Build Your Own Reverb
by Nicolas Collins

In the disembodied world of today's computer-based multitrack mixing, one can spend a lot of time crafting a unifying sense of "space." Despite the dozens of reverb plug-ins and rack devices available, you might like to experiment with some physical signal processing that can impart an authentically acoustic presence to your sound. The vocal chamber made with a speaker and mic in the bathroom makes periodic appearances in these pages, so I will limit myself to observing that omnidirectional mics generally sound better than cardioids in this application (more natural off-axis response). But if you're willing to spend a few dollars on parts and a half-hour soldering you can make yourself some distinctly different reverbs and signal processors.

The Contact Mic

The first thing you'll need is a contact microphone. This is a mic that picks up sound by direct contact with a vibrating surface, rather than responding to pressure waves traveling through the air. Contact mics are often sold as pickups for acoustic instruments like guitars and violins, but building one is easy and the parts are so cheap you'll never want to pay for one again. This is a useful enough mic in its own right that if you're dissatisfied with our reverb experiments you can always use it as a musical instrument pickup or for sampling weird sounds.

The heart of a contact mic is a piezo disc - a small disc of brass on which a thin layer of ceramic crystal has been deposited (see Figure 1). They are typically encased in a black plastic resonator and are used to make that beeping sound in microwave ovens, alarm clocks, ATMs, etc. You can buy one at your local Radio Shack if you're in a hurry, but you'll pay a premium for that convenience and will have to draw on your clam-shucking experience to extract the disc from its shell.

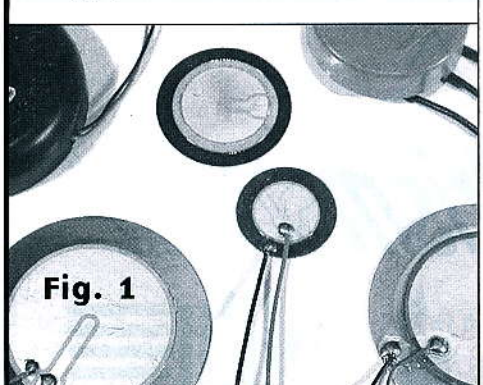
Fig. 1

It's cheaper and less painful to buy raw discs from an online retailer of electronic surplus - All Electronics (www.allelectronics.com) and Electronic Goldmine (www.goldmine-elec.com) stock good piezos for as little at 30 cents apiece. Look for one that already has short wires attached to it (like the small one in the center of Figure 1), since soldering directly to the crystal is infernally difficult. If the disc comes encased in a plastic lollipop you'll have to extract it carefully, without bending or scratching. If it has a small circuit board attached to the wires snip it off as close to the board as possible (this board contains a simple circuit that makes the disc beep - unneeded by us). The size is irrelevant - big ones are no louder than small ones. The disc should have one wire soldered to the metal part of the disc and one soldered to the white crystal - sometimes there's a third wire attached to a tongue-like strip in the center of the crystal, but this will not be used, so you can cut it off.


Fig. 2

The easiest way to turn the disc into a contact mic is to solder it to an old guitar cable - otherwise use any piece of shielded cable you have lying around. You should use shielded cable to keep the noise down to an acceptable level, and keep it under 10 feet long for the same reason. Cut the plug off one end of the cable if necessary, and strip back the wire as shown above. Solder the cable's shield (the outer conductor) to the thin wire attached to the metal rim of the piezo disc - then solder the inner conductor to the wire coming from the crystal, as shown in Figure 3 (if you swap these connections around the mic will hum). Solder a mono 1/4" plug to the other end if you're using raw cable.

