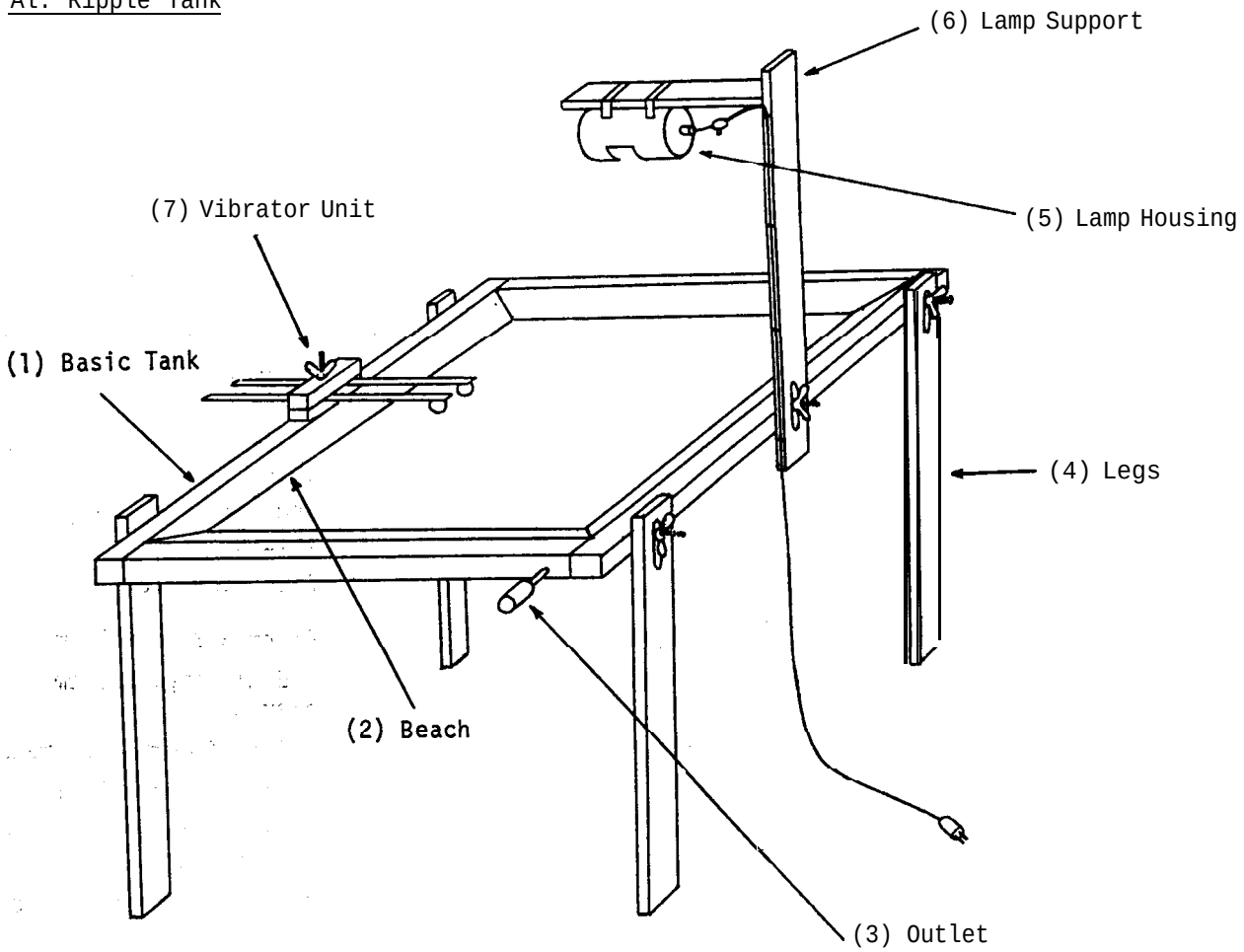
IV. WAVE MOTION APPARATUS

A. RIPPLE TANK APPARATUS

There are many ways of introducing wave motion to students, through observations of waves in water, heat radiation, acoustics, optics and electromagnetism. Each approach requires a different set of equipment. The materials here are limited to. presenting wave motion through the observation of waves on water, and the equipment is thus limited to ripple tanks and accessories.

A. RIPPLE TANK APPARATUS

Al. Ripple Tank©



a. Materials Required

Components	Qu	Items Required	Dimensions
(1) Basic Tank	2	Woo d (A)	60 cm x 3.5 cm x 3.5 cm
	2	Woo d (B)	57 cm x 3.5 cm x 3.5 cm
	1	Glass Plate (C)	57 cm x 57 cm x 0.3 cm
	1	Rubber Based Cement (D)	--

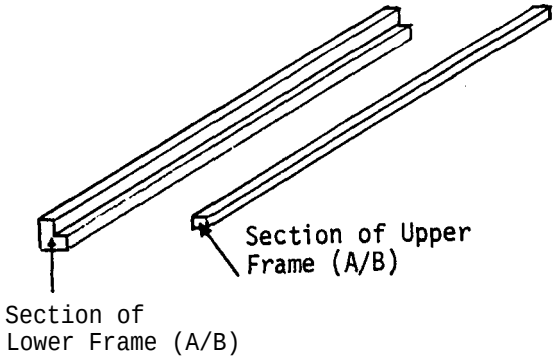
©From Reginald F. Melton, Elementary, Economic Experiments in Physics, Apparatus Guide, (London: Center fo Educational Development Overseas, 1972), pp 82-91.

