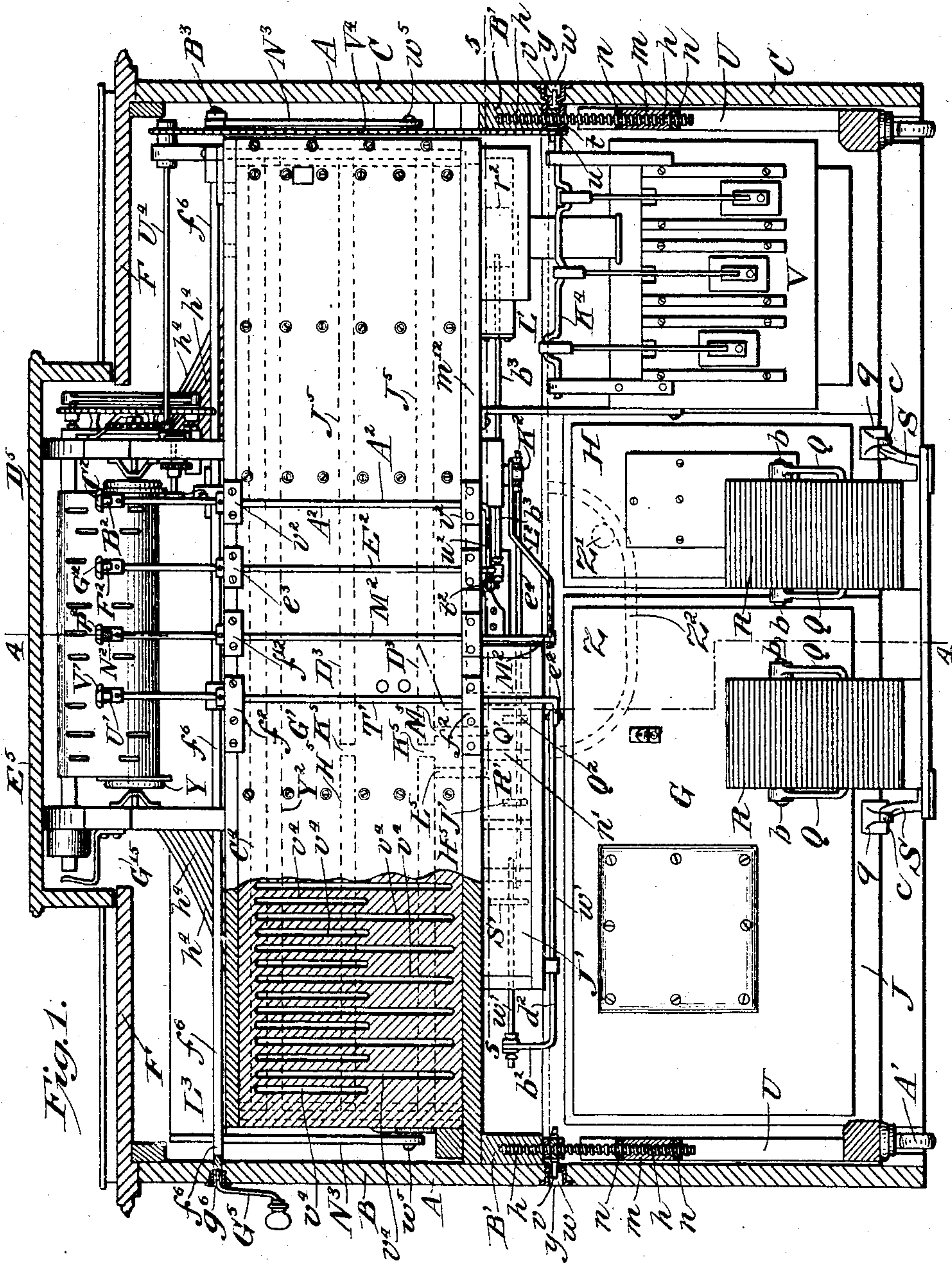


E. S. VOTEY.
KEYBOARD PLAYING ATTACHMENT.

APPLICATION FILED NOV. 16, 1899.

NO MODEL.

8 SHEETS—SHEET 1.



Witnesses
Edw. Mitchell
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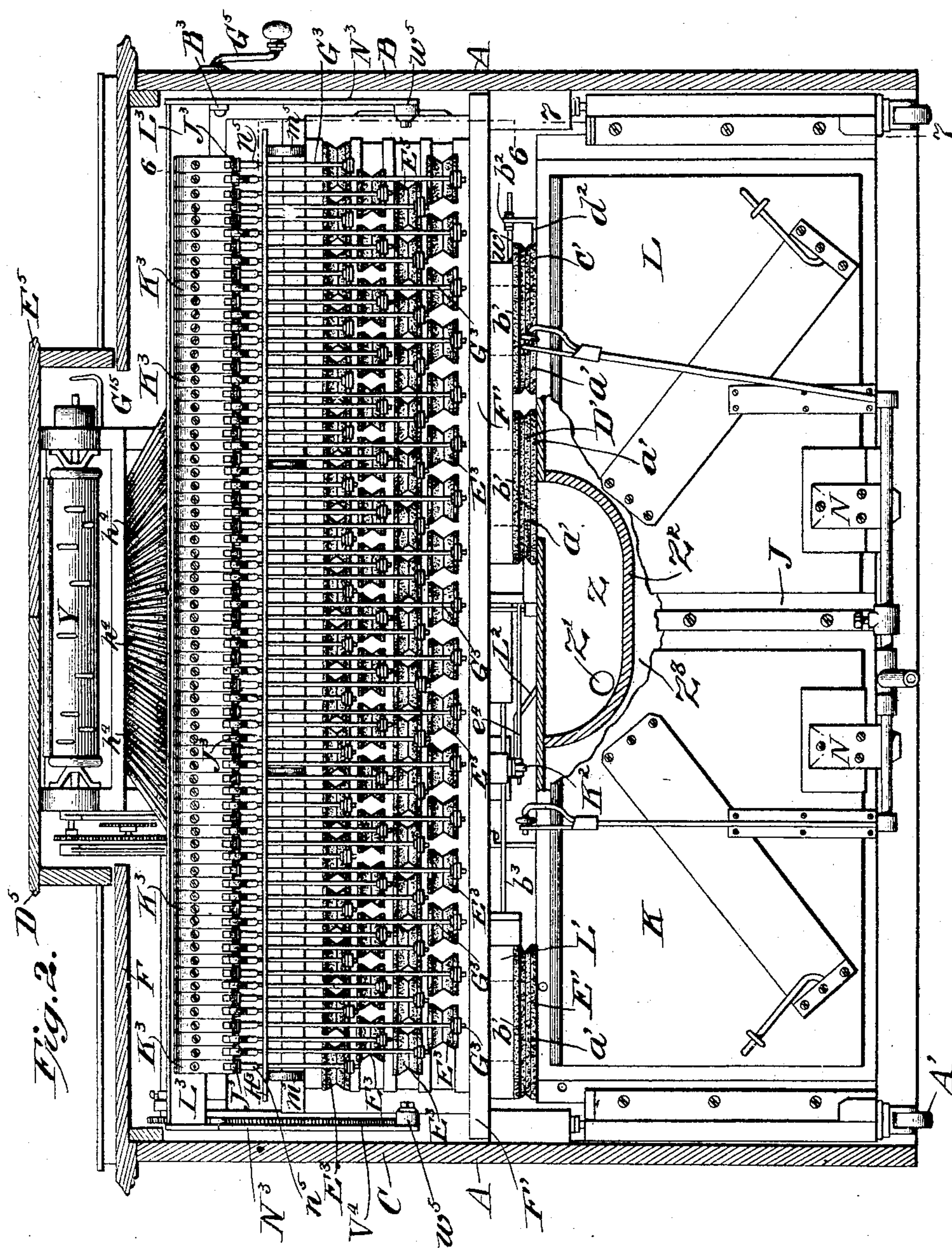
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NO MODEL.

8 SHEETS—SHEET 2.



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No. 765,645.

PATENTED JULY 19, 1904.

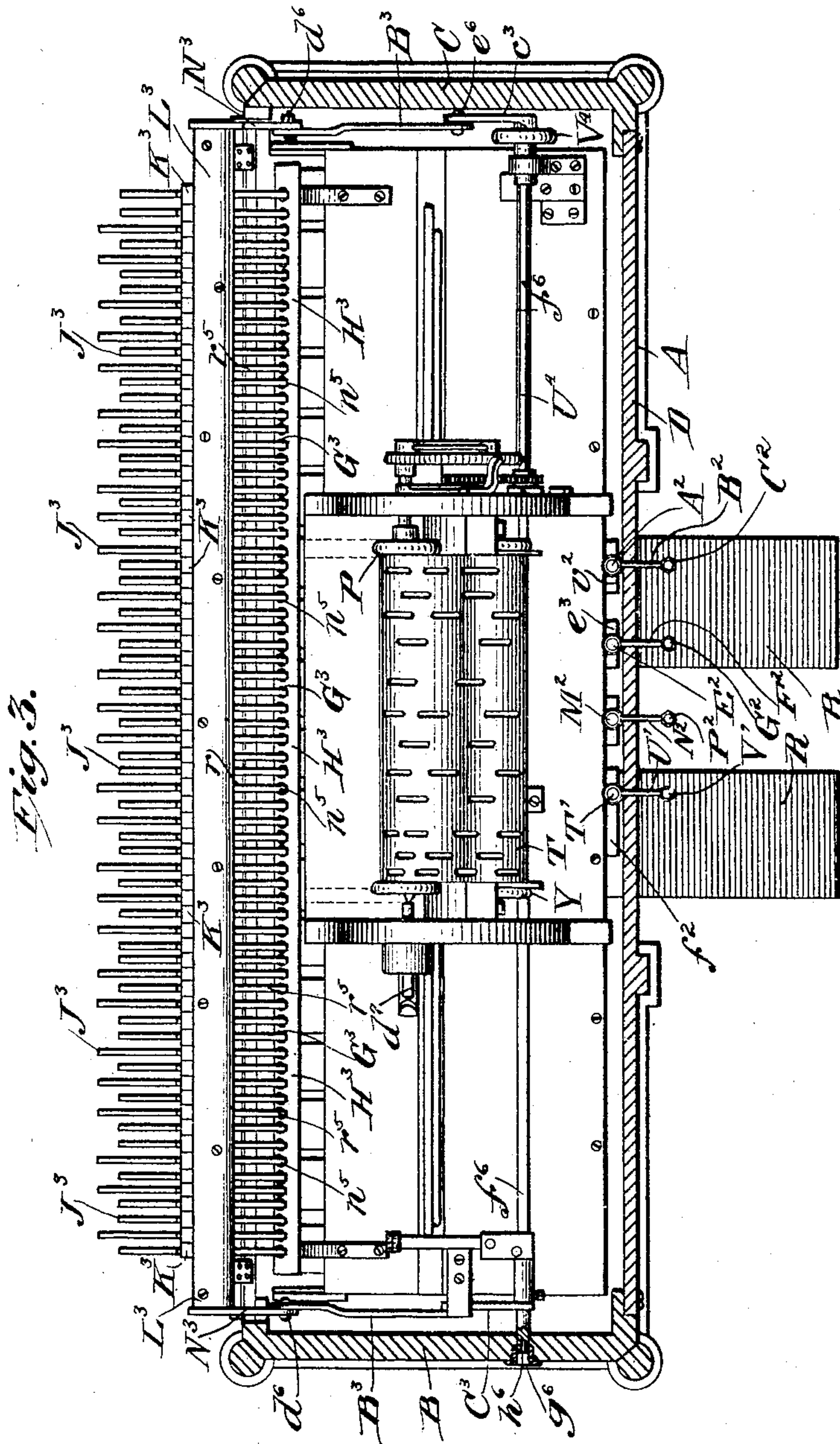
E. S. VOTEY.

