33030 Traveling Wave Machine

Purpose:

To demonstrate wave motion and allow identification of the components of a continuous wave, phase angle, and wavelength.

Required Accessories:
Overhead Projector

Assembly:

Align the slots on the cross bars with the slots on the end brackets and press into place (Fig 1).

Select a wave pattern coil and insert the ends into the grommets on either end of the apparatus as depicted in the illustration. The apparatus is now assembled for demonstration. Select a wave pattern coil and insert the ends into the grommets on either end of the apparatus as depicted in the illustration. The apparatus is now assembled for demonstration.

Background:

A *wavelength* is the distance between the crest of one wave and the corresponding point on the next wave that is moving in the same direction. The wavelength is equal to the speed of the wave motion divided by its frequency.

Frequency is the number of wavelengths that pass a fixed point in one second.

Wave motion is the transfer of energy in the form of a wave.

A *wave unit* is composed of a high point, called a *crest*, and a low point, called a *trough.*

The *amplitude* is half of the vertical dimension from a crest to a trough

The *phase angle* is the angle through which the crank is turned from one position of interest to another position of interest. A phase angle of 360 degrees or 2π radians corresponds to one wave length.

Procedure:

1. Place the stand on the overhead projector stage with the length of the unit parallel to the front of the projector. Mount one of the two springs by hooking each end (Fig 2).

2. Switch on the projector and focus the image.

3. Turn the crank. Observe how increasing the speed affects the wave motion.

The shadow will appear as a wave moving to either the left or right, depending on which way the crank is turned. Have the students identify the parts of a wave unit (crest and trough) and the wavelength, writing their labels on the projected image. Notice also that one wavelength can be measured starting anywhere on the wave and moving to the next place that is in phase with the first point. Mark two positions on the projected image that are in phase with one another. Confirm this by slowly turning the crank one complete turn. Find and confirm some positions that are 90 degrees out of phase, 45 degrees, and so forth. Also demonstrate the wave motion. As the crank is turned, the energy of the wave is transferred along the length of the spring.

In this model, the speed at which the wave crests traverse the length of the spring is variable, but the distance between wave crests remains constant for a given spring. Mounting the other spring changes the wave speed and wavelength for the same rotation rate of the crank.

Time Allocation:

To prepare this product for an experimental trial should take less than ten minutes. Actual experiments will vary with needs of students and the method of instruction, but are easily concluded within one class period.