W. C. REED.

ELECTRICALLY OPERATED PIANO PLAYER.

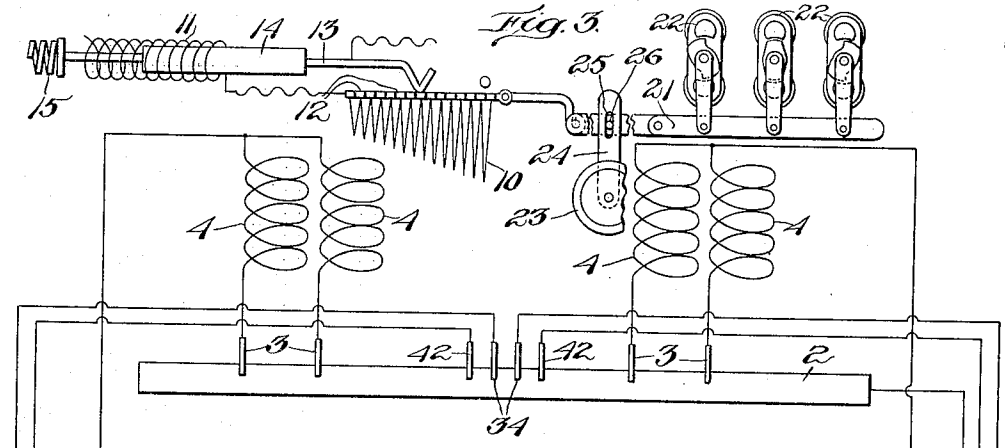
APPLICATION FILED SEPT. 18, 1912.

1,152,841.

Patented Sept. 7, 1915.

2 SHEETS—SHEET 1.

Fig. 3.



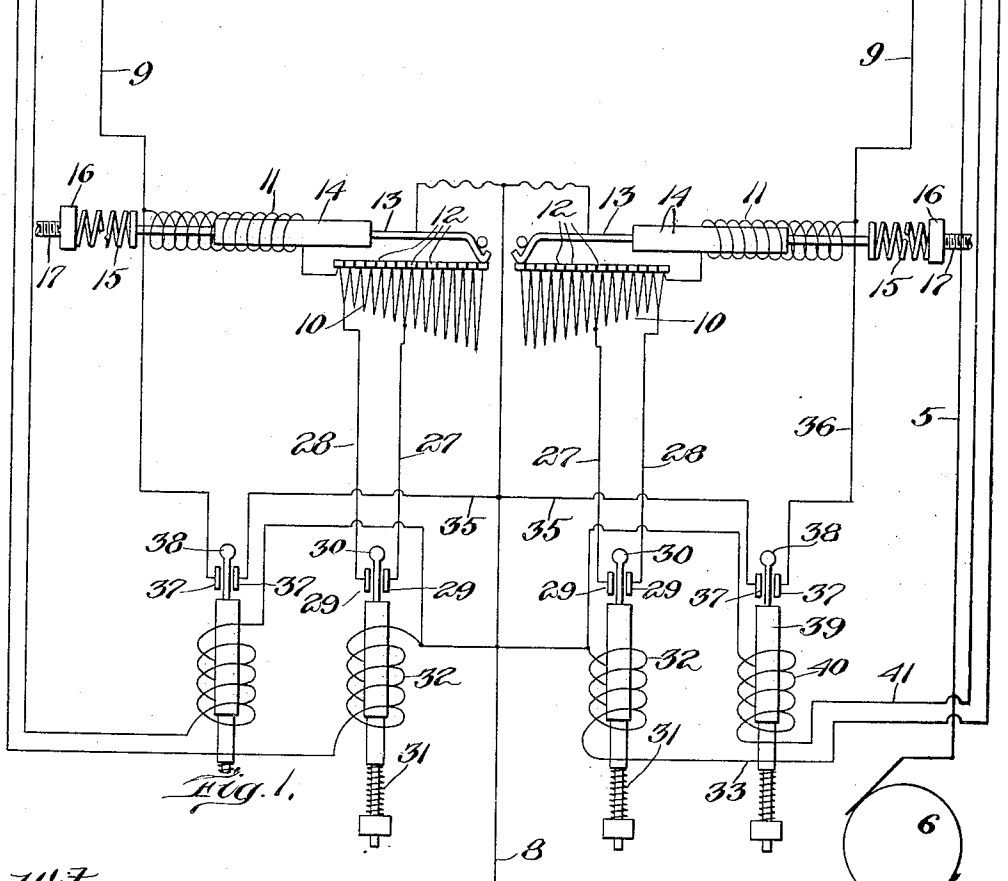


Fig. 1.