(2) Beach	4	Soft Wood (E)	56.5 cm x 6 cm x 2 cm
	4	Brass Discs (F)	0.05 cm thick;3 cm diameter
(3) Outlet	1	Metal Tube (G)	5 cm long, 1 cm diameter
	1	Rubber Stopper (H)	2.5 cm diameter, 2.5 cm deep
(4) Legs	4	Wood (I)	60 cm x 3 cm x 2 cm
	4	Bolts (J)	3 cm long, 0.4 cm diameter
	4	Wing Nuts (K)	0.4 cm internal diameter
(5) Lamp Housing	1	Aluminum Sheet (L)	35 cm x 16 cm x 0.05 cm
	1	Plywood (M)	11 cm diameter, 0.4 cm thick
	1	Aluminum Sheet (N)	15 cm diameter, 0.05 cm thick
	1	Lamp (0)	100 watt, straight filament
	1	Electrical Socket (P)	Fits above lamp
(6) Lamp Support	1	Wood (Q)	6 5 c m x 3 c m x 2 c m
	1	Bolt (R)	4.5 cm long, 0.3 cm diameter
	1	Wing Nut (S)	0.3 cm internal diameter
	1	Wood (T)	4 8 c m x 2 c m x l c m
	1	Triangular Wood (U)	5 cmx 4 cm x 3 cm, and 1 cm thick
	1	Packing Case Steel Band (V)	7 cm x 0.5 cm x 0.02 cm
	2	Aluminum Strips (W)	1.5 cm x 0.6 cm x 0.02 cm
(7) Vibrator Unit	2	Packing Case Steel Bands (X)	30 cm x 1 cm x 0.05 cm
	2	Glass Marbles (Y)	1.5 cm diameter
	2	Wood (Z)	7 cm x 2 cm 21 cm
	1	Bolt (AA)	2.5 cm long, 0.4 cm diameter
	1	Wing Nut (BB)	0.4 cm internal diameter

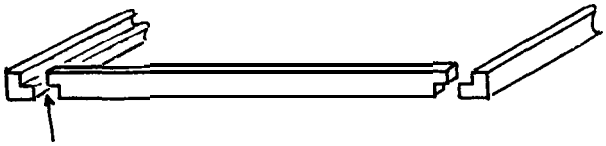
b. Construction

(1) Basic Tank

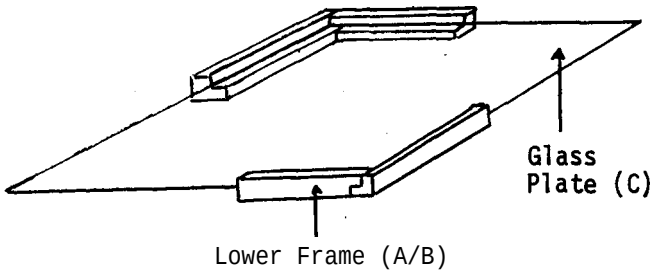
Out of each of the side wood strips (A and B) cut a single length approximately 2.0 cmx 2.0 cm, (A small circular



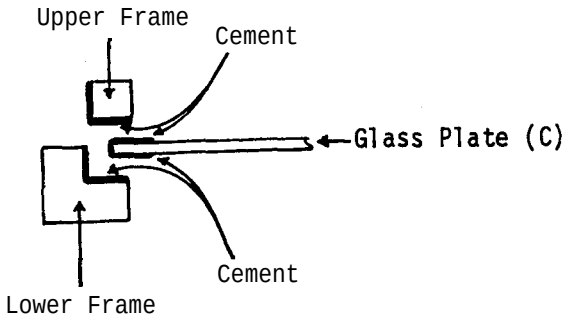
saw is useful in performing this task). You now have four large pieces of wood to make the lower frame, and four small pieces to make the upper frame.



The end pieces of the shorter lengths for the lower frame are cut (as illustrated) so that they may be firmly joined together with wood cement.

