Pulsed water jet or pump ?

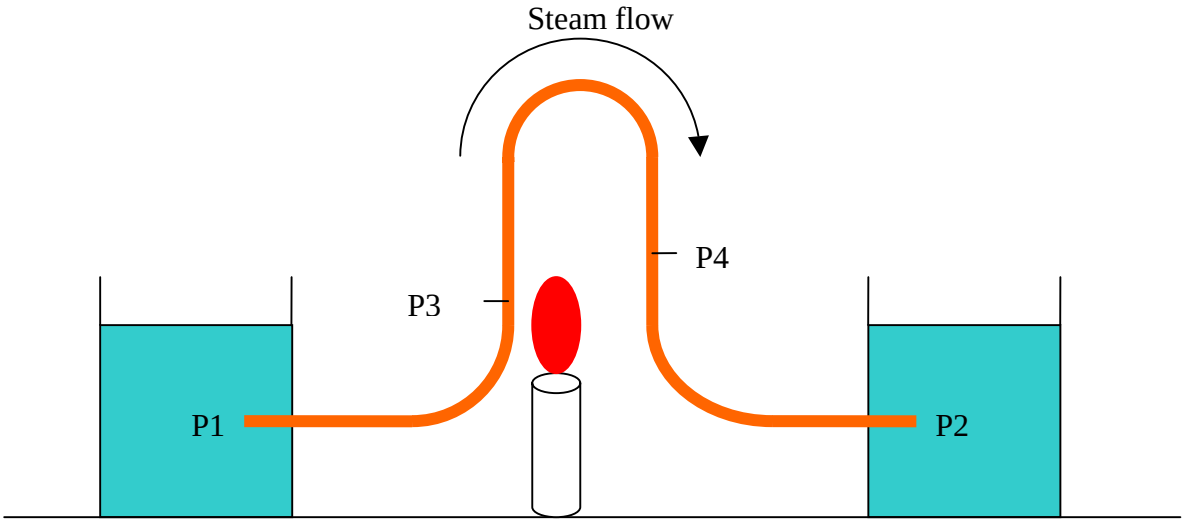
By jean-Yves

There could be several reasons why coil engines are not symmetrical:

- design with one pipe connected to the front of the coil and the other at the back
- building with bends that are not perfectly equal
- flame heating preferably one side
- …

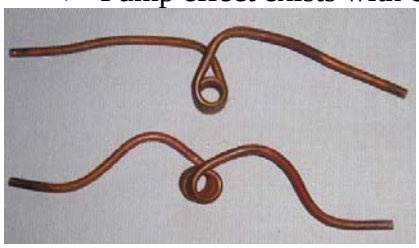
Due to this dissymmetry one pipe propels the boat more than the other one. Such a situation very likely exists on most of the boat without people knowing it. However, the dissymmetry can be so much as to decrease the engine performances or to prevent its oscillation. During our many tests we got situations where the mean pressure on one pipe outlet was approximately up to 1.4 mb more than the one on the other pipe. Very often it is between 0.8 and 1 mb (10mmWG).

Whatever its cause, the dissymmetry of the system can be represented by a vaporization on one side and a condensation on the other side as follows.



P1 and P2 are the static pressures at the pipe outlets.
The pressures at the steam water interfaces are P3 and P4.
Note: on a boat P1 and P2 are equal, but on our test bench we used two independent tanks. P1 and P2 were always equal at initial conditions. Then, during many test we got a final situation where the level in tank 2 was higher than in tank one, or vice versa.

- The pump-like working can exist with or without engine pulsations.
- Some engines are more sensitive to this phenomenon than others.
- Closing one pipe outlet during a couple of seconds could suffice to stop the pump-like working.
- The phenomenon can be reversible. For instance, once the level in tank 2 is upper than in tank one, if you close one pipe for a couple of seconds the flow sometimes reverse and level in tank 1 goes up, and up and exceeds the one in tank 2.
- Close to the tanks, the temperature of the sucking pipe is cold though the temperature of the delivering one is very hot.
- Pump effect exists with coil above pipes as well as with coil below pipes.



Ex: on this picture both engines have a coil with 4 turns. The engine on the bottom works fine, but sometimes there is a pump effect. The engine on the top works as a pump more than 9 times out of 10. Why?

To get a confirmation of our theory we built a very simple engine (picture) as the one on the previous sketch.

The engine (if we can say so) is symmetrical. The two pipe outlets are connected to two adjacent tanks.

First the pipe was filled and we waited for a long time to be sure to get the same level in both tanks.

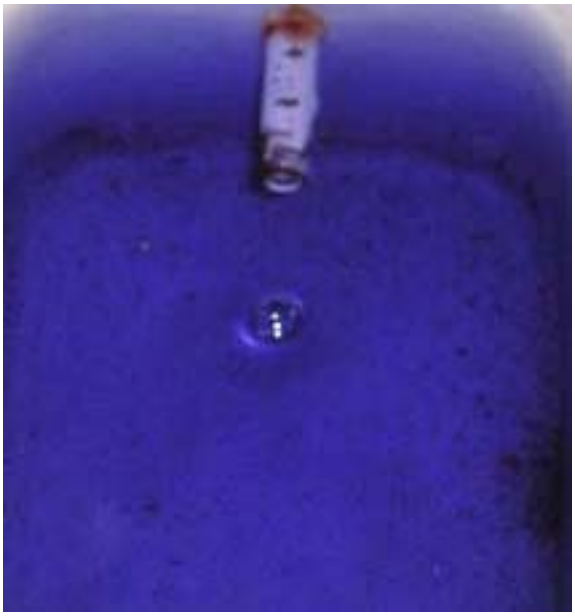
Then to force a dissymmetry the candle was set on one side.

