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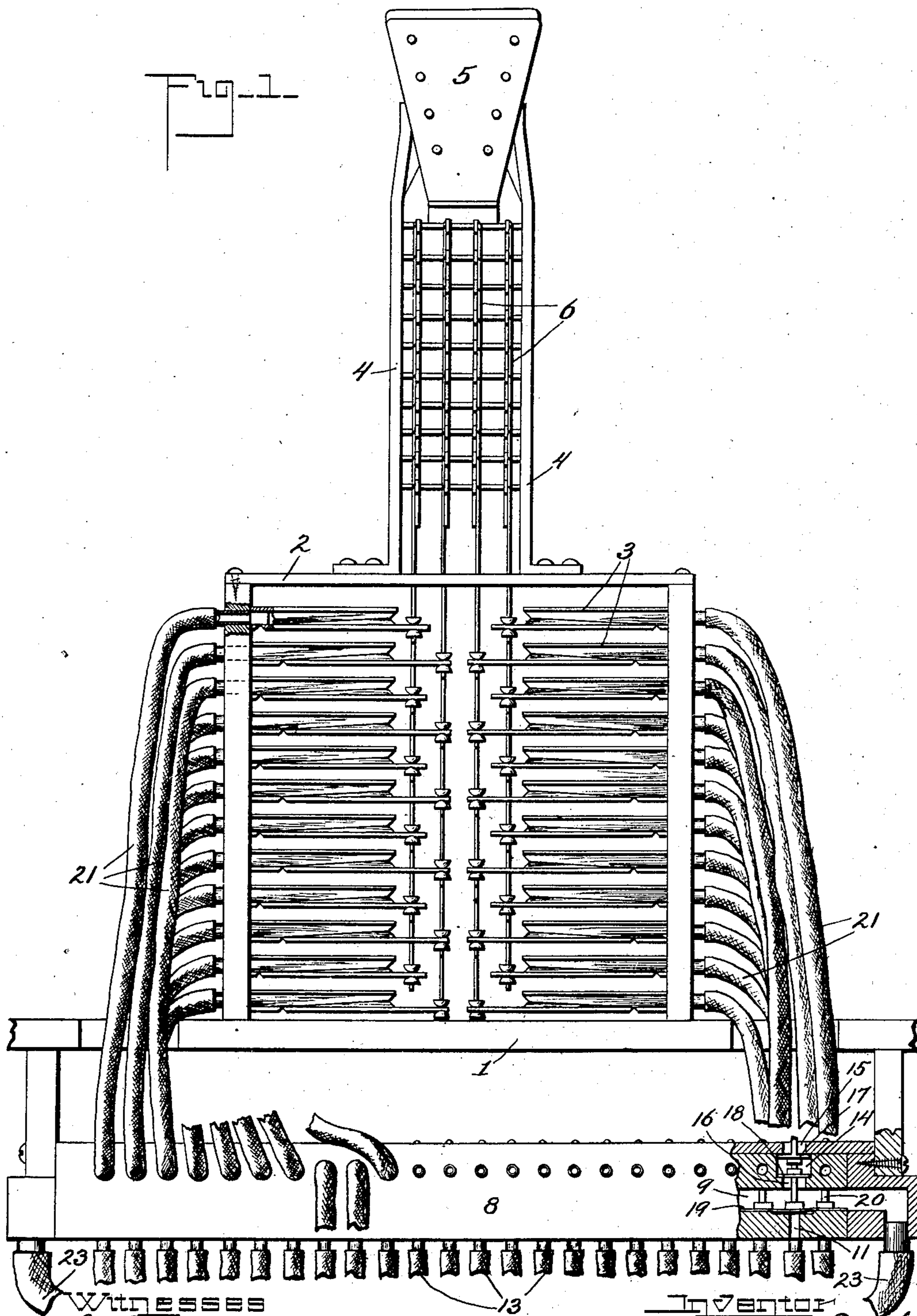
PATENTED FEB. 24, 1903.

H. M. SMITH.
MECHANICAL MUSICAL INSTRUMENT.

APPLICATION FILED NOV. 10, 1900.

NO MODEL.

4 SHEETS—SHEET 1.



Witnesses
Geo. D. Perry
J. B. Weir

Inventor
Harry M. Smith
By Chas. C. Bulkeley
Att.

