H. K SANDELL.

ELECTRIC SELF PLAYING VIOLIN.

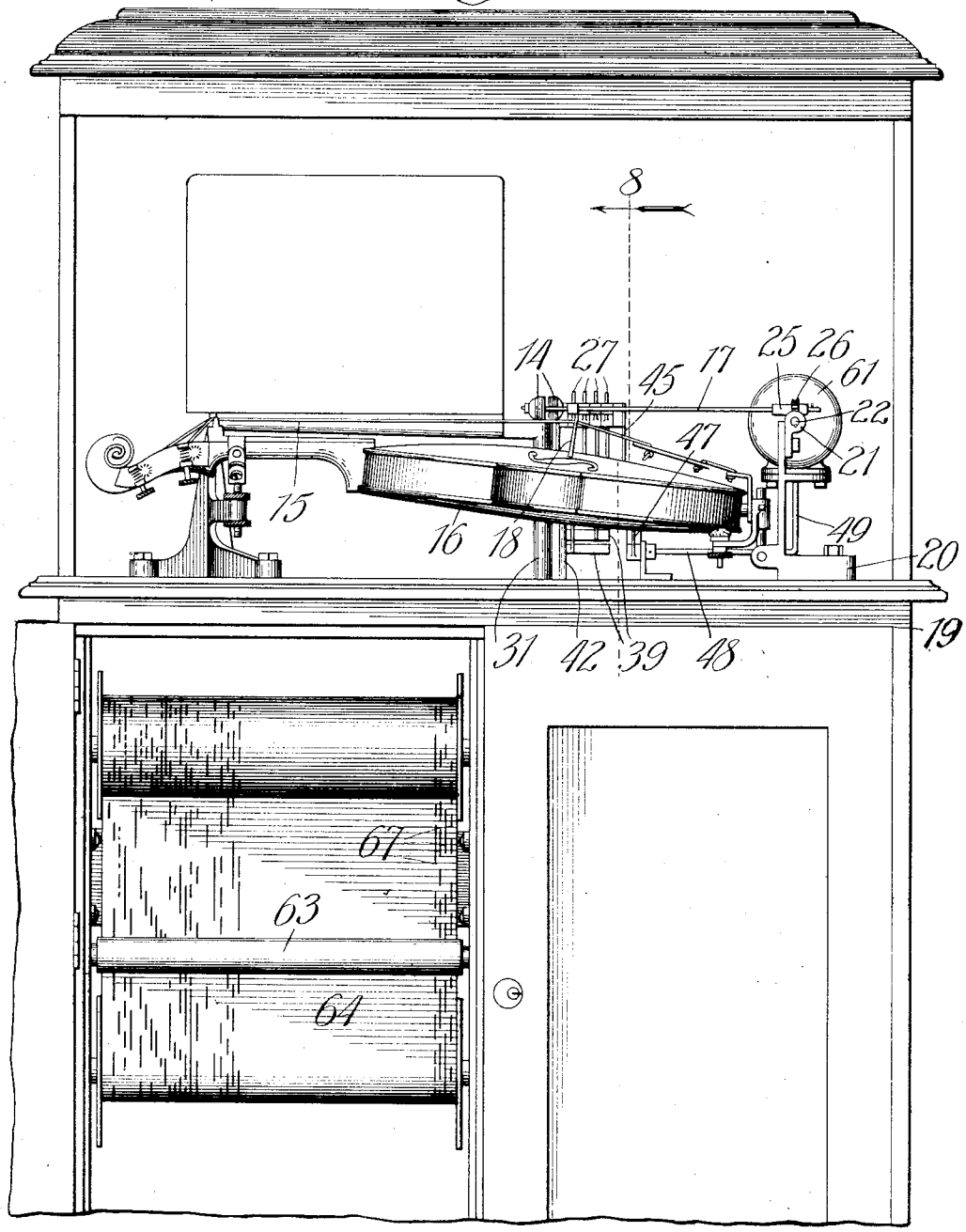
APPLICATION FILED MAR. 22, 1913.

1,085,943.

Patented Feb. 3, 1914.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
C. E. Taylord.
Chas. H. Buell.

