested the speed. Each boat had the same body, which was half of a bottle, with bolts taped on the bottom, so it was more balanced.

Data & observations

I observed the following things:

- The pop pop boat only uses one tube at a time, stopping before the switch.
- It shakes and makes a popping sound, but only when it switches exhaust pipes.
- The popping sound is very quiet

- It blows steam out of the exhaust pipes and they sometimes blow into little smoking rings
- It takes time to prime
- It stops for no observed reason sometimes.
- The second one did much better and is the best of them all.
- The third one kept going off the track.
- The third one also was the slowest, which disproves my hypothesis
- Interestingly, the third and second ones take the same amount of time to prime.
- The third one gets a lot of its momentum from the jolts in the switch, which are much stronger

My data is as follows:

Four coils lap time	Two coils lap time	No coils lap time.
43 seconds	42 seconds	2 minutes 28 seconds
1 minute 32 seconds	47 seconds	1 minute 54 seconds
1 minute 6 seconds	1 minute 12 seconds	1 minute 57 seconds

Four coils time to prime	Two coils time to prime	No coils time to prime
2 minutes 46 seconds	1 minute 50 seconds	1 minute 50 seconds

Bibliography:

Wikipedia: the free encyclopedia. 2015. 22 April 2015

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