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APPLICATION FILED NOV. 16, 1899.

NO MODEL.

8 SHEETS—SHEET 3.



Witnesses
E. Mitchell
 T. W. Oakley

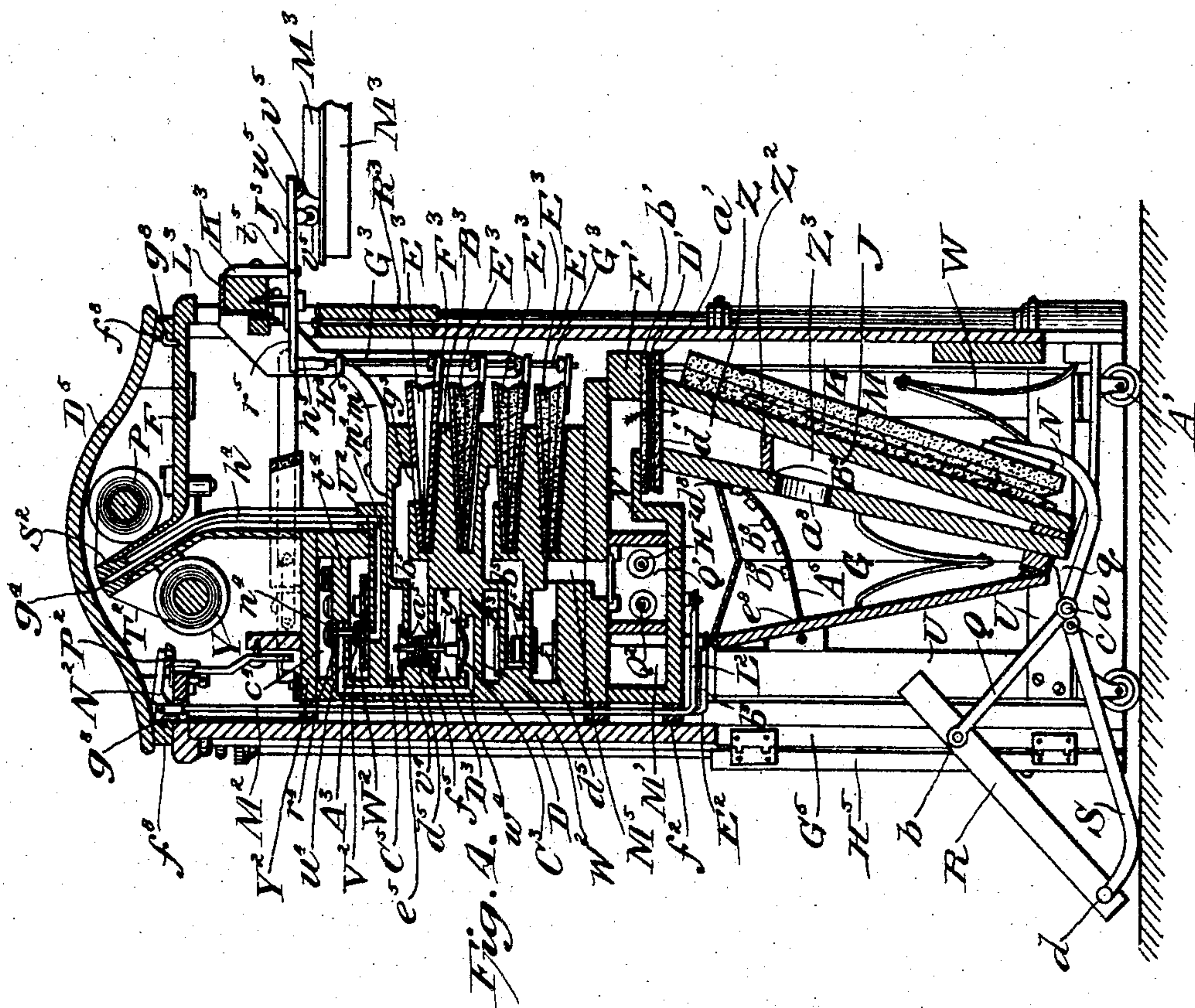
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APPLICATION FILED NOV. 16, 1899.

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8 SHEETS—SHEET 4.



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KEYBOARD PLAYING ATTACHMENT.

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NO MODEL.

8 SHEETS—SHEET 5.

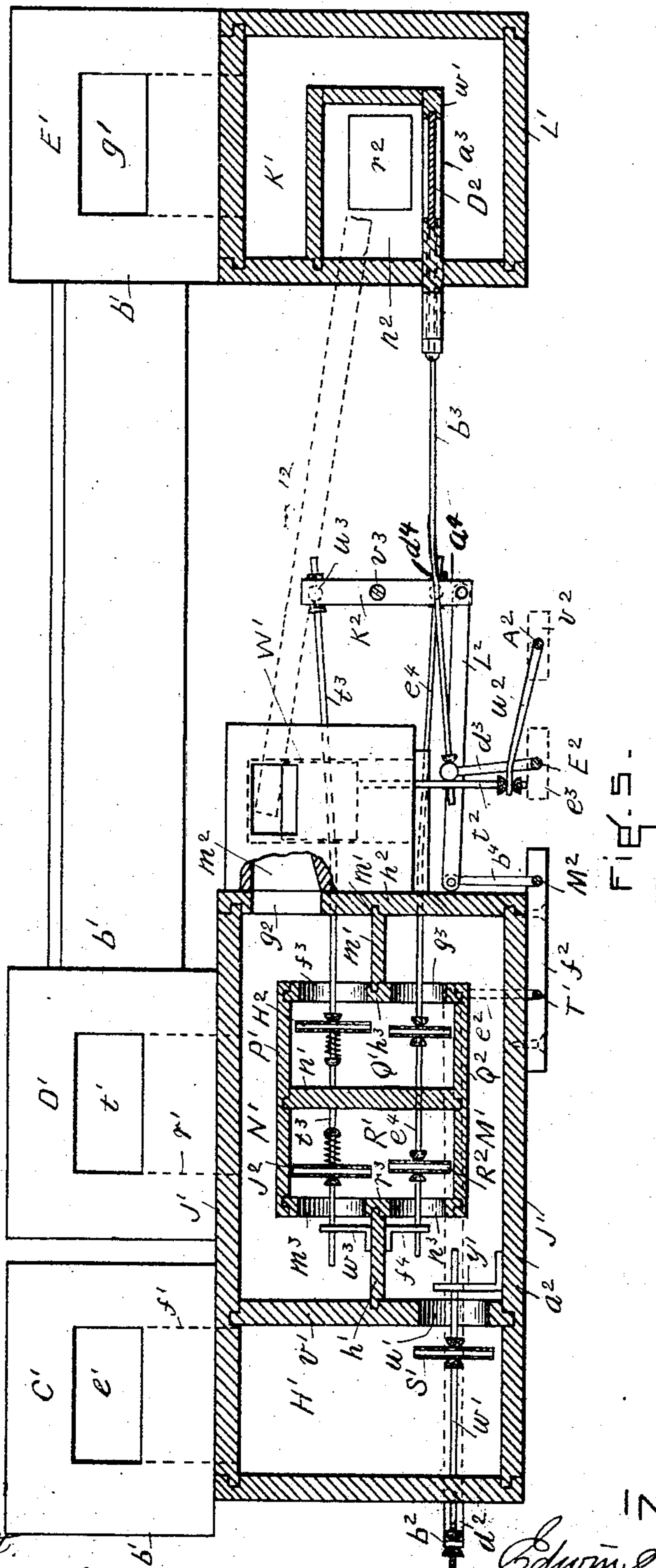


FIG. 5.

WITNESSES

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KEYBOARD PLAYING ATTACHMENT.

APPLICATION FILED NOV. 16, 1899.

NO MODEL.

