May 13, 1958 B. F. MIESSNER 2,834,243

TONE GENERATORS FOR ELECTRONIC MUSICAL INSTRUMENTS

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Fig. 1

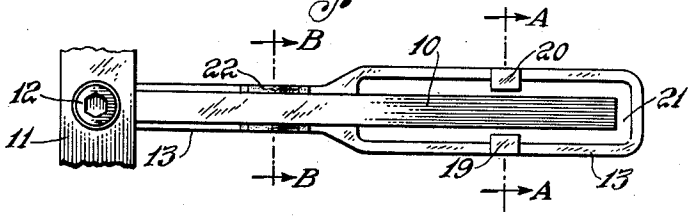



Fig. 3

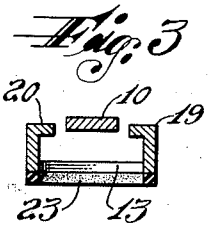



Fig. 2

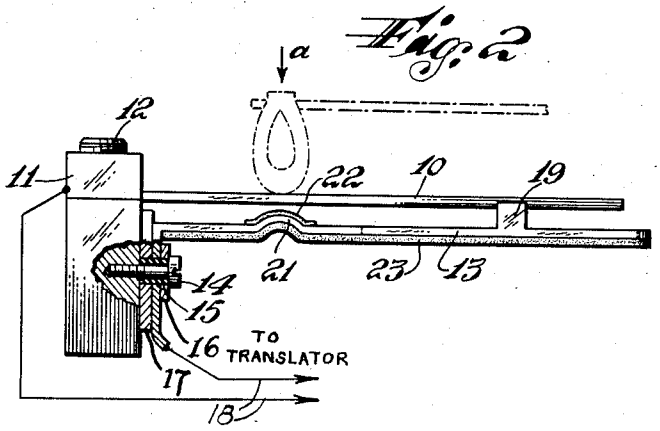
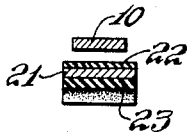



Fig. 4




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# TONE GENERATORS FOR ELECTRONIC MUSICAL INSTRUMENTS

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4 Claims. (Cl. 84—1.14)

This invention relates to electronic musical instruments and more particularly to a novel translating arrangement for converting the vibrations of mechanical vibrators into corresponding electrical variations.

In electronic musical instruments the mechanico-electric translating devices utilized in conjunction with the mechanical vibrators that constitute the tone-producers are themselves non-vibratile in their own right with respect to the vibrators. Such devices are commonly mounted on a rigid support in such manner that they maintain a predetermined, fixed translation efficiency that is established by a fixed distance or area between the vibrator and its associated pick-up whereby only the actual vibrations of the vibrator are translated into corresponding electrical oscillations. Representative of such arrangements are electronic guitars, pianos, carillons, organs, and the like, where it is customary to use a variable-distance type of pick-up. Where the vibrations of the tone-producing vibrator are planar, such as is the case of flat beams or ribbons, as distinguished from the orbital vibrations of tensioned strings, either a variable-distance or variable-area type of modulation may be used and the pick-ups may be capacitive or magnetic.

Every effort is made in conventional electronic musical instruments to prevent vibration of the pick-up in its own right relative to the vibrator as such vibration normally introduces extraneous and undesired components into the output tones of the instrument. For example, pick-up devices for piano strings are mounted either on the string bridge or adjacent thereto, or on the string frame. In electronic guitars the pick-ups are mounted on the string support; in carillons the pick-ups are mounted on the massive base that supports the tone-producing rods; and in reed organs the pick-ups are mounted on the non-vibratile reed housing.

The present invention deviates from common practice in that the pick-up itself is made vibratile in its own right relative to the tone-generating vibrator so that additional predetermined components will appear in the output tone of the instrument for the purposes set forth below.

An object of this invention is the provision of a novel translating arrangement for use with mechanical vibrators.

An object of this invention is the provision of a vibratile pick-up for use with a mechanical vibrator whereby vibrations of the pick-up are deliberately introduced into the associated electronic circuit for producing desired output tones.