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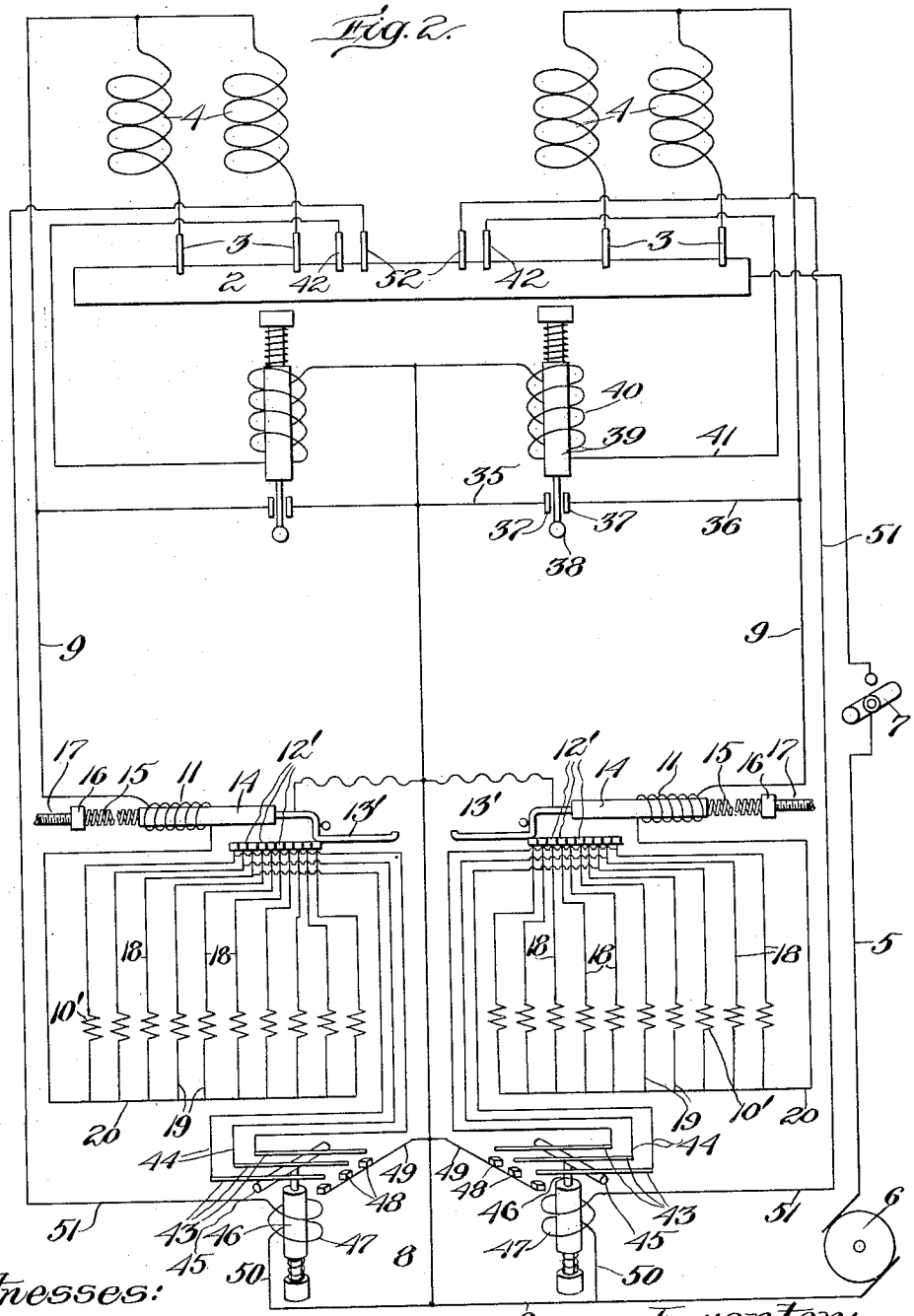
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2 SHEETS—SHEET 2.