8 SHEETS—SHEET 6.

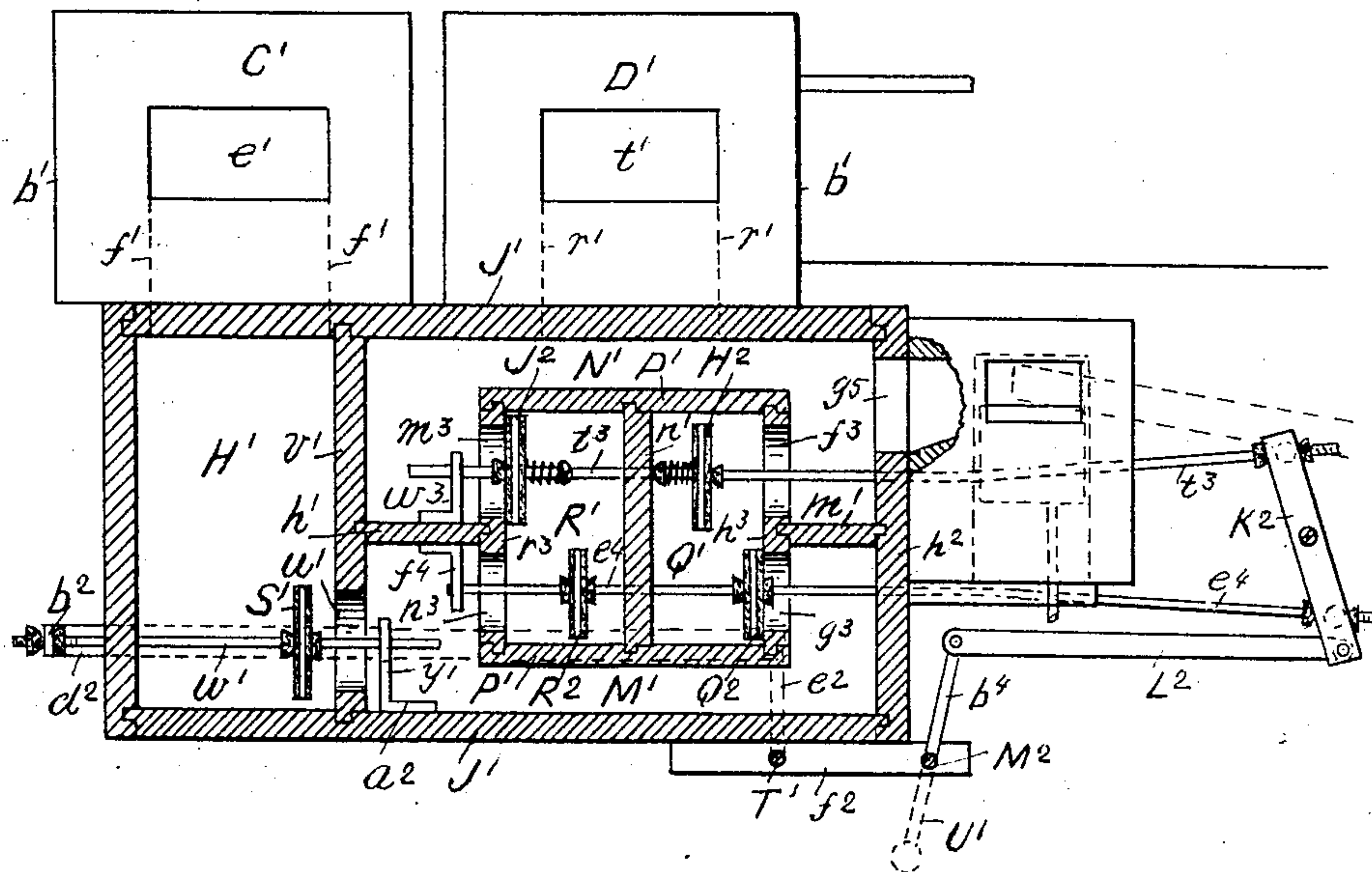


Fig. 5A

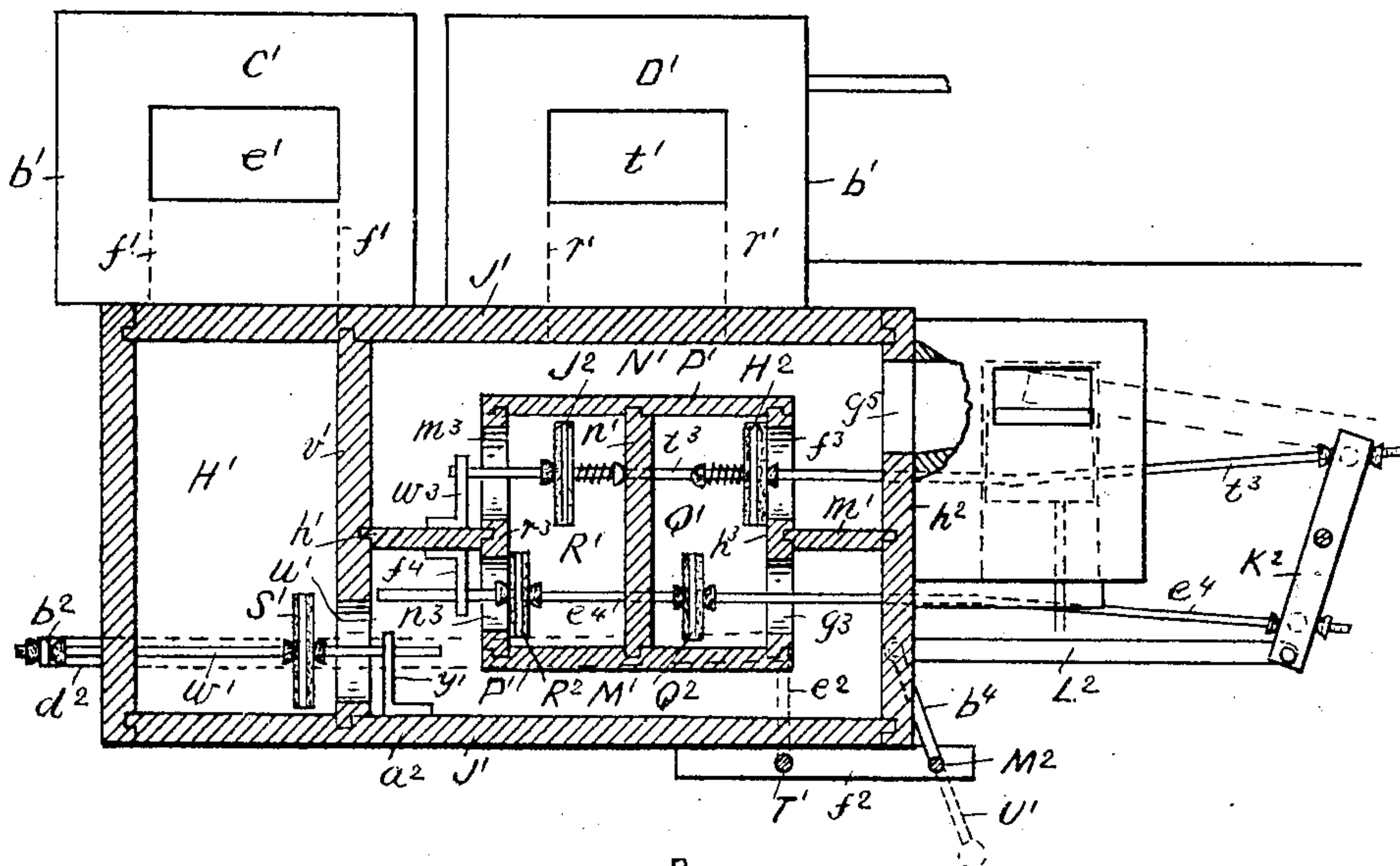


Fig. 5B

WITNESSES

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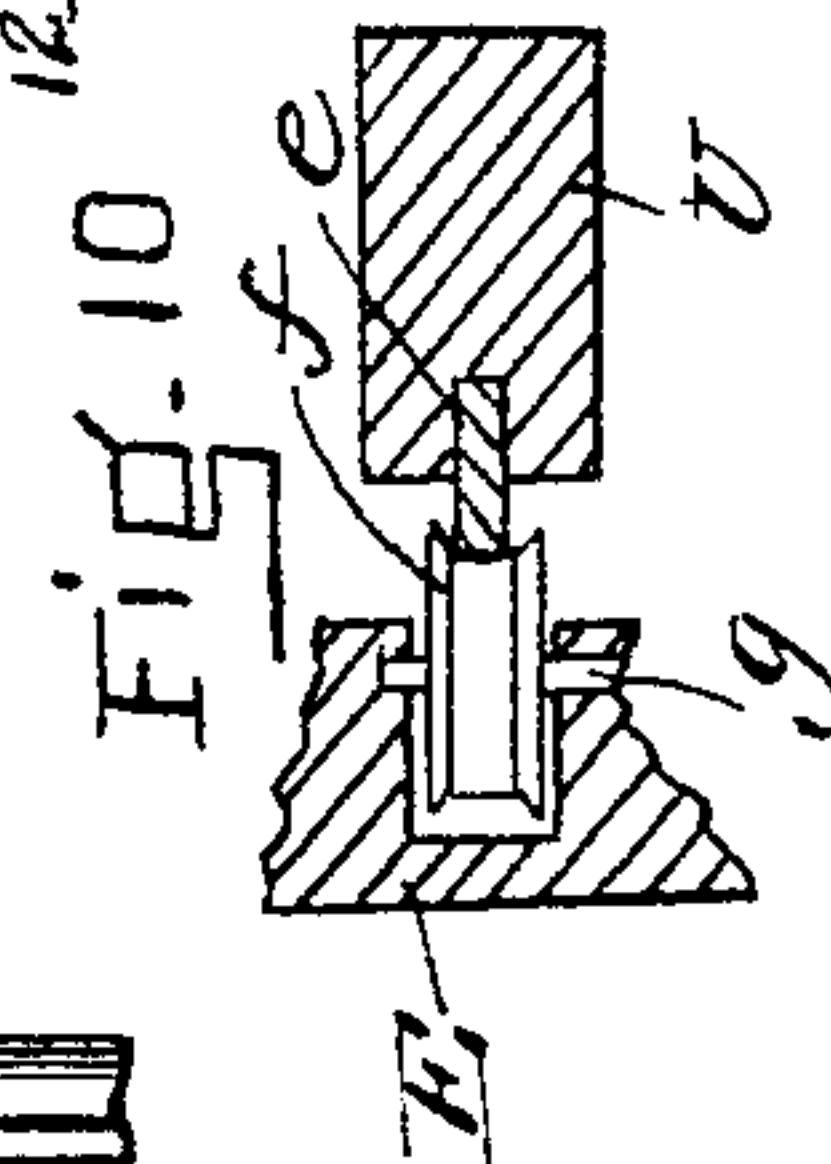
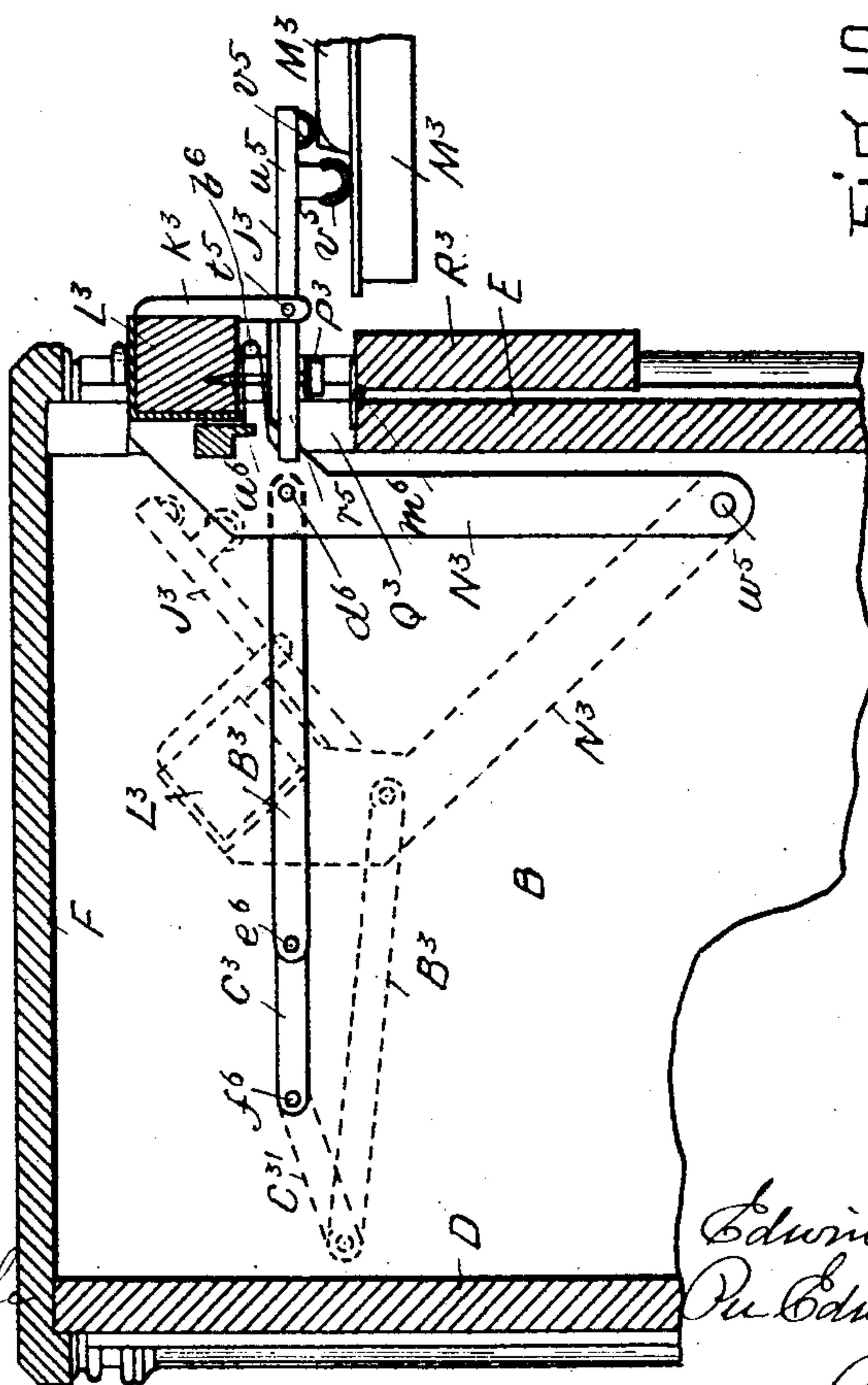
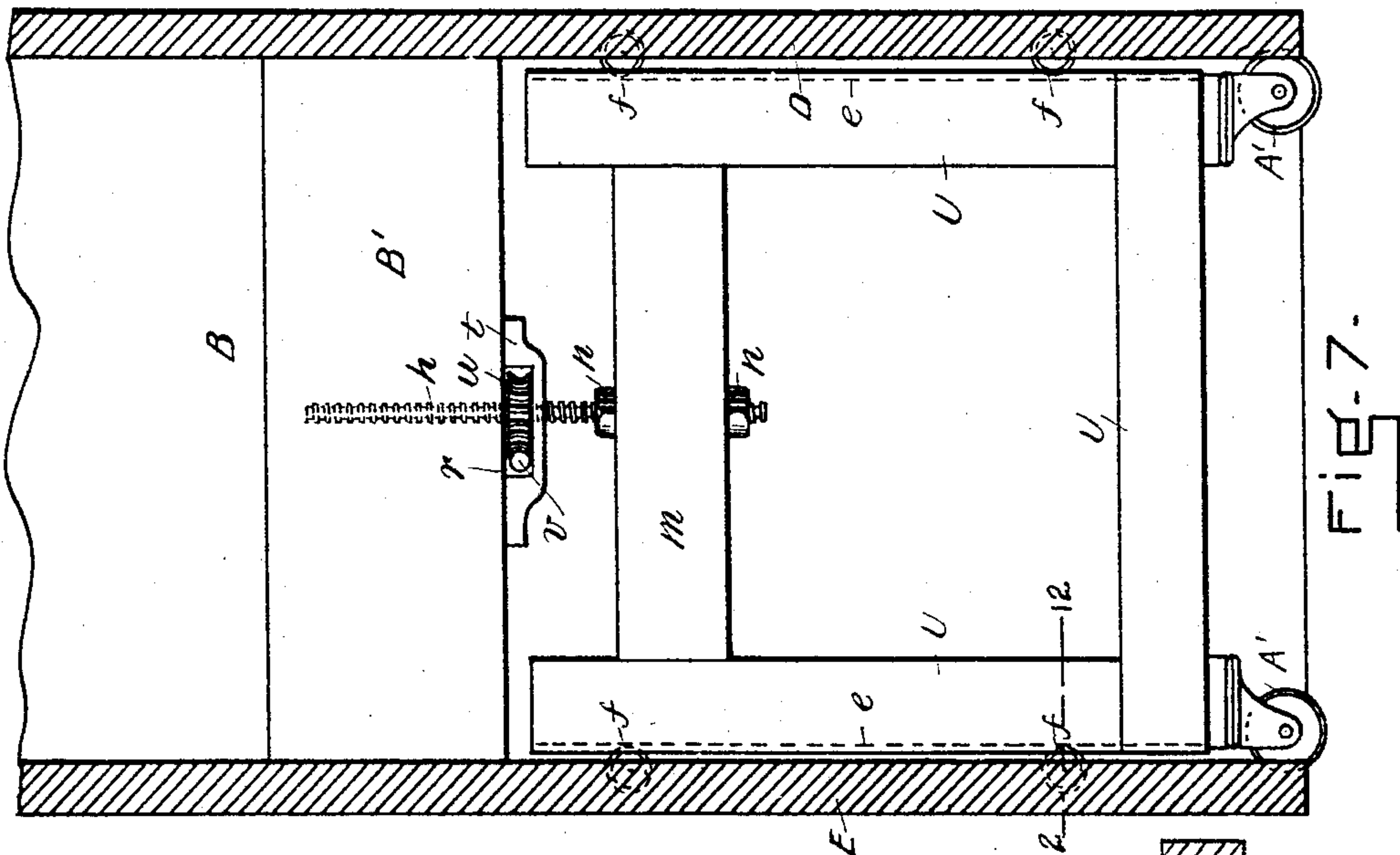
