

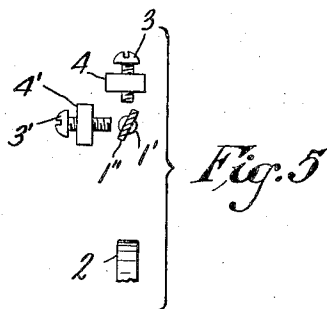
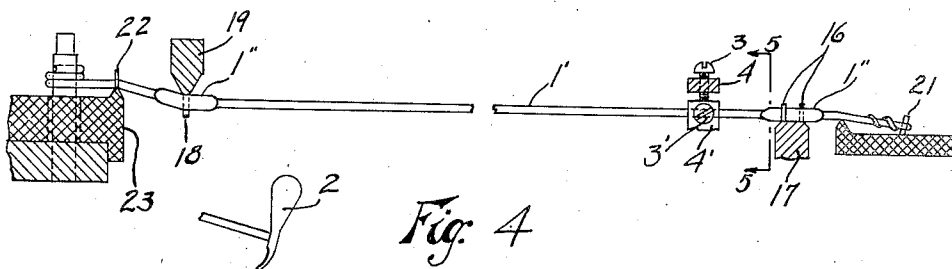
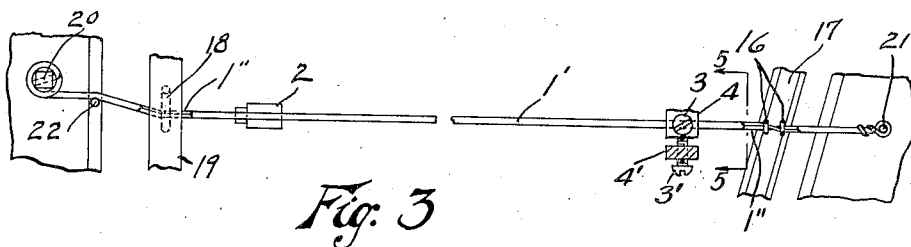
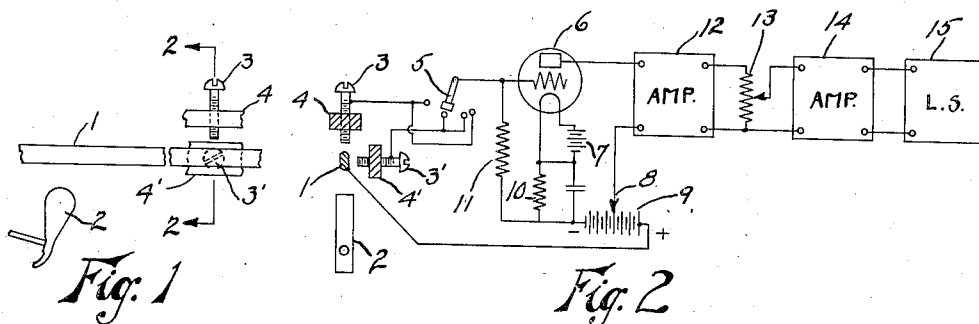
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B. F. MIESSNER

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METHOD AND APPARATUS FOR THE PRODUCTION OF MUSIC

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INVENTOR:-
Benjamin F. Miessner,
BY Charles T. Jacoby,
ATTORNEY.

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METHOD AND APPARATUS FOR THE PRODUCTION OF MUSIC

Benjamin F. Miessner, Millburn Township, Essex County, N. J., assignor to Miessner Inventions, Inc., a corporation of New Jersey

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This invention relates to the production of music from tuned vibrators, and more particularly to such translation by vibration-oscillation-sound (mechanico-electro-acoustic) translation.

In my copending applications, Serial Number 512,399, filed January 30, 1931, (on which U. S. Patent 1,929,027, has now been issued) and Serial Number 528,750, filed April 9, 1931, (on which latter U. S. Patent 1,915,858 has been issued) I disclosed and claimed instruments producing music in this manner, together with various mechanico-electric translating means and methods for use therein. In the latter of these two applications I disclosed and claimed among other things a vibrator, a translating device sensitive to components of vibration of such vibrator in a given plane, and means to produce a deflection of the vibrator in a plane substantially at right angles to the given plane, by which means the vibrator is set into vibration. As I showed in that application, this vibration will develop and contain components in the given plane, as well as in the initial deflecting plane. The translating device efficiently translates these components, but inefficiently translates the initial deflections. Thus a tone is produced lacking abruptness of inception and simulating an organ or other wind-instrument tone.

