

I have worked with wind harps since 1981 or so. I knew of aeolian harps and singing kite strings, but I was never interested in creating acoustic wind harps. Instead, I 'discovered' wind harps in tandem with other projects I was exploring at the time. Most of my sonic exploration finds roots in my use of piezo electric devices since 1977. After composing TRAVELON GAMELON for amplified bicycles that year, I set about to make a rugged and effective pickup device, because the first pickups I made were too fragile to last for more than one performance. This led me to working with ceramic phono cartridges, which I mounted onto 8-32 bolts to attach to bicycles. (See drawing #1, from the score to T Gam.) These cartridges are made of two layers of piezo electric ceramic material that sandwich a thin piece of metal to form what is called a 'bi-morph.' The basic property of any piezo electric device is that it behaves in 2 ways:

1. If you bend it, a small voltage is produced (a microphone)
2. If you apply a voltage to it, the device bends (a loudspeaker)

The phono cartridge can be an EV 81T, which must be taken apart and carefully soldered as shown. Clamp the plastic needle between the washers.

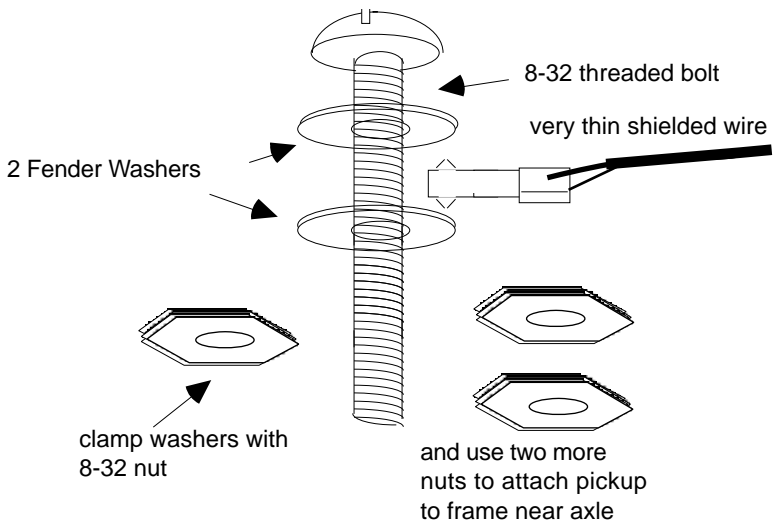
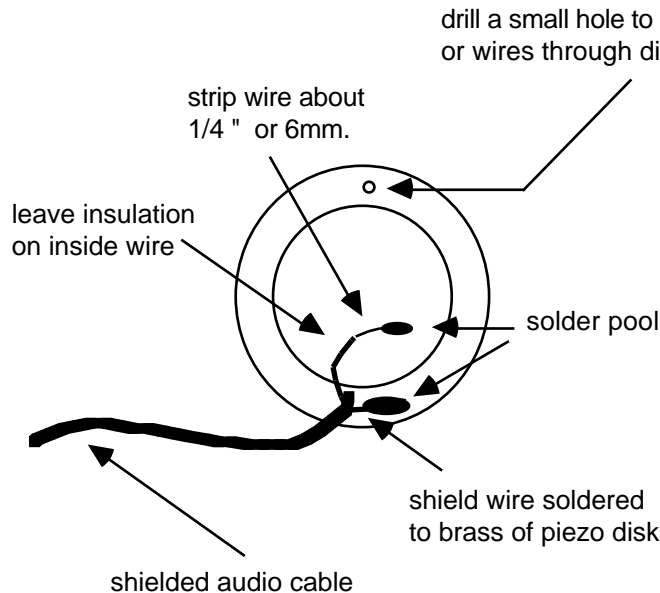


figure 1

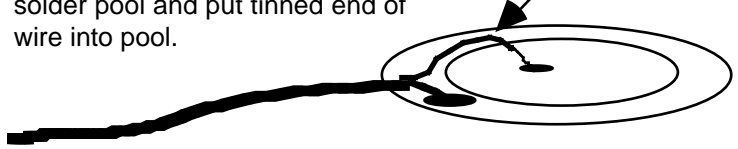
During the work for T Gam I explored all sources of piezo electric devices, largely through mail order surplus stores. Here, I came upon the piezo electric disc. To be sure, many other musicians and artists before me had worked with these materials. These devices are simply brass discs to which is epoxied a smaller piezo electric ceramic disc. The ground wire always goes to the brass and the hot or shielded wire goes to the ceramic. They are the ideal material to explore the 'micro'phonic world. They are rugged and inexpensive.

