B. L. CARTMELL.

SELF PLAYING MUSICAL INSTRUMENT.

APPLICATION FILED DEC. 14, 1908.

948,474.

Patented Feb. 8, 1910.

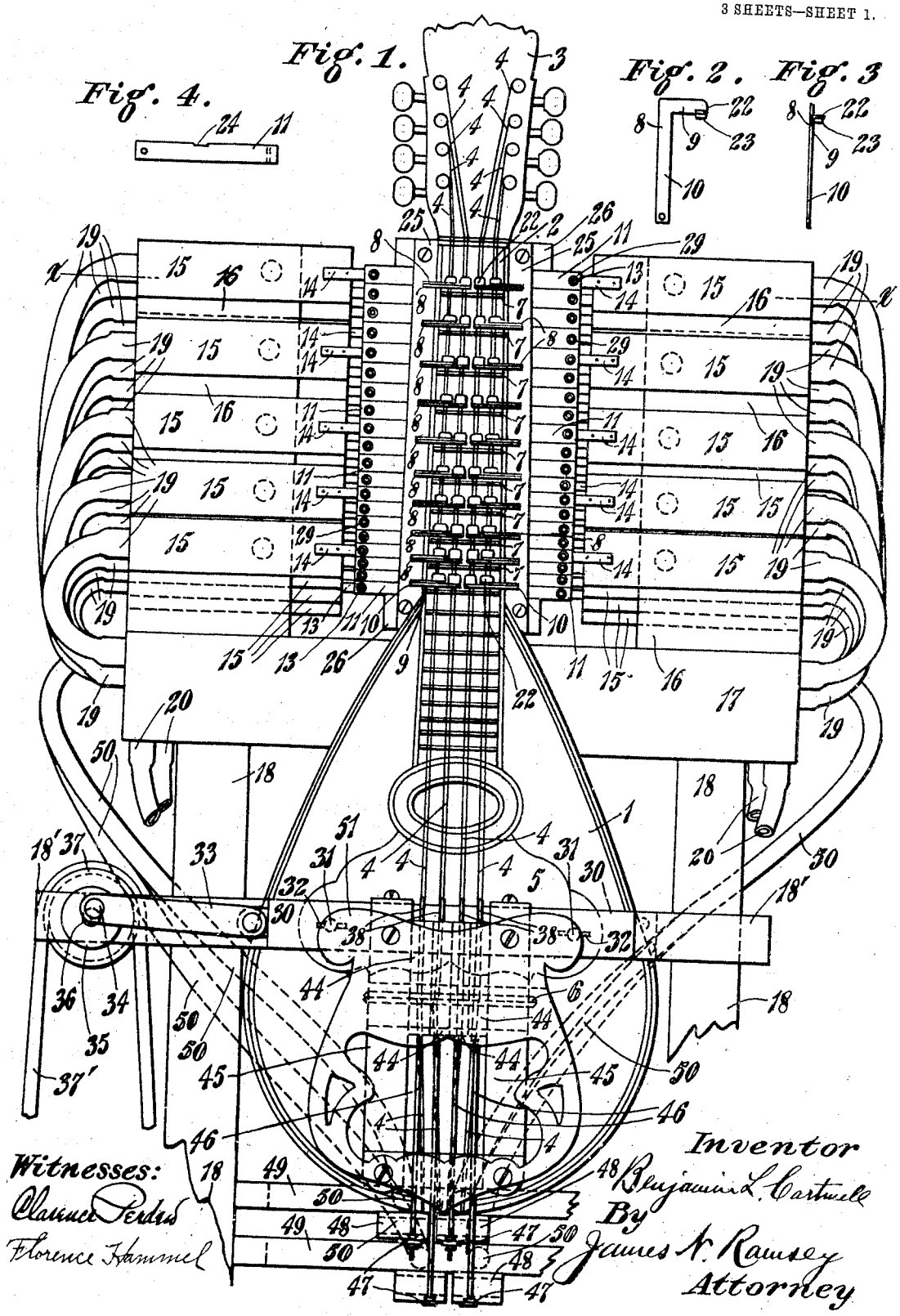
3 SHEETS—SHEET 1.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.



