

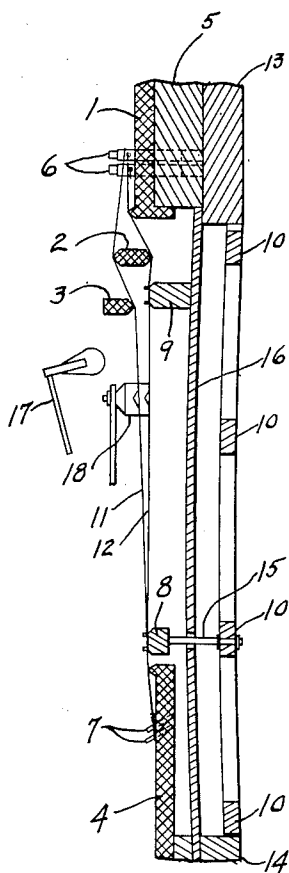
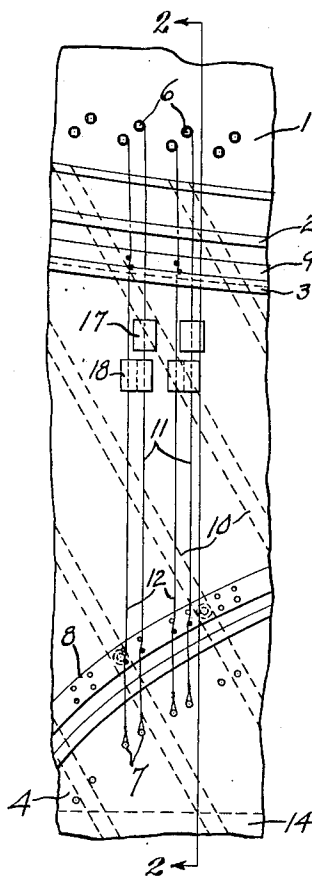
Oct. 31, 1933.

B. F. MIESSNER

1,933,295

METHOD AND APPARATUS FOR THE PRODUCTION OF MUSIC

Original Filed Dec. 29, 1931 2 Sheets-Sheet 1



INVENTOR:-
BENJAMIN F. MIESSNER,
BY *Charles I. Jacobs*
ATTORNEY.

Oct. 31, 1933.

