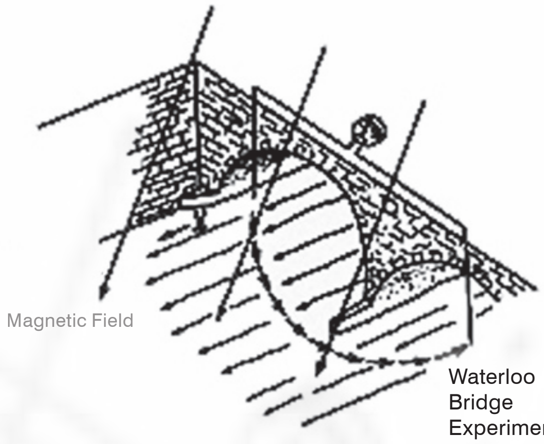
Magmeter History And Working Principle

Electromagnetic flowmeters (magmeters) are among the most widely used flowmeter types today. If conditions are suitable for their use, magmeters produce superior results as they rely on a measurement principle that is non intrusive and produces no pressure loss. Magmeters may be used on all commercially available pipe sizes.



Waterloo Bridge Experiment

Where it all began:

In 1832, Michael Faraday (1791 – 1867) assembled a large scale open channel magmeter and attempted to use this to measure the flow of water passing under London's Waterloo Bridge. His design concept was rather unusual, utilizing:

- magnetic field provided naturally by the earth, together with
- two large sheet-metal electrodes lowered from Waterloo Bridge into the river Thames to
- determine the flowrate of the river Thames in London

The result was not a 100% success due to electrochemical and thermoelectric effects as well as the unavailability in that day of highly sensitive instruments that could measure μVolt signals.

Michael Faraday

The next steps in development of the magmeter:

- In 1915, the Americans M.W. Smith and Joseph Slepian filed a patent for "A device to measure the speed of a boat by means of magnetohydrodynamics."
- In 1930 the same idea was adapted to closed conduits by the Briton E.J. Williams.
- In 1952 the Dutch company Tobi-Meter introduced the first commercial magmeter.
- In 1962 the British scientist J.A. Shercliff published the "Theory of electromagnetic flow-measurement."

Today there are a few dominant global companies providing more than 200,000 magmeter instruments annually to all industries.

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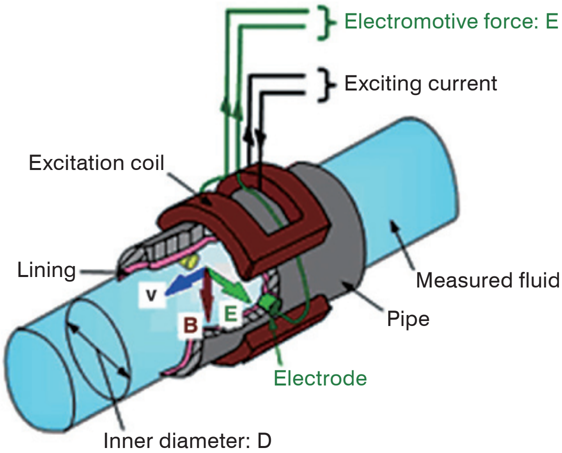
The development of robust and superior magmeters for common industrial applications presents major challenges to designers and engineers.

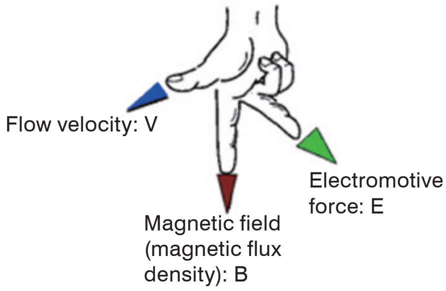
As shown in the drawing to the right, magmeters consist of the following elements:

- Non ferromagnetic flowtube
- Non conductive liner
- Excitation coils
- Electrodes

The generated magnetic field is perpendicular to the fluid flow direction, allowing measurement of the electromotive force E, which, according to Faraday law of induction ($E_{flow} \sim B * v * D$), is proportional to fluid flow velocity in the pipe.
The overall merits of this design are obvious:

- There is no obstruction in the pipe and therefore no pressure drop caused by the magmeter.
- It works on all commercially available pipe sizes.
- The impact on measurement accuracy by flow disturbances in the media is negligible, thus require less upstream and downstream straight pipe run.





Magmeter designs can be easily adapted to suit industry requirements and applications:

Integral Flange Type

Remote Ceramic Type

Food and pharmaceutical: sanitary versions

Recent advances in magmeter technology include electrodeless magmeters for adhesive applications, installation-cost-effective two-wire magmeters, and fieldbus versions for digital communications applications.