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3 SHEETS—SHEET 2.

Fig. 5.

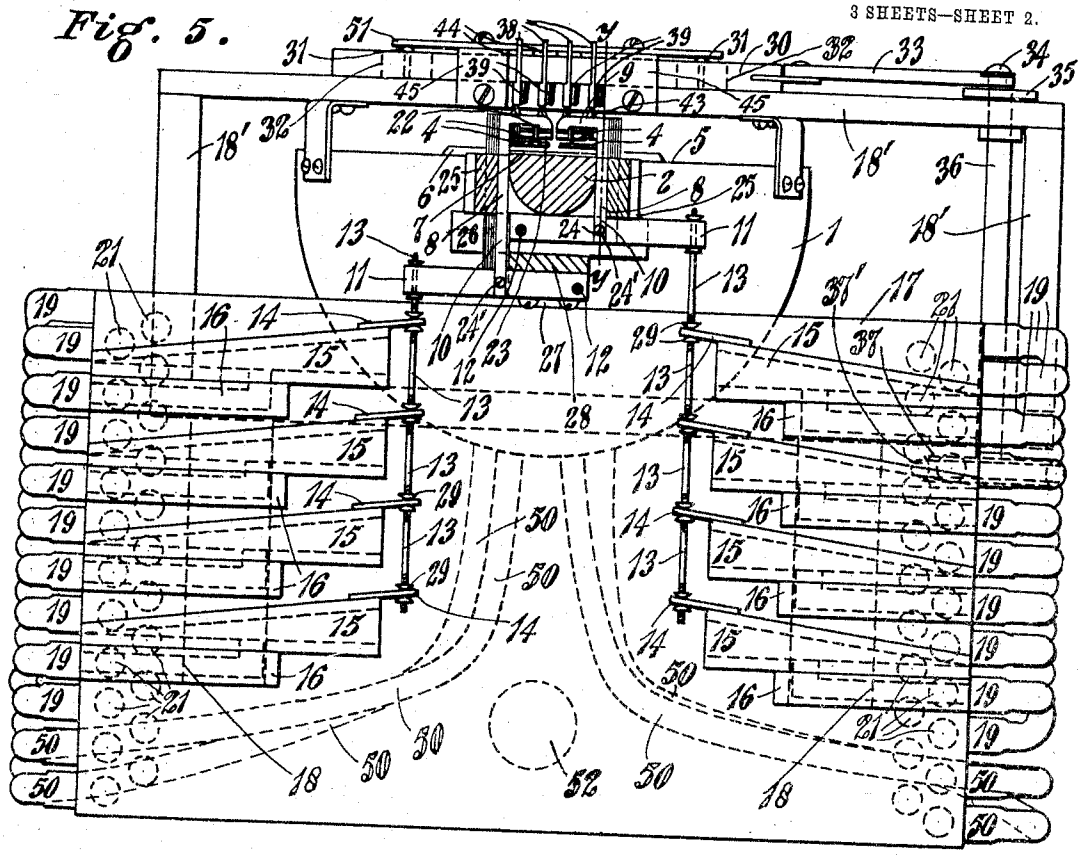


Fig. 7.

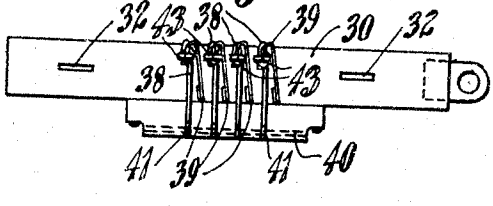


Fig. 8.

