M. L. SEVERY & G. B. SINCLAIR.

EXPRESSION DEVICE FOR MUSICAL INSTRUMENTS.

APPLICATION FILED JUNE 6, 1907.

1,156,321.

Patented Oct. 12, 1915.

2 SHEETS—SHEET 1.

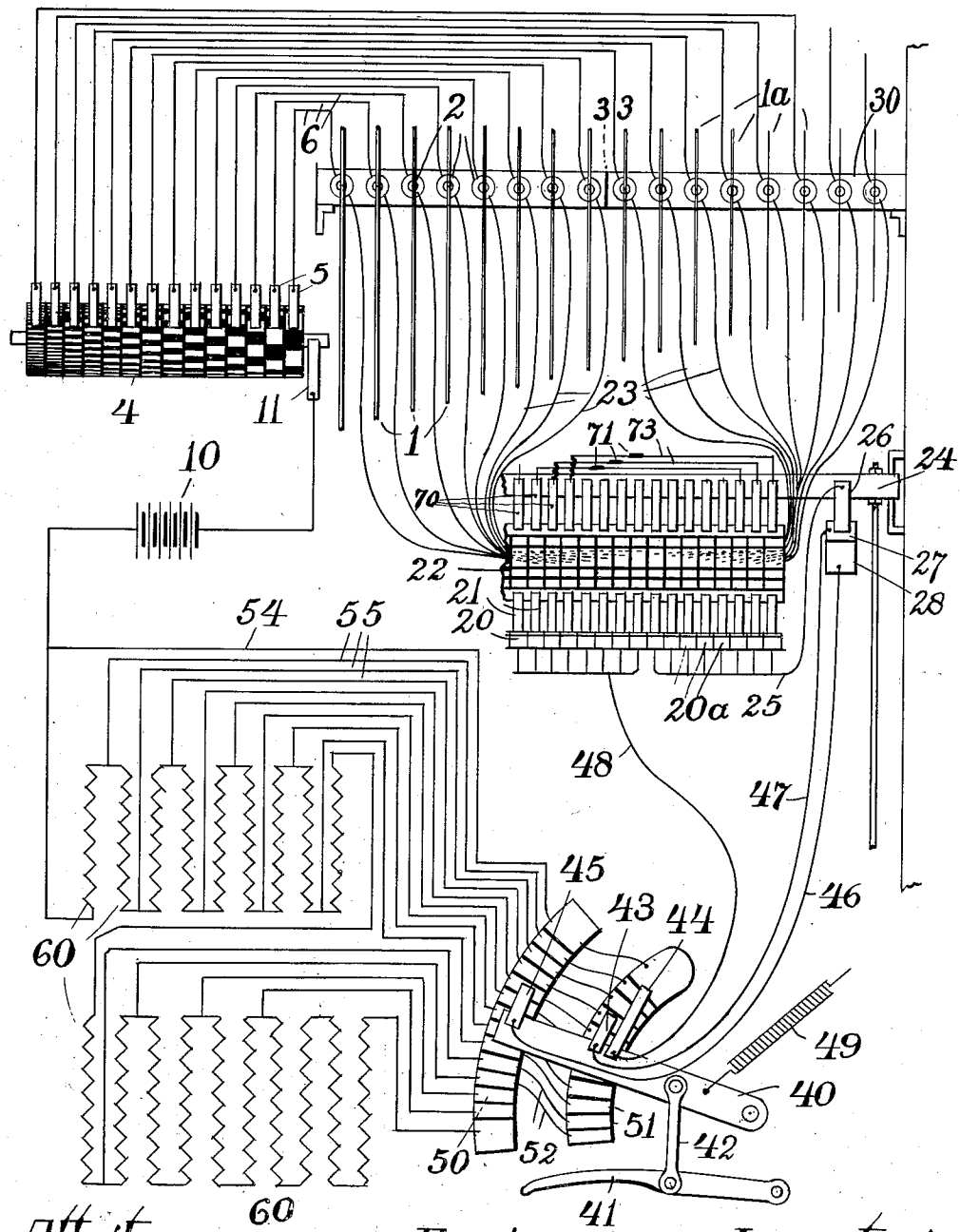


Fig. 1

Attest;

L. L. Parys.

E. A. Shannon.

Inventors,

Melvin L. Severy;

George B. Sinclair;

By A. B. Graham,

Attorney.