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E. S. VOTEY.
KEYBOARD PLAYING ATTACHMENT.

APPLICATION FILED NOV. 16, 1899.

NO MODEL.

8 SHEETS—SHEET 7.



WITNESSES

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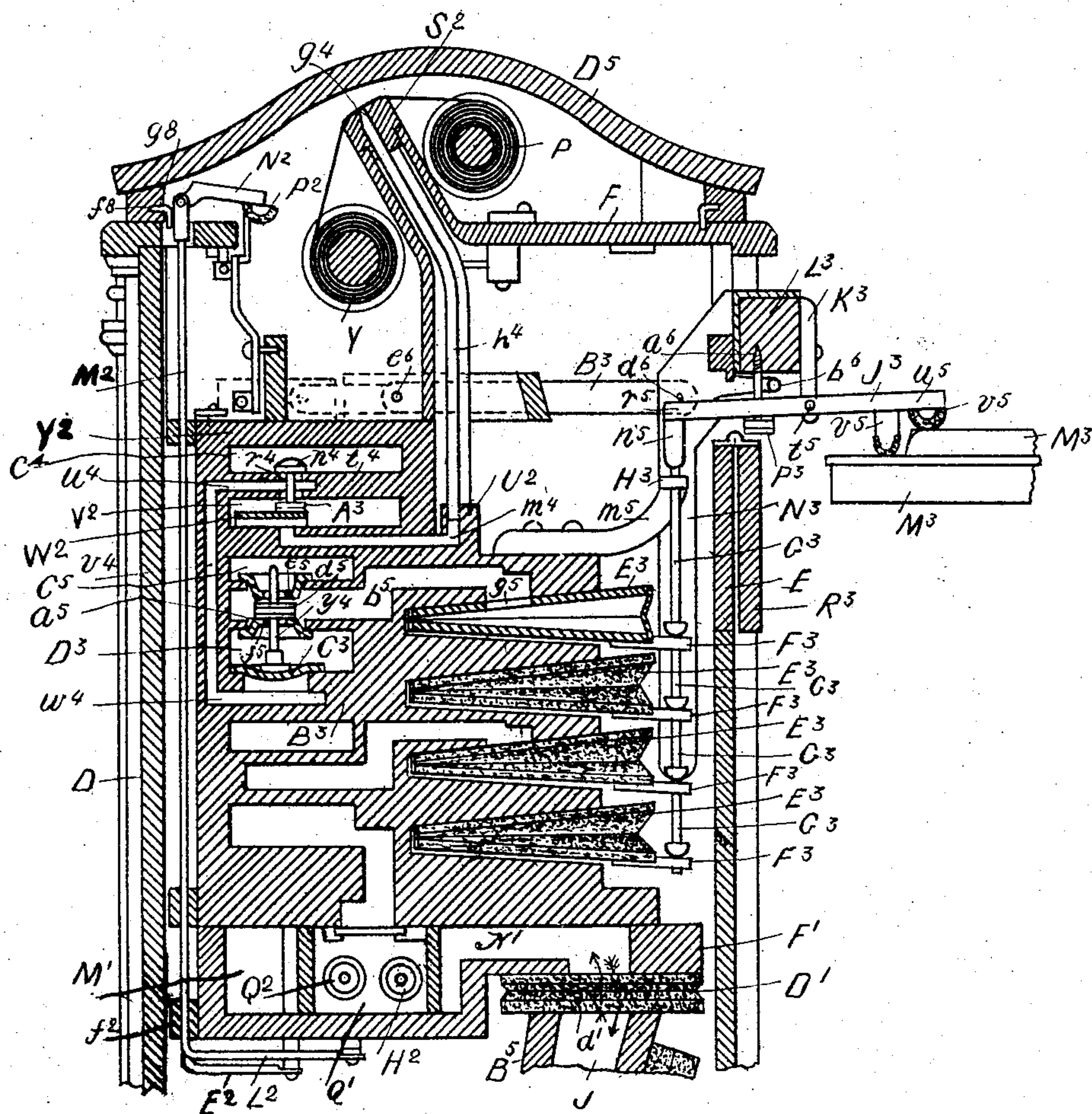
E. S. VOTEY.

