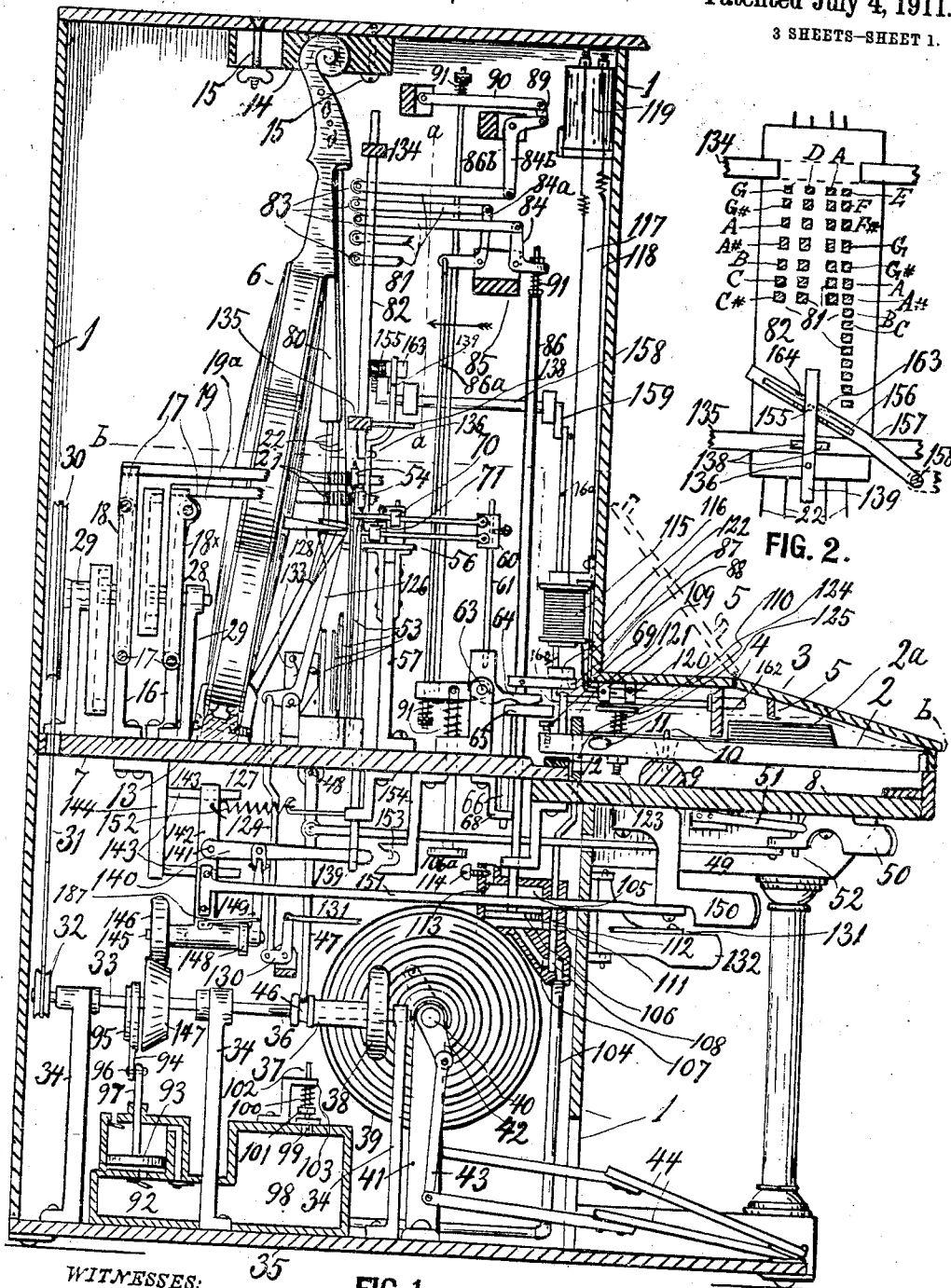


996,614.

Patented July 4, 1911.

3 SHEETS—SHEET 1.



WITNESSES:

FIG. 1.

INVENTOR:

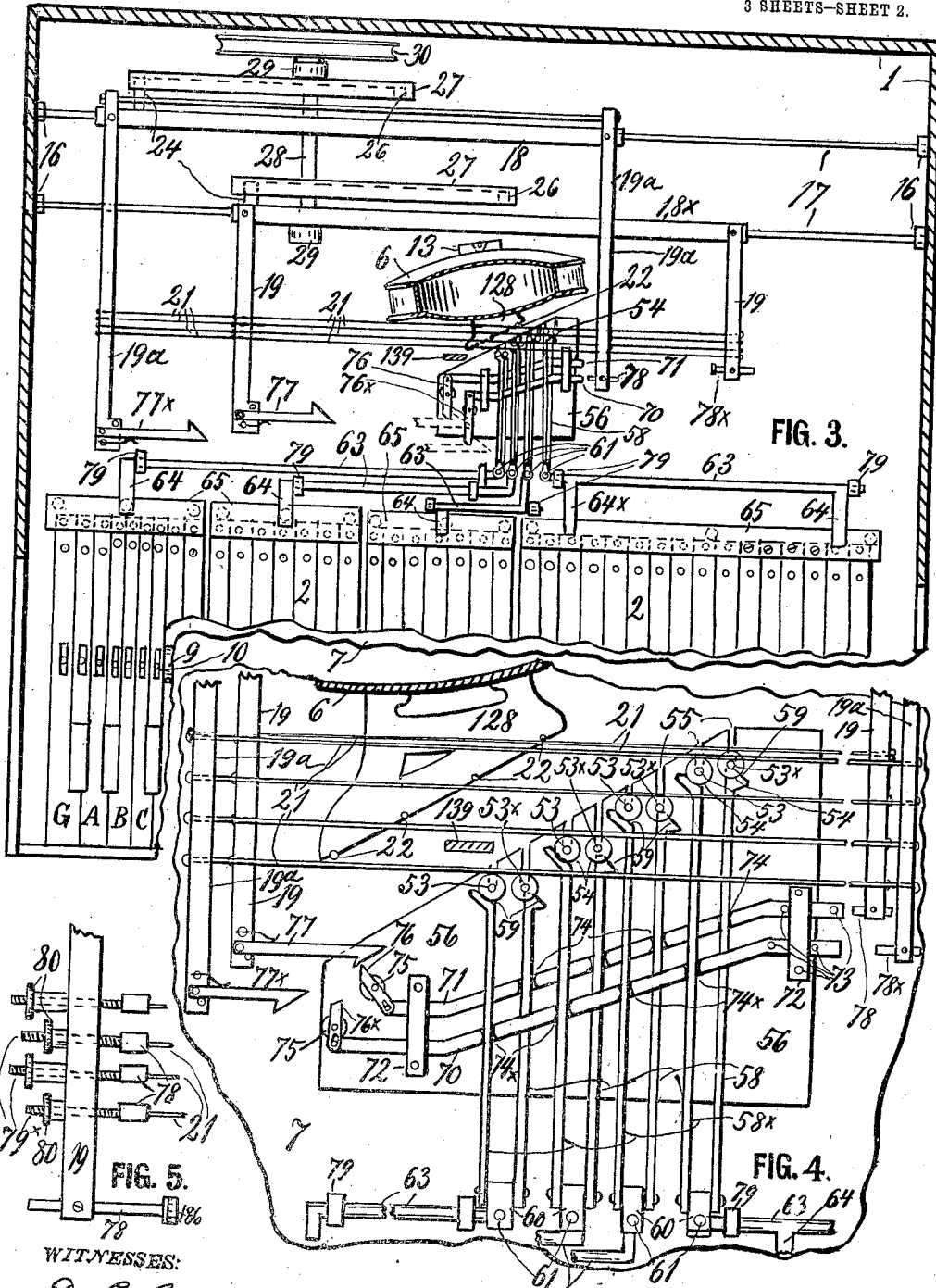
D. E. Carlsen.
L. E. Carlsen.