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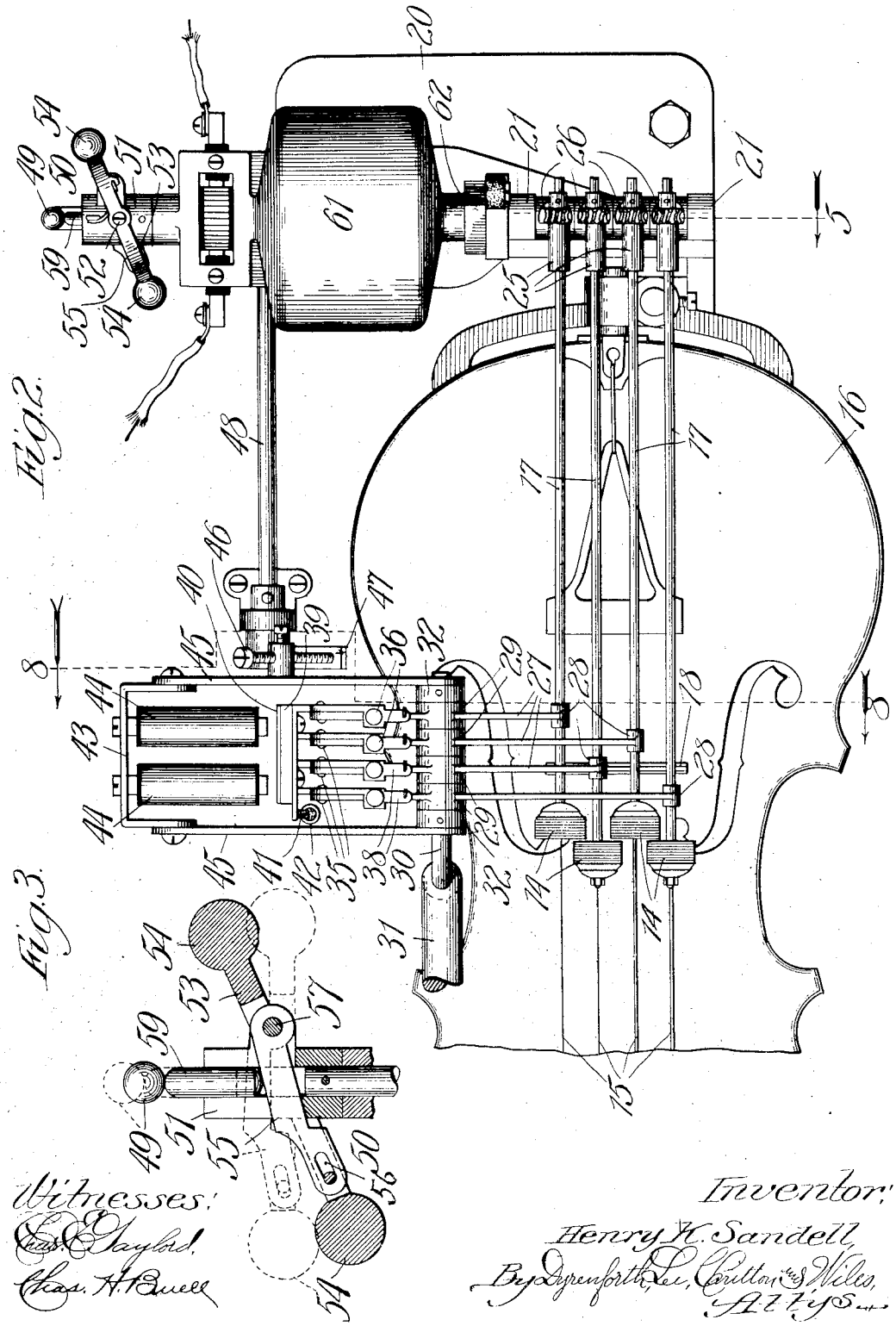

Fig. 2.

Fig. 3.

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5 SHEETS—SHEET 3.

Fig. 4.