An object of this invention is the provision of a novel mechanical vibrator and associated pick-up arranged for simultaneous excitation by a common means.

An object of this invention is the provision of a tone-generating assembly for an electronic musical instrument comprising a fixed-free vibratory reed, a fixed-free vibratile member spaced from the reed and adapted for simultaneous excitation therewith, integral arms extending from the member on opposite sides of the reed, and an aperture in the member through which the free end of the reed can vibrate.



These and other objects and advantages will become apparent from the following description when taken with the accompanying drawings illustrating several embodiments of the invention. It will be understood the drawings are for purposes of illustration and are not to be construed as defining the scope or limits of the invention, reference being had for the latter purpose to the appended claims.

In the drawings wherein like reference characters denote like parts in the several views:

Figure 1 is a top plan of a vibrator and pick-up assembly made in accordance with this invention;

Figure 2 is a side elevation of such assembly;

Figure 3 is a transverse sectional view taken along the line A—A of Figure 1; and

Figure 4 is a transverse sectional view taken along the line B—B of Figure 1.

In its broad aspects, this invention contemplates the provision of a multiple arrangement of mechanical vibrators one or both of which are tuned to predetermined vibration frequencies, one such vibrator constituting the pick-up through which the multiple vibrations of all vibrators influence the electrical variations of the translating device. One or more of such coupled vibrators may have a predetermined harmonic content, vibration amplitude and damping rate, all for the purpose of providing new and musically desirable tonal effects, which effects cannot be secured with conventional vibrator and pick-up arrangements. For example, it may be desired to simulate the formant effects of a piano soundboard in an instrument that utilizes essentially-sinusoidally-vibrating reeds as the tone producers. In such case a second vibratory reed is coupled to the primary tone-producing reed, such second reed being properly damped and tuned relative to the primary reed and excited simultaneously therewith, whereby complex relative vibrations between the two reeds produce, in the output tones of the instrument, an effect characteristic of the conventional piano soundboard.

In the various embodiments of my invention the primary vibrator and the secondary, or pick-up, vibrator may be arranged for simultaneous excitation as by a hammer, or the two vibrators may be coupled together in such manner that the impulsive excitation of one results in the vibration of the other. The specific arrangement will depend upon the characteristics desired in the particular instrument. Also, I prefer to use a capacitive type pick-up arrangement because such system is particularly well adapted for use with small vibratory reeds and tensioned strings. Such preference, however, is not intended as a limitation as those skilled in this art will understand that other types of pick-ups, or vibration-translating arrangements, may be employed with my novel vibrator-pick-up constructions.

Reference is now made to Figures 1–4 which illustrate one embodiment of my invention. The primary vibrator comprises a flat reed **10** having an end secured to a reed block **11**, as by the screw **12**. The secondary vibrator **13** is disposed under the primary reed and is secured to the reed block by the screw **14**, such screw being insulated from the vibrator by an insulator tube **15**. Such insulator tube passes through the insulator washers **16** and **17**, disposed on opposite side of the offset end of the vibrator **13**, whereby the vibrator is electrically insulated from the reed block **11** and the primary vibrator **10**. The vibrator **13** includes a pair of upwardly-extending arms **19, 20** that have their upper ends offset in the plane of the vibrator, as shown more clearly in Figure 3, which is a transverse, sectional view taken along the line A—A of Figure 1. As shown in Figure 1, the free end of the vibrator **13** is considerably wider than the primary vibrator **10** and is provided with an aperture **21** to afford relatively unre-

stricted vibration of the vibrator **10**. The vibratory **13** is also provided with an arched section **21** to which a pad **22** of suitable insulating material is secured as by cement. Alternatively, the upper surface of the arched section may be coated with rubber, or the like, the important requirement being to prevent electrical contact between the two vibrators. Further, the lower surface of the secondary vibrator may be coated with a visco-elastic material, such as rubber, vinylite, etc., as indicated by the numeral **23**, and which serves to damp the vibrations of vibrator **13**, when more than normal damping is desired.