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996,614.

Patented July 4, 1911.

3 SHEETS—SHEET 2.



WITNESSES:

D. E. Carlson
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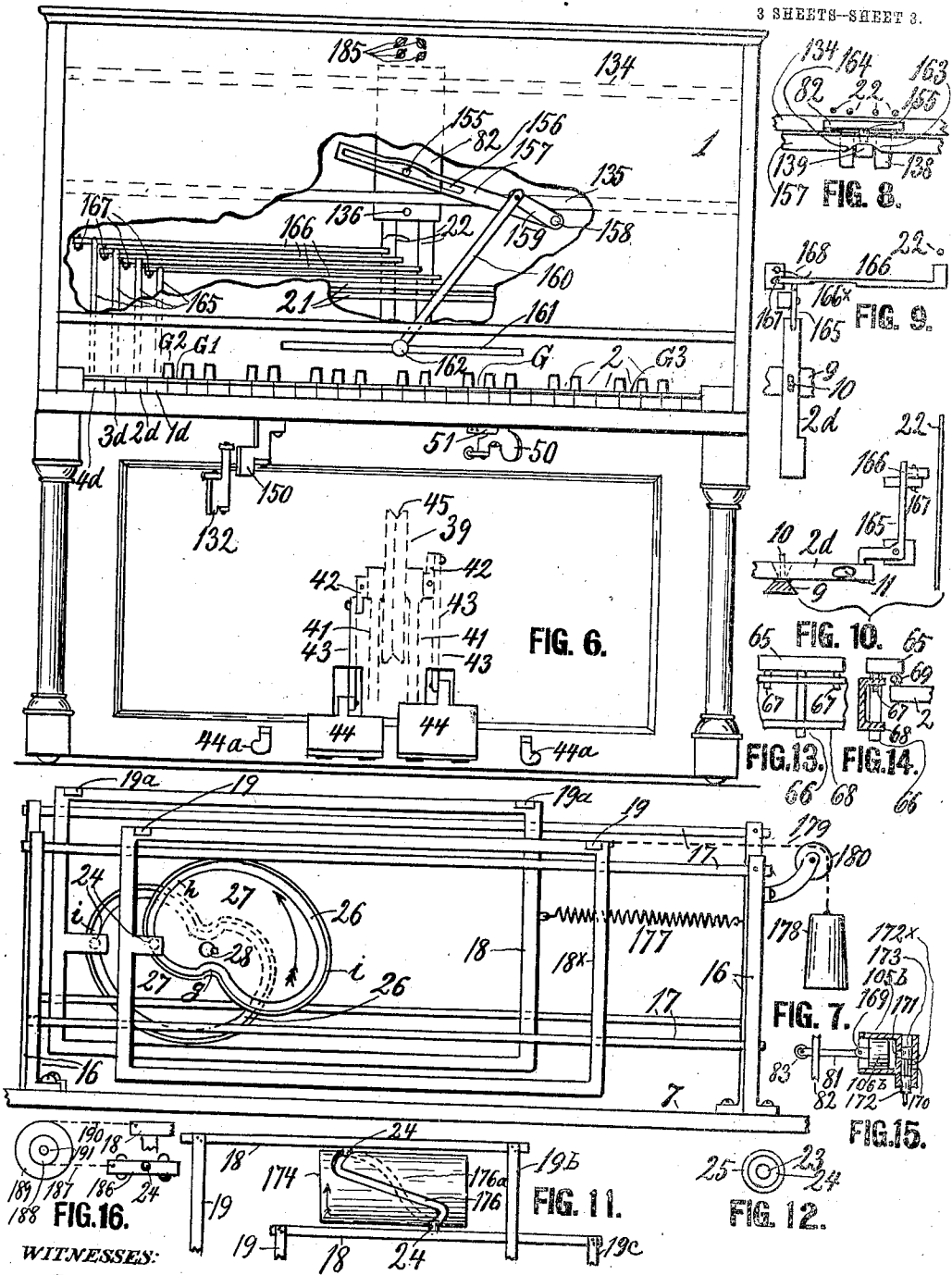
INVENTOR:

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Patented July 4, 1911.

3 SHEETS-SHEET 3.



WITNESSES:
D. E. Carlson
L. E. Carlson

INVENTOR:
Andrew M. Carlson

UNITED STATES PATENT OFFICE.

ANDREW M. CARLSEN, OF ST. PAUL, MINNESOTA.

PIANO-VIOLIN.

996,614.

Specification of Letters Patent.

Patented July 4, 1911.

Application filed June 8, 1907. Serial No. 377,968.

To all whom it may concern:

Be it known that I, ANDREW M. CARLSEN, citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented a new and useful Piano-Violin, of which the following is a specification.

