LISTEN IN ON THE TUBE

It may look like a bazooka, but instead of spewing out mortar rounds it sucks in the sound for your fun and listening pleasure.

HAVE YOU EVER WANTED TO EAVESDROP ON THAT SHY AND elusive Yellow-Throated Warbler, or catch what Ms. What's-her-name, from down the street, is saying to Mr. Know-it-all? If the answer is yes, then read on and see how to build your own version of the *Tube*.

What is it

The Tube is a super-sensitive, long-range listening device that's easy to build and a ball to use. Just aim the Tube at the object you want to place under surveillance and sleuth away.

This particular tubular microphone differs in design, from the shotgun and the parabolic mikes that are often seen at various sporting events, by using a single large-diameter tube as the sound-directing and gathering instrument. A special 3-inch microphone is used to take advantage of the enormous sound-gathering capabilities of the large tube, and the detected sound is fed to a three-stage IC amplifier to wiggle your ears with either a stereo or mono pair of headphones.

The Amplifier Circuit

The sensitive mike is no more than a 8-ohm, 3-inch round, replacement speaker connected to a mini output transformer, to better match the input impedance of the first amplifier stage. The high-impedance winding of T1 is coupled to the input of one section of a low-noise, low-power, dual operational amplifier U1, see fig. 1. Resistors R3 and R5 set the gain of the first amp to 21. Output from that amplifier is fed to the input of amplifier "B" which magnifies the signal 15 times. The total gain of stages "A" and "B" is 315.

A .4-watt, audio, IC amplifier, U2, performs double duty by supplying ample drive for today's popular low-impedance headphones, and boosting the gain an additional 50 times. Total AC-voltage gain for the three amps is over 15,000. With the gain set for a comfortable listening level, the circuit's

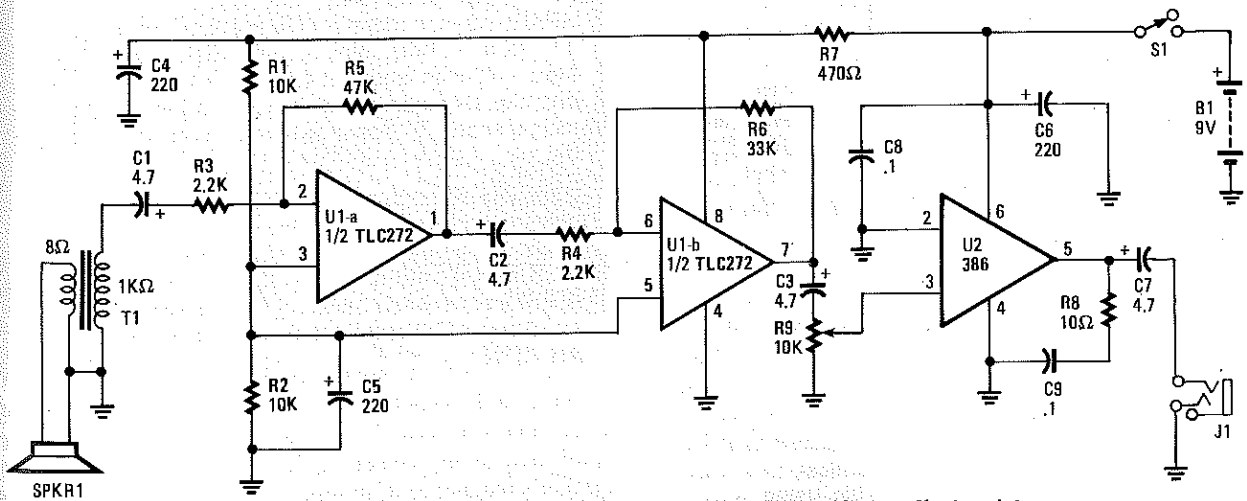
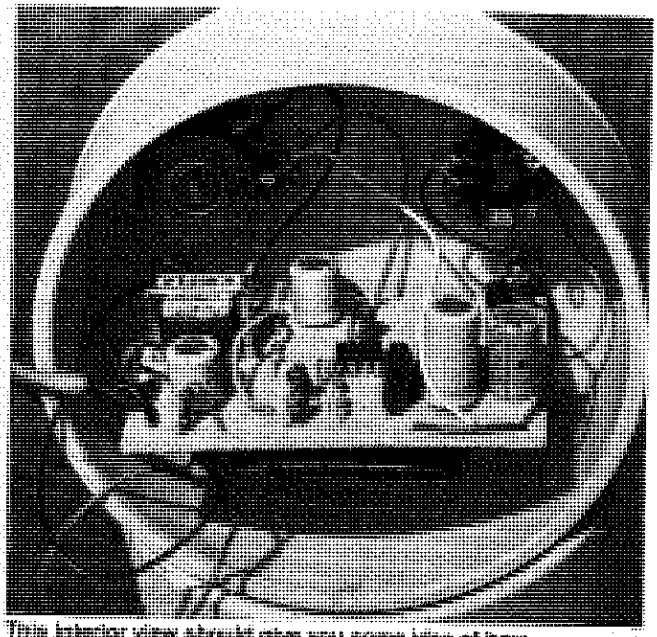
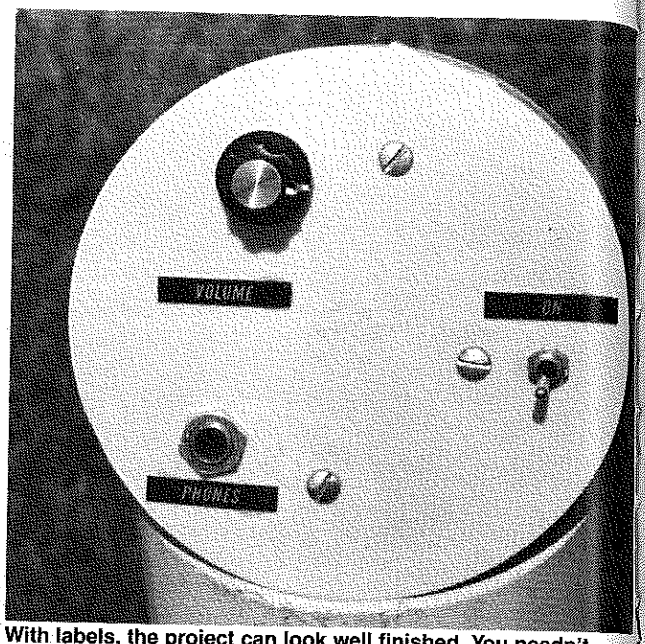