M. L. SEVERY & G. B. SINCLAIR.

EXPRESSION DEVICE FOR MUSICAL INSTRUMENTS.

APPLICATION FILED JUNE 6, 1907.

1,156,321.

Patented Oct. 12, 1915.

2 SHEETS—SHEET 2.

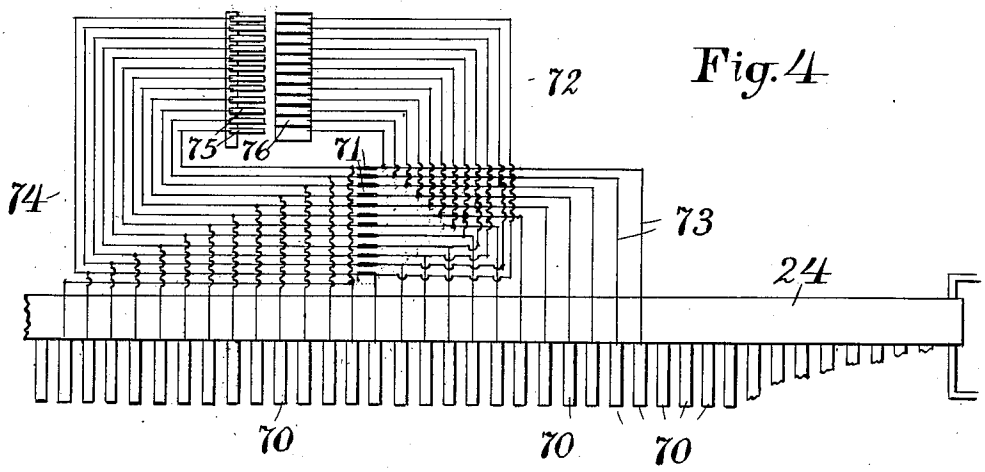
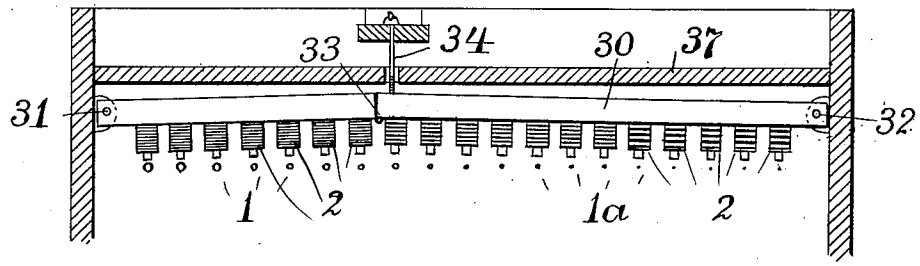


Fig. 4

Fig. 2



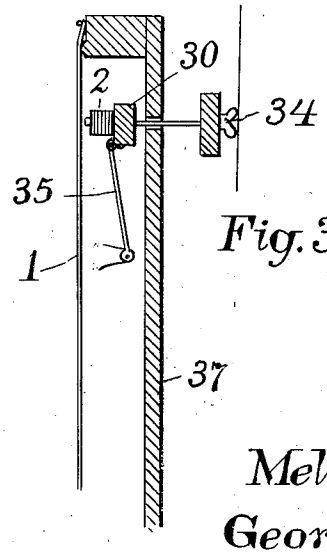


Fig. 3

Attest;

L. L. Boyce.

E. A. Shannon.

Inventors,

Melvin L. Severy,

George B. Sinclair;

By A. B. Graham,

Attorney

UNITED STATES PATENT OFFICE.