Fig. 2.



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ELECTRICALLY-OPERATED PIANO-PLAYER.

1,152,841. Specification of Letters Patent. Patented Sept. 7, 1915.

Application filed September 18, 1912. Serial No. 721,010.

To all whom it may concern:

Be it known that I, WALTER C. REED, a citizen of the United States, residing at Dalton, in the county of Berkshire and State of Massachusetts, have invented new and useful Improvements in Electrically-Operated Piano-Players, of which the following is a specification.

In electrically-operated piano players as heretofore constructed it has been customary to provide the playing magnet circuits with a corresponding number of resistances each included in one of the circuits only, and to employ means for varying these resistances collectively in such manner as to give the electric current a suitable strength for producing the desired loudness of the notes played by the apparatus. My present invention, which relates to playing apparatus of this general character, is particularly intended to simplify such apparatus by making it unnecessary to provide each playing-magnet-circuit with its own special resistance in order to secure the desired tone regulation, and thereby to lessen not only the cost of manufacture of the apparatus but also its liability to get out of order. To this end I include in some portion of the energizing circuit which is common to any desired number or group of the playing magnets a resistance which is automatically varied, according to the number of notes struck at the same time, in such manner that the strength of the current sent through each of these magnets is kept substantially constant, whatever the number of notes struck at the same time may be, and means are provided for independently varying this resistance, either manually or through the agency of the music sheet, or in both ways, and thereby regulating as desired the loudness of the various notes struck from time to time. Preferably the playing magnets are divided into two groups corresponding respectively to the base and treble notes of the key-board, and each group is provided with the variable resistance arrangement above referred to, which is included in the common return circuit for the magnets of that group, and in connection with any such group provision may be made, if desired, for differentiating selected notes as to loudness, as will presently appear.

The accompanying drawings illustrating my invention are diagrammatic in character, since the construction of the various parts employed will be readily understood without specific illustration of the details.

In these drawings: Figure 1 is a diagram showing one arrangement of the circuits and resistances for an apparatus in which the playing magnets are divided into two groups as previously indicated; Fig. 2 is a diagram showing another arrangement of the circuits and resistances for an otherwise similar apparatus; and Fig. 3 shows in somewhat more detail an arrangement for securing general regulation of the loudness of the tone produced.

The parts indicated in the drawings include a metallic contact bar 2, circuit-controlling fingers 3 adapted to make contact with the bar 2 independently of one another when permitted to do so by the music sheet which controls their operation, a playing magnet 4 in series with each finger 3, a circuit wire 5 leading from the contact bar to one terminal of a suitable generator 6 and including a starting and stopping switch 7 (Fig. 2), and a common return wire 8 leading from the other terminal of the generator 6 to the playing magnets through connections hereinafter described. The contact bar, circuit-controlling fingers and playing magnets may be of any suitable construction, such as is shown for example in U. S. Letters Patent No. 753,809, granted March 1, 1904, on the application of Powers and Jewell, to which Letters Patent reference may be made for a full description of the various parts and details of a complete apparatus of the general character under consideration. In the arrangements herein shown the playing magnets 4 are divided into two groups corresponding respectively to the base and treble notes of the key-board, two magnets of each group being represented, and all the magnets of each group are provided with a common return circuit wire 9.

Each group of playing magnets has associated with it a variable resistance which serves for regulating the loudness of the notes struck by all the magnets in that group, the resistance being so connected with the common return wires 8 and 9 for the corresponding group that it affects the strength of the current sent through all the

playing magnets in that group which are in closed circuit at one time, and means are provided for automatically varying this resistance in such manner that if the circuits through two or more of the playing magnets are closed simultaneously (as when a chord is struck,) the resistance is instantaneously diminished to such an extent as to maintain the current sent through each magnet at substantially the same strength, whatever the number of magnets in closed circuit may be. This provides for the automatic maintenance of what may be called the normal or intended loudness of the notes which are played by the apparatus, and, in addition, provision is made for varying this normal loudness as desired, as is hereinafter explained. Inasmuch as the resistances and resistance-varying means for the two groups of playing magnets illustrated are identical in construction and arrangement, the description of one set of parts will apply as well to the other.

