

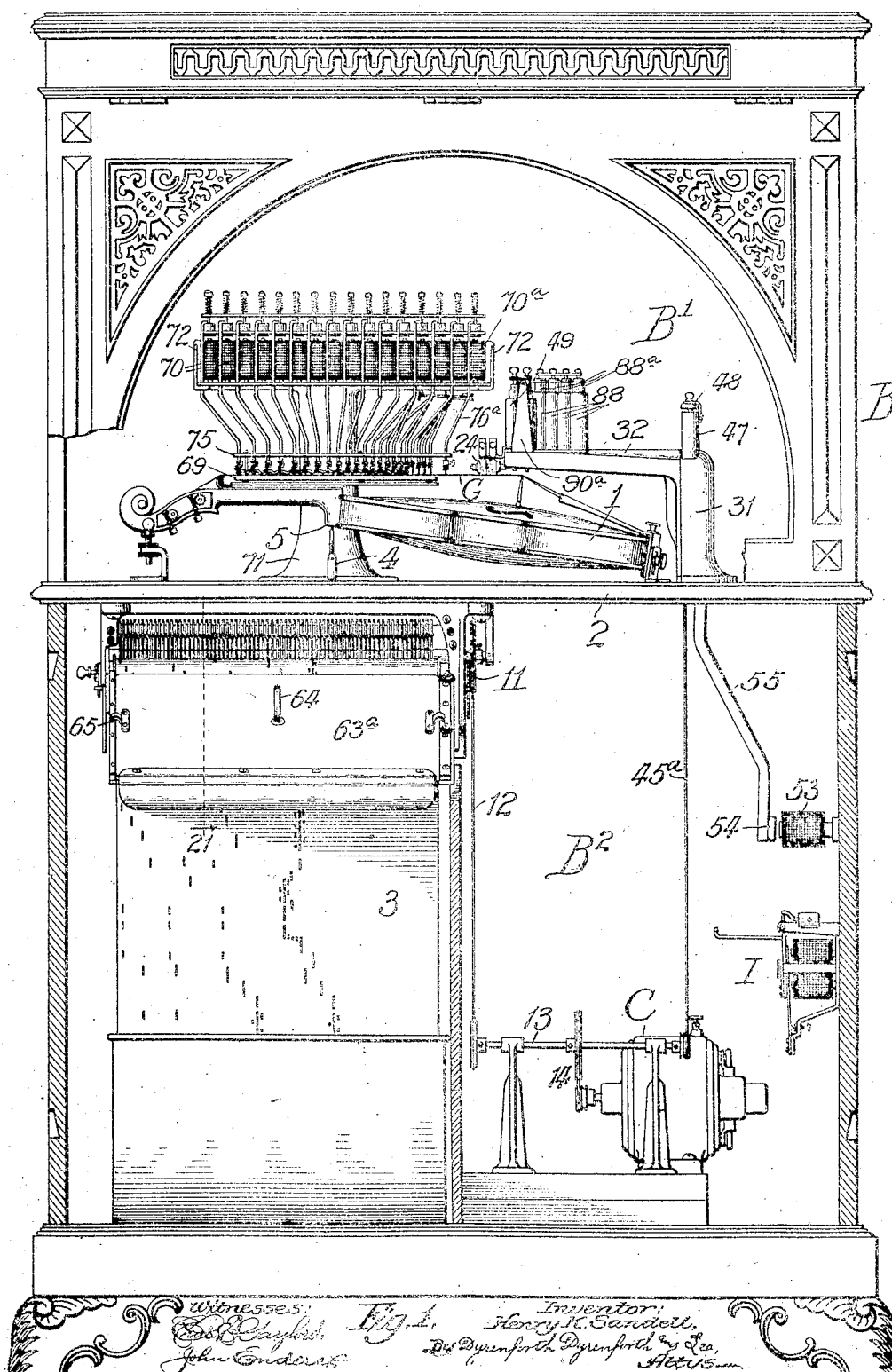
No. 856,604.

PATENTED JUNE 11, 1907.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 1.



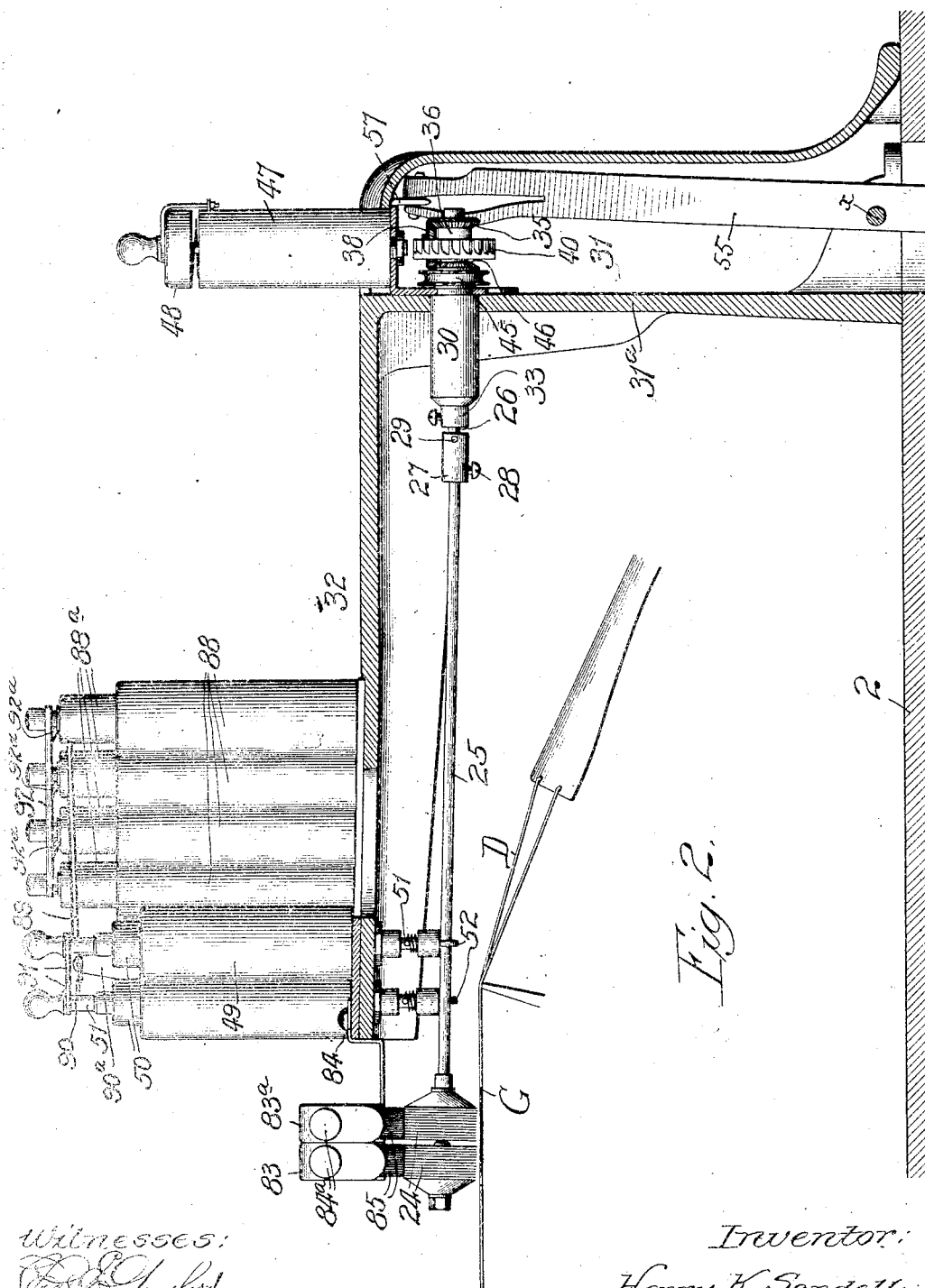
No. 856,604.

PATENTED JUNE 11, 1907.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 2.



Witnesses:

John Taylor

John Enders

Inventor:

Henry K. Sandell

By Dymforth, Dymforth & See, Attys.

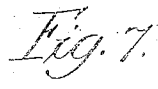
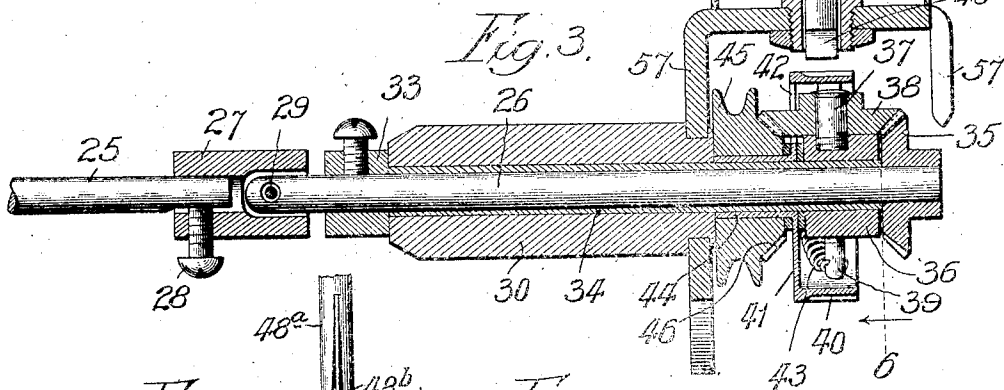
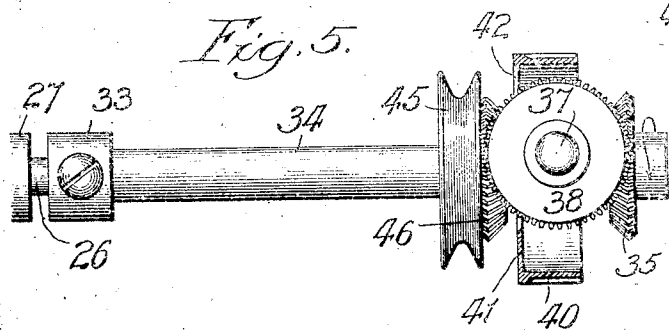
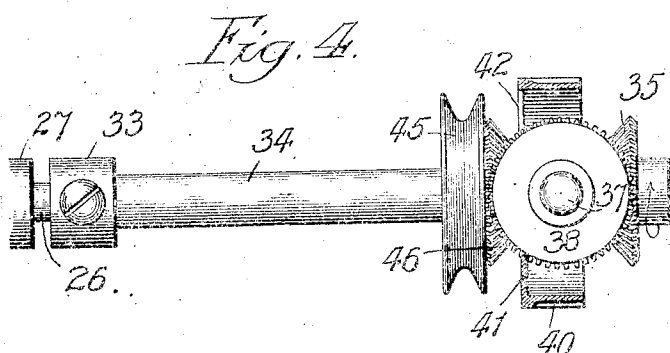
No. 856,604.