My invention relates to musical instruments of the class known as piano-violins, viol-pianos and viol-organs; and the general object is to provide a musical instrument in which a violin or other stringed instrument having strings vibrated by bowing, is played by fingering on a key-board similar to that of pianos and organs, while the bowing is performed by a mechanism operated by any available power and controlled and regulated by the operator through the keyboard and additional keys, stops, swells, pedals, &c. Another broad object is to so construct such an instrument that it will be possible for the player of it to produce by the instrument all the various kinds of violin music produced by a good violinist playing in the regular well-known way, with the bow in one hand and the fingers of the other hand pressing upon the strings over the finger-board.

These and other objects I attain by providing mechanical means for the production of bowing, tremolo, sliding movements, sympathetic sounds, for muting the strings, striking the strings and for imitating the beating of one or more drums, band music, the natural sounds of birds, animals, and of winds blowing at various objects, &c.

Before proceeding to describe the various combined mechanisms, I will try to facilitate the understanding of the invention by stating that I believe to have discovered or invented the only practical means and method of producing upon a mechanically played violin an endless sound from which the player by pressing on keys of the key-board may produce bowing sounds of any desired length according to the notes he is playing.

In making the foregoing and the following statement I have no intention to belittle earlier inventions along this line, but simply to help enlighten those who study the state of this art.

For a long time I have studied and experimented with all the viol-organs I could

find in the patent records of the United States, but found them all to be impractical, for the reasons that they either call for a bowing member consisting of a roller revolving with its face against the string, which produces an unpleasant grinding sound even when the roller is covered with horse-hair upon soft rubber or like material; or, they call for an endless bow, which if made of silk is difficult enough to make, and then will never produce nearly the fine musical tones that horse hair does; and to make and maintain an endless bow of horsehair, or with a horsehair surface, has proved to be impossible in spite of hundreds of experiments by expert mechanics, and for that reason, evidently, no practical viol organs, if any at all, have heretofore been put on the market. To solve the said difficulties of the bowing problem, I provide in my instrument two bows similar to hand bows but give each bow a strand of hair for each string on the violin. During playing these bows are reciprocated constantly so near the strings that a slight pressure by pressers operatively related with the keys brings them in playing contact with the strings; and the two bows are moved slowly forward and retracted quickly so that each of them will be started on its forward stroke before the other bow has completed the forward stroke; and the operating mechanism is such that the bows can only play during the forward stroke, and only one of them can play at a time, except during the moments one bow takes up the work of the other to let it make the quick rearward stroke and then come forward to act the same way as its mate did. I consider this to be a departure from all earlier methods; and by employing it I am able to produce musical sounds of any duration by pressing upon any key of the key board while the bows are in motion, and can do so by the best bowing means so far known for drawing rich sound from a string, namely a strand of horse-hair.

The hereinbelow presentation of the invention, while enabling a person skilled in the art to build and use the instrument, is not intended as a working drawing but more as a disclosure of principles, methods and some of the many forms of mechanisms by which the methods may be utilized.

In the accompanying drawings,—Figure 1 is a partly sectional side elevation of a viol organ embodying many of my improvements. Fig. 2 is a sectional view on the line *a—b* in Fig. 1. Fig. 3 is a sectional top view on line *b—b* in Fig. 1 with many parts omitted and other parts shown more fully than in Fig. 1. Fig. 4 is a modified and enlarged portion of Fig. 3. Fig. 5 is a detail view of a portion of one of the bows, showing means for adjusting the tension of the hair strands. Fig. 6 is a front elevation of the instrument with the music holder and cover of the key board removed, and the drumming mechanism disclosed through an opening broken out in the casing. Fig. 7 is a front elevation of the sliding frames carrying the bows, the bars on which they slide and the cams moving them. Fig. 8 is substantially a top view of Fig. 2. Fig. 9 is a detail top view of one of the drumming keys and the means by which it operates on a string of the viol. Fig. 10 is a right hand side view of Fig. 9. Fig. 11 is a modified top view of the cam mechanism shown in Fig. 7. Fig. 12 is a detail view of the antifriction roller of each bowing frame contacting with the cam operating the frame. Fig. 13 is a front elevation of one of the slides or actuators that convey motion from several keys to one bow-presser. Fig. 14 is a left side view of Fig. 13 with a portion of a key added. Fig. 15 is a modification of air-pressed means for operating the fingers, and Fig. 16 is a modification of the bow-operating mechanism.

Referring to the drawing by reference numerals, 1 designates the box or casing and 2 the regular keyboard of an organ-shaped or piano-shaped instrument embodying my invention.

3 is the cover over the key-board, it is hinged at 4 and provided with a music-holding ledge or shelf 5, which assumes its useful position when the cover is raised as shown in dotted lines in Fig. 1.

The violin 6, may be located in any desired position to the casing and the mechanisms arranged accordingly, but in the present instance it is given an upright about central position in the upper part of the casing, upon a horizontal supporting board or floor 7, whose front portion 8 supports the key board on a strip 9, having pegs 10 engaging loosely in apertures in the keys, and the keys may have inserted lead weights 11 to hold their rear ends normally downward upon the strip 12, all as usual in similar manuals. The violin is removably held by a clamping device 13 at its lower end and a block 14 adjustably held by bolts 15 to the top of the casing and having a cavity fitting snugly the scroll of the violin.

The bowing means are as follows:—Upon the floor 7 are fixed uprights 16 holding

horizontal bars 17, on which slide two yoke-shaped bow-frames 18, 18*, of which the front one, 18*, has two horizontal arms 19 and the rear frame has two similar arms 19^a moving closely above the arms 19. Between each pair of arms are stretched a set of four strands, 21, of horse-hair, each of which passes normally so close in front of one of the strings 22 of the violin that the strings are merely allowed to vibrate fully when played by the strand of the other set; the two sets of hair-strands are thus arranged to move across the strings as closely together as practical, so that either or both of them are in position to play upon the parts of the strings usually touched by the bow in playing on a violin.

