

June 29, 1943.

B. F. MIESSNER

2,323,232

APPARATUS FOR THE PRODUCTION OF MUSIC

Filed May 14, 1940

2 Sheets-Sheet 1

Fig. 1

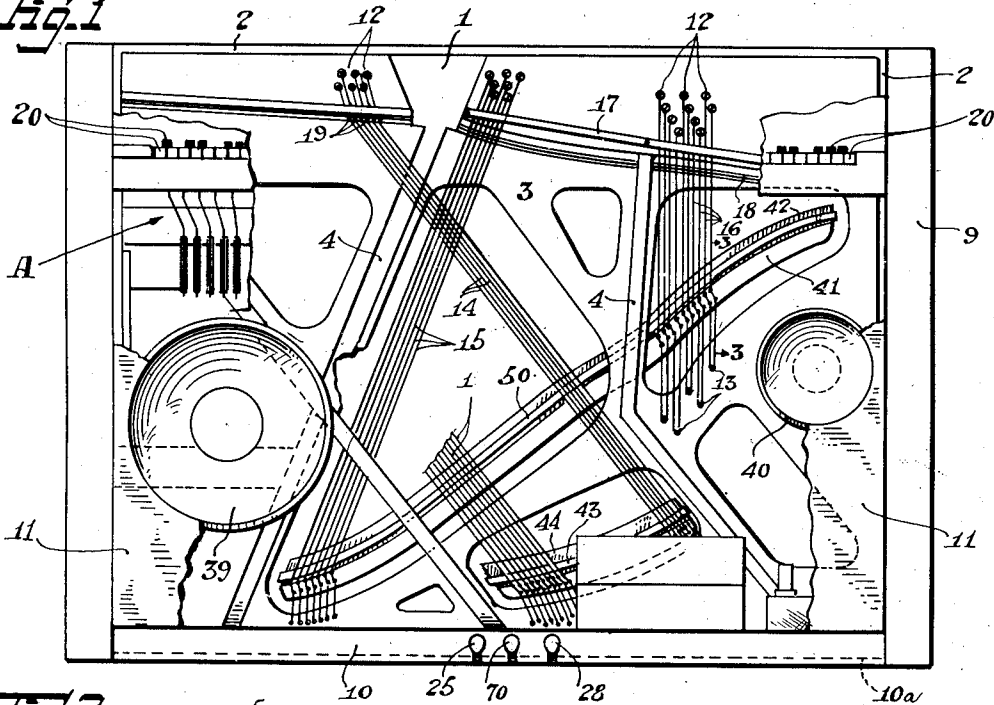
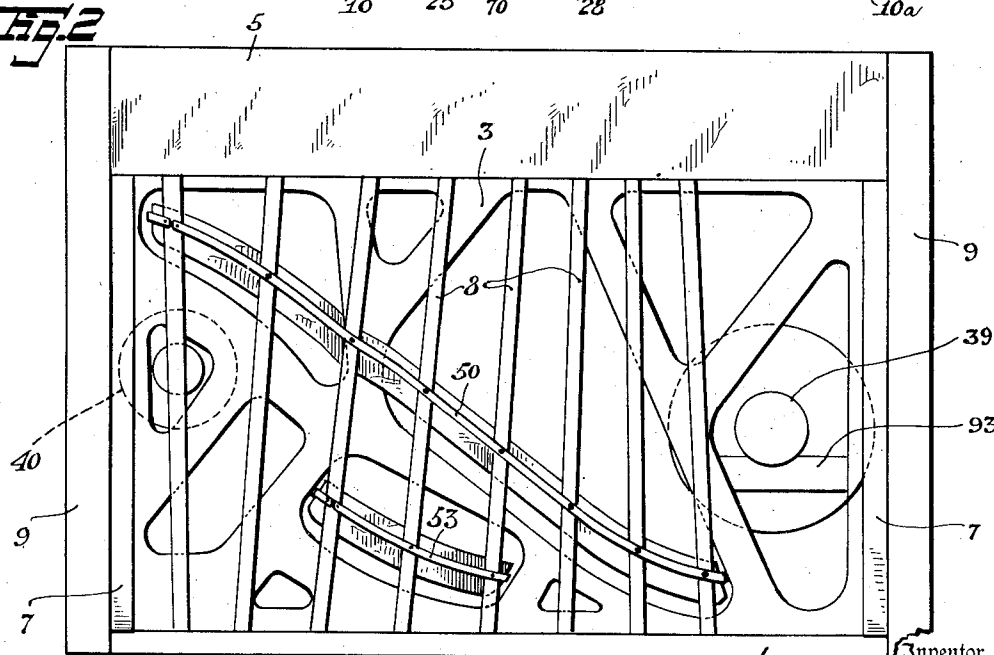