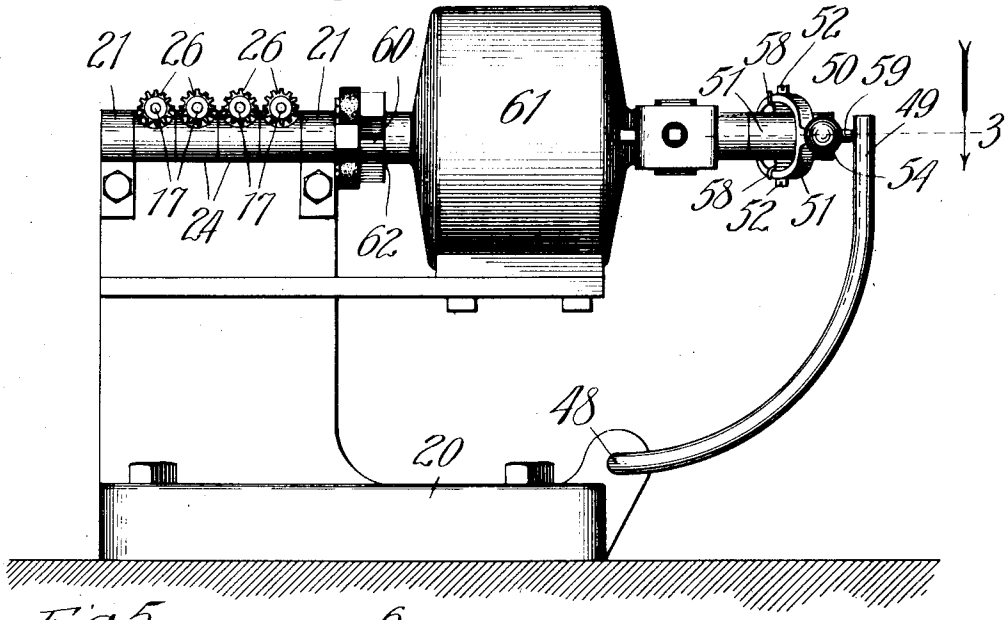


Fig. 5.

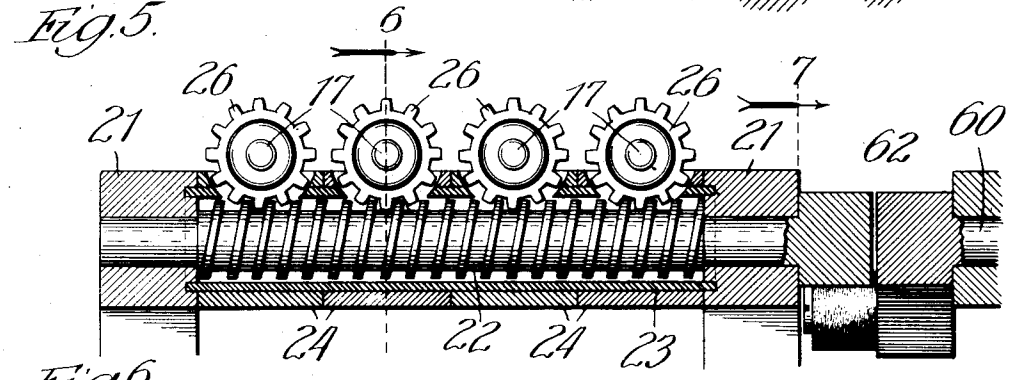


Fig. 6.

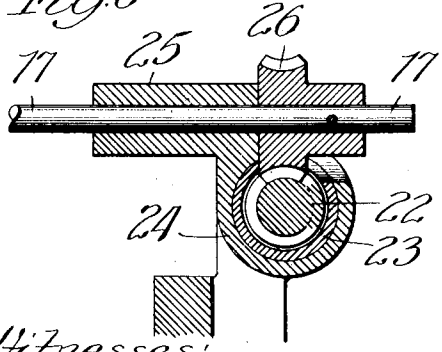
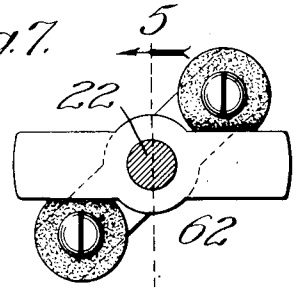


Fig. 7.



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5 SHEETS—SHEET 4.

Fig. 8.

