No. 678,095. Patented July 9, 1901.

H. S. BROWN.

ELECTRICALLY OPERATED MUSICAL INSTRUMENT.

(Application filed Oct. 16, 1900.)

(No Model.) 5 Sheets—Sheet 1.

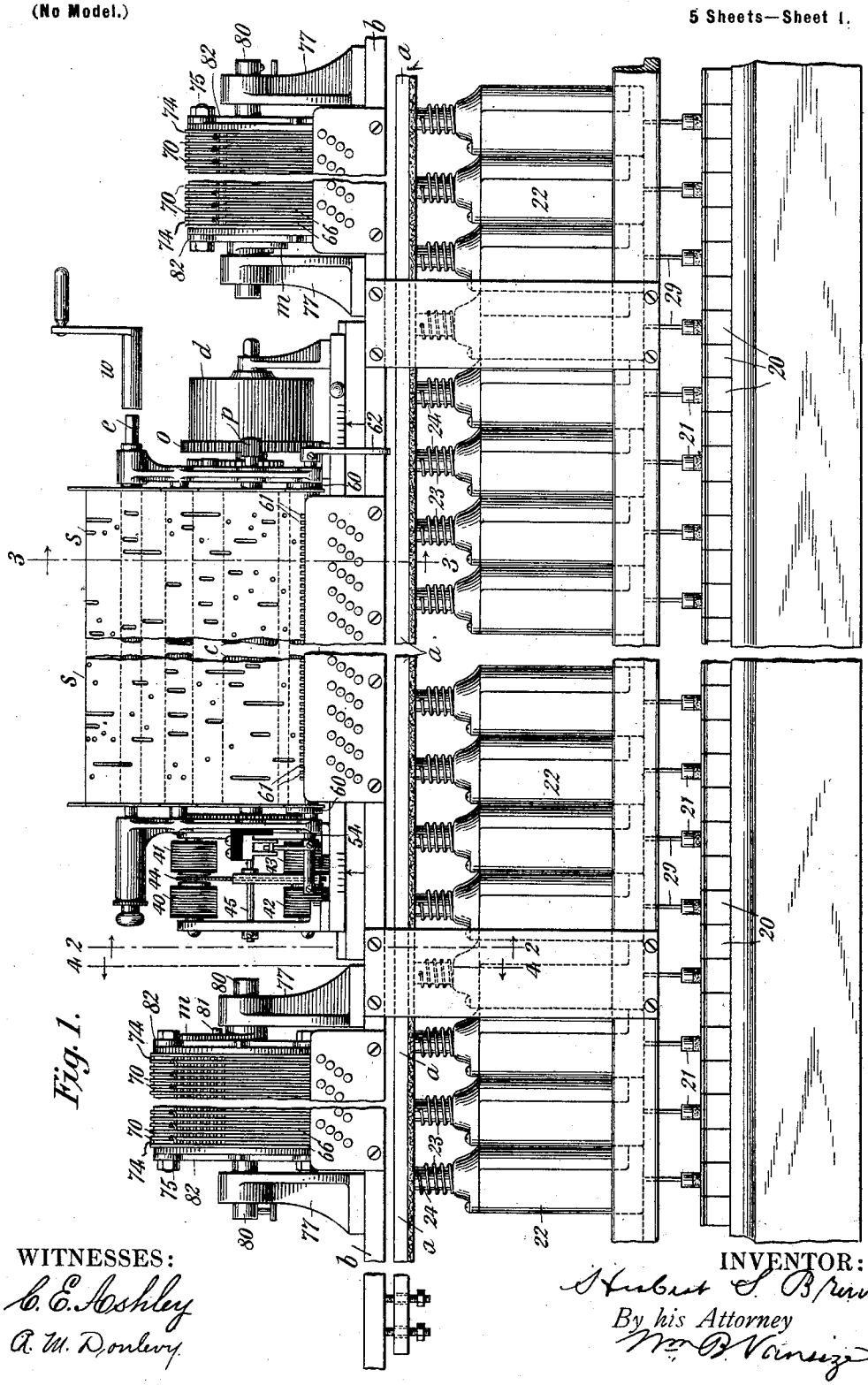


Fig. 1.

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Fig. 3.