Fig. 2



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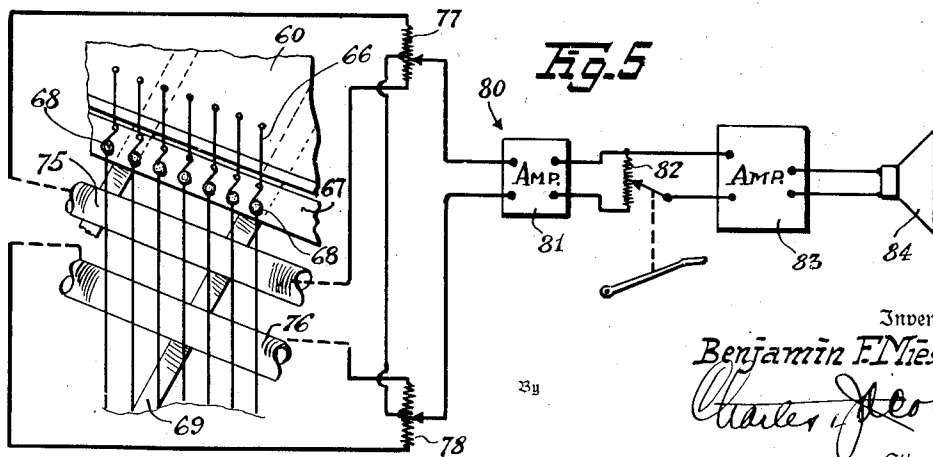
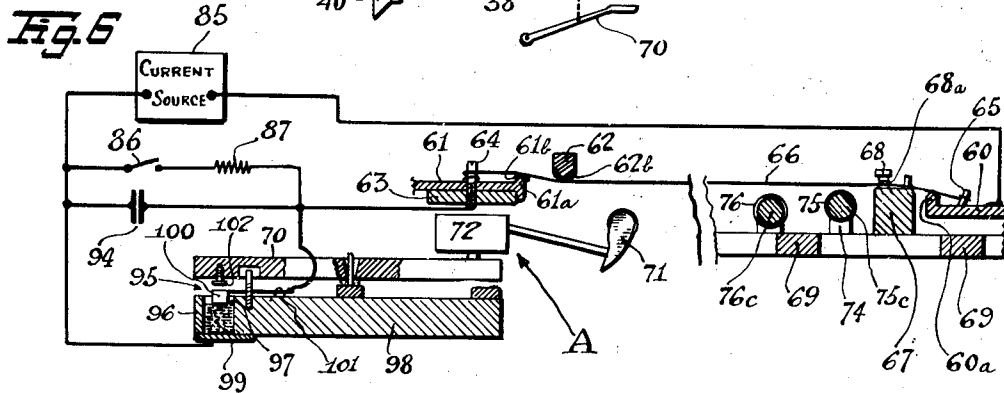
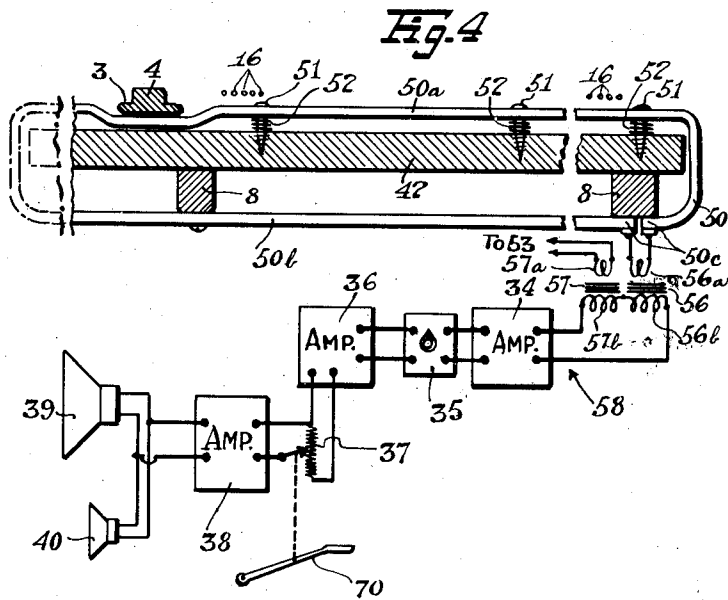
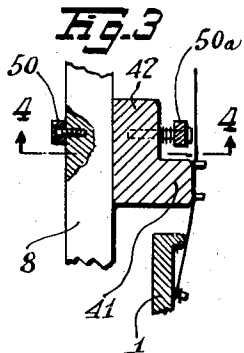
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,323,232