PATENTED JUNE 11, 1907.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 3.



Witnesses:

Ed. Clayford.

John Enders.

Inventor:

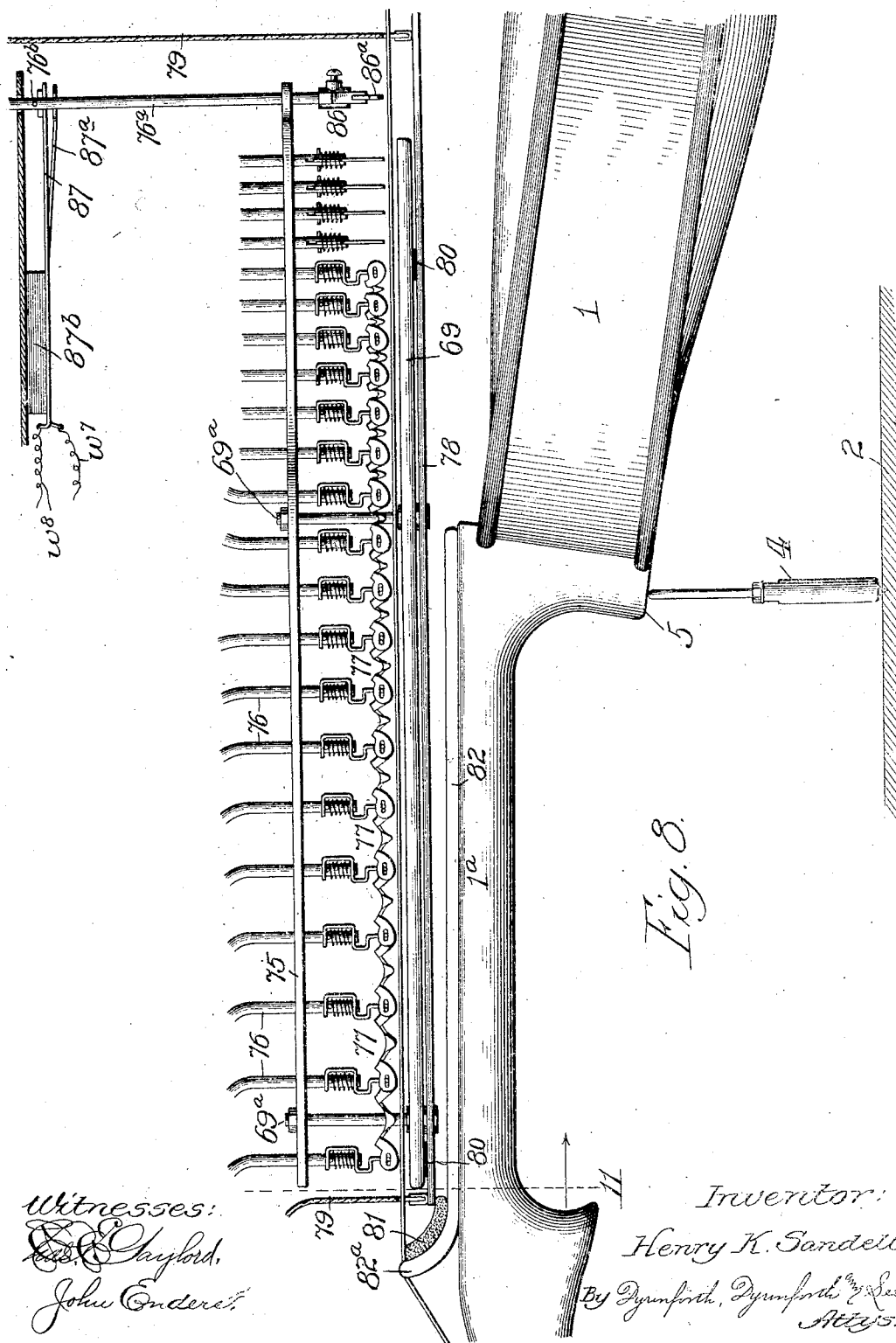
Henry K. Sandell.

By Dymfird, Dymfird & Co., Attys.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 4.



Witnesses:
Ed. Chylford,
John Enderes.

Inventor:
Henry K. Sandell,
By Dymfirth, Dymfirth & Lee,
Attys.

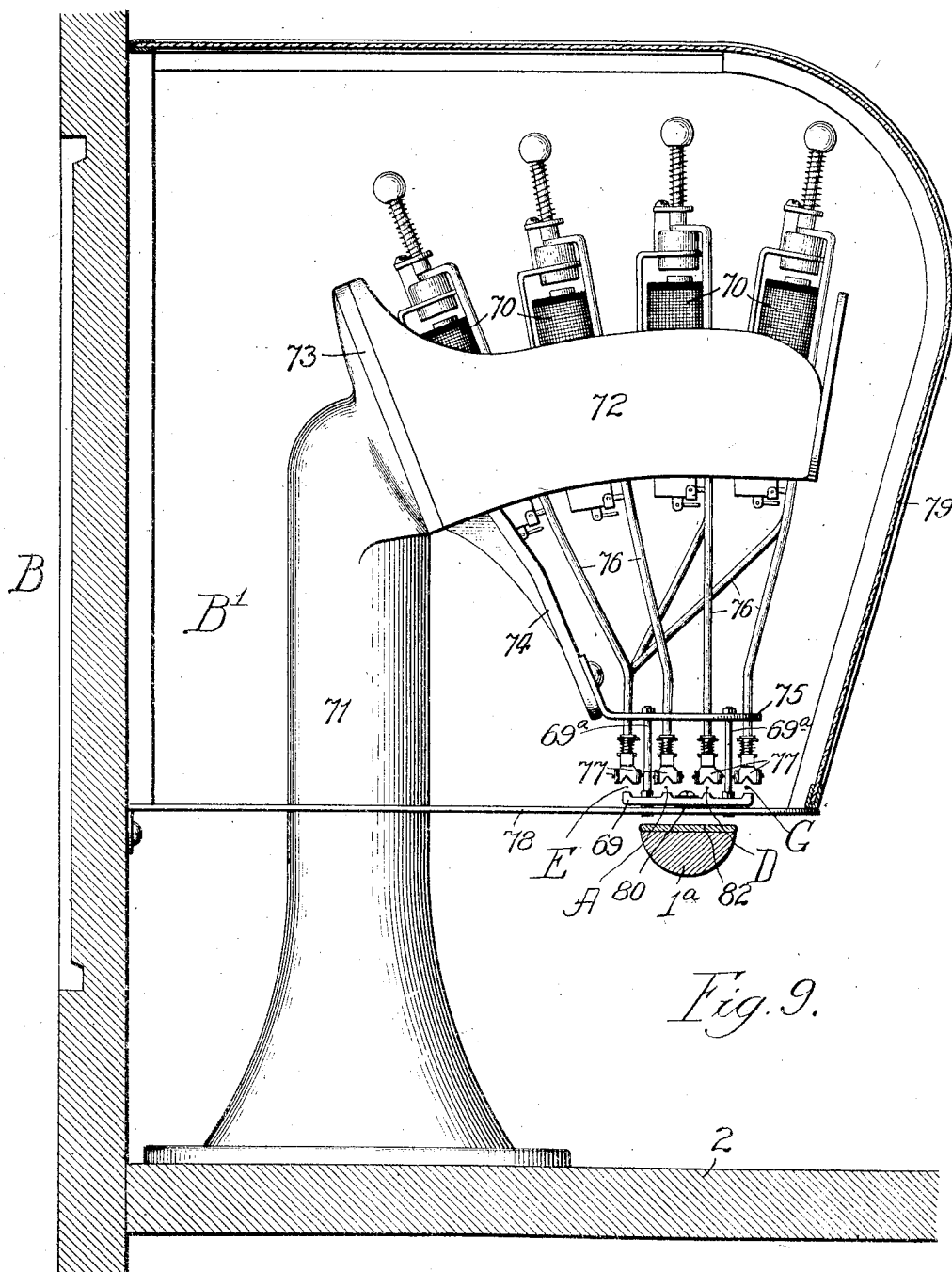
No. 856,604.

PATENTED JUNE 11, 1907.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 5.



Witnesses:
Edw. Taylor
John Enders

Inventor:
Henry K. Sandell
By *Dymforth, Dymforth & Co.*
Attys.