Fig. 1—Notice that the opamps are all AC coupled. That will allow you to skip the use of input-offset resistors.



This interior view should give you some idea of how you can easily place the components in the end of the tube. The circuit board is held to the back panel with right angle brackets and machine screws.



With labels, the project can look well finished. You needn't create your own. Just cut the labels from the faceplate of an old junk stereo out of your collection of parts

average current drain is slightly over 10 mA.

The output jack, J1, is wired to place the two earphones of a stereo headset in series, and will allow most mono phones to work as well. By increasing the impedance of the load (headphones) connected to the output of the driving amplifier, U2, the overall current drain from the battery will be reduced.

Building Your Own Tubes

Start out by gathering up the PVC tubing and cut a 42-inch length of 4-inch pipe, and a 8-inch length of 2-inch pipe.

Cut a 3-½-inch circle from a piece of circuit board, or similar material, and in the center of the circle cut another hole to allow the magnet on the 3-inch speaker to snugly pass through, see Fig. 2. Use contact cement and attach the PC-board circle to the speaker frame.

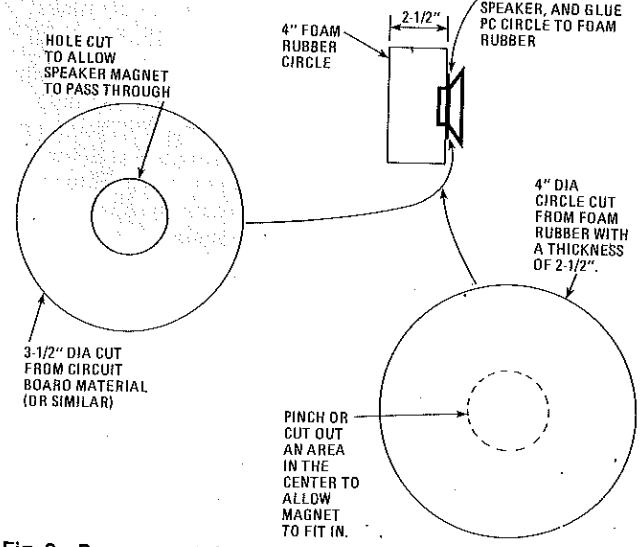


Fig. 2—Proper mounting of the speaker is not critical, but you should try to center it as best as possible. Using PC-board material may be a little expensive for your taste. If so, use a piece of plywood or plexiglas.

