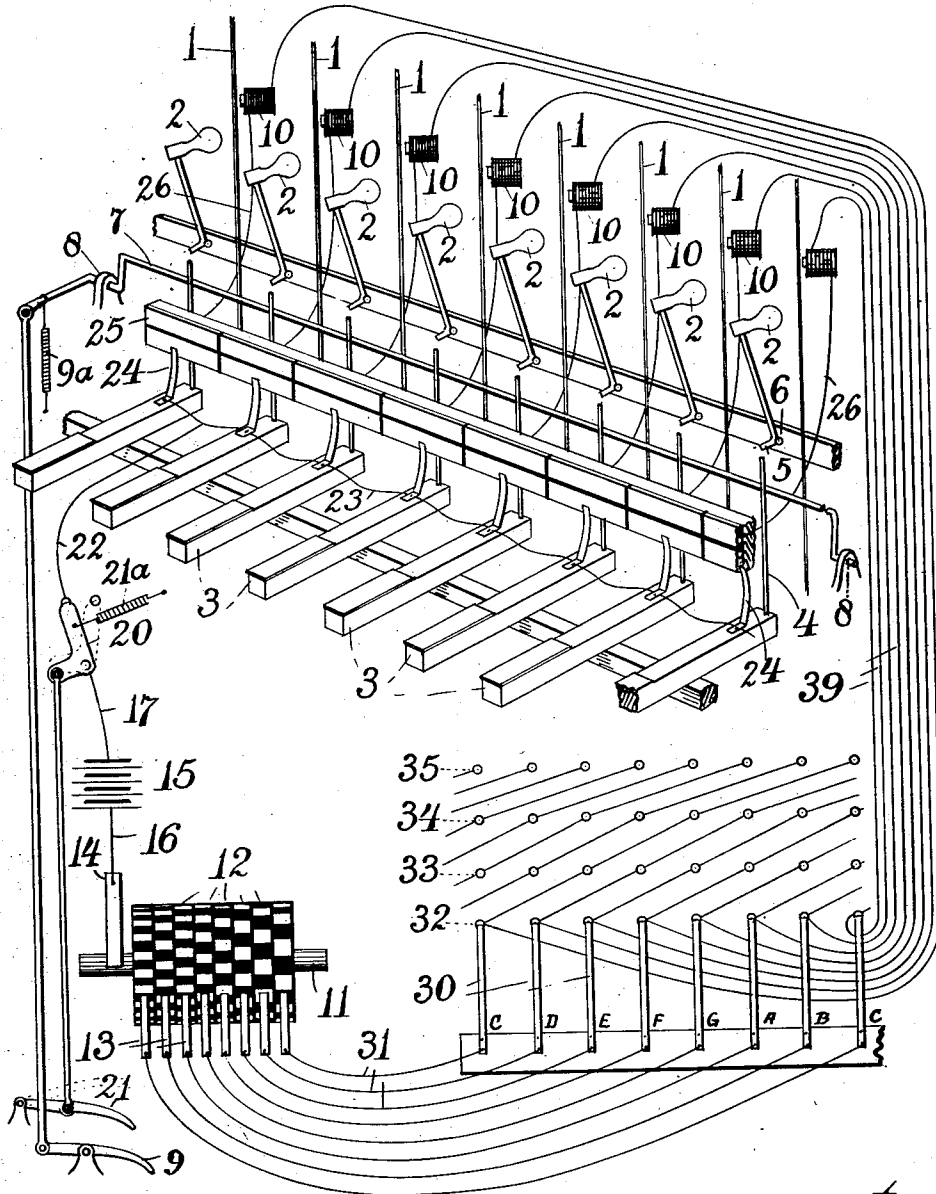


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TIMBRE CONTROL IN ELECTRICALLY OPERATED MUSICAL INSTRUMENTS.
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TIMBRE CONTROL IN ELECTRICALLY-OPERATED MUSICAL INSTRUMENTS.

1,185,251.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, MELVIN L. SEVERY, of Arlington Heights, county of Middlesex, in the Commonwealth of Massachusetts, and
5 GEORGE B. SINCLAIR, of Boston, county of Suffolk, in said Commonwealth, have invented certain new and useful Improvements in Timbre Control in Electrically-Operated Musical Instruments, of which the
10 following is a specification.