MELVIN L. SEVERY, OF ARLINGTON HEIGHTS, AND GEORGE B. SINCLAIR, OF WINTHROP, MASSACHUSETTS, ASSIGNORS TO CHORALCELO COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

EXPRESSION DEVICE FOR MUSICAL INSTRUMENTS.

1,156,321. Specification of Letters Patent. Patented Oct. 12, 1915.

Application filed June 6, 1907. Serial No. 377,571.

To all whom it may concern:

Be it known that we, MELVIN L. SEVERY and GEORGE B. SINCLAIR, both citizens of the United States, and residents of Arlington Heights, in the county of Middlesex, and of Winthrop, county of Suffolk, respectively, in the Commonwealth of Massachusetts, have invented certain new and useful Improvements in Expression Devices for Musical Instruments, of which the following is a full, clear, and exact description.

In the composition of music, it is often necessary for the composer to write full harmonies in passages that he desires played pianissimo, and, conversely, he may desire a simple melody to be played fortissimo. When music is produced by an orchestra, these requirements may be fairly well met, since each player in a complex harmony can so modulate his own part thereof as to produce either a pianissimo or fortissimo totality of effect. When, however, a selection is rendered upon the piano or organ, such modulation is manifestly impossible. No performer can stop to count the number of notes in a harmony for the purpose of making each one of just such a degree of loudness as shall cause them all to produce the requisite combined result. In those instruments where strings are electromagnetically actuated, certain selections having simple melodies and complex harmonies closely following each other exhibit sharp variations, not only in volume but in loudness, inconsistent with the conception of the composer and the musical sensibilities of cultured listeners, if each note be given the same energizing effect, irrespective of the number of notes simultaneously sounded. To produce ideal results, the player on an instrument should be able so to control his tone production that the passage from one note to a full chord would not create the effect of an increment in loudness or an unpleasant change in volume. From all of this it will be seen that any method, by which the loudness would be at any and all times under the control of the operator quite irrespective of whether he were playing one note or a full chord, or even coupled chords, would be of great musical significance, enabling the performer to graduate his effects even more perfectly than the leader of an orchestra with the multiplicity of different temperamental conditions with which he has to deal. In musical instruments having electrically actuated sonorous bodies, we have succeeded in producing just this result. Our improved means to this end are set forth in this specification and they consist chiefly in electromagnetic means for actuating the sonorous bodies; in means for delivering current to the electro-magnets; in means for so controlling this current that the loudness shall be sensibly constant whether one note or a full chord be played; in means for so positioning the electro-magnets relative to their opposed sonorous bodies that equal increments or decrements of current shall produce just and proper increments and decrements of tone; in means for causing such a change in the amount of current when a very large number of notes are simultaneously sounded as shall cause the loudness to be sensibly the same as if but a few notes were sounded; and in means whereby the decrement or increment of current, applicable to the actuation of electro-magnets opposed to certain strings in the gamut of the instrument, may be made to vary by the movement of a soft stop, or pedal, in a different ratio from the variation produced in the actuating of sonorous bodies in the other parts of the instrument's gamut, to the end that a just and proper balance may be obtained between various portions of the instrument's register throughout all variations of the soft-stop, or pedal, and irrespective of the number of notes simultaneously sounded, thus producing what is so desirable in music—absolute control at all times by the operator of the sensible volume and loudness of music; and finally, preponderance in loudness of any part of the instrument relative to any other.

Referring to the drawings forming part of this specification, Figure 1 is a diagram of an electrical musical instrument made in accordance with our invention. Fig. 2 is a plan view of the magnet rail forming a part of this invention. Fig. 3 is a cross section of the same. Fig. 4 is a view of means whereby the relative loudness of the bass and treble strings when coupled can be changed at will.