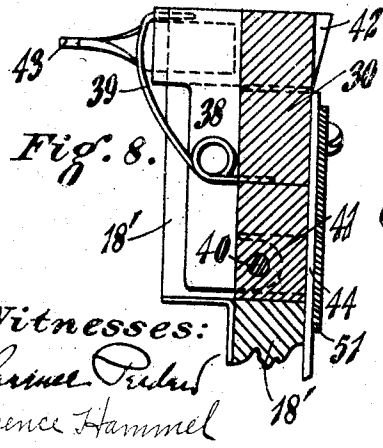
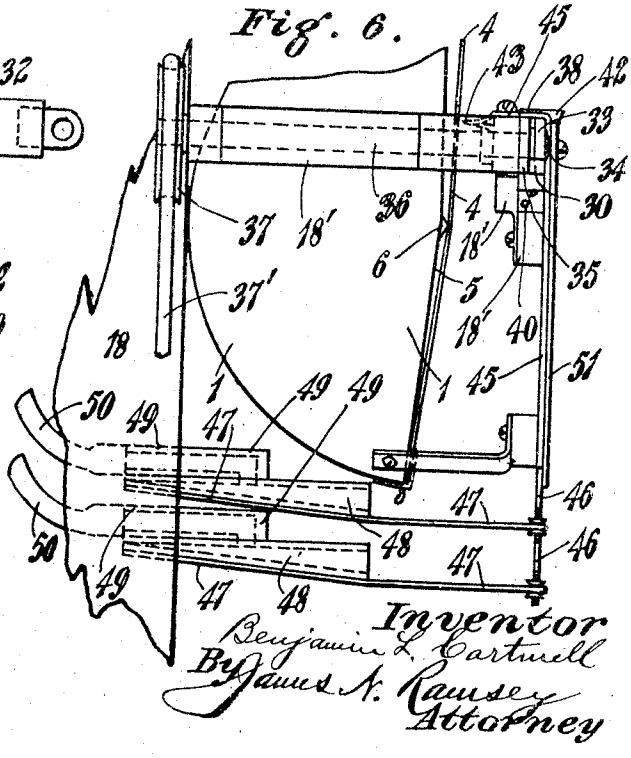


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 9.

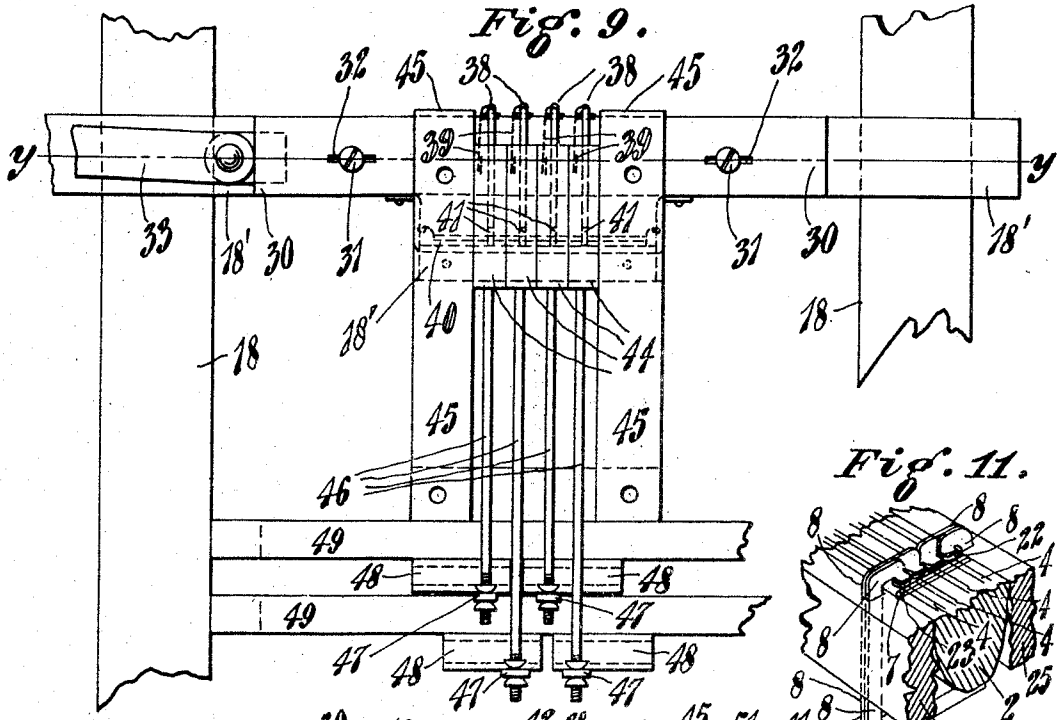
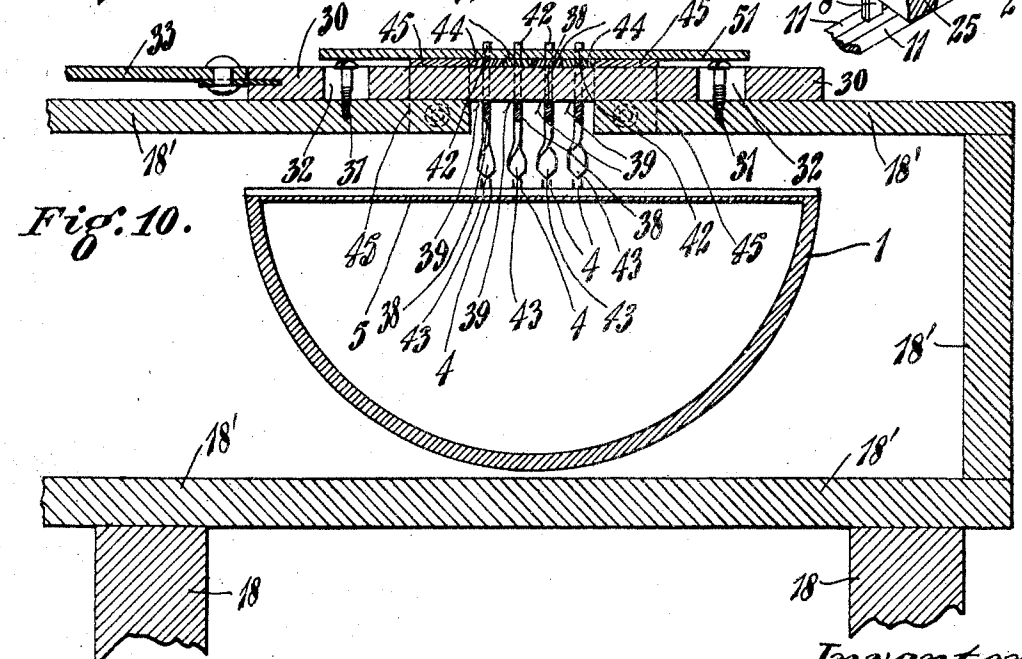