This invention pertains to that type of instruments wherein suitably tuned sonorous bodies are made to vibrate for the production of music; and it has for its object
15 a novel method and means whereby such sonorous bodies can have their tone quality changed at will. In those instruments where the sonorous bodies are strings, we contemplate the change of the pitch and
20 tone quality, of said bodies, without altering their normal length or tension.

The instrument to which our invention is especially applied is that of the piano type, and the way by which we change the tone
25 quality of the strings is to provide, in addition to the usual hammers, means for electrically vibrating the strings, and devices whereby the strings can be actuated by the
30 hammers alone, or by the electric means alone, or by the two alternately, or by both simultaneously, and also means whereby the strings can be made to vibrate to give their
normal fundamentals, or each made to give a plurality of clearly perceived tones of different
35 pitches and different qualities. The normal pitches of the strings under normal conditions correspond with the pitches usually associated with the keys actuating their hammers. These pitches correspond
40 respectively with the periodicities of the make-and-break or impulse-generating devices normally associated with the strings. When, however, it is desired electrically to change the tone qualities given off by the
45 strings, their actuating electromagnets have pulsations of higher frequencies switched into them, with the result that they give off pitches the same as those of the pulsations, but higher than those normally associated
50 with the strings and their corresponding keys, and higher than those produced by

their associated hammers. These tones are of an entirely different quality from those produced by the hammers, or electrically under the aforesaid normal conditions. It
55 is further to be noted that these new qualities are not harmonics having a more or less submerged graver tone present, as in the case of the piano, violin and the like, but they are distinctly new qualities having distinctly new ground tones, which ground
60 tones do not result from the length and tension of the strings, but do result from the periodicities of the make-and-break or impulse-producing devices which are at the
65 same time sending pulsations into the electromagnets actuating the strings. This distinction is vital and must not be confused with the so-called harmonics or partial tones of other instruments, which are the result
70 not of the substitution of a new ground tone, but rather of a change in the relative prominence of the harmonics forming composite tones. Such tones are natural or unforced,
75 whereas the new qualities we produce result from forced vibrations which determine with mathematical accuracy the pitches of the ground tones.

Such special type of our invention, wherein tuned strings are employed for the sonorous bodies, is set forth in the following
80 description, and in the drawings associated therewith.

In the drawing forming part of this specification, and which is a diagram representing essential parts of a musical instrument made in accordance with our invention, the reference numerals 1 designate the strings, which are of the usual magnetically attractive kind, and supported and
85 tensioned in the customary manner. The hammers 2 for percussively vibrating said strings may be of the well-known construction, but for the sake of simplicity and clearness in illustration, we show simply a
90 possible arrangement consisting of a jack 4 rising from the inner end of each key 3 to a point close beneath the ends of the projection 5 of the hammer associated therewith. These jacks 4 are adapted to stand
100 normally immediately beneath said projections, in order that when the former rise

upon the depression of the keys, the hammers, which are pivoted at 6, will be thrown into percussive contact with the strings.

To render the hammers inoperative we provide the rod 7 supported upon pivots 8, and normally swung forward by means of a suitable tension spring 9^a, out of operative position. In the drawing, a pedal 9 suitably connected with the arm of said rod 7 is shown as the means for enabling the player to render the strings capable of hammer-actuation, although we do not restrict ourselves to a pedal, inasmuch as a knee-actuated lever or any other suitable device is equally applicable.

The electric actuating devices comprise the electromagnets 10 suitably positioned with respect to the strings 1, and means for delivering suitably timed electric pulsations to the former. The preferable pulsation-means consists of a series of uniformly rotated toothed disks 12 in engagement with fixed brushes 13, and having a source of current 15 in circuit therewith.

The entire circuit to each magnet 10 embraces the wire 17 connected with one pole of the current-source 15, the switch 20 operated by a suitable pedal or stop 21, wires 22 and 23, brush 24, contact 25, wire 26, electromagnet 10, wire 39, contact 32, brush 30, wire 31, brush 13, disk 12, shaft 11, brush 14 and wire 16, back to the opposite pole of the current-source 15.

