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METHOD AND APPARATUS FOR THE PRODUCTION OF MUSIC

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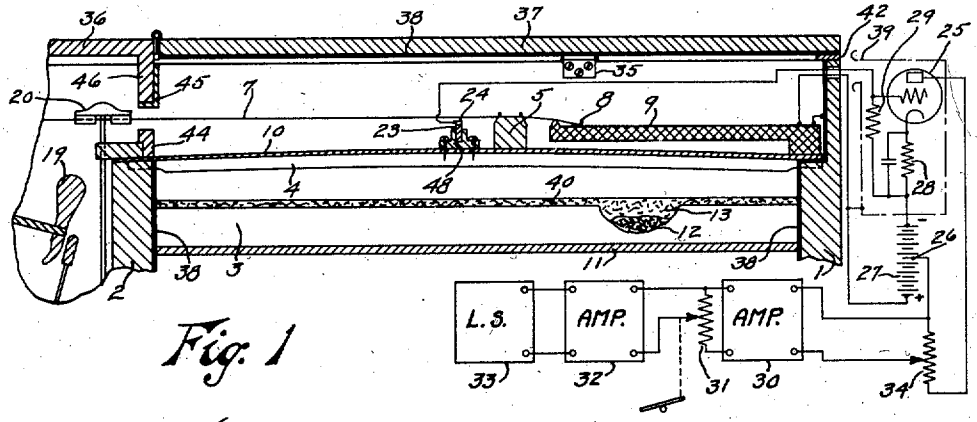


Fig. 1

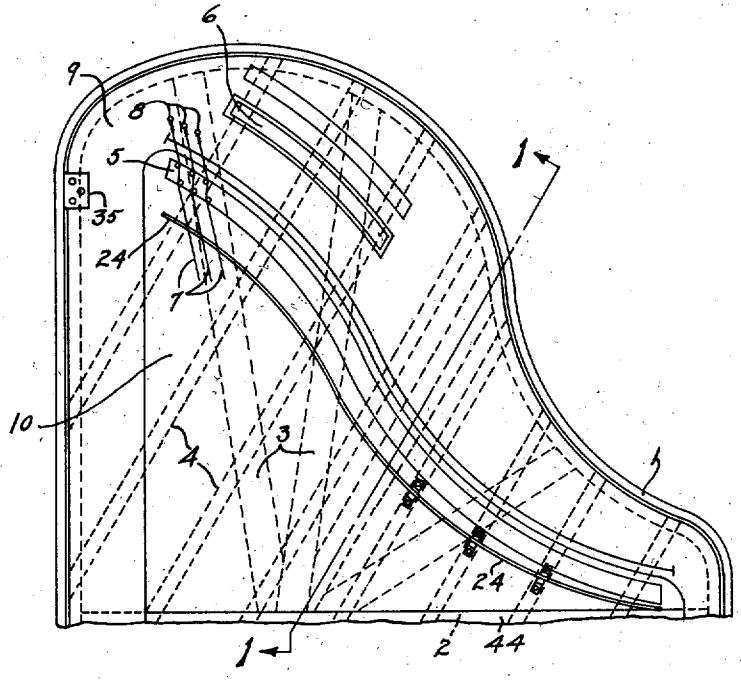


Fig. 2

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METHOD AND APPARATUS FOR THE PRODUCTION OF MUSIC

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11 Claims. (Cl. 84—173)

This invention relates to musical instruments, and more particularly to those of the piano type. This application is filed as a division of my copending application, Serial No. 647,154, filed December 14, 1932, now Patent No. 2,002,392, dated May 14, 1935.

Instruments of the piano type are customarily constructed with the bottom or back of the resonator substantially unobstructed and consequently providing relatively efficient radiation of sound. At the same time, and particularly in instruments of the grand piano type, a large sound radiation takes place from the opposite side of the resonator. In and near the plane of the resonator a large cancellation of one radiation by the other occurs at the longer sound wave lengths, or lower frequencies. This produces a serious loss of effective amplitude at these frequencies in the region wherein the player and still more particularly the listeners are usually located. The various and respectively dissimilar reflections which may occur to these two radiations before their arrival at any particular point undoubtedly mitigate this loss but by no means eliminate it.