Fig. 11.

Fig. 10.



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UNITED STATES PATENT OFFICE.

BENJAMIN L. CARTMELL, OF CINCINNATI, OHIO.

SELF-PLAYING MUSICAL INSTRUMENT.

948,474. Specification of Letters Patent. Patented Feb. 8, 1910.

Application filed December 14, 1908. Serial No. 467,362.

To all whom it may concern:

Be it known that I, BENJAMIN L. CARTMELL, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Self-Playing Musical Instruments, of which the following is a specification.

My invention relates to mechanism for self-playing stringed instruments, and its object is to enable such a mechanism to be used in conjunction with an ordinary stringed instrument without involving any changes in the construction of the instrument, thereby simplifying the construction as well as the operation of the device.

My invention consists in the combination with a musical instrument having a neck with a finger board and strings stretched thereover, and provided with a series of fingers overhanging the neck, having means for contacting with the strings, and means for individually actuating the fingers, of the improved details of construction and arrangement of the parts comprising the finger actuating means, together with means for individually vibrating the strings with pre-determined relation to the contact of the fingers with the strings, as will hereinafter be more fully described and claimed.

In the drawings: Figure 1 is a front elevation of a device embodying my invention. Fig. 2 is a detail plan view of one of the fingers. Fig. 3 is a side elevation of one of the fingers. Fig. 4 is a plan view of one of the levers. Fig. 5 is a cross sectional plan view of the device, the section being taken on a line corresponding to the line *x*—*x* of Fig. 1. Fig. 6 is a side elevation of the lower part of the device. Fig. 7 is a bottom plan view of the bar which carries the plectrums. Fig. 8 is a vertical section on a line corresponding to the line *y*—*y* of Fig. 5, enlarged, better illustrating the construction of the mechanism for actuating the plectrums. Fig. 9 is a front elevation of the mechanism for actuating the plectrums, with the instrument removed and the plate removed from over the slides. Fig. 10 is a horizontal cross section on a line corresponding to the line *y*—*y* of Fig. 9, the instrument and the plate, however, being illustrated as in position. Fig. 11 is a perspective view of part of the neck of the instrument with one fret and the fretting mechanism therefor, better illustrating the arrangement of those parts.