The instant invention is concerned with improvements on the methods and apparatus just discussed, both in respect of the encouragement of vibration components in the given plane following excitation in the plane at right angles thereto, and in respect of the selective production of tones having or lacking abruptness of inception.

It is an object of this invention to provide means and methods for encouraging components in the vibration of a vibrator at right angles to the direction of initial excitation. It is a further object to provide improved means and methods for reducing or eliminating abruptness of inception of the output tones of a musical instrument.

It is a further object to provide an improved instrument capable of selectively producing organ-like or piano-like tones. Other and allied objects will more fully appear from the following specification and the appended claims.

In the detailed description of my invention hereinafter set forth, reference is had to the accompanying drawing, of which:—

Figure 1 is a side view and Figure 2 a cross-sectional view of a simple embodiment of my invention, Figure 2 including a schematic showing

of certain electrical and electro-acoustic apparatus; and

Figure 3 is a plan view and Figure 4 a side view of a further embodiment, wherein certain alternative features are illustrated, Figure 5 being a cross-sectional view of a portion of Figures 3 and 4 taken along the lines 5—5 of those figures.

In Figures 1 and 2, I show a string 1 of a non-circular cross-section, which may be described as roughly elliptical. A suitable cross-section may be obtained for example by passing a string of round cross-section between parallel rollers exerting pressure against each other. A hammer 2 may be provided, operable in a plane containing the major transverse string dimension—e. g., the major axis of the elliptical cross-section. A suitable action (not shown), such as a piano action, may be employed for actuating the hammer.

Adjacent a point along the string may be provided a conductive stud or screw 3, mounted for example in stationary insulating member 4. Stud 3 may also be in the plane containing the major transverse dimension. Adjacent the same point along the string, but in a plane containing the minor transverse dimension—e. g., the minor axis of the ellipse—may be provided another similar stud or screw 3', similarly mounted. These studs may be connected to the contact points of a switch 5, by which either one, or both together, may be connected to the grid of a thermionic vacuum tube 6. The cathode of this tube may be energized in any suitable manner, as by battery 7, and its anode current may be supplied as from a positive tap 8 on high voltage battery or other source 9. The cathode of the tube may be connected to the negative terminal of source 9 through a condensively by-passed resistor 10, across which the anode current of the tube will develop a small voltage drop. The grid of the tube may also be connected to such negative terminal through high resistance 11 for biasing the grid slightly negative with respect to the cathode, as will be understood. In the output circuit of the tube may be provided in cascade amplifier 12, volume control 13, further amplifier 14 if desired, and loud-speaker or other electro-acoustic translating device 15.

Consideration being given to the manner of functioning of the apparatus as thus far described, it will be seen that if a blow be administered to the string by hammer 2, the string will be deflected from its mean position in a vertical plane. Its predominate initial tendency is therefore to vibrate vertically. As I pointed out in the second of the two above mentioned applications,

even a round string will under these circumstances develop and contain some horizontal components. But with the flattened or elliptical string cross-section, the development of such horizontal components is particularly encouraged. Thus in executing vertical vibration the string may be said to be in a condition of unstable equilibrium, because of its greater thickness in this plane than in the horizontal plane. Its vibration will therefore tend strongly to go over into the horizontal in a degree and at a rate determined by the degree of flattening on non-circularity of the wire cross-section. Thus with relation to the vertical end face of stud 3' nearest the string, the initial deflection and earliest ensuing vibrations will be essentially parallel, but later vibrations will be principally at right angles to the stud face. The minute electrostatic capacity between string 1 and stud 3' will therefore be little varied by the initial deflection and earlier ensuing vibrations, and more greatly varied by later vibrations.