APPARATUS FOR THE PRODUCTION OF
MUSIC

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Application May 14, 1940, Serial No. 335,064

16 Claims. (Cl. 84—1.13)

This invention relates to the production of music, and in its principal aspects to that production involving the translation of sound from sound-representing electric oscillations. Important aspects of the invention involve the production of the sound-representing electric oscillations by translation from the vibrations of tuned vibrators, and more specific aspects involve such translation from the strings of an instrument of the piano type. The invention has been specifically illustrated and described in connection with an instrument of the latter type, but it will be understood that in broader aspects no unnecessary limitation thereto is intended.

It is an object of the invention to provide improved and simplified arrangements for the translation of electric oscillations from the vibrations of tuned vibrators.

It is an object of the invention to provide improved arrangements of the type above described, operating magnetically.

It is an object to provide improved arrangements of the type abovementioned which may be effectively used to modulate high-frequency currents at the vibrational frequencies.

It is an object to provide, in association with arrangements such as abovementioned, appropriate means for controlling the envelopes, or amplitude-time characteristics, of the output tones.

It is an object to provide, in an electronic instrument of the piano type, an improved arrangement of sound-radiating means with respect to the other portions of the instrument.

Other and allied objects will more fully appear from the following description and the appended claims.

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

Figure 1 is a front elevational view of an electronic piano in which my invention has been embodied in one form, most of the front cover member and most of the action being removed for the better illustration of parts therebehind;

Figure 2 is a rear elevational view of the instrument of Figure 1;

Figure 3 is a fractional cross-sectional view, taken along the line 3—3 of Figure 1;

Figure 4 is a fractional cross-sectional view, taken along the line 4—4 of Figure 3, together with a schematic illustration of circuit components;

Figure 5 is a partial plan view of an electronic instrument of the grand-piano type in which

my invention has been embodied in another form, together with a schematic illustration of certain circuit components; and

Figure 6 is a partial cross-sectional view taken along the line 6—6 of Figure 5, together with a schematic illustration of other circuit components.

An embodiment of my invention has been illustrated in Figures 1, 2, 3 and 4, the latter two figures being enlarged cross-sectional views of restricted portions of the former. Figures 1 and 2 illustrate an instrument of the piano type, which in its general construction—other than that immediately involved in the translation of the string vibrations into electric oscillations—may for example be similar to that illustrated and described in Patent No. 2,200,718 to me, to which patent reference may be had for details not in themselves necessary to mention in the following brief description of that general construction.

In Figures 1 and 2 will be seen a vertical, rectangular metallic frame or plate 1 serving as a basis to which the other components may be directly or indirectly assembled. This plate is conveniently provided around its periphery with the forwardly extending flange 2. The central portions of the plate are apertured; but the plate is reinforced by cross-webs such as 3, some of these being in turn reinforced with forwardly extending flanges such as 4. To the back of the plate may be secured a peripheral framework, comprising for example the wrest-plank 5 across the top, the wooden cross-member 6 across the bottom, and the vertical wooden end members 7. To the plate 1, through the medium of this framework, may be supported a vibratile system comprising certain bridges (hereinafter described) and a plurality of vibratile ribs 8—the tops of the ribs being secured in the wrest-plank 5, the bottoms of the ribs being secured in the cross-member 6, and the ribs being preferably slightly bowed forwardly in their central portions. Forwardly and backwardly extending vertical standards 9 may be secured to the two ends of the plate 1 to form a support therefor and, if desired, to form the exposed ends of the instrument. A bottom front cross-member 10 may extend between the end standards 9, as may likewise a floor-member 10a, between the cross-member 10 and the plate 1. There may also be provided between the end standards 9, extending upwardly from the cross-member 10, a removable front cover member 11 (fractions of which only appear in Figure 1, adjacent the respective

vertical end standards 8). The illustration of ribs 8 has been omitted from Figure 1 in the interest of clarity of showing.

The top portion of the plate 1 is suitably apertured to permit a plurality of tuning pins 12 to extend forwardly therethrough from wrest-plank 5, wherein they are secured. From these pins to hitch pins 13 in lower portions of the plate 1 extend the several tuned strings of the instrument, of which the upper treble strings are indicated as 16, the lower treble strings as 15, and the bass strings as 14—it being understood that each of these groups of strings is only fractionally shown in the interest of simplicity of the drawings. All the treble strings have been shown as passing from the tuning pins 12 under a pressure bar 17 and over a ledge 18 defining the upper extremities of their active portions; the bass strings 14, which may be overstrung (i. e., disposed slightly in front of and somewhat transversely to the treble strings), may pass around respective localizing pins 19 in the defining ledge 18. The bridges over which the strings pass, and which define the lower extremities of the active string portions, are hereinafter described.