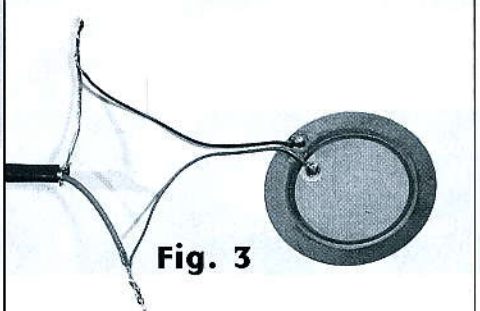
Fig. 3

Plug the mic into an amp or mixer and confirm that it works - tap it gently, clamp it to a cymbal, stick it on a banjo, etc. This is a high-impedance, high-output pickup and it sounds best plugged into the kind of front end that works well for guitars - the 1/4" inputs on most semi-pro mixers (like Mackies) or guitar amps are good, and a simple guitar effect pedal (like an EQ or preamp) can help buffer the signal. Most proper mic preamps have too low an input impedance, so don't bother wiring the disc to an XLR connector in pursuit of a better sound - if you need the gain of a real mic preamp, patch the contact mic through a DI box.

Once you know that the mic works, wrap some electrical tape around the wire joints near the piezo to keep them from shorting. Stick another piece of tape over the crystal side of the disc as well. This helps keep the wires from tearing off and prevents the humming you probably heard if you touched the surface while testing it. The fact that your contact mic looks pretty scruffy does not seriously affect its sound, but if you're fussy you can buy yourself a can of Plasti Dip at a hardware store and coat the disc and first few inches of cable. (This stuff not only looks cool, but it strengthens the solder joints on the disc and flattens the frequency response a bit, plus it waterproofs the mic if you're looking for a cheap hydrophone - see Figure 4.)

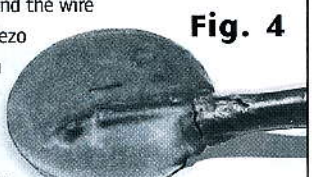
Fig. 4

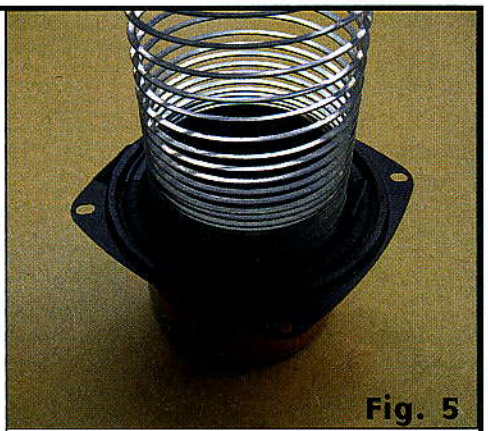
Fig. 5

Slinky Reverb

While you're out shopping for Plasti Dip, pick yourself up a Slinky from a toy shop. Tape down one end of the Slinky inside the cone of an expendable speaker (either a raw loudspeaker or one in a cabinet) - gaffer's tape works well - and place the speaker on the floor as shown in Figure 5. Clamp your contact mic to the other end of the Slinky with a strong spring clip and attach this assembly to the end of a mic boom 3-6 feet up from the speaker, with the Slinky stretched between (Figure 6.) Plug the contact mic into your mixer or a guitar amp and pluck the spring to check your level. Now play some audio through the speaker and listen to the contact mic as the speaker shakes the Slinky - you may want to use headphones so you can distinguish the sound of the Slinky from the music coming directly out of the speaker.