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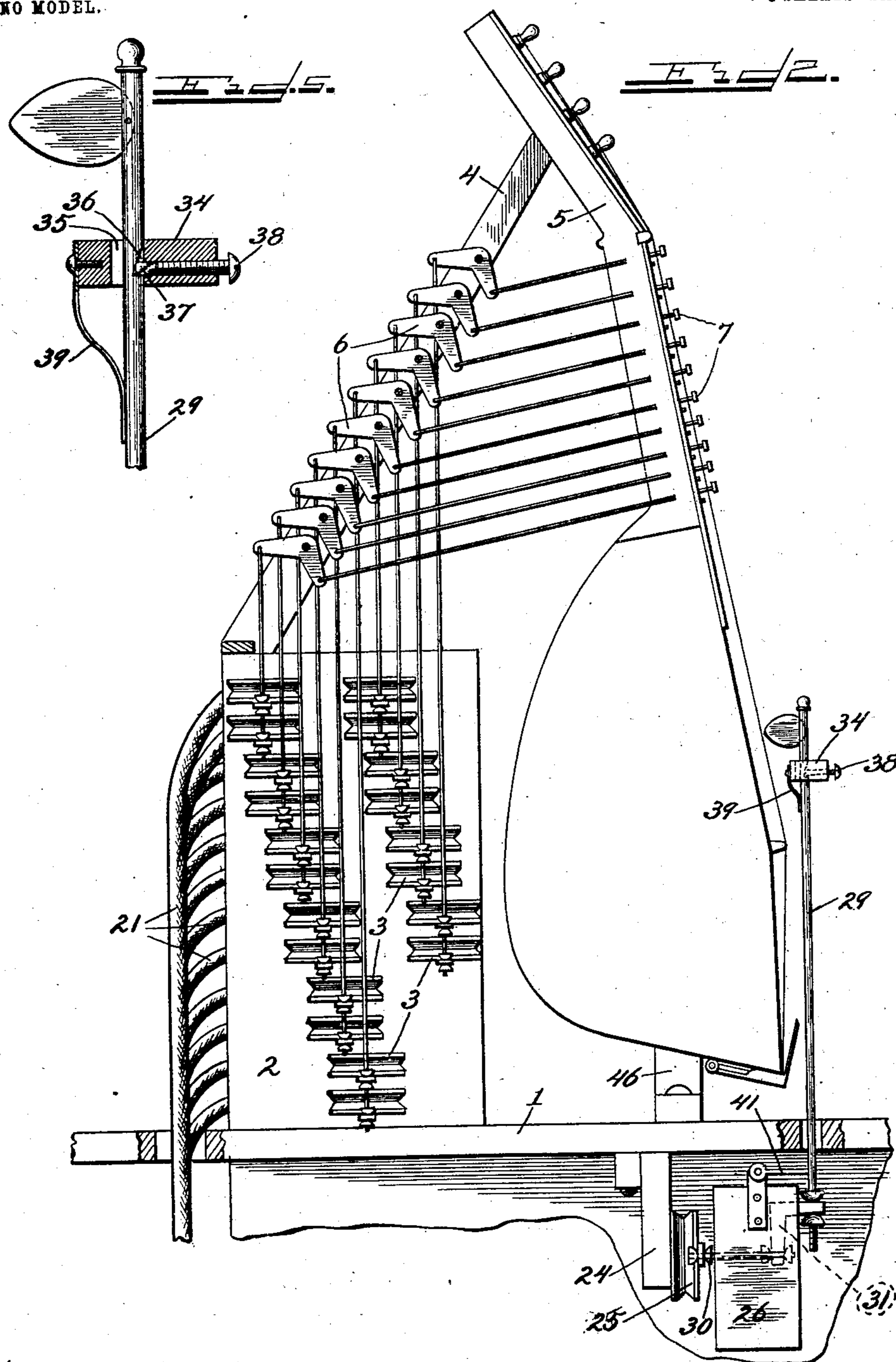
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Witnesses
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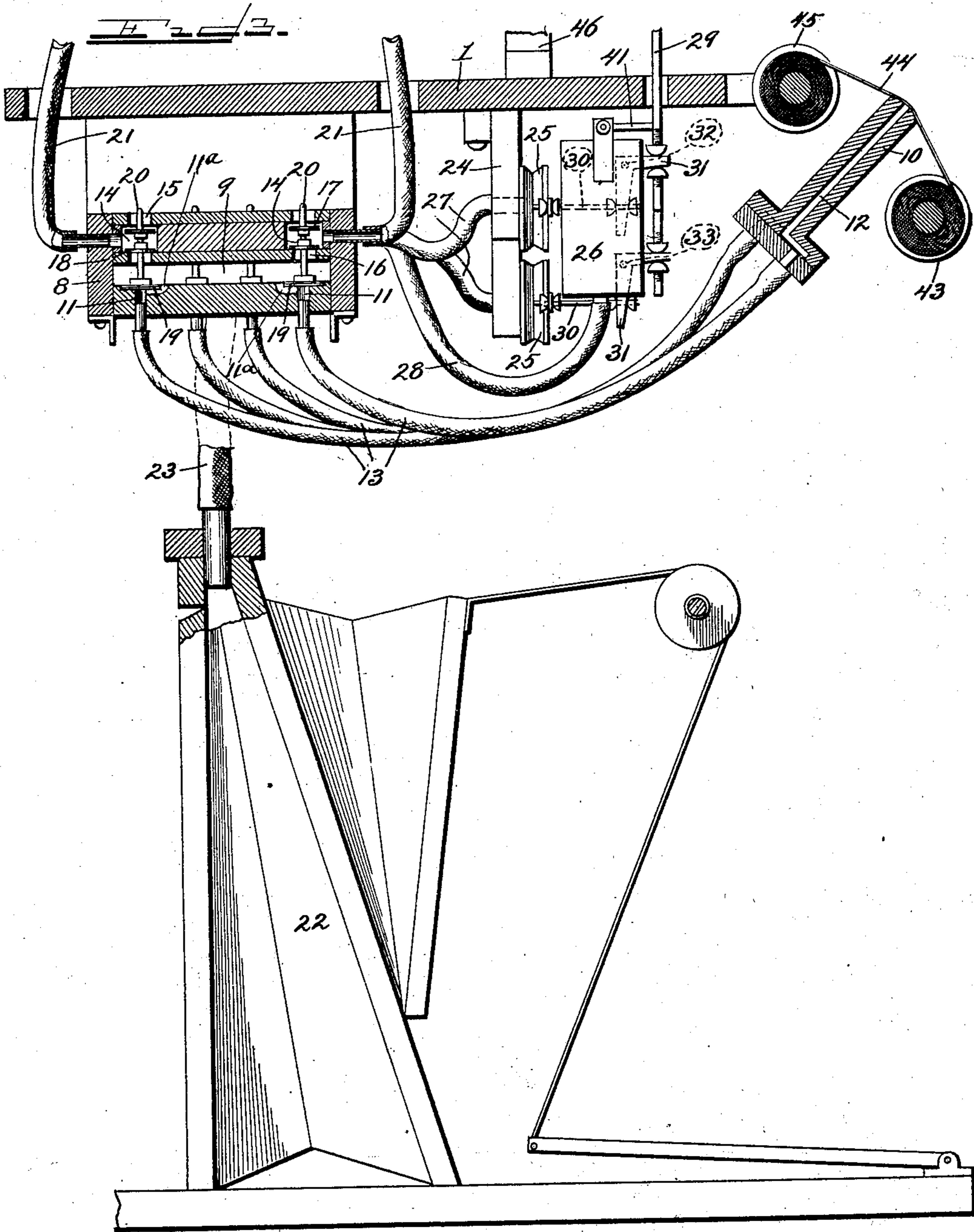