Both vibrators are made of a suitable, hardened metal, and both vibrators can be set into vibration by applying an impulsive force, as by means of a felt-covered hammer along the line designated by the letter *a* in Figure 2 (the hammer being shown in dotted lines). During such simultaneous vibrations of the vibrators the capacity between the vibrator **10** and the arms **19**, **20** of the vibrator **13**, will vary in accordance with the relative differences in the frequencies and amplitudes of the two vibrators. If the two vibrators are connected as by leads **18** to a suitable translator, as is well known in this art, such relative capacity variations will result in corresponding electrical variations which can be amplified to drive an electro-acoustic device to produce audible tones having a tonal quality determined by the relative vibrations of the two vibrators. It will be clear that the vibrator **13** serves as a vibratable pick-up for the primary vibrator **10** and that vibrator **10** serves as a pick-up for **13**. This type of device, then, will introduce Fourier series partials into the translated vibrations for both the primary tone-producing vibrator **10** and the pick-up vibrator **13** as disclosed in my copending patent application Serial #169,714, filed June 22, 1950. By properly damping the pick-up vibrator **13**, as by the visco-elastic coating **23**, and by designing the pick-up vibrator for predetermined partial frequencies relative to that of the particular tone-producing vibrator, the tonal qualities of the output tones of the instrument can be controlled as desired.

It may here be pointed out that the illustrated construction is, effectively, a dual type of pick-up. This has the particular advantage of restricting the capacity changes to normal vibrations of the two vibrators. Specifically, and with reference to Figure 1, lateral vibrations of either vibrator, within practical limits, do not alter the total capacity between the vibrator **10** and the two pick-up arms **19**, **20**. Also, I design the pick-up vibrator so that the arms **19**, **20** are positioned at the nodal point for the second vibration partial of each vibrator, such point being .226L from the vibrator's free end, where L equals the axial length of the vibrator's vibratory section. Consequently, the vibration partial **2**, which normally is inharmonious with the fundamental vibration, does not appear in the output tones of the instrument.

The described arrangement may be used to provide a soundboard formant effect in the output tones and such effect may be changed in pitch, amplitude and damping to suit each tone vibrator in a piano scale. For harp or other tones having different formant frequencies, band width, amplitude and damping, the pick-up reed may be altered accordingly.

For highly damped tones, such as those of drums, both vibrators may be heavily damped.

Having now described my invention what I desire to protect by Letters Patent is set forth in the following claims.

I claim:

1. A tone-generating arrangement for an electronic musical instrument said arrangement comprising a first vibratory reed having an end secured to a reed block; a second vibratory reed disposed under the first reed and having an end secured to the reed block; means electrically insulating the reeds from each other; an arched portion on the second reed and extending toward the first reed; insulating means covering the said arched portion; a pair of upwardly-extending arms on the second reed, said arms being spaced on opposite sides of the first reed; and offset ends on said arms, said ends extending toward the first reed.

2. The invention as recited in claim 1, wherein the said offset ends are disposed at the nodal point for the second vibration partial of the first reed.

3. A musical instrument for the selective production of plurality of notes comprising for each note respectively a tuned vibrator, a pick-up in spaced relation to the vibrator and a vibratory support for the pick-up, the pick-up and support together having a natural frequency of vibration musically related to the predominant natural frequency of the vibrator, and means for effecting impulse excitation of the vibrator, the vibratory support being positioned to be struck by the vibrator and thereby set into vibration upon such excitation of the vibrator.

4. A musical instrument for the selective production of a plurality of notes, comprising for each note respectively a pair of independently vibratable electrically conductive tuned vibrators having predominant natural frequencies musically related to each other, and means for effecting impulse excitation of a first of the vibrators, the other vibrator being positioned to be struck by the first vibrator and thereby set into vibration upon such excitation of the first vibrator, one of the vibrators constituting an electric pick-up for the other.

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