As illustrated, and as I prefer to construct my improvement, it is applied to a mandolin of ordinary well known construction, comprising the body 1, neck 2 and head 3, upon which are mounted the strings 4 by being stretched over the neck, and over the sound board 5 of the body. The strings are stretched over the bridge 6 on the body of the instrument and are prevented from lateral displacement thereby. The instrument is so mounted that the strings run vertically.

The manual playing of an instrument is sought to be most accurately imitated by the employment of mechanism for producing the music, and, with this end in view, it is desirable to use the mechanism in conjunction with an instrument identical in every detail with the instrument used for playing manually. This object I attain by providing a series of fingers 8, one of such fingers 8 being provided for each pair of strings 4 at each fret 7 on the finger board. The finger 8 for the particular fret 7 is placed slightly above the fret at the point required to press the strings against the fret, and in consequence of such arrangement it will be necessary for four fingers to make contact with the strings in horizontal alinement.

Each of the fingers 8 consists in a part 9 extending transversely of the finger board and a part 10 extending rearwardly past the rear side of the neck 2 and pivotally secured to a lever 11 fulcrumed on a pin 12, as is best shown in Fig. 5 of the drawings. The pivotal connection of the finger 8 with the lever 11 is between the fulcrum 12 and the free end of the lever. Near the free end of the lever a rod 13 is connected thereto and extends rearwardly, and is connected to a lug 14 on the movable part of a bellows 15, which bellows 15 has its stationary part rigidly secured to an upright board 16 resting on the wind chest 17, which is supported by the frame 18, and which frame 18 also forms the support for the instrument and the other mechanism constituting my invention. As shown, there are ten frets which are provided with fingers, and there being four pairs of strings passing over each fret, the total number of fingers provided for the instruments is forty. Each of the forty fingers is provided with a lever 11 and a bellows 15 mounted and connected together, as above described, the bellows all

being mounted on the upright boards 16. Air tight communication is provided between the interior of each bellows and the interior of the wind chest 17 by means of flexible tubes 19, one of which is provided for each bellows, and other tubes 20 lead from the wind chest to a suitable tracker board or other mechanism adapted to operate in conjunction with a punched sheet of paper or other device commonly used in self-playing musical instruments, and suitable valves 21 may be provided within the wind chest for enabling the bellows 15, which operate the fingers 8, to be individually and separably controlled by the tracker board or other mechanism, as above set forth. Since the frets are necessarily comparatively close together, and it is also necessary to arrange the fingers in groups of four in horizontal alinement above the frets, it is necessary to provide a compact construction for the fingers, their levers, and their bellows. Such a construction is provided by making the fingers very thin, and for this reason they are preferably constructed of sheet metal, the proper bearing surface to come into contact with the strings being provided by leaving a lug 22 near the end of the transversely extending part 9 of the finger, on the side adjacent to the string, and bending this lug 22 at right angles to the part 9. A piece 23 of soft material, such as leather, is secured to the side of this lug 22 thus brought adjacent to the string, by gluing or otherwise, and is thus adapted to make the contact with the string when the finger is drawn backward by the action of the bellows operating upon the finger by means of its lever. With the fingers thus constructed of thin sheet metal, or similar material of sufficient strength, it is possible to mount two of the fingers together and pivot one of them to each of two adjacent levers 11 in recesses 24 on the sides of the levers adjacent to each other. The levers are thus pivoted in the recesses in the adjacent levers so that the levers may be brought close together without interference of the fingers. The pivotal connections are formed by means of small screws 24′, the heads of which are countersunk into the fingers. Thus mounted in pairs, each pair of fingers may pass through a single slot in a bar 25, lying parallel to and against the side of the neck 2 and extending the full length of the finger board thereon. In each group of four fingers in horizontal alinement, two of the fingers are placed on one side and the other two on the other side of the neck, so that with two of such bars 25 provided, one on each side of the neck 2, they will form, by means of their slots through which the fingers pass, guides for all of the fingers. The levers for the fingers on one side of the neck have their fulcrums in alinement at the rear of the neck near the opposite side thereof and adjacent thereto, while the levers for the fingers on the other side of the neck have their fulcrums in alinement to the rear of the levers for the fingers on the opposite side and near to said opposite side of the neck. The fulcrums 12 of all the levers on the first mentioned side being in alinement, these fulcrums may consist in a single rod or pin mounted in blocks 26, one of which is near each end of the finger board and bears against and is secured to the rear of the neck 2 of the instrument, and to such blocks the bars 25 are also secured. The fulcrums of the levers for the fingers on the other side being also in alinement may consist in a single rod or pin which is secured in blocks 27, one of which is near one end of the finger board and mounted on a slat 28 which extends parallel with the neck of the instrument to the rear of the first mentioned levers, and is secured to the rear side of the blocks 25. Thus, a single frame work is provided for mounting the levers and fingers and forming guides for the fingers, and, being of simple rigid construction, it has the function of effectually maintaining the fingers and levers in proper alinement, preventing lost motion and derangement in the operation of the mechanism.