SOLDERING a PIEZO DISK



1. Tin both the inside or "hot" wire and the shield
2. Apply a small pool of solder (1/2" x 1/4") to the brass for the shield wire
3. Hold tinned shield wire on this pool with soldering iron. Tinned shield will flow into the solder pool making a very strong solder connection & strain relief
4. To solder onto piezo ceramic, you must use a very clean soldering iron--about 20 watts maximum
5. Apply very small pool of solder to the piezo disk
6. While holding insulated wire, reheat solder pool and put tinned end of wire into pool.

HINT: if you make this wire longer than it has to be, there will be less stress on the solder connection (see below)



Along with exploring pitch inside of bicycle spokes, I also explored amplifying voices sung into plastic cups which were attached to harpsichord wire amplified by piezo electric discs (in my piece *Accretion Disk, Event Horizon, Singularity*, in 1978). I used tuning forks suspended from harpsichord wire (in my theater piece, *Incident at 3 Mile Island*, 1980), and some early installation pieces included amplified brass, bronze and copper window screens. Because of the sonic richness of these sounds, I still work with these instruments.

These were the pieces lead me directly to woking with wind harps. Listening to ampliified window screens mounted outdoors, through headphones, one could hear the mesh moving against iitself, one could hear airborne objects

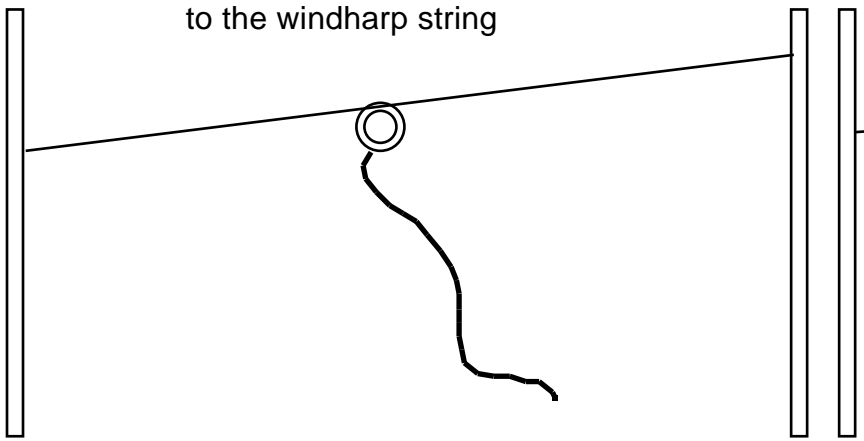
striking the screens (insects, dust, rain etc.) and one could hear a rising and falling tone. What ought to have been obvious to me before revealed itself through the process of working: THE STRING TO WHICH A SCREEN WAS SUSPENDED FROM WAS ALSO BEING PLAYED BY THE WIND. The rising and falling pitch was the string being transduced through the metal, and being stretched and unstrctched as the wind moved the screen up, down, left and right.

As a former trombonist my thinking turned to ways I could use the harmonic series, also present in the string, to improve and change the sounds of these harps. I also explored using many different kinds of materials to construct these instruments: carpet thread, cotton, dental floss, nylon cord, ribbons, thin brass strips, twisted thin brass strips, bamboo strips, and other materials.

My setup was always basic. I would locate a site I wished to record in, decide upon the wind harp or microphonic material, mount a piezo disk and then record using a Sony walkman Pro or a Canon Super 8 camera. I began to categorize in a loosely knit way, the kinds of wind harps I was working with. The following diagrams illustrate these.