The bow frames are reciprocated by having each on a stud, 23, an antifriction roller 24 covered with a layer 25 (shown in Fig. 12) of rawhide or other anti-rattling material; said roller being engaged by a groove 26 of a cam 27, fixed on a shaft 28, journaled in bearings 29 and having a fixed pulley 30, driven by a belt 31, and pulley 32, fixed on a counter-shaft 33, which is journaled in stands 34 fixed to the bottom of the casing. Said counter-shaft has a feather key 36, on which is slidably keyed a sleeve 37, having a friction pulley 38, driven by frictional contact with the side of the wheel 39, whose shaft 40 is mounted in stands 41 and may be driven by cranks 42, pitmen 43 and pedals 44, operated by the player's feet, or, where other power is available, an electric motor for instance, a belt may be taken from the motor over the face or into the groove 45 of the wheel 39, and the cranks, pitmen and pedals will then be dispensed with.

The sleeve 37 has an annular groove 46, engaged by a shifter arm 47, pivoted at 48 and by a rod 49 pivotally connected with a knee-swell 50, and the latter is by a spring 51 held against a stop 52, whereby the friction wheel 39 is normally held in a forward position or toward the center of wheel 39, so that when the latter wheel is revolved at a given speed the counter-shaft 33 will revolve at its slowest speed; but as the operator presses on the swell 50 the wheel 38 will move upon wider and wider circles of the wheel 39 and the counter-shaft will increase the speed of the bows accordingly.

It will be observed that both of the cams 27 are of a form which may be termed elliptical-heart-shaped, so that the roller 24 of the bow-frame is pushed in one direction at an even speed during about three-fourths of the turn of the cam, that is, by the portion *g—h—i* of the groove 26, and is then quickly moved in the opposite direction by the portion *i—g* of the groove. It will also be seen in Fig. 7 that when the roller 24, farthest to the left, is at the point *i* and has

just finished its slow motion, the roller 24, a little farther to the right, has already been moved from *g* and about half way to *h* in the groove of its cam, so that the one of the bow frames is always taking up the work of the other in time to avoid any break in the tone played.

The bow-pressing mechanism, by which each key of the manual is able to press the proper strand of one or both bows against the proper string, is as follows: In front of each bow strand is a limber upright wire arm 53, each carrying a roller 54, by which to press on the strand. In Fig. 1 two of said arms are shown with rollers on them while of the other arms only the lower portions are shown. Said wire arms are guided in deep notches 55, in the edge of a horizontal plate or table 56, (see Fig. 4) held by a post 57, (see Fig. 1). Upon said table are mounted as many horizontal push-rods 58 as there are arms 53, and each rod has at its rear end a cam-edge 59, and the front ends of the rods are pivoted in pairs to the heads 60 of the upright arms 61 projecting upward from four rock-shafts 63. Each of said shafts is journaled as at 79 in Fig. 4 and has another arm 64 held by a spring arm 53 down upon the horizontal top bar 65 of an actuator which is formed of said bar 65 and the long guiding stem 66 and short guiding stems 67 (see Figs. 13 and 14). Said stems, being guided in frame work 68, cause the bar or cap 65 to move vertically without tilting when actuated upwardly by the rear ends of the keys, as indicated in Figs. 1 and 14, where the key has an adjustment screw 69 engaging the actuator.

From the above it will be understood that when a key in the manual is pressed down, the actuator 65 will tilt the arms 64—61 and thereby push one pair of the cams 59 toward the bow strands, in which position the cams will press the spring arm 53 with its roller 54 against the corresponding strand and hold the latter in playing contact with the corresponding string of the violin, provided that the extreme rear end of the cam is in front of the spring arm, as at 53* in Fig. 4; if the cams are in the positions shown at the arms 53 in the same view, the pushing on the rods 58 will have no effect on the arms.

To bring the proper cams into active and into idle positions at the proper times, I provide a selecting mechanism, which in the present instance consists of two horizontal bars 70 and 71, sliding in bearings 72, fixed upon the table 56, and having their motion limited by pins 73. As best shown in Fig. 1, the bar 70 is located higher than the bar 71, which will explain that in Fig. 4 the bar 71 engages with its notches 74 the four lower push rods 58, which affect the strands of

the lower bow, and the bar 70 engages by its notches 74*, the four upper push-rods, 38*, which affect the strands 21 of the upper bow. Upon the table 56 are pivoted on studs 75 short levers 76 and 76*, each of which has one end pivoted to one of the shifter bars or slides 70 and 71, while the free ends are adapted to be operated by spring-pressed hooks 77 and 77* pivoted upon the projecting arms 19—19* of the bows, while the arms at the opposite ends of the bows carry adjustable pushers 78 and 78*. From this it will be understood that as each bow has finished its slow or playing stroke the pusher 78, or 78*, acts on the selecting slide 70, or 71, and throws the cams 59 in that slide into idle position, where they remain until the bow has made its quick return stroke and commences on its next slow stroke, at which moment the hook 77, or 77*, has taken hold of the lever 76, or 76*, and by pulling on it (as it has just done at 76 in Fig. 4) the selecting bar or slide is moved to the right, whereby the cams 59 are again brought into active position, ready to convert a touch on the keys into a touch by the bow strands against the strings.

In Fig. 5 is shown how the strands 21 are secured in suitable sockets 78, having screw-threaded stems 79*, provided with thumb-nuts 80 by which tension of each strand may be regulated.

While in the above 61—64 have but briefly been alluded to, the complete and correct construction is shown in Fig. 3 to be such that the two arms 61 and 64 of the lever are fixed on a rock-shaft 63, rocking in bearings 79 and being of the required length to bring each arm 64 near the middle of the actuators 65. The actuator farthest to the right in Fig. 3, being extra long to reach over all the keys playing the E-string of the violin, the rock shaft in rear thereof, has two arms 64—64* engaging it, so as to avoid the tendency of twisting of the shaft or tilting of the actuator; this may also be secured by using two smaller actuators and letting the middle of each of them lift one of the arms 64 and 64* of the long rock-shaft. In the left half of Fig. 3 is clearly shown that the rest of the keys are divided into three groups, each of which is related to one of the three lower strings through one of the actuators 65 and rockshaft 63 actuated thereby.