The rods 13 which connect the free ends of the levers 11 to the lugs 14 on the bellows 15 are preferably provided with buttons 29 screwed onto the rods, one of said buttons being provided on each side of the lever 11 where the rod makes connection with it, and one of them being provided on each side of the lug 14 where the lever makes connection with the lug. The rods pass loosely through the levers and through the lugs, and the buttons are convex on their sides adjacent to the levers and lugs so that the rods 13 constitute practically pivotal connections between the levers and the lugs on the bellows, allowing perfectly free movement of the parts, and reducing friction to a minimum.

In order that the bellows may be of ample width to operate with sufficient power on the fingers, they are arranged, as shown, in four tiers of five bellows each on each side of the instrument, each tier of bellows being mounted on a separate vertical board 16, as hereinbefore referred to, and the rods 13 of the bellows to the rear passing between the lugs 14 on the bellows forwardly. This allows each bellows to be connected in perfect alinement to its respective lever and allows the complete device to be compact in construction, as is desired.

Extending across the sound board 5 of the body of the instrument, is an extension 18′ of the frame 18, which supports a bar 30 in position for reciprocation transversely of the

instrument, this bar 30 being secured to the frame work by means of studs 31 taking through slots 32 in the bar. One end of the bar has one end of a connecting rod 33 pivotally secured to it and the other end of the connecting rod 33 is secured to a wrist pin 34 in a disk 35 rigidly mounted on a shaft 36 journaled horizontally in the extension 18′ and extending rearwardly of the device, where it is provided with a grooved pulley 37 also rigidly mounted on it and around which passes a belt 37′ which is adapted to pass around the pulley of a suitable motor for rotating the shaft. It will be seen that the rotation of the shaft imparts reciprocatory motion to the bar 30 over the strings 4 of the instrument, this rotation of the shaft and reciprocatory motion of the bar being adapted to be continuous and uniform during the operation of the device. The bar 30 has four plectrums 38 pivotally mounted in it in such position that each one of the plectrums will vibrate over one of the strings 4 of the instrument, the extent of reciprocation imparted to the bar 30 being such that each plectrum 31 may reciprocate over only one of the strings of the instrument. These plectrums 38, thus pivotally mounted in the bar 30, are adapted, when not actuated, to be out of engagement with their respective strings 4 and are held in such position normally by means of springs 39 secured in the bar 30. The pivotal connections of the plectrums with the bar 30 are in alinement and are constituted by a single pin 40 in an extension of the bar 30 lying transversely of the instrument. Each plectrum consists in a thin piece of sheet metal, or similar material, mounted with its edges presented upwardly and downwardly at the rear of the bar 30 with a lug 41, extending forwardly into a slot in the downward extension of the bar, through which lug the pin 40 passes to form the pivotal connection, as above referred to. The upper part of the plectrum, or the part near its free end, is provided with a forward extension 42 projecting through a slot in the upper side of the bar 30, and extending past the forward side of said bar. The terminal edge of this extension is inclined rearwardly from its top to its bottom so that it is substantially flush with the forward surface of the bar 30 at its bottom. The part 43 of the plectrum which engages with the strings of the instrument extends rearwardly from its main part and the material of which it is composed is so twisted that it presents its edges transversely of the instrument, while the part near its end is pointed so that it will make suitable contact with the strings.