We do not show in this case electrical resistances which are disclosed in our Patent No. 1,068,010 July 22, 1913, as such resistances are not involved in the present application, and may be used or omitted as deemed expedient in any given instance.

The pedal 21 in its normal position is elevated, being yieldingly so held by the spring 21^a. By depressing the pedal 21, the switch 20 is closed, and the instrument rendered electrically actuate, while the release of said pedal permits said spring 21^a to open the circuit and leave the instrument electrically dumb. Hence, by the proper actuation of the pedals 21 and 9, both the hammers and the electromagnets can be permitted to act conjointly upon the strings, or either to operate singly, at the will of the player. In this manner, the same strings can be given the tone color produced by percussive action, or the tone-quality which only electromagnets can impart to them, or the musical effect of both, acting simultaneously.

We have discovered that, by delivering to a string-actuating electromagnet a rate of pulsation other than that for which the string is tuned, we produce in the latter an entirely new quality of tone. For instance, if to the magnet of a string tuned to 256 vibrations per second there is delivered a rate of 512 pulsations per second, there will

not only be sounded a note an octave above the normal pitch, but one differing radically in quantity. Hence if a string be percussively vibrated by its hammer, and at the same time electric pulsations of higher frequency, such as above noted, be delivered to its electromagnet, two sets of vibrations will simultaneously take place, one having the frequency of and producing the normal or fundamental tone for which the string is tuned, and the other of higher frequency, producing a different fundamental tone of higher pitch and different quality. In devising means for carrying this discovery into effect, we provide a series of rows of fixed contacts 32, 33, 34 and 35, wired together in certain combinations, and also a movable brush 30 capable of being put into touch with any one of said rows, and to thereby throw into the circuit of each magnet the pulsations normal to certain other magnets. Suitable mechanical devices for moving the brushes and accurately determining their position are set forth and claimed in our application Serial No. 273,202, filed August 7, 1905, which eventuated in Patent No. 1,110,012 dated September 8, 1914, to which reference may be had for details not herein claimed and hence only diagrammatically indicated. Any suitable means for effecting such adjustment may, however, be employed. Recurring to the series of rows of contacts and brushes, let us suppose that the brushes 30 have been put in touch with the contacts of the row 35, then the current will pass from said brushes through the wires joining the said contacts 35 to the contacts 32, and thence to the electromagnets 10 through the wires 39. For the sake of simplicity in illustration, the contacts for the sharps and flats are not indicated, and, the contacts 32 being each eight notes from the connected contact 35, a C⁴-rate of pulsation, for instance, will be delivered to a C³ electromagnet 10, thereby causing the latter to vibrate an octave higher, and at the same time, which is the only important feature, with an absolutely different tone-quality. To make this clearer, and it being understood that when the brushes 30 are in touch with the contacts 32 each disk 12 will deliver to the magnet 10 with which it is then in circuit, pulsations of a frequency to cause the associated string to give off its fundamental tone, upon depression of its associated key, let us follow the course of current when said brushes are in touch with the contacts 35. The electric pulsations produced by the extreme left-hand disk 12 will now traverse its associated brush 13 and wire 31 to the right-hand brush 30. From this brush the current passes to the right-hand contact 35, thence down through the wiring to the left-hand contact 32, and then along the wire 39 to

the electromagnet 10 at the extreme left-hand; whereas when the brushes 30 are in touch with the row of contacts 32, the pulsations aforesaid will be delivered to the extreme right-hand electromagnet, to which they are normal or of a frequency to cause it to give off its fundamental tone. The position of said right-hand magnet is assumed to be an octave higher than that of the left-hand magnet in the present illustration. When the brushes 30 are moved into touch with the contacts 33, for instance, the strings will vibrate with higher pitches, and with entirely new qualities; the strings which will percussively sound with the pitch of A, for example, being electromagnetically forced to vibrate with the pitch of C. If the hammers are actuated at the same time, the same strings which are electrically vibrating with pitches an octave above their fundamentals, will also percussively yield their fundamental tones. By moving the brushes 30 into touch with some other row of contacts, as 33 or 34, or to other rows not illustrated, any other desirable rates of pulsations can be delivered to the electromagnets. The desirability of introducing these different rates of pulsation in rendering any given composition or portion thereof, will be determined by the performer, in whose control the matter is placed by the construction here set forth. So remarkable is the change in tone effects produced in this manner, that we are enabled to imitate, or rather to excel in their own field, almost every kind of musical instrument. For instance, with the hammers alone active, the instrument is a piano; with the electric devices alone, and in their normal condition, the effect is that of a large church organ; with the brushes 30 shifted to one specified row of contacts, a flute is apparently playing; to another row, a chorus of voices is simulated; to another, a wind instrument apparently sounds; with the hammers active and another shift in the brushes, a drum and fife duet; and, in fine, we are able with the one instrument and a single player, to produce tone effects indistinguishable except for their superior smoothness and uniformity, from those of a large variety of instruments, and also to produce numerous combinations involving a plurality of such tone effects.