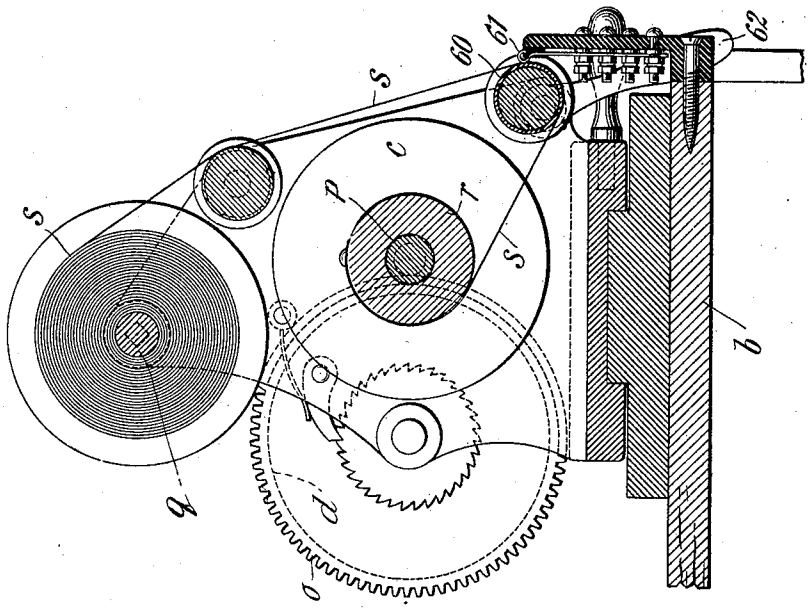
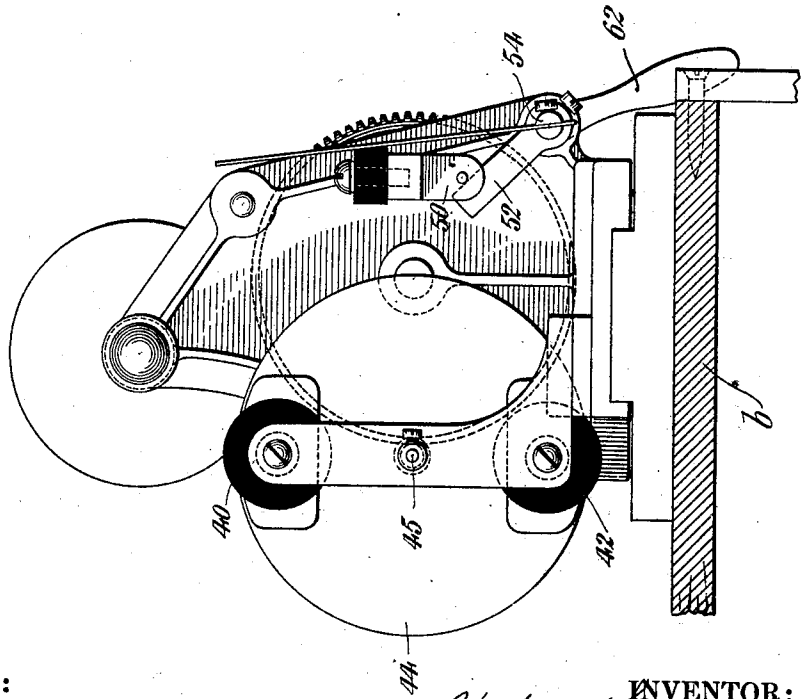


Fig. 2.



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Fig. 4.