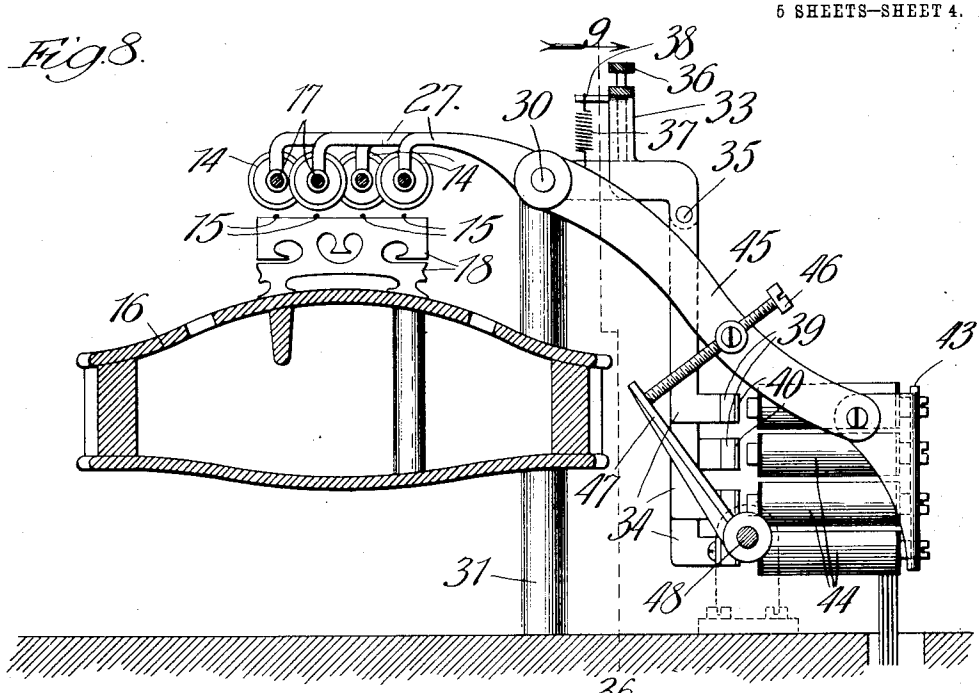


Fig. 10.

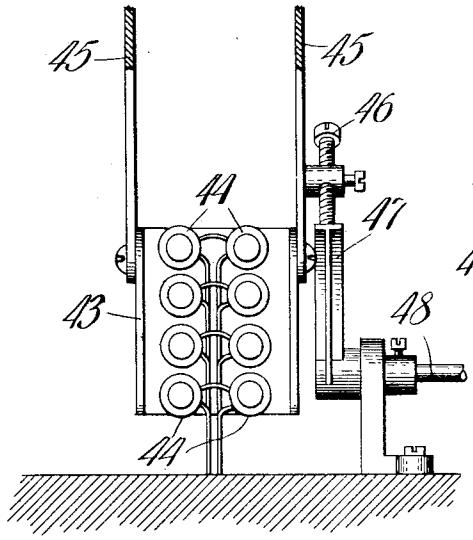


Fig. 9.

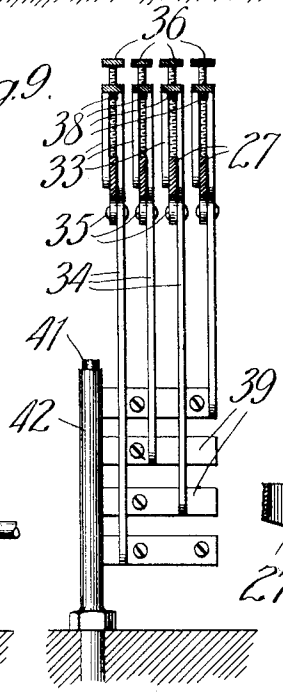


Fig. 11.

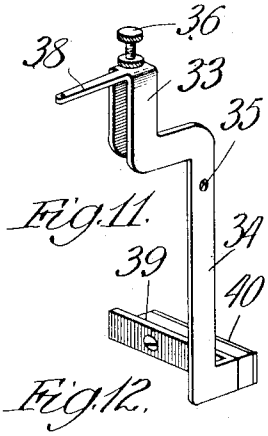
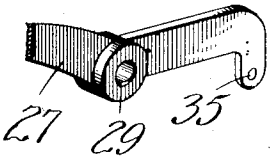


Fig. 12.



Witnesses:

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APPLICATION FILED MAR. 22, 1913.

1,085,943.

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5 SHEETS—SHEET 5.