For vibrating the strings there may be employed, for example, the impulse or striking excitation usual to the piano, typically by means of the usual piano hammer, damper and pedal action; this has been indicated in Figure 1 as including the keys 20 and pedals 25 and 26, and has been designated generally as A. It may for example be of the "dropped" type—details of which, over and above the quite fractional showing of Figure 1, have been illustrated and more fully described in the Patent No. 2,200,718 above-mentioned. While no particular limitation is intended as to the number of strings per note, I have in Figures 1 and 2 illustrated the use of two strings per note throughout the principal portion of the scale.

The bridges over which the strings pass are shown as 41 and 43 for the treble and bass strings, respectively. These extend transversely of, and are secured to, the ribs 8. The bridge 41 has been illustrated as provided with a portion 42 of reduced thickness extending underneath (i. e., behind) the active string portions (i. e., upwardly), and the bridge 43 with a corresponding extending portion 44. These portions form a convenient, though non-limitative, support for the mechanico-electric translating apparatus shown in this embodiment of my invention.

In carrying out my invention I cause the strings to have magnetic fields which intersect a conductive circuit and which, when the strings are vibrated, oscillatorily influence that circuit to create vibration-representing electric oscillations therein. According to an important aspect of the invention, I arrange the conductive circuit for a plurality of different-frequency strings as a single one, extending transversely of the strings and having portions adjacent thereto to be oscillatorily approached and receded from by the strings during their vibrations.

Such a circuit has been embodied in the construction of Figures 1 through 4 as a single-turn loop for all the treble strings, together with another single-turn loop for all the bass strings. One side of the loop is in close spaced relationship to the strings—typically at a spacing therefrom not greatly in excess of that required to avoid its being struck by the strings under conditions of their maximum-amplitude vibrations. It is on this side of the loop that the string vi-

brations have their significant and intended influence. The other, or "return," side of the loop is kept at a much larger distance from the strings, whose vibrations accordingly have negligible effect on it—which is desirable, since the latter influence tends to oppose the former within the loop circuit. The loop for all the treble strings has been specifically illustrated as a heavy conductor 50, typically though non-limitatively of rectangular cross-section. The active side 50a of the loop is disposed behind the strings, preferably opposite longitudinal portions thereof which vibrate with the most desirable harmonic development; and since these portions may typically be portions relatively near the bridge extremities of the strings, the loop side 50a may conveniently be secured to the portion 42 of the bridge abovementioned. This securing has been shown by way of preferred example as carried out through the medium of screws 51 passing rearwardly through the conductor 50 and into the bridge portion 42.

Between the conductor 50 and the bridge portion 42 there may be provided about the screws 51 respective expansion springs 52, which urge the conductor forwardly against the heads of the screws 51; this renders the turning of each screw effective to adjust the precise spacing of the conductor, in the region of that screw, from the strings. Several of the screws 51 may be employed at intervals along the conductor 50, and the latter may be made of a relatively soft metal to respond in its several portions to adjustment by the respective screws. Since the degree of influence of the vibrating strings on the loop will be directly affected by the spacing of loop from string, the voicing of the instrument as to relative outputs in different scale portions may be very precisely adjusted by means of the screws 51.

At the extremities of the bridge 41 the conductor 50 may be folded around the end of the bridge portion 42 (as appears for the extreme treble extremity in Figure 4) to form the second or return side 50b of the loop; this may conveniently be secured to the backs of the ribs 8, for example. At a convenient point in the loop side 50b the loop is provided with a discontinuity, formed between spaced extremities 50c of the otherwise continuous conductor. The loop circuit is closed by connection across these extremities of a very low impedance primary 56a of a transformer 56.

Because of the overstrung arrangement of the bass strings in the particularly illustrated instrument construction, it may be relatively difficult to extend the one loop 50 into an effective relationship to the bass as well as to the treble strings; accordingly I have preferred to employ for these strings, as indicated in Figures 1 and 2, a separate loop 53 related to them in an analogous manner to that described for loop 50 and the treble strings. While this loop 53 may be connected in any of a variety of ways to merge its output with that from the loop 50, I have by way of example indicated in Figure 4 the provision of a separate transformer 57 to the primary 57a of which the loop 53 may be connected (as was the loop 50 to the transformer primary 56a). This use of separate transformers may facilitate the minimization of length of leads in the low-impedance loop circuits.

