TAP 307- 6: Resonance of a mass on a spring

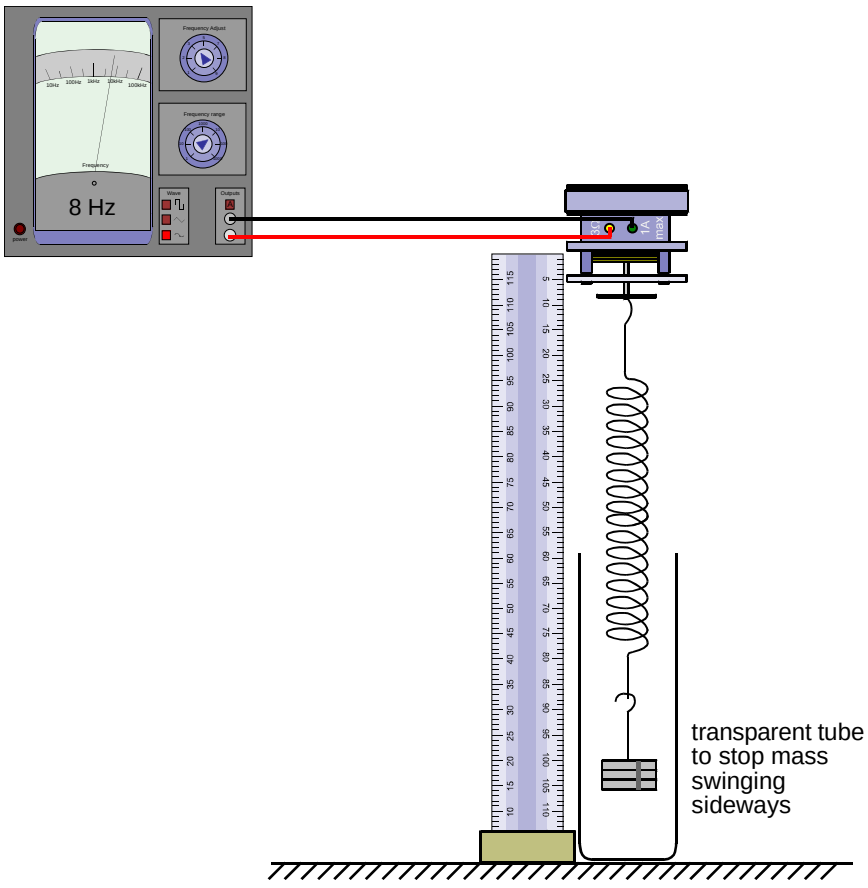
When the driving frequency matches the natural frequency of an oscillator the amplitude of oscillation can rise dramatically. This is resonance. This experiment gets you to measure how the amplitude of a mass on a spring varies as the driving frequency is changed.

You will need

- ✓ vibration generator
- ✓ signal generator
- ✓ steel springs
- ✓ 50 mm diameter, 250 mm long Perspex tube
- ✓ leads, 4 mm
- ✓ retort stand, boss and clamps
- ✓ mass hangers with slotted masses, 100 g

Setting up

Set the apparatus up:



What to do

1. First of all make a careful estimate of the natural frequency of your mass on a spring and write down this value.

Next attach the mass and spring to the vibration generator and hang it in the Perspex tube. Set the variable-frequency generator at 0.5 Hz and measure the amplitude of oscillation. Repeat this at 0.5 Hz intervals up to 8 Hz. Keep a record of the results – but it is even more vital than usual to plot the results as you go, to see where extra readings are needed to define the curve.

2. Use the graph plotting package to produce a graph of your results. What do they show you? What happens to the amplitude of the oscillation when the driving frequency matches the natural frequency of the mass on the spring?

3. Now repeat the experiment with the mass suspended in water. What differences do you notice?

You have seen

1. That the amplitude of oscillation of the mass increases markedly when the driving frequency matches the natural frequency of the mass on the spring.

2. That the amplitude at resonance is smaller when the oscillation is damped than when it is undamped.

Practical advice

This quick and effective activity gives a clear example of mechanical resonance. Although we are concerned with a qualitative understanding of resonance it is worthwhile encouraging students to attempt amplitude measurements as this will lead to more careful observations – they will ‘see’ how sharp the resonance peak is rather than quickly scanning through a range of driving frequencies.

A 200g mass hanging from one spring gives a natural frequency of about 5 Hz. Two springs in series give larger amplitude but the frequency becomes rather low – showing only one side of the resonance curve.

Alternative approaches

Students may suggest other resonating systems for exploration.

Social and human context

Resonance effects are widespread. Students could be encouraged to look for articles or books that refer to resonance effects.

External reference

This activity is taken from Advancing Physics chapter 10, 350E