KEYBOARD PLAYING ATTACHMENT.

APPLICATION FILED NOV. 16, 1899.

NO MODEL.

8 SHEETS—SHEET 8.



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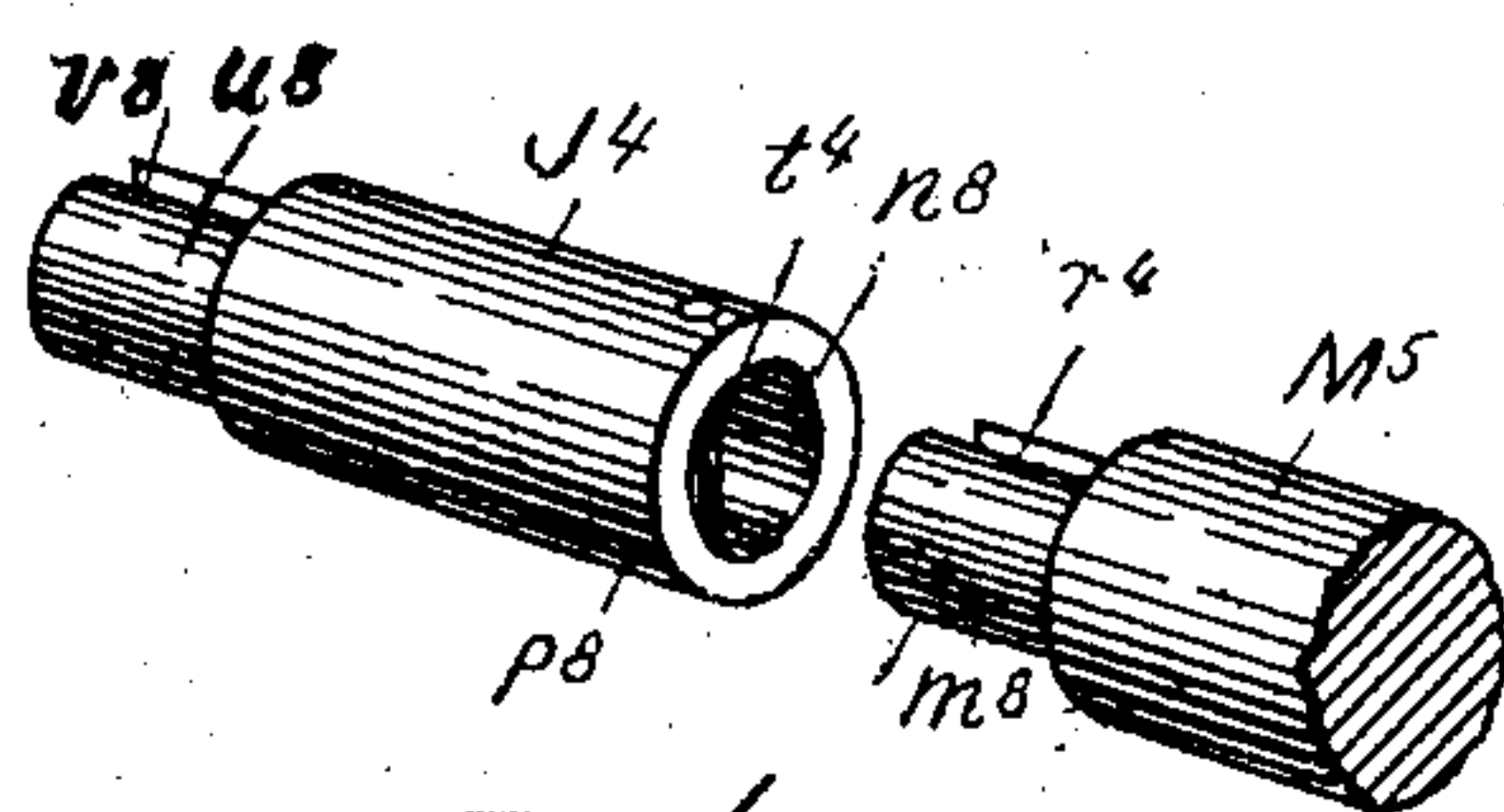


Fig. 9.

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UNITED STATES PATENT OFFICE.

EDWIN S. VOTEY, OF SUMMIT, NEW JERSEY.

KEYBOARD PLAYING ATTACHMENT.

SPECIFICATION forming part of Letters Patent No. 765,645, dated July 19, 1904.

Application filed November 16, 1899. Serial No. 737,223. (No model.)

To all whom it may concern:

Be it known that I, EDWIN S. VOTEY, director-superintendent Aeolian Company, of Summit, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Pneumatic Playing Apparatus for Keyboard Instruments; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates to apparatus—such, for example, as now well known in the “pianola”—for operation upon the keys or of the action of a pianoforte or similar keyed instrument, which apparatus is arranged to be operated by the travel of a perforated music-sheet over a series of ducts leading to valves and controlling pneumatics by which fingers or levers are caused to act upon the keys of the pianoforte when the instrument is placed in proper position therefor in front of the pianoforte, by which a musical composition can be played upon the pianoforte in accordance with the arrangement of the perforations in the music-sheet; and my invention consists of certain parts and combinations of parts, as hereinafter described, and pointed out in the claims, reference being had to the accompanying sheets of drawings, in which is illustrated one preferred embodiment of the invention.

It will be understood that some features of the invention can be used without the others and are applicable as well to apparatus built into a piano as to separate piano-players.

Figure 1 represents a front view of some of the working parts with some parts broken out, the outside casing of the instrument being in vertical transverse section. Fig. 2 is a view of some of the working parts of the instrument on the rear side, the casing being in vertical transverse section and the wind-chest being partly in section. Fig. 3 is a plan view of the working parts with the fingers or levers in position for action upon the keys of a pianoforte, the top of the casing being removed and the casing being shown in cross-section. Fig. 4 is a vertical cross-section on line 4 4, Fig. 1, with parts in their normal positions and ready for operation. Fig. 5 is a detailed horizontal section on line 5 5, Fig.

1, to be hereinafter referred to. Fig. 5^A is a sectional view like Fig. 5 with some parts left out and with some of the operating parts in different positions from that shown in Fig. 5. Fig. 5^B is a sectional view like Fig. 5^A, but with some of the operating parts in different positions from that shown in Fig. 5 and Fig. 5^A. Fig. 6 is a detail vertical section on line 6 6, Fig. 2, of the casing, showing in side elevation fingers or levers attached to their frame and the means for moving the frame outward and inward, respectively, for the fingers or levers to project beyond the casing in position for operation of the piano for the keys and for the fingers or levers to be in the casing out of the way when not in use. Fig. 7 is a detail view, partly in vertical section, on line 7 7 of Fig. 2, showing the casing and parts for raising and lowering the casing. Fig. 8 is a view of the upper part of Fig. 4 enlarged. Fig. 9 is a detail perspective view to be hereinafter referred to. Fig. 10 is a detail cross-section on line 12 12, Fig. 7.

In the drawings, A represents a casing consisting of side or end boards B C, a front board D, a rear board E, and top board F, the end boards being arranged to support all of the upper parts of the instrument called the “action-work,” the front, rear, and top boards being secured by screws, so they can be attached and secured to the end uprights for easy and convenient removal for access to the parts of the instrument for repairs, &c.

G is the main bellows, and H is a small bellows at the side of the main bellows, both suction-bellows and both in communication with the wind-chest chamber J, and K L are the two exhausters or pumping-bellows on the rear of the chest J for exhaustion of air from the two bellows and the wind-chest chamber, and consequently from various chambers and other parts of the action-work.

Attached to the movable board M of each exhauster is a separate arm N, which extends under it and the bellows toward the front of the instrument (see Figs. 1 and 4) and is pivoted at *a* to a forked link or arm Q, in turn pivoted by its arms at *b* to the edges of a pedal R, the two pedals being pivoted at their front ends at *d* to two arms S, pivoted at *c* to a sta-

tionary bracket g , secured to the bottom of chest J, which extends between the upright side or end frames U within the case, one next to each end board. To uprights of frame U and not to the casing A the main bellows, wind-chest, and pedals R are secured and supported, as shown in Figs. 1, 2, and 4 more particularly. The pedals R are operated by the feet to operate the bellows and exhaust air from the wind-chest chamber, as usual in the operation of bellows in reed-organs and other musical instruments and needing no more particular description herein.

The frames U have casters A', which rest on the floor and support the whole. On the front and rear edges of each frame U is a vertical rib e , projecting therefrom, over which are disposed two wheels f , turning on pivots g , secured to the end boards D E of the case A, by which the case in being moved up and down will be guided by the wheels running over the ribs e , as shown in section more particularly in Fig. 10.

To move the case up and down, the following mechanism is provided: A cross-bar B', Figs. 1 and 7, is secured to the inner side of each end board of the case A above the frame U, and it has a central vertical screw h , which extends up into it and down through the upper cross-bar m of the frame U and is secured rigid with the bar m by screw-nuts n . Screwing on each screw h and disposed in a horizontal opening r in a block t , secured to the underside of the casing cross-bar B', to prevent up-and-down movement of the same, is worm-wheel u , which engages with a horizontal worm-screw v , turning in bearings in the end board and having a square head w in an opening y therein in convenient position for operation by a square socketed key to be placed thereon from the outside of the casing for turning the worm-screw. As each end of the casing is thus independently provided, by turning the worm-screw in each frame in one or the other direction the casing can be raised or lowered, as may be desired, for the purpose of adjusting the fingers or levers of the instrument to a height corresponding to that of the piano-keys for the fingers to be in proper position over the keys to suit the varying heights of piano-keys, and as each end of the casing can be raised and lowered independent of the other end the fingers can be adjusted to the keys from one end to the other, accordingly as the keyboard is accurately level or inclined. This raising and lowering of the casing carries with it all the action-work of the instrument secured within it; but the bellows and operating parts being secured to the frame remain stationary, which is desirable in order that the pedals shall always maintain the same relation to the floor for the proper action of the same by the person's feet.