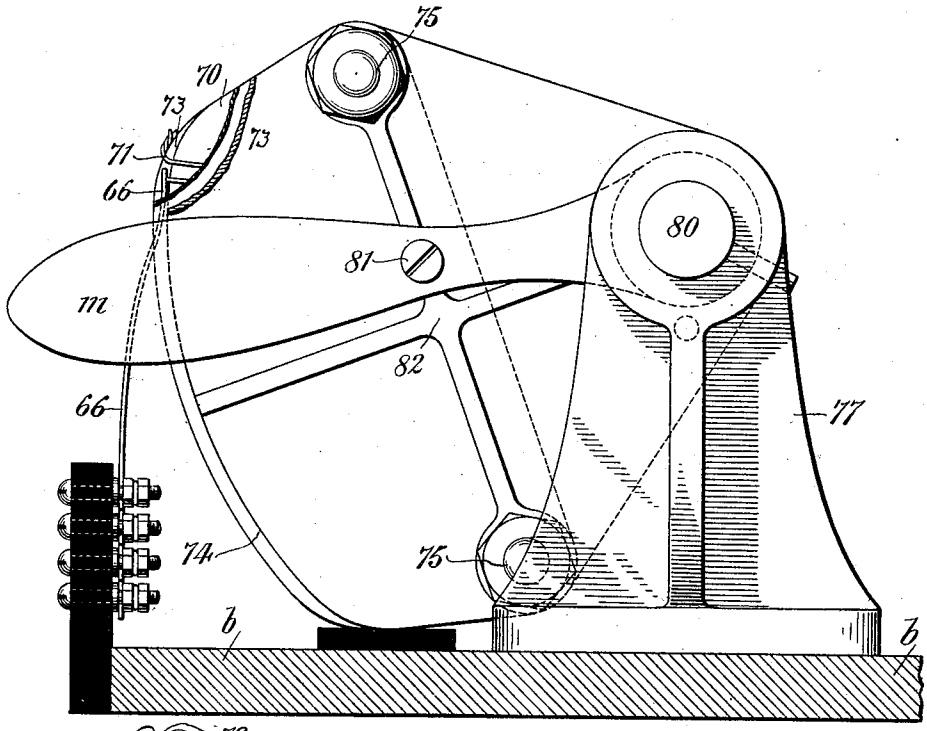


Fig. 6.

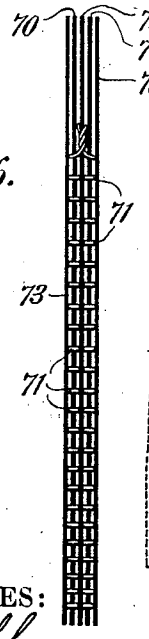
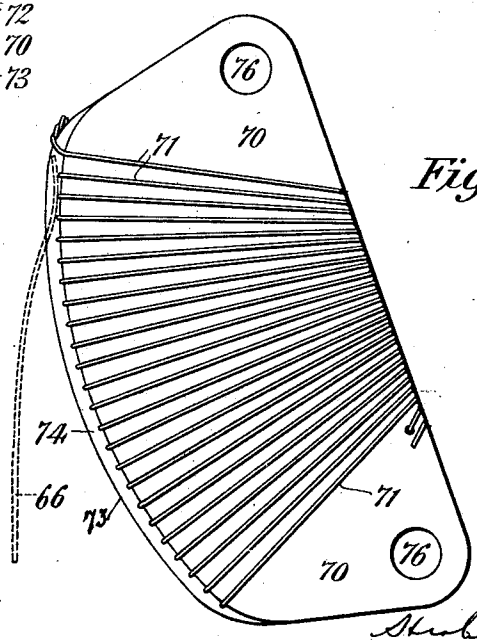


Fig. 5.



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Fig. 9.