According to the present invention the radiation of one side of the resonator—for example the bottom side of a grand piano soundboard or the back side of an upright piano soundboard—is absorbed without being permitted to escape from the instrument. In effect the radiation efficiency—i. e., sound energy output with constant vibratory energy input—of that side of the soundboard is rendered substantially zero. In this way the cancellation abovementioned is obviated. At the same time the opportunity is afforded to regulate the volume of sound output by regulation of the efficiency of radiation from the other side of the resonator, as by means of the adjustable closures normally provided on one side of the resonator—e. g., the hinged lid and its front portion on the conventional grand piano. Finally the instrument may be additionally provided with means for translating the string vibrations into electric oscillations, means for controlling the amplitude (and if desired other characteristics) of the oscillations, and means for translating the oscillations into sound, thus providing an instrument whereby direct vibration-sound translation (i. e., by the resonator) or vibration-sound translation through the intermediary of electric oscillations are available each in regulable degree.

Thus it is an object of my invention to provide an instrument with improved low frequency radiation. It is a further object to provide means for improving the low frequency radiation of an instrument of the class described.

It is another object to provide an instrument with a resonator, the radiation from one side of which is absorbed and from the other side of which is controllably regulated. It is a still further object to provide an instrument with a resonator, with an alternative or auxiliary translating system, and with means controlling the relative sound radiations from said resonator and said translating system. 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 partial cross-sectional view of a piano embodying my invention, Figure 1 being taken along the line 1—1 of Figure 2; and

Figure 2 is a partial plan view thereof with the lid removed.

Reference being had to Figure 2, there will be seen a grand piano having a rim assembly comprising a rim 1, a rim cross-member 2, and a plurality of rim-beams 3 angularly disposed between cross-member 2 and rim 1. Spaced above the rim-beams 3 may be provided a soundboard or resonator 10, reinforced by ribs 4 on the bottom thereof, and maintained in slightly arched form by compression between rim 1 and cross-member 2. Secured to the top of soundboard 10 may be the main or treble bridge 5 and the bass bridge 6, over which bridges the strings 7 may be strung to hitch pins 8 in plate 9. These parts and their disposition may thus be conventional; and they appear in cross-section in Figure 1, together with the usual hammers 19 and dampers 20, which may be actuated by the customary key-operated action, not shown. In Figure 1 there will also be seen the conventional lid 37, hinged to the top of rim 1 by hinges such as 35, and having front hinged portion 36.

It will be understood that upon excitation of any string or strings 7 by the associated hammer 19, the resulting vibration of the strings will produce a vibration of the bridges and the soundboard 10. Sound waves are thereupon radiated from both top and bottom of the latter. Customarily the sound waves radiated from the bottom are unobstructed, excepting to a slight degree by virtue of the rim-beams 3. According to my invention, however, this bottom radiation is absorbed and thus prevented from emanating into the surrounding air.

The absorption may be advantageously accomplished by providing a relatively stiff, but prefer-

ably vibrationally dead, member 11 underneath the rim-beams 3 and extending over the entire area bounded by the rim 1, and cross-member 2. The member 11 may conveniently be attached to the bottom of the rim-beams. Supported by this member, and preferably filling the space between the rim-beams and at least thinly covering them, may be provided acoustically absorptive material, such as felt. It is desirable that this material be graded in softness, the softest material being nearest the soundboard and somewhat less soft material adjacent the outer member 11. Thus in Figure 1 a portion of the rim-beam 3 is broken away, showing a lower layer 12 of medium hard felt, covered by a further layer 13 of soft felt, which may extend over the tops of the rim-beams.