Another important use for this instrument is that of a dumb key-board for student's practice, such being the normal condition thereof until depression of pedal 21 or pedal 9, or both.

By having the hammer-control devices, and also the control for the electrical-actuating mechanism held at will in operative condition by suitable detaining means which, when released, automatically returns the hammers and electromagnets to their dumb condition, from which they may at

will be operatively moved by the player, the latter is given a most perfect control of the instrument, and is in this way assured that neither the hammers nor the electrical devices will act unless desired.

It is to be remembered that each of the uniformly rotated toothed disks 12 before mentioned must be maintained in sensibly perfect synchronism with the sonorous body with which it is normally associated. No ordinary governing is of any avail, since variations in speed too slight to be detected by any other means impair or destroy both the loudness and the timbre of the tones. The synchronism for the best musical results must be so perfect as not to exhibit the slightest beat between the frequency of the current and that of the sonorous body it is intended normally to operate.

It is manifestly requisite to the obtaining of different musical timbres after the manner of our invention, that each current pulsator shall be practically perfectly synchronized with the sonorous body with which it is normally associated, if good musical results are to follow the switching of different frequencies of pulsation into the different magnets, for we have discovered that a defect hardly noticeable in the tone emitted by a sonorous body energized by pulsations from the pulsator normally associated with it, will be greatly amplified when this sonorous body speaks in response to pulsations from any other pulsator. In view of this it will be seen that a change of speed in the rotative mechanism might easily render nugatory a change in the quality of the controller, for which reason the necessity of constant synchronism as a prerequisite to proper change of tone timbre will be perfectly apparent.

While some means capable of producing perfect or substantially perfect timing of the electric pulsations is essential to the attainment of the results herein set forth, the present invention is not restricted to any particular form of such means. Forms of apparatus suitable to the purpose are set forth in our joint Patent No. 1,098,983, dated June 2, 1914, and in the sole applications of M. L. Severy, Serial No. 619,633, filed April 7, 1911, and Serial No. 620,002, filed April 10, 1911. As these are distinct inventions, and some of them sole inventions, they are not set forth or claimed in this application.

Having thus described our invention, what we claim is:—

1. The combination with a sonorous body, of means for its percussive actuation; and electromagnetic means for simultaneously eliciting from the same sonorous body a tone of different quality and of a higher pitch than that incident to its percussive actuation.

2. The combination with a tuned sonorous body adapted to be electromagnetically actuated, of an electromagnet for its actuation; means for delivering properly timed electrical impulses to said electromagnet causing its sonorous body to emit a tone of a definite pitch; and means utilizable at will for simultaneously eliciting from said sonorous body a tone of a lower pitch.

3. In combination with a sonorous body tuned to a definite musical pitch, means for causing said body to emit a ground tone of the pitch to which it is tuned; and electrical means for simultaneously causing said body to emit a ground tone of another and predeterminate pitch.

4. The combination with a tuned sonorous body, of means for simultaneously eliciting from said body a plurality of ground tones of different and predetermined pitches.

5. A musical instrument having sonorous bodies, electromagnets to which said sonorous bodies sustain the relation of armatures; means for delivering to said electromagnets timed pulsations; means for percussively actuating said sonorous bodies; means controllable at will for bringing into operation either or both of said percussive and electromagnetic means of actuation; and means controllable at will for independently delivering to each of said electromagnets pulsations of frequency greater than the frequency of vibration to which its associated body is tuned.