The string-pressers or fingers pressing the strings against the finger board 80, are partly shown in Figs. 1 and 2, to consist of straight push rods or finger rods 81, sliding in apertures in a plate 82 and having their rear ends provided with rollers 83, of leather, rubber or similar material adapted to press upon the strings 22 of the violin, while the front ends are operatively connected with a power-operated mechanism controlled by

the keys of the manual, and where the required pressure on the string is very light the power may be omitted and the key connected to the finger rod by any mechanism that will convert the motion of the key into a pushing motion of the finger against the string. The pressure required to press the light and heavy strings of small and large stringed instruments against the finger boards at various distances from the points where the strings are supported varies so considerably that the pressing means may to good advantage, if not of necessity, be varied in order to perfect this invention. Thus in Fig. 1 is shown that for light pressure the finger may be operated by a bell-crank lever 84, pivoted to the frame work 85 and actuated by a vertical pushing rod 86, having a lateral arm 87 adapted to be engaged and raised by an upright peg 88 fixed in the rear end of the key, while lever 84^a is arranged to be operated by a pulling rod 86^a, and lever 84^b is operated by a link 89, lever 90 and pulling rod 86^b. 91 are cushion springs to prevent the fingers from striking too hard on the strings.

Of power-operated means for pressing the fingers against the strings I have in Fig. 1 shown two kinds, both of which may be used in the same instrument, especially when, one manual is to operate a combination of instruments, like a first violin, second violin, cello and bass violin. One of said means consists of an air-pump 92 having its piston 93 operated by an eccentric 95 fixed on the shaft 33 and embraced by a yoke 94 pivoted at 96 to the piston rod 97.

98 is a reservoir in which the pump stores the air under a pressure regulated by a safety valve 99, whose closing spring 100 may have its tension changed by a nut 101 threaded on the valve stem 102, which is guided in a bracket 103. From said reservoir the air is distributed by piping 104 to cylinders of which one, 105, is shown in section. In the cylinder is a normally lowered piston 106, fixed on the lower end of a push rod like 86. The air is let into the cylinder below the piston through a port 107 when the slide valve 108 closing the port is raised by the key 2, which in Fig. 1 is shown as inserted with its rear end into a yoke 109, which is in section so as to show that it has a clearing 110 below the key, to allow the key to resume its normal position as soon as released from the operator's finger, and thus allow the bow-presser and bow strands to recede instantly from the string, while the piston may not recede quite so quickly but may need a fraction of a second to let the air escape from below it through the exhaust port 111 and the aperture 112 in the slide valve, registering with said port whenever the slide is down and closing the inlet

port. When the slide is raised the solid part of it below aperture 112 closes the exhaust port. The air above the piston escapes through port 113, which is partly closed by a screw 114, whereby the upward speed of the piston is regulated so the piston will not make a blow upward.

The second means to operate the fingers may be electro-magnets, of which one, 115, is shown in a position to pull upward the rod 86 by drawing on an armature 116 secured upon the arm 87. The magnet receives electric current through wires 117—118 from one or more batteries like 119, or any other available source. The wire 118 runs to a contact post 120, near which is another contact post 121 holding a wire 122, running from the magnet while the wire 117 runs to it. In the key 2^a is slidably inserted a screw 123, retained and adjusted downwardly by a nut below the key, as shown, while the upper end is provided with a contact plate 124 supported on a very light coil-spring 125. When the key 2^a is pressed down with ever so light a touch the contact plate touches the two contact posts and completes the circuit around the magnet, which at once pulls the rod 86 upward and thus causes the finger to press on the string just as long as the key is held down; and when the key is released the circuit is broken by the sinking of the contact plate on the key away from the contact posts. Whether compressed air or magnet, or both, or neither of them be used the actuators of the bow-pressers are operated by the keys in the same manner, as already described.

The muting device consists of an L-shaped lever 126 pivoted at 127 and having at its upper end a common violin mute held near the strings where they rest on the bridge 128, the short arm of the lever is pivoted to a rod 129, operated by a bell-crank lever 130, rod 131 and knee swell 132, so that by touching the latter the mute will be applied to the bridge for any short or long period and far more readily than when applied and removed by the hand in the common way. When the swell is released the spring 133 raises the mute from the bridge and restores the swell to normal position.

The tremolo or vibrating mechanism is as follows: The plate 82, in which all the fingers 81 are supported near the strings, is guided to slide vertically in the frame bars 134—135. Said plate has its lower end provided with a pin 136, which normally engages in a hole in a rod 139, and the latter rod is guided between pegs or guides 138 of the bar 135 and having in its lower end an aperture engaged by the free end of lever 140, which is pivoted at 141 to a frame 142 sliding on arms 143 of a bracket 144 and carrying a journaled shaft 145, having

affixed on it a friction pulley 146, turned by a friction pulley 147, fixed on the shaft 33. The front end of shaft 145 is provided with a crank 148, which by a pitman 149 vibrates vertically the lever 140 and thereby the rod 139, plate 82 and all the fingers 81 guided in the plate. Such vibration is controlled by a knee swell 150 and rod 151 by which the frame 142 is slid rearwardly so that the pulley 146 will engage the pulley 147 and be driven by it as long as the tremolo is wanted, when no longer wanted the swell is released and the spring 152 will draw the frame 142 forward, separating the friction pulleys and sending the end of the vibrator lever 140 into a notch 153 of a bracket 154, whereby the vibrator plate 82 is restored to and held in correct normal position; when the vibrating mechanism is in action and a key is pressed down, the corresponding roller 83 in the bifurcated end of the finger will roll up and down on the string and cause the most perfect tremolo.

The sliding movement, which violinists often make by moving the finger several notes along the string while the bow is in motion, I produce by moving the entire plate 82 while the desired finger is pressing on the string. Such motion of the plate is in the present instance obtained by fixing in the plate a pin 155 and engaging it by the slot 156 of an arm 157 of a rock-shaft 158, which is rocked by an arm 159 and rod 160; the latter has at its lower end a stem projecting through a slot 161 near above the key board, and is provided with a knob or finger-hold 162, which the player takes hold of and moves it toward either end of the slot with one hand while holding down the desired key by the other hand. The knob is then restored to a certain mark (not shown) at the middle of the slot. During such sliding movements of the plate 82 it must be released from the vibrator rod 139, and when the sliding movement is finished the plate must be coupled again to the rod. This is done by providing the arm 157 with a V-shaped notch (as shown in Fig. 8) forming two cams 163—164; one of which ejects the rod 139 from the notch and thereby from the pin 136 when the arm 157 begins to swing upward, the other when it begins to swing downward; hence the cams force the rod out of coupling engagement with the plate and let it rest upon the arm beyond the cam-notch until the arm resumes its normal position when the rod, being slightly springy, snaps into the notch in the arm and engages again the pin 136 in the plate.