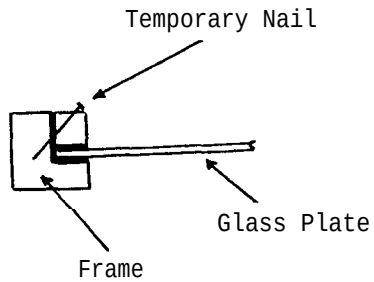


Set the glass plate (C) on the ledge of the lower frame. Cover the edges of the glass, and the inner edges of the lower and upper frame with a waterproof cement (D) as illustrated. An asphalt or rubber based cement is ideal. Set the glass on the ledge of the lower frame, and hold it in position by placing the upper frame on top of it.



Cross Section of Frame

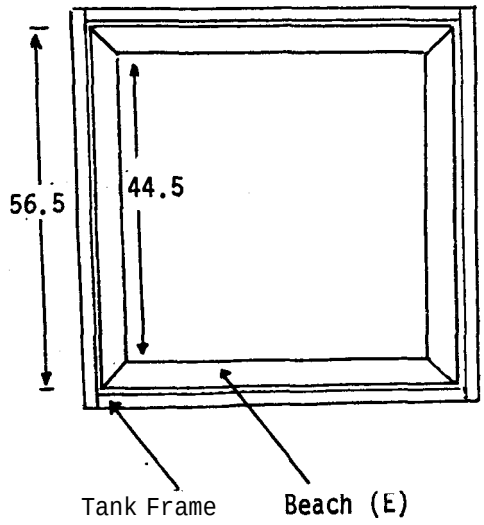
The whole frame may be held together by clamps, or nails, tacked temporarily through the two frames, until the cement is dry.



Cross Section of Frame

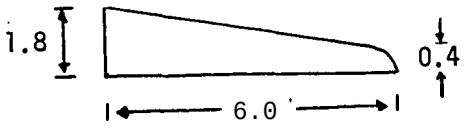
You now have a basic tank with an inner and outer frame insuring the tank is leak proof.

(2) Beach



Plan of Frame and Beach

The beach is any device which will cut out unwanted reflection from the sides of the tank. One of the most effective, and durable of beaches is made from soft pine wood (packing case material). Make the beach rather like a picture frame from the softwood (E) so that it sits on the glass surface of the tank, and fits snugly within the upper frame.



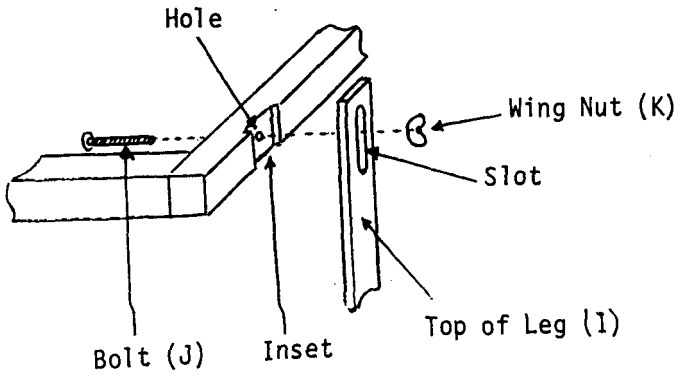
The most important aspect of the beach is the angle of the surface as it slopes downward from its outer to inner edge. The dimensions of a cross section to cope with water depths varying from 0.5 cm to 1.5 cm is illustrated.

Smooth the surface of the beach with fine sandpaper (leaving a smooth, but porous, surface), but do not varnish. Wetting the surface of the beach at the commencement of a series of experiments makes the damping of the waves most effective.

may be assisted by tilting the tank towards the corner. The bottom edge of the outlet hole should be at the same level as the top surface of the glass (or just a little below),

Seal the metal tube (G) into the horizontal hole with a waterproof cement. Bore a hole (0.9 cm diameter) partway into the rubber stopper (H) using an electric drill (not a cork borer). Fit the stopper on the tube, thus controlling the outflow of water.