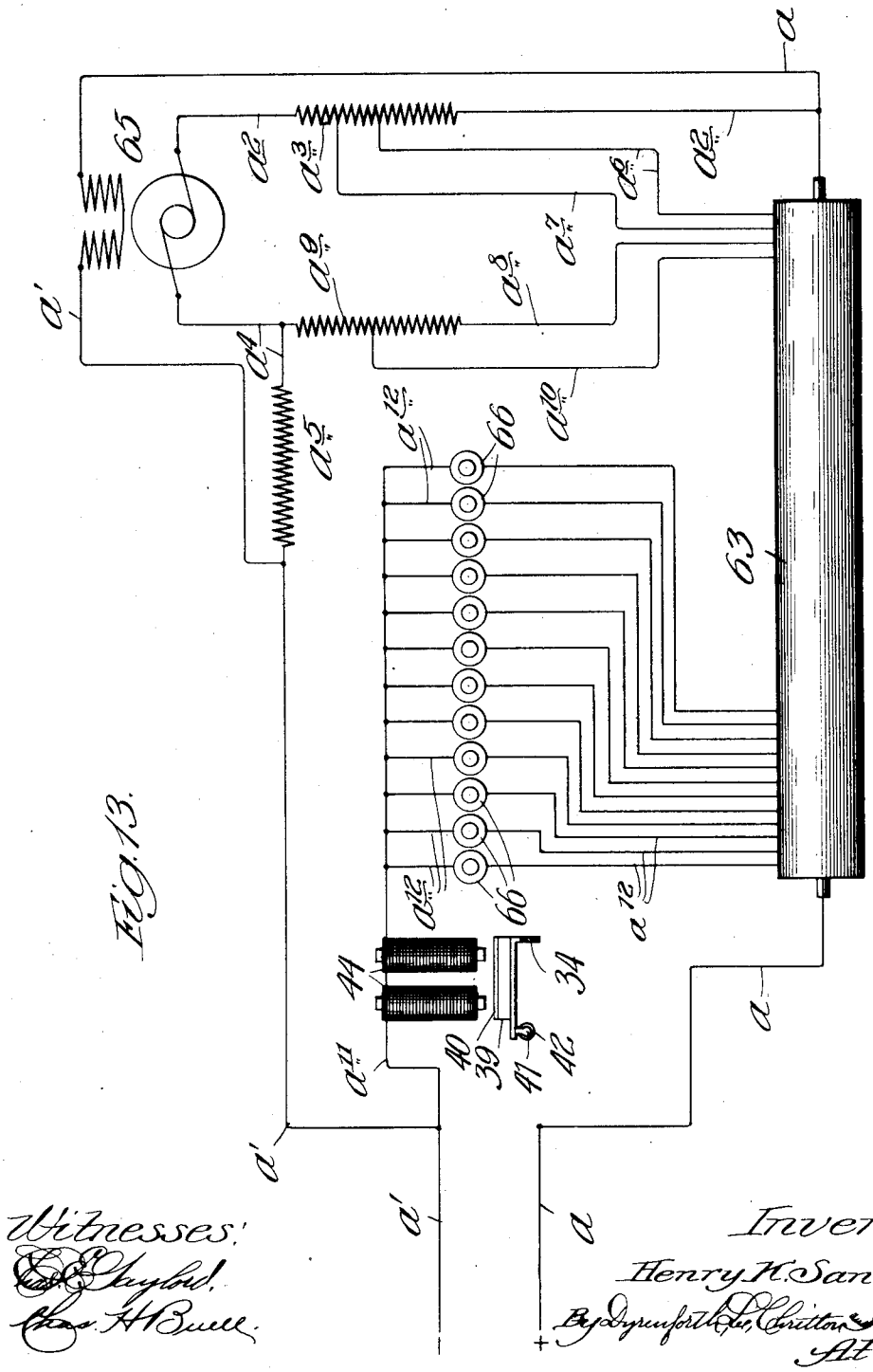

Fig. 13.

Witnesses:
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UNITED STATES PATENT OFFICE.

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ELECTRIC SELF-PLAYING VIOLIN.

1,085,943. Specification of Letters Patent. Patented Feb. 3, 1914.

Application filed March 22, 1913. Serial No. 756,122.

To all whom it may concern:

Be it known that I, HENRY K. SANDELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Electric Self-Playing Violins, of which the following is a specification.

My invention relates to an improvement in self-playing instruments of the viol class, exemplified in United States Letters Patent No. 807,871, granted to me December 19, 1905.

The primary object of the present invention is to greatly simplify the expression mechanism for causing loud and soft playing of the instrument. This is accomplished by varying the speed of the sounder-driving motor through the medium of resistances interposed in the circuit at opposite sides of the motor, and a governor on the motor controlling the pressure of the rotary sounders against the strings of the instrument correspondingly with the motor-speed; thereby to increase the sounder-pressure by increase in the speed of the motor for loud playing; and for soft playing, and gradations between soft and loud, to decrease the sounder-pressure by decrease in the speed of the motor.

In the accompanying drawings, Figure 1 is a view in front elevation of an electric self-playing violin provided with my improvement; Fig. 2 is an enlarged broken plan view of the violin and improved expression-mechanism; Fig. 3 is an enlarged broken and sectional plan view, diagrammatic in character, showing the preferred form of governor for the sounder-driving motor, the section being taken on line 3, Fig. 4; Fig. 4 is a view in side elevation of the electric motor with the governor on one section of its divided shaft and a pivotal arm actuated by it to control the sounder-pressure, and showing the sounder-shafts geared to its other section; Fig. 5 is a section taken on line 5, Fig. 2 and enlarged, or on line 5, Fig. 7; Fig. 6 is a section on line 6, Fig. 5; Fig. 7 is a section on line 7, Fig. 5; Fig. 8 is a section on line 8—8, Fig. 2, or on line 8, Fig. 1, and enlarged; Fig. 9 is a section on line 9, Fig. 8, but omitting the electro-magnet-carrying frame, and Fig. 10 is a section on the same line showing the electro-magnet-carrying frame, but with the parts shown in Fig. 9 removed; Figs. 11 and 12 are perspective views showing different details, and Fig. 13 is a diagram of the motor and its circuit.