The reference numeral 1 designates the lower strings of a musical instrument of the piano type; 1^a, the upper or treble strings;

2, the electromagnets carried by the two-part magnet-rail 30; 4, the make-and-break disks; 5, the brushes contacting therewith; 6, the wires between said brushes and the appropriate electromagnets 2; and 10, the source of currents having one pole joined by a brush 11 to the shaft or other conducting portion of the disks. As shown in Fig. 1, each key 20 is provided at its inner end with a brush 21 adapted to be elevated into touch with a contact 22 when the appropriate key is depressed; said contacts 22 being joined by wires 23 to the electromagnets 2. The treble keys 20^a are joined by a common wire 25 to the brush 26 carried, preferably, by the coupler bar 24, and designed to be moved by the latter from its normal position upon the contact 27, to the contact 28. The contact 27 is joined by a wire 47 to the brush 43 carried by the swinging arm 40, and the contact 28 is joined by a wire 46 to the brush 45 at the free end of said arm. The brush 44 is joined by a wire 48 to the bass keys 20; such brush being located at one side of, or superimposed upon, the brush 43, and reaching to a substantially farther distance. The arm 40 is operated by a spring 49 and the pedal 41 connected thereto by a rod 42.

Fixed in the paths of the brushes 45, 44 and 43 are the two sets of contacts 50, 51; the latter containing preferably ten and the other three or four more, and all of the set 51 being joined by wires 52 to the ten upper contacts of the set 50. The topmost of the contacts 50 is connected by a wire 54 to the pole of the current-source 10 opposite to that wired to the brush 11; while the remainder of said contacts are joined by wires 55 to different points of the resistance 60; the arrangement being such that the second contact from the top is given a relatively low resistance; the third, a somewhat higher resistance, and so on down, increasing to a relatively high resistance for the tenth contact, and a much higher one for the last. By means of the wiring 52 above described, the contacts 51 have the same arrangement of resistances as the upper ten of the contacts 50. In its normal elevated position, the arm 40 holds the brushes 43, 44 and 45 upon the topmost of the contacts 51, 50, and hence gives a circuit to the actuating magnets 2 free from the resistance 60. When this arm is depressed, the brush 45 moves over more of the contact-surface than does the brush 43, owing to its proportionally greater distance from the pivotal center of the arm; and, the contacts of one set being equal in width to those of the other, the brush 45 will consequently, as said arm descends, be always in touch with contacts connected with higher resistance than will the brush 43. Since, then, the brush 43 is in circuit with the contact 27, while the brush 45 is in circuit with the contact 28; so long as the octave coupler bar 24 remains in its normal position its brush 26 is in touch with said contact 27, the treble keys 20^a are in circuit with the brush 43, and so the resistance is less than when the coupler is depressed and its brush 26 brought into touch with the contact 28. When the coupler bar 24 is depressed, as it is in the performance of its function of coupling octaves together and thereby causing the simultaneous sounding of numerous harmonic notes, greater resistance is switched into their circuits automatically through the above described devices. This, therefore, achieves one object of our invention,—that of automatically increasing the resistance to the string-actuating currents whenever numerous octaves are simultaneously sounded, and so preventing the increased loudness which we have discovered accompanies the same. It being also a fact, as we have discovered, that the simultaneous sounding of several treble notes overbalances the lower notes, we prefer to wire the upper notes alone to the contact brush 26, and to wire the lower notes to the brush 44 by means of the wire 48. This brush 44 is made considerably longer than the brush 43, in order that it shall reach a contact 51 in circuit with less resistance than the contact simultaneously touched by the shorter brush. Hence, no matter to what degree the arm 40 may be depressed in order to throw in resistance, the connections to the magnets of the bass strings will always transmit more current than the connections to the treble magnets. When a selection is being played containing substantial variations in numbers of simultaneously sounded notes, the performer depresses the pedal 41 to throw more or less resistance into the circuit, according to the general loudness desired. Several strings sounded simultaneously being thus restricted to a strength of actuating current no greater than that to a single string, the same are each vibrated with a correspondingly weaker effect. But, since such simultaneously sounded strings are together acting upon their common sounding board, and so causing it as above set forth to vibrate more vigorously than when influenced by fewer strings, the diminished loudness due to lessened current for each will be offset by the increased vibration of the sounding board, and the loudness will remain substantially constant irrespective of the number of the strings sounding at different instants.