Direct Wind Harp

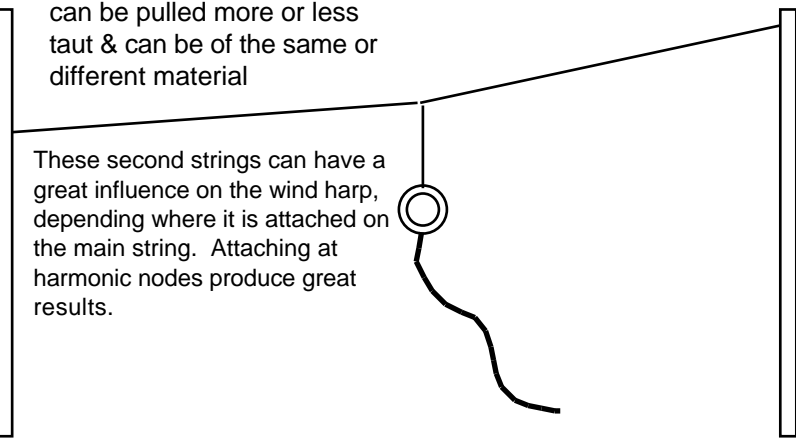
piezo disk attached directly to the windharp string



Indirect Wind Harp:

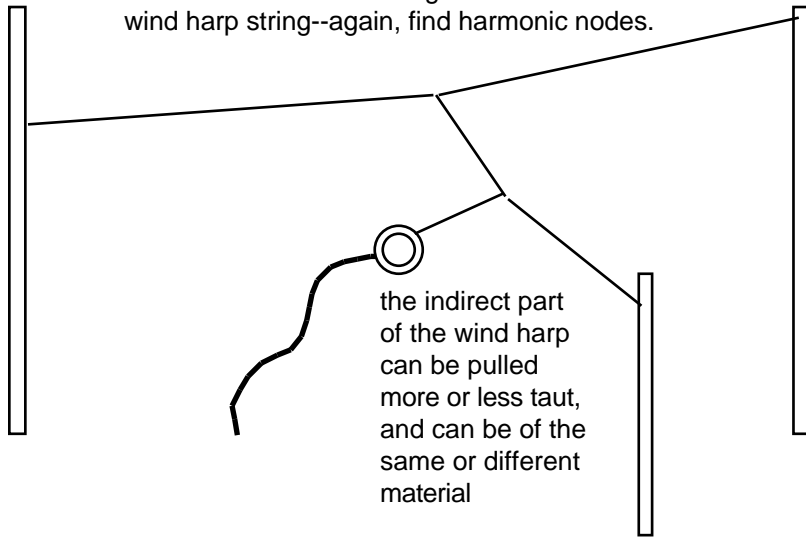
the indirect part of the harp can be pulled more or less taut & can be of the same or different material

These second strings can have a great influence on the wind harp, depending where it is attached on the main string. Attaching at harmonic nodes produce great results.



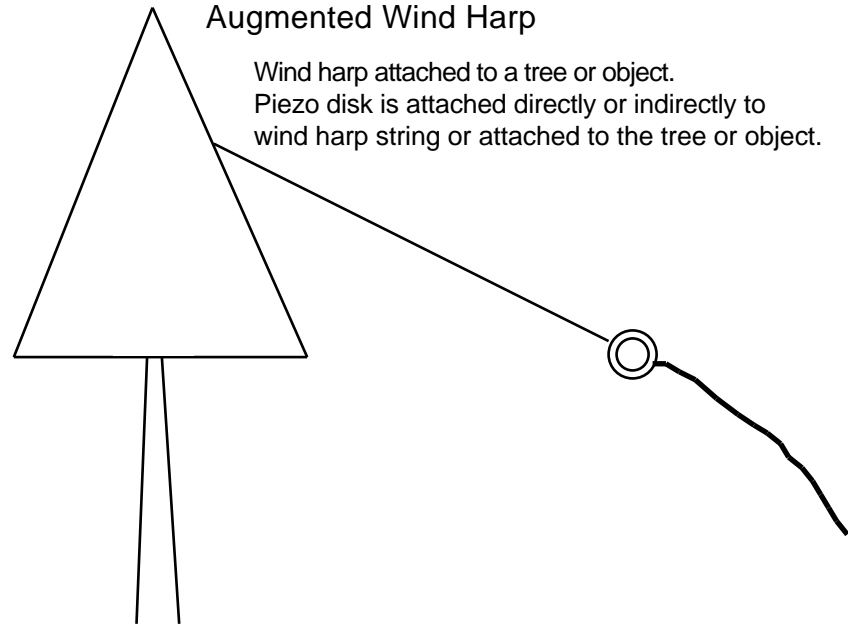
Diminished Wind Harp

piezo disk attached to a third string, which is attached to a second string which is attached to the wind harp string--again, find harmonic nodes.

