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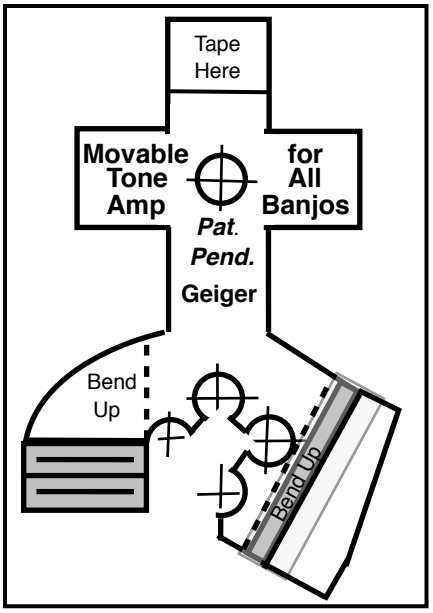
Theory and Directions for Use, Rev 9, (Page 1 of 3)
Geiger Movable, Tunable Tone Amplifier for Banjos

1. Theory: *(Note: Reading this paragraph is not necessary to use the device but helps in understanding how it works. This theory is offered without proof by the inventor based on his years of experiments with sound surface waves and as a performing solo banjoist for 26 years.)*



Introduction. It is understandable that most people will find it hard to believe that our "Movable Tone Amplifier for All Banjos" can greatly increase volume and sound quality simply by taping it to a banjo's wood rim or to its coordinator rod. - Especially since it consists only of thick paper, two staples, one or more 3/8" x 1" irregular polygons of thin metal and/or wood, and two types of clear tape. Fortunately, the theory for this unexpected performance is easily explained.

Basis of Invention. When any musical instrument is played all surfaces of the instrument are covered with sound surface waves. These waves are tiny deformations or "ripples" in all surfaces of the instrument and are analogous to the sound of the music being played. Unfortunately, these physical deformations, like waves on a lake, cannot be heard because our ears can only hear air pressure waves, not surface deformations. And these deformations are too small to move adjacent air sufficiently to be heard.

Approach of Invention. Our Movable Tone Amplifiers solve this problem, first by being made of easily deformed flexible paper, thin acrylic adhesive tape and other thin materials which have been shown to transmit sound surface waves. Two energy inputs to the tone amp are considered: (1) Energy from sound surface waves which are analogous to the audible sound and circle in great number on the inside surface of the banjo's circular wood rim. These surface waves on the wood rim are "captured" by the tone amp's tape and then flow to the tone amp's paper that hangs from the tape below the upper inside surface of the wood rim. (2) Energy in the form of air pressure waves of audible sound present in the instrument's sound chamber. These waves deform the tone amp by impact, creating additional sound surface waves on the tone amp's paper.

Increased Volume. The design of our devices increases volume in two ways: (1) By the physics principle of "Constructive Interference". This principle states that when waves having identical or similar frequencies meet coming from from different directions they will amplify. This is true for sound surface waves traveling on the tone amp's surfaces and also for air pressure waves (sound waves) emitted from the tone amp in air. Surface wave amplification on the tone amp is fixed by its design which causes surface waves to meet multiple times coming from different directions and so be amplified multiple times.

Fortunately, the player has considerable control of amplification in air by adjusting the angles of two outer planes by bending the tone amp along the dashed lines. Minimum volume occurs when the outer planes are almost in the same plane as the center section. The player's goal in bending these two planes should be an optimum mix of sound volume and sound quality for the particular instrument and playing situation.

The second method used by the tone amp to increase volume is a tiny two-sided loudspeaker containing two or more diverging planes separated by a diverging air space from a distance of zero to some small distance. This configuration causes the surface waves traveling on the planes to "squeeze" the air between the planes and create analogous air pressure waves. The diverging air space causes the waves to amplify as they fill the expanding air space. Significantly, this amplification can be greatly increased by adding more polygons in a stack. The use of one or more five-sided polygon surfaces in this loudspeaker, increases intersections of tiny surface waves reflecting from edges which helps amplify harmonics. For this reason we refer to this device as a "harmonic loudspeaker".

Improved Sound Quality. Our devices also (usually) increase the quality of musical sound from the banjo. Musical sound quality is largely determined by the presence of harmonics in the sound. Harmonics are waves having frequencies which are multiples of the primary or base frequency of a musical note which add "depth" and "pleasantness" to the sound of the note. The paper, tape and metal parts used in our devices are highly flexible and quite small, and so are able to vibrate at very high frequencies used by harmonics. This is believed to be true in the very small cantilever shapes of paper in the center of the device (between the punched holes). As mentioned above, one or more of the small five-sided metal polygons at the lower right of the Tone Amp are believed to amplify harmonic frequencies many times by reflections from edges. Sound "character" can also be modified by changing the material mix of the polygons. An optional "Tone Kit" of three polygons of thin steel, brass, and maple is available.

Production of Audible Sound. Audible sound is produced from sound surface waves in two ways: (1) By vibration of cantilever shapes. After much amplification the surface waves on the paper are either already on or are routed to cantilever shapes located at or near the center and bottom of the device. The now amplified energy of these surface waves causes these cantilever shapes to vibrate which vibrates their adjacent air creating "new" audible sound in the banjo's sound chamber. (2) Audible sound, and especially high frequency sound, is also created from sound surface waves in the "loudspeaker" previously described, e.g. in the diverging air space between diverging planes of matching polygons that contain the same sound surface waves. The same sound surface waves on diverging planes "squeeze" the air to create analogous air pressure waves.

Important Caution for Open Back Banjos: Care should be taken that clothing such as a shirt does not move into the open back of the banjo during play and touch the vibrating tone amp.