Another improvement which we have effected in this type of musical instruments is that by which the actuating magnets 2 are accurately positioned with respect to the strings 1. These electromagnets are fixed to the two-part magnet rail 30, which is terminally hinged to the instrument-case at

31, 32, and the juncture 33 of said parts is loosely united and provided with means for adjustment toward and from the strings. To thus adjust the magnet-rail, said joint or juncture is supported by the inclined link 35, as shown in Fig. 3, thereby causing said rail to tend toward the strings by gravity; and an elongated screw 34 is provided for holding the rail back in its desired position. The long line of electromagnets supported by the rail being quite heavy, the action of gravity thereon in pressing them toward the strings is hence sufficient to insure against any tremble or other alteration of position on the part of the magnets relative to the strings, except such as is permitted by the adjusting screw 34. In Figs. 2 and 3 the sounding-board of the instrument is shown at 37. It is hardly possible to overestimate the importance of thus accurately positioning the magnets with respect to their strings. Were the magnet rail one rigid whole, and the attempt made to obtain the requisite distance between the magnets and strings by moving bodily such rail toward or from the strings, the result would be absolute failure. When the lower treble magnets had reached a point for properly vibrating their strings, while also positioning them so that they should not be struck by the strings when strongly sounding, the upper treble magnets would be found to be so far away from their strings as practically to make them inaudible. On the other hand, the lower bass strings would also fail of actuation on account of the distance between them and their magnets being too great to allow the latter properly to set them in vibration,—in the limited period of time ordinarily allowed by the players,—on acount of their weight. Hence the extreme upper treble strings, because of their small mass and tightness of tension, and the extreme lower bass strings on account of their large mass, require to be closer to their actuating magnets than their neighboring strings nearer the center of the scale. The intermediate strings near the rail-joint, the position of which has been carefully determined by experiment, because of their medium condition as to mass and tension, can be located farther from their actuating magnets. The same thing holds good in regard to the adjustments of the magnets toward and from the strings. The upper treble strings and the lower bass strings, being nearer their magnets than the intermediate strings, the same degree of adjustment that would serve for the latter would be altogether too much for the others. Consequently, as we have found through years of experiment and construction, the ends of the magnet rail require substantially no adjustment after being once located correctly; while the intermediate magnets require degrees of adjustment increasing from each end of the rail to a point about one third up from the bass end, as indicated in Fig. 2. Such a positioning of the magnets is necessary in order that the same strength of actuating current to each magnet will produce a substantial equality in loudness on the part of all the strings; for it is evident that, according to the law of inverse squares, the magnetic pulls upon the various strings will vary inversely according to the squares of the distances of the various magnets from their strings, and the loudness of each string's vibration can be greatly reduced by removing its magnet farther therefrom.

In certain copending applications we have shown, described and claimed features which are illustrated and described in the present application but which are not herein claimed, and in other copending applications we have broadly claimed the art of producing musical tones, which art is involved but is not claimed in the present application. All matters set forth and claimed in copending applications filed in our names, or in the name of either of us, and not specifically claimed herein, are expressly saved and reserved for one or another of such applications. Among these may be noted our joint applications, Serial No. 273,199, filed August 7, 1905; Serial No. 379,714, filed June 19, 1907; Serial No. 380,987, filed June 26, 1907; Serial No. 537,257, filed January 10, 1910; and Serial No. 740,201, filed January 4, 1913.

