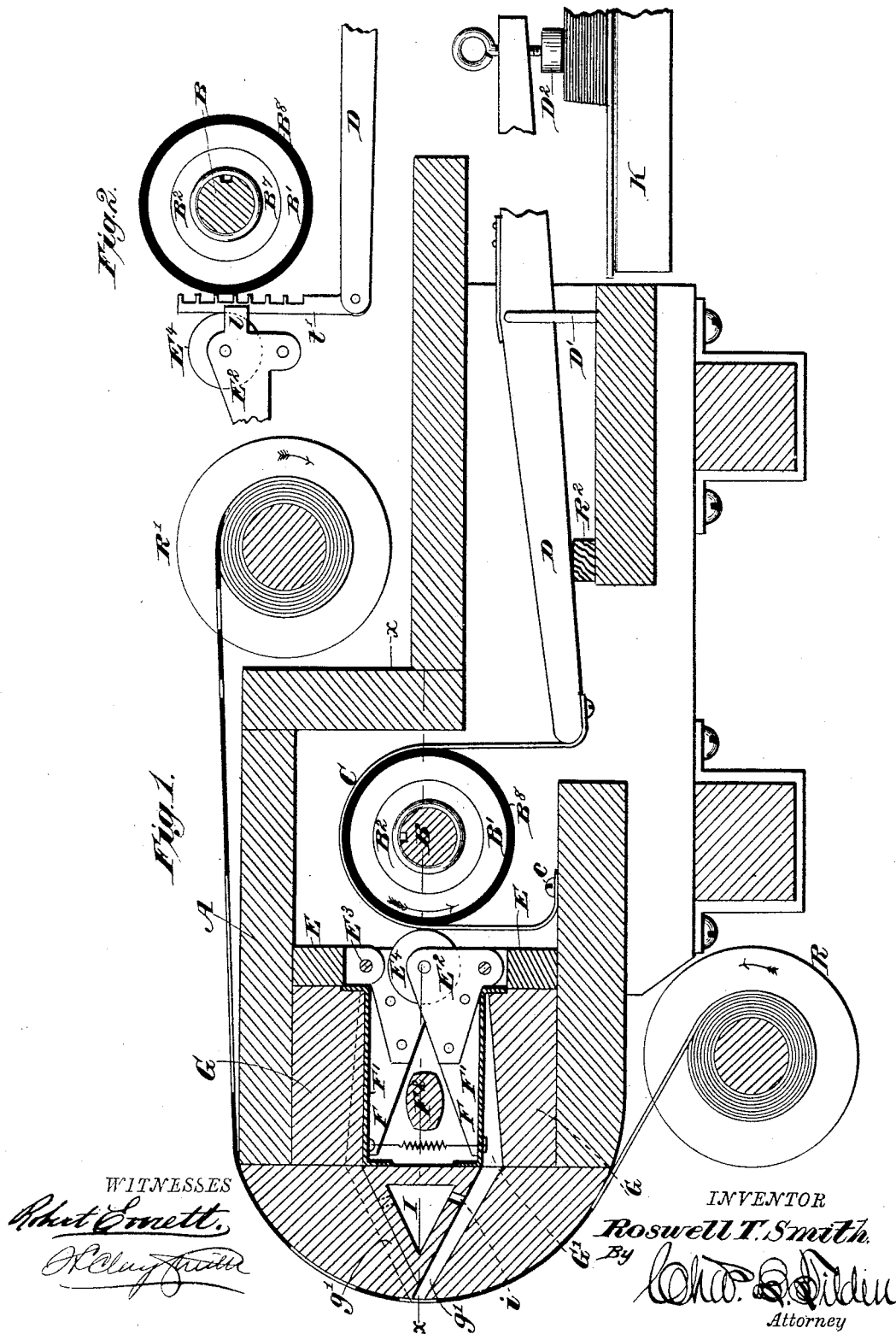


R. T. SMITH.

KEY BOARD ATTACHMENT FOR MUSICAL INSTRUMENTS.