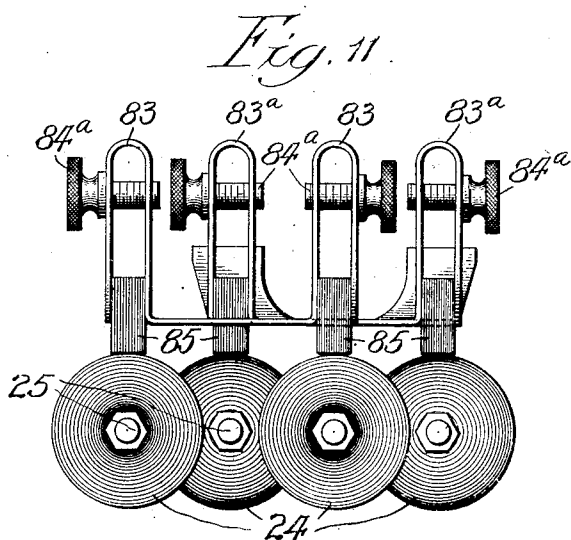
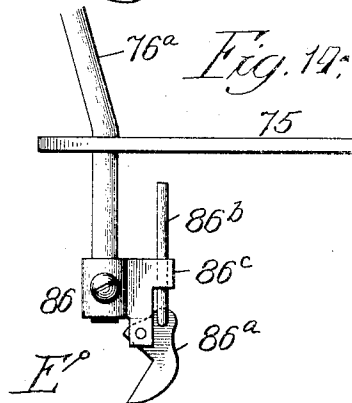
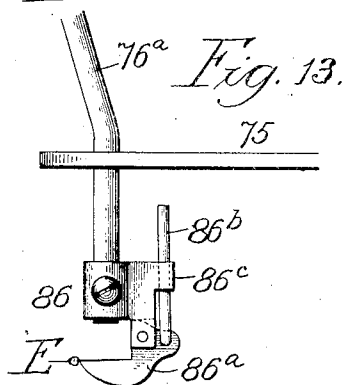
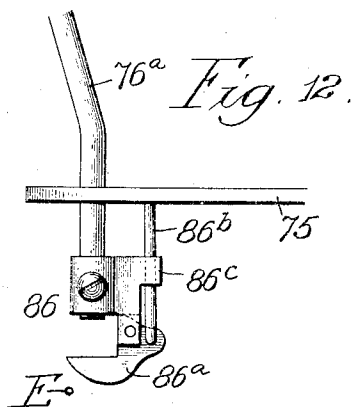
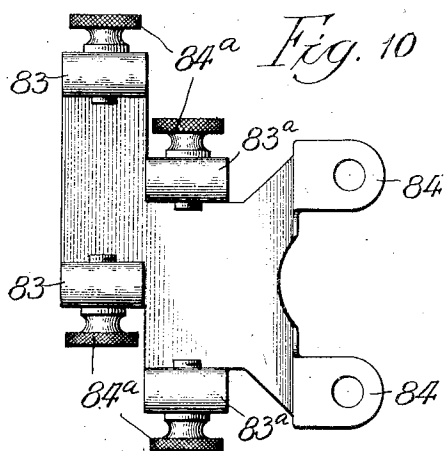
No. 856,604.

PATENTED JUNE 11, 1907.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 6.



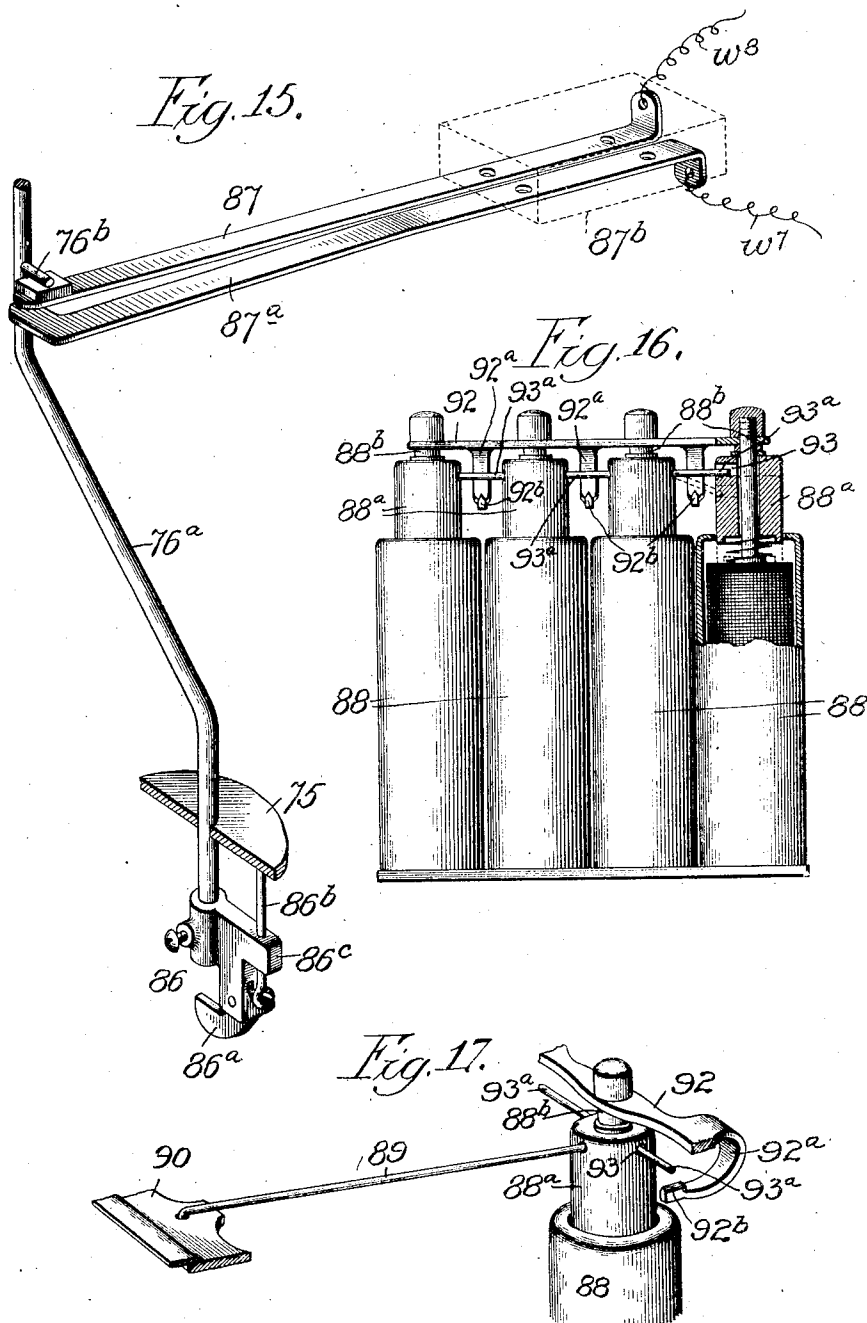
Witnesses:
E. C. Gaylord,
John Enders.

Inventor:
Henry K. Sandell,
By Dymally, Dymally & Lee,
Attys.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 7.



Witnesses:
E. J. Gaylord,
John Enders.

Inventor:
Henry K. Sandell,
By *Dymally, Dymally & Lee,*
Attys.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 8.

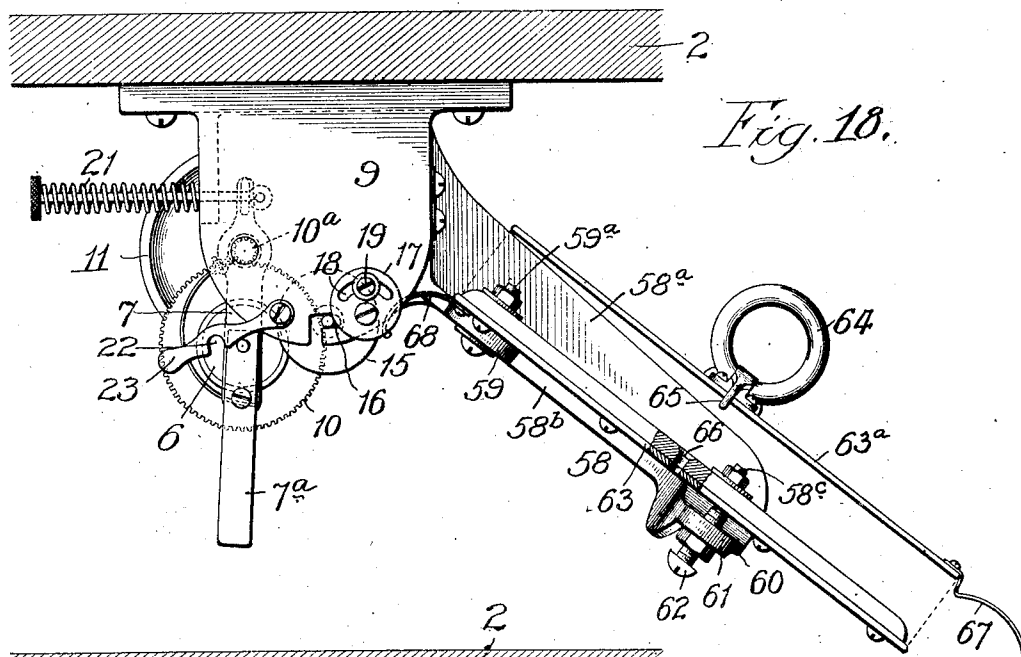


Fig. 18.

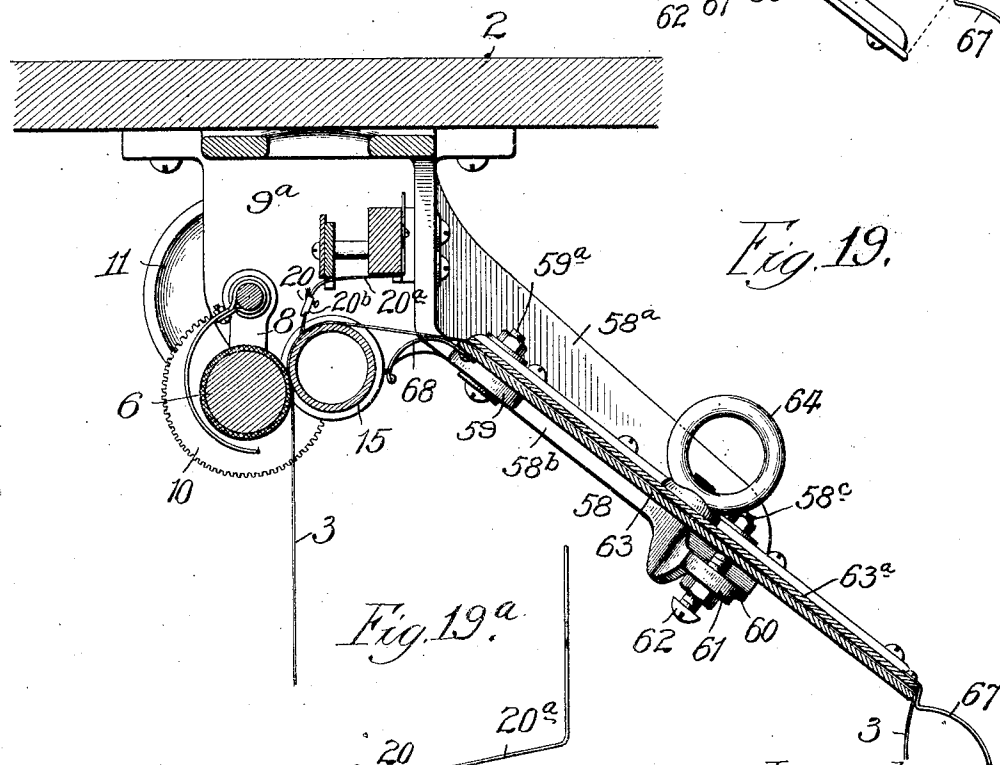


Fig. 19.