Since the axis of the loop is very approximately parallel with the strings, the magnetic fields which the strings are caused to have are preferably longitudinal of the strings. Such a field is most simply provided for each string by

permanently magnetizing it, particularly in the region adjacent the loop. Means and methods for magnetizing the string, being themselves known in the art and forming no necessary permanent part of the instrument, need not be specifically described herein.

It will be understood that as any one of the strings is vibrated toward and away from the loop—for example as a result of its being excited by the action A—the influence of its magnetic field on the loop is oscillatorily varied in accordance with the frequency and wave form of the string portion adjacent the loop, thereby generating in the loop circuit a corresponding alternating voltage representing the string vibration. The voltages so generated by as many strings as may be simultaneously vibrated, superimposed on each other, are stepped up by the transformers 56 and 57, and appear in their magnified amplitude in the circuit 58 in which the secondaries 56b and 57b of those transformers are both connected.

The circuit 58 forms a load circuit for the utilization of the translated oscillatory voltages. It may comprise a cascade of electrical amplifying and control means and electro-acoustic translating means. In Figure 4 it has been shown as comprising for example amplifier portion 34, tone control 35, amplifier portion 36, volume control 37 (controlled for example by pedal 70), amplifier portion 38, and electro-acoustic translating means 39 and 40. The translating means 39 may be a "low-frequency" sound radiator—e. g., a loudspeaker which, while it may have a response at all audio frequencies, is particularly efficient in the lower frequency range—while the translating means 40 may be a "high-frequency" sound radiator—e. g., a loudspeaker having a response wholly or principally at high audio frequencies.

The low-frequency and high-frequency radiators, or loudspeakers 39 and 40 respectively, are mounted within the instrument in a preferred embodiment of the invention. The low-frequency speaker may be mounted to the plate 1 in any convenient manner, as by securing to a cross member 93 extending between one of the web flanges 4 and the edge flange 2 abovementioned. It may be forwardly directed, and if desired may be baffled by the removable front cover member 11, suitably apertured for this purpose. The relatively smaller high-frequency speaker 40 may be secured to the plate 1 in any convenient manner, likewise preferably forwardly directed to emit sound through the front cover member 11, which may be further suitably apertured for this loudspeaker. A preferred embodiment of the invention contemplates the disposition of the low-frequency radiator or loudspeaker relatively adjacent the low-note extremity, and the disposition of the high-frequency radiator or loudspeaker relatively adjacent the high-note extremity, of the keyboard and instrument, and the speakers have accordingly been so illustrated. I have found this arrangement markedly to enhance the naturalness of pianistic performance by an instrument of this type.

In Figures 5 and 6 I show another embodiment of my invention, wherein the conductive circuit may be in the form of a coil whose axis extends transversely of the strings, peripheral portions of the coil being adjacent the strings to be oscillatorily approached and receded from by the strings in their vibrations. Purely by way of example, I have shown this construction em-

bodied in an instrument of the grand-piano type. Thus in these figures there will be seen the rear portion 60 of a metallic plate, or frame, which may further include the front portion 61 and the "capo" or cross-bar portion 62 as seen in Figure 6. Underneath the front plate portion 61 appears the wrest-plank 63; tuning pins 64 may extend downwardly into the wrest plank through oversize holes in the plate portion 61. From the tuning pins to respective hitch pins 65 in the rear plate portion 60 there may be strung the respective tuned strings 66 of the instrument. These may pass over ledge 61a on front plate portion 61, under the capo 62, over a bridge 67, and over a ledge 60a on rear plate portion 60. The strings are caused to engage the bridge; and while this may be done by respective pairs of bridge pins as in the instrument of earlier figures, I have by way of alternative example shown the forward pin of each pair replaced by a grooved screw 68—the string resting in the circumferential groove 68a therein, so that adjustment of the screw serves to raise and lower the string (as disclosed in Patent No. 1,915,859 to Miessner et al.). The bridge 67 has been shown as vibratily supported, for example to the usual vibratile ribs 69. For effecting and controlling the string vibrations I have shown as A', partially schematically, a typical grand-piano action. This may include the pivoted keys 70, hammers 71, and action mechanism schematically indicated as 72 interposed therebetween. In the illustration of this embodiment there has been shown, by way of example, the employment of a single tuned string per note.