No. 346,238.

Patented July 27, 1886.

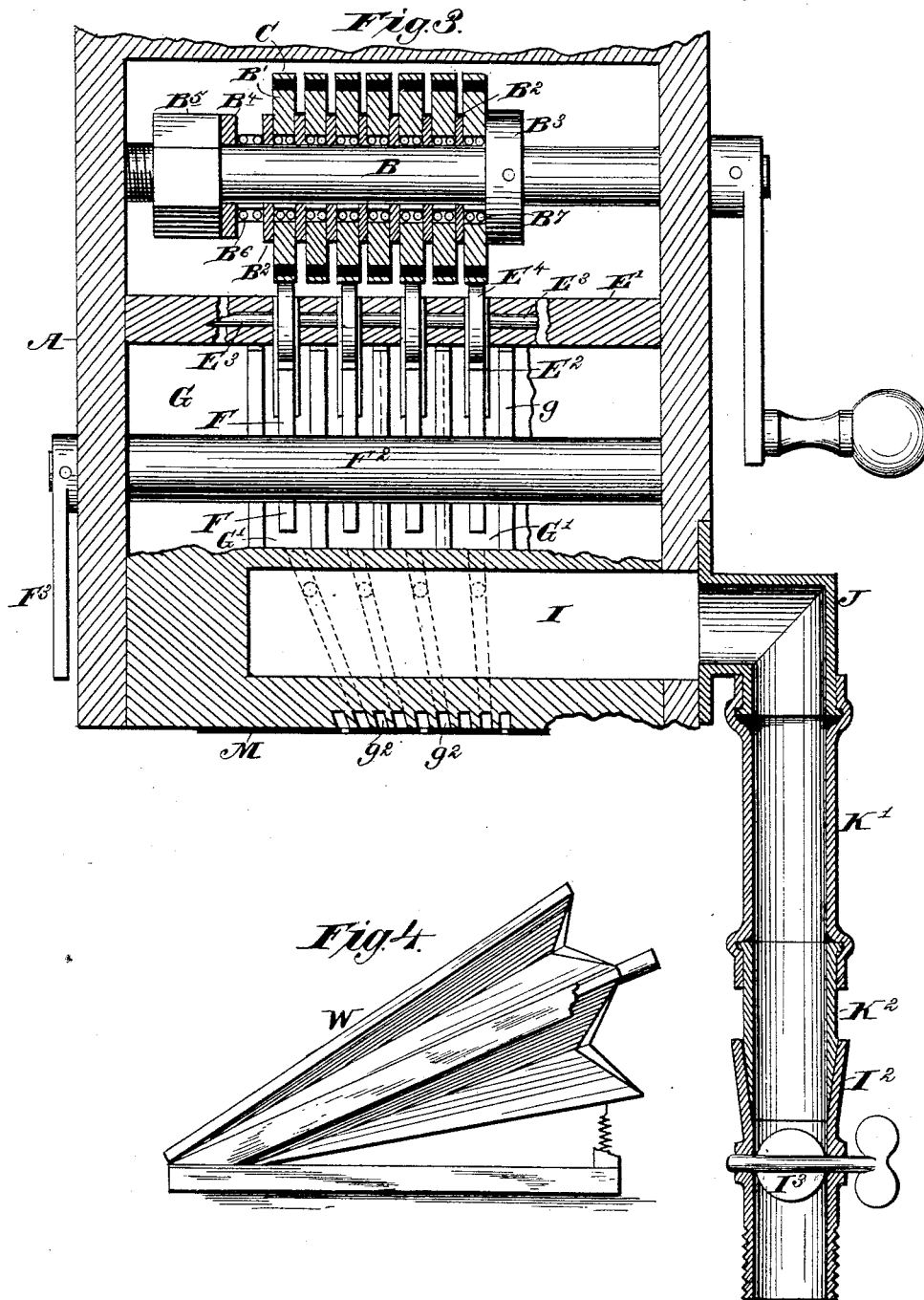


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Fig. 7.