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WITNESSES
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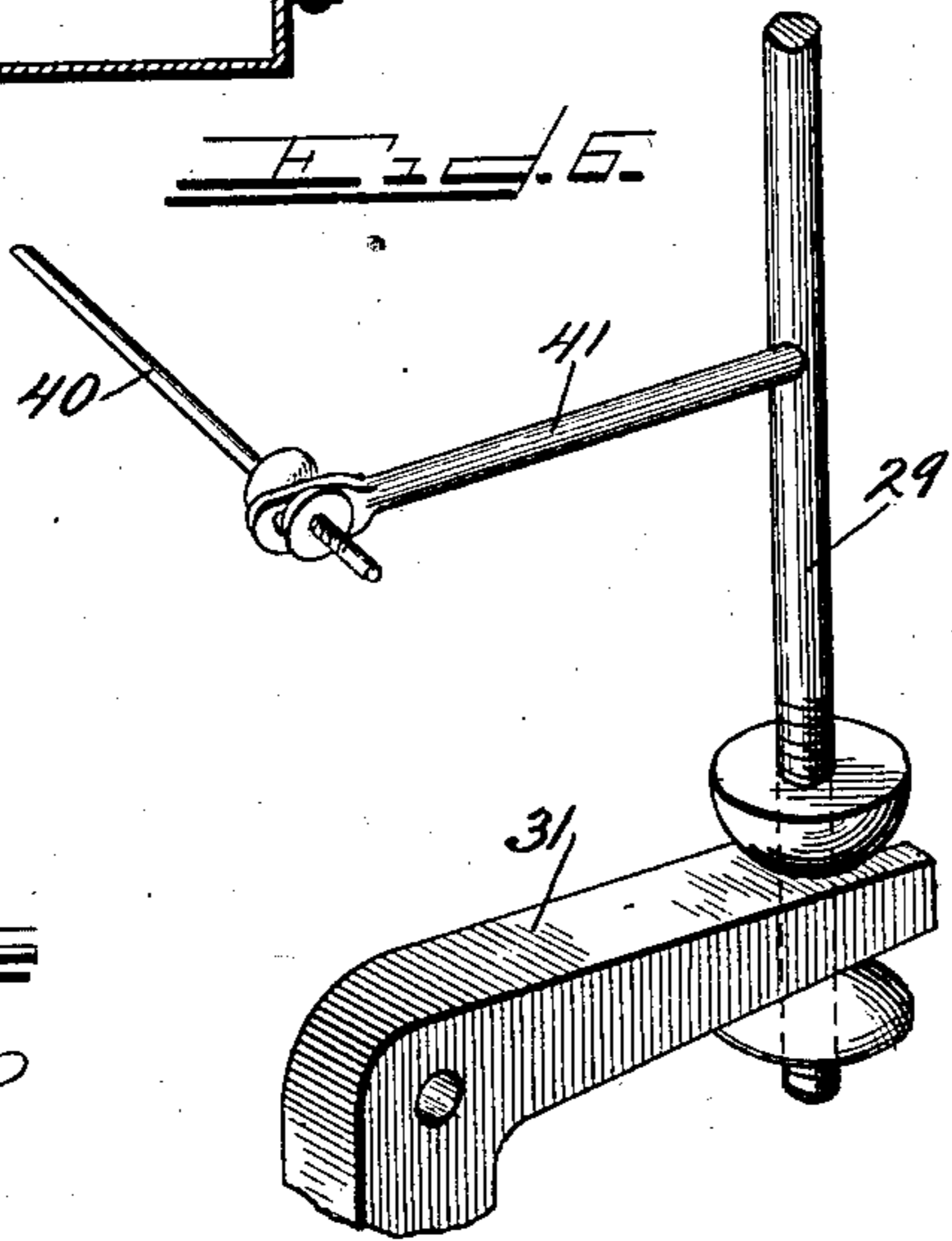
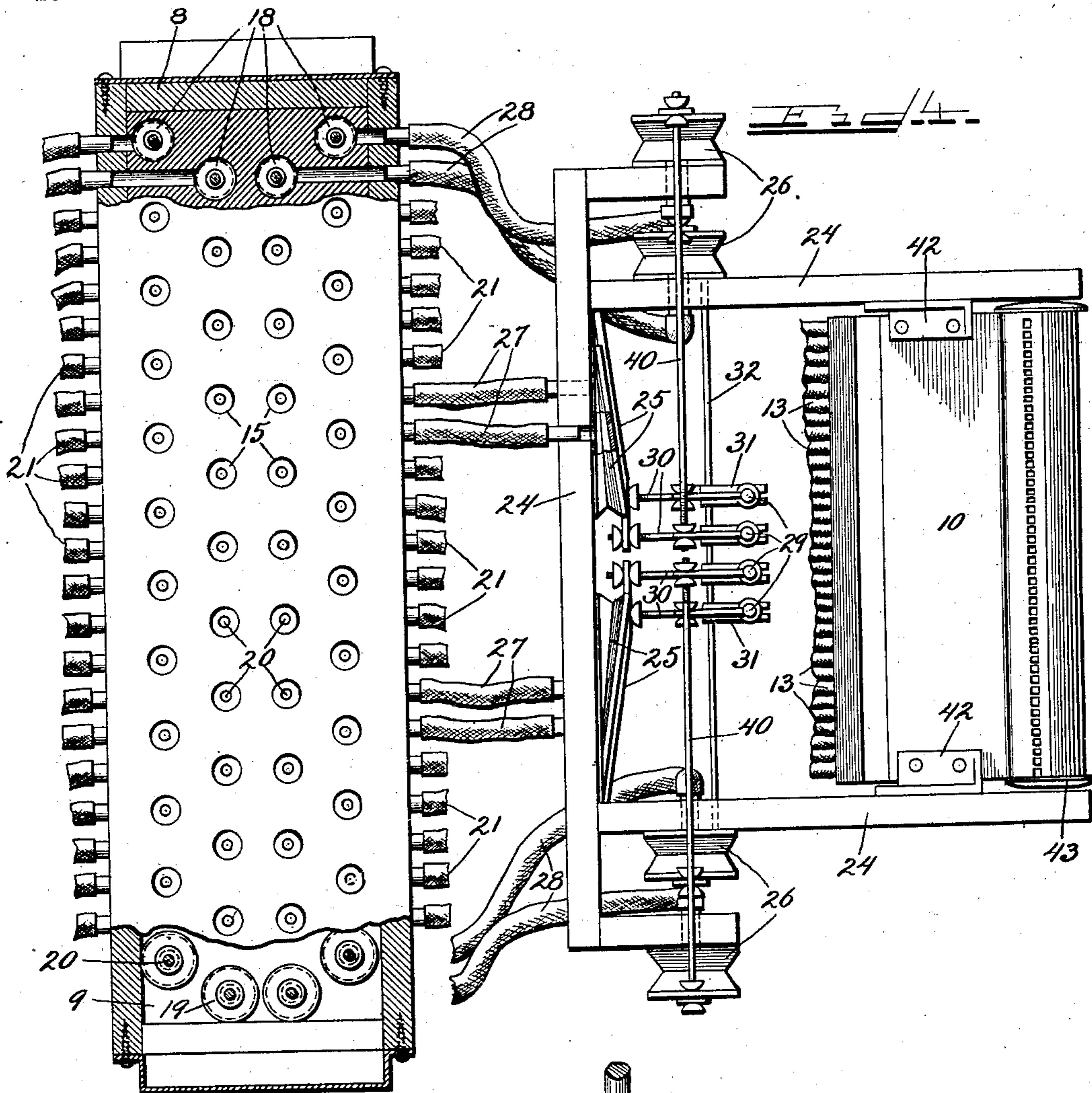
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4 SHEETS—SHEET 4.