A coil forming a conductive circuit in the instrument of Figures 5-6 appears as 75. This coil may for example be positioned underneath that portion, of each of the strings, whose vibrational wave form is considered satisfactory for translation, the coil being arranged in an appropriate longitudinal configuration; the coil 75 has been illustrated as positioned underneath string portions relatively near the bridge 67. The coil may be mounted so that its top side is slightly spaced underneath the strings; for example, it may be mounted on the ribs 69, through the medium of spacing members 74. The strings being caused to have appropriate magnetic fields, as herein-after more fully explained, their up-and-down vibrations will induce in the coil and alternating voltage representing the vibrations of the string portions above the coil. A load or utilization circuit for this voltage, to which the coil 75 is connected, appears as 80; and while it may comprise components generally similar and similarly arranged to those of the utilization circuit 58 already described, it has for simplicity been shown as comprising the amplifier portion 81, volume control 82, amplifier portion 83 and loudspeaker 84.

In the various embodiments of my invention there may of course be employed a plurality of the mechanico-electric translating means, or conductive circuits, respectively associated with different portions of the strings, with differential phase and/or amplitude control over their respective outputs (as disclosed for mechanico-electric translating devices broadly in Patent No. 1,906,607 to Jacobs). I have illustrated this availability in the instrument of Figures 5-6 by the showing of a second coil 76 arranged similarly to the coil 75 excepting that it is underneath a more forward portion of each string. To provide the differential control over respective out-

puts of the two coils, I may connect them across respective potentiometers 77 and 78, the fixed mid-points of the potentiometers being connected together, and their variable contacts being connected to the input of the amplifier portion 81—the impedance of this input, and the impedances of the potentiometers, being of course preferably chosen at values appropriate to the impedances of the coils 75 and 76.

With the conductive circuit arrangement illustrated in Figures 5-6—particularly when, as illustrated, the coil axis is obliquely (as distinguished from right-angularly) transverse to the strings—a permanent magnetization of the strings may be employed as in the case of the embodiment of earlier figures. But since the coil axis is more nearly at right angles to the strings than parallel thereto (and may be quite at right angles to certain strings of the instrument), I prefer that the magnetic fields of the strings extend at right angles to—for example, in planes transverse to—their longitudinal directions. Such a field for a string may be created by the passage of a current longitudinally through the string; and in Figure 6 I have schematically illustrated an arrangement for such current passage.

This arrangement may comprise a current source 85, one terminal of which may be electrically connected with the rear plate portion 89 and therethrough to the rear extremities of all the strings. The other terminal of the source 85 may be connected to all the tuning pins 84 (i. e., to the front extremities of the strings). For purposes hereinafter apparent it may be desirable that these connections to the front string extremities be individual to the several strings; and such individual connections may for example be made through individual switches 86. (To preserve the individuality of the front-extremity connections, the strings in passing over the ledge 61a and under the capo 62 may be insulated from those respective elements by thin curved pieces of insulation 61b and 62b respectively, seen in Figure 6). It will be understood that with the switches 86 closed, currents will be continuously passed through the strings; to limit or to equalize these currents there may if desired be employed, for example in series with the switches 86, respective resistances 87. The magnetic fields abovementioned will be continuously maintained; the voltages translated from the strings, and the sounds translated therefrom by the electro-acoustic translating means, will have envelopes (or amplitude-time characteristics) corresponding throughout to those of the string vibrations; and, in an instrument of the disclosed type, the tones will accordingly be of initially percussive, pianistic nature.

The creation of magnetic fields by current passage, however, may be employed to permit the variation of the envelopes of the electric oscillations and output tones from those of the string vibrations respectively giving rise thereto. Thus the current passage through each string may be controlled in predetermined relationship to the excitation of that string; and by way of specific example, the current passage may be initiated as or just after the instant of beginning of the string vibration (e. g., of the hammer striking the string), so that the percussive initial peak of the vibration envelope is eliminated from the envelope of the electric oscillations and the output tone.

There have been disclosed in prior patents to me or to me and another (e. g., 1,915,860; 1,915,-

859; 2,071,649) and in a copending application of mine (Serial No. 208,357, filed May 17, 1938, now Patent No. 2,233,058) various variable-resistance arrangements for controlling (by control of sensitizing voltage, oscillation output, or the like) the translation from a string or other vibrator in predetermined relationship to the excitation thereof; and a variable-resistance arrangement basically similar to one of these may for example be employed for the control of the current through the string. By way of example I have shown in Figure 6 a respective variable resistance, designated generally as 95, positioned underneath the front portion of each key 70 for operation thereby. Specifically each variable resistance may comprise a pile of carbon discs 96 retained in a hole 97 in the baseboard 98 of the action A', and resting on a common conductive plate 99 which extends transversely across the bottom of the baseboard and may form a common connection to one side of all the resistances 95. For contact with the top of each pile there may be provided a respective contact button 100, carried for example on the bottom of the front portion of a forwardly extending leaf spring 101 whose rear extremity is secured to the top of the baseboard 98. Extending downwardly from the bottom of each key 70, above the forward extremity of the respective spring 101, may be an adjustable screw 102.