It may be noted that the layer 13 should not only avoid contact with the soundboard 10 or ribs 4, but is preferably spaced away from the latter to provide an air chamber. If this be not provided or be made too small, excessive damping of the vibration of the soundboard may result; and on this account the customary spacing between rim-beams 3 and the soundboard 10 may be somewhat increased to advantage. It is convenient to provide means for retaining the layer 13 in its spacing from the soundboard. Such means may comprise a light copper wire screen 40 stretched between rim 1 and cross-member 2.

The only effective sound radiation from the soundboard 10 is now from the top-illustrated side. This radiation is customarily under a considerable range of control by the closing and the opening to different degrees of the lid 37; and when this is closed, by the closing and opening of the usual separately hinged front portion 36 thereof. It is to be noted, however, that the degree of this control is now considerably increased, since the normally uncontrolled radiation from the bottom-illustrated side is now absorbed.

The degree of radiation reduction with lid 37 and its front portion 36 closed may be further increased by providing a felt or other absorptive seal 42 between lid and rim, and by providing absorptive material vertically disposed between the front edge of the soundboard and the lid, of course with an appropriate gap for the strings. Such absorptive material is shown below the strings as 44, and thereabove as 45. The latter may be secured to a flange 46 carried by and at right angles to the hinged front lid portion 36; the material 45 is thus precluded from interfering with the radiation when the front lid portion is opened.

Various refinements carrying still further the radiation reduction under the closed lid conditions may comprise the provision of absorptive material on the entire bottom of lid 37; the provision of such material in back of the fallboard of the instrument above the keys; and the assembly of the ribs 4 and the parts thereby carried to a modified form of plate, which in turn is vibrationally insulated from the rim, as shown in U. S. Patent No. 1,912,293, issued to me May 30, 1933. This last construction has the advantage of reducing vibration of the rim and parts thereto rigidly secured by conduction from the soundboard and plate, which vibration is to some extent radiated as sound by the rim, etc.

A mechanico-electro-acoustic translating system, the sound radiation from which may be employed under the closed lid conditions as an alternate to the normal radiation, and as an auxiliary thereto under open lid conditions, is illustrated in Figure 1. A strip 23 is shown having a conductive top edge 24 in spaced relation to each of the treble strings; and it will be understood that a similar strip may be provided for the bass strings. This strip is the element of the translating system sensitive to the string vibrations and it may if desired be rigidly mounted; I prefer, however, to mount it to the soundboard 10, having found this mounting especially adapted for the production of good tonal characteristics. The mounting may be accomplished by inverted T-shaped pieces 48, the upright of the T being slotted to receive the strip and the horizontal portion of the T being fastened to the soundboard. The slot may be of such a width that it will frictionally engage the strip 23. After adjustment of the latter in the slot to a position generally as close to the strings as possible without risk of contact therewith under conditions of maximum vibration of the latter, the strip may be glued or otherwise fastened to its supporting pieces.

The conductive edge 24 may be connected to the grid of a thermionic vacuum tube 25, whose cathode may be energized in any well-known manner, whose anode current may be supplied as from a tap 26 on high voltage battery or other source 27, and whose grid may be connected through high resistance 29 to a point rendered slightly more negative than the cathode by virtue of anode current flow through condensively by-passed resistance 28. In the anode circuit of tube 25 are connected in cascade potentiometer or output control 34, amplifier 30, pedal-operated potentiometer of volume control 31, further amplifier 32 and loudspeaker or other electro-acoustic translating device 33. It is desirable to provide electrostatic shielding 39 around tube 25 and immediately associated apparatus, and to provide a continuation thereof at least partially about the strings and translating system. Such continuation may take the form of one or more coats of conductive paint 38 applied to interior surfaces of the piano rim, lid, etc.