PARTS LIST FOR THE TUBE

CAPACITORS
C1,C2,C3,C7—4.7-μF, 25-WVDC electrolytic capacitor
C4,C5,C6—220-μF, 16-WVDC electrolytic capacitor
C8,C9—.1mfd, 100-WVDC electrolytic capacitor

RESISTORS
(All fixed resistors are ¼-watt, 5% units)
R1, R2—10,000-ohm
R3, R4—2200-ohm
R5—47,000-ohm
R6—33,000-ohm
R7—470-ohm
R8—10-ohm
R9—10,000-ohm potentiometer

ADDITIONAL PARTS AND MATERIALS
B1—9-Volt transistor-radio battery
U1—TLC272 dual operational amplifier integrated circuit, Radio Shack #276-1749
U2—386 4-watt audio amplifier
J1—¼-inch stereo headphone jack
SPKR1—3-inch round 8-ohm speaker
T1—1K to 8-ohms, mini, output transformer
Misc.—42-inch length of 4-inch (dia.) PVC sewer pipe, end cap, 8-inch length of 2-inch (dia.) PVC pipe, 2 ½-inch spacers, PC board or perfboard, foam rubber, solder, etc.

Complete kit of parts for building your own Tube, less only the handle, and including tubing, hardware, circuit board, component parts, pot, switch, jack, speaker, foam rubber, and end cap, all for $39.95 plus $2.50 (UPS) shipping and handling. Circuit board only $7.95 pp. Order from Krystal Kits, P.O. Box 445, Bentonville, AR 72712.

Cut a circle 4-inches in diameter out of a piece of foam rubber that's at least 2-½-inches thick. Pinch or cut out a small area in the center of the foam rubber to allow the speaker's magnet to fit in place. Center the speaker, with an attached collar, in the center of the foam-rubber circle, and make a permanent joint with contact cement.

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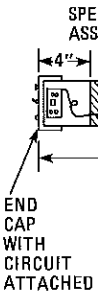

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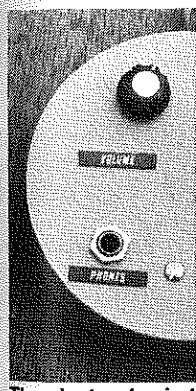

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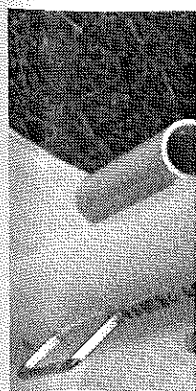

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Connect a 10-inch length of twisted or shielded twin-wire cable to the speaker terminals, and cut a shallow slit down the side of the foam rubber, below, and in line with, the terminals, to let the cable slip in and hide in place.

Both the handle and sight tube are located in the center of the 42-inch tube (see Fig.3), with the handle centered at the bottom and the sight tube centered lengthwise, but off from top center about 20 degrees in either direction. By mounting those two items in the center, lengthwise, the assembly will work equally well for a left-handed or a right-handed person.