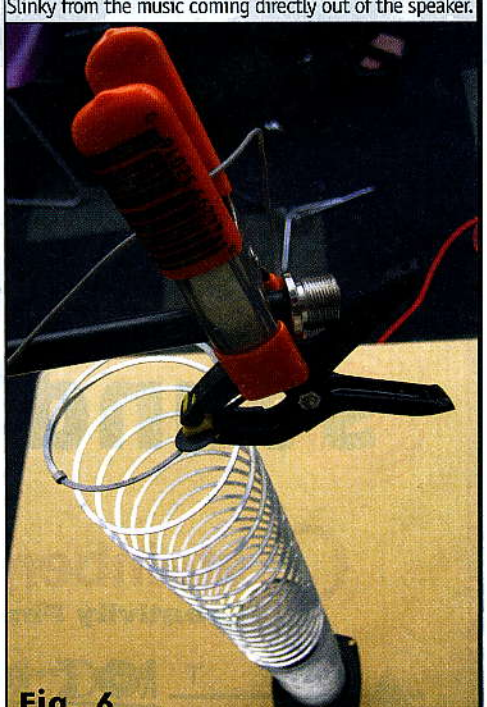
Fig. 6

You should hear a "spoingy," vaguely spring reverb-y cloud around your original signal.

You can tune this effect by -

- Raising and lowering the boom to change the tension on the Slinky or moving the stand so the spring is stretched at an angle.
- Varying the equalization on both the source driving the Slinky and the contact mic.
- Clamping the Slinky at various locations to damp the sustain (try wooden clothespins).

- Substituting a different size Slinky, or other stretchy springs.
- Swapping out a different speaker.
- Clipping a second contact mic to another spot on the Slinky for stereo, or adding a complete second channel with another speaker, Slinky and contact mic.

Test this in a mix the way you would any other reverb, using a send and return. Percussive sounds "ring" the reverb, letting you hear its decay curve. Soloed the Slinky may be unacceptably goofy, but in a mix - possibly in conjunction with "normal" reverberation - it might be just what you need. The noise coming from the speaker is distracting for sure, but you can always lock this construction up in a closet somewhere. Use a DI box to run the contact mic over distances longer than its own cable.

Sort of a Plate Reverb

This technique of rattling a spring with an ordinary speaker can be adapted to make a crude form of plate reverb as well. First find your "plate" - this can be a sheet of steel or other metal, but you might also try a gong or large cymbal. Spend some time tapping pieces of junk with a drumstick or mallet until you find something that sounds nice. Hang it from your ceiling or a pair of mic stands in such a way as to minimize damping. Clamp your contact mic along an edge. Find another small speaker around three to five inches in diameter and glue a wine cork to the center of the cone with epoxy (see Figure 7). The cork must be taller than


Fig. 7

the cone is deep, so it extends beyond the mounting gasket of the speaker. Attach the speaker to the end of a mic boom using a spring clip or some gaffing tape (see Figure 8). Test it with the same audio setup as before - send to the speaker, return from the contact mic. While the driving signal plays, carefully move the speaker in just close enough that the cork vibrates against the plate and listen to the contact mic.

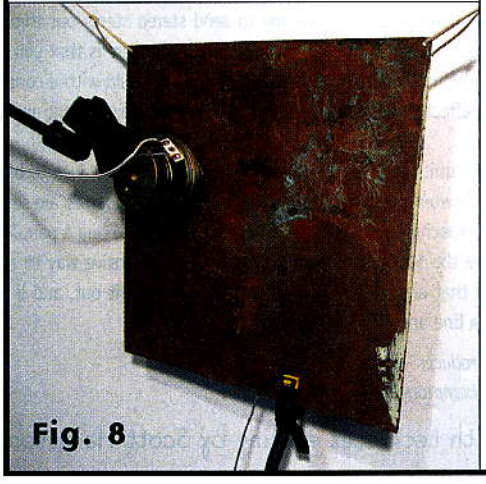
Fig. 8

You can tune this reverb by:

- Adjusting the distance between the cork and the plate.
- Moving the contact mic and/or driving speaker to different locations.
- Attaching materials of different hardness to the end of the cork (thumbtack, felt, wood, Blu-Tack, etc.).
- Substituting a different speaker.
- Damping the plate with clamps, Silly Putty, Moon Gel, etc.
- Adding a second contact mic and/or speaker for stereo.
- Trying different objects for the plate - car hood, rebar, plumbing pipe, bass drum, oil drum, a banjo, a barbed wire fence, etc.
- Tweaking the send and return EQ.