NO MODEL.



Witnesses

Ira D. Perry
J. B. Wein

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Harry M. Smith
 By Chas. C. Burley.
 atty.

UNITED STATES PATENT OFFICE.

HARRY M. SMITH, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-THIRD TO
MATTHEW SINCLAIR, OF WESTFIELD, NEW JERSEY.

MECHANICAL MUSICAL INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 721,248, dated February 24, 1903.

Application filed November 10, 1900. Serial No. 36,027. (No model.)

To all whom it may concern:

Be it known that I, HARRY M. SMITH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Mechanical Musical Instruments, of which the following is a specification.

My invention relates to mechanism for operating stringed musical instruments of the mandolin and mandola type; and it has for its object to produce an entirely automatic device capable of rendering single or double notes, trills, chords, arpeggios, &c., in the relation and succession called for by any given musical composition with all the musical effects of which such instruments are capable in the hands of a skilful player.

My improvements are based upon the well-known pneumatic mechanism commonly employed in self-playing pianos and organs and known in the music trade as the "pianola," "aeolian," &c. In these devices a roll of perforated paper is caused to travel over the face of a "tracker-board," the said paper controlling the opening and closing of a series of air-ducts in said tracker-board, which ducts communicate through a series of tubes with a primary pneumatic-action containing a vacuum-chamber which is constantly exhausted by an exhaust bellows or blower. From this primary pneumatic-action a series of valve-controlled tubes corresponding to the ducts in the tracker-board lead to a series of pneumatics, which latter actuate a series of fingers that depress the keys of the instrument producing the musical tones. In the application of this mechanism to stringed instruments of the guitar and banjo type a double series of pneumatics has been employed, one series being known as the "power-pneumatics" and actuating the pickers, which by a single movement in one direction cause the strings to vibrate, producing musical sounds, and the other series being known as the "finger-board" pneumatics and controlling the stopping of the strings to produce the proper notes, chords, &c. My present invention contemplates an extended application of this fundamental mechanism and its operative principle to instruments which are strung double—i. e., in which each note is yielded

by a pair of strings tuned in perfect unison, as the mandolin or mandola, and in which the strings are ordinarily struck by a "pick" or "plectrum" instead of being vibrated by the fingers of the operator; and my invention resides, generally speaking, in novel mechanism for securing a fine adjustment or regulation of the position of the picker and for throwing the latter into and out of engaging relation to its string or pair of strings, and, further, in a novel mechanism for producing a movement of the picker-blade or plectrum across the strings to produce a single or a double note or a trill, as desired.