The harmonic tones are obtained by the sliding movement just described when the same is performed while the key presses one of the fingers 81 against the string so lightly

that the string will not be pressed against the finger board.

The beating of any string in imitation of drumming or picking of the string, as in pizzicato, is performed by the following means: As shown in Figs. 6, 9 and 10, certain keys, in Fig. 6 the four lowest keys of the key board, 1^a, 2^a, 3^a and 4^a, engage by their rear ends bell-crank levers 165, whose upper arms engage each with a beating stick or striker 166, pivoted at 167 and normally held by a spring 168 (see Fig. 9) away from the strings, but when the operator gives a quick stroke on the key the corresponding striker, there being one operating on each string as shown in Fig. 6, will give a single stroke on its string and recede, the same as when the ordinary violin player picks a string with one finger while playing; but if the key be quickly pressed down and held down, the striker, having a spring 166^x in its arm, (see Fig. 9), will vibrate and cause a drumming sound on the string, and if two keys be alternately thus used, and each of them is held down the proper period, about the same as drum sticks are used, a fair imitation of the beating of a common drum will be obtained, the best sounds for the purpose may be selected by holding down certain keys by one hand while the other hand operates the drumming keys. The bass drum is imitated by using one finger on the key 4^a at proper intervals.

To imitate band music, the operator should play music with one hand and operate the drumming keys with the other hand simultaneously and alternately as the notes will call for. This and the whole playing of the instrument may require some practice, but such practice and study is much more interesting than if one could do without it and operate the instrument by merely turning a crank or winding up a spring. The same is true of the many other sounds obtainable on this instrument by proper manipulations of the various mechanisms already described. Thus chiming, tolling and ringing of bells may be produced by using the drumming keys and alternating the sounds by the other keys. And by combining the sliding movements with the beating and playing on the strings under different finger pressure, &c., the most fantastic variations, like the bellowing of cows, the bleating of sheep, rustling of leaves, running of water, singing of birds, cow bells, sleigh bells &c., may be obtained, for which, further direction will in due time be given with the music and instructions going with the instrument. Only this one more idea may here be given as an example: To imitate the song of a canary bird, the sliding movement is applied to the appropriate notes on the E-string selected by keys on

the manual, and when the trill is reached the proper key in the E-string part of the manual is held down while the drumming key 1^a is struck and held down until the drum stick on the E-string has vibrated long enough on the string to imitate the regular trill in the song, whereupon the key 1^a is released and the next chirping sounds are produced by short notes played on the proper keys.

Of the many modifications coming within the scope and spirit of this invention, I have in Fig. 1 shown a piston 106^a adapted to be embraced by a cylinder and by air pressure be pulled downward instead of piston 106 being actuated upward. And in Fig. 15 is shown that the piston 106^b may be a plunger or long enough to guide itself against tilting in the cylinder 105^b and the finger rod 81 is pivoted at 169, so that when the plate 82 makes a sliding movement with the finger the air pressing on the piston will compensate for the variation in distance between the piston and the different points of the string. In said view is also shown that the air may enter the cylinder at 170—171, passing a narrow neck 172^x of a cylindrical valve plug 172, when the latter is pushed upward, and when it is pulled downward by the released key the air exhausts through port 171 and passes out above the end of the valve plug while the latter closes by its upper portion 173 the access to port 171 as an inlet. In this modification much mechanism between the fingers and the pistons is avoided, and as the air pressure on the valve plug is balanced to avoid friction, a very light connection between the keys of the manual and the several fingers 81 may easily be carried to any preferred location of the cylinder.

In the top view Fig. 11 of the bow frames is shown how a single cylindrical cam 174 may move the two bow-frames 18 by a spiral-groove 175 engaging the rollers 24 of the frames. It will be observed that the short portion 176 of the groove imparts the quick return motion of the bows, while the longer portion 176^a, which extends about three-fourths of the circumference of the roller, imparts the slow forward motion of the bows. In this connection any mechanic will understand without illustration that also one of the cams in Fig. 7 may operate the two bow-frames by simply employing a bell-crank lever having the roller 24 on one of its arms, and the other arm connected by a link to one of the bow frames so that the vertical motion of the lever arm engaged by the cam will impart a horizontal motion to the frame moved by the other arm of the lever. In using either of those forms of cams the fast motion of the bow-frame may have an undesirable tendency to resist the even turning of the cam. To overcome this

difficulty I have shown in Fig. 7 how a spring 177, or a weight 178 attached to a cord 179 resting over a pulley 180, may be employed to help move the frame on its quick return stroke.

It is obvious that I may place the bow-frames in front as well as in the rear of the violin and may have the strands to act upon the front or rear sides of the strings, and may place the violin in vertical, slanting, horizontal or any other position. I may also use a gang-bow frame, carrying several bows playing upon several violins by a single key board, but it would be an unnecessary and useless complication to here show and fully describe all that.

From what is shown in Fig. 3 it will be understood that while on ordinary violins and viol-organs the lowest note of each string is the open string. I also make special violins with so long strings that the open strings are each a half note lower than the "open strings" G, D, A, E, on common violins; this enables me to use freely the tremolo also on the lowest note played on each string. I am also thereby able to take G flat on the key G² in Fig. 6 which is the real open G-string and needs no finger 81 to press on the string. It will also be seen that while the key board on the ordinary viol organ ends with the key G³ in Fig. 6 I provide several keys for still higher notes on the finest string so as to enable the player to play as high notes as he can obtain on the string for ordinary or extraordinary purposes; and for special instruments I provide more or less than four strings and may then give the bows hair strands in corresponding numbers. When I say hair strands I do not mean to limit my invention to the use of hair bows, for although horse hair is at present by far the best it is not a perfect material for the production of a bow that will draw the full tones from the string. I also use shutters adapted to let out from the casing more or less of the sound, and swells or stops for manipulating them, but as such shutters on organs casings are very old and my muting device also to a great extent regulates the volume of sound from "pppp" to "ffff" I have not shown and described shutters. I also use resin-applying devices but have not shown them as they are old in the art. Also the connection of the tuning pegs 185 in Fig. 6, by which the player is able to tune the strings while sitting at the key board, is not fully shown, as any mechanical expedient will establish connection between such tuning pegs and the pegs on which the strings are wound in the instrument. Neither is it necessary to show and describe that when an electric or other motor is used and the pedals 44 are thus dispensed with, so that the operator has his feet free, he may use pedals like 44^a in Fig. 130

6 in any desired number instead of the knee swells 50, 132 and 150.