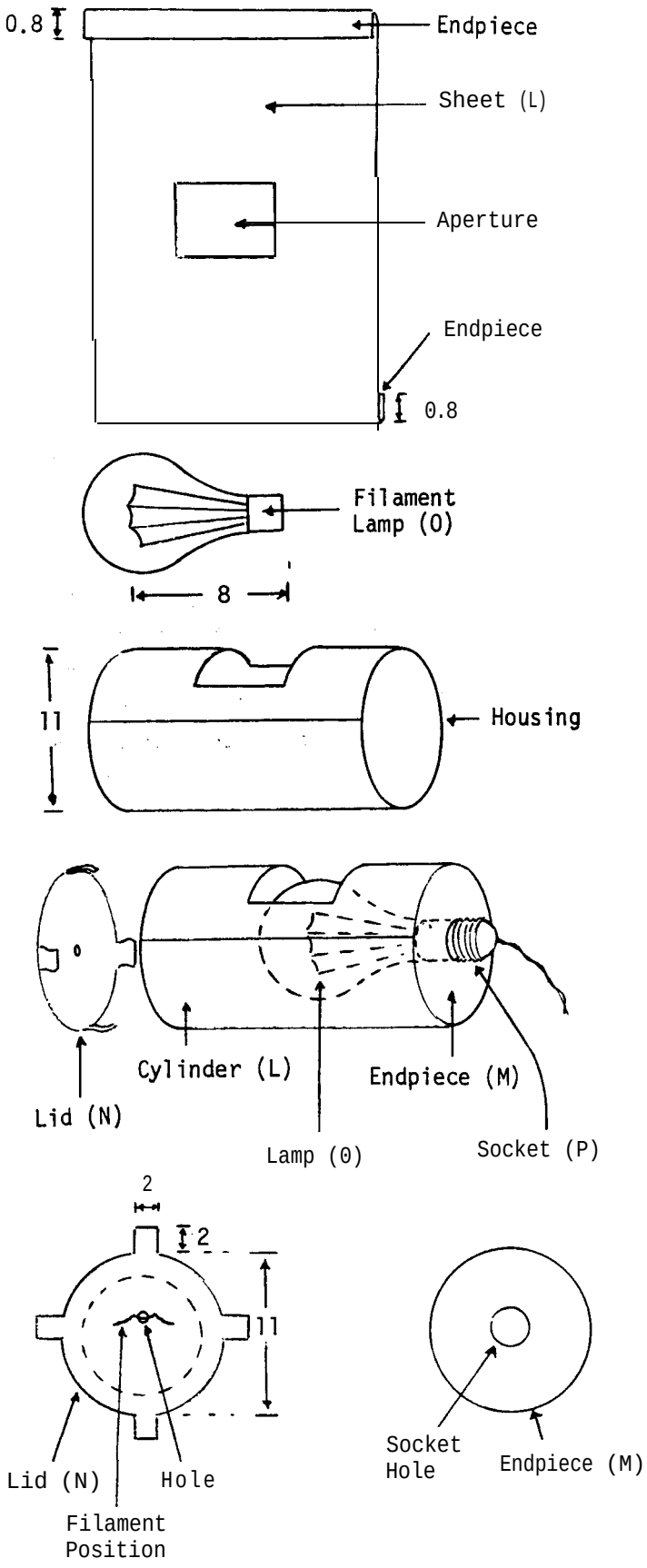
(4) Legs



Drill and chisel a slot (2 cm x 0.5 cm) in the top of each of the four wood pieces (I) to make adjustment slots for the legs. Make four insets (0.3 cm deep) in the frame to hold the legs firmly in a vertical position. Then, drill a horizontal hole (0.4 cm diameter) through the lower part of the outer frame (that is beneath the level of the glass) at the middle of each inset. Attach each leg to the frame with a bolt (J) passed through the hole in the frame and the slot in the leg. Fasten the bolt and leg firmly in position with a wing nut (K).

(5) Lamp Housing

The size of the lamp housing will be dependent on the size of the contained lamp. In this case the lamp (0) utilized was 8 cm from the socket to

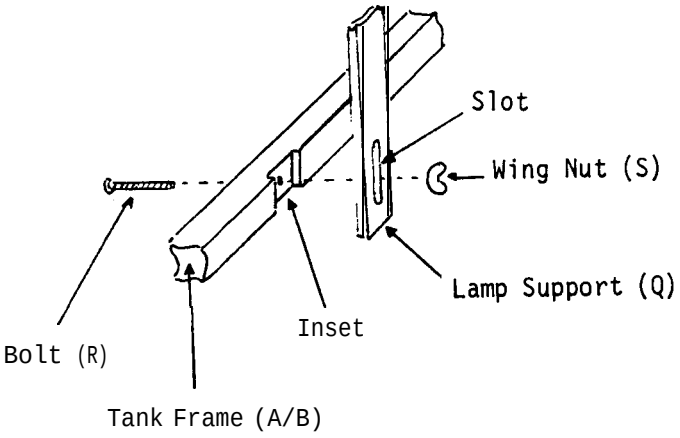


to filament. Ideally the filament should be a straight line, but a slightly bent filament such as that illustrated will serve the same purpose.

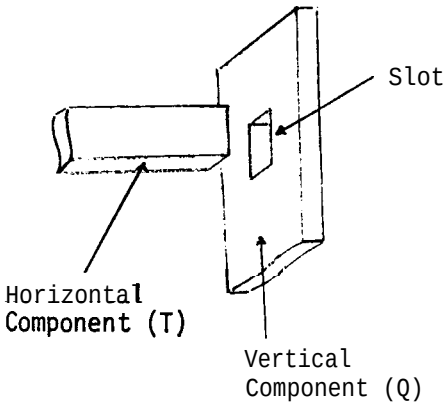
To make the housing for the above lamp take a sheet of aluminum (L) and cut an aperture (5 cm x 5 cm) from its center. Roll the sheet into a cylindrical shape, and hold it in position. by means of bent end pieces.