B. F. MIESSNER

1,933,295

METHOD AND APPARATUS FOR THE PRODUCTION OF MUSIC

Original Filed Dec. 29, 1931 2 Sheets-Sheet 2

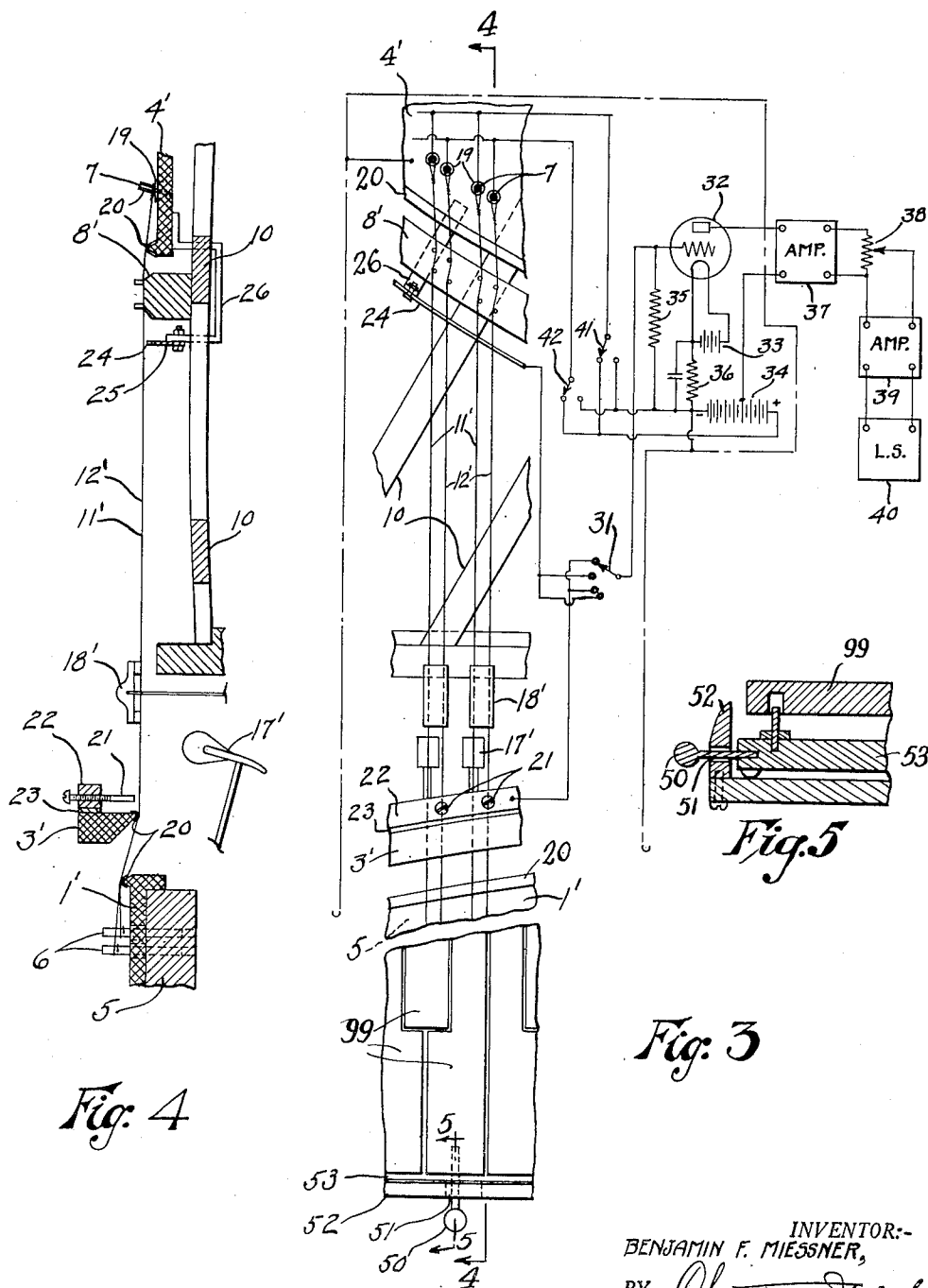


Fig. 3

Fig. 4

Fig. 5

INVENTOR:-
 BENJAMIN F. MIESSNER,
 BY *Charles I. Jacobs*
 ATTORNEY.

UNITED STATES PATENT OFFICE

1,933,295

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

Application December 29, 1931, Serial No. 583,613. Renewed May 23, 1933

16 Claims. (Cl. 84—1)

This invention relates to methods and apparatus for producing music from a plurality of tuned vibrators, and more particularly for producing tones whose initial characteristics are or may be modified from those ordinarily produced by the particular form of vibrator excitation employed. The invention is useful with any form of such excitation, percussion excitation being the form herein illustrated; and with any form of translation into sound of vibrator vibration—e. g., not only with direct (mechanico-acoustic) translation, but also with mechanico-electro-acoustic translation, such as is broadly described and claimed in my co-pending application, Serial No. 512,399, filed January 30, 1931 (on which U. S. Patent 1,929,027 has now been issued).

It is an object of my invention to provide methods and apparatus for producing, from a plurality of vibrators, musical tones whose initial characteristics are relatively free of the influence of the form of vibrator excitation employed. It is a further object to provide methods and apparatus for minimizing, eliminating, or emphasizing particular initial tone characteristics.

It is another object of my invention to provide a musical instrument employing percussion excitation of vibrators, which yields output tones from which the usual percussion-produced effects are substantially absent; and it is likewise an object of the invention to provide such an instrument in the output tones of which such effects may be rendered present, or substantially absent, or present in heightened degree, at will.

A more specific object is the provision, in an instrument wherein the vibrations of tuned vibrators are translated into electric oscillations, of means and methods for reducing, eliminating or increasing the high initial amplitudes of such oscillations which may tend to occur momentarily upon vibrator excitation; and for selectively producing oscillations having or lacking such high initial amplitudes. A further specific object is the provision in this class of instrument of means and methods for reducing the effective rate of damping of vibrator vibration and of translated oscillations. Other and allied objects will more fully appear from the following description and appended claims.

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

Figure 1 is a partial plan view of an instrument in general of the upright piano type, embodying my invention in a simple form;

Figure 2 is a cross-sectional view taken along the line 2—2 of Figure 1;

Figure 3 is a partial plan and diagrammatic view of an instrument of the grand piano type, in which is embodied a preferred form of my

invention wherein the vibrations of the vibrators are translated into sound by mesne vibration-oscillation (mechanico-electric) and oscillation-sound (electro-acoustic) translation;

Figure 4 is a partial cross-section taken along the line 4—4 of Figure 3; and

Figure 5 is a partial cross-section taken along the line 5—5 of Figure 3.