In Fig. 5, 186 is a cushion at the end of any of the pushers 78—78* of the bows.

5 Cushions (not shown) are also used wherever necessary to prevent rattling or other noise in the mechanism.

In Fig. 1 187 designates a spring-arm bearing against one side of the pitman 149 to prevent the crank 148 from stopping at its upper or lower dead center, as such stopping would prevent the arm 140 from entering the notch 153.

In Fig. 6 is shown that the slot 156 in the lever 167 is wider at the middle than nearer the ends; the purpose of this is to allow the lever when in normal position to swing enough up and down to enable the cams 163—164 to eject the rod 139 and thus set plate 82 free to move, before the lever engages the pin 155 and try to move the plate. The wide part of the slot can cause no rattling, because during the sliding movements of the plate the pin 155 always bears against either the upper or the lower side of the slot when at the middle thereof, and beyond the middle the pin fills the slot while the lever changes direction of stroke. The wide middle portion of the slot also enables the plate 82 to vibrate during tremolo without vibrating the slotted lever or arm and its hand-operating mechanism 153—160—162.

In Fig. 16 is shown how I may reduce the size of the bowing cam or cams by mounting the roller 24, on which the cam acts, on a guided slide 186 and let the slide pull on a cord 187, wound on a small pulley 188, secured on the same shaft with a larger pulley 189 having a cord 190 moving the bow frame 18, or the two pulleys may be secured together and oscillate on the shaft 191. When this arrangement or its equivalent is used either the spring 179 or weight 178 in Fig. 7 is employed to retract the bow-frame during its fast movement.

Having thus described my invention, what I claim is:—

1. The method of playing a stringed instrument by bows, which consists in applying two reciprocating bows near each other upon the same string, and having the two bows reciprocate slowly and at the same speed partly simultaneously in one direction and faster in the other direction, and having the bows make the fast movement without touching the string, and applying them to the string during the slow movement partly one at a time and partly both at one time, so that each bow continues the note the previous bow is playing before the said previous bow leaves the string to make its quick return stroke.

2. The method of playing by bows a stringed instrument having a series of strings, which consists in applying two bows

near each other across the strings, each bow having as many playing strands as there are strings to be played on, and each strand being disposed near the string it is to play on, then reciprocating the bows slowly and at the same speed partly simultaneously in one direction and faster in the other direction, and having the bows make the fast movement without touching the strings, and during the slow movement applying the strands of the bows to the strings part of the stroke a single strand and part of it two strands to the same string.

3. The method of playing by bows upon a stringed instrument, which consists in applying a plurality of reciprocating bows alternately and simultaneously with overlapping strokes upon the same string, for the purpose set forth.

4. The method of playing a stringed instrument by bows, which consists in applying two reciprocating bows with overlapping strokes and pressing mechanical fingers against the strings by power and employing a key board for controlling the power so as to apply it at the right time and to the right fingers.

5. In a piano violin, a viol, two bows adjacent thereto and having each a bowing device passing near each string of the viol, means for reciprocating the bows by partly overlapping slow strokes in one direction and by faster strokes in the other direction, bow-pressers interposed between the keys of the instrument and the bowing devices and means controlled by the bows whereby the bow-pressers are automatically rendered inactive during the fast strokes of the bows and active during the slow strokes.

6. In a piano violin, a viol, a bowing mechanism comprising two bowing devices reciprocating near each string of the viol, means for imparting to the two devices a reciprocating motion by fast strokes in one direction and by slow and partly overlapping strokes in the other direction.

7. The combination with a stringed musical instrument, of two bowing devices reciprocating near each other across the strings and adapted to be pressed against the strings, means for imparting to said bowing devices a fast alternating movement in one direction and a partly overlapping slow movement in the other direction.

8. In a piano violin, a viol, reciprocating bows having bowing devices passing in front of each string and between some of the strings, and means for moving the bows fast in one direction and slowly in the other direction.

9. In a piano violin, a viol, a plurality of reciprocating bows adjacent thereto and having each a bowing device passing near each string and between some of the strings of the viol, in ready position to be pressed

against the string, means for reciprocating the bows, fast in one direction and slowly in the other direction and means for pressing the bowing devices into contact with the strings.

10. In a piano violin, a suitable casing, a viol mounted in the interior of the casing, string-shortening fingers near the strings, a key board at the front of the casing operatively connected with the fingers, bowing devices near the strings and means for reciprocating the same, a lever pivotally mounted near the viol, a muting device fixed on the lever, a rod extending from the lever, a bell-crank lever and a second rod extending therefrom to the front of the casing, an operating piece mounted on the casing near the key board and operatively connected with the second rod.

11. In a musical instrument and arranged in a suitable casing, a viol, reciprocating bowing devices adjacent the strings thereof, means for operating the bows, string-shortening fingers, a key board operatively connected with the fingers, hard strikers arranged to beat on the strings, keys operating the strikers, said bows and the string-shortening fingers being adapted for operation simultaneously with or independently of the strikers, for the purposes set forth.

12. In a musical instrument and arranged in a suitable casing, a viol, reciprocating bowing devices adjacent the strings thereof, means for operating the bows, string-shortening fingers, a key board operatively connected with the fingers, hard strikers arranged to beat on the strings, keys operating the strikers, said bows and the string-shortening fingers being adapted for operation simultaneously with or independently of the strikers, said strikers being formed with springy operating arms and provided with springs to hold them normally away from the strings for the purpose set forth.

13. In a piano violin, a viol, string-shortening fingers adjacent to the strings, rollers in the ends of the fingers, a key board operatively connected with the fingers, a guided plate having apertures guiding the fingers, power-operated means for imparting a longitudinally vibrating movement to the plate, means near the key board for starting and stopping the vibrating movement while playing, and automatic means for restoring the plate to normal position.

14. In a piano violin, a viol, string-shortening fingers adjacent to the strings, rollers in the ends of the fingers, a key board operatively connected with the fingers, a guided plate having apertures guiding the fingers, power-operated means for imparting a longitudinally vibrating movement to the plate, means near the key board for starting and stopping the vibrating movement while

playing, and automatic means for restoring the plate to normal position, said power-operated means consisting of a crank and a pitman having operative connection with the plate.