My invention, as applied to an ordinary form of mandolin, is illustrated in the accompanying drawings, in which—

Figure 1 is a rear view, partly in vertical section, broken away, of the mechanism employed in carrying out my invention. Fig. 2 is a similar side elevation thereof. Fig. 3 is a vertical transverse section through the tracker-board and paper-rolls and the primary pneumatic-action, showing the connection of the former with the latter and also showing a foot-power bellows for exhausting the vacuum-chamber in the primary pneumatic-action. Fig. 4 is a plan view of Fig. 3 with certain parts removed and others drawn in section to more clearly illustrate the mechanism. Fig. 5 is a detail, in enlarged vertical section, of the means I have devised for adjusting the pickers relatively to their respective strings and for moving them into and out of position to act on said strings; and Fig. 6 is an enlarged detail in perspective, broken away, showing part of the mechanism for effecting the double (longitudinal and oscillatory) movement of the picker-rods.

Like numerals of reference refer to like parts throughout the several views.

I will first briefly describe such parts of the mechanism as are substantially old and well known in analogous mechanical musical instruments and I will then more particularly set forth the additions and improvements forming the subject-matter of my present invention and show the connection of the latter with the former.

1 represents a table or shelf which may be supported from the floor or walls in any suit-

able manner and which supports the principal operative parts of my device.

2 designates a frame resting on the table 1 and containing a series of finger-board pneumatics 3. Resting on and secured to the frame 2 is a yoke 4, the upper end of which rigidly supports the neck of the instrument 5 near its outer extremity and within which yoke are pivoted a series of bell-crank levers 6, forming an intermediate connection between the finger-board pneumatics 3 and their corresponding stops 7 in a manner plainly shown in Fig. 2.

Supported by and beneath the table 1, in the manner plainly shown in Figs. 1 and 3, is a chest 8, containing the vacuum-chamber 9 and a series of valve-chambers and ports and passage-ways controlling the communication between the said vacuum-chamber and the various pneumatics, which chest 8, with its contained parts, is termed as a whole the "primary pneumatic-action," inasmuch as through its agency the operation of all the pneumatics is governed and controlled from the tracker-board 10. Through the floor of the vacuum-chamber 9 are formed a series of ports 11, corresponding in number to the ducts 12 in the tracker-board, said ports and ducts being severally connected by a like number of tubes 13. In the upper part of the chest 8, above the vacuum-chamber 9, are cored a series of valve-chambers 14, directly above the ports 11 and having top and bottom ports 15 and 16, communicating, respectively, with the atmosphere and the vacuum-chamber 9. The valve-disks 17 18 and the diaphragm 19, mounted on a common stem 20, control the opening and closing of the ports 15, 16, and 11, respectively, in the manner plainly shown in Fig. 3. From a number of said valve-chambers 14, corresponding to the number of finger-board pneumatics employed, lead off laterally a series of tubes 21, connected to and communicating severally with said finger-board pneumatics, as best shown in Figs. 1 and 4.

At 22 I have shown a means for maintaining a vacuum in the chamber 9, the same consisting in the illustration shown of an ordinary treadle-operated exhaust-bellows connected with said vacuum-chamber by a pair of tubes 23. An exhaust fan or blower or any other equivalent suction device may be employed when desired.

The mechanism as thus far described is old in its principle of operation and in substantially the same coöperative relation of its parts in various forms of mechanical piano and organ playing devices, wherein the pneumatics through suitable rod and lever connections operate to strike or depress the keys of the instrument. When applying or extending this principle to a stringed instrument, such as the mandolin, however, new problems arise for solution, inasmuch as mechanical substitutes for a much greater number and variety of manual movements must

be provided in the organization of the mechanism itself, and it is in the provision of means for effecting the adjustment and compound movement of the picker whereby I can produce all the various strokes and effects known in the art of mandolin playing mechanically with far greater rapidity, smoothness, and certainty than by the human hand that my present invention resides, and my preferred form of such means will next be described.

Referring to Fig. 4, 24 designates a suitable framework secured beneath and extending in front of the table 1. To the rear wall of this framework are secured four pneumatics, which as they are identical in construction, arrangement, and function I designate by the same reference-numeral 25, and to the forwardly-extending sides or arms of said framework are secured four more similar pneumatics 26, arranged at right angles to the group 25. The pneumatics 25 communicate through tubes 27 with certain of the valve-chambers 14 in the chest 8, and the pneumatics 26 similarly communicate through tubes 28 with certain other valve-chambers 14 in the chest 8. It may here be remarked that all the pneumatics of the system operate in one direction of movement (the closing) by suction and in the other direction or movement (the opening) by spring action. One pneumatic of each of these groups is connected with and actuates one of the four pickers 29 by the means and in the manner now to be described. In the free ends of the expansible sides of the pneumatics 25 are secured rods 30, the outer ends of which engage the depending arms of a series of bell-crank levers 31, pivoted upon a pair of transversely-extending rods 32 33, Figs. 3 and 4. The horizontal arms of said bell-cranks engage the lower ends of a series of vertically-disposed rods comprising the stems of the pickers 29 in the manner best shown in detail in Fig. 6. These picker-rods pass loosely through holes in the table 1 and are guided and supported near their upper ends in a transversely-extending bar 34 in the manner and by the means clearly shown in Fig. 5. Through said bar 34 and opposite the strings of the instrument are formed a series of vertical transverse slots 35, one for each picker-rod. These slots are made just wide enough to allow the picker-rods to play therein sufficiently to carry the point of the picker-blade or plectrum from a position just above a pair of strings to a position just below them, and vice versa. A cam-notch 36, cut in the back of each picker-rod, is engaged by an oblique-faced cam-block 37, backed by a regulating set-screw 38, whereby it will be seen a very fine adjustment or regulation of the picker rod or stem can be secured, and when the stem is drawn downwardly, by the means already described, it will be thrown forward by the coöperation of the notch 36 and block 37 across the slot 35 till the point of the plectrum

is below and in an operative position relatively to its string. A spring 39 normally tends to press the stem back into its outer or inoperative position.

