the spiral water pump – part 1 an interesting innovation

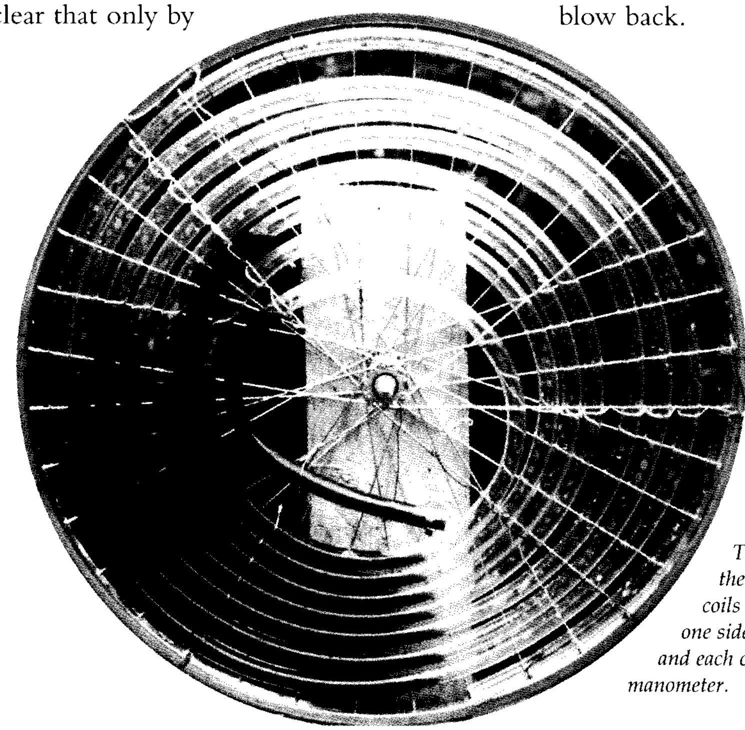
Frank Eliason

Issue 65 of *ReNew* (October 1998) featured an ingenious water pump made simply from a flat spiral of black polyethylene three quarter inch pipe. The spiral, when partly immersed in a running stream and rotated by paddle, pumped water against a nine metre head. The pump has no valves and just one moving part, the rotor carrying the spiral pipe and paddles. However the idea of a spiral pump is not new, having been invented apparently by a man named Wirtz in Zurich in 1746.

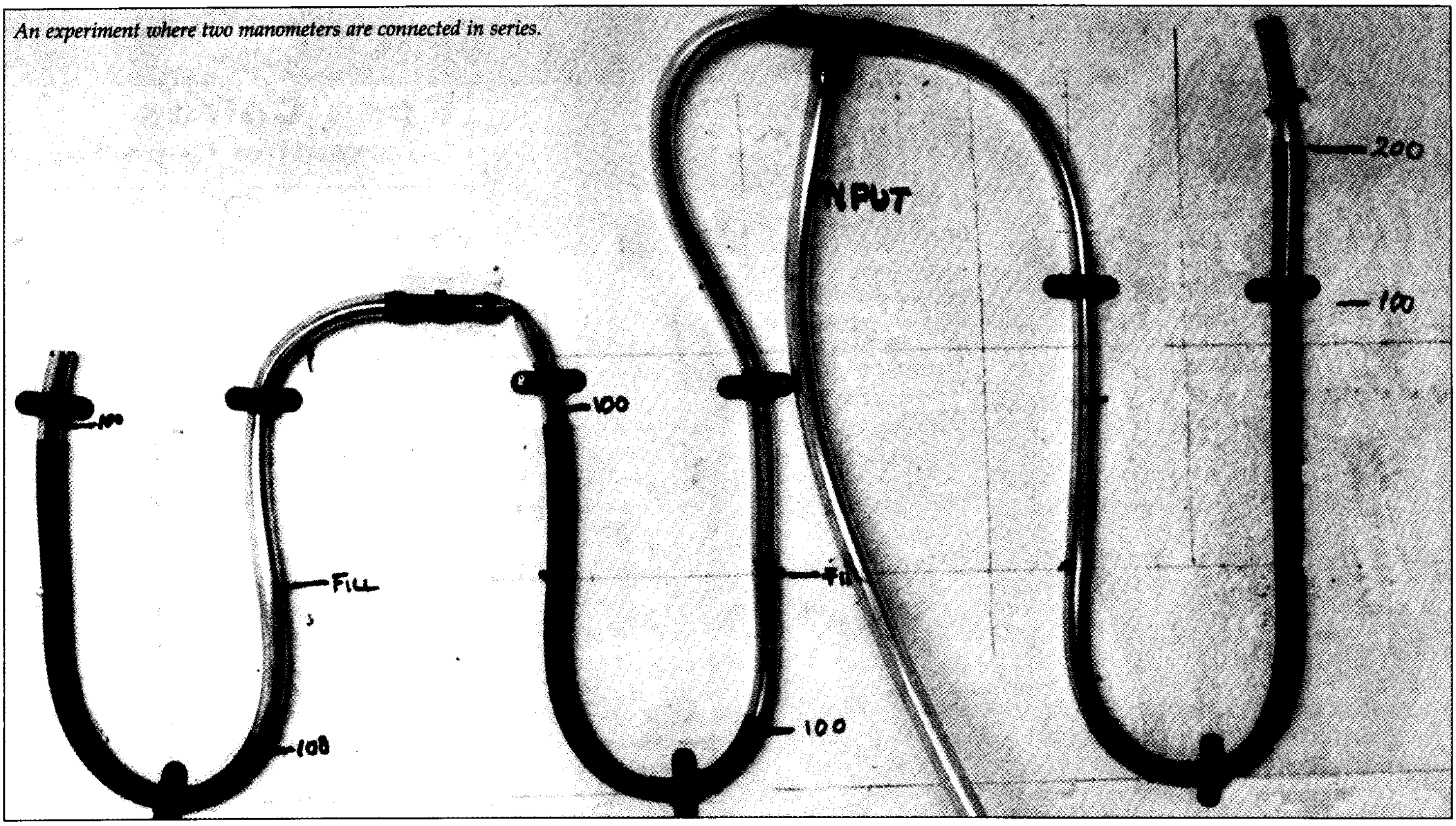
The author of the article in *ReNew* and the builder of the pump was John Hermans of Clifton Creek, Victoria, Australia. John built his pump by trial and error and it pumps water quite well. The two obvious questions are: how on earth does this machine pump water and more importantly, since there is no discharge valve, why doesn't the head it is pumping against simply blow back through the spiral and into the river?

