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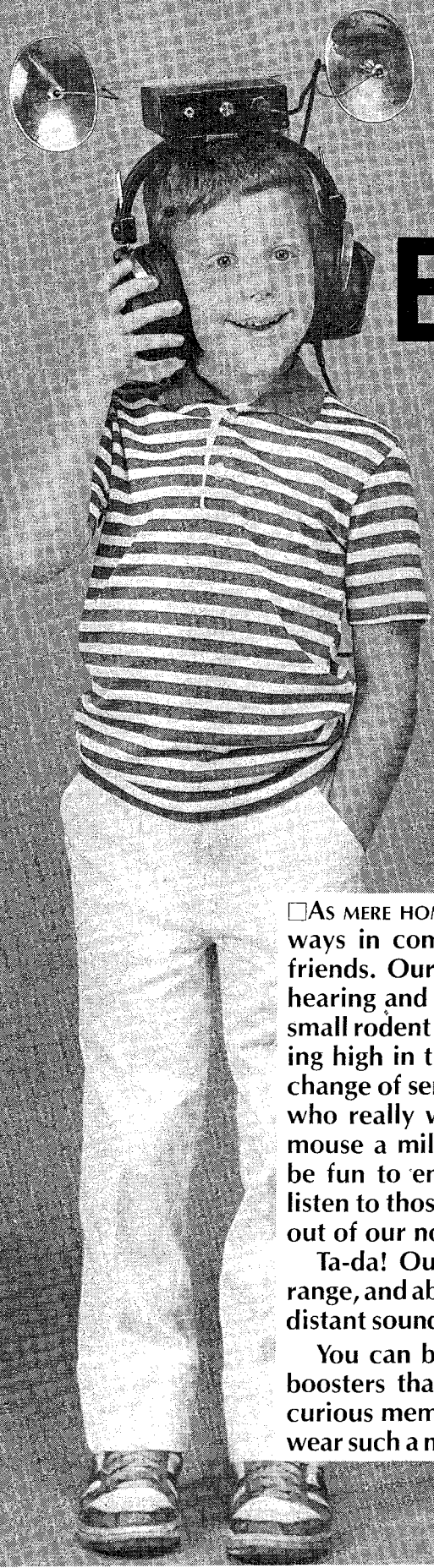


BIONIC EARS

When all is said and done you'll catch every word with this device that would put a Doberman's sense of hearing to shame!

By Charles D. Rakes

□AS MERE HOMO SAPIENS OUR SENSES ARE LIMITED IN MANY ways in comparison to our furred and feathered friends. Our canine pals can out do our sense of hearing and smell, and our national bird can see a small rodent scurrying across a meadow, while soaring high in the sky. No, I'm not advocating an exchange of senses with any of our gifted friends, and who really wants to sniff like Benji, or observe a mouse a mile away? Certainly not I, but it would be fun to enhance our hearing ability so we can listen to those weak and distant sounds that are just out of our normal hearing range.

Ta-da! Our bionic ears can extend our hearing range, and ability to determine the direction of those distant sounds that were only faint whispers before.

You can build a pair of electronic bionic audio boosters that can thrill and excite the brave and curious members of your family who are willing to wear such a marvelous piece of high-tech equipment.

How Does it Work?

A pair of precision solar reflectors, with mini electret-mike elements located at their focal points, collect the sound and feed their minute signals to U1 to be amplified. The two ears are separated by a distance of about 8-inches to create a stereophonic effect and are supported by the amplifier's cabinet and stereo earphones.

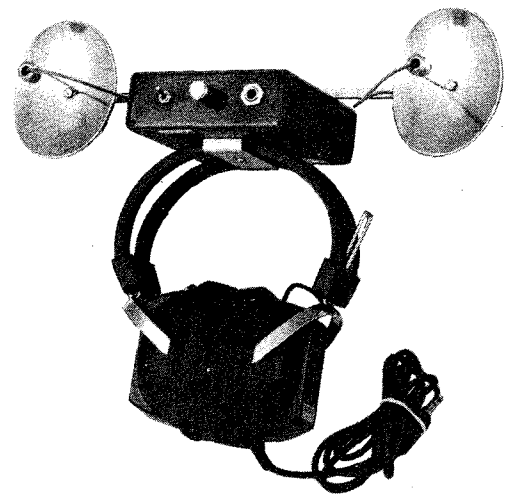
Here's how the circuit works: Take a gander at the schematic diagram in Fig. 1, and you'll see that the circuit is a straight-forward, dual audio amplifier designed to drive a pair of low-impedance stereo phones. Both amplifiers are identical in design using the same component values, and share a dual gain-control potentiometer, R15/R16.