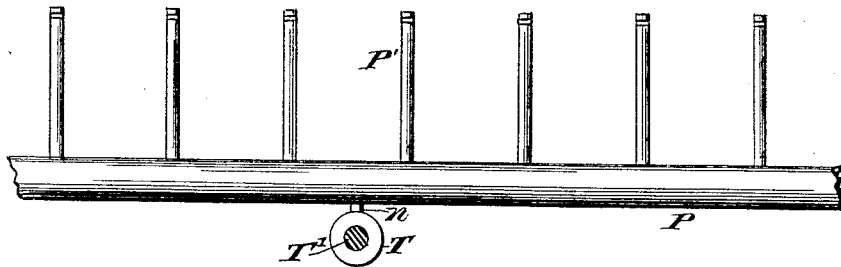


Fig. 5.

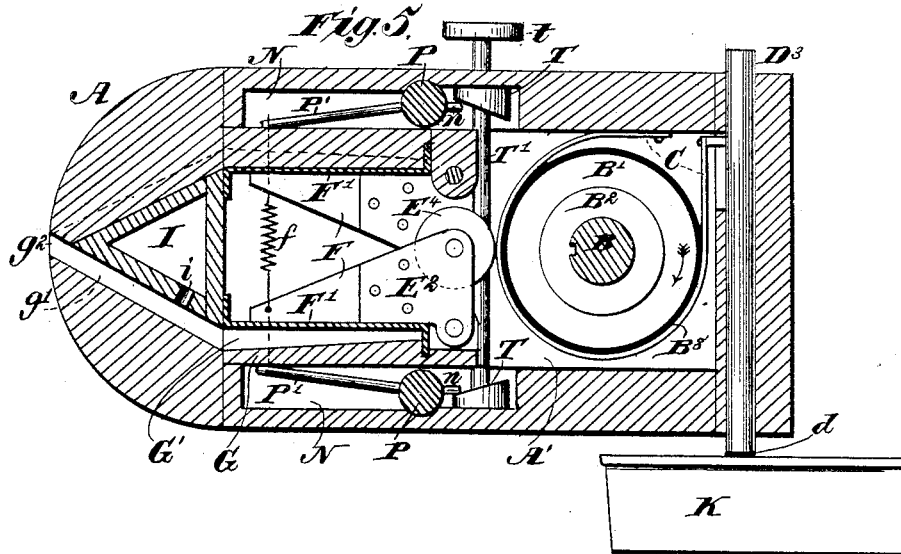
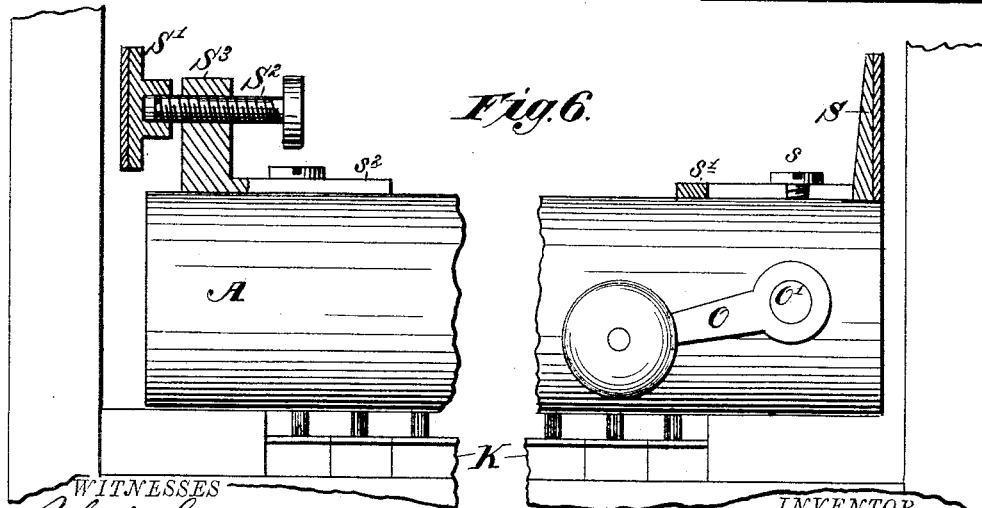


Fig. 6.