6. A musical instrument comprising tuned sonorous bodies, and means for simultaneously producing from each of said bodies a plurality of predetermined ground tones.

7. In a musical instrument, a tuned sonorous body; means for educing from said body the tone for which it is tuned; and electromagnetic devices for impressing upon said body vibrations of a frequency greater than that which produces its fundamental tone, whereby such single sonorous body is caused to give off simultaneously two distinct tones.

8. The art of educing a complex quality of tone from a tuned sonorous metallic body, which consists in electrically causing said body to vibrate with a frequency materially different from that which produces the fundamental tone for which it is tuned, and thereby to yield a tone differing from that of its fundamental, and simultaneously therewith causing said body to vibrate at another frequency.

9. The art of educing a tone of complex quality from a single tuned sonorous metallic body, which consists in electrically causing said body to vibrate with a frequency materially different from that which produces the fundamental tone for which it is tuned, and thereby to yield a tone different from that of its fundamental, and simulta-

neously therewith causing said body to vibrate with the frequency of its fundamental.

10. The art of educing a tone of complex quality from a single tuned metallic sonorous body, which consists in electrically imparting to such body vibrations of a frequency greater than that of the fundamental tone for which it is tuned, and simultaneously therewith causing said body to vibrate with the frequency of its fundamental.

11. The art of producing musical tones which consists in electrically causing a string to vibrate with a frequency greater than that which produces the fundamental tone for which it is tuned, and concurrently therewith percussively vibrating said string, whereby the same string is made simultaneously to emit a plurality of tones of different pitches.

12. The art of educing from a tuned sonorous body two distinct tones of different quality, which consists in electrically causing said body to vibrate with a frequency materially different from that which produces the fundamental tone for which it is tuned, and thereby to yield a tone not usual to said body, and simultaneously therewith causing said body to vibrate at another frequency.

13. The art of educing two distinct tones of different quality from a single tuned sonorous body, which consists in electrically imparting to such body vibrations of a frequency materially different from that which produces the fundamental tone for which it is tuned, and thereby causing it to yield a tone not usual to said body, and simultaneously causing it to vibrate with the frequency which produces its fundamental tone.

14. The art of educing musical tones, which consists in separately but simultaneously setting up in a tuned sonorous body vibrations of a plurality of different and predetermined frequencies, thereby producing a plurality of different ground tones.

15. The art of educing a complex quality of tone from a single tuned sonorous body, which consists in electrically imparting to said body vibrations of a frequency materially greater than that which produces the fundamental tone for which it is tuned, and simultaneously therewith causing such body to vibrate with the frequency which produces such fundamental tone.

16. The art of educing musical tones, which consists in electrically and percussively setting up separately but simultaneously in a tuned sonorous body, vibrations of a plurality of different frequencies.

17. The combination with a tuned sonorous body of a definite pitch, of percussive means for causing said body to emit a tone of the pitch to which it is tuned, and means for simultaneously causing said body to emit another tone of a different pitch.

18. The combination with a sonorous body tuned to a definite musical pitch, of means for causing said body to emit a tone of the pitch to which it is tuned, and at the same time to emit an entirely distinct ground tone of a different pitch from the fundamental of said first-named tone.

19. The combination with a tuned sonorous body adapted to be electromagnetically actuated, of an electromagnet for its actuation; means for delivering properly timed electric impulses to said electromagnet causing its sonorous body to emit a tone bearing some recognized musical relation to its fundamental pitch other than unison; and means utilizable at will for simultaneously percussively eliciting from said sonorous body a tone of the pitch to which it is tuned.

20. The combination with a sonorous body adapted to be electromagnetically actuated, of an electromagnet for its actuation; means for delivering properly timed electric impulses to said electromagnet causing its sonorous body to emit a tone bearing some recognized musical relation to its fundamental pitch other than unison; and means utilizable at will for simultaneously percussively eliciting from said sonorous body its fundamental tone.

In testimony that we claim the foregoing invention, we have hereunto set our hands this 15th day of June, 1907.

MELVIN L. SEVERY.
GEORGE B. SINCLAIR.

Witnesses:

A. B. UPHAM,
WARREN N. AKERS.