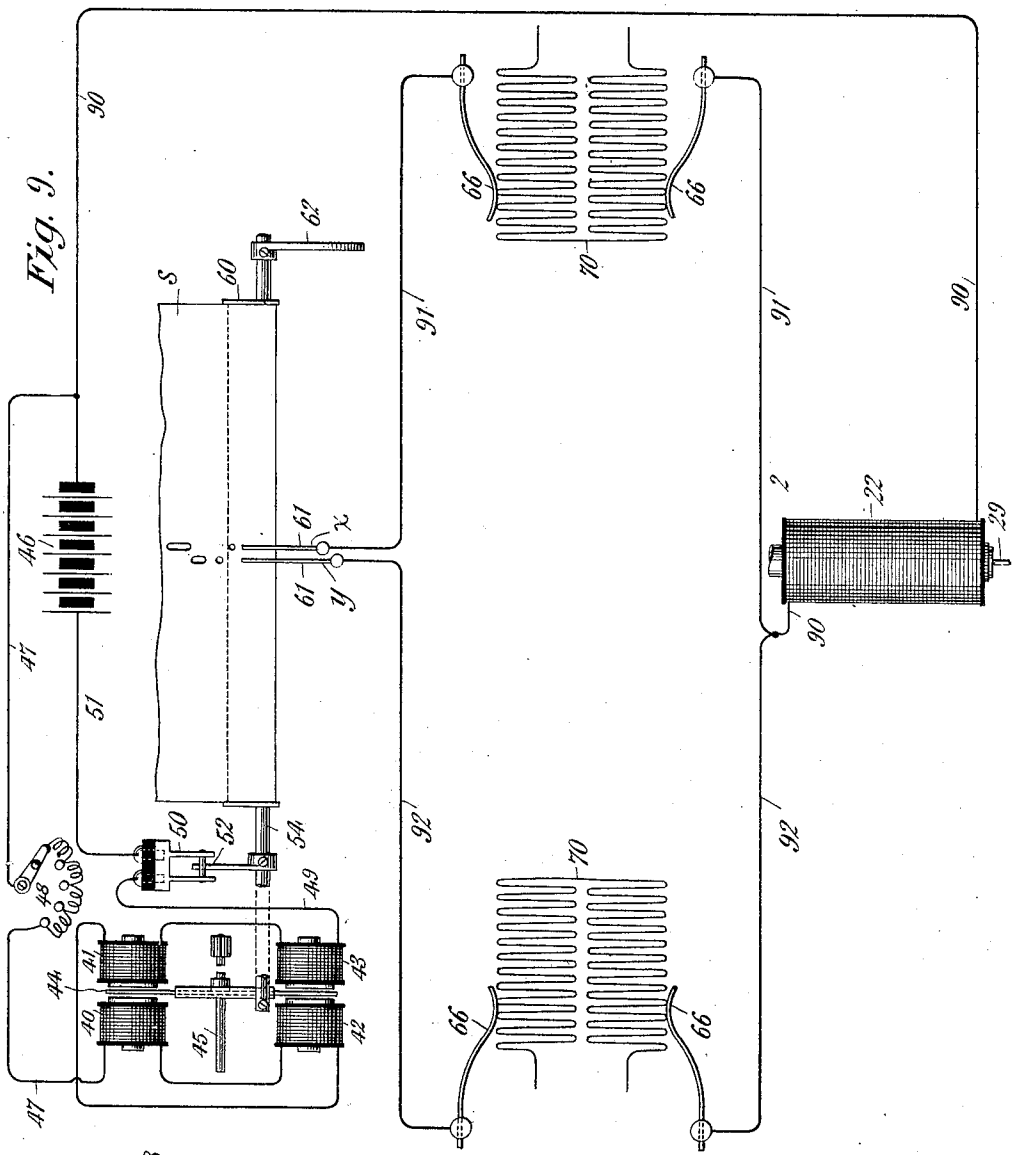


Fig. 7.

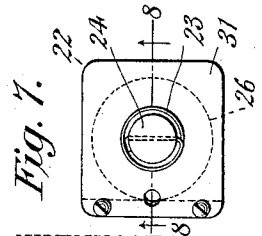
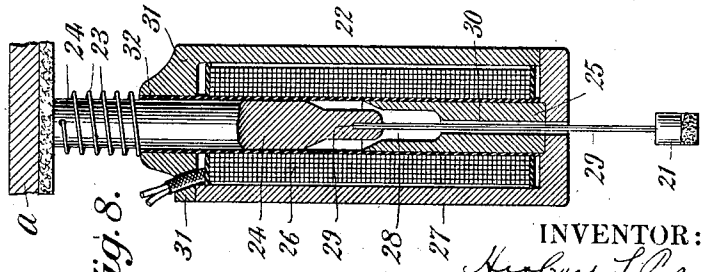


Fig. 8.



