KLAUS HÜNIG

The Steam Gyro

Instructions for construction and use

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Steam Engines

like the steam gyro have been around for quite a while. The first recorded one was invented in the first century AD by the Greek mathematician Hero of Alexandria. The so-called “aeolipilie” or “hero ball” is a metal ball which can turn around its vertical axis and has little jets projecting tangentially (sideways) out of its equator. The axles are hollow and when steam is injected into these, it exits through the jets and makes the ball spin. This aeolipilie was only considered a toy and it took another 1600 years before the principle was used technically. In 1690 Denis Papin invented the first “proper” steam engine, followed by Thomas Newcomen who built the first atmospheric steam engine in 1712. Then in 1769 James Watt was the first one to use steam pressure to drive a piston.

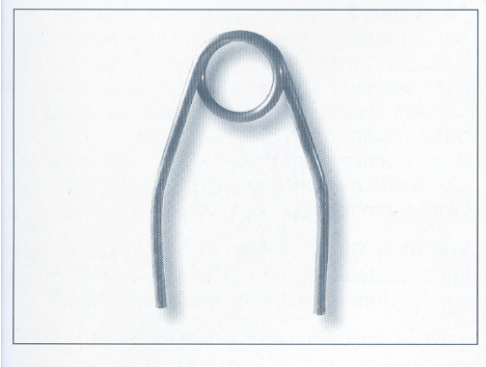
This is how the steam gyro works:

A copper pipe is bent into a spiral with its ends fitted through a floating cork disk. The ends sticking out of the underside of the cork disk are bent into opposite directions. The pipe is filled with water which is then heated by a tea light under the spiral. The water in the spiral first starts to boil and then evaporates. Because steam has 1,650 times more volume than water, we get much more steam than fits into the whole length of tube from just one drop of water. Therefore the water in the pipe is pushed out very fast and the recoil sets the gyro spinning. Almost instantly the expanding steam condenses on the colder parts of the pipe, so the steam volume is decreased by a factor of 1,650. This leads to a near vacuum, so water is sucked into the pipe again and the process repeats itself as long as the tea light burns.
Of course you could ask why the gyro turns at all: is the momentum of the ejected water not instantly cancelled by the momentum of the in-flowing water a split second later? A simple analysis shows that this can't be the case: The ejected water only flows in one direction whereas the in-flowing water comes from all directions around the jet. Therefore only a small part of the recoil is compensated in each cycle.

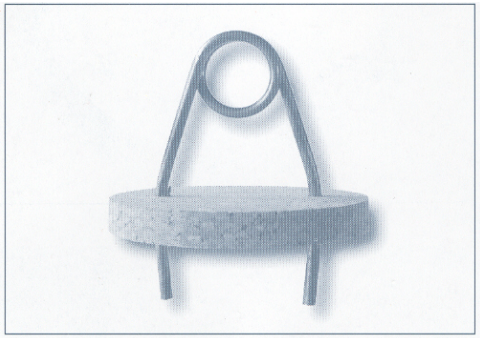
Assembly:

First the ends of the copper spiral need to be bent to the right shape. Be very careful that you don't kink the pipe, otherwise the water won't be able to flow freely.

Step 1: By hand, bend the ends slightly outwards and in the middle back inwards again, so that lower parts are nearly parallel. The distance should be the same as the one of the holes in the cork disk. You don't need tools for this, the copper is soft enough to be bent by hand.



Step 2: Push the ends of the pipe through the holes in the cork disk as far as possible.



The pack contains a metal rod that you can use as a bending tool. If preferred you can also use needle-nosed pliers to help with the bending.

Step 3: Now the last 20mm of the pipe ends have to be bent by 90 degrees into opposite directions as shown in the picture. This way the recoil of the ejected water will spin the gyro. This is how you make the 90 degree bends:

Push the bending tool (metal rod) a few millimetres into the end of the pipe and bend the pipe into the right direction. Use your thumb to push against the inside of the bend to make sure it is even and smooth and that the pipe doesn't kink.
Finally check that the pipe isn't blocked, for example by running water through it.
Step 4: Push the spiral back up so that the bent ends lie flat against the cork disk.

Now the steam gyro is ready.

To operate the gyro you only need a normal tea light.

Operating the gyro:

Step 5: Check that the tea light fits under the spiral with the wick just beneath it. Remove the tea light again.
Step 6: Fill a bowl or a big cup with water. It must be big enough so that the gyro can spin freely in it. Of course you can also use the sink.
Step 7: Hold one end of the pipe under the tap so that water comes out of the other end. Put a finger on the lower end to keep the water trapped inside the pipe and put the gyro on the water surface in the bowl. Important: there should be no air trapped inside the pipe!
Step 8: Put the tea light under the spiral and light it. The flame should be directly under the spiral.

Congratulations! Your steam gyro, the most ancient of all steam engines, is ready to spin.

After about 30 seconds, when the copper pipe is hot enough to boil the water inside, the gyro will start spinning on the water surface. If everything goes well, it will continue to spin for hours – as long as the temperature of the pipe is high enough and it is filled with water. If you want you can make a coloured transparent cylinder (6-7 cm diameter) that you can place over the spiral. That looks very nice, especially in the dark. But don't forget to make some holes at the bottom of the cylinder so that the tea light gets enough air.

Problems and solutions:
The steam gyro stops although the tea light is still burning? That can have the following reasons:

1. The distance between flame and spiral is to big or to small. Solution: adjust the height of the spiral by moving it up or down.
2. The spiral is covered with soot. This insulates the spiral so it doesn't get hot enough to boil the water. Solution: wipe off the soot, but let the pipe cool down first!
3. There might be air trapped inside the pipe. Solution: re-fill it with water.