As the spiral rotates with an arc of the outer coil immersed in the river, the amount of water picked up by this arc of the coil is wound successively into the next coil and so on until each and all of the coils carry at their bottom an amount of water equal to that picked up by the first coil on its pass through the river. Also each coil will have air trapped above this pocket of water. The innermost smaller coil, which contains the same amount of water as that picked up by the outer coil on any one pass, but which has a smaller circumference and hence smaller volume, will compress the trapped volume of air in it. This is the pumping principle and it is clear that only by having coils of decreasing radius will there be compression and hence pumping. The ratio of the radius of the outer coil to the inner coil is all important in establishing what pressure is generated by the pump. The bigger the ratio the bigger the pressure.

But why doesn't the water blow back around the coils and into the river? Here the number of coils and the diameter of the coils are important. The more coils and the larger the diameter of these coils, the more back pressure can be tolerated. Each coil has some water at the bottom of it, filling about twenty per cent or more of the coil. To push that water out of a coil, a pressure is required to raise the water by an amount equal to the diameter of the coil less about twenty per cent for the water level. For a two meter diameter coil, a head of about two metres is required. Each coil in the spiral must be regarded in the same way and all the heads add up. For twenty coils starting off at one metre radius for the outer coil and a 250mm radius for the inner coil, a head of about 22 metres is generated and this is the reason why the pump does not blow back.



Test rig showing the water in the coils displaced up one side of each coil and each coil acting as a manometer.



An experiment where two manometers are connected in series.

Pictures – Frank Eliason

('Head' is a reference to the head which can withstand this blow back.) The picture above shows an experiment where two manometers are connected in series. The input pressure required to maintain 200mm in each manometer on the left is 400mm and is registered on the right hand manometer, which shows 400mm. This experiment was carried out to demonstrate that in the case of the spiral pump the pressure head in each spiral are all to be added together since they are all in series. (If there were twenty manometers in series then it would take 20 x 200 mm = 4000mm to maintain 200mm in each of the 20 manometers in series).

The picture on the opposite page shows an experimental model where the pump is discharging into a pressure and the back pressure due to the column head is about to blow back. The water in each of the coils is pushed off centre and each is generating a head. As in the manometer example, all these coil heads are adding together to resist the back pressure.

It is possible to expound a number of principles about the spiral pump as follows:

- for a given inner radius, increasing the outer radius increases compression and head.
- the number of turns affects the head, as does the inner and outer radius: the more turns the greater the head.
- the immersion of the pick up coil, if increased, reduces the head, increases the compression, and will increase the quantity of water picked up at each revolution of the wheel.

Issue 48 of *Clean Slate* will explain how to do the calculations for applying the principle of the spiral water pump to your own requirements.