Fig. 19a.

Witnesses:
Ed. Chyld.
John Enders.

Inventor:
Henry K. Sandell,
By *Dymfuth, Dymfuth & See,*
Attys.

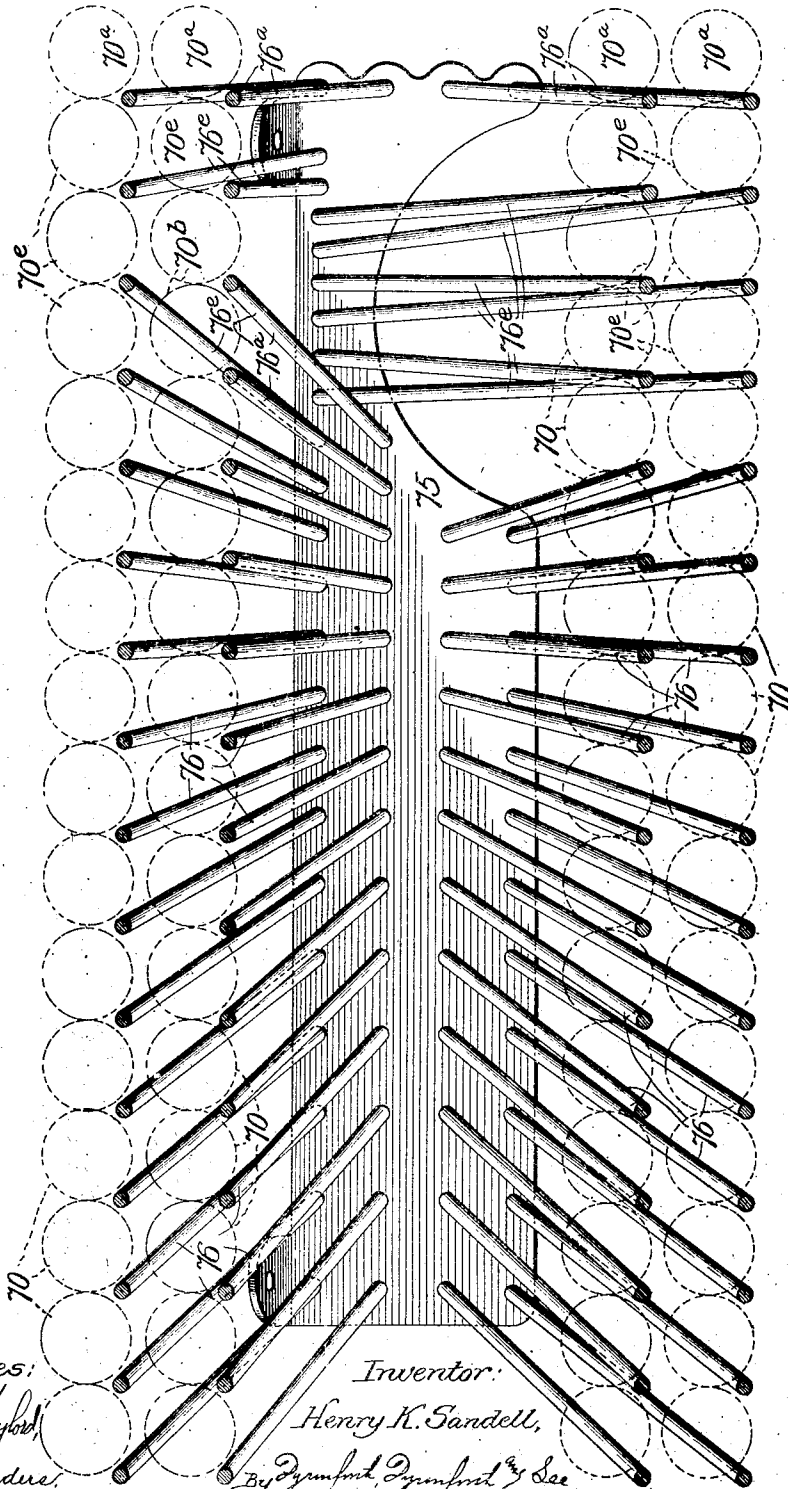
No. 856,604.

PATENTED JUNE 11, 1907.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 9.



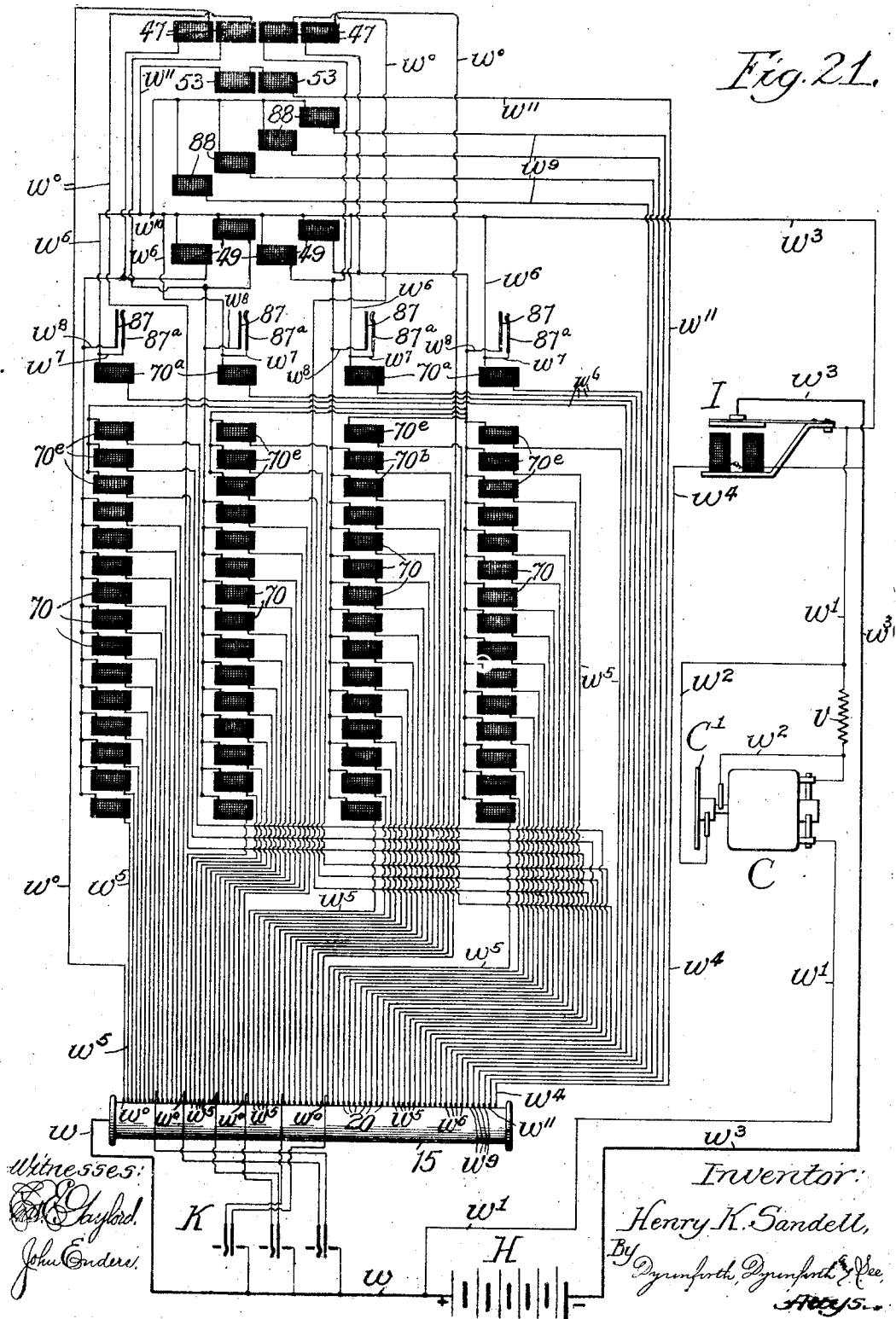
Witnesses:
Ed. Gaylord,
John Enders.

Inventor:
Henry K. Sandell,
By Dymond, Dymond & See,
Attys.

H. K. SANDELL.
ELECTRIC SELF PLAYING VIOLIN.

APPLICATION FILED FEB. 27, 1906.

10 SHEETS—SHEET 10.



UNITED STATES PATENT OFFICE.

HENRY K. SANDELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO MILLS NOVELTY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

ELECTRIC SELF-PLAYING VIOLIN.

No. 856,604.

Specification of Letters Patent.

Patented June 11, 1907.

Application filed February 27, 1906. Serial No. 303,172.

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.

The primary object of this invention is to improve, in matters of detail, the self-playing musical string-instrument which forms the subject of Letters Patent of the United States No. 807,871, dated December 19, 1905, and which includes electrically, pneumatically or otherwise actuated string-sounding and fingering devices operated under the control of a traveling perforated music-sheet, through the perforations in which the circuits, controlling the sounding and fingering devices are closed or actuated to cause these devices to engage, and perform their functions on the strings for reproducing the music for which the sheet is cut.