Three small accordion-bellows or expansion-boxes C', D', and E', (Figs. 2, 4, and 5,) hav-

ing four sides of flexible material, such as leather or india-rubber, are secured by their lower boards a' to the upper end of the wind-chest, and each has communication with the top of the wind-chest, in ways presently to be explained, by a hole d' in its bottom board a' , the upper board b' being secured to the under side of the lower board F' of the action-case G'. The object of these accordion-bellows or expansion-boxes is to make connection between the vertically-adjustable action-case and the fixed wind-chest for the passage of air from one to the other by a flexible or extensible connection, so as to allow for the action-case to be moved up and down from the wind-chest when adjusting the fingers to the piano-keys, air communication being constantly maintained between the wind-chest chamber and the action-case at all times. The upper boards of the three accordion-bellows therefore move up and down with the action-case, the flexibility of their sides allowing such movement.

The accordion-bellows E' by an opening g' in its upper board communicates with a chamber K' in a box L', secured to the action-case, located over the motor V and forming communication with the motor for the operation of the same.

The accordion-bellows C' communicates by an opening e' in its upper board b' and by a passage f' in the board of the action-case with a high-tension chamber H' in a box J'. In the box J' (see Fig. 5) are two chambers M' and N', separated from each other by two short vertical partitions h' and m' and a central box P', which central box is divided into two chambers Q' and R' by a vertical partition n' , these chambers Q' and R' having communication through openings m^3 and f^3 in the central box P' with the chamber N', which has communication by a passage v' through the board F' of the action-case with the accordion-bellows D' through an opening t' in its upper board, and thence to the smaller and weaker bellows H by way of passage Z and opening Z'. (Figs. 1 and 2.) The front chamber M' of the box is in communication with the chamber H' through an opening u' in its separating-partition v' , which opening has a valve S' to open and close it, the valve being secured to a rod w' , guided at one end in a guide-bracket y' , secured to the inner side of the wall a^2 of the box J', its other end extending through the wall of box J' and being secured to an upright end b^2 of a bar d^2 , which at its other end is pivotally connected to arm e^2 of an upright rock-shaft T', which is arranged to turn in guide-blocks f^2 , secured to the front of the action-case, and has an arm U', provided with a handle V' for operation by hand. The arm U' is pivoted to the rod T', so as to swing vertically thereon and be held in a horizontal position whether projecting forward or backward. When forward, as

shown in Fig. 3, it is in convenient position for operation by the hand and when swung backward it is within the instrument out of the way when not in use. The chamber N' also has communication through an opening g^2 in the end wall h^2 of the box J' by a channel m^2 and passage m^{12} through the lower board of the action-casing with an inner chamber n^2 of the box L' and then down through an opening r^2 with the motor V, which is below it. The channel m^2 has a flat-slide-valve W' to close and open it to passage m^{12} , the valve being adapted to slide back and forth beneath the opening, as shown, and it is connected by a rod t^2 to the end of arm u^2 of a vertical rock-shaft or rod A², arranged to turn in blocks v^2 on the front of the casing and extending up and above the casing and provided with a pivoted arm B² and handle C², like the arm U' and handle V', already described, for operation in a similar manner. The object of this valve W' is to allow air from the motor to pass directly to the large high-tension chamber or bellows, (J², H², R², Q², and S' being in normal position, as in Fig. 5,) for rewinding the music-sheet in order to obtain more power and speed than are supplied from the small bellows H or a special bellows connected to the motor, but not shown in the drawings, which small bellows operates the motor in playing, as will be well understood by those familiar with the art.

In the wall w' of the chamber n^2 in box L' is a valve-opening a^3 , in which is adapted to slide back and forth to control the motor a valve D², which is connected by a rod b^3 to one end of an arm d^3 of a vertical rock-shaft or rod E², adapted to swivel in blocks e^3 on the front of the action-casing, having an arm F² and handle G², like U' and V', for operation above the casing.

The chamber Q' of the central box P' has two openings f^3 and g^3 in its end wall h^3 , which make communication, respectively, with the two longitudinal chambers N' and M' of the box J', and the other chamber, R', has two openings m^3 and n^3 in its end wall r^3 , which makes communication, respectively, with the two longitudinal chambers N' and M'.

In the chambers Q' and R' are two valves H² and J², one in each chamber, which are secured to a rod t^3 , one end of the rod extending through the opening f^3 and freely through the end wall h^2 and being connected at w^3 to one end of a lever K², pivoted at v^3 to the casing. The rod t^3 passes through the central partition n' and through the valve-opening m^3 and guide w^3 , secured to the partition h' . Similarly there are two valves Q² R² in the chambers Q' R', respectively, which are connected to a rod e^4 , one end of which extends through valve-opening g^3 and through the wall h^2 , and is connected to the other end of the lever K² at d^4 , while the other portion of the rod, passing through the cross-partition n' and through the valve-opening n^3 , runs in

a guide f^4 , secured to the partition h' , all as shown in section in Fig. 5.

The valves J² H² R² Q² are respectively for controlling the openings m^3 , f^3 , n^3 , and g^3 in the end walls of the central box.

The lever K² is connected at its end a^4 by a link-rod L² to an arm b^4 of a vertical rock-shaft or rod M², adapted to turn in blocks f^{12} , secured to the front of the case and provided with an arm N², pivoted thereto at its upper end, provided with a handle P² for operation thereof like parts U' V'.

To the upper board Y² of the action-case G' is secured the tracker-board S², as shown in Fig. 4 more particularly, over which travels the perforated music-sheet T² from its music-roll P to its take-up roll Y in operating the instrument. This tracker-board inclines forward, as shown in cross-section in Figs. 4 and 8, and it has a row of tracker air ducts or passages g^4 opening at its curved upper edge or surface, over which is arranged to travel the perforated music-sheet, as usual in mechanical musical instruments, and each air-duct at its lower end has a small flexible tube h^4 connected thereto, preferably of lead, which extends downward and at its lower end is secured in a horizontal board U², each having communication with a separate horizontal passage m^4 in the board, and as these passages m^4 are necessarily farther apart to communicate properly with the valves and pneumatics of the instrument the lead tubes as they lead from the air-ducts diverge or spread apart to make proper connection with their respective horizontal passages m^4 . Each passage m^4 extends forward in the board U² and at its front end opens to the upper surface of the board into an air-exhaust chamber V², over which opening is secured a small pneumatic W², the pneumatic having communication with the air-passages m^4 , and on top of this pneumatic is a valve A³, its stem extending up through a vertical passage r^4 in a horizontal partition t^4 , to which is connected another valve, n^4 , in a chamber c^4 , open to the air, the two valves being arranged and adapted to open and close alternately the respective ends or ports of the vertical passage r^4 . This passage r^4 opens at its side into a horizontal passage u^4 in the partition, which extends forward, then downward, as at v^4 , in the front, and then backward a short distance in a partition B³, as at w^4 . In the upper part of this partition B³ a large opening is made over the passage w^4 into an air-exhaust chamber D³, in which is secured a flexible diaphragm C³, of leather or other suitable sheet material, having secured to its upper side a vertical stem y^4 , which extends upward through an opening a^5 in the partition. This opening forms communication between the exhaust-chamber D³ and horizontal passage b^5 above it and an atmospheric-air chamber C⁵ above the passage b^5 . The valve-stem has secured to it a valve

d^5 between two seats e^5 and f^5 , the lower one, f^5 , for the valve when in its lowermost or normal position, so as to close communication through the opening a^5 between the chamber D^5 and passage b^5 and leave open communication between the passage b^5 and air-chamber C^5 , and the other or upper one, e^5 , for the valve when moved up to it to close communication between the passage b^5 and chamber C^5 .

The chamber D^5 and the other like chambers are divided into two portions H^5 and J^5 , respectively, by partitions K^5 , one, H^5 , for the bass notes and the other, J^5 , for the treble notes, the portion H^5 being in communication with the chamber R' by a passage L^5 and the other portion, J^5 , in communication with the chamber Q' by a passage M^5 , respectively, of the central box P' in the box J' . (See Fig. 1 more particularly.) The other end of each passage b^5 opens through g^5 into a pneumatic E^5 , suitably secured by its upper board and leaving its under board free to be moved up and down by the air. From its outer end extends an arm F^5 , to which is attached or connected a vertical rod or wire G^5 , which extends upward through a hole in a guide-bar H^5 , secured by arms m^5 to the action-case and having on its upper end a button n^5 , which lies close to the under side of the inner arm r^5 of a finger or lever J^5 , pivoted at t^5 in an upright flange K^5 , secured to a bar L^5 , its other arm, w^5 , extending forward beyond the casing and having a pad v^5 on its under side at its end to rest upon a piano-key M^5 , all as shown in Figs. 4 and 8 more particularly. These fingers are for operating or acting directly upon the keys of the piano and are arranged to correspond with the keys of the piano in number according to the compass desired—in the present instance sixty-five notes—and they are all pivoted in one line to the horizontal bar L^5 . This bar has at each end a downwardly-projecting supporting-lever N^5 , pivoted at w^5 to the end board of the action-case. A horizontal bar P^5 extends under the inner arms r^5 of the fingers and upon this they rest, the bar being secured at intervals by screws a^6 , extending up freely between the fingers and screwing into the horizontal bar L^5 , so as to prevent the inner arms of the fingers from dropping down too far. Each finger is yieldingly held to the bar by a bent spring b^6 , secured by one end to the bar, its free arm bearing on the upper side of the inner arm of the finger, as shown in Figs. 6 and 9.