It will be appreciated that between each string 7 and the conductive surface 24 a small electrostatic capacity exists, and that these capacities in parallel with each other form a total capacity between strings and conductive surface. This capacity is charged from battery or source 27 through resistance 29, and this charge cannot change rapidly because of the high value of the latter resistance. If now any string 7 be vibrated in a vertical plane, as by striking by its hammer 19, the capacity between it and the conductive surface 24 will be varied oscillatorily in accordance with the frequency and waveform of the point of the string opposite the conductive surface. The total capacity between the strings and surface will be likewise varied, though in reduced degree; and by virtue of the relatively constant charge in this capacity the voltage across it will likewise vary. The oscillatory variations in this voltage will be seen to be applied to the grid of tube 25; by this tube and succeeding amplifier 30 they are amplified; they may be controlled in respect of amplitude and further amplified if desired by controls 31 and 34 and by further amplifier 32, respectively; and finally they may be translated into sound and radiated as such by loudspeaker 33. Thus a mechanico-electro-acoustic chain of translation is provided which may be employed to produce a sound radiation of amplitude fully regulated by controls 31 and 34, and of general characteristics which may be subjected to wide further control.

While I have disclosed my invention in terms

of a particular embodiment thereof, it will be understood that such disclosure is intended to be exemplary rather than comprehensive, and that the scope of my invention is intended to be expressed by the following claims.

I claim:—

1. In the production of music by an instrument having a resonator, the method of sound output control which comprises absorbing the sound radiation from one side of said resonator and selectively regulating the efficiency of radiation from the other side thereof.

2. In the production of music by a piano, the method of sound output control which comprises absorbing the sound radiation from one side of the soundboard of said piano and selectively regulating the efficiency of radiation from the other side of said soundboard.

3. The combination with a piano including a soundboard and a plurality of tuned strings on one side of and coupled to said soundboard, of means for improving low frequency sound propagation from said soundboard in its own plane, comprising means disposed on the opposite side of said soundboard for absorbing the sound radiation from said last mentioned side.

4. The combination with a grand piano including a plurality of tuned strings and a substantially horizontal soundboard underneath and coupled to said strings, of means for improving low frequency sound propagation from said soundboard in its own plane, comprising means disposed underneath said soundboard for absorbing the sound radiation from the bottom of said soundboard.

5. The combination with a piano including a soundboard and a plurality of tuned strings on one side of and coupled to said soundboard, of means for absorbing the sound radiation from the other side of said soundboard, comprising acoustically absorptive material disposed on said second mentioned side of and in spaced relation to said soundboard.

6. The combination with a piano including a soundboard and a plurality of rim-beams in spaced relation thereto, of sound absorptive means associated with said rim-beams and at least partially interposed between the same and said soundboard.

7. The combination with a piano including a soundboard and a plurality of rim-beams in spaced relation thereto, of sound absorptive material disposed between said rim-beams, and retaining means for said material secured to the side of said rim-beams further removed from said soundboard.

8. The combination with a piano including a soundboard, of means for absorbing the sound radiation from one side of said soundboard, comprising acoustically absorptive material disposed on said side of said soundboard, and acoustically transparent means for retaining said material in spaced relation to said soundboard.

9. The combination with a piano including a soundboard, of means for absorbing the sound radiation from one side of said soundboard, comprising acoustically absorptive material disposed on said side of said soundboard, said material being graded in softness, and the softest material being nearest said soundboard.

10. The combination with a piano including a soundboard and a plurality of tuned strings on one side of and coupled to said soundboard: of means disposed on one side of said soundboard for absorbing the sound radiation from said side; and an adjustable closure on the other side of said soundboard, whereby the efficiency of radiation from said other side may be regulated.

11. The combination with a grand piano including a plurality of tuned strings and a substantially horizontal soundboard underneath and coupled to said strings, of means disposed underneath said soundboard for absorbing the sound radiation from the bottom of said soundboard; and adjustable lid means above said strings, whereby the efficiency of radiation from the top of said soundboard may be regulated.

BENJAMIN F. MIESSNER.