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UNITED STATES PATENT OFFICE.

ROSWELL T. SMITH, OF NASHUA, NEW HAMPSHIRE.

KEY-BOARD ATTACHMENT FOR MUSICAL INSTRUMENTS.

SPECIFICATION forming part of Letters Patent No. 346,238, dated July 27, 1886.

Application filed January 15, 1885. Serial No. 152,946. (No model.)

To all whom it may concern:

Be it known that I, ROSWELL T. SMITH, a citizen of the United States, residing at Nashua, in the county of Hillsborough and State of New Hampshire, have invented new and useful Improvements in Apparatus for Automatically Playing Keyed Musical Instruments, of which the following is a specification.

My invention relates to that class of inventions generally termed "self-playing instruments;" and the purpose thereof is to provide a simple and comparatively inexpensive apparatus which may be attached to the manual of any keyed musical instrument—such as a piano or an organ—whereby any musical composition may be rendered upon such instrument.

It is a further object of my invention to combine with a self-playing key-board apparatus means whereby each note is given its proper relative value as it is written upon the musical staff, and to provide, also, simple and efficient apparatus whereby the action of the key-striking devices may be so far modified and controlled as to produce "staccato" and other effects.

It is my purpose, also, to improve, simplify, and cheapen the construction of this class of mechanism, to materially diminish its bulk, and to provide a key-board player which may be readily attached to and detached from any musical instrument having the ordinary key-board or manual.

My invention consists in the several novel features of construction and combinations of parts hereinafter fully described, and pointed out in the claims, the same constituting an improvement upon the invention shown in applications for Letters Patent filed by me upon the 23d day of February and the 7th day of March, 1884, and numbered in serial 123,444 and 129,014, respectively.

Referring to the drawings forming part of this application, Figure 1 is a vertical section taken from front to rear. Fig. 2 is a detail elevation showing a modified construction of part of the devices shown in Fig. 1. Fig. 3 is a horizontal section taken in the plane $x-x$ of Fig. 1. Fig. 4 is a side elevation of one form of supplemental bellows used in operating these instruments. Fig. 5 is a vertical section from front to rear, showing a modified con-

struction of the parts illustrated in Fig. 1. Fig. 6 is a front elevation of the instrument attached to a piano or organ. Fig. 7 is a detail, enlarged, of one of the expression-shafts, together with its operating cam-shaft detached.

In the said drawings the reference-letter A indicates the frame-work or casing in which the operative parts have support. Within this frame is formed a recess or pulley-chamber, A', within which is placed a transverse shaft, B, journaled in the side walls of the frame A, and carrying a series of pulleys, B', each mounted upon said shaft in the manner hereinafter described. These pulleys are separated from each other by intermediate washers or annuli, B², which are splined to and revolve with the shaft B. At a suitable point upon the latter is placed a fixed collar, B³, against which the pulley at one end of the series has frictional bearing, and near the other end of the shaft is a collar, B⁴, splined thereon, and adjustable by means of a nut, B⁵, which turns upon the threaded end of the shaft. By turning the nut the friction between the pulleys B' and the washers B² may be increased or diminished and established at any fixed point, a spring, B⁶, being interposed between the splined collar B⁴ and the washer bearing against the outer face of the pulley at that end of the shaft. Each pulley B' is mounted upon a spring-bushing, B', coiled upon the shaft and exerting tension in opposite directions upon the adjacent washers B². This method of mounting insures the separation of each pulley from its washers whenever the nut B⁵ is turned back to decrease the frictional pressure between said parts. The bushings may conveniently be formed of elastic wire coiled upon the shaft, but may also be made of rubber in the form of an annulus, or of other suitable material. The pulleys B' are loose upon the shaft, being held and rotated by the washers B², between which they are clapsed. Each pulley is provided with a shoe or tire, of rubber or other suitable material, as shown at B⁸ in the drawings, and over each pulley is carried a belt, C, having one end attached to a key-striker, D, pivoted upon a bearing, D', and projecting from the casing to bring its free end over the manual. Upon the free end of each striker is mounted a

