Visualization of Tesla's Valvular Conduit

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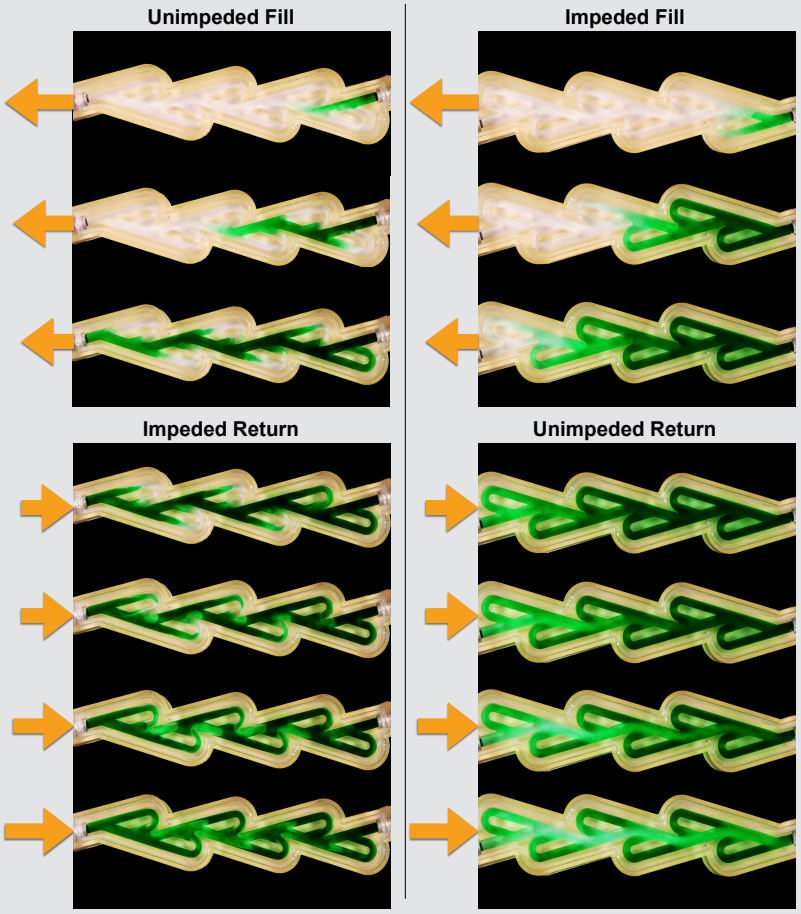
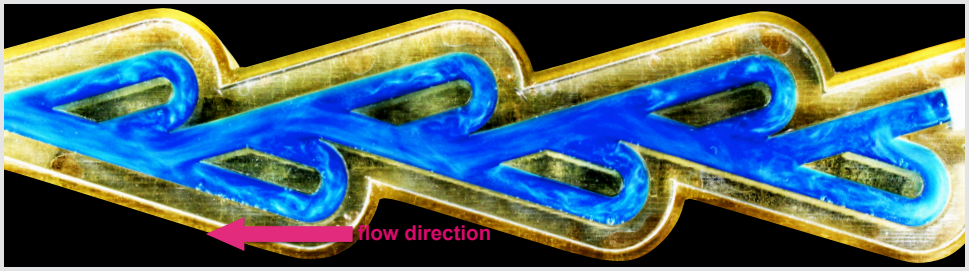


Arrows indicate direction of pressure forcing.

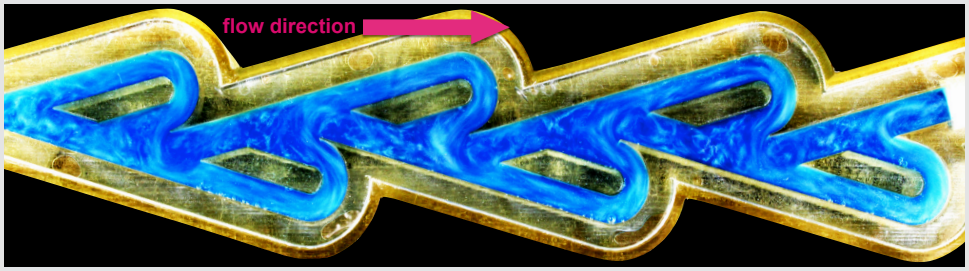
Left: In the first three images a slug of dye fills the valve in the unimpeded direction, primarily moving through the central channel. In the last four images, the flow is reversed, and the dye flows into the outer, serpentine channels.

Right: A slug of dye is first pumped through the valve in the impeded direction, flowing through the serpentine channels. In the lower four images, clear water is pumped in the unimpeded direction, passing by the serpentine outer channels and rushing through the central channel.



Above: Rheoscopic fluid flows through the Tesla Valve in the unimpeded direction. Motion blur in the central channel illustrates rapid flow, while the marbling in the peripheral channels indicates stagnation.

Below: Flow in the impeded direction is forced to trace a long serpentine path exclusively through the alternating peripheral channels. Fluid within the central channel is blocked by the crossing flow.



Tesla's Valvular Conduit is a fluid diode patented in 1920 by Nikola Tesla.[1] The valve preferentially allows fluid to flow in one direction without any moving parts. The valve has microfluidic applications, and might be chosen over other valves for its scalability, durability, and ease of fabrication.[2]

A four segment CFD model yields a pressure difference 15 times greater in the impeded direction than the unimpeded.[3] Tesla claimed that "The resistance in the reverse may be 200 times that in the normal direction … so that the device acts as a slightly leaking valve." [1] His claim is reasonable considering that his original design used 15 segments. Using the equation:

$$P_{differential} = 1 / X^{n}$$

where n is the number of segments, and 1-X is percentage leak, one can show that a factor of 200 can be expected if 30% of pressure leaks at each junction.[1]

The Coandă effect also plays a role creating low pressure vortices which block the main channel when fluid flows in the impeded direction, as shown in the rheoscopic fluid images.

References:

1. "Patent #: US001329559". *United States Patent and Trademark Office*. Office of the Chief Communications Officer.
2. Deng, Yongbo; Liu, Zhenyu; Zhang, Ping (28 Jan 2010). "Optimization of no-movig part fluidic resistance micro valves with low reynolds number"
3. "Tesla's Valvular Conduit - Fluid Power Journal". Fluid Power Journal. 2013-10-23.