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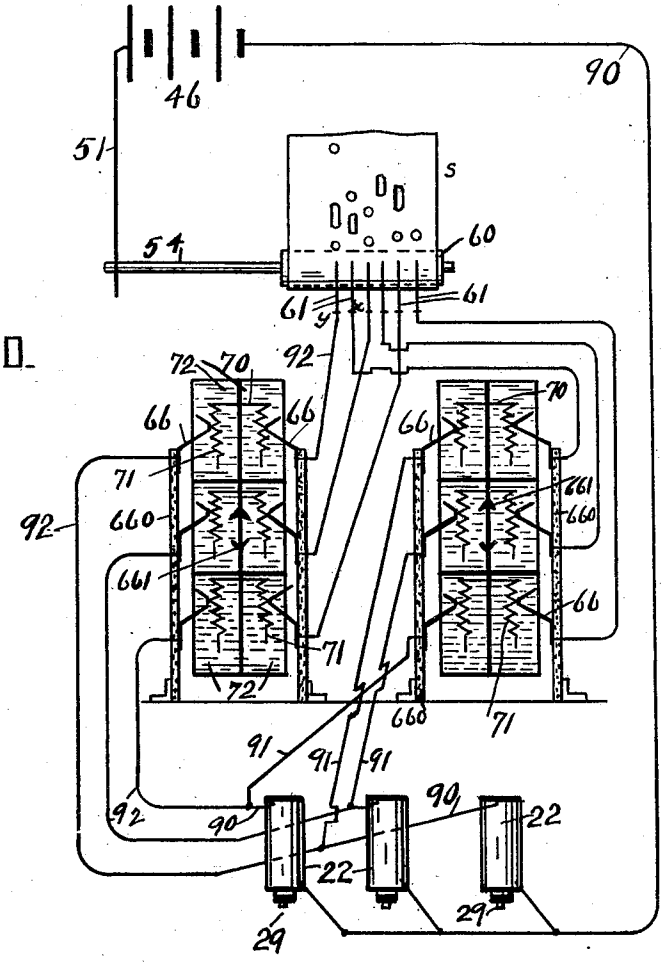
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(Application filed Oct. 16, 1900.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 10.



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UNITED STATES PATENT OFFICE.

HERBERT S. BROWN, OF NEW YORK, N. Y.

ELECTRICALLY-OPERATED MUSICAL INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 678,095, dated July 9, 1901.

Application filed October 16, 1900. Serial No. 33,195. (No model.)

To all whom it may concern:

Be it known that I, HERBERT S. BROWN, a citizen of the United States, residing in the city of New York, county and State of New York, have made certain new and useful Improvements in Electrically-Operated Musical Instruments, of which the following is a specification.

My invention is an improvement in apparatus for playing musical instruments, such as pianos, automatically and manually.

The object of my improvement is to provide improved means to relieve the player from the mechanical technique of musical execution, but to leave absolutely within his manual control the interpretation of the notes—that is, the determination from instant to instant of the exact time in which the composition shall be played and of the exact intensity of tone by which each note shall be made to vary from the notes immediately preceding or succeeding it or from other notes struck simultaneously with it. I provide an electromagnet for each key of the piano. Each magnet is in an electric circuit having two branches. There is a manually-adjustable or variable artificial resistance in each branch and a switch-arm by which the resistance may be varied at will manually. All the notes belonging to the theme, melody, or air of the musical composition may be regulated in intensity by one set of these variable resistances, and all the notes of the accompaniment may be regulated in intensity by the other set of resistances. The theme or air may thus be inflected through the entire range of capacity of the instrument, while the accompaniment, no matter how intricately interlaced with the theme, is simultaneously softened and inflected in an entirely-independent degree. To produce a stroke corresponding in power and sensitiveness to the skilled human touch, I employ an electromagnet or solenoid having a long uniform stroke, specially constructed to reproduce the firm attack of the expert pianist rather than the jerky bang of the ordinary electromagnet. This forms an important part of my invention.

The accompanying drawings illustrate my invention.

Figure 1 is an elevation of the keyboard of the piano, showing the magnet and apparatus employed by me partly in section. Fig. 2 is a section on the line 2 2, Fig. 1. Fig. 3 is a section on line 3 3, Fig. 1. Fig. 4 is a section on line 4 4, Fig. 1, showing a side elevation of one set of the adjustable resistances and a contact-varying arm. Fig. 5 is a view of one of the artificial resistance pieces in side elevation, the front outside insulating-sheet being omitted to show the winding of the resistance-wire. Fig. 6 is a view of the contact edge of the resistance. Fig. 7 is a top view of one of the magnets. Fig. 8 is a vertical central section of the magnet on the line 8 8, Fig. 7, and Fig. 9 is a diagram of the electrical connections and apparatus for operating a magnet. Fig. 10 is a diagram showing the electrical connections and resistances for several of the operating-magnets.