Attach the hardboard or plywood endpiece (M) to the base of the container with very small nails. Drill a central hole in the endpiece to facilitate the placement of the lamp (0) and electrical socket (P). Complete the housing by making a lid out of aluminum sheet (N). Drill a small hole (0.2 cm diameter) in the lid, such that it is in line with the filament.

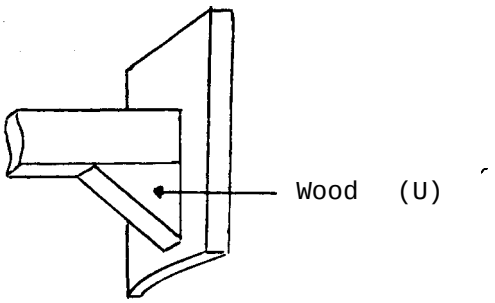
(6) Lamp Support

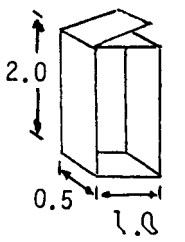


The vertical component of the lamp support is made, and attached to the ripple tank, in very much the same way as the legs. Drill and chisel a slot (7 cm x 0.5 cm) near to the bottom of end wood (Q) to permit adjustment. Attach the support to the ripple tank frame with bolt (R) passed through the lower part of the frame, and held in position by wing nut (S).

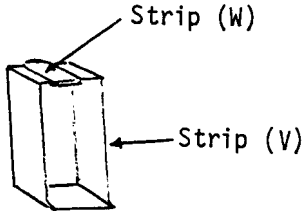


Cut a rectangular slot (2 cm x 1 cm) in the top of wood (Q) to take the horizontal component, wood (T). Fasten the two firmly together with wood cement. Glue a triangular piece of wood (U) between the two components to make a stronger junction.

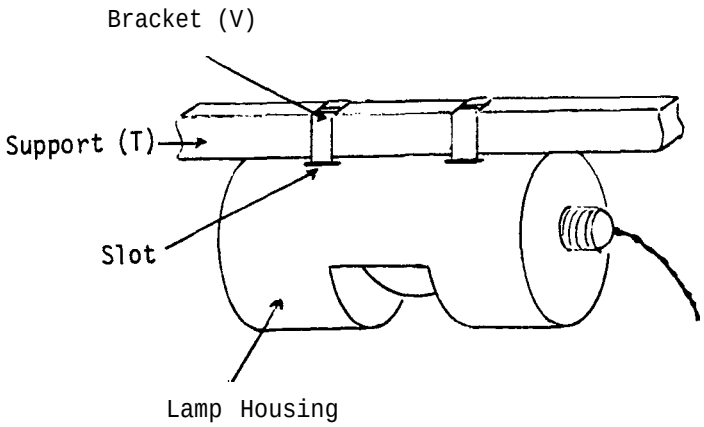




Strip (V)
Folded

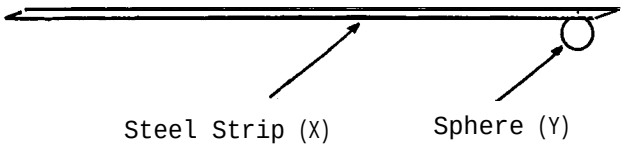


In order to attach the lamp housing to the horizontal components of the support make two brackets from steel strips (V) as illustrated. Cut four horizontal slots in the upper part of the lamp housing and



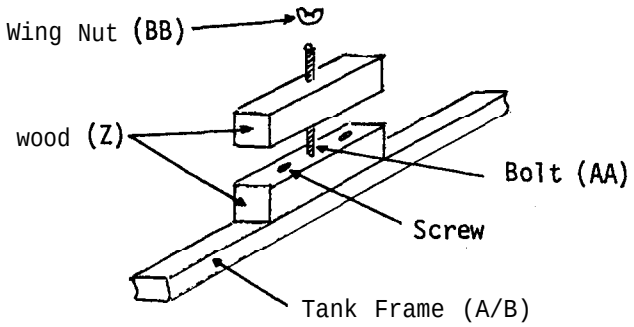
pass the steel strips through. Fasten the loose ends of the brackets together with folded pieces of aluminum (W). Then slide the brackets over the lamp support.

(7) Vibrator Unit



The steel strips (X), or stiff coat hanger wire, will serve as the arms of the vibrator. Attach a glass sphere (Y) to the end of each arm using epoxy resin.