Generally stated, the mechanism shown and particularly described in the aforesaid patent for playing the violin, which is the string-instrument therein selected for illustration, consists of a motor-driven feed for the traveling perforated music-sheet, involving an electrical contact-roller between which and a row of contacts the music-sheet passes; the roller being included in the circuit of an electric generator; and each contact forms a terminal of a different branch of the circuit including an electro-magnet, which controls one of the fingering devices for a violin-string, and an electro-magnet for raising and depressing the sounder which plays on the string. The sounder comprises a series of nested dish-shaped thin disks, preferably of celluloid, on a rotatory shaft adapted to be depressed by the action of the sounder-controlling electro-magnet to engage the disks, while rotating with the shaft carrying them, with the string for sounding it. Another feature of the patented mechanism is an electro-magnet-controlled device for regulating the extent of depression of the sounder against the string upon which it plays, to moderate the tone produced.

The more important features of improvement in this application relate, directly or indirectly, to certain of the parts of the mechanism mentioned in the foregoing gen-

eral statement. Of these features, one consists of means under the control of the traveling music-sheet for reversing the direction of rotation of the sounder-shaft, thereby more closely to simulate the action of the ordinary violin-bow by imitating the up-stroke and the down stroke therewith, particularly on an open string or in playing successively repeated notes on a string. It is not necessary for this feature of the present improvements that the rotary sounder shall involve the dished-disk construction referred to, for it may be used with advantage on any construction of sounder adapted to be rotated against a string for playing it.

Another feature of improvement consists of means for simultaneously depressing temporarily all the sounders to diminish the distance of separation of each from the string upon which it acts, so that with the rotating sounder-shafts closer to the strings they may be depressed, by their controlling magnets, more heavily against the strings for augmenting, accordingly, the sound.

Another feature of improvement consists in supporting the finger-board of the instrument independently of and out of contact with the latter, thus to materially improve its tone-quality, which is marred by the depression of the fingering devices against the finger-board when the latter, as hitherto, is on the neck of the instrument.

Still another feature of improvement consists in supplementing the fingering devices with one or more string-picking fingers for producing the effect of pizzicato, *madolin* and like playing on the violin.

The features of improvement thus outlined and other features are illustrated in the accompanying drawings.

Figure 1 shows the entire machine by a view in front elevation, partly sectional. Fig. 2 is an enlarged broken view in longitudinal section, showing a sounder-reversing device in elevation; Fig. 3, a broken enlarged view of the reversing device, including its controlling electro-magnet, in sectional elevation; Fig. 4, a broken view showing the reversing device in elevation, partly sectional, but omitting its controlling electro-magnet, and representing the device in its normally locked condition; Fig. 5, a similar view of the same, but showing the device in its unlocked reversing condition; Fig. 6, a section taken

at the line 6 on Fig. 3 and viewed in the direction of the arrow, and Fig. 7, a face-view of the ratchet-element of the reversing device. Fig. 8 is a broken view in elevation, showing the finger-board, supported above and out of contact with the neck of the violin, and Fig. 9, a section taken at the line 11 on Fig. 8 and viewed in the direction of the arrow. Fig. 10 is an enlarged plan view of the rosin-holders for the sounders, showing the preferred construction thereof, and Fig. 11 shows the same in front elevation, with pieces of rosin in place to contact with the peripheries of the sounders. Fig. 12 is a broken view showing a picker-device in elevation in its normal condition relative to a string; Fig. 13, a similar view of the same in its condition of partial depression, wherein it is engaging the string; Fig. 14, a similar view of the same in its condition of complete depression after sounding the string, and Fig. 15, a perspective view of the same showing a supplemental electric-contact device with which it is equipped. Fig. 16 is a view in elevation, partly broken, of the modified construction of the device, hereinbefore referred to, for lightening the contact with the violin-strings of the sounders, and Fig. 17, a broken perspective view of a portion of the same. Fig. 18 shows the novel construction of the guide for the perforated music-sheet, by an edge view, partly broken, and the sheet-feed with its adjusting mechanism, in end elevation, and Fig. 19 is a section of the same taken at the line 21 on Fig. 1, viewed in the direction of the arrow and enlarged. Fig. 19^a is a view in elevation, partly sectional, of a contact-device. Fig. 20 is a plan diagram of the guide-plate for the rods which terminate in the fingering devices and showing dotted the electro-magnets which actuate the rods; and Fig. 21 is a diagram illustrating the electric circuit and its branches containing the operating mechanisms of the machine.

At 1 is represented a violin contained in a suitable casing B and supported therein at its ends on a partition 2 dividing the casing into an upper compartment B¹, inclosing the instrument and the fingering and sounding devices for playing it, and a lower compartment B², housing the perforated music-sheet 3 and its feeding mechanism and a motor C for driving the feed and the rotatory sounder shafts, all as disclosed in the aforesaid former patent. It is found to be desirable to support the instrument also between its ends, and for that purpose a prop, shown as a species of jack-screw 4, is provided to extend from the partition 2 against the shoulder 5 of the instrument, from which its neck extends.

The playing mechanisms of the machine, meaning the rotatory sounders with the

electro-magnets for raising and depressing them relative to the strings, and the electro-magnet-actuated fingering devices, except for the added picker-fingers, are, as shown in the drawings, generally the same as those of the said patent and need not, therefore, be described herein in detail; and the same applies also to the feeding mechanism for and the circuit-closing action of the perforated music-sheet, except as to novel means for adjusting the rollers of the sheet-feeding device.

The details of the sheet-feeding mechanism are illustrated in Figs. 18 and 19: The spring-pressed friction-roller 6, journaled in pivotal hangers 7 and 8 on the similar brackets 9 and 9^a depending from the partition 2, carries a gear-wheel 10 with which meshes a pinion 10^a on the shaft of a drive-pulley 11 having a belt-connection 12 with a horizontal shaft 13 journaled in suitable bearings in the casing-compartment B², the shaft 13 being geared, as represented at 14, to the shaft of the motor C. The other roller, 15, is the electrical-contact roller, journaled at its ends in the brackets 9 and 9^a, the journal-bearing 16 in the bracket 9 being a horizontally elongated slot, shown as extending from a vertical slot rising from the lower edge of the bracket. Adjacent to the bearing 16 is eccentrically journaled on the bracket 9 a disk 17 containing an arc-shaped slot 18 through which a set-screw 19 works in the bracket. The eccentric head 17 bears at its edge against the adjacent journal of the roller 15, whereby turning the head in one direction presses it against that journal to move the latter and the roller 15 toward the roller 6, and turning the head in the opposite direction permits the said journaled end of the roller 15 to be moved in the bearing 16 in the contrary direction under the spring-pressure against the contact-roller of the roller 6. Preparatory to turning the eccentric adjusting head it is freed by loosening the set-screw 19 to be tightened for securing the head in any adjusted position. Thus, when, from wear on the journals of the feed-rollers, or from other cause, their required parallelism is impaired, setting the roller 15 through the medium of the eccentric head 17 will restore the parallelism for producing the necessary straight feeding of the sheet 3, which passes between the rollers 15 and 6 and under the row of electrical contacts 20, which bear against the contact-roller through the perforations in the sheet for closing the circuit to actuate the fingering devices and depress the rotatory sounders, as described in said patent.

From the journal-end of the friction-roller 6 presented in Fig. 18 there depends a handle 7^a whereby turning the handle in opposition to the spring 21 swings the friction-roller 6 by its hangers 7 and 8 away from the companion-roller 15 to separate it therefrom

when desired, as for freeing the sheet 3; and when thus swung, the roller 6 may be releasably locked in that position by engaging its protruding journal-end with a recess 22 in an arm 23 pivoted at one end on the bracket 9, and affording a releasable catch for said journal-end.

A desirable construction of the contacts 20 is that illustrated in Fig. 19^a, each consisting of a suitably supported spring finger 20^a carrying on its free end a metal sleeve 20^b, in which the contact-proper, 20^c, in the form of a bunch of fine wires, is adjustably confined by a set-screw 20^d working in the sleeve. This brush-form of the contact-proper renders it highly flexible and insures its engagement, through a registering perforation in the traveling music-sheet, with the surface of the contact-roller, even though a portion of the brush may extend over the edge or edges of the perforation; whereas, with a mere spring finger forming the contact, if by any slight disarrangement its free end should extend over either or both edges of a perforation in the sheet, it would fail to meet the surface of the contact-roller. And the adjustability of the brush adapts it to be set, as its contacting end wears away, toward the roller to compensate for the wear, thus greatly prolonging the usefulness of the contact.