In order to secure the automatic variation of the resistance above referred to, I divide the resistance into a suitable number of portions and I employ a contact device operated by an electromagnet and arranged to cut more or less of the resistance portions into or out of the circuit, and this may be done in various ways. One arrangement for the purpose is illustrated in Fig. 1, in which the several portions of the resistance 10 and the coil of the actuating magnet 11 are in series with one another and with the common return wire 9, the various resistance portions being independently connected to corresponding insulated segments 12 forming collectively a bar along which the contact finger 13 electrically connected to the common return wire 8 is adapted to slide.

The resistance 10 should have such capacity that it will safely carry the maximum current liable to be sent through the common return circuit in which it is included, and should be given such length that when it is all included in the circuit it will transmit just enough current to give the softest tone required when the circuit is closed through a single playing magnet only. The contact finger 13 is connected to the movable member 14 of the actuating magnet 11, which is preferably of the solenoid type, and is operated in one direction by a spring 15, being normally held in contact with that one of the segments 12 which throws the entire resistance into the circuit. When the actuating magnet 11 is energized, however, its plunger 14 is drawn into the coil against the pressure of the spring 15, and the contact finger 13 is thereby moved along the segment bar until enough of the resistance 10 has been cut out to maintain the current at the desired strength, according to the number of playing magnets in closed circuit at that time. In other words, the greater the number of playing magnets thrown into the circuit at one time, the stronger will be the current sent through the actuating magnet 11, and therefore the position assumed by the contact finger 13 will be governed by the number of playing magnets in closed circuit and by the resistance opposed to its movement by the spring 15, which is so calibrated as to stop said contact finger at the right point to cut out the proper amount of resistance as above explained. The effect of this spring is preferably made adjustable by causing it to bear at one end on an abutment 16 mounted on a threaded rod 17.

The resistance 10 may be divided into any suitable number of portions, but since not more than ten notes are liable to be struck at one time there would be no advantage, except for the reasons hereinafter explained, in dividing the resistance into more than five or six portions in case it operates in connection with the base or treble playing magnets only. Theoretically, the total resistance outside of the playing magnets should be inversely proportional to the number of such magnets in closed circuit at the same time, if a current of given strength in each playing magnet is to be maintained, and hence it is desirable to divide the resistance into portions of unequal length and so arranged that the contact finger 13 will cut out the resistance faster during the first portion of its movement than during later portions of its movement, as indicated in Fig. 1. It is not necessary, however, that the automatic variation of the resistance should be mathematically accurate, since approximate uniformity of current strength is all that is necessary to be maintained in order to produce satisfactory tone effects.

Instead of connecting the portions of the variable resistance in series with one another they may be connected in parallelism with one another, such an arrangement being shown in Fig. 2, in which the resistance 10′ is shown as divided into ten portions each connected by a lead 18 to a corresponding segment 12′ of the segment bar and by another lead 19 to a circuit wire 20 which is in series with the coil of the actuating magnet 11. When this arrangement is employed each of the resistance portions should have such length as to transmit just enough current to produce the softest tone required when but one playing magnet is in closed circuit, and the contact finger 13′ should have the form of a shoe adapted to make simultaneous contact with a sufficient number of the segments 12′, the effect of such contact being to throw all the corresponding resistance portions into parallel circuit with one another and thus to reduce the effect of the resistance in inverse proportion

to the number of segments on which said finger 13′ rests, since the resistance thus established is in series with the common return circuit wires 8 and 9. Whether one or the other of the resistance arrangements above described is employed, the actuating magnet 11 should be so wound as to have a negligible resistance, and should be so constructed as to have as little inductance as possible in order that it may build up and act more quickly than the playing magnets and thus vary the effect of the resistance in time to transmit the desired strength of current through said magnets, so as to render the same effective for striking the keys with the necessary force.