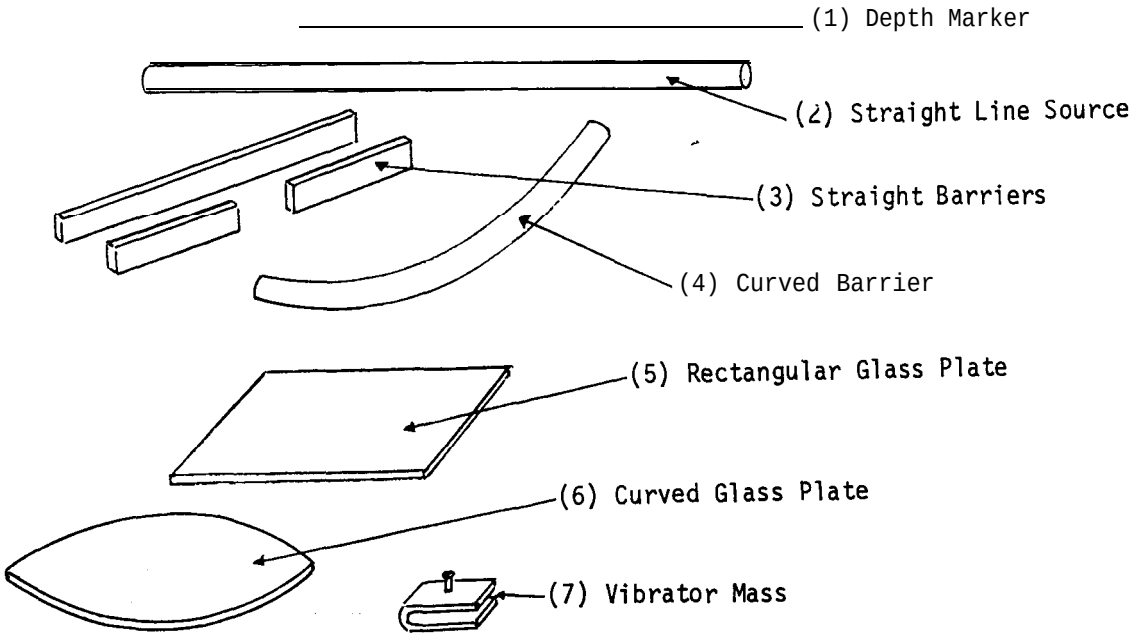
Make the vibrator clamp from two strips of wood (Z). Drill a hole (0.4 cm diameter) through the lower strip, and then attach the strip to the frame with two screws. Set the top strip on top of the first, and fasten it in position with the bolt (AA) and wing nut (BB). The vibrator arms may now be clamped firmly between the strips of the clamp, being held at the middle of the arms. This insures the maximum possible period of vibration.



C.Notes

(i) With the help of the Ripple Tank Accessories (IV/AZ) it is possible to observe the phenomena of reflection, refraction, interference and diffraction in waves created in the Ripple Tank.

AZ. Ripple Tank Accessories ©



a. Materials Required

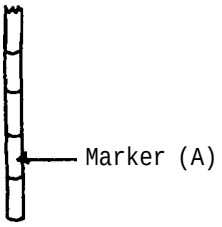
Components	Qu	Items Required	Dimensions
(1) Depth Marker	1	Coat Hanger Wire (A)	10 cm long
(2) Straight Line Source	1	Wooden Dowel (B)	40 cm long, 2 cm diameter
	2	Nails (C)	15 cm long approximately
(3) Straight Barriers	1	Wood (D)	40 cm x 2.5 cm x 1 cm
	1	Wood (E)	15 cm x 2.5 cm x 1 cm
	2	Wood (F)	10 cm x 2.5 cm x 1 cm
	1	Wood (G)	5 cm x 2.5 cm x 1 cm
(4) Curved Barrier	1	Hose Pipe with Smooth Surface (H)	55 cm long, 2 cm diameter
(5) Rectangular Plate	2	Glass Sheets (I)	25 cm x 15 cm x 0.4 cm
(6) Curved Glass Plate	2	Glass Sheets (J)	25 cm x 15 cm x 0.4 cm

© From Reginald F. Melton, Elementary, Economic Experiments in Physics, Apparatus Guide, (London: Center for Educational 1 Development Overseas, 19/2), PP 92-95.

(7) Vibrator Mass	1	Iron Bar (K)	11 cm x 2 cm x 0.3 cm
	1	Bolt (L)	0.2 cm diameter, 1 cm long

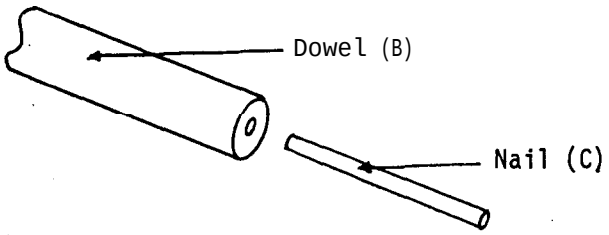
b. Construction

(1) Depth Marker



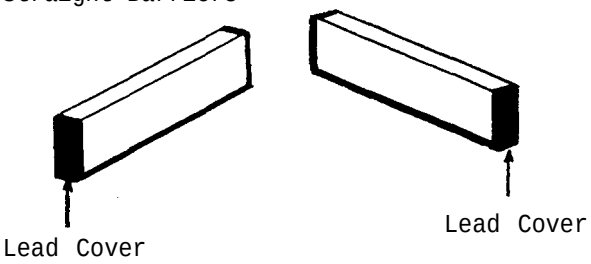
Mark off the end of wire (A) in half centimeter intervals (0-2 cm). The marker may then be used to determine the depth of the water at the four corners of the ripple tank, and makes the levelling of the tank simpler.