5 The mechanism thus far described operates to draw the pickers into and out of operative position with relation to their respective strings. I will next describe the mechanism for oscillating the pickers, whereby the point
10 of the plectrum of the latter is caused to sweep across the strings, vibrating the latter and producing a musical tone. The four pneumatics 26 are the principal agents for producing this result. Through the free ends of the
15 expansible sides of said pneumatics are secured rods 40, the other ends of which rods engage lateral arms 41, formed on each of the rods or stems of the pickers 29 in the manner plainly shown in the detail view Fig. 6.
20 From this mechanism it is plain that a longitudinal reciprocating movement of said rods 40 will cause the picker-rods to oscillate on their longitudinal axes, thus causing an oscillation of the picker-blades or plectrums
25 across their respective strings.

Between the two inner and longer forwardly-extending sides of the framework 24 may be secured, as by brackets 42, the tracker-board 10, and beyond the latter is removably
30 journaled a spool 43, containing a roll of perforated paper 44, from which in the operation of the mechanism the paper is unwound, passing over the face of the tracker-board, and being rewound on a receiving-spool 45, similarly journaled in the forwardly-projecting
35 portion of the table 1. Any suitable and known gearing may be employed for rotating the receiving-spool 45 at the required speed from the treadle of the exhaust-bellows or
40 other operating device, such gearing not being herein shown, as it forms no part of my present invention.

The instrument to be played upon is rigidly supported at its lower or body end on a
45 suitably-shaped bracket 46, secured to the table 1, and its neck beyond the finger-board is rigidly held between the arms of the yoke 4, as plainly shown in Figs. 1 and 2. The instrument is so positioned as to bring each of
50 its four pairs of strings just behind or below and slightly to one side of the point of its respective picker-blade or plectrum.

In operating my invention a spool 43, containing the perforated-paper roll of any desired musical composition, is selected and put
55 in place, as shown in Fig. 3. The outer end of the roll is passed over the face of the tracker-board 10 and is then secured in the drum of the empty receiving-spool 45, all in the manner well known and understood in instruments of this general character, such as the pianola. With reference, however,
60 to the character of the perforated paper employed on an instrument such as I have described it will be noted that three distinct sets of perforations will be employed to perform the three functions of operating the fin-

ger-board pneumatics 3 and the two sets of power or picker pneumatics 25 and 26. The bellows 22 being then continuously operated
70 a substantial vacuum is created and maintained in the chamber 9. Whenever now a perforation in the paper-roll 44 registers with one of the ducts 12 in the tracker-board 10, air at atmospheric pressure is admitted to
75 said duct and its connected tube 13 and will raise the latter and with it the valve-stem 20 and its connected valve-disks 17 and 18, thus by the closing of valve 17 cutting off the communication between the outer air and one
80 of the finger-board or power pneumatics through its tube 21, 27, or 28, as the case may be, and through open valve 18 throwing said pneumatic into communication with the vacuum-chamber 9, whereby the movable side of
85 said pneumatic is instantly closed and held closed as long as the exhaust communication thereto is maintained. This of course is determined by the length of the aperture in the paper-roll that is in registry with that particular duct 12 of the tracker-board. At the
90 instant said duct is closed by a solid section of the paper-roll the vent or small duct 11^a allows air to escape from the tube 13 into chamber 9, and in this way the pressure below the diaphragm or pallet 19 being relieved
95 the valves 18 and 19 return to the position shown in Fig. 3. This instantly cuts off the vacuum communication to the pneumatic and opens the air communication through open
100 port 15, whereupon the pneumatic instantly expands under spring action, its movable side returning to the normal open position. In the above-described manner all of the pneumatics are caused to operate in proper rela-
105 tive time and order, as determined by the perforations in the paper roll. The actuation of the finger-board pneumatics 3 through the described connections causes the buttons 7 to stop the strings at the musical intervals
110 and in the time and succession demanded by the notes of the composition being played. The actuation of each of the four pneumatics 25 through the connections described draws its respective picker 29 down into operative
115 position relatively to its string, and the instantly-following actuation of its associated pneumatic 26 oscillates the picker and draws the point of its plectrum across the strings, thus producing a musical tone. If a single
120 stroke only is called for, the pneumatic 25 will by its expanding movement return the picker to its upper or inoperative position prior to the return stroke of the picker by the expanding movement of the pneumatic
125 26, the plectrum swinging back idly above the strings. If a double note is required, the pneumatic 25 will be kept closed while the pneumatic 26 is making both its opening and closing movements. In this case the point
130 of the plectrum will sweep the strings in both directions. If a trill is required, the pneumatic 25 will be kept exhausted for a still longer period, while the pneumatic 26 is

opened and closed several times in very rapid succession. If an arpeggio or rapid run is to be executed, the pickers will be actuated singly in rapid succession, and a full chord may be struck by actuating all the pickers simultaneously and singly, doubly, or in the manner of a trill, as desired. It will be understood that the character of the musical notes produced, the period or tempo allowed to each, and the relative order or succession in which they are rendered are all determined by the character and order of the perforations in the paper-roll.