The features above described, which suffice for automatically maintaining the energizing current at what may be termed the normal strength, regardless of the number of playing magnets in closed circuit at one time, have been explained on the assumption that this normal current strength is such as to produce the softest tones required, and in order to adapt the arrangement for general regulation of the loudness of the tones produced, various means may be employed. For example, provision may be made for shifting the position of the segment bar longitudinally with respect to the contact finger, independently of the automatic movements of the latter, the effect of which will be to cut in or out more or less of the resistance and thereby vary the normal strength of the current. This requires that the resistance portions be sufficient in number to provide a range of movement for the contact finger such as will enable the latter to effect the automatic regulation of the resistance in all positions of the segment bar, and this is the principal reason for employing more than five or six resistance portions in connection with either the base or the treble playing magnet group.

For the sake of clearness of illustration no means for shifting the resistance as a whole are shown in Figs. 1 and 2, but a suitable arrangement for the purpose is illustrated in Fig. 3, in which the segment bar is assumed to be capable of sliding in an endwise direction and is connected to a bar 21 adapted to be moved longitudinally by one or another of a group of electromagnets 22, the circuits through which are under the control of the music sheet. An arrangement of this character as employed for operating a piano pedal is shown and described in the Powers and Jewell patent above referred to, so that the details of the same need not be explained herein, as it will be readily understood that by providing the music sheet with special perforations each coöperating with a finger which controls the circuit through one or another of the magnets 22, automatic tone-regulation may be secured by energizing any given one of said magnets and thereby shifting the segment bar accordingly. Said bar may also be shifted manually, if desired, as by means of a hand wheel 23, Fig. 3, carrying an arm 24 with a slot 25 therein which receives a pin 26 connected to the bar 21. By turning the wheel 23 the segment bar may be shifted in either direction without regard to the electromagnets, which become effective to operate said bar whenever the hand wheel 23 is left free to move.

As another way of varying the resistance a portion of the same may be short-circuited through a special circuit. For example, in Fig. 1 is shown a short-circuiting arrangement comprising circuit wires 27 and 28 leading from different portions of the resistance to a pair of metallic terminals 29, a contact piece 30 normally held out of contact with said terminals by a spring 31, and an electromagnet 32 of the solenoid type, the plunger of which carries the contact piece 30 and serves to move it into contact with the terminals 29 whenever said magnet 32 is energized. This magnet is included in a circuit leading on one side to the common return wire 8 and on the other side through a circuit wire 33 to a special finger 34 under the control of the music sheet, so that whenever the circuit through the magnet 32 is closed at the finger 34, so much of the resistance as is included between the circuit wires 27 and 28 will be short-circuited through the terminals 29, with the result that the current strength and therefore the loudness of the tones produced will be correspondingly increased.

The resistance-varying arrangement just described is not so well adapted as that shown in Fig. 3 for effecting slight or gradual variations in the loudness of the tones produced, but it is useful for producing instantaneous and considerable variations in loudness and hence is well adapted for accenting purposes if controlled by the music sheet in the manner shown and described in another application for Letters Patent filed by me on the 26th day of May, 1910, Serial No. 563,490, according to which each perforation corresponding to a note to be accented is cut slightly in the rear of the perforations corresponding to any simultaneously-sounding notes and is accompanied by a supplemental perforation cut slightly in advance and located in position to control a finger, such as 34, which closes the circuit through a magnet, such as 32, by the operation of which the desired variation in the current strength is produced, this variation being caused by the relative location of the perforations in the music sheet to affect only the note or notes which it is desired to accent. It will be readily understood that at the time when partial short-circuiting of

the resistance occurs the contact finger 13 will be located on some one of the segments 12 corresponding to those portions of the resistance which are not short-circuited, since otherwise the desired change in the current strength would not necessarily result from the short-circuiting, and although the resistance portions which can be short-circuited are preferably connected to corresponding segments of the segment bar, as shown, so that they can be utilized for gradual tone regulation as previously described, this is not at all essential, since said resistance portions, so far as they are useful for short-circuiting purposes, constitute in effect a resistance which is supplementary to the portions subject to the operation of the contact finger 13.