A basic arrangement involved in my invention is the provision for each musical tone to be produced of two vibrators similarly tuned i. e., to the same frequency and coupled together, the first only being subject to excitation of whatever basic form be provided; and translation into sound of the vibration of the second vibrator, either directly or by mesne translations. Vibration of the second vibrator will be understood to be caused by the vibration of the first; but regardless of the abruptness of inception of vibration of the first, the amplitude of vibration of the second may be made to rise far more gradually. This basic arrangement is capable of being modified and enlarged, and of being applied in a variety of combinations of apparatus, as will hereinafter become more fully apparent.

In Figures 1 and 2 I have shown an instrument of the upright piano type. Herein 1 may designate a top frame, 2 and 3 each a pressure bar or "capo", and 4 a bottom frame, it being understood that 1, 2, 3 and 4 will form portions of an integrally cast iron frame or plate. Passing through top frame 1 and into wrest-plank 5 may be provided in the usual manner tuning pins 6; and hitch-pins 7 may be provided in bottom frame 4. For each tone there may be provided, strung between a hitch-pin 7 and a tuning pin 6, two strings 11 and 12, each of which may bear on and be secured by pins to bridge 8. This bridge is not coupled or connected to any resonator but is secured, as by members 15, to a vibratile support or supports such as strips or rods 10. These strips may be secured at their extremities to rigid top beam 13 and rigid bottom beam 14; they are furthermore preferably slightly bowed toward the bridge 8 the better to resist the pressure of the strings against the bridge. Thus any pair of strings 11 and 12 are coupled together, as well as to all the other strings 11 and 12, by a substantially non-radiating vibratile system.

The string 11 for each tone, after being passed from its hitch-pin 7 over bridge 8, may be passed under capo 3 and over capo 2 to its tuning pin 6, thus at no point in its entire length being connected to any resonator. The string 12 for each tone, however, after being passed from its hitch-pin 7 over bridge 8, may bear on and be secured to bridge 9, which is affixed to resonator or soundboard 16. The soundboard 16 and bridge 9 may be termed a resonator system engaging the strings 12. This soundboard may be reinforced

by ribs (not shown) in the usual manner. A hammer 17 is provided for exciting each string 11; and a damper 18 may be provided for damping simultaneously the strings 11 and 12 for each tone. The usual key-operated action may be provided for actuating each hammer 17 to strike its associated string 11, and for simultaneously raising damper 18 from such string and the adjacent string 12.

Upon the striking of a string 11 by hammer 17 and coincident raising of damper 18 therefrom and from the adjacent string 12, string 11 will be caused to vibrate with an amplitude initially relatively high and thereafter diminishing. It will be seen that, excepting for the inter-string coupling effected by bridge 8 and its supporting structure, none of the other strings would be caused to vibrate at all. Since this coupling exists, however, energy will be transferred from the vibrating string 11 to all other strings, and particularly to the adjacent string 12, which is similarly tuned and is coincidentally undamped. This energy will cause such string 12 to go into vibration at an amplitude steadily increasing until of the same order as that of the originally excited string 11. Thereafter string 12 will vibrate coincidentally with string 11 until both die out or until damper 18 seats against them. The vibration of the string 11 is negligibly translated into sound, due to the lack of a resonator attached thereto; the gradually beginning vibration of string 12, however, is translated into sound by the resonator or soundboard 16 against which each string 12 bears through the bridge. In the arrangement shown translation into sound of vibration of strings 12 is effected at the ends of those strings opposite to the ends where coupling to strings 11 is effected; furthermore strings 11 are excited at a point removed by almost their full lengths from the point of their coupling to strings 12. Thus momentary displacement or shock of the soundboard or resonator 16 upon impact of a hammer 17 with a string 11 is reduced to a negligible value.

In Figures 3 and 4 I show my invention in the preferred form. Herein 1' may designate the front frame, 3' a pressure bar or capo, and 4' the rear frame, it being understood that 1', 3' and 4' may each form a portion of an integrally cast frame or plate. Wrist plank 5, tuning pins 6, and hitch pins 7 may be provided as in earlier figures. Two stringers per note, 11' and 12', are again employed; but they are similarly strung from tuning pins 6 under capo 3' to hitch pins 7, and each bears on and is secured by pins to bridge 8'. Bridge 8' is preferably supported as in earlier figures by strips or rods 10, slightly bowed toward the bridge and secured to rigid mountings at their extremities. A hammer 17' may be employed for each tone, normally positioned to strike only the string 11'; and a damper 18' may be provided for each tone, always associated with both string 11' and string 12'. Keys 99 may control hammers 17' and dampers 18' through the medium of an action, not shown.