Each spring 101 may be biased so that normally there is little or no pressure of the button 100 on the carbon disc pile; accordingly the normal value of each resistance 95 will be very high or infinite. In the downstroke of the key, however, the screw 102 will impinge on the spring and force the button to compress, and lower the resistance of, the carbon disc pile—the structure serving as a downstop for the key. The variable resistances 95 may be connected across the respective switches 86 and resistances 87 abovementioned, becoming effectively substituted therefor when those switches are open. Each screw 102 may be adjusted so that the respective key will have its normal downstroke, and so that the resistance of the respective carbon disc pile will still be high (and the current through the respective string therefore negligible) at the instant of contact of the respective hammer with the respective string—the resistance reduction, and consequent rise of current flow through the string, occurring wholly or principally after that contact.

In its simplest embodiment the current source 85 may of course be a source of direct current, the magnetic fields of the strings accordingly being steady (as distinguished from alternating) fields. The source 85 may alternatively, however, be a high (over-audible) frequency alternating current source. In the latter case the magnetic fields of the strings will be high-frequency alternating fields, and the electric oscillations in the coils 75 and 76 will be high-frequency oscillations modulated at the string vibrational frequencies. In this case the amplifier portion 81 may be operated as a demodulator, so that the oscillations passing to the loudspeaker will be the modulating frequencies and thus will again represent the string vibrational frequencies.

The choice of the type of source 85 may of course be made independently of whether the current flow through the string is to be varied, as by resistance 95, or maintained steady. It may be observed, however, that when the source 85

is a direct current source, there may if desired be associated with each variable resistance 95 a filtering or time-delay means, to insure a smoothness and a desired degree of graduality in the rise of the string currents and output tones. Such means have been quite schematically illustrated in Figure 6 as condensers 94 respectively shunted across the variable resistances 95.

The coils 75 and 76 may if desired be constructed without magnetic cores, the cylindrical space therewithin being either open or filled with a generally cylindrical member (such members appearing as 75c and 76c respectively) which in this case may be of insulating material and may act simply as a mandrel for the coil. The members 75c and 76c may, however, constitute magnetic cores for the coils, in which case they may be of appropriate magnetic material in appropriate form. The latter arrangement, in view of an increasing effect on the efficiency of the translation by the coils, is usually to be preferred.

The illustration of the instrument of Figures 5-6 has been presented in fractional form, since there will be obvious from the earlier embodiment manners in which the invention will be carried out in a complete instrument. It will be understood that while I have shown various more specific features of my invention in different groupings in the two embodiments, this has been primarily for purposes of illustration and explanation rather than limitative; many of those features will be seen to be mutually interchangeable. Again, it will be understood that while I have chosen instruments of the piano type for the illustration of my invention, various of its features are obviously applicable to other types of instruments. Finally, it will be understood that in general many modifications of the instruments shown and described will readily suggest themselves to those skilled in the art, and that these will not necessarily constitute departures from the spirit of the invention, or from its scope as expressed in the appended claims.

I claim:

1. In a musical instrument including a load circuit for the utilization of sound-representing oscillations: the combination of a plurality of variously tuned vibrators having magnetic fields and disposed essentially in a plane; and a closed conductive circuit electrically feeding said load circuit, extending transversely of said vibrators with operatively substantially uniform structure continuously throughout that extent and having portions adjacent to said vibrators to be approached and receded from by the vibrators and thereby magnetically influenced at the vibrator vibrational frequencies.

2. In a musical instrument including a load circuit for the utilization of sound-representing oscillations: the combination of a plurality of variously tuned vibrators having longitudinal magnetic fields and disposed essentially in a plane; and a conductive loop electrically feeding said load circuit, extending transversely of said vibrators with operatively substantially uniform structure continuously throughout that extent and having one side adjacent to said vibrators to be approached and receded from by the vibrators and thereby magnetically influenced at the vibrator vibrational frequencies.

3. The combination according to claim 2, wherein the loop comprises a heavy conductor of relatively soft material, and further including a plurality of means spaced along said one loop

side for adjusting the spacing of the same from the vibrators.

