Moscow Institute of Physics and Technology

Sprengel Pump

Physical Project

Lugovtsov Gleb

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What is the Sprengel pump?

The Sprengel pump is a vacuum pump that uses drops of mercury falling through a small-bore capillary tube to trap air from the system to be evacuated. It was invented by Hanover-born chemist Hermann Sprengel in 1865 while he was working in London. The pump created the highest vacuum achievable at that time, less than 1 mPa.

Pump drawing

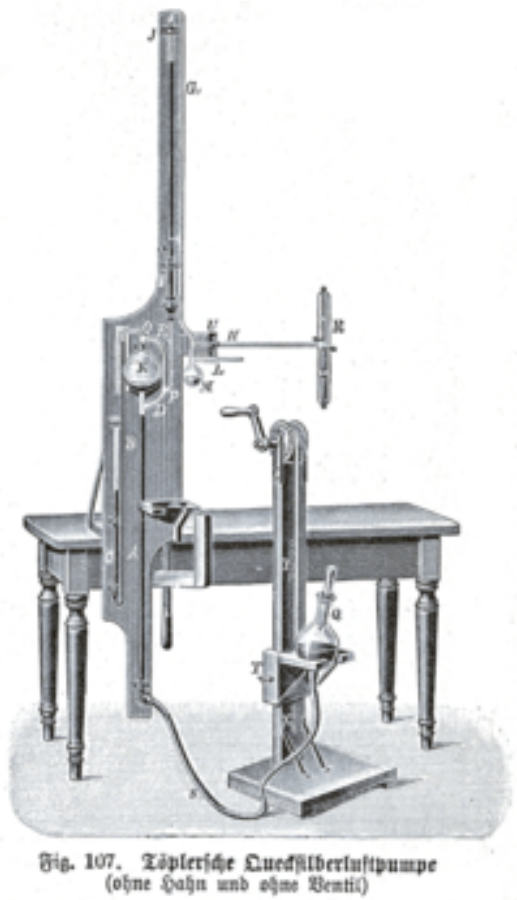

Figure: Mercury air pump

Why would Sprengel need a pump?

William Crookes used the pumps in his studies of electric discharges. William Ramsay used them to isolate the noble gases, and Joseph Swan and Thomas Edison used them to evacuate their new carbon filament lamps.