Electret mike, MIC1, is supplied an operating current through R5, and the audio signal is coupled to the input of U1-a through C3 and R9. The gain of that stage is set by the ratio of R9 and R11, or 220K/1K, giving a voltage gain of 220. The input of the second amplifier, U1-b, is connected to the wiper of the gain control potentiometer, R15, through coupling capacitor C8 and input resistor R7. The gain of the second stage is 220 also. Theoretically the accumulated gain of both amplifier stages together, with the gain wide open, is near 50K.

The audio output of U1-b is coupled through C5 to the primary winding of a mini audio-output transformer, T1, with it's secondary driving one earphone through J3. Resistors R3 and R4 set the bias of the positive inputs of the four op-amps to about 1/2 of the supply voltage. That biasing arrangement allows each amplifier to obtain an equal positive and negative output swing. The mirror amplifier circuit of U1-c and U1-b operates in the same manner, as the described amplifier, to drive the other earphone.

Building Your Own

A good place to commence is to build up the two sound-reflector mikes. Refer to the photos and the drawing in Fig. 2. Two Radio Shack solar cigarette lighters are modified to reflect sound by mounting the electret elements at the focal point. A brass pipe fitting with an inside diameter slightly larger than the mike's diameter is used to house each of the mike elements. A .062-in. diameter, brass rod is cut and



The Bionic Ears require no external amplification. The unit is self-contained and fully portable. Just the thing for the super snooper. (The next company picnic should be revealing!)