One of the more important features of the present improvement is a device for instantaneously reversing the direction of rotation of the sounders, which, according to the aforesaid patent, are adapted to rotate only in one direction. One of these devices is provided for each sounder, and as they are all alike, description of one, with particular reference to Figs. 1, 2, and 4 to 7, inclusive, will suffice: The rotary shaft of each sounder 24 is composed of a forward section 25 and a rear section 26, these sections entering at their adjacent ends into the opposite ends of a sleeve 27, wherein the flattened end of the forward section is rigidly secured by a set-screw 28, while the end of the sleeve which receives the section 26 is enlarged internally and that section is fastened in the sleeve by a pivot-pin 29, whereby the sleeve and the forward section 25 have a limited vertically swinging movement on the section 26, throughout the axial rotation of the latter. This section has its bearing in a rigid sleeve 30 extending horizontally through the front wall 31^a of the housing 31 which rises from the partition 2 at the rear end of the violin and has the arm 32 extending horizontally from its upper end lengthwise and centrally over the violin-strings. The housing 31, which is formed of thin metal, is slightly resilient, for a purpose hereinafter explained. In the sleeve 30, against the forward end of which a collar 33 is fastened by a set-screw, is stationarily confined about the shaft-section 26, a cylindrical tube 34, which pro-

trudes into the housing 31 but beyond which, in the housing, the rear shaft-section protrudes and carries rigidly secured on its end a beveled pinion 35. Adjacent to this pinion the tube 34 is loosely surrounded by a hub 36 from which radiates a stud 37 having journaled upon it a beveled pinion 38 like and meshing with the pinion 35; and the hub carries diametrically opposite the stud 37, a pin 39 serving the purpose hereinafter explained. 40 is an annular ratchet open on its side adjacent to the pinion 35, but having a face 41 covering its opposite side and containing a slot 42. The ratchet, which is connected at its face 41 with the pin 39 by a light spiral spring 43, has a sleeve 44 extending from a central opening in said face and loosely surrounding the tube 34, while this sleeve is loosely surrounded by a grooved pulley 45 having a beveled pinion 46 formed on one face like and meshing with the pinion 38, which projects through the slot 42 for the meshing purpose. The pulleys 45 of all the sounder-shafts are connected by an endless belt 45^a (Fig. 1), as in the aforesaid patent, with the motor-driven shaft 13, whereby the motor C, in operation, rotates all of the four sounder-shafts. The spring 43 yieldingly holds the pinion 38 in engagement with an end of the slot 42, to lock that pinion and the ratchet together, as represented in Figs. 4 and 6, so that rotation of a pulley 45 causes the pinion 46 to rotate the pinion 38, and with it the ratchet 40, about the tube 34, while this rotation of the pinion 38 causes it to revolve the pinion 35 and thus revolve the entire sounder-shaft. By arresting rotation of the ratchet 40, however, the strain of the rotating pinion 46 against the pinion 38 forces the latter against the resistance of the locking spring 43, to disengage the last-named pinion from the end of the slot 42, thereby unlocking it to enable it to rotate freely about the stud or axis 37. Thus freed, and with the ratchet thus held stationary, the pinion 38 is rotated about its axis 37 and rotates the pinion 35, and with it the shaft-sections 26 and 25 in the direction contrary to that of the rotation of the pulley 45; thereby reversing the rotation of the sounder. For arresting the ratchet an electro-magnet 47 is provided on the top of the housing 31, the magnet having a spring-cushioned armature 48 carrying a plunger-rod 48^a extending vertically through the magnet-core and terminating in a blade 48^b which registers with the ratchet, whereby when the magnet is energized through closure of the circuit by a certain contact 20 engaging the roller 15 at a perforation in the traveling music-sheet brought into registration with such contact, the resultant attraction of the armature will drive the plunger-rod against the ratchet and stop its rotation until the magnet is deenergized. This occurs by the perforation clear-

ing the contact to open the circuit and results in the rise of the armature, under the recoil-force of its cushioning spring, and the withdrawal of the plunger-rod from engagement with the ratchet, whereupon the spring 43 again forces the pinion 38 against the ratchet, at the end of its contained slot 42, thereby locking the ratchet to cause the pinion 35 and sounder-shaft to rotate correspondingly with the pulley 45, as already described. This reversing device is extremely sensitive and instantaneously responsive, so that the axially reversing action it induces of the sounder against a string of the instrument may, in accordance with the length of the perforation through which the circuit-closure is effected as described, be rapid or slow in imitation of the reciprocating movements with the ordinary violin-bow.

Provision is made, by the construction illustrated in Figs. 1, 2, for deflecting simultaneously the four rotatory sounders 24 toward the violin-strings, so that when any one is depressed by its actuating electro-magnet against a string for playing it, the pressure of the sounder against the string will be augmented and the resultant sound accordingly rendered louder. As in the construction set forth in said patent, the sounder-shafts are supported toward their forward ends by upright electro-magnets 49, on the forward end of the arm 32, the armature 50 of each magnet being carried on a vertically reciprocable rod 51 passing through the magnet-core and terminating at its lower end in an eye 52, through which the sounder-shaft passes to be supported toward its forward end. Obviously, then, by deflecting downward, from its normally horizontal position, the arm 32 and with it the magnets 49, the sounders will be correspondingly depressed to a lower plane, from which to be actuated by the rods 51 against the strings of the instrument. To accomplish this purpose, a double-spool electro-magnet 53 is supported on one side of the casing-compartment B', its armature 54 being carried on the lower end of a lever 55 passing through an opening 56 in the partition 2, into the housing 31, wherein it is fulcrumed at *x*; and the upper forked end of the lever embraces and is riveted to a bracket 57, which is securely fastened to and extends backward from the front wall of the housing 31, and to which the sleeves 30 of the reversing devices are fastened. By turning the lever on its fulcrum, the force of turning it will spring the resilient housing 31 to deflect the arm 32 and thus depress the sounders to a lower plane from which to be pressed against the violin-strings by the rods 51 of the electro-magnets 49, as explained in the aforesaid patent. This springing of the housing 31 is produced by attracting the armature 54 under energizing of the magnet 53, which occurs whenever the proper con-

tact 20 engages the surface of the contact-roller through a perforation in the traveling music-sheet brought into registration with such contact.

To enhance the smoothness of travel of the music-sheet 3 under the action of the feed-mechanism, it moves toward the latter between the regular flat surfaces of substantially like, areas of a pair of plates forming a guide-table 58 of the construction most clearly illustrated in Figs. 18 and 19: From the bracket 9^a a sheet-guiding arm 58^a inclines downwardly and is formed with an inwardly projecting plate-seating base-flange 58^b, provided near one end with a perforated lug 59 and at its opposite end with a lateral-extension 60 describing a right-angle with the arm 58^a, at the junction with which it forms an offset to cause the extension to occupy a somewhat lower plane than the arm. The extension terminates at its free end in an apertured head 61, through which works a set-screw 62. A base-plate 63 is bolted near one edge-portion, to bear against the inner side of the arm 58^a through the lug 59 at 59^a, and lower down through the flange 58^b at 58^c, and bears near its center upon the set-screw 62, the base-plate extending both downwardly and laterally beyond the extension 60 and being free along its left-hand edge. The set-screw 62 is provided for straining the base-plate back into true or level position relative to the feed-rollers in the event of sagging toward its free lateral edge. With the base-plate co-operates a top-plate 63^a, shown in position, superimposed upon the inclined base-plate in Fig. 19 and represented in Fig. 18 as undergoing placing into position. The top-plate is provided on the center of its upper side with a handle 64, shown as a ring, by means of which to manipulate it for its removal and replacement; and on each edge, in alignment with the handle, it carries a depending stud, like the one represented at 65 in Fig. 18, to enter a hole 66 provided to receive it in the edge-portion of the base-plate and thereby guide the placing of and hold the top-plate properly upon the base-plate. An apron 67, extending from the lower end of the top-plate, guides the music-sheet between the two plates, and an apron 68 on the upper edge of the base-plate guides the sheet from between the plates across the contact roller 15. The weight of the top-plate thus loosely imposed upon the sheet and the even surfaces of the two plates between which the sheet passes, causes it to travel smoothly and regularly.

Another especially important feature of improvement is the longitudinally ridged finger-board 69 supported in raised position out of contact with the neck of the instrument, as represented in Figs. 1, 8 and 9, differing in this particular from the con-

struction of the aforesaid patent, wherein the finger-board is directly upon the neck, so that the action of the fingering devices against the board, by compressing the instrument upon its supports, tends to mar the tone-quality in playing. The frame which supports the four rows of electro-magnets 70, and involving the hollow post 71, the curved and flanged end-pieces 72 on a back 73 and connected at intervals by bars, with the depending arms 74 carrying the horizontal perforated plate 75 through which the armature-actuated rods 76 reciprocate, said rods carrying on their lower ends the fingering-mechanism 77, are all as in the patent. The finger-board 69, however, is rigidly suspended by bolts 69^a, at suitable intervals, from the plate 75 and supported in raised position over the neck 1^a of the instrument. The bolts 69^a pass at their lower ends through the base of a frame 78 supported in the compartment B¹ and carrying a transparent housing 79, which envelops and shields the mechanism of the fingering-devices. Sound-deadening strips 80, of felt, or the like, are interposed at intervals between the frame-base and finger-board 69 above it, and the frame 78 bears at its forward end upon a cushion 81, of felt or the like, seated in the upwardly curved forward end 82^a of a metal plate 82 extending lengthwise upon the neck 1^a, and over the edge of which end are stretched the strings of the instrument leading to its tuning-keys.

Rosin-holding means are provided, as another improvement illustrated in Figs. 1, 10 and 11 and comprising the following-described preferred construction: As in the said patent, two of the sets of nested sounder-disks are in advance of the other two sets thereof. A sheet of spring-metal is reduced to the shape represented in Fig. 10, whereby two vertical resilient end-loops 83, 83, are formed in alinement with each other, with their lower ends open to afford jaws, and also two similar end-loops 83^a, 83^a, behind and in staggered relation to the loops 83; and the rear end of the metal sheet has perforated clips, 84, 84, projecting from it through which to fasten it upon the forward end of the arm 32 in position to cause the loops 83 to register, respectively, with the forward sets of sounder-disks and the loops 83^a to register, respectively, with the rear sets of said disks. A clamping-screw 84^a passes transversely through the upper portion of each holder-loop for bringing its jaws together to clamp between them a cake of rosin 85, which is supported in the loop to register and contact with the respective set of sounder-disks at the perimeter thereof. Thus, as the sounders rotate, the disks are constantly supplied with rosin, the cakes of which may be lowered in the holders, upon loosening the screws 84^a to be again tight-

ened after the adjustment to compensate for consumption of the rosin.