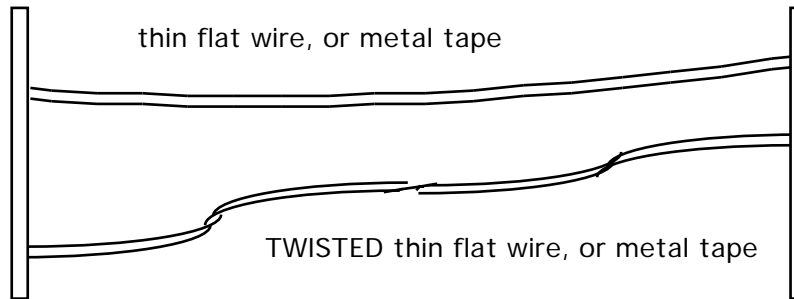


Augmented Wind Harp

Wind harp attached to a tree or object. Piezo disk is attached directly or indirectly to wind harp string or attached to the tree or object.



The above 'catalog' (while not complete) is one way I have approached working with wind harps. I had also experimented with using different strings and wires attached to each other. Obviously, a primary wind harp string made from harpsichord wire versus nylon twine will produce different sounds. Also, if the piezo disk of a secondary WH is attached to a nylon cord, which is attached to a long wire wind harp string, one will get different timbres if the order is reversed (the piezo disk of a secondary WH attached to a wire, which is attached to a long nylon cord wind harp string). Another technique, referred to earlier in this article included using long and flat metallic wires. When twisted, different timbres emerged than if the wire was left simply flat. The wire wind harp string twisting in the wind, actually becomes longer and shorter, and this creates doppler shifts inside the wire. In electronic terms, it's a phase shifter.



A windharp is like any other stringed instrument. The string or wire can be stretched taut or loose to change pitch. But the wind is the bow. If the string is very smooth, sometimes there's not too much sound (something like a bow without

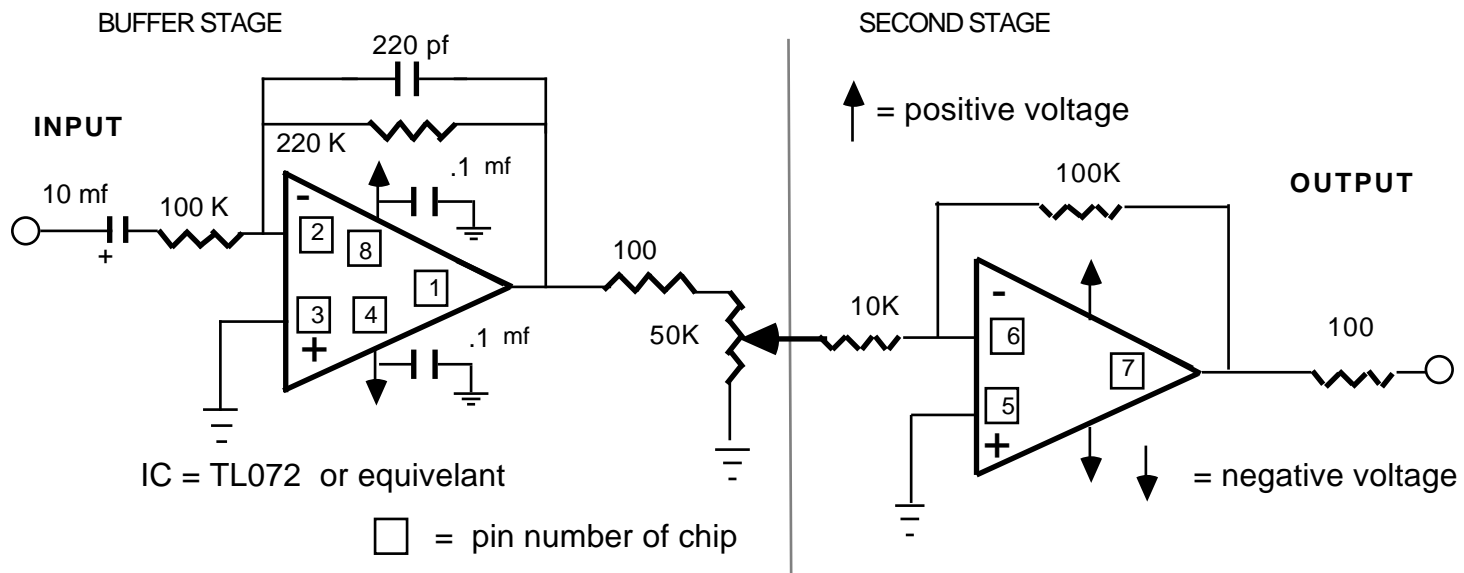
rosin). Rough strings catch more wind, and if a string is very rough, the timbre may change. Positioning a string to get the wind at a certain angle also affects the sound, like up bow/down bow/bowing at angles, etc.