The rotary sounders 14 shown are the same as in the aforesaid patent, each being in the form of nested dished disks of celluloid, for a string 15 of a violin 16, on the forward end of a shaft 17 extending lengthwise over the string to bring the sounder into proper bowing position in advance of the bridge 18.

The violin is supported at its opposite ends, as shown, in the upper compartment of a suitable case 19, the rear support being a bracket 20 having secured to the back of its upright member at the upper corners of the latter, bearings 21 for the ends of a worm-shaft 22. The worm-shaft is incased in a sleeve 23 loosely surrounded by four collars 24 confined between the bearings and having formed on their upper parts tubular bearings 25 for the rear ends of the shafts 17 which carry worm-pinions 26 meshing through openings in the tops of the bearings 24 and sleeve 23 with the worm-shaft to be turned by it for rotating the sounder-shafts. This construction enables the sounder-shafts to be moved independently of each other relative to the violin-strings while maintaining the pinions in mesh with the worm. The shafts 17 are carried, near their forward ends, to maintain the sounders normally raised off the strings 15, by curved levers 27 terminating at their forward ends in collars 28 loosely surrounding the shafts, the levers being provided between their ends with hubs 29, at which they are fulcrumed on a rod 30 extending horizontally from a post 31 and confined between collars 32 secured on the rod. Each lever 27 extends at its tail-piece through the socket-like head 33 of an angular extension 34, to which it is pivotally jointed at 35, this head carrying a set-screw 36 bearing against the back of the lever 27 for turning the latter to adjust the normal height of the respective sounder relative to the string it plays; the adjusting means including a spiral spring 37 connecting the lever with a tongue 38 projecting from the head of the socket 33. The lower end of each lever-extension 34 carries an armature 39 (Fig. 11), shown to be faced with leather 40, these armatures forming a bank and abutting at one end against a felt

or other soft strip 41 confined and projecting through a vertical slot in a hollow post 42 rising in the return-path of one end of the armature-bank to noiselessly limit the swing of the armatures away from the electro-magnets. A frame 43 carrying a bank of electro-magnets 44, one for each armature, is hinged at arms 45, extending from it, on the rod 30, one of these arms carrying, as an abutment, a set-screw 46 against which abuts a finger 47 extending from one end of a rock-shaft 48 supported in suitable bearings and formed at its opposite end with a curved section 49 extending into the path of the governor, as hereinafter described.

The preferred construction of governor 50 is that shown of a hub 51 slotted longitudinally throughout part of its length and having projecting from opposite points studs 52, on which is fulcrumed a yoke 53 carrying balls 54 on its opposite ends, and a bent lever 55 fulcrumed at its slotted end (at 56, Fig. 3) adjacent to one ball and passing thence through the slot in the hub, beyond which it is fulcrumed at 57, the yoke being resiliently held in its normally-inclined position relative to the hub by spiral springs 58 confined against it and extending from the studs 52. In the split end of the hub is reciprocably confined a pin 59. A governor fits at its hub on the rear end of the shaft 60 of an electric motor 61, to which it is secured. In that position the pin 59 abuts against the adjacent end of the curved section 49 of the rock-shaft 48 whereby, in the rotation of the motor, resultant motion of the yoke works the lever 55 between its ends against the pin to protrude it more or less against the resistance of the finger 47, thereby to back the electromagnets away from the armatures and increase, more or less, their separation therefrom, thus to vary the space through which the armatures may move, under attraction by the electromagnets and, consequently, the pressure of the sounders against the strings. The motor-shaft is coupled, as shown at 62, to the worm-shaft 22, the two forming together a divided motor-shaft having their sections coupled in a manner to be driven without requiring them to be in perfect alinement.

