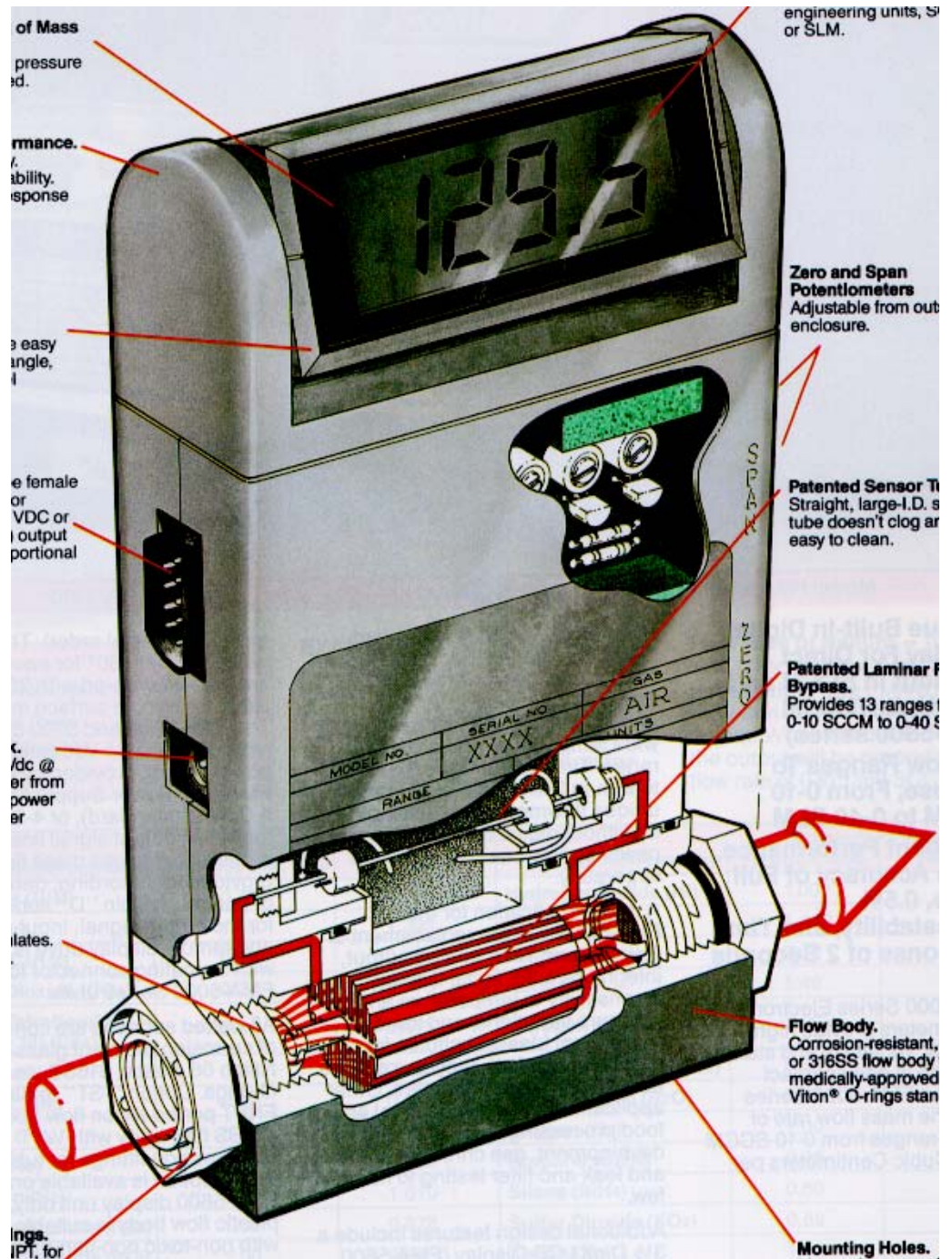


Mass flow meter



Vortex Shedding Flow Meter

- As fluid flows past a cylinder or other object, alternating vortices are shed off the trailing edge.
- Vortex frequency described by Strouhal No.