4. In a musical instrument including a load circuit for the utilization of sound representing oscillations: the combination of a plurality of variously tuned vibrators having magnetic fields and disposed essentially in a plane; and an elongated coil electrically feeding said load circuit, having an axis extending transversely of said vibrators substantially parallel to said plane and having peripheral portions adjacent to said vibrators to be approached and receded from by the vibrators and thereby magnetically influenced at the vibrator vibrational frequencies.

5. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a plurality of variously tuned strings disposed essentially in a plane; means for passing currents longitudinally through said strings, whereby to create magnetic fields about said strings; and an elongated coil electrically feeding said load circuit, having an axis extending transversely of said strings and having peripheral portions adjacent thereto to be approached and receded from by the strings and thereby magnetically influenced at the string vibrational frequencies.

6. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a plurality of variously tuned strings disposed essentially in a plane; a plurality of means respectively associated with different-frequency strings for exciting the same; means, operatively associated with each exciting means, for passing current through the excited strings in predetermined time relationship to their excitation; and a closed conductive circuit electrically feeding said load circuit, extending transversely of said strings and having portions adjacent thereto to be approached and receded from by the strings and thereby magnetically influenced at the string vibrational frequencies.

7. In a musical instrument including a load circuit for the demodulation and utilization of electric oscillations modulated at sound-representing frequencies: the combination of a plurality of variously tuned strings disposed essentially in a plane; means for passing high-frequency currents through said strings, whereby to create high-frequency magnetic fields about said strings; and a closed conductive circuit electrically feeding said load circuit, extending transversely of said strings and having portions adjacent thereto to be approached and receded from by the strings, whereby there is induced in said conductive circuit a high-frequency voltage modulated at the string vibrational frequencies.

8. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a plurality of variously tuned vibrators having magnetic fields and disposed essentially in a plane; and a plurality of closed conductive circuits electrically feeding said load circuit, each conductive circuit extending transversely of said vibrators with operatively substantially uniform structure continuously throughout that extent and having portions adjacent to respective longitudinal regions of said vibrators to be approached and receded from by said vibrator regions and thereby magnetically influenced in accordance with the vibrations of those vibrator regions.

9. The combination according to claim 8, further including means for varying the relative am-

plitudes of oscillations fed by the respective conductive circuits to said load circuit.

10. The combination according to claim 8, further including means for varying the relative phases of oscillations fed by the respective conductive circuits to said load circuit.

11. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a tuned string; means for exciting said string; means operatively associated with said exciting means for passing a current longitudinally through said string in predetermined time relationship to its excitation; and a conductive circuit electrically feeding said load circuit, having a portion adjacent to said string to be approached and receded from by said string and thereby magnetically influenced at the string vibrational frequencies.

12. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a tuned string; means for exciting said string; means operatively associated with said exciting means for passing a current longitudinally through said string in predetermined time relationship to its excitation; and a coil electrically feeding said load circuit, having an axis transverse to said string and a peripheral portion adjacent thereto to be thereby magnetically influenced at the string vibrational frequencies.

13. In a musical instrument including a load circuit for the demodulation and utilization of electric oscillations modulated at sound-representing frequencies: the combination of a vibratable tuned string; means for passing a high-frequency current through said string, whereby to create a high-frequency magnetic field about said string; and a closed conductive circuit electrically feeding said load circuit, having a portion adjacent to said string to be approached and receded from by the string, whereby there is in-

duced in said conductive circuit a high-frequency voltage modulated at the string vibrational frequencies.

14. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a tuned vibrator; means for exciting said vibrator; means operatively associated with said exciting means for passing a current through said vibrator in predetermined time relationship to its excitation; and a conductive circuit electrically feeding said load circuit, having a portion adjacent to said vibrator to be approached and receded from by said vibrator and thereby magnetically influenced at the vibrator vibrational frequencies.

15. In a musical instrument including a load circuit for the utilization of sound-representing electric oscillations: the combination of a tuned vibrator; means for exciting said vibrator; means operatively associated with said exciting means for passing a current longitudinally through said vibrator in predetermined time relationship to its excitation; and a coil electrically feeding said load circuit, having an axis transverse to said vibrator and a peripheral portion adjacent thereto to be thereby magnetically influenced at the vibrator vibrational frequencies.

16. In a musical instrument including a load circuit for the demodulation and utilization of electric oscillations modulated at sound-representing frequencies: the combination of a tuned vibrator; means for passing a high-frequency current through said vibrator, whereby to create a high-frequency magnetic field about said vibrator; and a closed conductive circuit electrically feeding said load circuit, having a portion adjacent to the vibrator to be approached and receded from by the vibrator, whereby there is induced in said conductive circuit a high-frequency voltage modulated at the vibrator vibrational frequencies.

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