Another highly important feature in equalizing the loudness of the strings, and also in producing a proper quality of vibration, is that of varying the windings of the various magnets. Contrary to all expectations in the matter, we have discovered that the lower magnets should be wound with relatively fine wire; and the upper magnets, with heavier wire; and while theoretically each magnet should be of a wire finer that that above it, we find that practically it is not necessary to vary the windings of all the magnets, but that it is sufficient to make variations between groups thereof. The reason for thus varying the windings of the magnets is that, for the upper notes, the numbers of vibrations per second are exceeding high, some being more than 2000, and the magnetic lag so interferes with the pulsatory passage of the energizing current through the windings of the magnets, that it is necessary to very materially reduce the number of such windings and increase the size of the wire employed in order to properly actuate the strings. On the other hand, should the size of wire suitable for the upper magnets be employed for the bass magnets, their resistance to the current would be insufficient to prevent their burning out.

While the pedal 41 and the resistance-controlled thereby as herein before described

serve to suitably equalize the loudness of the upper and lower strings, for certain music it is desirable to have the instrument capable of giving an increased loudness to either the upper or the lower notes at will when the octave coupler is in use. To accomplish this, we have devised the following arrangement: Referring to Fig. 4, 24 is the octave coupler bar carrying the brushes 70 coupled together in octaves, or other desired intervals. In each of the wires 73, in a certain selected portion of the coupled brushes 70,—preferably the octave above and the octave below the point corresponding to that numbered 33 in Fig. 2,—is introduced a resistance 71. Although such resistance acts to reduce the loudness of the vibrations which might otherwise be given when the octave coupler is put into use, its most important function is to enable the player to further vary the character of the music. For instance, by depressing the keys controlling the strings above the point 33, the latter will sound more loudly than the coupled ones the circuits to whose magnets 2 include the resistances 71. In the same manner, by using the keys controlling the strings below the point 33, the coupled bass notes will be the louder and the coupled upper notes the softer. If it is desired to have both upper and lower coupled strings vibrate without such differences in strength, the resistances 71 can be short circuited by moving the brushes 75 into touch with the contacts 76, so that the coupled circuits will be through the wires 74, brushes 75, contacts 76 and wires 72, and so around said resistances. Ordinarily, said contacts and brushes will be in engagement, but whenever the above described overbalancing of parts is desired, a suitable stop or pedal can be operated to separate the same.

What we claim as our invention for which we desire Letters Patent is as follows, to wit;—

1. A musical instrument comprising magnetically attractive sonorous bodies, electromagnets adapted for actuating said bodies, means including circuits for delivering electric pulsations to said electromagnets, a resistance common to all the circuits of said electromagnets, and means for simultaneously switching different amounts of resistance into the circuits of the different electromagnets.

2. A musical instrument comprising sonorous bodies, electromagnets for their actuation, means including branch circuits, one to energize each of said electromagnets, a resistance common to all said branch circuits, and means for switching in at will different amounts of resistance, and at the same time automatically proportioning the resistance switched into the circuits of one part of the instrument relative to the resistance switched into the circuits of another part of the instrument.

3. A musical instrument comprising sonorous bodies, electromagnets for their actuation, means including branch circuits, one to energize each of said electromagnets, a resistance common to all said branch circuits, and means for switching in at will different amounts of resistance and automatically maintaining an excess of such resistance in the circuits of the upper notes of the instrument as compared with the resistance in the circuits of the lower notes of the instrument.

4. A musical instrument comprising sonorous bodies, electromagnets for their actuation, means including branch circuits, one to energize each of said electromagnets, a resistance common to all said branch circuits, an interval coupler, and means automatically operated by said coupler to switch in an increased amount of resistance when such coupler acts to multiply the number of simultaneously vibrated sonorous bodies.

5. A musical instrument comprising sonorous bodies, electromagnets for their actuation, means including branch circuits, one to energize each of said electromagnets, a resistance common to all said branch circuits, means for varying the amount of resistance at will, an interval coupler, and means automatically operated by the movement of said coupler to increase the amount of resistance.