To each lever N^5 of the finger-bar L^5 is pivoted at d^6 a link B^6 , to which is pivoted at e^6 a short crank C^{61} , rigidly secured one at each end to a rock shaft or rod f^6 , extending all across the instrument, as shown in Fig. 3, mounted to turn freely. One end of this rod f^6 projects nearly through a hole g^6 in the casing end board and has a square socket h^6

adapted to receive the square end of a key or crank-arm G^5 , which being inserted therein and turned in the proper direction turns the rod through the links B^6 and G^3 and swings up and backward the cranks or links B^6 , pushing back and out the bar L^5 of finger-frame for the fingers to project outward through the opening Q^5 in the back of the casing into position to be over the piano-keys, as shown in Figs. 4 and 6, for playing the piano. Turning the crank in the opposite direction swings the bar, with the fingers, back into the casing out of the way when not in use, as shown in dotted lines in Fig. 6, whereupon the board R^5 , hinged to the back board of the casing, can be swung up and secured in any suitable manner, closing the opening. As the finger frame or bar is so connected to the rod f^6 at each end, it is moved out and in firmly and squarely.

In Fig. 9 is shown in perspective the end of the shaft which operates the music-roll when rewinding the music-sheet thereon and also the socket-piece J^4 for making connection between the shaft and a shorter music-roll carrying a narrower music-sheet. The tip m^8 of the shaft is of smaller diameter than the body M^5 , and it is adapted to freely fit in the socket n^8 in the end of the socket-piece J^4 and to secure the two together, so that motion shall be communicated from the shaft to the socket-piece. The end of the shaft has a longitudinal central slot r^4 , into which when the socket-piece is placed in position on the shaft end a cross-pin t^4 of the socket-piece projects. One end of the music-roll has a socket like the socket of the socket-piece, and into this the end U^8 , slotted at V^8 , of the socket-piece for a short roll or the end of the shaft for a long roll is inserted to operate the music-roll.

The motor V is located at the right of the small bellows H , its shaft K^4 being connected to the upper driving-shaft U^4 by a chain V^4 for operation thereof. The parts connected thereto for operation on the music-roll and the take-up roll can be constructed and arranged in any of the usual ways of operating mechanical musical instruments.

In the operation of the complete instrument it is placed in front of the pianoforte, its finger-frame being first moved outward into the position shown in Figs. 4, 6, and 8, and the instrument then raised or lowered by turning the worm-screws until the fingers bear properly upon the keys of the piano, as shown. The roll and perforated music-sheet are then inserted in place and the end of the sheet drawn over the tracker and attached to the take-up roll in the usual manner. Swinging the handle G^2 more or less to the right, which opens the valve D^2 , controls the air to the motor, and consequently the tempo. The pedals work the bellows K L to exhaust air from the wind-chest and chambers in the action-case

and also operate the motor, causing the take-up roll to be turned in the proper direction to draw the music-sheet over the tracker-board air-ducts. As a perforation comes over an air-duct g^1 in the tracker-board as the bellows is operated air passes through the perforation into the air-duct h^1 into the horizontal passages m^1 and raises the pneumatics W^2 in the exhaust-chamber V^2 , which chamber is in communication with the bellows, which in turn raises the primary valve A^3 , closing the opening p^4 to the chamber V^2 and opening it to the chamber C^4 , which is open to the outside air, allowing air to enter the passage u^4 and pass down the passage v^4 , and on account of the exhaustion of air from the exhaust-chamber D^3 the diaphragm C^3 is caused to rise, raising the valve d^5 , closing the passage b^5 to the chamber G^5 , and opening it to the exhaust-chamber D^3 , when air will be exhausted from the passage b^5 and from the pneumatic E^3 in communication therewith, causing its lower board to rise and through the rod G^3 to operate the finger J^3 , connected thereto, and strike its piano-key, sounding the string or note, and when the unperforated portion of the paper again comes over the air-duct g^1 and air is prevented from entering therein the pneumatics W^2 and C^3 , the valves, and the finger-pneumatic all return to their normal positions, as shown in Fig. 4 in cross-section. The pneumatics W^2 and C^3 close by gravity, leakage being sufficient usually to insure them acting promptly, or "bleed-holes" being intentionally provided, as well understood in the art.

When desirous of rewinding the music-sheet, the handle C^2 is moved to the right, by which, as well understood, the take-up roll is disengaged and the music-roll connected to turn in the opposite direction until the sheet is rewound thereon, when the roll can be removed and another put in its place. Moving the handle C^2 back, the valve W' is closed, the music-roll disengaged, and the take-up roll is again connected with the motor.

The small bellows H is for the purpose of playing softly or "piano," and in its use the handle V' is turned to the left, which closes the valve S' in the chamber H' , (see Fig. 5,) so that the exhaustion of air from the pneumatics and valve-chambers in the action-case is not caused by the main bellows, but operated only by the small bellows through the chamber in the box J' , which obviously, this bellows being of much less capacity and weaker power than the main bellows, reduces or diminishes the power of the pneumatics upon the fingers, consequently giving lighter blows upon the piano-keys, resulting in a lighter or softer tone from the strings of the piano. Turning the handle V' back, the valve S' is opened, letting air pass to the main bellows, and consequently giving the full force

and power in striking the piano-keys, as before.

The valve D^2 to the motor can be opened more or less, controlling the amount of air leading to the motor by which the speed or tempo of the take-up roll is controlled, so that the time of the music can be varied for the purpose of making retards, accelerandos, &c.

The chamber H' is always in communication with the large bellows G through the passage f' and flexible connection C' by way of main part of wind-chest chamber, Z^3 , Figs. 3 and 4, and the chamber M' is always in communication with the large bellows through the chamber H' except when the valve S' is operated to close the opening u' between the two chambers. The chamber N' is always in communication with the small and relatively weak bellows H through the passage v' and flexible connection D' by way of wind-chest chamber J, through passage Z, formed by partition Z^2 , and through opening Z' therefrom through the rear wall of the bellows H. The chamber Q' is in communication by air-passages with and for the operation of the treble-notes or portion of the action, while the chamber R' is in communication by air-passages with and for the operation of the bass-notes or portion of the action. To cause the bass-notes of the music to be sounded stronger and heavier than the treble, by moving the arm N^2 by the handle P^2 to the left the valves J^2 and Q^2 are moved to close, respectively, the openings m^3 and g^3 in the central box P' , by which the chamber R' , connected to bass portion of the action, is in communication, through opening n^3 , with the chamber M' and with the large bellows through the chamber H' and is cut off from the chamber N' in communication with the small bellows H by the closing of the opening m^3 by the valve J^2 , so that the bass is operated by the large bellows only, while the chamber N' being cut off from communication with the chamber R' , and consequently the large bellows, the treble is only operated by the small bellows through the passage f^3 , which is open, consequently making it (the treble) light and soft, all as shown in Fig. 5^A. Moving the arm N^2 to the right opens the valves J^2 and Q^2 and the passages m^3 and g^3 , at the same time closing the valves H^2 and R^2 to close, respectively, the passages f^3 and n^3 , by which the chamber R' , operating the bass, is cut off from communication with the chamber M' in communication with the large bellows, but is in communication, through opening m^3 and chamber N' , with the small bellows, while the chamber Q' , operating the treble, is in communication, through the passage g^3 , with the chamber M' and through it with the large bellows, correspondingly making the bass light or soft and the treble heavy or loud, all as shown in Fig. 5^B.

In Fig. 4 is shown a special form of flexible

restricting-valve for bellows. Over the opening a^8 into the wind-chest J is a valve A^5 , made of flexible sheet material, having strips b^8 of wood secured transversely across the same on one side, as shown in Fig. 4, and one end is fastened at a^8 to the permanent board B^5 of the bellows and the other end to the movable board at c^8 , so that in the movement of the bellows is exhausted the valve will close over the opening gradually and limit the suction in the bellows according to strength of its expansion-spring, and as the movable board recedes or opens it pulls the valve from its seat over the opening in a gradual movement—that is, from one end to the other end of the valve—which causes an even and gradual opening of the same and not abruptly and decidedly as a valve which is made of a rigid piece of material.

The details of the construction by which the bellows H maintains a weaker pressure, or rather suction, than that in the wind-chest J and bellows G being immaterial are neither illustrated nor described, because such means for regulating and maintaining low pressure relatively to a higher source of pressure are very well understood in the art of pneumatic musical instruments.

In the operation of the instrument the valves shown in Fig. 5 are in their normal positions, except the valve D^2 to the motor, which is normally opened more or less, as desired, to have the music play faster or slower by operating the handle G^2 accordingly, and in such operation with the other valves in the positions shown in said figure air passes from the action-chambers through the various openings in the box J' to the large and small bellows, and in such case the full force and effect of the main bellows is secured, the small bellows being so much weaker than the large bellows as to then be practically inoperative and collapsed; but when desirous of playing softly the valve S' in the chamber H' is closed by operating the handle V' , which disconnects the main bellows G from the chambers M' and N', leaving these chambers connected to the small bellows only for the air to pass thereto, which being of smaller capacity and weaker expansive power reduces the force or blow upon the piano-keys and lightens the tone given by the strings. To give the full force and effect again, the valve S' is opened by moving the handle V' to its normal position, by which the main bellows is then in communication. Thus by the proper manipulation of these several valves the speed of the instrument is regulated as desired and expression given to the music in the playing of the piano, approaching to a great degree the playing of a good pianist.

The top board F of the main casing has a central opening G^{15} , up through which projects the two music-rolls and some of their op-

erating parts, and over this opening slides a cover made in two parts D^5 and E^5 , its upper part being curved, as shown in Fig. 4, in cross-section, and these two parts of the cover are arranged to slide longitudinally back and forth over the opening and when in such position, as shown in Figs. 1 and 2, to cover up and protect the music-rolls. The sides of these covers have on their inner surfaces longitudinal grooves f^8 , respectively, which are disposed over ribs or tongues g^8 , secured to the top F, (see Fig. 4 more particularly,) so that the covers can be freely moved back and forth and be guided in such movements and held in place from accidental detachment, suitable end stops being provided, against which the covers abut to prevent more movement than is necessary in either direction.

The pedals are so connected to their swinging frames that when depressed they can be swung up on their pivots C through the opening G^5 and into the front of the case in front of the bellows out of the way when not using the instrument and closed in from view by the doors H^5 , hinged to each side of the opening.

It will be well understood by those skilled in this art that although I have only described this invention as operating by suction—that is to say, pressures less than atmospheric—the apparatus can be slightly varied to operate by pressure without further information and as so varied will be its known equivalent. Furthermore, I have omitted the description and illustration of several of the pneumatic connections, because these will be well understood and their details are not of the essence of the present invention. It will also be understood that while some of these improvements are applicable especially to attachments for playing existing instruments others are more broadly applicable to self-playing apparatus and keyboard-playing apparatus, whether separate or built into the instrument.