(2) Straight Line Source



Bore holes into both ends of the wooden dowel (B) and insert long nails (C) into the holes to prevent the rod from floating in the ripple tank.

(3) Straight Barriers



Nail thin strips of lead along the sides and base of the pieces of wood (D, E, F and G) to prevent them from floating in the ripple tank. The weighted pieces serve as suitable barriers.

(4) Curved Barrier

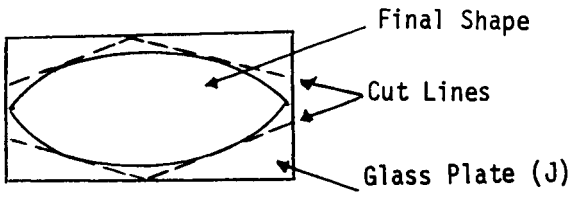
A smooth surfaced hose pipe (H) serves as a suitable curved barrier. The pipe may be curved into any desired arc.

(5) Rectangular Plate

Take a sheet of glass (0.4 cm thick) and mark out two sections (each 25 cm x 15 cm x 0.4 cm) with a glass cutter. Break the glass along the marks by hand, The two newly produced sheets (I) may be set one on top of the other in water, thus

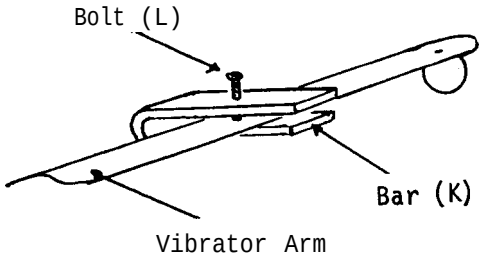
creating a plate of thickness 0.8 cm.

(6) Curved Glass Plate



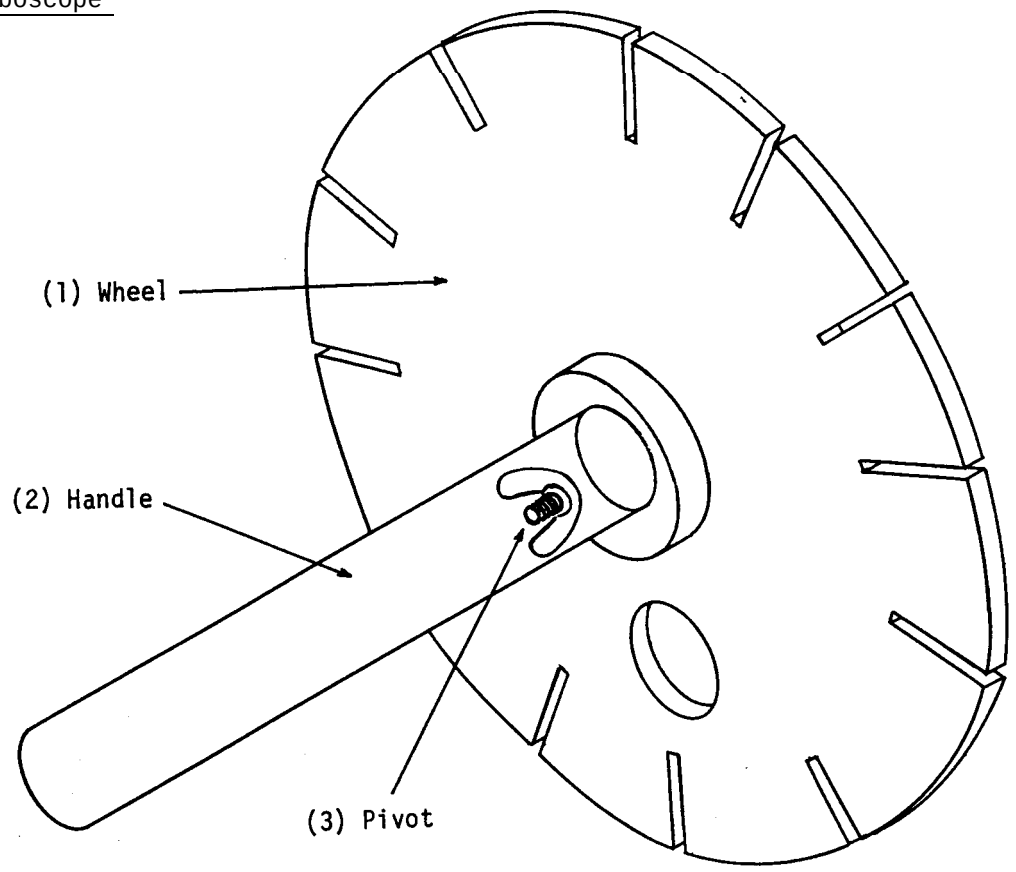
Scratch guidelines on the glass plates (J) in the shape of a parallelogram. Cut along the lines with a glass cutter, and break the glass along the lines. Grind down the shape to a curve, as indicated, with the help of a sandstone. The two plates may be used one on top of the other in the ripple tank, making a plate of thickness 0.8 cm.