Lamp researches

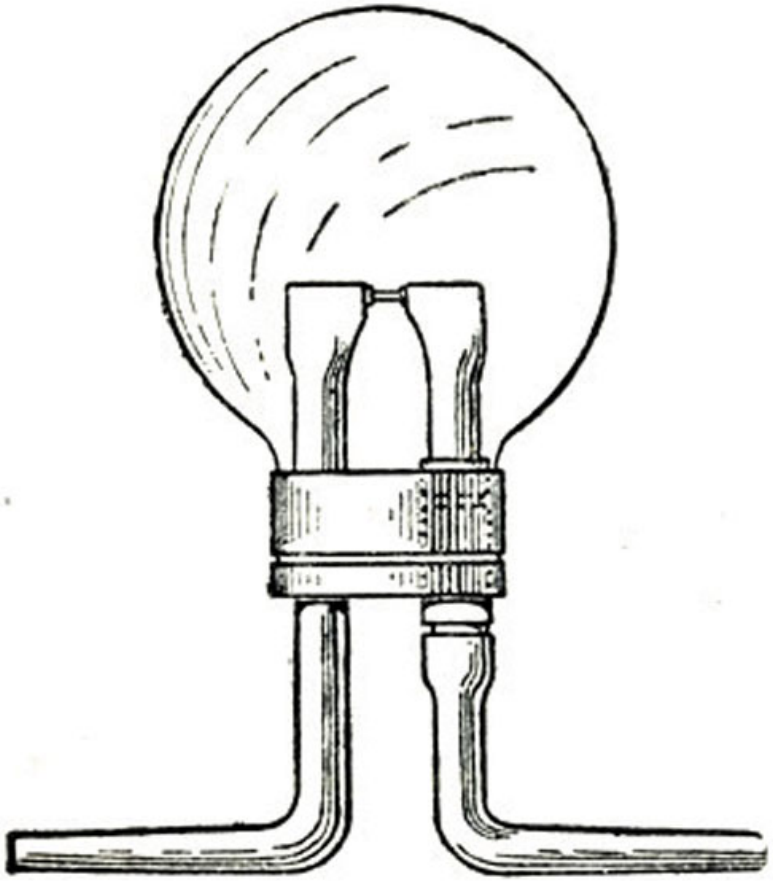

Figure: Carbon lamp

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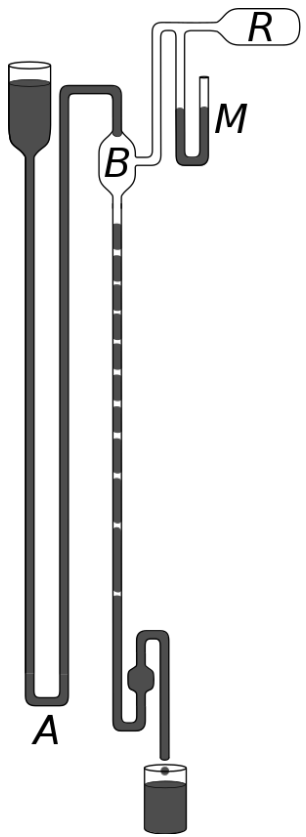
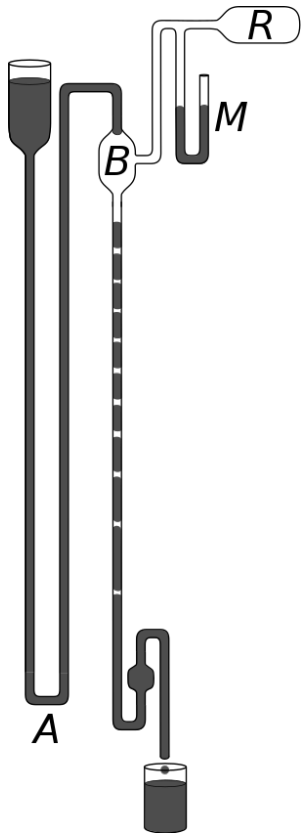
How does it work?



The supply of mercury
is contained in the reservoir on the left. It flows over into the bulb B, where it forms drops which fall into the long tube on the right. These drops entrap between them the air in B. The mercury which runs out is collected and poured back into reservoir on the left. In this manner practically all the air can be removed from the bulb B, and hence from any vessel R, which may be connected with B. At M is a manometer which indicates the pressure in the vessel R, which is being exhausted.

How does it work?



Falling mercury drops
compress the air to atmospheric pressure which is released when the stream reaches a container at the bottom of the tube. As the pressure drops, the cushioning effect of trapped air between the droplets diminishes, so a hammering or knocking sound can be heard, accompanied by flashes of light within the evacuated vessel due to electrostatic effects on the mercury. The speed, simplicity and efficiency of the Sprengel pump made it a popular device with experimenters. Sprengel's earliest model could evacuate a half litre vessel in 20 minutes.

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Cody's Lab

One researcher from YouTube replicated the Sprengel pump almost exactly and we plan to use the experience. He used a simple radiometer to measure the vacuum.

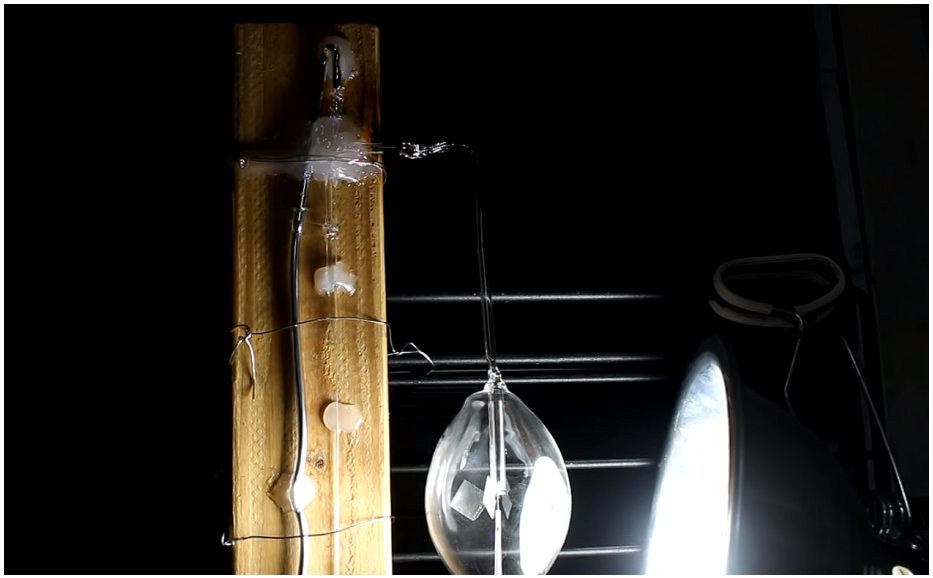

Figure: Sprengel pump from YouTube

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Fundamental differences

The main differences of our setup:

1. Oil will be used instead of mercury for safety reasons.
2. Since oil is much lighter than mercury, we will have to add an extra pump to the setup to help the oil drip down (to keep the dimensions acceptable).

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Will it work?

We don't yet know if it will succeed in replacing the mercury with oil, but even if it fails, it will be a rewarding experience.

Thanks!