It will be seen that each picker consists, preferably, of a plectrum mounted upon the upper end of a rod or stem and that each picker thus constructed is mounted and arranged for rotary movement. As explained, this rotary movement is preferably only partial, and for this reason the movement of the pickers more specifically considered is of an oscillating character. Furthermore, each picker is arranged for longitudinal or endwise shift in a direction parallel or substantially parallel with the strings of the instrument. This shift, as explained, is preliminary to the actuation of the picker and is for the purpose of bringing the latter into an operative position. For this reason such longitudinal shift is also accompanied by a lateral shift of the said rod or stem, the two movements in this way combining to bring the picker into the desired position. As explained and in order to secure better results, the pickers are preferably of a rotary character, each picker being capable of rotative movement about an axis extending parallel or substantially parallel with the strings of the instrument. The adjusting-screws are provided for changing the normal position of the pickers, and with the change in the normal position each picker is of course caused to assume a different position while operating. In other words, an adjustment of one of the screws to an extent to move the picker toward the strings not only alters the normal position of the picker, but also produces a lateral shift of the axis about which the picker rotates while picking or engaging the strings. The pneumatics serve as picker-shifters coöperating with the cams in the bar 34 in causing the plectrums to move toward the strings. It will also be observed that the bell-cranks 31 provide axially-shifting bearings for the lower ends of the rods 29. This method of mounting and operating the pickers is simple and effective and is instrumental in securing the desired musical effects.

My invention is not only capable of rendering any musical composition adapted to be manually performed upon the mandolin or mandola, but the scope of its finger-board operating mechanism is manifestly far beyond the possibilities of the human hand. The pickers also operate with perfect smoothness, evenness, and uniformity, and I have found by experiment are capable of trilling

at a speed far exceeding the similar manual effort of the most expert performers.

I am aware that in analogous pneumatic mechanisms for playing such instruments as the banjo and guitar pneumatically-operated pickers for vibrating the strings have been employed; but so far as I am aware such pickers have been incapable of adjustment relatively to the strings and have had but a single movement in one direction. My invention is distinguished from all such in that it purposes and accomplishes not only a fine adjustment of the pickers, but also a double or compound movement of the same, such a movement being practically a necessity in connection with instruments which are strung double and played in the peculiar manner of the mandolin and kindred instruments. I do not, therefore, limit myself to the precise mechanism shown and described for effecting this result, as it is obvious that numerous changes and modifications might be made and mechanical equivalents substituted in said mechanism without departing from the principle or scope of my invention.

I claim as my invention—

1. The combination with a stringed musical instrument of the character specified, of a picker supported in proximity to its respective string, but normally held out of operative relation thereto, pneumatically-actuated means for drawing said picker into operative relation to its string prior to its engagement with said string, and pneumatically-operated means for actuating said picker while the latter is in its operative position.

2. The combination with means for rigidly supporting a stringed musical instrument of the character specified of a picker supported in proximity to its respective string, but normally held out of operative relation thereto, said picker being mounted for rotative movement about an axis extending parallel or substantially parallel with said string, pneumatically-actuated means for first drawing said picker into operative relation to its string, and other pneumatically-actuated means for subsequently causing the picker to vibrate its string.

3. The combination with means for rigidly supporting a stringed musical instrument of the character specified of a picker supported in proximity to its respective string, but normally held out of operative relation thereto, pneumatically-actuated means for first drawing said picker into operative relation to its string, and other pneumatically-actuated means for subsequently oscillating said picker on its longitudinal axis, whereby the point of its plectrum is caused to sweep across and vibrate the string.

4. The combination with a picker and a rigid slotted support through which the stem of the picker passes of a cam-block carried by one of said parts, which, when the picker is in inoperative position, engages a cam-notch formed in the other of said parts, pneu-

5 matically-actuated means for drawing said picker in the direction of its longitudinal axis, whereby the picker is placed in operative relation to its respective string, and pneumatically-operated means for vibrating or actuating said picker while held in its operative position.

10 5. The combination with a picker and a rigid slotted support through which the stem of the picker passes of a cam-block carried by one of said parts, which, when the picker is in inoperative position, engages a cam-notch formed in the other of said parts, pneumatically-actuated means for first drawing
15 said picker in the direction of its longitudinal axis, whereby the picker is placed in operative relation to its respective string, and other pneumatically-actuated means for subsequently oscillating said picker on its longitudinal axis, whereby the point of its plectrum is caused to sweep across and vibrate
20 the string.

6. In an instrument of the character described, a picker normally supported with the
25 point of its plectrum above and slightly to one side of its respective string, in combination with means for adjusting the distance of said plectrum above its string, so as to vary the normal position of said picker, together
30 with pneumatically-operated devices for first shifting said picker toward the string, and also with pneumatic devices for then vibrating or actuating said picker while held in its operative position.

35 7. In an instrument of the character described, a picker normally supported with the point of its plectrum above and slightly to one side of its respective string, in combination with a stationary slotted support in
40 which the stem of said picker is guided, and a set-screw passing through said support and engaging the stem of the picker to adjust the distance of the plectrum above its string.

45 8. In an instrument of the character described, the combination with a picker normally supported with the point of its plectrum above and slightly to one side of its respective string, and means for adjusting the distance of said plectrum above its string, of
50 pneumatically-actuated means for first carrying the point of the plectrum below its string, and other pneumatically-actuated means for subsequently causing the plectrum to strike across and vibrate the string.

55 9. In a mechanical musical instrument, the combination of a suitable stringed instrument, a plurality of pickers adapted for engaging the strings of said instrument, a plurality of rods upon which said pickers are
60 suitably mounted, pneumatically-operated means for causing said rods to shift endwise or longitudinally, cam devices for causing said rods and pickers to shift or move toward the said musical instrument, and pneumatically-operated means for partially rotating or
65 oscillating said rods, so as to cause the pickers to engage the strings of said instrument.