15. In a piano violin, a viol, string-shortening fingers adjacent to the strings, rollers in the ends of the fingers, a key board operatively connected with the fingers, a guided plate having apertures guiding the fingers, power-operated means for imparting longitudinally vibrating movement to the plate, means near the key board for starting and stopping the vibrating movement while playing, automatic means for restoring the plate to normal position, and means operated at the front of the instrument and connected with the plate for imparting a sliding movement to it in the longitudinal direction of the strings.

16. A piano violin comprising, a viol, reciprocating bowing devices adjacent each string of the viol, a key-board having its keys divided into groups relating one to each string of the viol, a series of actuators operated each by the rear parts of the keys of a group, bow-pressing devices actuated one by each actuator and arranged to press the bowing devices against the string played by the group of keys of the key-board relating to such string.

17. A piano violin comprising, a viol, reciprocating bowing devices adjacent each string of the viol, a key board having its keys divided into groups relating one to each string of the viol, a series of actuators operated each by the rear parts of the keys of a group, bow-pressing devices actuated one by each actuator and arranged to press the bowing devices against the string played by the group of keys of the key board relating to such string, mechanical fingers adapted to press on the strings, said fingers being operatively related to the keys of the key board.

18. In a musical instrument of the kind described, the combination with a violin, of bow frames with bowing means adjacent to the strings of the violin, and power-operated rotary cams imparting alternately fast and slow reciprocating motion to the bow frames.

19. In a musical instrument of the kind described, the combination with a violin, of bow frames with bowing means adjacent to the strings of the violin, and power-operated rotary cams imparting reciprocating motion to the bow frames, said cam or cams being of such form as to reciprocate each bow-frame slowly in one direction and fast in the other direction.

20. In a musical instrument of the kind described, the combination with a violin, of bow frames with bowing means adjacent to

the strings of the violin, and power-operated rotary cams imparting reciprocating motion to the bow frames, said cams being of such form as to reciprocate each bow-frame slowly in one direction and fast in the other direction, and auxiliary means arranged to receive power from the frame during its slow movement and return the power and help to move the frame during its fast movement.

21. In a piano violin, a viol, reciprocating bowing devices arranged adjacent the strings thereof, a main shaft adapted to be operated by suitable power, a friction disk secured on the main shaft, a counter shaft adjacent thereto, a friction pulley or wheel slidably keyed on the counter shaft and having its face engaged frictionally by the side of the friction disk, means operated from the front of the instrument by which the friction pulley may readily be moved to and from the periphery of the disk, and operative connections between the counter shaft and the bowing devices to reciprocate them slow or fast as the player may regulate while playing.

22. In a piano violin, a viol, reciprocating bowing devices adjacent the strings thereof, fingers arranged to press the strings against the finger-board of the viol, a key-board, a motor, an air pump operated by the motor, a reservoir for the compressed air, cylinders, pistons in the cylinders and having piston rods operatively connected with the fingers, valves operated by the keys of the key board and controlling the air passages between the reservoir and the cylinders.

23. In a piano violin, a viol, mechanical fingers adapted to press on the strings, and a tremolo device for vibrating the fingers so as to produce tremolo, means for operating the tremolo device, means for controlling its operation by the player at the front of the instrument, and means for locking the tremolo device with the fingers in normal position on the strings.

24. In a stringed musical instrument, a series of strings, reciprocating bowing devices, two for each string and normally out of contact therewith, and means for deflecting each bowing device through its flexibility from its normal path of travel and thus bringing it into contact with the string one at a time or both at one time, for the purpose set forth.

25. In a stringed musical instrument, a finger board, a series of strings adjacent thereto, reciprocating bowing devices arranged in pairs, one pair adjacent each string, means for moving the bowing devices of each pair alternately, fingers for pressing the strings against the finger board, deflectors for deflecting the bowing devices

against the strings, and keys arranged to operate said fingers and deflectors simultaneously.

26. In a stringed musical instrument, bowing devices arranged in pairs near each string, means for moving the two bowing devices in each pair alternately and by fast strokes in one direction and slow and partly overlapping strokes in the other direction, keys, deflecting devices operated by the keys to bring the bowing devices against the strings, and an automatically-operated selecting device controlling the deflecting devices to cause the two bowing devices to produce a continuous tone as long as a key is held down.

27. In a piano violin, a reciprocating bow, a cam imparting slow and fast motion to the bow, and a stroke-increasing device connecting the bow and the cam, to give the bow a longer stroke than the cam has.

28. In a piano violin, a viol, reciprocating bowing devices adjacent the strings thereof, fingers arranged to press the strings against the finger board of the viol, a key board, a motor, an air pump operated by the motor, a reservoir for the compressed air, cylinders, pistons in the cylinders and having piston rods operatively connected with the fingers, valves operated by the keys of the key board and controlling air passages between the reservoir and the cylinders; said cylinders each having one of said valves arranged in one end and ports adjacent thereto for the inlet and outlet of the compressed air; the other end of the cylinder being closed and provided with a vent hole and means for regulating the size of said hole, and means for retracting the piston when the compressed air escapes from the cylinder.

29. In a piano violin, a viol with finger board and strings, bowing devices near the strings, a series of cylinders, pistons in the cylinders, piston rods extending from the piston, elements operatively connected with the piston rods and arranged to act as fingers by pressing upon the strings, an air-compressing device arranged to supply compressed air to the cylinders, a valve at each cylinder to control the inlet and outlet of the air, and a key-board having keys operatively connected with said valves.

30. In a piano violin, a viol with finger board and strings, bowing devices near the strings, a series of cylinders, pistons in the cylinders, piston rods extending from the pistons, elements operatively connected with the piston rods and arranged to act as fingers by pressing upon the strings, an air-compressing device arranged to supply compressed air to the cylinders, a valve arranged at each cylinder to control the inlet and outlet of the air, and a key-board

having keys operatively connected with said
valves; said piston rods having each a joint
to allow its string-pressing element to be
swung or moved in longitudinal direction of
5 the strings, and means for so moving the
string-pressing elements, for the purpose
set forth.

In testimony whereof I affix my signature,
in presence of two witnesses.

ANDREW M. CARLSEN.

Witnesses:

M. H. CARLSEN,
L. C. CARLSEN.