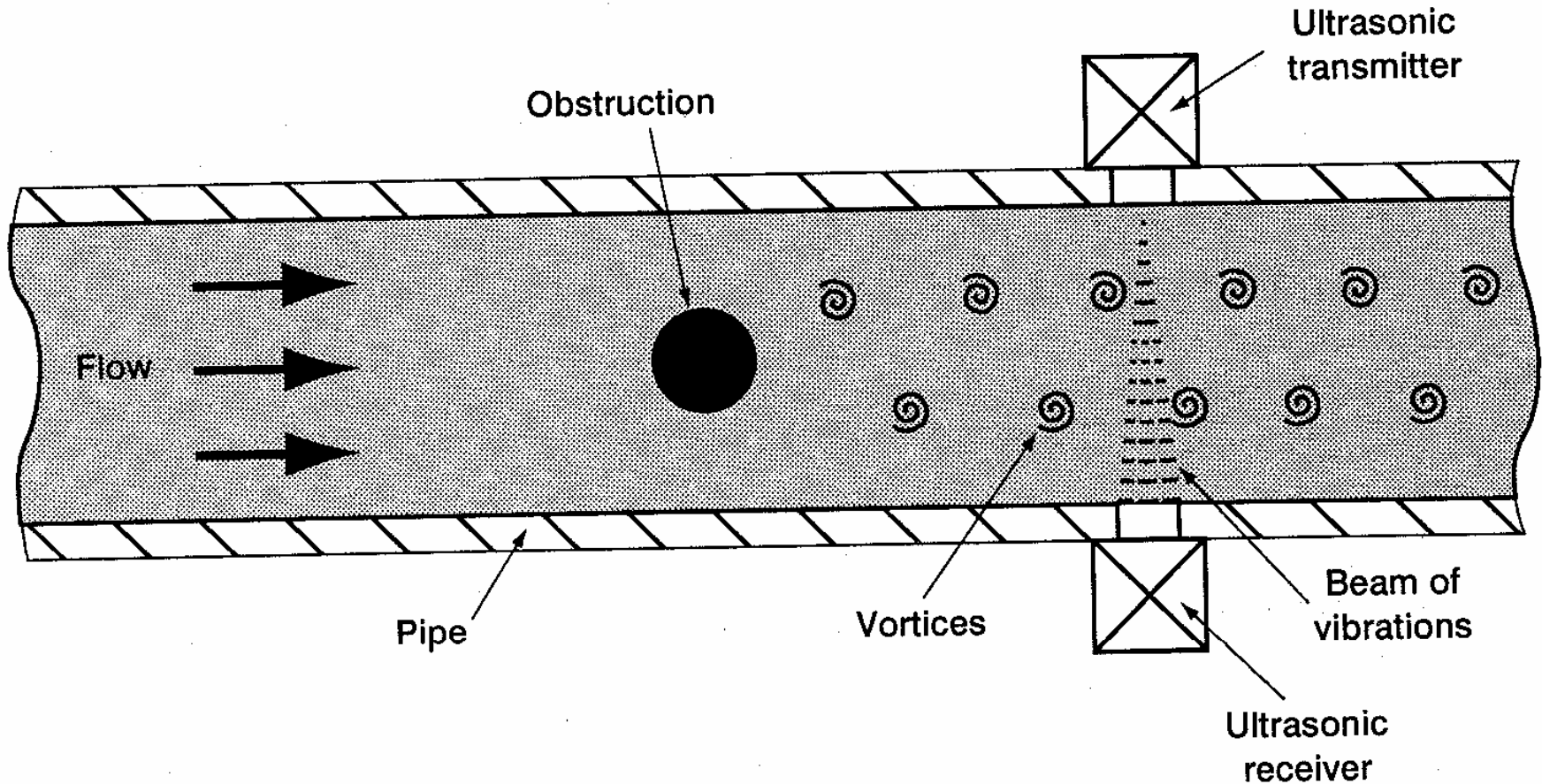
$$St = fD/V$$

- For cylinder, $St = \sim 20.5$ for $500 < Re < 10^5$
- Over this range of constant St , a measurement of vortex frequency f is directly proportional to V

Vortex Shedding Flow Meter

- Several different shapes can be placed in the flow, with varying ranges of Re over which St is constant.
- Vortex frequency f is measured by several different methods.
- The picture on the following page shows measurement by an ultrasonic transmitter and receiver.