It was not really expected, but the engine started to pulsate. Roughly it was one group of high frequency pulses during half a second every ten seconds. Then the engine vibrations stopped. We checked that the upper part was overheated by pouring some drops of water. Then the engine pulsated erratically several times.

After approximately twenty minutes we looked at the levels in both tanks. In the right tank the level was approximately 3 millimetres higher than in the left tank. This is visible on the picture where a spirit level has been added to materialize the perfect horizontality.

Then, another test was run with some drops of ink into the water to get a better picture. We noticed some bubbles on one side and nothing on the other side.

On the picture, one can see a bubble that just escaped from the nozzle (of the left tank).



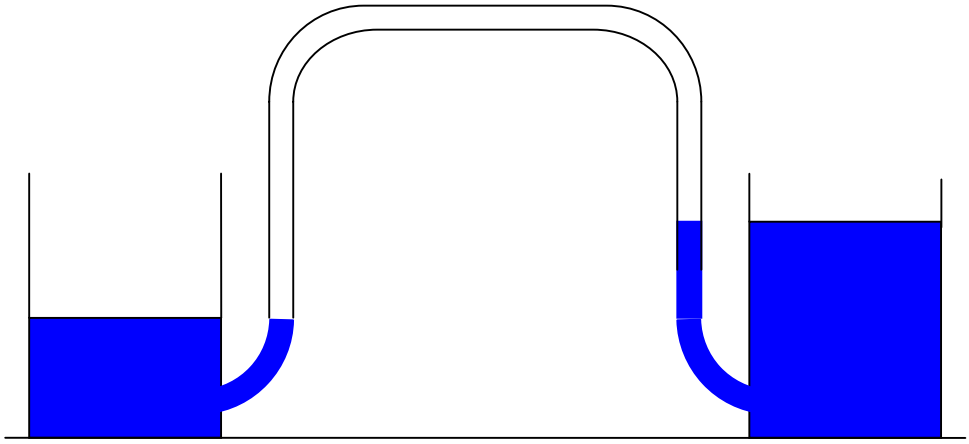
Note: For those who would like to run such a test, we have to say that the heating power seems an important factor unless you are ready for a several hour test.

Finally, after approximately 50 minutes we got a level difference of 9mm clearly visible on the next picture.

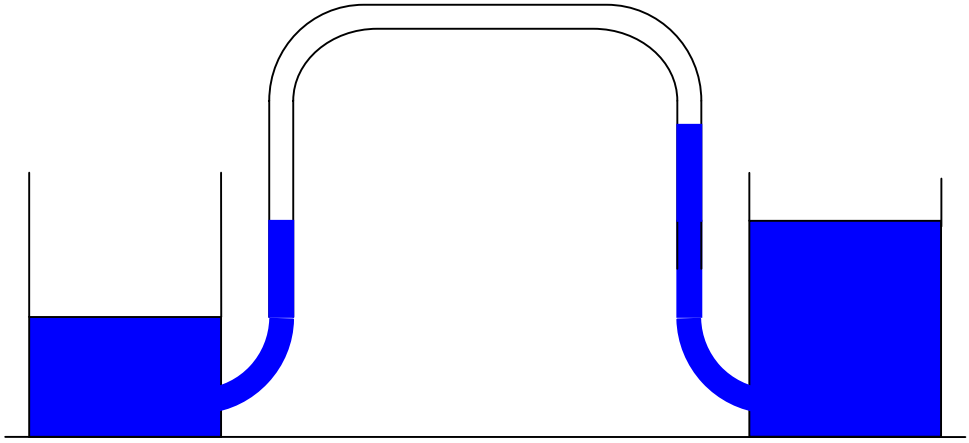
We blew the candle and waited. We didn't see any level change. How was it possible? See next page.

Let's apply the principle of connected vessels on two independent systems.

Then, let's connect both systems together.



And let's add or subtract some pressure. (subtract on our design).



This is the situation with steam and/or any other gas on the upper part of the pipe.

There, one can imagine that if the flame is heating the left side, some water will vaporize on the left, and it will condense on the right side. Thus, there will be a water transfer from the left tank to the right one. (This principle is used in a still for distilling alcoholic drinks.)

Note: when taking off the candle steam condenses and the water climbs up in both sides of the pipe, this water being sucked in both tanks. We didn't notice any change because the tank surface is about 600 times larger than the pipe cross section area. 6 centimetres in the pipe corresponds to only 0.1mm in the tank.

Conclusion: We can encounter a pump effect with pop-pop engines, but don't forget that this is due to a dissymmetry between the pulsations of the two pipes. However, don't believe, as we can read sometimes, that the propulsion is due to sucking by one pipe and delivering by the second one.