If switch 5 be connected to stud 3', as shown in Figure 2, the capacity between string and stud 3' is charged to the potential of source 9 through resistance 11. By virtue of the high value of the latter the charge in this capacity cannot change rapidly. If therefore the capacity be subjected to oscillatory variation, the voltage across it will contain a corresponding oscillatory variation. This appears as an A. C. voltage across resistance 11, which voltage is amplified by tube 6 and amplifier 12, may be controlled in respect of amplitude by volume control 13, may be further amplified by amplifier 14, and is translated into sound by loud-speaker 15. In view of the nature of the capacity variation as above described, a tone is produced lacking abrupt inception and thus simulating the tone of a wind-operated instrument.

It will be seen that the initial deflection and earliest ensuing vibrations will produce great variations, and the later vibrations relatively small variations, of the capacity between string 1 and stud 3. Thus if this capacity be substituted for that between string and stud 3' by connecting the blade of switch 5 to stud 3, the output tones produced upon excitation of the string by hammer 2 will have a percussion component and an early amplitude of a height emphasized by the ensuing reduction.

A tone of most nearly normal piano characteristics may be obtained by using in combination the capacities of string to studs 3 and 3' respectively. Thus switch 5 may be moved to the most right-hand position as shown in Figure 2. In this case the relative prominences of tone inception and tone continuation may be adjusted by adjusting the relative spacings of the studs 3 and 3' to the strings.

The flattening of the string need not be effected along its entire length. Thus it may be flattened only at and near one or both of the extremities of its active length, as I have shown in Figures 3, 4 and 5. In these figures the string is shown at 1'. The Figures 2, 3, 3', 4 and 4' designate parts similar to those in Figures 1 and 2. The string may have flattened portions 1''. One of these may engage the pins 16 in bridge 17, and the other pin 18 on the bottom of capo 19. The pin 18 and the forward (left-shown) pin 16 may be parallel to each other and at a slight angle to the vertical. The rear (right-shown) pin 16 may be set at an equal and opposite angle to the vertical, as customary in piano construction. In

order that the flattened face of the string at the forward flattened portion 1'' may be held against pin 18 rather than the horizontal bottom of capo 19, the string may be passed around pin 18 at an angle, maintained by passing the string around a further pin 22 in front frame portion 23.

The electrical and electro-acoustic apparatus shown in Figure 2 will of course be understood to be employed with the apparatus of Figures 3, 4 and 5. The manner of functioning is quite similar to that described for Figures 1 and 2, subject to two qualifications. One of these is that the urge on the string to change its plane of vibration from the vertical plane initially established by the hammer to the plane of the minor transverse dimension of the flattened portions is somewhat reduced by virtue of the restriction of the flattening to the portion at and near the active extremities. This tends to reduce the rate at which the principal vibration plane will change.

The other qualification is that the eventual plane of vibration—i. e., the plane containing the minor transverse dimensions of the flattened portions—is not quite horizontal. This means that the change of plane of vibration is somewhat less than 90°, which assures the change always taking place in the same angular direction. This is particularly advantageous when stud 3 and stud 3' are being employed simultaneously, these two studs being positioned so that the minor axis of the elliptical cross-section passes between them. Under these circumstances vibratory variations in the capacities of string to studs 3 and 3' respectively will always be in phase with each other. It will of course be understood that such slight angling of the minor transverse dimension with respect to the horizontal (or of the major dimension with respect to the vertical) may be carried out with the string flattened along its entire length.

While I have shown and described my invention with an electrostatic form of mechanico-electric translation, it is equally adaptable for use with other forms of translation, such for example as electromagnetic. Various further modifications may be made in the choice and disposition of the components without departing from the spirit or scope of my inventions, as in the appended claims defined.

I claim:—

1. The method of producing a sound of gradually rising initial amplitude from a tuned vibrator, of which there is established a single plane of freest vibration, which consists in initiating vibration of said vibrator in a plane substantially normal to said first mentioned plane, and in translating into sound only components of vibration of said vibrator occurring substantially in said first mentioned plane.

2. The method of selectively producing sounds of various inception amplitude characteristics from a tuned vibrator, of which there is established a single plane of freest vibration, which consists in initiating vibration of said vibrator in a plane substantially normal to said first mentioned plane, and in selectively translating into sound components of vibration of said vibrator occurring substantially in said first mentioned plane and those occurring substantially in said normal plane.