2. Directions.

Remove the device from its plastic envelope. Remove the foam tape protector strip from the back side of the tone amp which protects the staple points from compression during shipment. Note that the adhesive on the tape is protected with a red plastic strip but do not remove the red strip yet. Also note that the free end of the tape is covered with a non-sticky tab to aid in removal and placement.

Next, look at the photo of the tone amp installed in a banjo on page 3. Read and follow the instructions in the box next to the photo which relates to how much to bend the tone amp along the two bend lines. After bending the tone amp remove the red plastic strip from the tape and, with the tape held to the left of the tone amp, stick the tape to the inside top surface of the wood rim at approximately 45-degrees to the wood rim (Important) as shown in the photo on page 3. The tone amp will hang freely from its tape when held in the seated or standing playing positions. Play the banjo before replacing the resonator and note the increased volume and sound quality from the banjo. Before replacing the banjo's resonator you may want to experiment with different bend angles or different polygons ("Tone Pieces") if you purchased the optional set of three for $6 (steel, brass and maple) with your Tone Amp.

Thank you for your order. We would like to hear from you and welcome your recommendations.

Sincerely,

Frank Geiger

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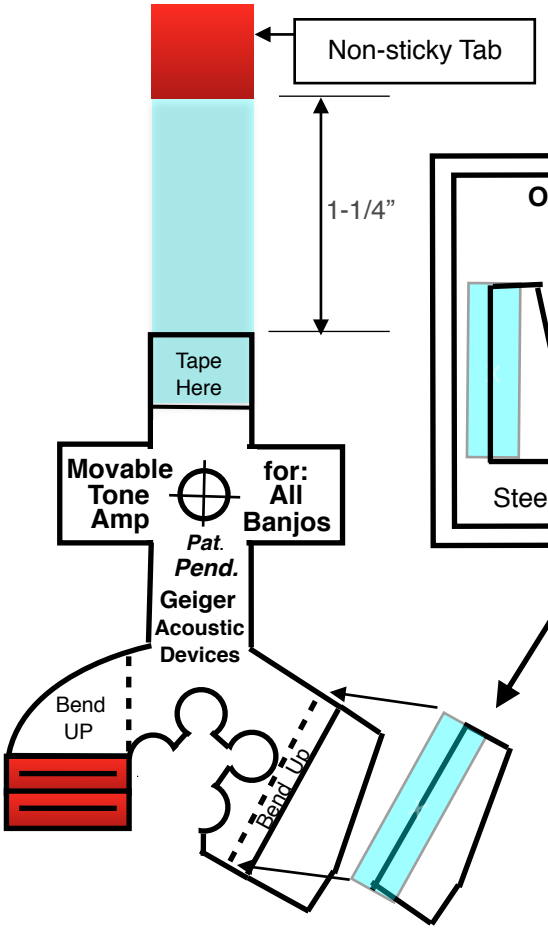
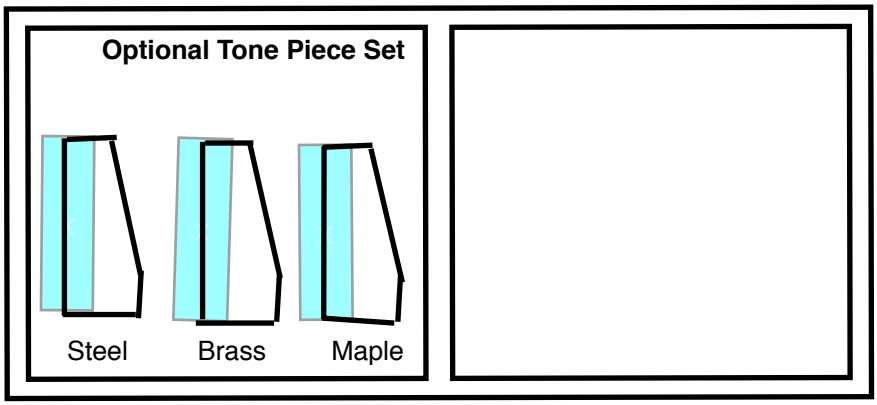
Tone Amp Placement

For placement first remove the resonator and hold the banjo as if you are going to play it in a seated position. Tilt the banjo forward and, with a clean cloth or tissue, wipe the inside top of the wood rim to remove all dust so the tone amp's tape will stick thoroughly to the wood rim. With your fingers bend the left plane (with the staples) up 90-degrees at the bend line. Bend the right plane (with the steel) up 15 to 20-degrees at its bend line. Hold the tone amp with its tape on the left. Remove the red plastic protector strip from the tape and stick the tape to the wood rim. It is important to stick the tape at an angle of about 45-degrees to an imaginary circumference line on the wood rim. For a different sound you may wish to hang the tone amp from one of the banjo's coordinator rods. Changing the bend angles of the outer planes also changes the sound but try changing those last. If your banjo uses rim bolts or has other metal parts on the rim try to avoid having the tape touch any metal parts inside the banjo. Disregard the Velcro dot on the rim behind the tone amp in the photo. (The Velcro dot is used to hold the "Travel Caddy".)





Optional tone pieces (above) can be used to replace the steel tone piece already on the tone amp **or added above it in a stack for greater volume.** Tape attached to all tone pieces should not be removed but reused as long as possible. To unstick any tone piece grasp it near the tape and lift it slowly. Store unused tone pieces in any space on the left.

Lift any tone piece on the left the same way and stick it on the tone amp in place of or next to the steel tone piece which came installed on the tone amp. The narrow strip of tape covering the words, "Bend Up", protects the paper and should not be removed.