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APPARATUS FOR THE PRODUCTION OF MUSIC

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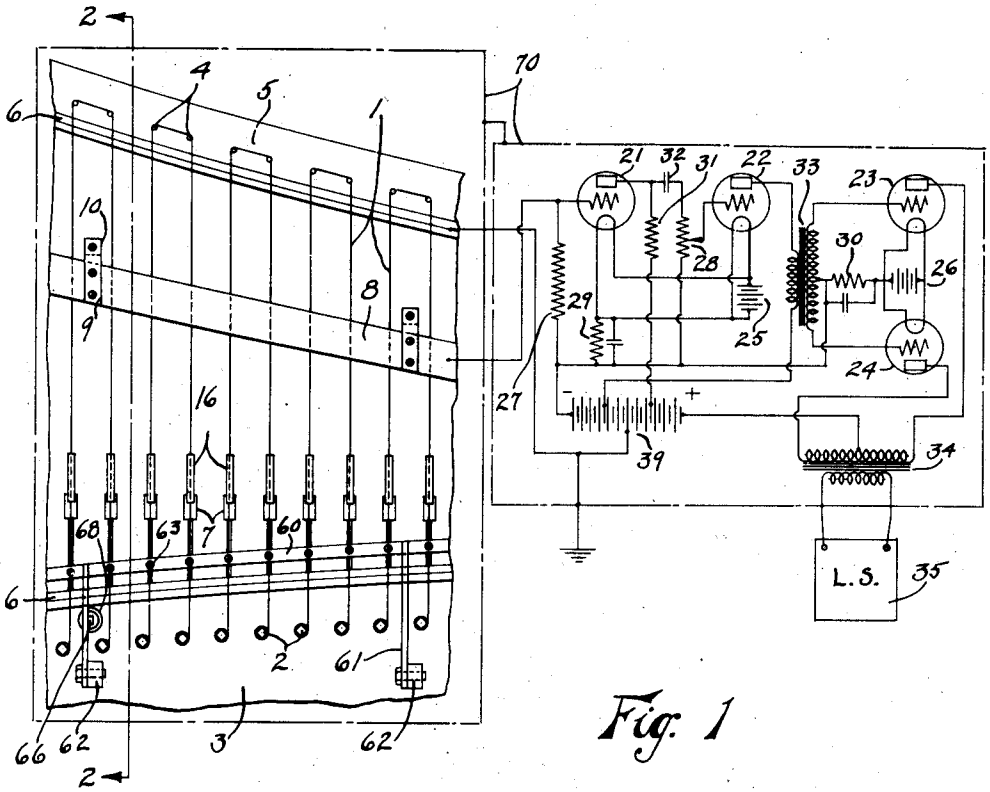


Fig. 1

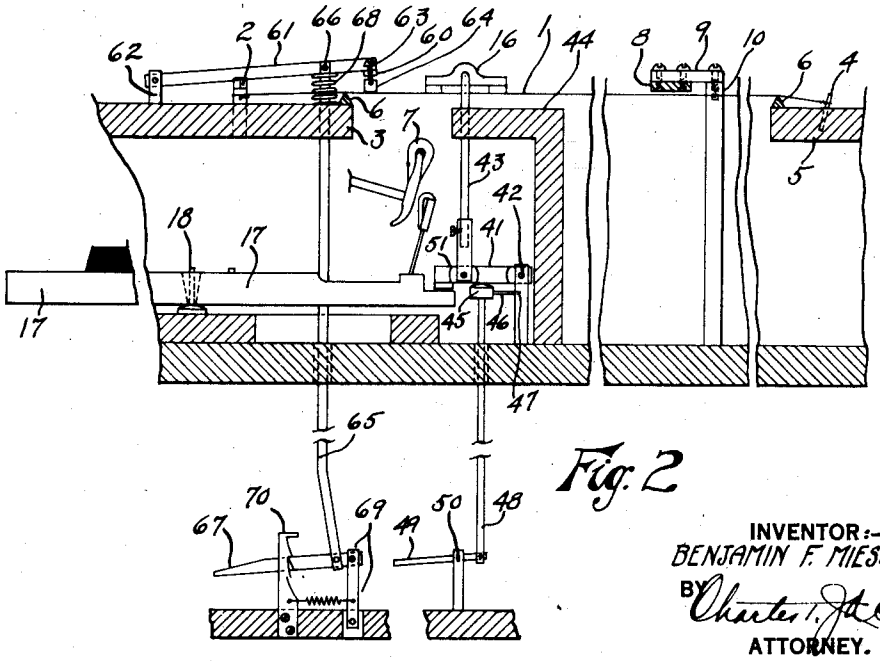


Fig. 2

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

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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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3 Claims. (Cl. 84—1)

This invention relates to musical instruments and systems wherein the vibrations of tuned vibrators are translated into electric oscillations and thence into sound, and more particularly to the control of the damping rate of such sounds. This application is filed as a division of my prior co-pending application Serial Number 534,849, filed May 4, 1931, now Patent No. 1,929,031, dated October 3, 1933. The invention, although useful with any mode of excitation of the tuned vibrators, is illustrated in connection with an instrument of the class described comprising strings caused to vibrate by percussion. Such instruments and improvements therein have been disclosed and claimed generally in my co-pending application Serial Number 512,399, filed January 30, 1931, now Patent No. 1,929,027, dated October 3, 1933.