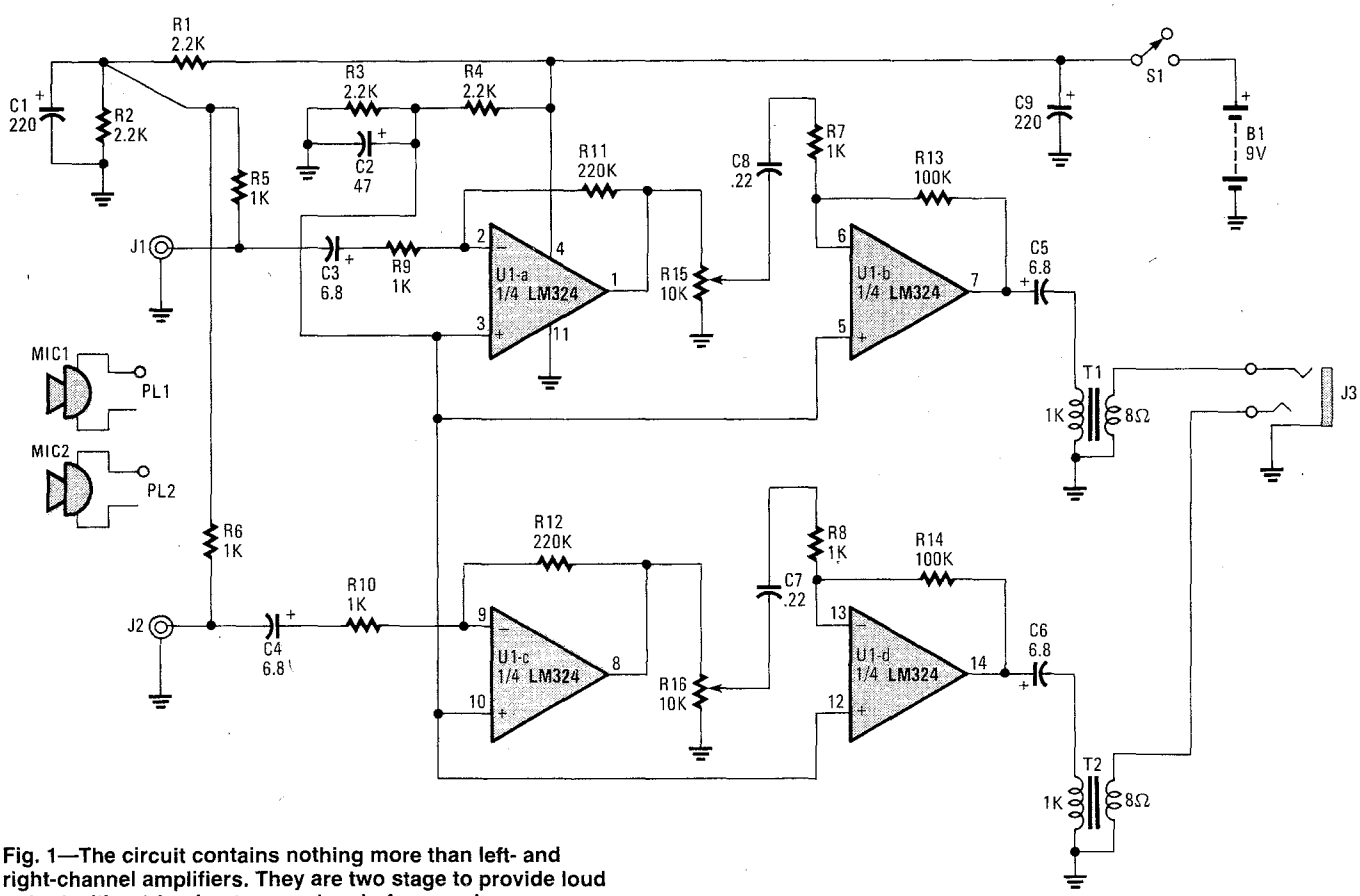


Fig. 1—The circuit contains nothing more than left- and right-channel amplifiers. They are two stage to provide loud output without forcing too much gain from each op-amp.

shaped to hold the pipe fitting in the center of the reflector and at the focal point. The rod is soldered to the fitting and kept in place on the reflector with a 6-32 screw and a 1/2-in. metal spacer (see Fig. 2). A 12-in. length of 1/4-in. square, brass tubing connects the ears together and to the amplifier's cabinet.

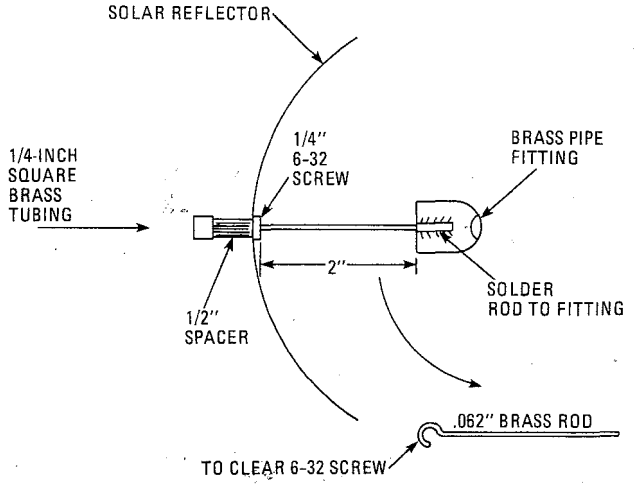
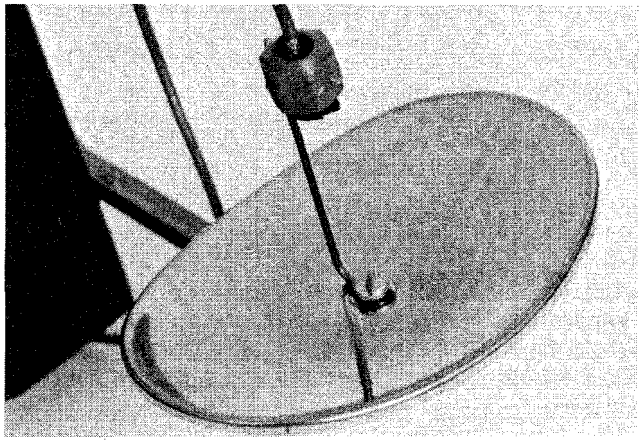
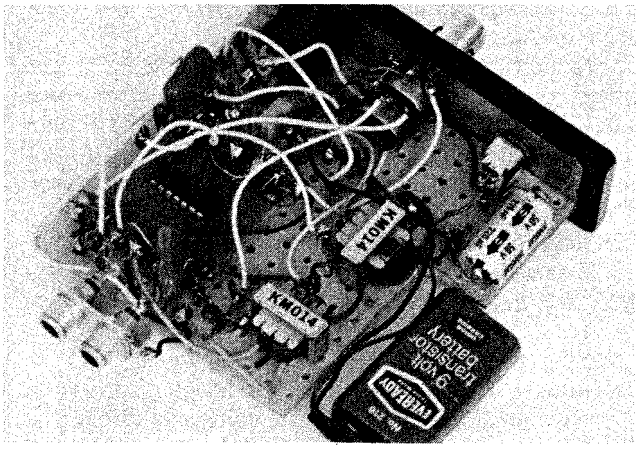