(7) Vibrator Mass



The soft iron bar (K) should weigh approximately 50 g. Place the bar in a strong clamp, and use a hammer to bend it in half so that it becomes two parallel bars about 0.3 cm apart. Drill a hole (0.2 cm diameter) in the middle of the top bar, and make a thread (0.2 cm diameter) in the hole. Screw bolt (L) into the hole thus making it possible to clamp the bar onto the ripple tank's vibrator arm.

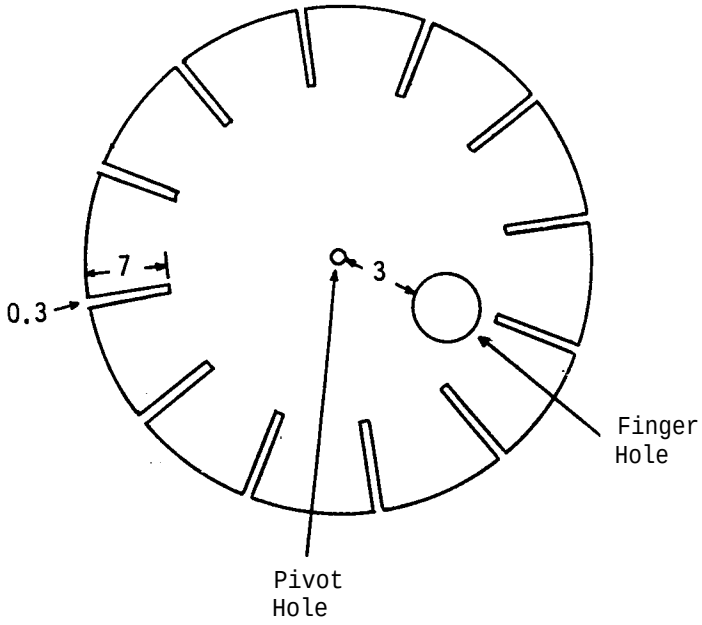
A3. Stroboscope ©



a. Materials Required

Components	Qu	Items Required	Dimensions
(1) Wheel	1	Hardboard (A)	25 cm diameter, 0.3 cm thick
(2) Handle	1	Wooden Dowel (B)	25 cm long, 2 cm diameter
(3) Pivot	1	Bolt (C)	4.5 cm long, 0.4 cm diameter
	1	Wing Nut (D)	0.4 cm internal diameter
	1	Nut (E)	0.4 cm internal diameter
	1	Wood (F)	3 cm diameter, 1.5 cm thick

(1) Wheel

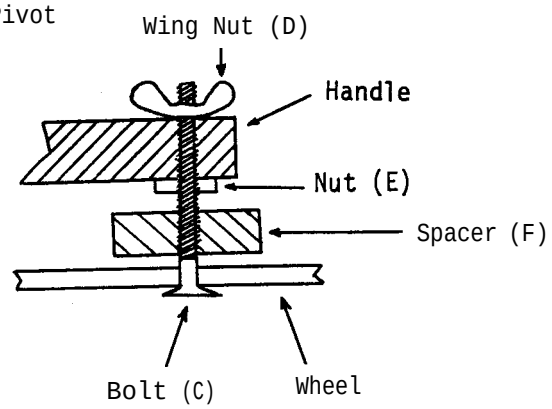


Cut the stroboscope wheel from the piece of hardboard (A). Make.12 equally spaced slits in the perimeter of the wheel. Drill a finger hole (2 cm diameter) at a distance of 3 cm from the center of the wheel, and a pivot hole (0.5 cm diameter) at the center of the wheel.

(2) Handle

The handle is simply a wooden dowel (B). Drill a hole (0.4 cm diameter) through one end of the handle to take the pivot bolt (C).

(3) Pivot



Detail
(Cross-section)

Use the bolt (C) to serve as the pivot for the wheel. Insert this through the wheel, the spacer (F), a locking nut (E) and the handle (B). Use the locking nut (E) and the wing nut (D) to hold the handle in a fixed position on the pivot,

c. Notes

(i) If the components of a moving body repeatedly take up fixed positions at regular intervals (e.g., vibrating bodies, waves) it is possible to "stop" the motion by viewing it through the slits of the stroboscope, rotated at an appropriate speed.