6. A musical instrument comprising sonorous bodies, electromagnets for their actuation, means including branch circuits, one to energize each of said electromagnets, a resistance common to all said branch circuits, means for varying the amount of resistance at will, an interval coupler, and means operated by the movement of said coupler to automatically increase the amount of resistance to the upper notes of the instrument.

7. A musical instrument comprising a sounding board, magnetically attractive sonorous strings, connected therewith, electromagnets for actuating said strings, key-controlled means including circuits for delivering electric pulsations to said magnets, a resistance common to the circuits of said magnets, an interval coupler, means for switching in at will different amounts of resistance and automatically maintaining an excess of such resistance in the circuits of the magnets coöperating with the upper strings as compared with the resistance in the circuits of the lower magnets, and means operated by said coupler to vary such resistance.

8. A musical instrument comprising sonorous bodies, electromagnets for their actuation, means including branch circuits, one to energize each of said electromagnets, a

resistance common to all said branch circuits, and means for switching into said circuits at will different amounts of resistance and at the same time automatically differentiating the resistance switched into the circuit of one part of the instrument relative to that of another part thereof; such means comprising a row of contacts connected with corresponding sections of such resistance, a pair of brushes simultaneously movable over said contacts, and connections between said brushes and separate parts of the instrument, said brushes being adapted to touch different contacts and thereby to switch currents of different strengths to the corresponding sections of the instrument.

9. An electrically operated musical instrument comprising sonorous bodies, electromagnets for actuating them, branch circuits, one to energize each of said electromagnets, a resistance common to said circuits, a series of contacts connected with different sections of resistance, a smaller number of contacts connected separately with an equal number of the first-named contacts, a brush for each set of said contacts, means for moving said brushes simultaneously but unequally, a pair of contacts connected with said brushes respectively, an interval coupler, and a brush normally in contact with one of said pair of contacts and moved by the action of said coupler into touch with the other of said pair of contacts.

10. An electrically operated musical instrument comprising sonorous bodies, electromagnets for actuating them, branch circuits, one to energize each of said electromagnets, a resistance common to said circuits, a series of contacts connected with different sections of said resistance, a smaller number of contacts connected separately with an equal number of the first-named contacts, a pivoted arm and means for moving it over the face of said contacts, two brushes carried by said arm in touch with the respective sets of contacts, a pair of contacts connected with said brushes respectively, an interval coupler, and a brush normally in touch with one of said pair of contacts and moved by the action of said coupler into touch with the other of said pair of contacts.

11. An electrically operated musical instrument comprising sonorous bodies, electromagnets for actuating them, branch circuits, one to energize each of said electromagnets, a resistance common to said circuits, a series of contacts connected with different sections of said resistance, a smaller number of contacts connected separately with an equal number of the first-named contacts, a rigid member and means for moving it over said contacts unequally, a brush carried by said member in touch with the more numerous set of contacts, a pair of brushes carried by said member in touch with the other set of contacts, one of which pair of brushes is longer than its companion, an interval coupler, a brush carried by said coupler and connected with the circuit to the upper notes of the instrument, a pair of contacts in the path of the last-named brush, one of said contacts being normally in engagement with said brush, connection between the last-named contact and the shorter of said pair of unequal brushes, and connection between the other of said pair of contacts and the brush in touch with the first-named series of contacts, and connection between the longer of said pair of brushes and the lower notes of the instrument.

12. The combination of a plurality of octaves of tuned electrically operated sonorous bodies, electromagnets actuating the same, and electric circuits therefor, electric conductors between electromagnets in octave relationship with each other, and resistances in said conductors.

13. The combination of a plurality of series of coupled sonorous bodies of different pitch, electromagnets for the actuation of said sonorous bodies, means including branch circuits for energizing said electromagnets, conductors each having resistance and adapted to couple together widely separated electromagnets, and means for short circuiting said resistances.