It is convenient in this embodiment of my invention to have each string electrically insulated from the others and from the frame. Accordingly the bottom of capo 3', the hitch pins 7, and the ledges in front frame 1' and rear frame 4' over which the strings pass, may be enamelled with an insulating vitreous enamel, or otherwise insulated, as indicated by insulation 20. Insulating washers 19 may be provided around hitch pins 7 to prevent the strings from contacting directly with rear frame 4'.

In this embodiment of my invention the vibrations of the strings 12' are translated into electric oscillations by a mechanico-electric translating system having portions in spaced relationship to the strings. Such portions may be provided by positioning opposite each string 12' an electrically conductive stud or screw 21. These studs may be mounted in and electrically connected together by conductive member 22; this member in turn may be secured to but insulated from capo 3' through the medium of insulation 23. The ends of the studs should in general be as close to their respective strings as is possible without actual contact with such strings under conditions of maximum vibration of the latter. Conductive member 22 may be electrically connected to the grid of a thermionic vacuum tube 32, through switch 31 hereinafter more fully explained. The cathode of tube 32 may be energized in any suitable manner, as by battery 33; its anode current may be supplied as from a tap on battery or other current source 34. The grid of tube 32 may be connected to the negative terminal of battery or source 34 through a high resistance 35; and the grid may be biased negatively with respect to the cathode by the flow of anode current through a condensively by-passed resistor 36. In the output circuit of tube 32 may be connected electrical amplifier 37, volume control or potentiometer 38, further amplifier 39 if desired, and loudspeaker 40. All the strings 11' may be electrically connected together and all the strings 12' may be connected together; and the group of strings 11' and the group of strings 12' may each be connected to the positive terminal of battery or source 34, respectively through switches 41 and 42 hereinafter more fully explained.

Consideration now being given to the manner of functioning of the apparatus of Figures 3 and 4 as thus far described, it will be seen that upon striking of a string 11' by hammer 17' and coincident raising of damper 18' therefrom and from the associated string 12', string 11' will be caused to vibrate with an amplitude initially relatively high and thereafter diminishing. In similar manner to that described above for strings 11 and 12 of Figures 1 and 2, this vibration of string 11' will produce a gradually beginning vibration of string 12', which is similarly tuned and coincidentally undamped. The vibration of each string 12' is translated into electric oscillations by virtue of the capacity formed between such string and its associated stud 21, which capacity is varied oscillatorily in accordance with the frequency, waveform and relative amplitude of the vibration of the portion of the string opposite the stud. These capacities all being in parallel with each other, their total capacity is likewise varied, but in reduced degree, by vibration of any string or strings 12'. The total capacity is charged to the potential of the battery or source 34 through the high resistance 35; and the oscillatory variations in the capacity produced by string vibration will cause a similar oscillatory variation to occur in the voltage across the capacity, and a similar series of electric oscillations to appear across the resistance 35. These oscillations are applied to the grid of tube 32, are amplified by that tube and by amplifier 37, may be controlled in respect of absolute amplitude by volume control 38, may be further amplified by

amplifier 39, and are translated into sound by loudspeaker 40.

In the above described operation, avoidance of translation of the vibration of the directly excited strings 11', with their high initial amplitudes, is dependent on the absence of appreciable capacity between those strings on the one hand and the studs 21 and conductive member 22 on the other, and on the absence of appreciable vibration-produced variation of such capacity as may exist. For the more positive avoidance of such translation these strings may be connected, as by switch 41, to the negative instead of the positive terminal of battery or source 34, thereby removing any potential difference between them and the studs 21 and member 22. If such zero potential difference be relied on to avoid translation of vibration of strings 11', the studs 21 opposite the individual strings 12' may be dispensed with, if desired, and the conductive member 22 itself (or preferably a smaller such member) moved as close to all the strings as studs 21 were to strings 11'. It will thus be seen in general that either constructional, or electrical, or combined constructional and electrical means may be employed to avoid incidental unwanted translation from the directly excited strings 11'.