A still further improvement consists in providing picker-finger devices, shown in Figs. 1, 8, 12, 13, 14, 15 and 20, one for each string of the instrument, to supplement the other fingering devices of the aforesaid patent: Each of the four picker-finger devices, comprises the following-described preferred construction: A magnet 70^a, like the magnets 70, is located in line with the respective series of the latter at the end thereof nearest the rear end of the instrument, the armature of this magnet being carried by a rod 76^a, like the rods 76 and passing through its proper opening in the plate 75. Below this plate the rod carries, adjustably, the picker-device consisting of a head 86 on which is pivoted a finger 86^a having loosely connected with its heel-portion a stop-rod 86^b extending upward and reciprocally through a guide-extension 86^c of the head to abut at its free end against the bottom of the plate 75. Figs. 12 to 14, inclusive, show this device in the different positions of its action. Thus, under attraction of the armature of the magnet 70^a, the rod 76^a is lowered to depress the finger 86^a from its normal position (Fig. 12), wherein the rod 86^b abuts against the plate 75, to the position represented in Fig. 13, wherein the finger 86^a has encountered and is just clearing a string, as the string E, to sound it, and whence the continued descent of the rod carries the finger downward and gravity turns it to the position in which it is represented in Fig. 14, the finger being so pivoted as to tend to assume that position by gravity. In this last-name^d position the picker-finger hangs from its pivot, as shown, but is again brought to the normal position by the turning action upon it of the rod 86^b in encountering the plate 75 as it does in being raised by the recoil-force of the armature-spring when the magnet is de-energized. The rod 76^a carries, near its upper end, a laterally projecting stud 76^b to extend across one of two contact-making springs 87 and 87^a suitably supported on a block 87^b and included in the electric operating circuit of the apparatus, as and for the purpose hereinafter described. In the descent of the rod, the stud closes the circuit by bringing together the contact-springs, which separate, by the resilience of the upper spring, when freed from the stud 76^b by the rise of the rod.

The remaining one of the improvements referred to, and which relates, and is in the nature of an addition, to the device of the aforesaid patent, therein mentioned as an adjunct of the sounding-devices for regulating their pressure against the strings thereby to regulate the degrees of and graduations in loudness of playing, is most clearly illustrated in Figs. 2, 16 and 17 of the accompanying drawings: The series of four similar elec-

tro-magnets 88, like the corresponding magnets of the patent and located behind the sounder-actuating magnets 49 in a line inclined at an angle of about 45° thereto, have, each, a spring-raised armature 88^a connected by a rod 89 with a bar 90 supported to rock in end-bearings 90^a to raise and lower the forward edge of the bar to cause it to be engaged, as a stop, at four different elevations, by stop-fingers 91 on the piston-rods 51 of the sounder-magnets, the variation in elevation of the rock-bar being due to the increasing distance from the sounder-magnets of the respective magnets 88 in the slanting row thereof, whereby each rod 89 describes a shorter arc of movement than the longer one adjacent to it. The purpose of the improvement is to double the number of graduations of elevation of the forward stop-edge of the rock-bar, and thereby increase the crescendo and decrescendo effects in playing. In the patented construction, each armature 88^a is independent, as to its action, of the others, therefore that construction provides only for the playing of the sounders with the same degree of pressure against their respective strings in each of the four raised positions of the stop-edge of the rocker-bar. Now, however, by the improved construction, in the frequently recurring event of two adjacent magnets 88 being successively energized, the armature of the magnet which is the second to be energized can only descend one-half the possible distance of its movement until the first magnet is de-energized and its armature rises, so that the raised edge of the rocker-bar remains in its first position notwithstanding energizing of the second magnet, until the first magnet is de-energized, when the full movement of the armature of the second magnet occurs with the result of accordingly raising or lowering, as the case may be, the forward edge of the rocker-bar. As will, therefore, be understood, with the rocker-bar temporarily in one position with two successive magnets 88 energized and each armature of one or more magnets 49, in action, stopped by the rocker-bar at that position to depress the sounder it controls against the respective string, a more gradual crescendo or decrescendo effect will be produced, since the second of the two magnets 88 to be energized can not change the position of the rocker-bar and, therefore, the pressure of the sounders against the strings until the first one of the same has been de-energized. To this end the fixed guide-post 88^b for the four armatures 88^a are connected by a stationary bar 92 having three bowed arms 92^a projecting downwardly from it between the pairs of armatures and each terminating at its free end in a knife-edge bearing 92^b. In the inner side of each of the two outer armatures 88^a and in the opposing sides of the intermediate armatures are formed horizontal recesses, like the

recess 93 in Fig. 16; and straight rods, 93^a, of lesser diameter than the recesses, are confined at their ends in these recesses to extend across the bearings 92^b.

To explain the operation by reference to Fig. 16, when the armature 88^a at the right-hand end of the series of electro-magnets 88 is attracted by its magnet, which armature is the one having the shortest rod 89, the rod 93^a connecting that armature with the one next to it will occupy the dotted position illustrated. When the next electro-magnet in order is energized to attract its armature, before de-energizing of the first magnet occurs, the second armature can only descend far enough to bring the respective rod 93^a to a horizontal position across and in contact with the bearing 92^b, which stops it and thus prevents further descent of the second armature until the first electro-magnet is de-energized. When the first magnet is de-energized and its armature is released and rises to its normal position, thus freeing the rocker-bar 90, the armature 88^a of the second magnet is released from its arrest by the respective stop 92 and will be attracted to its full extent, thereby bringing the first rod 93^a to a position of inclination the opposite of that represented. With the armature of the second magnet 88 thus fully depressed, the forward edge of the rocker-bar 90 is turned to occupy a lower plane than before under the attraction of the first armature 88^a, and the sounders will therefore press harder against the strings in playing; but the pressure has thus been regulated to produce a gradual crescendo. Obviously, if the order of energizing the two magnets 88 were contrary to that explained, the pressure of the sounders will be similarly regulated to produce a gradual decrescendo. The same result takes place, with relation to any two of the successive positions of elevation of the forward edge of the rocker-bar, when any two of the magnets 88 are energized in succession and the energizing of both is maintained temporarily. Of course provision for this operation is made in cutting the perforations in the music-sheet.

According to the arrangement disclosed in the aforesaid patent, each row of the fingering-device magnets consists of twelve of such magnets, to correspond with the number of tones in the chromatic scale. It is desirable to increase the number of the fingering-devices, and accordingly of their controlling magnets for fingering the E-string, by ten, and the number thereof for fingering the A-string, by two; and it is found expedient to distribute these twelve additional magnets by adding three for the E-string to the end of its series of magnets nearest the rear end of the violin, by adding two for the A-string and one more for the E-string to the same end of the electro-magnets over the

A-string; by adding three more magnets for the E-string to the same end of the row of magnets over the D-string, and by adding three more of the E-string magnets to the row of magnets over the G-string. This, of course, necessitates bending and extending each rod controlled by an E-string magnet in the magnet-rows other than the row over the E-string, to fingering-devices over the last-named string, which said added devices are separate from each other, or not linked one to the other as are the first twelve in each row according to the construction in said patent, but are otherwise like the latter. This arrangement is represented diagrammatically in Fig. 20, wherein the electromagnets added to the rows thereof over the E, D and G strings are denoted by the character 70^c and the plunger-rods they control by the character 76^c, those added to the row over the A-string, for fingering that string, are denoted by the character 70^b with their plunger-rods denoted by 76^a and that for the E-string added to the A-string row is denoted by the character 70^a with the plunger-rod it controls denoted by the reference-character 76^a.

Following is the explanation of the electric-circuit arrangement illustrated in the diagram presented by Fig. 21: Seventy-four contacts 20 are provided in a row, to bear against the contact-roller 15, one end of which is connected by a wire *w* with the positive pole of a generator, indicated at H. Thus one contact is provided for each of the sixty fingering-device magnets, one for each of the four picker-device magnets 70^a, one for each of the four sounder-regulating magnets, one for the depresser-magnet 53, one each for the four reverser-magnets 47, and one for the magnet of the cut-out device I, which is the same as that of the said patent.

The motor-circuit is traceable as follows: from the positive pole of the generator over the wire *w* and a branch *w*¹ leading therefrom through the motor-brushes, beyond which the branch contains a resistance-coil at *v* to direct a portion of the current over a shunt-line *w*² through the motor-governor C¹; and, as in the aforesaid patent, the branch *w*¹ leads to one side of the cut-out device I, the opposite side of which is connected by a wire *w*³ with the negative pole of the generator. On the completion of a piece, a certain perforation in the music-sheet registers with the spring-contact at the extreme right-hand end of the series of contacts co-operating with the roller 15, permitting that contact to bear, through the said perforation, against the said contact-roller, though this engagement is only momentary, since the perforation is necessarily small and the inertia of the sheet-driving mechanism carries the perforation beyond the contact in its path, to interpose the insulating paper between it and the roller

15. When the aforesaid momentary contact-engagement occurs, the motor is cut out of the circuit.

In the travel of the music-sheet the contacts engage, through its perforations, the roller 15 and close branches of the circuit containing the magnets 70, 70^a, 70^b to actuate the fingering-devices, the magnets 70^a to actuate the picker-fingers, the magnets 49 to depress the sounder-shafts, the magnets 88 to regulate the pressure of the sounders against the strings, the magnet 53 to actuate the lever 55 to spring the housing 31 and effect lowering of the magnets 49 and of the sounders toward the strings, and the magnets 47 to actuate the sounder-reversing mechanism: Each contact 20 forms a terminal of a branch of the circuit. Each of these branches denoted by the reference-character *w*⁰ on Fig. 21, namely, counting from the left-hand end of the series of contacts, the first, the fourteenth, the twenty-seventh and the forty-second, is an open-string branch, leading through one or the other of the reverser-device magnets 47 to a corresponding magnet 49. As all the branches containing the magnets 70 are alike, description of one of them will suffice, taking the one which terminates in the second contact at the left-hand end of the series, which is the particular contact that controls the magnet 70 for actuating the first fingering-device magnet over the G-string to engage the latter at the g-sharp position thereon. When a perforation in the traveling music-sheet registers with the contact last referred to, the circuit closes over the wire *w*, roller 15, said contact and the branch-wire *w*⁵ leading therefrom through a magnet 70, thence through a sounder-magnet 49 to the wire *w*³, which returns to the generator through the cut-out device. All the wires *w*⁵ leading from the twelve contacts to the magnets 70 controlling the G-string fingering-devices lead through the magnet 49 controlling the G-string sounder-shaft and connect with the return-wire *w*³, and each of the three succeeding groups of wires *w*⁵, constituting, respectively, twelve branches *w*⁵ leading through the D-string magnets, fourteen branches *w*⁵ leading through the A-string magnets, including the magnets 70^b, and twenty-two branches leading through the E-string magnets, including the ten additional magnets 70^c, hereinbefore described, leads in order, through the magnet 49 which controls the D-string sounder-shaft, through the magnet 49 which controls the A-string sounder-shaft and the magnet 49 which controls the E-string sounder-shaft and connects with the return-wire *w*³. All the fingering-device magnets for each string are thus each connected by one of the branches *w*⁵ with a different contact and the branches for the fingering-device magnets for each