3. In a musical instrument, the combination of a tuned vibrator tending to vibrate in a given plane; mechanico-electric translating means sensitive to components of vibration of said vibrator

in said plane and relatively insensitive to components in directions normal to said plane; and means for provoking vibration of said vibrator, comprising means for momentarily displacing said vibrator in a plane substantially different from said given plane.

4. In a musical instrument, the combination of tuned vibrator; means associated with and influencing said vibrator for determining a single plane of freest vibration thereof; means for initiating vibration of said vibrator in a plane substantially normal to said first mentioned plane; and mechanico-electric translating means sensitive to components of vibration of said vibrator in said first mentioned plane and relatively insensitive to components in said last mentioned plane.

5. In a musical instrument, the combination of a tuned string; means associated with and influencing said string for determining a single plane of freest vibration thereof; a hammer movable in a direction substantially normal to said plane to strike said string; and mechanico-electric translating means sensitive to components of vibration of said string in said plane and relatively insensitive to components in directions normal to said plane.

6. In a musical instrument, the combination of a tuned vibrator; means associated with and influencing said vibrator for determining a single plane of freest vibration thereof; means for initiating vibration of said vibrator in a plane substantially normal to said first mentioned plane; mechanico-electric translating means principally sensitive to components of vibration of said vibrator in said first mentioned plane; mechanico-electric translating means principally sensitive to vibration components in said normal plane; and means selective with respect to said two translating means for controlling their operation.

7. In a musical instrument, the combination of a tuned string; means associated with and influencing said string for determining a single plane of freest vibration thereof; a hammer movable in a direction substantially normal to said plane to strike said string; mechanico-electric translating means principally sensitive to components of vibration of said string in said plane; mechanico-electric translating means principally sensitive to vibration components in directions normal to said plane; and means selective with respect to said two translating means for controlling their operation.

8. In a musical instrument, the combination of a vibrator tending to vibrate in a given plane; means for provoking vibration of said vibrator, comprising means for momentarily displacing said vibrator in a plane substantially different from said given plane; mechanico-electric translating means principally sensitive to components of vibration of said vibrator in said given plane; mechanico-electric translating means principally sensitive to vibration components in directions substantially normal to said given plane; and means selective with respect to said two translating means for controlling their operation.

9. In a musical instrument, the combination of a non-circular tuned string having a major and a minor transverse dimension; means active substantially in a plane through said string containing said major dimension for initiating vibration of said strings; and translating means principally sensitive to components of said vibration substantially normal to said plane.

10. In a musical instrument, the combination of a tuned string having the approximate cross-section of an ellipse; means active substantially in a plane through said string containing the major axis of said ellipse for initiating vibration of said string; and translating means principally sensitive to components of said vibration substantially normal to said plane.

11. In a musical instrument, the combination of a tuned string having at least one end portion characterized by a major and a minor transverse dimension; means active substantially in a plane through said string containing said major dimension for initiating vibration of said string; and means for translating components of said vibration normal to said plane.

12. In a musical instrument the combination of a tuned string having its end portions of non-circular cross-section and in substantial alignment with each other; vibration initiating means for said string active substantially in a plane through said string containing the major dimension of said cross-section; and means for translating components of said vibration normal to said plane.

13. In a musical instrument, the combination of a tuned string having at least a portion characterized by a major and a minor transverse dimension; vibration initiating means for said string active substantially in a plane through said string slightly divergent from the plane through said string containing said major dimension; and two mechanico-electric translating devices in spaced relation to said string and respectively sensitive to vibrations thereof in the plane of action of said vibration initiating means and to vibrations in a plane through said string at right angles thereto, said devices lying on the same side of the said plane containing said major dimension.

14. In a musical instrument, the combination of a tuned string having at least a portion characterized by a major and a minor transverse dimension; vibration initiating means for said string active substantially in a plane through said string slightly divergent from the plane through said string containing said major dimension; two mechanico-electric translating devices in spaced relation to said string and respectively sensitive to vibrations thereof in the plane of action of said vibration initiating means and to vibrations in a plane through said string at right angles thereto, said devices lying on the same side of the said plane containing said major dimension; and selective means controlling the operation of said translating devices, whereby there may be operated at will either one or both said translating devices.

BENJAMIN F. MIESSNER.