Vortex Shedding Meter



Ultrasonic Doppler Flow Meter

- Ultrasound can also be used to measure flow rates in ultrasonic transit time meters or ultrasonic Doppler meters.
- These meters measure either transit time or frequency shift of emitted/received waves that bounce off of particles and bubbles in fluid.
- These meters are completely non-obtrusive (but not cheap!)

Ultrasonic Doppler

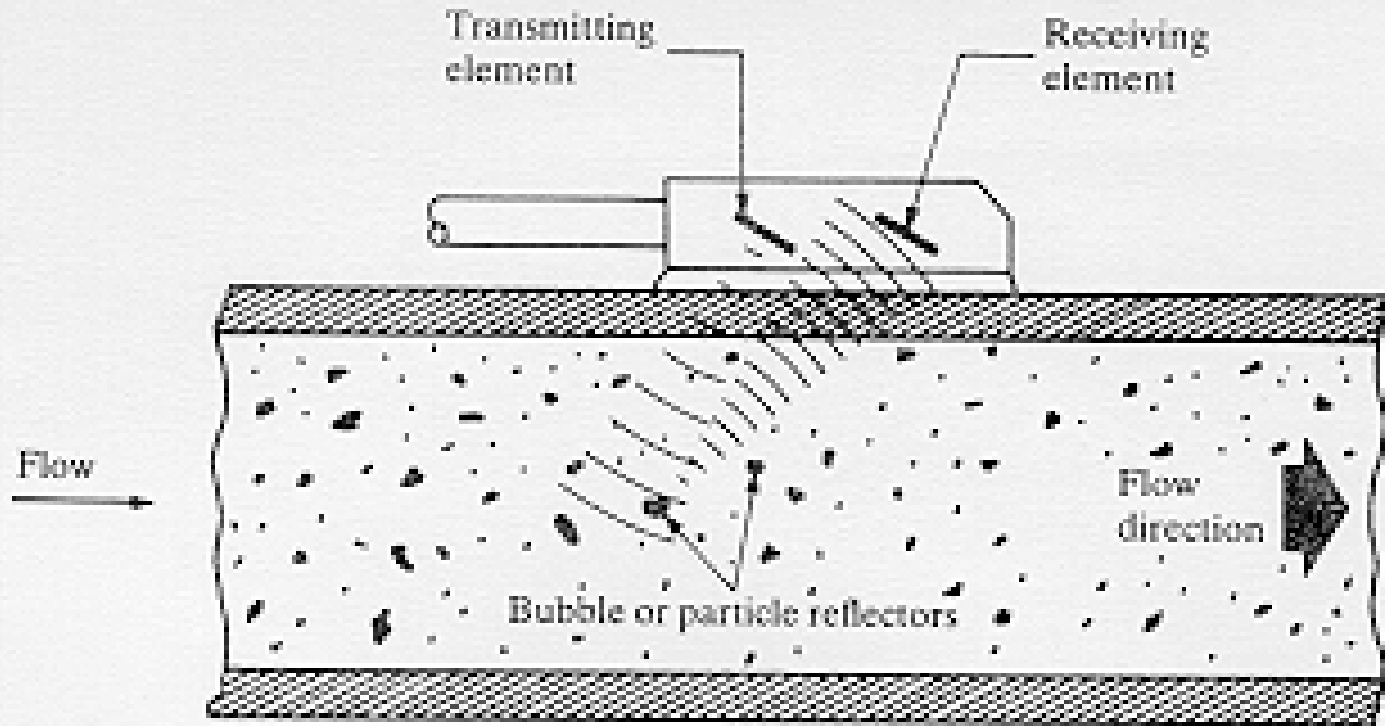


FIGURE 7-21
Ultrasonic doppler flowmeter.