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An acoustic interferometer - used to study interference or relative phasing in sound waves.

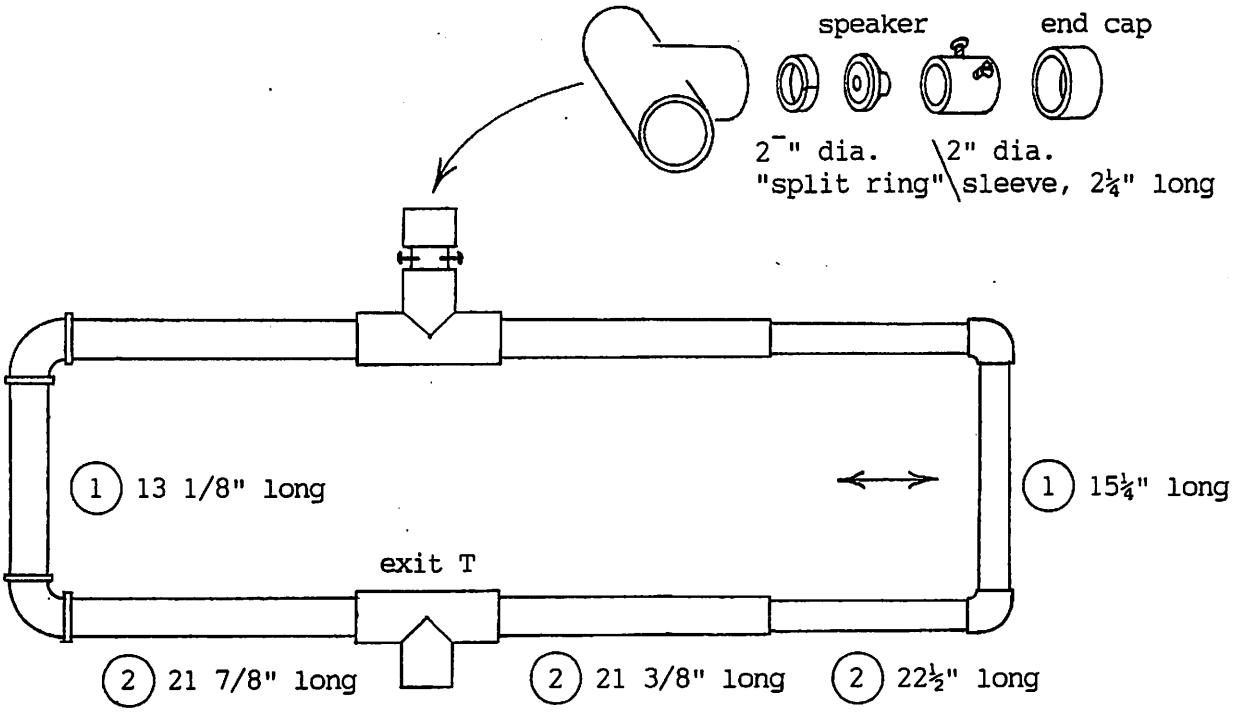
One 2" dia. U-shaped PVC pipe at the left (see diagram) is joined with one 1½" dia. U-shaped PVC pipe at the right. The smaller 1½" dia. pipe is adjustable or slides inside the right side of the larger 2" dia. pipe. A 2¼" dia. speaker fits inside one of the 2" dia. T connectors. With both sides at equal length, tune the speaker (adjust the freq.) for maximum amplitude (resonance) with the tube assembly. The sound waves travel exactly 2λ on each side and arrive at the open T connector in phase or with constructive interference and maximum amplitude. By adjusting (pulling out) the right side (1½" dia. pipe) so the path is $\frac{1}{2}\lambda$ longer, the sound waves arrive at the open T connector 180° out of phase or with destructive interference and minimum amplitude. By adjusting another $\frac{1}{2}\lambda$ longer or now one full λ longer from the original starting position, another in phase, constructive interference, or maximum amplitude situation is located. Continue the extension until the end point is reached (depends on the chosen freq.).

EXTRA - Repeat the experiment taking measurements to determine λ. Using the freq. on the function generator (audio oscillator) and $v = \lambda f$, calculate the speed of sound.

Remember - human hearing sensitivity in large group listening is much better at lower freq. and lower volume. A freq. between 400 and 500 Hz is recommended. The dimensions of this apparatus are based on this freq. range and the speaker's capacity. Also, the 2λ size allows for several maxi-mini locations at higher frequencies.

