Experiment finally proves 100-year-old thought experiment is possible (w/ Video)

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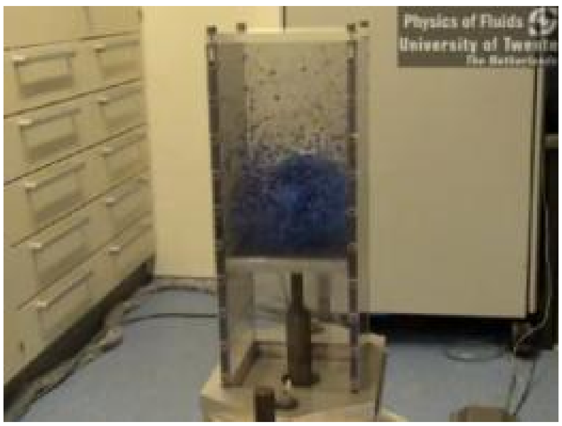

This image from the video below shows the machine that uses bouncing beads to perform work, confirming a thought experiment from 1912. Credit: University of Twente.

(PhysOrg.com) -- By building a machine that uses 2,000 bouncing beads to spin a paddle and perform work, researchers from the University of Twente have finally realized a long-debated thought experiment.

A similar machine was first proposed in 1912 by the Polish physicist Marian Smoluchowski. In his thought experiment, he suggested that tiny moving particles could generate enough force to spin a windmill-type paddle. A locking mechanism such as a pawl could prevent backward motion, forcing the wheel to move in the forward direction only.

However, several years later, physicist Richard Feynman argued that, in reality, the bouncing beads would not be capable of doing meaningful work. Feynman showed that, since the entire system operates at the same temperature, a pawl would occasionally slip off the wheel. As a result, the system would generate zero net movement.

Now, physicist Devaraj van der Meer from the University of Twente and his colleagues have demonstrated that such a machine can in fact spin the paddles forward only, generating a positive net movement. The details of their study will be published in an upcoming issue of Physical Review Letters.

Looking somewhat like a high-speed lotto machine, the new system consists of a vigorously shaken platform that causes 2,000 small glass beads to bounce around. When the beads make contact with the vanes of a windmill-like device inside the machine, the vanes move, turning a rod, which rotates a sensor.

In this machine, 2,000 bouncing beads spin the vanes of a ratchet. Credit: University of Twente.

The key challenge was getting the vanes to move in the forward direction only, which the scientists achieved with - somewhat surprisingly - duct tape. With duct tape covering one side of each vane, the vanes spun in one direction only. Since the beads lost more energy when they hit the soft duct-taped side than the non-taped side of the vanes, the machine generated a positive net movement.

Van der Meer noted that the machine doesn't come close to violating the second law of thermodynamics, since the system is extremely inefficient. Most of the beads' energy is lost through heat and sound.

However, the system could still provide scientists with insight into classical mechanics. For instance, the system exhibits a property called back interaction, so that not only do the beads move the vanes, but the vanes also move the beads. After the vanes begin to turn in one direction, the researchers observed a new roiling pattern in the beads.

The physicists say this back interaction might also occur in tiny "molecular ratchets," which include molecules in the body such as RNA polymerase and protein kinesin. At much smaller scales, these molecules move themselves through the body by ratcheting along tracks inside cells. The macroscopic system built here could help researchers better understand how molecular ratchets work by allowing the researchers to observe and manipulate the interactions on a large scale.

More information: via: Science News