I therefore claim as my invention, and desire to secure by Letters Patent, the following:

1. In keyboard playing apparatus, in combination, two bellows of different pressure, chambers in communication with the two bellows, independent of each other, one of said chambers having a pneumatic action for operation of the upper or treble notes, and the other chamber having a pneumatic action for operation of the lower or bass notes, and means for opening and closing communication between the chambers and the two bellows, so that either one of the chambers, or both chambers, can be put in communication with one or the other, or with both bellows for the purpose specified.

2. In pneumatic playing apparatus for keyboard instruments, in combination, a bellows, two chambers in a box separated by a central box and partitions in communication with the bellows, two chambers in said central box, opening in each end of the central box form-

ing communication respectively with said first two chambers and the central-box chambers and valves to each opening in the central-box chambers, said valves being connected to means for operating them by which the opening in the ends of the central box can be alternately closed and opened.

3. In a machine for playing pianos and other musical instruments, the combination of the strikers, the pneumatic motors connected therewith, and means for varying the pressure of groups of motors, said means consisting of air-exhausting devices connected with said motors by two or more passages, each passage being controlled by a suitable valve, whereby variations in the striking effect of groups of fingers or strikers are controlled.

4. In a machine for playing pianos and other musical instruments, the combination of the strikers, pneumatic motors connected with the strikers, a relatively weak air-exhaust connected with all the pneumatic motors and a relatively powerful air-exhaust and means whereby it may at will be connected with all the pneumatic motors or with groups of said motors.

5. In a pneumatic playing apparatus for keyboard musical instruments, the combination of the strikers, the pneumatic motors connected therewith, a relatively weak air-exhaust connected with the motors, a stronger air-exhaust, and means for connecting it with all the pneumatic motors or with those operating the bass register of strikers or those operating the treble register of strikers.

6. In a machine for playing pianos and other musical instruments, the combination of the strikers, the pneumatic motors connected therewith, the air-chamber in two parts, its secondary valves, the low-tension exhaust-reservoir, the high-tension exhaust-reservoir, the passages between the low-tension reservoir and both sections of the chamber, the passages between the high-tension reservoir and both sections of the chamber, and the valves.

7. In a machine for playing pianos and the like, the combination of the base having a longitudinal air-chamber, reservoirs mounted on one side of said base, one of said reservoirs having greater power than the other, and connected with said chamber, exhaust-bellows on the other side of the base also connected with the air-chamber, passages connecting the air-chamber and the weaker reservoir with the chambers controlling the pneumatic operation of said machine, the said pneumatic controlling-chambers, and suitable controlling-valves.

8. In a machine for playing pianos and other musical instruments, the combination of the fingers or strikers, the pneumatic motors connected with them, an air-chamber in two or more sections, channels connecting the sections of the air-chamber with the pneumatic motors and having ports to the outer air,

valves for connecting the channels with either the air-chamber or the outer air, air-exhausting reservoirs of different pressures, channels connecting said sections of the air-chamber with said reservoirs and means for closing and opening at will the channels connecting the sections with the reservoir of greater power and means controlled by the music-sheet and tracker-board for actuating the valves.

9. In an autopneumatic playing apparatus for musical instruments, the combination with a pneumatic key-operating action, and mechanism for developing a normal operating wind-pressure thereon, of means for diminishing the operating pressure separately upon different portions of said action to soften the operation thereof.

10. In a pneumatic playing apparatus for musical instruments, the combination with a pneumatic action and mechanism for developing a normal operating pressure thereon, of means for diminishing the pneumatic pressure separately upon different portions of said action to soften the operation thereof, and a single actuating device for controlling the pressures on said different portions.

11. In a machine for playing pianos and other musical instruments, the combination of the strikers, the pneumatic motors, an exhaust-reservoir for exerting lesser exhausting pressure upon the motors, an exhausting-reservoir for exerting greater exhausting pressure upon the motors, means for varying the application to the motors of said greater pressure, the tracker-board, connections between its passages and diaphragm-chambers, the said diaphragm-chambers, air-channels, passages and ports and the primary and secondary valves.

12. In an automatic piano-player, the combination with power-pneumatics and suitable key-operating instrumentalities, of a low-tension vacuum-chamber communicating with said pneumatics, a high-tension vacuum-chamber independent of said low-tension chamber communicating with said pneumatics, valves controlling the ports leading from said chambers to said pneumatics, a low-tension bellows communicating with said low-tension chamber, a high-tension bellows communicating with said high-tension chamber, and pumping-bellows for said high and low tension bellows.

13. In a self-playing apparatus for musical instruments, the combination with a series of key-actuating pneumatic motors, and pneumatic connections therefor, of means for varying the operating pressure on a portion of said motors relative to the operating pressure upon the remainder of said motors.

14. In self-playing pneumatic mechanism for musical instruments, the combination with key-actuating pneumatics, of a wind-chest having a series of passages leading therefrom to the key-actuating pneumatics, a series of valves respectively controlling said passages,

a series of controlling-pneumatics for actuating said valves, located within said chest, a partition dividing said chest into two compartments, and means for producing different pressures in the compartments.

15. In a machine for playing pianos and other musical instruments, the combination of the fingers or strikers, their actuating pneumatic motors, a sectional air-chamber connected with the pneumatic motors, means for varying the pressure of the air-exhaust in the said sections at will, the secondary valves directly controlling the air-pressure on the motors, their actuating-pneumatics and the primary valves controlling the times of operation of the secondary valves and means of operation of said primary valves.

16. In pneumatic playing apparatus for musical instruments, the combination with actuating-pneumatics, wind connections, controlling-pneumatics, and tracker-board connections therefor, of pumping-bellows, reservoir-chambers of differing wind tension or pressure, wind connections therefrom, and means for controllably connecting one of the said chambers or both of them to actuate the said actuating-pneumatics for giving varying expression to the music.

17. In pneumatic playing apparatus for musical instruments, the combination with the actuating-pneumatics, wind connections, controlling-pneumatics, and tracker-board connections therefor, of two sources of higher and lower wind tension or pressure, and connections and valves for controlling the admission of the higher tension or pressure to actuate the actuating-pneumatics, whereby piano and pianissimo effects are obtained.

18. In a pneumatic musical apparatus, the combination of the strikers and pneumatic motors connected with the strikers for operating them, a relatively weaker air-exhaust connected with the pneumatic motors and a relatively powerful air-exhaust and a valve whereby it may at will be connected with the pneumatic motors or disconnected therefrom, whereby the said motors may operate at will under the weak or the strong air-exhaust as desired.

19. In a mechanical playing attachment for keyboard musical instruments, the combination of a base, an air-pumping device mounted thereon, finger-levers and a pneumatic action for operating the same arranged above said base, the said action having a connection with said pumping device consisting of an extensible wind-trunk, and a casing vertically adjustable in relation to said base and carrying said finger-levers and action.

20. In a keyboard playing attachment, in combination, a frame on which is supported the operating-bellows, wind-chest and pedals, an action-case containing and supporting the action-work or parts of the instrument arranged to be moved up and down on said frame, in combination with flexible extension-cham-

bers between the frame and the action-case forming communication between the action-case and wind-chest and bellows, so that the passage of air from the action-work to the wind-chest chambers will be maintained at all times.

21. In a keyboard playing apparatus, in combination, a casing having end uprights to which the action-work is adjustably secured on the inner side of each end upright, the bellows and wind-chest fixed relatively to said uprights, and screw mechanisms for raising the action-work independently at each end.

22. In keyboard playing apparatus the combination of key-actuating levers and pneumatic action therefor, a base supporting the same, pedals, pumping-bellows and wind connections for the said action, and carried by the said base, and a means for vertically adjusting the said action and levers upon the said base relatively to the said pedals and base to vary the height of the levers to suit the keyboard to be played upon, for the purposes set forth.

23. In keyboard playing apparatus the combination of key-actuating levers and pneumatic action therefor, a casing within which the said levers, action, and frame are adjustable, pedals, pumping-bellows, and wind connections for the action, and a means for adjusting the said levers and action relatively to the casing to vary the height of the levers to suit the keyboard to be played upon.

24. In keyboard playing apparatus the combination of key-actuating levers and pneumatic action therefor, a casing within which the said levers, action, and frame are adjustable, pedals, pumping-bellows, and wind connections for the action, and a means for adjusting the said levers and action relatively to the casing to vary the height of the levers independently at each end of the apparatus to suit the keyboard to be played upon.

25. In keyboard playing apparatus the combination of keyboard playing levers and pneumatic action, a casing therefor, and a means for adjusting the action and levers within the casing to suit the keyboard to be played upon.

26. In keyboard playing apparatus the combination of keyboard playing levers and pneumatic action, a casing therefor, and a means for adjusting the action and levers within the casing independently at each end to suit the keyboard to be played upon.

27. In keyboard playing apparatus the combination of keyboard playing levers and pneumatic action, a casing therefor, and a means for adjusting the action and levers within the casing independently at each end, each said means comprising a worm and worm-wheel and a screw-adjusting device actuated thereby from outside of the casing, for adjusting the levers to suit the keyboard to be played upon.

28. In combination in pneumatic musical

apparatus, a bellows, a wind-chest, an opening or air-passage between the two, a flexible valve to said opening secured by one end to the board between the bellows and wind-chest and by its other end secured to the movable board of the bellows, for restricting the motion of the bellows.

29. In combination in pneumatic musical apparatus, a bellows, a wind-chest, an opening between the two, a valve to said opening consisting of sheet material with transverse ribs secured at intervals on one side, one end of the valve being secured to the board between the bellows and wind-chest and the other end secured to the movable board of the bellows.

30. In pneumatic musical apparatus, in combination, a casing, one or more upright rods near the front wall of the casing, valves connected to and operating thereby, a handle for each rod pivoted thereto and arranged to swing

vertically thereon for it to be moved forward in position for operation of the rod and to be swung back into the instrument out of the way.

31. In pneumatic musical apparatus, a casing, an action-case within said casing and spaced away from the front thereof, a music-roll support above said action-case, a plurality of mechanism-controlling rods movable in the space between said case and said casing, and handles on said rods operatively extending out of the front of said casing adjacent said roll-support and pivoted to swing backward in said casing.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWIN S. VOTEY.

Witnesses:

OWEN WARD,
W. B. TREMAINE.