I also show in Figures 3 and 4 means for producing tones which, instead of gradually rising in their inception, possess that abruptness of inception which is the natural result of the type of original excitation employed—percussion in the example illustrated. Thus a conductive member or string 24 may be provided adjacent all strings, both 11' and 12', preferably near the ends opposite the exciting devices, or hammers 17'. This conductive strip may conveniently be cemented to the top edge of bakelite or other insulating strip 25, which may be mounted to the frame as by brackets 26. The proper position of conductive strip 24 with respect to the strings is similar to that of studs 21 with respect to strings 12'—i. e., in general as near to the strings as it may be without contacting therewith under conditions of maximum vibration of the latter. By switch 31 strip 24 may be substituted in the electrical circuit for studs 21. If such substitution is effected and strings 11' are connected by switch 41 to the positive terminal of battery or source 34, the vibrations of the excited strings 11' will be directly translated into electric oscillations, in a manner similar to that discussed above for the vibrations of strings 12'.

It is to be noted, however, that vibration of strings 12' will still take place because of the coupling thereof to the excited strings 11', as above described. This vibration of any string 12', produced by excitation of the similarly tuned string 11', will be out of phase with respect to that of such string 11'. Therefore if strings 12' are connected by switch 42 to the positive terminal of battery or source 34, the oscillations translated from the vibration of a string 12' by strip 24 will partially oppose those translated from the synchronously tuned string 11'. This opposition will of course take place in accordance with the amplitude of vibration of string 12'; and since this rises from zero more or less gradually upon excitation of string 11', the oscillation opposition will take effect gradually, rather than abruptly. Thus the net amplitude of oscillations as translated from the two strings will be reduced in a degree which increases for a time after excitation. Thus results in some emphasis of the beginning of the tone with relation to the succeeding part

of the tone; and the apparatus may be employed as last described if and when this effect is desired. In order to eliminate this effect when it is not desired, however, the strings 12' may be connected by switch 42 to the negative terminal of battery or source 34, removing d. c. potential difference between them and the conductive strip 24.

In addition to the opportunity afforded as abovementioned for creating emphasis of tone inception, the presence of the non-excited strings 12', each closely coupled to its similarly tuned string 11', has another effect. This is of reducing the rate of damping of vibration of the excited strings 11'. This would appear to result from the abovementioned phase opposition of the vibration of an excited string 11' and its corresponding string 12', which tends to stabilize the vibratile bridge 8' and thus to reduce its string damping tendency. This effect may be perceptible either when translation is being effected from both strings 11' and 12' or from one set only.

A means of eliminating the effect of damping rate reduction, and of eliminating the effect of tone inception emphasis without removing the potential difference between string 12' and the frame, is also shown. Thus by handle 50 protruding through hole 51 in front rail 52 and secured to the base 53 to which the hammer action is mounted, or by any other suitable mechanism, the hammer action and hence each hammer 17' may be moved slightly to the right. Under these circumstances any string 11' and its associated string 12' are simultaneously struck by a single hammer; and resulting vibrations of the two strings are of course in similar phase, and are translated into aiding electric oscillations.

Finally by means of handle 50 the hammer action and hence each hammer 17' may be shifted to strike only string 12'. Thus three action adjustments are provided, whereby the hammers are caused respectively to strike either set of strings or both. Thus instead of effecting translation selectively from the strings 11' and 12', the translation may be effected constantly from one or both sets of strings, and selection effected by action adjustment. A special case is that wherein strings 11' are differently translated from strings 12', as for example will be the case if both strip 24 and studs 21 (the latter active only as to strings 12') are connected by switch 3 to the grid of tube 32; in this case each of the three action adjustments provides an output tone of respectively different harmonic structure. Action shifting may also be employed in the apparatus shown in Figures 1 and 2 to cause hammers 17 to strike strings 12 directly (either alone or with strings 11) and thus to produce modified percussion types of tone.

It will be appreciated that various modifications may be made in the instruments and apparatus described and illustrated, without departing from the spirit or scope of my invention, as hereinabove disclosed and in the appended claims defined.

I claim:—

1. In a musical instrument, the combination of an oscillator; means for initiating oscillation thereof of gradually rising initial amplitude, said means comprising a second oscillator similarly tuned, means coupling said oscillators together, and means for initiating oscillation of said last mentioned oscillator; and a work circuit responsive to oscillations of said first oscillator only.

2. In a musical instrument, the combination of

a tuned vibrator; means for initiating vibration thereof of gradually rising initial amplitude, said means comprising a second vibrator similarly tuned, means coupling said vibrators together, and means for initiating vibration of said last mentioned vibrator; and means for translating into sound the vibration of said first mentioned vibrator only.

3. In a musical instrument, the combination of two similarly tuned vibrators; means coupling said vibrators together; means for exciting one only of said two vibrators; and means for translating into sound the vibrations of the other only of said two vibrators.

