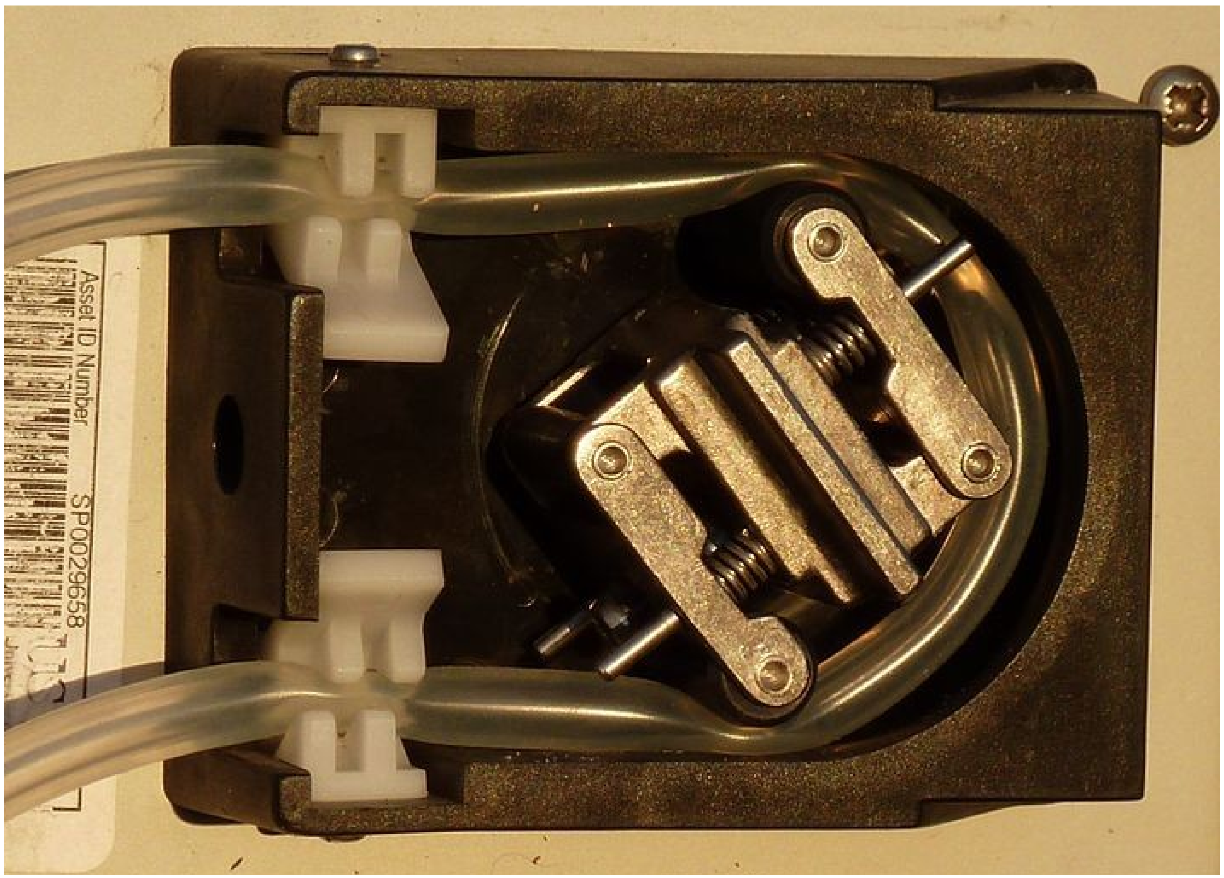
Instrumental technique



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12.04.2014

A **peristaltic pump** is a type of positive displacement pump used for pumping a variety of fluids.