If you use a sizzle cymbal for your plate, the rivets will add accents. Other plates can be similarly prepared with metal scraps that vibrate sympathetically (like the bottle cap resonators encircling the gourd of an mbira.) As with the Slinky Reverb, the speaker makes enough noise on its own that you'll want to stash the whole thing behind a closed door.

Drivers

If you cut the cork to exactly the right height you may be able to bolt a speaker directly to the plate, thus eliminating the need for the finicky mic stand. The weight of the speaker will have a damping effect, but if the plate is large and reverberant (and the speaker is small) this may work. Alternatively, you can hunt down one of the various specialized transducers (or drivers) available that are basically speakers without cones - they vibrate objects more efficiently than ordinary speakers and they radiate less direct sound as well (making isolation less of a problem). The granddaddy of them all is the "Rolen-Star" (www.rolen-star.com) transducer, used by avant-garde composer David Tudor in his *Rainforest* installations. As you might be able to tell from Figure 9,

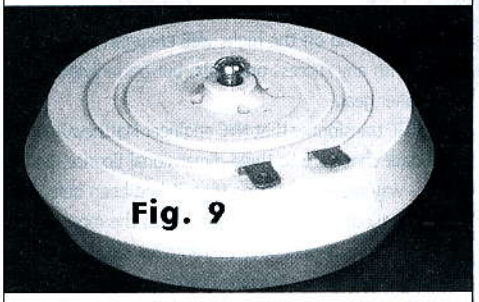
Fig. 9

this lump screws directly into whatever surface you want to resonate. Drivers designed for turning car trunks or theatre seats into sub-woofers are modern, more robust updates of the Rolen-Star, useful for vibrating heavier materials - these include Aurasound's Bass Shakers (Figure 10), Sonic Immersion's I-Beam and the delightfully-named ButtKicker. Despite being marketed as subwoofers, their frequency response extends high enough to make them quite functional in our reverbs. If you're resonating lightweight plates, cymbals, gongs, etc., you might consider removing the very efficient transducer from the Sonic Impact SI-5 Flat Panel Speakers (see Figure 11) or using the same company's SoundPads stick-on speakers, which looks as though they were designed just for our crazy application (Figure 12).

Other Techniques

Sit a loudspeaker inside a grand piano with the sustain pedal wedged down and a contact mic on the soundboard..

Drop a small speaker into the sound hole of an acoustic guitar (12-strings are great) or autoharp and stick the contact mic to the bridge - this trick sounds better when the instrument is really out of tune (one of the best reverb effects I've ever heard resulted from talking near a very out-of-tune sarangi, an Indian bowed string instrument with dozens of sympathy strings.)

Sending a drum track back through a speaker resting on a drum opens up a world of re-amping possibilities (see "Re-amping Drum Tracks", issue #67).

Pre- and Post-EQ

The piezo contact mic is loud, but far from flat in its frequency response. Our homemade drivers, the Slinky and the other metal scrap have similar roller-coaster response curves. You'll probably need to equalize both the driving signal and the contact mic quite radically to get an acceptable sound. A cheap stomp box graphic EQ is a useful tool here.

Final Words

These reverbs may look silly on paper, but they sound wonderful and are cheap and easy to build. A whole world of new sounds and spaces is within your grasp. Try this at home! ☮

www.nicolascollins.com

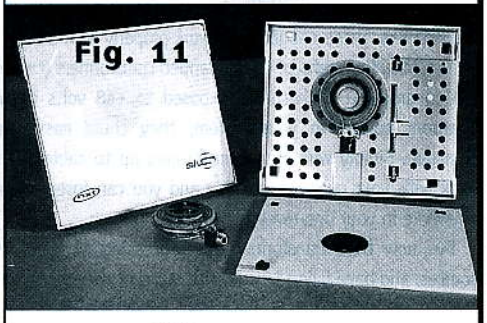
Fig. 11


Fig. 10


Fig. 12