Special note: I recognize and thank David Sonday of Corning East H.S., Corning, NY for showing me his version of this apparatus first.

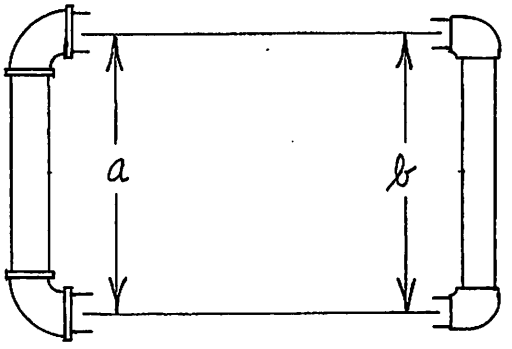
Materials: #40-246 Radio Shack 2¼" speaker, 10' length of 2" PVC pipe, 10' length of 1½" PVC pipe, two 2" pressure T's, two 1½" pressure 90° elbows, two 2" wp 90° elbows, 2" end cap, two 3/4" #6 x 32 bolts, two mini alligator clips (#270-380 RS), two 6" #22 wires



Some construction tips (details):

(a) Cut and assemble the 2" pipe section first. Then cut the two 22½" pipes for the 1½" pipe section.

(b) The 15¼" length may have to be changed. See diagram below. Measure the distance "a" of the 2" pipe section from the center of one elbow to the other. Test fit the 1½" elbows for insertion length and figure out the length of 1½" pipe needed to match the 2" end from the center of one 1½" elbow to the other ("b").



? length b must equal a

(c) All T connectors are not alike. To figure out the correct length (width) of the split ring, insert the speaker (without wires) in the T, followed by the sleeve pressed in hard. Hold the T up so the speaker rests on the sleeve and try to measure the gap between the T's "stop" and the speaker. A small piece of paper with ruler markings on it may help. The split ring should be just slightly longer (wider) than the gap.

(d) Cut off a piece of 2" pipe to the length determined above. Cut through (split) one side of the ring. It will naturally curl in slightly, just enough to fit perfectly in the gap and hold the speaker.

(e) Test fit the sleeve to see that the split ring, speaker, and sleeve are snug. Press on the end cap. Locate the two holes (far enough apart) for the bolts.

(f) Disassemble and drill the proper size holes for a #6 x 32 thread. Carefully tap (thread) the holes. Screw in the bolts so about equal lengths project inside and out of the sleeve.

(g) Solder 6" long #22 wire to the speaker and alligator clips. Clip the alligator clips onto the inside bolts, mark the outside of the sleeve with the correct polarity (+ and -), and carefully fold the wire inside the sleeve as the unit is reassembled or pressed together.

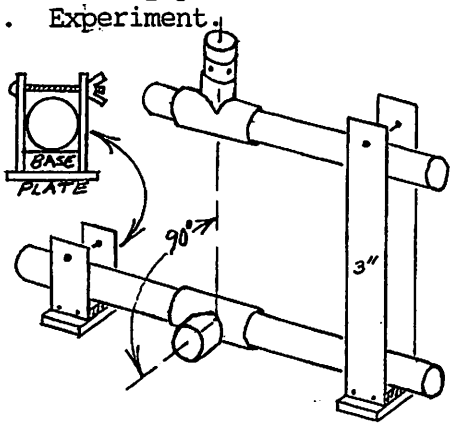
Further considerations:

(A) If the best freq. for your apparatus is 440 Hz, for example, then try simple multiples like 880 Hz, 1320 Hz, 1760 Hz, etc. to produce more interference maxima and minima. Experiment. Its simple design lends itself to many possibilities.

(B) Where hearing sensitivity is not as critical because the listening group is small, higher frequencies can be used in a laboratory setting. A lab version could be scaled down or made shorter, thus, using less pipe and storage space. It could be a good lab activity.

(C) For large group demonstrations, a small megaphone added to the exit T improves the effect. Or make a cone that fits. Experiment.

Display: Standing up on edge is best; thus, the exit T needs to be rotated 90° . A stand is needed to stabilize it. (See illustration.)



2 long #10-24 RH bolts and wing nuts
¼" plywood sides, 3"wide
3/4"thick wood base, 3"L
¼"x3"x4" base plate