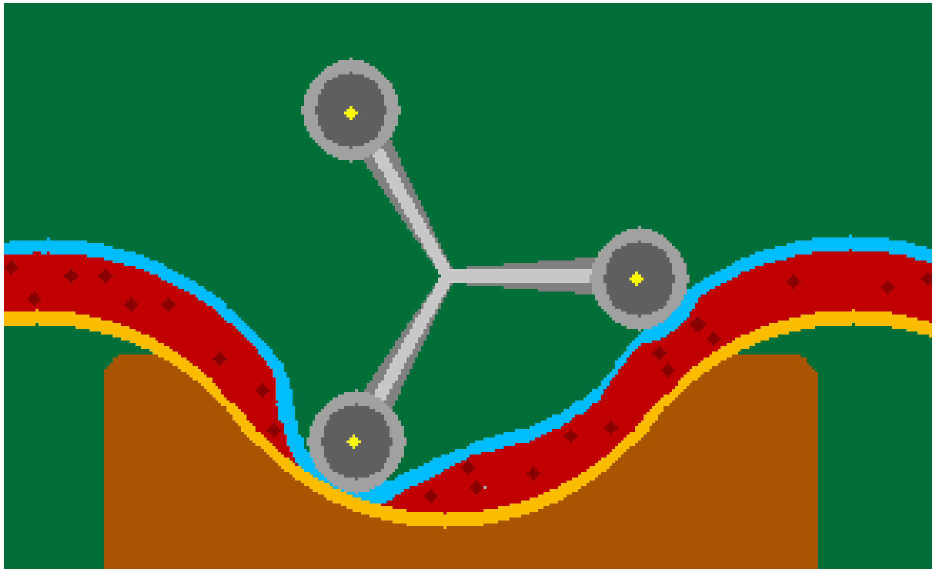
Peristaltic Pumps are the simplest possible pumps, with no valves and seals.

History

The peristaltic pump was first patented in the United States by Eugene Allen in 1881. It was popularized by heart surgeon Dr. Michael DeBakey while he was a medical student in 1932.

Concept: Peristaltic Pumps

- Peristalsis – a natural process of involuntary wave-like successive muscular contractions by which food is moved through the digestive tract.
- Operates by batching a certain volume of water and forcing it along a tube.
- A rotor attached to an external circumference compresses and releases a flexible tube with rollers, creating a squeezing action that draws fluid through the tubing.



How do peristaltic pumps work?