The circuit may be traced on Fig. 13 as follows: A wire a leads to a brass roller 63 across which the perforated music-sheet 64 (Fig. 1) travels, and from the roller to one side of the field of the motor 61, from the opposite side of which leads the return-wire a^1. A wire a^2 connects the wire a with one armature-brush and has interposed in it a resistance-coil a^3, and the other armature-brush is connected with the wire a^1 by a wire a^4 containing a resistance-coil a^5. A wire a^6 connects at one end with the coil a^3 between its ends, to cut out a portion of the resistance, and brushes at its opposite end against the roller 63 through perforations in the traveling music-sheet. Similarly brushing through the aforesaid perforations are a wire a^7 leading from the same coil a^3 to cut out more resistance, a wire a^8 leading from the wire a^4 and containing a resistance-coil a^9, and a wire a^{10} leading from the coil a^9 to cut out a portion of the resistance. A wire a^{11} leading from the wire a^1 contains the electromagnets 44, and has branches a^{12} leading through electromagnets 66 controlling the fingers which play the violin-strings to brush against the roller 63 through the music-sheet, as in the aforesaid patent, and of which electromagnets a series of twelve are shown, for playing one string, which is all that is necessary to illustrate in the present connection.

The fingering of the instrument is produced, generally stated, as described in said former patent. That is to say, with the motor in action, each time a predetermined perforation in the traveling music-sheet registers with the brush-end of a wire a^{12}, the circuit is closed over the wires a, a^1, interposed roller 63, wire a^{11} and respective wire a^{12} to energize the electromagnet 66 controlling a finger to be depressed against a string 15; and the proper electromagnet 44, being in series with the electromagnets 66, is simultaneously energized to depress the sounding-device against that string.

Four lines of perforations are indicated at 67 near the right-hand edge of the music sheet in Fig. 1, registering with the brushing ends of the wires a^6, a^7, a^8 and a^{10} in the travel of the music-sheet. The resistances a^3, a^5 are just enough to cause the motor to run at normal speed. The resistance a^3 is a rheostat of variable resistance in series with the armature; a^9 is a rheostat of variable resistance in a shunt around the armature, and the sections of these resistances may be short circuited by means of perforations in the music-sheet; if parts of a^3 be short-circuited more current will flow through the armature; if parts of a^9 be short-circuited, more current will flow through the shunt and less through the armature. All of the current over wire a^2 and rheostat a^3 flows through the resistance a^5; and when part of the current is shunted over wire a^8 and resistance a^9, it prevents so much of the current over a^2, a^3 from passing through the armature and thus slows down the motor.

The showing in Fig. 13 may be regarded as that of the fingering devices and sounder-controlling electromagnet 44 for playing the G-string of the violin; and when the circuit is closed over the wire a, roller 63, wire a^2, through the armature, and thence over wire a^4, rheostat a^5 and wire a' the tone is normally loud, none of the resistance a^3

being cut out, so that the extent of space through which the armature 39 is attracted is normal and its movement under such attraction is just sufficient to depress the sounder 14 with the proper pressure against the string, and with the proper motor-speed, for playing with the normal quantity of tone. When the contact is made at wire a^6, the playing is loud, or forte, because part of the resistance a^3 is cut out, thereby speeding up the motor and causing the governor 50 to protrude the pin 59 sufficiently to rock the shaft 48 and thereby swing backwardly the bank of electromagnets 44 to increase the distance through which the respective armature 39 is attracted and thereby turn the lever 27, 34 to depress the sounder the more against the string. In the same way, the playing is still louder, or fortissimo, when the contact is made at the wire a^7, since then more of the resistance a^3 is cut out, thereby further speeding up the motor and causing the governor to protrude the pin 59 to rock the shaft 48 sufficiently to still further increase the space through which the armature is attracted and therefore increasing the pressure of the sounder against the string. Soft, or piano, playing ensues when the contact is made at wire a^8, since the shunt current then flowing through the entire resistance a^9 and added to the current flowing through the armature encounters the resistance a^5 interposed in the wire a^4 leading from the armature, so that less current passes over a^2 and through the armature; and very soft, or pianissimo, playing ensues when the contact is made at wire a^{10}, which cuts out part of the resistance in the rheostat a^9, throwing therefore more current into the rheostat a^5, with the effect of further slowing down the motor. In each instance of piano and pianissimo playing, the effect is produced by thus slowing the motor-speed, with the result of actuating the governor-pin 59 to reduce the extent of rocking the shaft 48 and the space through which the armature 39 is attracted and, therefore, the extent of depression of the sounder, which lightly bears against the string for piano playing and barely touches it for the pianissimo.

As will be understood, in playing any stringed instrument with a bowing device, such as a sounder 14, the speed of movement of the latter must increase with its pressure on the string. The effect of the resistances in the circuit at opposite sides of the armature is to vary motor speed and, therefore, that of the sounders driven by the worm-gear connections 22, 26 with the sounder-shafts, and, through the governor, to vary the pressure of the sounders on the violin-strings, thereby causing the gradations in soft and loud playing, according to the arrangement of perforations 67 in the music-sheet, necessary for producing the varying expression required in performing a musical composition. This arrangement has the further advantage of greatly simplifying the expression-mechanism and that of enabling it to be disposed to one side of the violin, thereby leaving the instrument unencumbered by any superstructure.