The short-circuiting arrangement above described is such as to produce partial accent, that is, it cuts out a portion only of the resistance, but it is evident that so-called total accent may be secured by cutting out the entire resistance, and means for doing this are shown in Fig. 1, in which 35 and 36 indicate circuit wires connected respectively to the common return wires 8 and 9 on opposite sides of the resistance 10 and actuating magnet 11, and extending to a pair of metallic terminals 37 at which the normally-open circuit may be closed by a contact piece 38 carried by the spring-supported movable member 39 of a solenoid or other electromagnet 40, the latter being included in a circuit which leads on one side to the common return wire 8 and on the other side through a circuit wire 41 to a special finger 42 under the control of the music sheet.

In Fig. 2 a similar total accenting arrangement is shown, and also an arrangement for securing partial accent by short-circuiting a portion of the resistance 10′. In the arrangement for this purpose which is illustrated in Fig. 2 a number of spring contact fingers 43, each connected by a wire 44 to one of the leads 18, rest on an insulating bar 45 carried by the spring-supported plunger 46 of a solenoid magnet 47 and are normally held in elevated position thereby, in which position they are out of contact with corresponding metallic terminals 48 connected by a wire 49 to the common return wire 8. The magnet 47 is connected by circuit wires 50 and 51 to the common return wire 8 and to a special finger 52 controlled by the music sheet, and whenever the circuit through the magnet 47 is closed thereby the bar 45 is drawn downward until the fingers 43 make contact with the terminals 48 and thus short-circuit the corresponding resistance portions to which they are connected. Except as previously described, the parts illustrated in Fig. 2 are constructed and arranged to operate like those illustrated in Figs. 1 and 3.

From the foregoing description it will be seen that by the provision of two variable resistances (assuming that the playing magnets are divided into two groups) and appropriate resistance-varying devices, the same capacity for tone regulation is secured as has heretofore required the employment of a special resistance for each playing magnet, that is, 65 such resistances in a 65 note player and 88 such resistances in an 88 note player, so that by my improvements the construction of apparatus of this character is greatly simplified.

It is to be understood that the specific arrangements herein described are merely illustrative of preferred embodiments of my improvements, and that many changes therein and in various details thereof may be made without departing from the invention, which is broadly characterized by the employment of a resistance included in a circuit which is common to a group of playing magnets and is automatically varied in such manner that the current sent through each one of any given number of playing magnets which are in closed circuit at one time will be substantially maintained at a predetermined strength, this predetermined current strength being subject to variation by independent means for producing expression effects in the composition played.

I claim as my invention:

1. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the several magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, and means for automatically varying said resistance to such an extent as to substantially maintain a predetermined strength in the current sent through each one of such magnets as are in closed circuit at one time.

2. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the several magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, means for automatically varying said resistance to such an extent as to substantially maintain a predetermined strength in the current sent through each one of such magnets as are in closed circuit at one time, and means for varying the predetermined current strength.

3. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the

magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, and means for varying said resistance comprising an electromagnet and circuit connections for supplying the same with a current the strength of which varies according to the number of playing magnets in closed circuit at one time.

4. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, means for automatically varying said resistance according to the number of playing magnets in closed circuit at one time, and means for independently varying said resistance to regulate the normal current strength transmitted through the same.

5. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, means for automatically varying said resistance according to the number of playing magnets in closed circuit at one time, and independent means for short-circuiting a predetermined amount of resistance.

6. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, means for automatically varying said resistance according to the number of playing magnets in closed circuit at one time, independent means for short-circuiting a portion of the resistance, and means for short-circuiting the entire resistance.

7. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit, and means for varying said resistance comprising an electromagnet in series with the playing magnet circuit and having less inductance than one playing magnet.

8. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions, a segment bar having its segments connected to said resistance portions respectively, a contact finger arranged to move along said bar, and means operative with the closing of the circuit through one or more playing magnets for actuating the contact finger, said contact finger and resistance being included in the common portion of the playing magnet circuit.

9. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions, a segment bar having its segments connected to said resistance portions respectively, a contact finger arranged to move along said bar, means operative with the closing of the circuit through one or more playing magnets for actuating the contact finger, said contact finger and resistance being included in the common portion of the playing magnet circuit, and means for varying the relative position of the segment bar and contact finger independently of the automatic operation of the latter.

10. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions, a segment bar having its segments connected to the resistance portions respectively, a contact finger movable along the segment bar, circuit connections for including said contact finger and resistance in the common portion of the playing magnet circuit, and means for operating the contact finger comprising an electromagnet and circuit connections for supplying the same with a current the strength of which varies according to the number of playing magnets in closed circuit at one time.

11. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the

branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions, a segment bar having its segments connected to the resistance portions respectively, a contact finger movable along the segment bar, circuit connections for including said contact finger and resistance in the common portion of the playing magnet circuit, means for operating the contact finger comprising an electromagnet and circuit connections for supplying the same with a current the strength of which varies according to the number of playing magnets in closed circuit at one time, and independent means for shifting the segment bar beneath the contact finger.

12. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance connected at one end to the common portion of the circuit and divided into a number of portions, a segment bar having its segments connected to the resistance portions respectively, a contact finger movable along the segment bar, circuit connections for completing the common portion of the playing magnet circuit through said contact finger and resistance, and means for operating said contact finger comprising an electromagnet included in series with the resistance and a spring arranged to oppose the movement of the contact finger when its actuating magnet is energized.

13. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance connected at one end to the common portion of the circuit and divided into a number of portions, a segment bar having its segments connected to the resistance portions respectively, a contact finger movable along the segment bar, circuit connections for completing the common portion of the playing magnet circuit through said contact finger and resistance, means for operating said contact finger comprising an electromagnet included in series with the resistance and a spring arranged to oppose the movement of the contact finger when its actuating magnet is energized, and means subjected to manual control and to automatic control for shifting the segment bar beneath the contact finger.

14. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions, a segment bar having its segments connected to said resistance portions respectively, a contact finger movable along said bar, connections for including said contact finger and resistance in the common portion of the playing magnet circuit, means for automatically operating said contact finger according to the number of playing magnets in closed circuit at one time, independent means for shifting the segment bar beneath the contact finger, and means for short-circuiting a predetermined amount of resistance.

15. An electrically-operated piano-player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance included in the common portion of the circuit and divided into a number of portions arranged in parallel circuit with one another, and means for automatically closing the circuit through a sufficient number of said resistance portions to substantially maintain a predetermined strength in the current sent through each one of such playing magnets as are in closed circuit at one time.

16. An electrically-operated piano-player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions arranged in parallel circuit and connected at one end to a common portion of the playing magnet circuit, a segment bar having its segments connected to the other ends of said resistance portions, respectively, a contact finger movable along the segment bar and connected to the common portion of the playing magnet circuit, said finger being in the form of a shoe adapted to make simultaneous contact with a number of segments of the segment bar, and means for operating the contact finger comprising an electromagnet and circuit connections for supplying the same with a current the strength of which varies according to the number of playing magnets in closed circuit at one time.

17. An electrically-operated piano player comprising a series of playing magnets arranged in parallel branches of a circuit having a portion which is common to all the

magnets of the series, means for closing the branch circuits through the respective magnets according to the notes to be played thereby, a resistance divided into a number of portions arranged in parallel circuit and connected at one end to a common portion of the playing magnet circuit, a segment bar having its segments connected to the other ends of said resistance portions, respectively, a contact finger movable along the segment bar and connected to the common portion of the playing magnet circuit, said finger being in the form of a shoe adapted to make simultaneous contact with a number of segments of the segment bar, means for operating the contact finger comprising an electromagnet and circuit connections for supplying the same with a current the strength of which varies according to the number of playing magnets in closed circuit at one time, and means independent of the movements of the contact finger for varying said resistance.

In testimony whereof, I have hereunto subscribed my name this 13th day of September, 1912.

WALTER C. REED.

Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."