string have a common part, including a sounding-device magnet 49. Each of the four branch-wires w^a leads from its contact 20 through a different picker-device magnet 70^a and connects with the return-wire w^3 ; but to the section of each branch wire w^6 that connects with the return-wire is connected a wire w^7 leading to the adjacent end of the respective contact-bar 87^a, and the corresponding end of the companion contact-bar 87 is connected by a wire w^8 with the line which leads to the return wire w^3 of the fingering-device magnets which belong to the string upon which the respective picker-device acts. The purpose of this arrangement is to cause the switch 87, 87^a to short-circuit the sounder-device magnet 49 when a picker-device on the string to which that magnet belongs is operated, the fingering devices remaining in condition to be controlled by the music-sheet. From this, it will be seen that when one of the magnets 70^a is energized to depress a picker, the stud 76^b on the rod 76^a will engage the bar 87 and carry the latter downward into contact with the bar 87^a. This makes a short circuit between the branch w^6 and the branch w^3 and consequently completes the circuit between the branches w^6 and w^3 without energizing the sounding device magnet 49 with which the particular picker depressed is in line. The four branches w^9 in the group succeeding, in the direction toward the right, the branches w^6 , lead each through a different magnet 88 to the return-wire w^3 at w^{10} , for regulating the sounder-pressure against the strings in the manner described. The branch-wire w^{11} leads through the depressor-magnet 53 to the return-wire w^3 to energize that magnet for the purpose described whenever the contact 20 on that wire engages, through a perforation in the music-sheet, the roller 15.

Fig. 21 also has indicated upon it at K the tuning adjunct, which is the same as that of the aforesaid patent and need not, therefore, be described herein.

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

1. In combination with a stringed instrument, a sounding device supported adjacent to a string of the instrument and comprising a sounder on a rotatable shaft, means for rotating said sounding device, and a sounder-shaft reversing device connected with said shaft.

2. In combination with a stringed instrument, a sounding device supported adjacent to a string of the instrument, and comprising a rotatable sectional shaft having its sections pivotally connected together end to end and a sounder on the forward shaft-section, means for rotating said sounding device, and a sounder-shaft reversing device connected with the rear section of said shaft.

3. The combination with a stringed instru-

ment, of a sounding device supported adjacent to a string of the instrument and comprising a sounder, a rotatable shaft on which said sounder is mounted, means for rotating said shaft and means whereby the direction of rotation of said shaft can be reversed.

4. The combination with a stringed instrument, of a sounding device supported adjacent to a string of the instrument and comprising a sounder, a rotatable shaft on which the sounder is mounted, means for rotating said shaft and controllable means for reversing the direction of rotation of said shaft.

5. The combination with a stringed instrument, of a sounding device supported adjacent to the string of the instrument, means constantly moving in one direction for rotating the sounding device, and means whereby the direction of rotation of the sounding device can be reversed.

6. In combination with a stringed instrument, a sounding device comprising a rotatory shaft and a sounder for a string on said shaft, and a reversing device comprising a driving pinion loosely mounted on said shaft, a pinion firmly mounted on the shaft and an intermediate pinion loosely supported on the shaft to be rotated about the latter and meshing with said two first-named pinions, a ratchet encircling said intermediate pinion and having a normally locked engagement therewith, and ratchet-arresting means, for the purpose set forth.

7. In combination with a stringed instrument, a sounding device comprising a rotatory shaft and a sounder for a string on said shaft, and a reversing device comprising a drive-pulley and a pinion thereon loosely supported on said shaft, a pinion firmly mounted on the shaft and an intermediate spring-pressed pinion loosely surrounding the shaft to be rotated about the latter and meshing with said two first-named pinions, an annular ratchet loosely surrounding the shaft and having a closed side containing a slot through which said intermediate pinion extends and with which it normally interlocks by its controlling spring-pressure, and ratchet-arresting means, for the purpose set forth.

8. In combination with a stringed instrument, a sounding device comprising a shaft formed of flexibly connected sections with a sounder for a string on the forward section, a sleeve having a tube extending longitudinally through it, and in which the rear shaft-section is rotatably mounted; a beveled pinion rigidly mounted on the rear end of said shaft, a hub loosely mounted on said sleeve adjacent to said pinion, a beveled pinion journaled on said hub and meshing with said rigid pinion, an annular ratchet having a closed slot-containing side and provided with a sleeve-extension loosely surrounding said tube to cause the ratchet to encircle said hub

and the pinion thereon with the latter crossing said slot, a spring connecting said hub and ratchet, a drive-pulley loosely mounted on said sleeve and provided on one face with a beveled pinion meshing with said pinion on the hub, and an electro-magnet mounted over said ratchet and having, to engage therewith, a stop-rod connected with the armature to be reciprocated thereby relative to said ratchet, for the purpose set forth.

9. In a self-playing stringed instrument, the combination with a string, of a sounding device comprising a rotatably mounted shaft and a sounder thereon adapted to sound said string, said sounding device including an electro-magnet; a plurality of fingering-devices each provided with an electro-magnet and adapted to finger said string when its magnet is energized; an electric circuit having branches, each branch including one only of said fingering-device magnets and the common part including the sounding-device magnet, whereby each of said fingering-device magnets is included in series with said sounding-device magnet, and a reversing device connected with said shaft.

10. The combination with a stringed instrument, having a neck, of fingering devices for the strings, a finger-board supported independently of the neck of the instrument and extending between the neck and the fingering devices and out of contact with the neck with the strings of the instrument extending over the finger-board.

11. The combination with a stringed instrument having a neck, fingering devices for the strings, a finger-board rigidly supported out of contact with the neck and extending over the neck and between it and the fingering devices, the strings of the instrument extending over the finger-board.

12. In a self-playing stringed instrument, the combination of the neck a frame provided with a perforated plate, fingering devices for the strings provided with reciprocating rods movable through the perforations in said plate, and the finger-board of the instrument rigidly suspended from said frame to extend over the neck.

13. In a self-playing stringed instrument, the combination of the neck a frame provided with a perforated plate, fingering devices for the strings provided with reciprocable rods movable through the perforations in the plate, the finger-board of the instrument rigidly suspended from said frame to extend over the neck, and a plate on said neck provided with an upturned forward end across which the strings leading to the tuning-keys of the instrument are stretched.

14. In a self-playing stringed instrument, the combination of a casing in which the instrument is mounted, the strings of the instrument, an upright housing provided with an arm extending lengthwise over said

strings, and rotatory sounder-devices supported on said arm for playing said strings and a depressor-device connected with said housing and operative to spring it and depress the said sounder-devices to a lower plane relative to said strings, for the purpose set forth.

15. In an electric self-playing stringed instrument, the combination of a casing in which the instrument is mounted, the strings of the instrument, an upright housing provided with an arm extending lengthwise over said strings, rotatory sounder-devices supported on said arm, a depressor-device comprising a lever fulcrumed between its ends and having one end connected with said housing, an armature on the opposite end of the lever, an electro-magnet supported to attract said armature and an electric circuit in which said magnet is included, for the purpose set forth.

16. In a self-playing instrument, the combination with a string, of a sounding device including an electro-magnet, a fingering-device including an electro-magnet, an electric circuit including said magnets in series and having a branch, a picker device including an electro-magnet in said branch, a circuit opening and closing device and connections whereby said sounding device magnet may be short circuited, comprising normally separated contact bars and means for bringing them into contact when said picker device is operated.

17. In a self-playing stringed instrument, the combination with a string, of a sounding device including an electro-magnet, a fingering-device including an electro-magnet, an electric circuit including said magnets in series and having a branch, a picker device comprising an electro-magnet in said branch, an armature carrying rod provided with a stud and terminating in a head having pivotally supported upon it a finger, a stop rod extending from said finger, normally supported contact springs extending at their free ends into the path of said stud and connections whereby said springs when brought in contact will short circuit said sounding device magnet.

18. In a self-playing stringed instrument, the combination with a string, of a sounding-device including an electro-magnet adapted to sound said string, a plurality of fingering devices each provided with an electro-magnet and adapted to finger said string when its magnet is energized, an electric circuit having branches, each of said fingering device magnets being included in a different one of said branches with their common part including the sounding device magnet whereby each of said fingering device magnets is included in series with said sounding device magnet; a picker device including an electro-magnet in another of said branches, a circuit

opening and closing device and connections whereby said sounding device magnet can be short circuited, comprising normally separated contact bars and means for bringing them into contact when said picker device is operated.

19. In an electric self-playing stringed instrument, the combination with a casing supporting the parts, of a circuit having branches, a motor, an electrical contact-roller in said circuit and means for feeding a perforated music-sheet across said roller: contact fingers co-operating with said roller through perforations in said sheet sounder-devices for the strings, each including an electro-magnet, fingering devices for the strings, each including an electro-magnet, lugs on the armatures of the sounding-device magnets and a rocker-bar in the paths of said fingers, and a regulator comprising electro-magnets supported at successively increasing distances from said sounding-de-

vice magnets, rods connecting the armatures of said regulator-magnets with said rocker-bar, said armatures containing lateral recesses, rods extending between said armatures with their ends confined in the recesses, and a fixed bar extending across the series of said armatures and having depending knife-edges between the armatures in the paths of said last named rods, said fingering-device magnets being each connected by one of said branches with one of said contact fingers and the branches for the fingering-devices of each string having a common part including a sounding-device magnet, and others of said contacts being each connected by a branch with one of said regulator-magnets.

HENRY K. SANDELL.

In the presence of—

J. H. LANDES,
A. M. UHER.