4. In a musical instrument, the combination of two similarly tuned vibrators; means coupling said vibrators together; means for exciting one only of said two vibrators; and selective means for translating into sound at will either the vibrations of said one or those of the other of said two vibrators.

5. In a musical instrument, the combination of two similarly tuned vibrators; means coupling said vibrators together; means for exciting one only of said two vibrators; and selective means for translating into sound at will either the vibrations of one or those of both of said two vibrators.

6. In a musical instrument, the combination of two similarly tuned vibrators; means coupling said vibrators together; means for translating into sound the vibrations of one only of said two vibrators; and selective means for exciting at will either one or the other of said two vibrators.

7. In a musical instrument, the combination of two similarly tuned vibrators; means coupling said vibrators together; means for translating into sound the vibrations of one only of said two vibrators; and selective means for exciting at will either one or both of said two vibrators.

8. In a musical instrument, the combination of a plurality of variously tuned vibrators; a second plurality of tuned vibrators respectively similarly tuned to those of said first plurality; means coupling all of said vibrators together; vibrator exciting means associated with and operative upon the vibrators of said first plurality only; and a resonator system engaging the vibrators of said second plurality only.

9. In a musical instrument, the combination of a plurality of variously tuned vibrators; a second plurality of tuned vibrators respectively similarly tuned to those of said first plurality; means coupling all of said vibrators together; vibrator exciting means associated with and operative on the vibrators of said first plurality only; and a mechanico-electric translating system associated with the vibrators of said second plurality only, said system having portions in spaced relationship to said last mentioned vibrators and operating in accordance with vibratory variation of such spaced relationships.

10. In a musical instrument, the combination of a plurality of variously tuned vibrators; a second plurality of tuned vibrators respectively similarly tuned to those of said first plurality; means coupling all of said vibrators together; selective exciting means associated with and operative on the vibrators of said first plurality only; a mechanico-electric translating system having portions in spaced relationship to all of said vibrators and operative in accordance with vibratory variation of such spaced relationships; and adjustable means included in said translating system for controlling its operation selectively

with respect to the vibrators of said first plurality and those of said second plurality.

11. In a musical instrument, the combination of a plurality of variously tuned vibrators; a second plurality of tuned vibrators respectively similarly tuned to those of said first plurality; means coupling all of said vibrators together; a mechanico-electric translating system associated with the vibrators of said first plurality only, said system having portions in spaced relationship to all of said vibrators and operating in accordance with vibratory variation of such spaced relationships; means for exciting said vibrators; and selectively adjustable means associated with said exciting means for controlling the operation thereof selectively with respect to the vibrators of said first plurality and those of said second plurality.

12. In a musical instrument, the combination of two similarly tuned strings; a vibratile system engaging each of said strings at an extremity of the active portion thereof, and coupling said strings together; means for exciting one of said strings near the extremity thereof opposite its said first mentioned extremity; and means for translating sound from the vibration of the extremity of the other said string opposite its said first mentioned extremity.

13. In a musical instrument, the combination of two similarly tuned strings; a vibratile system engaging each of said strings at an extremity of the active portion thereof, and coupling said strings together; means for exciting one of said strings near the extremity thereof opposite its said first mentioned extremity; and means for translating sound from the vibration of a portion of the other said string near the extremity thereof opposite its said first mentioned extremity.

14. In a musical instrument, the combination of two similarly tuned strings; a vibratile system engaging each of said strings at an extremity of the active portion thereof, and coupling said strings together; a hammer adapted to strike one of said strings at a point thereon near the extremity thereof opposite its said first mentioned extremity; and a mechanico-electric translating system having a portion in spaced relationship to a portion of the other said string near the extremity thereof opposite its said first mentioned extremity, said system operating in accordance with vibratory variation of such spaced relationship.

15. In a musical instrument, the combination of a metallic frame; ledges forming portions of said frame; a metallic string strung in said frame and bearing on said ledges; a mechanico-electric translating system associated with said string and including means for maintaining a potential difference between said string and said frame; and a coating of insulating vitreous enamel on said ledges, whereby said string is insulated from said ledges.

16. In a musical instrument of the type wherein a plurality of tuned vibrators are selectively excited, the method of producing output tones having characteristics relatively free of the influence of the excitation employed, which consists in transferring a portion of the vibratory energy of each said excited vibrator to a similarly tuned vibrator and in translating into sound the resulting vibrations of such similarly tuned vibrators.

BENJAMIN F. MIESSNER.