Fig. 2—Proper positioning of the microphones is important. Be sure that the mic's are not only centered, but at the focal point of the parabolic dishes as well.



The mikes pickup will be enhanced by proper placement at the parabolic-reflector's focal point. If you haven't got an iron hot enough to solder the rod to the outside of the fitting carefully, then try placing the rod inside the fitting and squeezing the mike into place instead.



With creative placement, the unit can be fitted in a reasonably small cabinet. The authors model was fitted with phono jacks to facilitate its use as a stereo preamp.

PARTS LIST FOR THE BIONIC EARS

CAPACITORS

C1,C9—220-μF, 16-WVDC electrolytic
C2—47-μF, 16-WVDC electrolytic
C3-C6—6.8-μF, 35-WVDC, tantalum electrolytic
C7,C8—.22-μF, 100-WVDC, mylar

RESISTORS

(All resistors are 1/4-watt 5% units unless noted otherwise.)
R1–R4—2200-ohm
R5–R10—1000-ohm
R11, R12—220,000-ohm
R13, R14—100,000-ohm
R15/R16—10,000-ohm, dual, mini potentiometer

ADDITIONAL PARTS AND MATERIALS

B1—9-volt, transistor-radio battery
U1—LM324 quad-op-amp.
J1,J2—RCA phono jack
J3—Stereo 1/4-in. jack
M1,M2—Electret mike element, Radio Shack #270-090
P1,P2—RCA phono plug
S1—SPST mini toggle switch
T1, T2—1000-ohm to 8-ohm mini, audio-output transformer

Aluminum utility case 1-9/16 × 4-3/4-in., (2) Solar cigarette lighters Radio Shack #61-2797, (2) small brass pipe fittings, IC socket, perfboard hardware, stereo headphones etc.

Approximately 11 inches of small, shielded, audio cable connects each mike element to an RCA phono plug. Use just enough electrical tape wrapped around the mike element to keep it snugly in place inside the fitting, and take care not to short the positive mike lead to the fitting.

The headphones can be mounted to the bottom of the amplifier's cabinet with a metal or plastic bracket or bolted directly in place with 6-32 hardware. actually any workable construction scheme, as long as the ears are constructed to pick up the reflected sound, can be used in the physical layout of the project. Build to suit.

Wiring up the circuit. A 3-3/4 × 4 inch piece of perfboard, with a small section cut out to allow a nine volt battery to fit in place hold the amplifier's components. The general component layout shown in the photo can be followed, or a PC board could be made, but in any case the layout isn't critical, so if a good approach is taken no problems should occur.

The perfboard is mounted to the front panel with a "L" bracket made from a scrap piece of aluminum, and a similar small bracket holds the two mike input jacks, J1 and J2 on the rear. Drill or punch matching holes in the back panel of the cabinet to allow the two input jacks to stick through about 1/4-in.

Trying Out the Ears

Install a nine-volt battery in place and slide the circuit into the cabinet and turn on the power. Surrounding sounds should be loud and clear in both earphones. Adjust the gain to match the application and check out the ears for gain balance and overall directivity. If one channel seems to be more sensitive than the other check to see that both mikes are set at their focal point.

The only problem with the bionic ears is in convincing someone over the age of seven to pose for a picture, and I just can't see why anyone would mind, can you? ■