When the vibrations of a plurality of vibrators—strings for example—are translated into sound by a mechanico-electro-acoustic series of translations, and particularly when this is done by means of mechanico-electric translating devices in spaced relation to the vibrators, the latter are freed of the damping influences of the resonator system ordinarily coupled thereto in conventional instruments—in other words the impedance of the resonator is no longer reflected into the vibrators, and the latter are isolated from acoustic impedance. This results in a decrease of the rate of damping of the output tones. This decrease may be exaggerated in certain cases and at certain frequencies by the action of acoustic feed-back from the electro-acoustic translating device to the vibrators. Differences in damping rate between individual output tones may also result from non-uniformity of the tuned vibrators themselves and/or of their respective mountings.

It is an object of my invention to provide methods and apparatus for individually adjusting the damping rates of the output tones of a musical instrument of the class described. It is a further object to provide methods and apparatus for simultaneously adjusting the damping rates of all the tones. A still further object is the provision of methods and apparatus for selectively providing a plurality of such damping rates. Other and allied objects will more fully appear from the following description and the appended claims.

In such description reference is had to the accompanying drawing, of which

Figure 1 is a partly plan and partly schematic view of portions of an instrument embodying my invention, and

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

In Figure 1, I show strings 1, strung for example between tuning pins 2 in plank 3 and pins 4 in rear block 5, over triangular bars 6, at least one of which latter may conveniently be electrically conductive in order that the strings may be connected together electrically. There may be employed a hammer 7 underneath each string for vibrating the latter and a damper 16 above each string for stopping the vibration thereof. Such a hammer 7 and a damper 16 more clearly appear, and actuating means therefor are shown, in Figure 2, a cross-sectional view taken along line 2—2 of Figure 1. Keys 17, pivoted as at 18, may be employed with a repeating action, not shown but well known in the art as a component of the grand piano, to propel hammer 7 toward string 1 upon depression of the front or left-shown end of the key. Such depression may also serve to raise arm 41, pivoted at 42; and by virtue of damper rod 43 pivoted at 51 and passing through guide 44, to raise damper 16 from its normal position of contact with string 1. Bar 45, supported by rods 46 pivoted as at 47, may pass under the several arms 41 and connect by rod 48 to pedal 49, pivoted as at 50; depression of pedal 49 thus raising all the dampers 16 simultaneously from the strings 1, according to principles well known in the art. The dampers 16 are intended to perform the usual function of either fully permitting or efficiently preventing vibration of the associated strings. Excepting as to these dampers 16, the term "damping" and its derivatives are herein employed in their broader sense, denoting decay of a vibration, or its decrease with time, whether inherent in a particularly mounted vibrator or otherwise caused.

For translating the vibrations of the strings 1 into electric oscillations I show electrically conductive bar 8, which may be insulatedly mounted above strings 1 as by uprights 10 and insulating blocks 9. Bar 8 may be electrically connected to the grid of a thermionic vacuum tube 21, which I show in Figure 1 as the first tube of an electrical amplifier including tubes 22, 23 and 24, the last two being shown in push-pull arrangement. Battery 25 is shown for exciting the filaments or cathodes of tubes 21 and 22 and battery 26 for those of tubes 23 and 24. Battery 39 may serve as a source of anode current for tubes 23 and 24 and, in reduced potential if desired, for tubes 21 and 22. The filaments or cathodes of tubes 21 and 22 may be connected to the negative terminal of battery or source 39 through condensively

by-passed resistor 29 for the biasing, through high resistance 27 and potentiometer 28 respectively, of their grids negatively with respect to their cathodes; likewise the filaments or cathodes of tubes 23 and 24 may be connected to such negative terminal through condensively by-passed resistor 30. A different potential from that of bar 8 is applied to strings 1 by connection of one of the triangular bars 6 to a point of positive potential in battery or source 39. Electrostatic shielding, shown schematically as 70, may advantageously be provided at least partially about the strings 1 and the translating and amplifying apparatus.