Each of the plectrums 38 is provided with a slide 44 mounted to move vertically and lying against the forward side of the bar 30 so that when the slide moves upwardly it will engage with the inclined surface of the forward extension 42 of the plectrum and press the plectrum rearwardly into position for engagement with the string. These slides 44 lie side by side between vertically extending parts 45 secured to the frame work and also secured to the body 1 of the instrument at its lower end. Each of the slides 44 is provided with a downwardly extending rod 46 and the lower end of each of the rods 46 is connected with a forwardly extending lug 47 in the same manner as the rods 13 are connected to the levers 11 and lugs 14 on the bellows 15, the lugs 47 being rigidly secured to the movable parts of the bellows 48, one bellows being provided for each slide 44. Two of these bellows are mounted on one board 49 and the other two are mounted on another board 49, which boards are suitably rigidly supported by an extension of the frame work of the device. Air tight communication between the interior of the bellows 48 and the interior of the wind chest 17 is provided by means of tubes 50, and these bellows are also controlled by means of valves and tubes, such as the valves 21 and the tubes 20, leading to the tracker board or other device. As will be noted, the bellows 48 will operate to move the slides 44 upwardly, which, engaging with the inclined surfaces of the extensions on the plectrums 38, will cause the plectrums to engage with the strings of the instrument, and, the plectrums, being reciprocated transversely of the instrument, will produce the vibration of the strings. The slides 44 are held in place against forward displacement by means of a plate 51 which may be of ornamental construction, as shown. The plectrums being thus pivotally mounted in the bar 30, which is continuously reciprocated during the operation of the device and being adapted to make only a sliding contact with the slides 44, which serve to individually engage the plectrums with the strings of the instrument, the construction of the vibrating mechanism may be substantial and in its operation unnecessary vibration of various parts may be eliminated with the result that loss of power as well as wear and tear on the parts of the mechanism is avoided.

The wind chest 17 may communicate with a suitable vacuum producing apparatus through a tube 52 opening into its bottom, as illustrated in Fig. 5 of the drawings, the vacuum producing apparatus being operated by the same motor which imparts the reciprocatory motion to the bar 30, as above described.

Thus, it will be seen that the fingers operating on the strings over the finger board, and the plectrums operating on the strings over the sound board of the instrument may all be controlled by the same device, and

with suitably prepared music sheets or other devices for this purpose may be made to operate as desired to produce the music, the fingers varying the vibrating lengths of the strings, while the plectrums produce the vibrations in conjunction therewith.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a self-playing musical instrument, the combination with a neck provided with a finger board with frets extending transversely thereof at intervals therealong, and strings extending longitudinally of the finger board in front of the frets, of fingers having parts for contacting with the strings adjacent to each fret, a lever for each finger to the rear of the neck, individual separately controlled actuating means secured to each lever, and means for vibrating the strings, each finger being composed of a thin flat strip presenting edges transversely of the finger board, and having a part overhanging the neck on which the contacting part of the finger is mounted, a bar extending longitudinally of the neck at each side thereof, having slots through each of which a plurality of the fingers extend, the contacting parts of the fingers being offset from the overhanging parts and the plurality of fingers extending through a single slot being so proportioned with relation to each other that, when they present flat sides together to extend through the slot, said contacting parts may be in alinement parallel to the frets, substantially as and for the purposes herein set forth.