14. A musical instrument comprising tuned sonorous bodies, electromagnets for actuating said bodies, means including branch circuits for energizing said electromagnets, keys controlling said circuits, and conductors coupling together certain of the branch circuits to enable the depression of any one of said keys simultaneously to energize a plurality of said electromagnets, and a resistance in each of a multiplicity of said conductors, said resistances serving to render unequal in loudness certain of the sonorous bodies thus simultaneously actuated upon the depression of a single key.

15. A musical instrument comprising sonorous bodies sustaining musical relationship with each other, electromagnetic means including branch circuits for actuating said bodies, keys controlling said circuits, conductors coupling together certain of the first-named circuits to enable the depression of any one of said keys simultaneously to actuate a plurality of said bodies, a resistance in each of a multiplicity of said conductors, and a switch-controlled shunt circuit about each of said resistances.

16. A musical instrument comprising magnetically attractive sonorous bodies, electromagnets for actuating said bodies, means for delivering electric pulsations to said electromagnets, an octave coupler adapted to electrically connect notes of the same letter in the scale, resistances in the electrical connections between certain of

said coupled notes, and means whereby the player may at will cause one coupled portion of the instrument to be loud relative to the other coupled portion of the instrument.

17. A musical instrument comprising, in combination, a sounding-board; magnetically attractive sonorous bodies supported in proximity thereto; electromagnets for vibrating said bodies; means for delivering electric pulsations to said electromagnets; means for coupling a plurality of the electromagnets to effect simultaneous vibration of a corresponding number of sonorous bodies; and means operable through the movement of such coupler to reduce the current delivered to each of the electromagnets so coupled.

18. A musical instrument comprising magnetically attractive sonorous bodies, electromagnets for actuating said bodies, means including a resistance for delivering electric pulsations to said electromagnets, means for varying the amount of said resistance at will, an octave coupler, and means automatically operated by said coupler to vary the amount of said resistance.

19. A musical instrument comprising, in combination, sonorous bodies; electromagnets associated with and serving when energized to vibrate said bodies; a source of electric energy; branch circuits connecting said source of energy and said electromagnets; a resistance common to said circuits; a coupling device to cause simultaneous energization of a plurality of said magnets; and means operable by said coupler to vary the amount of resistance in circuit when said coupler acts to cause simultaneous vibration of a plurality of said sonorous bodies.

20. An electrical musical instrument having sonorous bodies of different pitch, electromagnets for their actuation, rotating mechanism for delivering properly timed electric pulsations to said electromagnets, and means adapted simultaneously to switch into the circuits of the actuating electromagnets differing amounts of resistance, the resistance in the circuits associated with the bodies of relatively high pitch being materially more than that in the circuits associated with the bodies of low pitch, whereby to preserve a proper ratio of loudness between the vibrations of said sonorous bodies.

21. A musical instrument comprising magnetically attractive sonorous bodies of different pitch, electromagnets for their actuation, means for delivering properly timed electric pulsations to said magnets, said means embracing circuits thereto, and means adapted simultaneously to switch into the circuits of the actuating electromagnets differing amounts of resistance, the resistance for the circuits associated with the treble sonorous bodies being greater than that for the circuits associated with the bass sonorous bodies.

22. A musical instrument comprising magnetically attractive sonorous bodies, electromagnets for their actuation, means embracing circuits for delivering properly timed electric pulsations to said electromagnets, and means adapted simultaneously to switch into the circuits of the electromagnets resistance the increments of which shall be more for the circuits associated with the treble sonorous bodies than for the circuits associated with the bass sonorous bodies.

In testimony that we claim the foregoing invention, we have hereunto set our hands this 3rd day of June, 1907.

MELVIN L. SEVERY.
GEORGE B. SINCLAIR.

Witnesses:
A. B. UPHAM,
HELEN MACOMBER.