If now one of the keys 17 be depressed, causing the associated hammer 7 to be propelled toward the associated string 1 and the associated damper 16 to be raised therefrom, such string 1 will be caused to vibrate at its fundamental and harmonic frequencies, producing an oscillatory variation in the minute electrical capacity between such string 1 and bar 8. This capacity in parallel with other similar capacities is charged from source 39 through resistance 27, but by virtue of the high value of the latter this charge cannot change rapidly. Hence the vibration-produced variations in the capacity will produce across it an A. C. voltage substantially corresponding in its various characteristics, including harmonic structure, to the vibration of the mean string point below bar 8. This voltage will be seen to be applied to the grid of tube 21. Amplified by this tube, it appears across resistor 31 and is applied through stopping condenser 32 to potentiometer 28, whereby it may be selectively adjusted in respect of amplitude and applied to the grid of tube 22. Again amplified by tube 22 and push-pull transformer 33, it is applied to the grid of tubes 23 and 24, in equal amplitudes but in opposite phases on such two grids, as will be understood. From the output circuit of these tubes it is applied to loudspeaker 35, through the medium of transformer 34 if desired.

It will be understood, of course, that the particular amplifier system shown is illustrative only and that any suitable form of electrical amplifier may equally well be employed in an instrument embodying my invention.

To regulate the damping rates of the output tones I employ mechanical means for adjusting the damping rates of the vibrators themselves, which means are illustrated in the figures. Thus bar 60 may be provided above all the strings, being mounted to a plurality of arms 61 which in turn may be pivoted to stationary blocks 62. Into bar 60 above each string may be threaded a screw 63, carrying at its lower extremity pad 64 of soft material such as felt or soft rubber. The vertical position of the bar 60 and pads 64 may be varied by rod 65, pivotally secured to one of the arms 61 as at 66, and passing through plank 3 and between parts of the action to pedal 67, flexibly pivoted as at 69. Spring 68 may be provided to impart an upward moving tendency to bar 60; and toothed L-shaped bar 70 may be provided adjacent pedal 67, wherewith pedal 67 may be engaged to maintain against the force of spring 69 any desired position adjustment and whereby the upward motion of the pedal end of bar 60 may be limited.

The ends of the active portion of a string may be considered vibrational nodes thereof, being points of no vibration for fundamental and all harmonic components. With any vibrators, pads 64 are preferably employed near a vibrational node. Consequently I have shown them above a point on each string near its extremity.

With pedal 67 and bar 60 in some definite position, for example the upmost possible position, the pad 64 above any string having an inherently slower rate of damping or vibration decay than the others may be adjusted to press against the string with any desired force and thus to equalize the damping of the latter with that of the other strings. Again, the pad 64 above any string which tends to be sustained to vibration, as by acoustic feed-back from the loudspeaker, may be adjusted to overcome such feed-back tendency and to cause such string to approximate the others in rate of damping. A pad not required in such adjustment to press against the associated string may be adjusted to a position as close to the string as possible without pressure against the latter or without actual contact therewith. If now more rapid damping rate than normal for all the strings be desired, pedal 67 may be depressed and, if desired, maintained in its new position by engagement with toothed bar 70.

It will be obvious that the function of the pads 64 may be described as that of reflecting impedance into the strings, and that this impedance may be varied for all the strings by pedal 67, and for any individual string by the associated screw 63.

It will be appreciated, of course, that the motion of bar 60 may be dispensed with, if desired, the bar being employed as a rigidly mounted base for the individual adjustment pads 64; conversely that if individual adjustment of the pads 64 be not required, they may be similarly mounted with respect to bar 60 and their individual positions not varied, or a single long piece of felt underneath bar 60 substituted therefor.

It will finally be understood that my invention is not to be limited by the form of the specific embodiments disclosed, but is rather to be determined by the scope of the following claims.

I claim:—

1. In combination in a musical instrument, a plurality of tuned vibrators; selectively operable impulse exciting means therefor; a mechanico-electro-acoustic translating system for translating from said vibrators substantially the entire output sound of said instrument, said system having portions in spaced relationship to said vibrators and operating in accordance with vibratory variation of such spaced relationship, whereby said vibrators are substantially isolated from acoustic impedance; and mechanical impedance means coupled to said vibrators for reflecting thereinto mechanical impedances to simulate reflected acoustic impedance.

2. In combination in a musical instrument without a resonator, a plurality of tuned vibrators; selectively operable impulse exciting means therefor; a mechanico-electric-acoustic translating system for translating from said vibrators substantially the entire output sound of said instrument, said system having portions in spaced relationship to said vibrators and operating in accordance with vibratory variation of such spaced relationship, whereby said vibrators are substantially isolated from acoustic impedance; and mechanical impedance means coupled to said vibrators for reflecting thereinto mechanical impedances to approximate the reflected impedance of a resonator.

3. In combination in a musical instrument without a resonator, a plurality of tuned vibrators; selectively operable impulse exciting means

therefor; a mechanico-electro-acoustic translating system for translating from said vibrators substantially the entire output sound of said instrument, said system having portions in spaced relationship to said vibrators and operating in accordance with vibratory variation of such spaced relationship, whereby said vibrators are substantially isolated from acoustic impedance; and a plurality of mechanical impedance means adjustably coupled to the individual said vibrators for reflecting mechanical impedances into the several vibrators to prevent sustention of vibration thereof by acoustic feed-back from said translating system.

BENJAMIN F. MIESSNER.