2. A self-playing musical instrument having in combination a series of fingers, each finger consisting in a part extending transversely of the finger board, and a part extending rearwardly past the rear side of the neck and having a lug near the end of the transversely extending part adjacent to a string on the instrument, the lug being provided with a piece for contacting with the string, means for individually actuating the fingers, and means for vibrating the strings, each finger being composed of a thin flat strip presenting edges transversely of the finger board, a bar having a slot inclosing the rearwardly extending parts of the fingers and forming a support and guide therefor, each slot being occupied by a plurality of said fingers with their flat sides presented together and their lugs offset different amounts from their respective transversely extending parts, substantially as and for the purposes herein set forth.

3. A self-playing musical instrument having in combination a series of fingers, each finger consisting in a part extending transversely of the finger board, and a part extending rearwardly past the rear side of the neck and having a lug near the end of the transversely extending part adjacent to a string on the instrument, the lug being provided with a piece for contacting with the string, each finger being composed of a thin flat strip with its edges presented transversely of the finger board, a bar having slots, each of which slots incloses the rearwardly extending parts of a plurality of the fingers, a lever for each of the fingers, each of the plurality of fingers inclosed in a single slot being pivoted to its respective lever on the side of said lever adjacent to the pivotal connection of the other lever, means for individually actuating the levers to bring the contacting parts of the fingers against the strings on the instrument, and means for vibrating the strings, substantially as and for the purposes herein set forth.

4. A self-playing musical instrument having in combination a finger for each string adjacent to each fret, each finger consisting in a part extending transversely of the finger board and a part extending rearwardly past the rear side of the neck, and having a lug near the end of the transversely extending part adjacent to a string on the instrument, the lug being provided with a piece for contacting with the string, each finger being composed of a thin flat strip presenting its edges transversely of the finger board, a plurality of the fingers in a series near one side of the finger board being arranged with their transverse parts and their rearwardly extending parts against each other and projecting over that side of the finger board, and a plurality of the fingers in the series, near the other side of the finger board, being arranged with their transverse parts and their rearwardly extending parts against each other and projecting over that side of the finger board, a bar on one side of the finger board having a slot through which the rearwardly extending parts of the plurality of fingers lying against each other projecting over that side of the finger board extend, a bar on the other side of the finger board having a slot through which the rearwardly extending parts of the plurality of fingers lying against each other on that side extend, said bar projecting longitudinally of the neck of the instrument, a lever for each of the fingers thus extending through a single slot, each of said fingers being pivoted to its respective lever on the side of the lever adjacent to the pivotal connection of the other lever, the levers for the fingers on one side of the neck having fulcrums in alinement to the rear of the neck near the opposite side thereof and adjacent thereto, the levers for the fingers on the other side of the neck having their fulcrums in alinement to the rear of the levers for the fingers on the opposite side and near to said opposite side of the neck, a single pin constituting

the fulcrums of the fingers on the first mentioned side, blocks secured to the rear of the neck of the instrument, to which blocks the bars having the slots are secured and in which blocks said pin is secured, another single pin constituting the fulcrum of the levers on said other mentioned side, a slat extending parallel to the neck of the instrument and secured to the blocks which are secured to said neck, and blocks secured to the slat, in which said second mentioned pin is secured, means for individually actuating the levers through connection with their free ends, and means for vibrating the strings.

5. A self-playing musical instrument having in combination a series of fingers overhanging the neck and provided with means for contacting with the strings, means for individually actuating the fingers, a bar extending transversely of the instrument in front of the strings, means for imparting transverse reciprocation to said bar continuously during the operation of the device, a plectrum for each string, pivotally mounted in the bar, a slide for each plectrum adapted to be reciprocated at an angle to the line of reciprocation of the bar, whereby it may engage with its respective plectrum to depress it and engage it with the string or whereby it may disengage from the plectrum, and means for individually reciprocating the slides.

6. In a musical mechanism, the combination with a musical instrument having strings, of means for individually varying the vibrating length of the strings, a bar adapted to reciprocate transversely of the strings, plectrums pivotally mounted in the bar, springs adapted to hold the plectrums normally out of engagement with the strings, slides movable at an angle to the line of movement of the bar and adapted to contact with the plectrums to cause them to engage with the strings, and means for individually actuating the slides, the bar being provided with means for reciprocating it continuously during the operation of the device.

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