Through my own circuit building and conversations with other musicians, it came clear that one could dramatically improve the quality of the recordings by making better preamps. The persons who assisted me the most in this part of the process were Godfried Willem Raes and John Driscoll. Below is a schematic of a preamp that I still use, although newer integrated circuits could improve the behavior and noise level of these circuits. Most often, I have used this circuit, powered by two 9 volt batteries to feed the preamplified signal from a windharp into the line input of a Sony Walkman Pro cassette deck, a super 8 camera, and more recently a DAT recorder. When inputting to a video 8 camera, I usually work with using the camera's mic inputs. Few cameras allow a line level input while in camera record mode, but I have also worked with some home brew transformers to get the level down.

Schematic for preamps for piezo disks

This is a good, and quiet preamp for any piezo disk applications. There are other variations and combinations that work better. A preamp made in a single stage will be quieter, but usually, electronic noise is not a factor in working with Piezo materials. The buffer stage here is basically an impedance changer. Because the gain is kept relatively low, the slew rate, (how fast the preamp can respond) works well with little distortion. Because the impedance has been changed by the first stage, the larger gain of the second stage is less of a problem.

Use any power supply from ± 9 volts to ± 18 volts. This can be run from two 9 volt batteries. Some of the newer chips on the market can be run with only one battery. Explore



In recording these wind harp pieces, I began to adopt the approach that many visual artists take in creating installation pieces: each piece is done for the individual location. I would use materials at the site, and would try to purchase or find string, cord or wire from that region to create the pieces. I began to think of the pieces as site-specific sound installations. Also, while recording, I would monitor the audio. Often, I was also making films and/or video tapes of these pieces. I allowed the cassettes to run while filming or taping, would then put the camera down, and return to the tape..... These films and video tapes were an extension of the idea of camera and microphone, and I have shot more than 100 films and videotapes, although many of these use other objects other than wind harps, (cactus thorns, metal sheets, money, credit cards, etc) as the microphones. In any case, while filming, I always worked with headphones, so to react and respond to the sound. Following are some concrete examples of wind harps I have worked with.

ST. JOHNS, NEWFOUNDLAND

In Newfoundland, at the 1986 Sound Symposium, I was a guest at the home of Isabella St. John and Paul Steffler, which was right on the water's edge near the mouth to the harbor. I set up an installation there consisting of 2 very long secondary wind harps, which were at right angles to each other, to record the shifting wind direction. The nylon cord wind harp strings for this wind harp were tied to float above the grass and weeds. But, at times, I also attached amplified window screens, (about 2 ft x 3 ft). The wind was very strong, and when the screens were attached, it caused the structure to move up and down, often violently. This allowed the grass and weeds, also blowing in the wind to, strike the cord--making a percussive sound not unlike, *col legno batutto*, or tapping a string instrument with the wood of the bow.