I realize that considerable variation is possible in the details of construction thus specifically shown and described, and I do not intend by illustrating a single, specific or preferred embodiment of my invention to be limited thereto; my intention being in the following claims to claim protection for all there may be of novelty in my invention as broadly as the state of the art will permit. And it is to be understood that while the resistances herein shown are electrical, specifically for controlling the expression of an electrically-played violin, they are tantamount to pneumatic or liquid resistances in a pneumatic or liquid circuit for driving a motor with air or water pressure to play the instrument.

What I claim as new and desire to secure by Letters Patent is:

1. In a stringed instrument, the combination with a string, of a rotatable sounding device therefor, an electric motor geared to the sounding device to rotate it and provided with a governor, a circuit containing the motor-armature, a variable resistance in the circuit and a shunt around the armature containing a variable resistance, and means having operative connection with the governor for varying the degree of depression of the sounding device against the string with variation in the motor-speed.

2. In a stringed instrument, the combination with a string, of a sounding device therefor having a rotatable shaft, an electric motor geared to the shaft, and provided with a governor, an electric circuit containing the motor-armature, a variable resistance in the circuit, and a shunt around the motor-armature containing a variable resistance, lever-mechanism connected with the shaft to depress and raise the sounding device relative to the string and carrying an armature, an electromagnet supported to be moved back and forth relative to said armature, and means connecting the governor and the lever-mechanism to vary the degree of depression of the sounding device against the string with variation in the motor-speed.

3. In a stringed instrument, the combination with a string, of a sounding device therefor having a rotatable shaft, an electric motor geared to the shaft and provided with a governor, an electric circuit containing the motor armature, a variable resistance in the circuit and a shunt around the motor armature containing a variable re-

sistance, lever-mechanism connected with the shaft to depress and raise the sounding device relative to the string and carrying an armature, an electromagnet supported to be moved back and forth relative to said armature, and a rock-shaft operated by the governor to move the electromagnet.

4. In a stringed instrument, the combination with the strings, of sounding devices therefor having rotatable shafts, an electric motor geared to the shafts and provided with a governor, an electric circuit containing the motor-armature, a variable resistance in the circuit and a shunt around the motor-armature containing a variable resistance, levers carrying on one end the shafts and on the other end armatures, a swinging frame, electromagnets supported on the frame, a rock-shaft operated by the governor to swing the frame, and abutting-means between said frame and rock-shaft.

5. In a stringed instrument, the combination with the strings, of sounding devices therefor having rotatable shafts, an electric motor geared to the shafts, a governor on the motor-shaft having a reciprocating pin, an electric circuit containing the motor-armature, a variable resistance in the circuit and a shunt around the motor-armature containing a variable resistance, levers carrying on one end the shafts and on their opposite ends armatures, a swinging frame, electromagnets supported on the frame, and a rock-shaft supported to present one end to the pin and abuttingly engaging the frame at its opposite end.

6. In a stringed instrument, the combination with the strings, of sounding devices therefor having rotatable shafts, an electric motor geared to the shafts, a governor on the motor-shaft, an electric circuit containing the motor-armature, a variable resistance in the circuit and a shunt around the motor-armature containing a variable resistance, levers carrying on one end the shafts and on their opposite ends armatures, a frame having arms by which it is pivotally supported, electromagnets supported on the frame to oppose the armatures, and a rock-shaft operated by the governor to swing the frame.

7. In a stringed instrument, the combination with a string, of a sounding device therefor having a rotatable shaft, an electric motor geared to the shaft and provided with a governor, an electric circuit containing the motor-armature, a variable resistance in the circuit and a shunt around the motor-armature containing a variable resistance, a divided lever carrying the shaft on one end and an armature on its opposite end and provided with means for adjusting its sections to set the sounding device relative to the string, a swinging frame, an electromagnet supported on the frame to oppose the armature, and a rock-shaft operated by the governor to swing the frame.

8. In a stringed instrument, the combination with a string, of a sounding device therefor having a rotatable shaft, an electric motor geared to the shaft and provided with a governor, a contact-roller in the field and armature circuits of the motor, a rheostat in the armature-circuit having branches leading from different sections thereof to the contact-roller, a shunt around the armature leading to said roller and having a branch leading to the same, and means operated by the governor for varying the degree of depression of the sounding device against the string with variation in the motor-speed.

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In presence of—
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