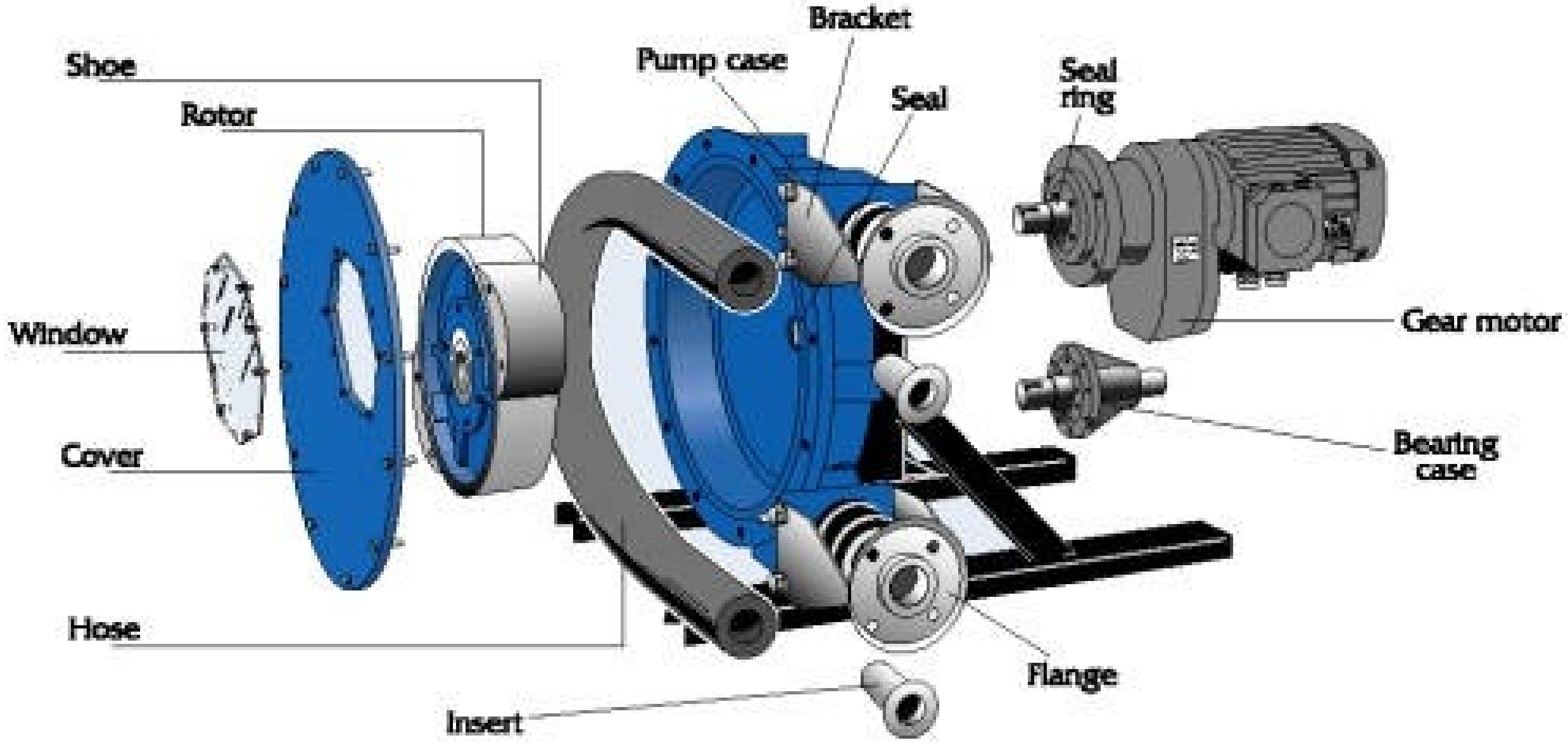
1. The peristaltic pump is based on alternating compression and relaxation of the hose or tube drawing the contents into the hose or tube, operating in a similar way to our throat and intestines.

2. A rotating shoe or roller passes along the length of the hose or tube totally compressing it and creating a seal between suction & discharge side of the pump, eliminating product slip.

3. Upon restitution of the hose or tube a strong vacuum is formed drawing product into the pump.

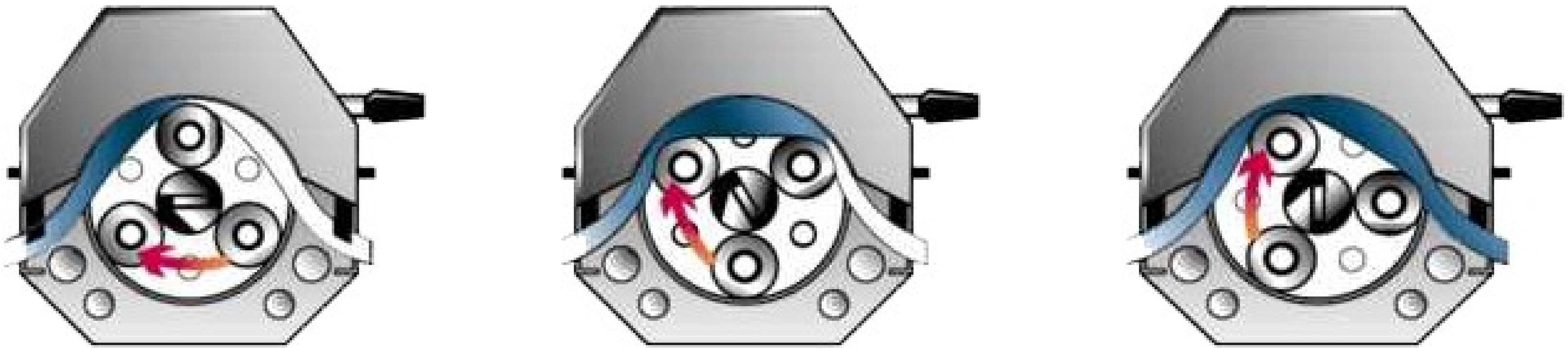
4. The medium to be pumped does not come into contact with any moving parts and is totally contained within a robust, heavy-duty hose or a precision extruded tube.