10. In a mechanical musical instrument, the combination of a suitable stringed instrument, pneumatically-operated means for
70 pressing down the strings of said instrument, a plurality of rods arranged practically parallel with said strings and mounted for both rotary and endwise movement, pickers carried by said rods and adapted to engage the
75 strings of said instrument, suitable cam devices for throwing said rods and pickers toward the face of said instrument, pneumatically-operated means for causing endwise or longitudinal shift on the part of said rods for
80 the purpose of bringing the pickers into position to engage the strings of said instrument, crank-arms on said rods, and pneumatically-operated devices having suitable connection with said crank-arms, whereby the
85 rods may be partially rotated or oscillated for the purpose of causing the pickers to engage the strings of said instrument.

11. In a mechanically-played musical instrument, the combination of a plurality of
90 strings, a plurality of pickers suitably associated with said strings, each picker being mounted for rotary movement about an axis extending parallel or substantially parallel with the strings, picker-shifters for causing
95 the pickers to shift axially, cams adapted and arranged to cause the pickers to move toward the strings when shifted axially by the picker-shifters, and picker-actuating members for partially rotating the pickers while held in
100 their shifted positions.

12. In a mechanically-played musical instrument, the combination of a plurality of
strings, a plurality of pickers suitably associated with said strings, each picker consisting of a plectrum mounted upon a stem or
105 rod, a stationary bearing in which said stems or rods are mounted to turn, axially-shifting bearings in which the ends of said rods or stems are mounted to turn, picker-shifter
110 members for shifting said axially-shifting bearings, so as to bring the pickers into position to engage the strings, and picker-actuators for partially rotating said pickers.

13. In a mechanically-played musical instrument, the combination of a plurality of
115 strings, pickers suitably associated with said strings, each picker consisting of a plectrum mounted upon the upper end of a rod, bearings in which the upper end portions of said
120 rods are mounted, each bearing being adapted to permit lateral shift on the part of said rods, springs tending to hold said pickers out of engagement with the strings, picker-shifters for drawing said rods downwardly, cams
125 adapted and operative to shift the pickers toward the strings when the rods are drawn downwardly, and a plurality of pneumatics for causing rotary movement on the part of said rods, so as to cause the plectrums to pick
130 the strings.

14. In a mechanically-played musical instrument, the combination of a plurality of
strings, a plurality of pickers associated with

said strings, each picker consisting of a plectrum mounted upon a rotatable rod or stem, a tracker-board and perforated music, springs tending to normally hold said pickers out of engagement with the strings, pneumatics for causing an endwise shift on the part of said rods or stems, and pneumatics for producing a rotary movement on the part of said rods or stems.

15. In a mechanically-played musical instrument, the combination of a tracker-board, perforated music and rolls controlling the admission of air through the passages of said tracker-board, a plurality of strings, a plurality of pickers associated with said strings, each picker being mounted for rotary movement about an axis extending parallel or substantially parallel with the strings, picker-shifting pneumatics adapted and arranged to be brought into action by the admission of air through the passages of said tracker-board, so as to cause the said pickers to move toward and away from the said strings, and picker-actuating pneumatics also connected and arranged to be suitably brought into action by the admission of air through the passages of said tracker-board.

16. In a mechanically-played musical instrument, the combination of strings, a plurality of pickers associated with said strings, a plurality of pneumatics and cam devices associated with said pickers, the said pneumatics and cam devices coöperating in shifting the pickers toward the strings, springs tending to normally hold said pickers away from the strings, a plurality of pneumatics, and suitable connections between said pneumatics and pickers, the said pneumatics thereby being capable of vibrating the pickers independently of each other.

17. In a mechanically-played musical instrument, the combination of a plurality of strings, a plurality of independently-actuated pickers associated with said strings and mounted for independent oscillatory movement or partial rotation, a plurality of pneumatics connected and arranged to draw the pickers toward the strings, a plurality of suitable pneumatics, suitable power-transmitting connections between said pneumatics and pickers, the said pneumatics thereby being operative to oscillate or partially rotate said pickers independently of each other.

18. In a pneumatically-played musical instrument, the combination of a plurality of strings, a plurality of pickers suitably associated with said strings, each picker being mounted for rotary movement about an axis extending parallel or substantially parallel with the strings, picker-shifting members for both longitudinally and laterally shifting said pickers, and picker-actuating members for causing rotary movement of the pickers while held in operative positions.

19. In a mechanically-played musical instrument, the combination of a suitably-supported stringed instrument, a plurality of independently-actuated pickers associated with the strings of said instrument, each picker consisting of a plectrum having a stem or rod which extends parallel or substantially parallel with the strings, bearings in which each stem or rod is mounted, springs tending to hold the pickers normally away from the strings, means for shifting the pickers toward the strings, and actuating members for causing rotary movement on the part of said stems or rods, so as to cause the said plectrum to strike or engage the strings.

20. In a mechanically-played musical instrument, the combination of a plurality of strings, a plurality of oscillatory or partially-rotating pickers, a crank-arm for each picker, a plurality of pneumatics, and reciprocating rods for connecting the pneumatics with said crank-arms.

21. In a mechanically-played musical instrument, the combination of a plurality of strings, a plurality of oscillatory or partially-rotating pickers associated with said strings, pneumatics and bell-cranks connected and arranged to cause longitudinal shift or endwise movement on the part of said pickers, cam devices for causing the pickers to move toward the strings when thus shifted longitudinally or endwise, a crank-arm for each picker, a plurality of picker-actuators, and reciprocating rods arranged to connect said actuators with said crank-arms.

In testimony whereof I have hereunto set my hand this 2d day of November, 1900.

HARRY M. SMITH.

Witnesses:

CHAS. C. BULKLEY,
W. A. EAGER.