Computational Fluid Dynamic Analysis of the Tesla Valve

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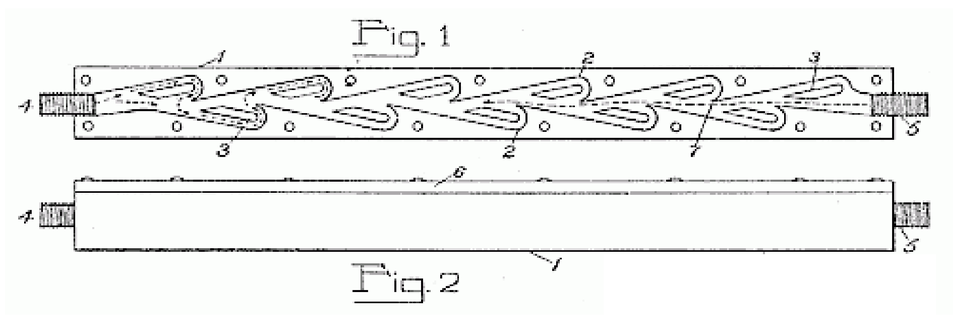
Abstract

Serbian-born inventor Nikola Tesla invented the Tesla valve (Tesla's Valvular Conduit) and patented it in 1919. The Tesla valve is unique in the sense that it does not have any moving parts, but it can work as a one-way valve. Nikola Tesla invented this unit without advanced mathematical models, nor with the help of modern computing power.

The original Tesla valve consisted of a set of cavities and fluid-flow guides that allow flow with low resistance in one direction but result in a high resistance to flow in the opposite direction, hence building up a backpressure. The advantage of this valve is that it does not require any moving parts and hence makes it a vital invention for microfluidic applications and designing of fire-safe equipment.

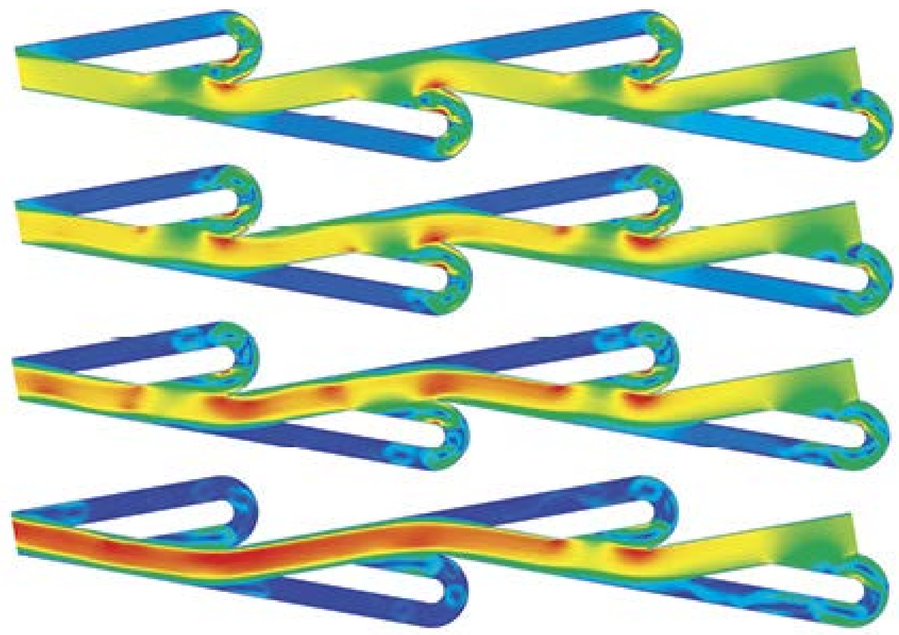
It is proposed in this work to conduct computational fluid dynamics analysis of Tesla valve. The study will help in revealing its working principles and hence allows us to optimize its parts for various applications, such as lab-of-chip, fire safety, etc.

Tesla Valve (Patented by Nikola Tesla in 1919)



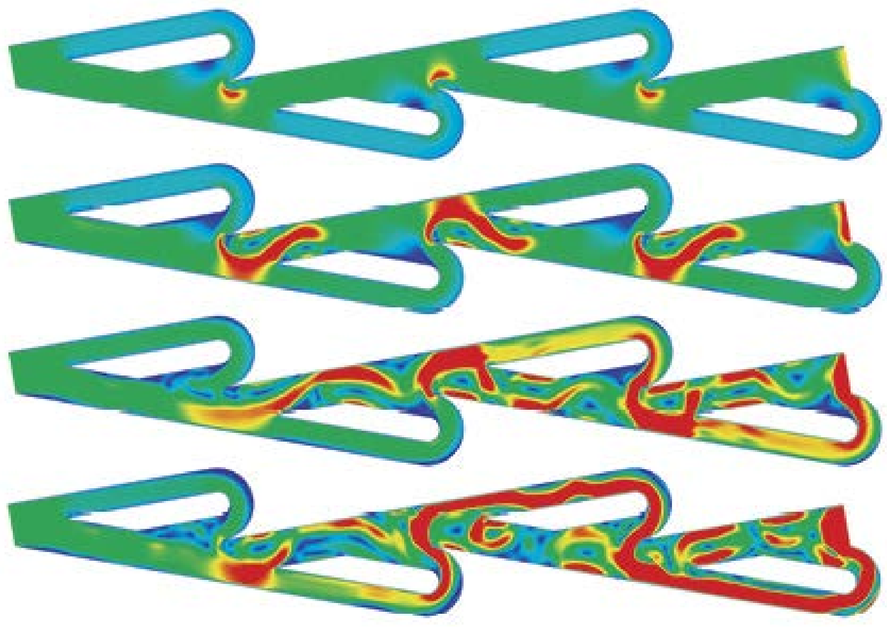
Tesla Valve (epicphysics.com)

CFD Modelling of Tesla Valve (forward flow direction)



* CFD illustration from Nathan West (2013), Fluid Power Journal

CFD Modelling of Tesla Valve (reverse flow direction)



* CFD illustration from Nathan West (2013), Fluid Power Journal

Conclusions

- Tesla valve stands out among one-way valves because it has no moving parts.
- CFD study revealed that pressure required for the same amount of flow in reverse direction is significantly higher than the forward direction. This can even be modified by increasing the number of reversal rings.
- The Tesla valve has a drawback that it only works for dynamic flows and it is not a complete leak proof solution. Due to which it has not been used in industrial applications.

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