5. This pumping action makes the pump suitable for accurate



Shoe
Rotor
Window
Cover
Hose
Insert
Pump case
Bracket
Seal
Seal ring
Gear motor
Bearing case
Flange

Peristaltic Pump



- Positive Displacement Pump (PDP)
- 3 Parts
  - Pump Head
  - Drive Mechanism
  - Tubing

Occlusion

The term "occlusion" is used to measure the amount of squeeze. It is either expressed as a percentage of twice the wall thickness, or as an absolute amount of the wall that is squeezed.

Let

y = occlusion

g = minimum gap between the roller and the housing

t = wall thickness of the tubing

Then

$y = 2t - g$ (when expressed as the absolute amount of squeeze)

$y = (2t - g) / (2t) \times 100$ (when expressed as a percentage of twice the wall thickness)

The occlusion is typically 10 to 20%, with a higher occlusion for a softer tube material and a lower occlusion for a harder tube material.

Thus for a given pump, the most critical tubing dimension becomes the wall thickness. An interesting point here is that the inside diameter of the tubing is not an important design parameter for the suitability of the tubing for the pump. Therefore, it is common for more than one ID be used with a pump, as long as the wall thickness remains the same.

Inside diameter

For a given rpm of the pump, a tube with larger inside diameter (ID) will give higher flow rate than one with a smaller inside diameter. Intuitively the flow rate is a function of the cross section area of the tube bore.

Flow rate

Flow rate is an important parameter for a pump. The flow rate in a peristaltic pump is determined by many factors, such as:

1. Tube ID - higher flow rate with larger ID
2. Pump head OD - higher flow rate with larger OD
3. Pump head RPM - higher flow rate with higher RPM

Increasing the number of rollers doesn't increase the flow rate, instead it will decrease the flow rate somewhat by reducing the effective (i.e. fluid-pumping) circumference of the head. Increasing rollers does tend to decrease the amplitude of the fluid pulsing at the outlet by increasing the frequency of the pulsed flow.

The length of tube (measured from initial pinch point near the inlet to the final release point near the outlet) does not affect the flow rate. However, a longer tube implies more pinch points between inlet and outlet, increasing the

Advantages

No contamination. Because the only part of the pump in contact with the fluid being pumped is the interior of the tube, it is easy to sterilize and clean the inside surfaces of the pump.

Low maintenance needs. Their lack of valves, seals and glands makes them comparatively inexpensive to maintain.

They are able to handle slurries, viscous, shear-sensitive and aggressive fluids.

Pump design prevents backflow and syphoning without valves.

Disadvantages

The flexible tubing will tend to degrade with time and require periodic replacement.

The flow is pulsed, particularly at low rotational speeds. Therefore, these pumps are less suitable where a smooth consistent flow is required. An alternative type of positive displacement pump should then be considered.

Typical applications

- Laboratory peristaltic pump
- Medicine
  - Dialysis machines
  - Open-heart bypass pump machines
  - Medical infusion pumps

- Testing and research
  - AutoAnalyzer
  - Analytical chemistry experiments
  - Carbon monoxide monitors
  - Media dispensers

- Agriculture
  - 'Sapsucker' pumps to extract maple tree sap

- Food manufacturing and sales
  - Liquid food fountains
  - Beverage dispensing

- Chemical handling
  - Printing, paint and pigments
  - Pharmaceutical production
  - Dosing systems for dishwasher and laundry chemicals

- Engineering and manufacturing
  - Concrete pump
  - Pulp and paper plants

- Water and Waste
  - Sewagesludge
  - Aquariums, particularly calcium reactors

Thank You