That week, it also rained off and on (mostly on--it was a cold damp summer), and as the rain began slowly, I could hear occasional rain drops striking the wind harp string. These sounds varied in timbre depending upon where each drop struck the wind harp. Both strings had a different pitch, and that pitch mostly stayed the same as each drop struck. The big surprise though occurred whenever a drop struck a harmonic node of a string--the sound changed in timbre, and seemed to reverberate a bit. It was like hammering a finger on the node of a stringed instrument. Finally, I could also hear metallic pings when a drop struck the piezo disk itself.

TOKYO, JAPAN

In 1989, while in Tokyo, my wife, Mona Higuchi was working on a series of rubbings from some of the stones at the Tokugawa Emperor's Women's Grave. I constructed 2 wind harps at the site, which were anchored by some of the pine trees. The harps were indirect, and one of them was amplified by having the piezo disk and wire coiled around one of the wind harp strings about 12 times. This damped that string (something like a mute on the bridge of an instrument). The piezo disk hung free, and I had soldered small pieces of harpsichord wire to the disk, that also behaved like many other strings in the wind. The harps were recorded using a video 8 camera with stereo audio. This video tape later became part of a collaborative installation with dance between us and three Japanese artists in 1991. I also used these recordings as digital samples and composed a piece from these windharps.

MACHU PICCHU, URUBAMBA, PERU

In 1987, we visited Machu Picchu. I knew that the Incas had told their history through knotted cords. I purchased cord in Cusco, and found a location at the bottom of the site where there was a small cave. It had rained very heavily the night before, and there was water dripping inside the cave. The wind was very still, and I decided a direct harp would be the best. With the piezo disk anchored inside the cave, and extending out about 15 feet, the wind harp string picked up occasional sighing wind sounds along with the drips inside the cave.

MANZANAR, near LONE PINE, CALIFORNIA

The site of one of the Japanese-American internment camps during World War 2, which we visited in 1994 to research a collaborative installation on one of the stranger ironies in history: the concentration camp Dachau was liberated by Japanese-American soldiers whose families were being interned at the same time in the US. Wind harps were set up in 2 locations. The first had been an old orchard, planted by the internees, which had now become completely wild--the indirect harps went from the trees down to the ground. The second harps were from 2 vertical poles which were set in slabs of concrete. I tied the harps very tightly here, making one direct and one indirect. Manzanar is very near the same range as is Mt. Whitney, and I videotaped and recorded the beauty of the mountains while recording the howling winds.

Since 1987, working with windharps as instruments has lead me to amplifying and recording objects directly, including leaves of palm trees, tops of pine trees, cactus thorns, fields of grass, stems of desert bushes, rocks, salt flats, and spider webs, (although I am still not pleased with the results from the webs.) There is a conceptual leap here. Everything is a wind harp. A windharp needs to be anchored in two places, so it can be bowed by the wind. But a cactus thorn for example, anchored at one end is stiff enough to behave like wind harp. The wind, if it is strong enough will bow the sharp instrument. We just need a way to listen to it.

In collecting all of this material, I finally faced the task of editing it. I began to compile the material I wanted to release onto 1/4" tape, and fortunately for me (and others) digital audio editing came of age. Many of the pieces I have recorded since 1984 are now on a CD called, WITHIN EARREACH: SONIC JOURNEYS on the Artifact label. (All the pieces above except the one recorded at Manzanar are contained on this CD.) For about 1 1/2 years I wrestled with the proper way of structuring these pieces. I finally decided on a kind of sonic order in which 3-5 pieces would be grouped together making a single piece.

As I have extended this work into the visual media of film, video and installation, I have also made 2 desktop or one-of-a-kind CD's for use in performance. Here the CD of the many individual sound files is played through speakers, and picked up again through self-built microphones, put through a cassette tape delay, and at times, a pitch to midi converter. The resulting performance will use as its form geographical location, timbral similarities, chronological order, or other structural devices.

I have always felt that the investigative process of making art can provide the driving force that leads to finished work. When I first began to record and film wind harps, I had no idea it would take me this far, or that it would take so long to complete, or that I would even complete anything from my investigations. I am also certain that others following similar investigations will arrive sonic places I will never reach

The CD WITHIN EARREACH: SONIC JOURNEYS, and more complete schematics, diagrams and scores are available from Frog Peak, <http://www.frogpeak.org>; and from Anomalous Records, <http://www.anomalousrecords.com>.