In Fig. 1, 20 indicates the usual arrangement of separately-movable keys of a piano-keyboard, which when depressed operate a hammer or striking device through the medium of a compound lever arrangement. (Not shown and of well-known construction.) Above each key 20 there is a soft-surface plunger 21, which when depressed actuates the corresponding key 20.

22 indicates a series of individual magnets having a solenoid-coil 26, Fig. 8, and a plunging magnetic core-section 24, with a retracting-spring 23 therefor. Fixed in the bottom of the coil 26 is a core-section of magnetic metal 25. The section 25 extends a portion of the distance through the coil and has an aperture 28 at its upper end. This axial aperture is preferably in the form or outline shown in the drawings, and the terminal 29 of the reciprocating core-section 24 is of the same outline, the two terminal core-sections being complementary parts.

29 is a rod fixed to the end of the core-section 24 and sliding freely in the axial perforation 30 in the core-section 25. The head of the plunger 21 is fixed to the lower end of the rod 29 and has a soft contact-surface. Around the coil 26 there is a magnetic metal case or jacket 31, included in the magnetic circuit through an aperture 32, in which the movable core-section 24 slides freely. The merit of this special construction of magnet is that its action on the plunger is smooth and uniform

throughout the range of its movement, its movement being thus rendered variable by the variations in strength of current employed to magnetize the coil. *a* is an adjustable soft-surface upper-limit stop for the series of movable core-sections.

On a board or platform *b*, Fig. 1, above the magnets is located a motor for advancing the paper strip *s*, which strip is perforated to represent musical notes and forms part of the circuit-closing apparatus. The motor is driven by a spring in the case *d*. The paper strip *s* passes from a roll *r* to a roll *q* and back again. The act of winding the paper from *r* to *q* by the crank *w* on the squared arbor *e* winds the spring in the case *d*, and the spring through a train of gearing, including the pinion *p* and the toothed wheel *o*, then rolls the paper off from the roll *r* onto *q*. There is a regulator for the motor composed of four magnets 40, 41, 42, and 43, arranged in a local circuit in series. There is a disk 44, of aluminium or some non-magnetic metal, fixed to the spindle 45, and this spindle is on the shaft bearing the pinion *p*. The arrangement of the circuit of the electromagnetic governor is shown in Fig. 9. Circuit passes from the battery 46, via 47, adjustable resistance 48, through the magnets 40 42 43 41, to the circuit-closing device 50, thence to the battery via 51. The circuit-closing device 50 is composed of two fingers, which are fixed in position. There is a movable contact 52 on the shaft 54, bearing the handle 62. By varying the resistance at 48 the strength of current in the magnet-coils 40 to 43 is varied. The induced currents in the disk 44 are thus varied and the rate of rotation of the disk is changed in substantial harmony with such variation in resistance to govern the rate or speed of the motor which operates to feed the perforated paper strip.