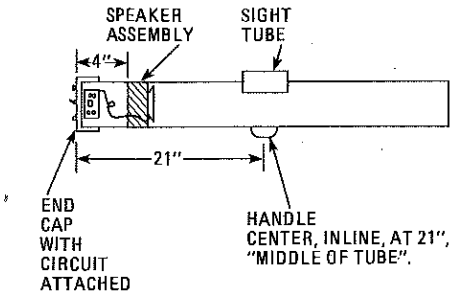
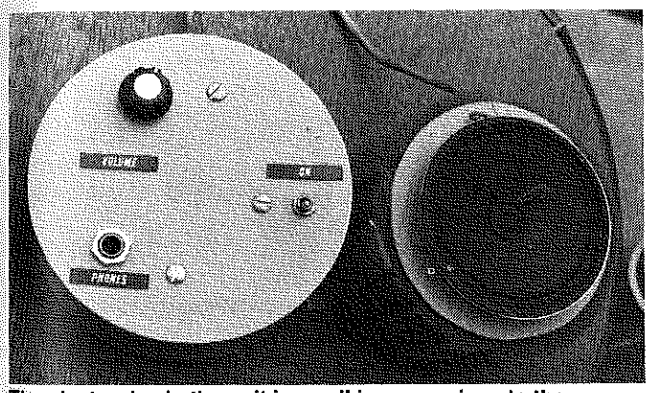
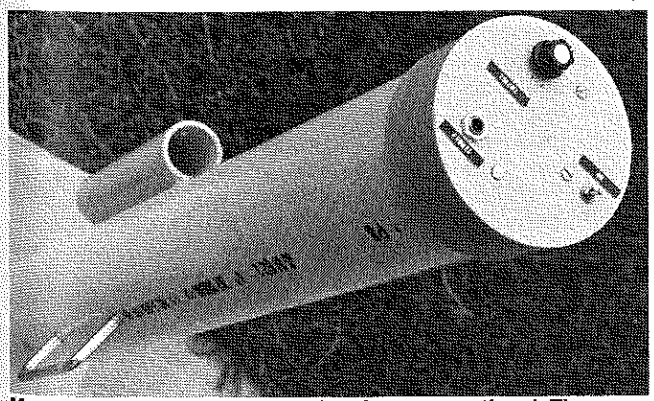


Fig. 3—The completed unit should have a handle and sight for easy aiming. be sure to use sufficient leads on the speaker to allow easy connection with the circuit board.



The electronics in the unit is small in comparison to the overall project size. The electronic unit can be used in a variety of applications, especially if you switch the leads to the speaker and jack. Then speaker will be the output and the jack can be used to amplify any desired input.



Mounting the handle and sight is, of course, optional. The handle is a good idea as it keep sound of the movements of your hand upon the tube at a minimum

The Circuit Board

The electronics can be built on a PC board or perfboard, whichever you choose will work okay. Just keep all leads short, and follow the general layout as shown in Fig. 4.

The circuit board is mounted in the lid with two small metal angle brackets, with the battery and on/off switch on one side, and the pot and phone jack on the other. Since the layout for the lid is certainly noncritical, you can rearrange the components to suit any scheme you desire, but try to keep the interconnecting wiring as short as possible.

Fig. 4—The circuit board can be constructed using this foil pattern as a guide. Be sure to trim the solder pads as shown so that they do not interfere with other traces.

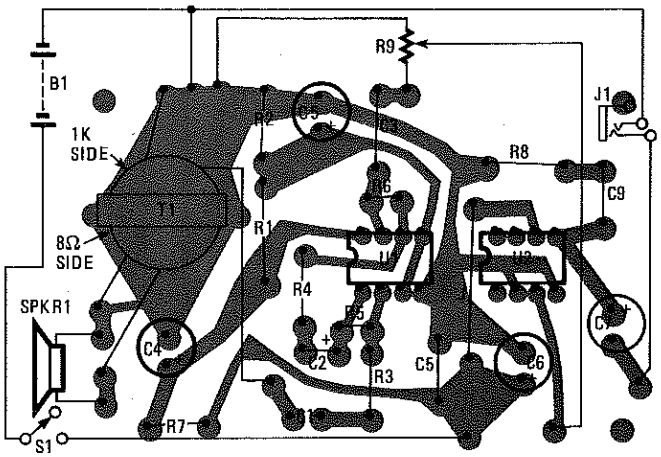


Fig. 5—Please note that the negative battery terminal must be connected to the ground circuit trace and to J1. Be sure that the windings of T1 are connected to they proper pads.

Take the speaker assembly and slide it into one end of the 4-inch tube, leaving a 4-inch space behind the back of the foam rubber, see Fig. 3. When positioning the speaker in place be sure that the speaker's cone is perpendicular to, and in line with the tube opening.

Fire it Up

Give the Tube a workout. Connect a battery to the circuit and slide it in the metal battery clip and slip the end cap assemble on the tube. Turn the gain to its minimum setting and with headphones in place flip the power on. Set the gain to about mid-position and rest the back of the tube on your shoulder, and aim toward whatever you want to listen in on.

The Tube is an ideal instrument to use in locating the noisy little critters that occupy our back yards, parks, and forests. Birds, in particular, are easy to locate and listen to at distances of several hundred feet; and kids at play can be checked on at even greater distances. Like any other new gadget the Tube will need some playing with to obtain the best possible results, and it's possible to get cauliflower ear before you tire from just listening in on the outside world. ■