60 is a roller, of conducting material, as metal, over which the perforated strip *s* passes. 61 is a series of contact-fingers fixed in position to engage with the surface of the roller 60. The roller 60 is on a bearing arranged eccentrically and controlled by the handle 62. When the roll 60 is thrown forward by depressing 62, the contact-strips 61 are brought into engagement with the said roller. The roller 60 forms one terminal of the magnet-circuit. The contacts 61 are arranged in pairs, each contact in position to engage a line of perforations in the perforated strip. Each contact 61 forms the terminal of one branch of an electric circuit containing a magnet 22. Between each contact 61 and its junction with the corresponding magnet-coil 22 there is an adjustable artificial resistance, like 70, Fig. 5. Each resistance 70 consists of two sheets of insulating material, around which separated coils of bare wire 71 are wound. The sheets of insulating material, with the coils of wire 71, are separated by a similar sheet of insulating material 72, and on the exterior of the wire-wound sheets forming the resistances 70 there are similar sheets of insulating material 73, as shown in Fig. 6. In Fig. 5 the front insulating-sheet is omitted in order to show the winding of wire 71. The separating-sheet 72 and the exterior sheets 73 project slightly at their outer arc-shaped edges, and thus furnish a channel 74, in which the contact-fingers 66 are free to pass or slide in contact with the exposed edge of the bare wire 71, forming the artificial resistance. This form and arrangement of artificial resistance is very compact, and the several separate resistances—one for each branch circuit—are arranged as shown in Figs. 1 and 4. They are tied or fixed together by bolts 75 passing through holes 76. The two series of resistances, each having an arc-shaped contact-surface, are supported on rotatable shafts 80, located in bearings in the brackets 77 at the right and left of the player. There is a handle *m*, Fig. 4, on each shaft 80, firmly connected to the resistances by a spider 82 and screw 81. It will thus be seen that by moving a handle *m* up or down the position of the contact 66 with respect to the wire 71 may be varied at pleasure to include or exclude more or less resistance with respect to any branch circuit. The arrangement of this circuit is shown in Fig. 9. Each magnet 22 is in a circuit 90, including the battery 46. One pole of this battery 46 is connected with the conducting-roll 60, over which the perforated paper passes through the wire 51, circuit-closer 50 52, and shaft 54. The circuit 90 after passing through the magnet has two branches 91 and 92. The branch 91 contains a variable resistance 70 and terminates in one of the trailing contacts 61, (distinguished by the letter *x*.) The branch 92 after passing through a variable resistance 70 terminates in a trailing contact 61, (distinguished by the letter *y*.) The branch 91 is controlled by a handle *m*, operating a variable resistance 70 at the right-hand side of the instrument in Fig. 1, while the resistance 70 in the branch 92 is controlled by switch-handle *m* at the left-hand side of the instrument. It will thus be seen that by manipulating the handle *m* on one side of the instrument or the other the magnet 22 may be caused to act with a determinate and different force in playing any note or actuating any key of the piano and that this force or stroke may be varied in passing from one note to another and so be made to manifest the individual will of the operator.

The operation of selecting and determining the notes to be struck and the distinguishing them as belonging in tone treatment respectively to theme and to accompaniment is performed by the automatic circuit-closer, consisting of the conducting-roll 60 and the contacts 61, while the force or energy with which the notes are struck is under the instantaneous and constant control of the operator. Two or more notes simultaneously sounded may thus be varied in intensity with respect to one another according as the contact is made

through one magnet or another in a circuit or branch having more or less resistance.

Fig. 10 shows diagrammatically several of the magnets 22, their circuits 91 92, and adjustable resistances 70 for each circuit 91 92. In this figure for convenience of illustration the insulating plates or sheets 72 in each group are shown edge to edge, the resistances 70 thereon being in position to move under and in contact with the fixed contacts 66, which are shown on insulating-supports 660. The resistances in each group are adapted to reciprocate together, as indicated by arrows 661.

What I claim, and desire to secure by Letters Patent, is—

1. The combination in a musical instrument with a series of independently-vibrated strings of a suitable hammer for each string; a magnet for each hammer, an electric circuit for each magnet, having two or more branches, a separate adjustable resistance in each branch, a separate manually-operated switch for adjusting the resistance in each branch, and an automatic circuit-closer for each branch.

2. The combination in a musical instrument having a series of independent keys or notes, of a series of operating-electromagnets, one for each such key, an electric circuit for each magnet, having two or more branches, a separate adjustable or variable resistance in each branch, a manually-operated and independent switch for each resistance in said two or more branches, and an automatic circuit-closer for each branch.

3. The combination in a musical instrument having a series of independently-vibrated strings, of a suitable hammer for each string, an electromagnet for each hammer, an electric circuit having two or more branches for each magnet, means for manually varying the resistance of either branch independently of the other branch and an automatic circuit-closer for each branch.

4. The combination in a musical instrument having a series of independently-vibratory strings of a series of electromagnets, one for each string, an electric circuit for each magnet in two or more parts or branches, means for automatically making and breaking circuit in either part or branch and means for manually changing the current strength in either part or branch independently.

5. The combination in a musical instrument having a series of independently-vibratory strings of a series of electromagnets, one for each string, an electric circuit for each magnet in two or more parts or branches, an automatic circuit-closer in each part or branch consisting of a trailing contact, a rotating drum or cylinder and a non-conducting strip perforated with a series of holes arranged in two separate lines, and a manually-operated resistance-changing device for each part or branch circuit whereby the strength of current may be changed in one part or branch with respect to the other part or branch at the will of the operator.

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