striker-block, D^2 , which is vertically adjustable, and which is brought into practical contact with the key of the musical instrument when the apparatus is in place. The other end of the belt C may be attached to the casing by a screw or tack, c , a little slack being allowed between the attached end and the pulley. Each belt also is normally loose upon its pulley, so that the rotation of the latter will not exert a draft upon its belt until an operative engagement between the belt and pulley is effected by the action of a third element. This engagement is effected in the following manner: In front of the pulley-shaft B, and parallel therewith, are strips E and E' , attached to the upper and lower walls of the casing A, respectively. These strips or blocks are notched at intervals to receive ear-plates E^2 , supported pivotally upon a rod or shaft, E^3 , which passes through the lugs formed in each plate by said notches. The plates E^2 are arranged in pairs, and between each pair is journaled an idle-roll, E^4 , the periphery of which lies in close proximity to the belt C of one of the pulleys B^2 . For the purpose of economizing space the rolls supported by the upper block, E , are so arranged as to alternate with those mounted in the lower block, E' , substantially as shown in Figs. 1 and 3. Each pair of ear-plates E^2 embraces a plate, F , which is inserted between them and fastened by rivets or otherwise. Each plate F is attached by its edge to a flexible diaphragm, F' , which may be formed of leather, rubber, or other suitable material, and to which the plates F are preferably glued.

It will be understood that there are two separate diaphragms, F' , for the two series of plates F , the members of the latter alternating with each other in the manner already described in connection with the idle-rolls E^4 . Each diaphragm F' has support upon a block, G , extending from side to side of the machine-casing. In each block G , I form a series of air cells or chambers, G' , corresponding in number and arrangement with the number and position of the plates F upon the overlying diaphragm, the latter having support upon both sides of each air-cell by means of intermediate septa, g , forming part of the block G , and to which the diaphragm is glued or fastened in any suitable manner. To each plate F , near its outer extremity, is fastened a spring, f , having its other end passed through or attached to the face of the opposite block, G . These springs are, as nearly as possible, of equal tension, and by their action the outer ends of the diaphragm-plates F in both series are drawn toward each other. This movement, as will readily be seen from the drawings, throws the idle-rolls E^4 in both series toward the pulleys B^2 , and causes them to make contact with the belts C upon that side of each pulley which is most remote from the point where the draft of the belt is directly exerted. Each of the air-cells G' is preferably increased in depth from its inner toward its outer end,

and each cell communicates with the outer air by a duct, g' , leading from the outer end of the cell to an opening or mouth, g^2 , situated in a horizontal line drawn centrally across the outer end or head of the casing. The ducts leading from both series of air-cells have their mouths situated in the same horizontal plane, and they are therefore inclined from the upper and lower blocks, G , as shown in Fig. 1. The ducts g' may, if desired, be cut in vertical parallel planes; but as the music-paper or perforated sheets used in this class of instruments is preferably of narrow width compared with the casing A, it is desirable to group the outer ends or mouths of the air-ducts within an area of corresponding width upon the end of the casing. To this end, therefore, I give to the ducts in each series a converging arrangement, substantially as shown in dotted lines in Fig. 3. By this construction I am able to operate an instrument which is coextensive with the manual by a perforate sheet of a few inches in width.

Between the two converging series of air-ducts leading from the upper and lower series of alternating air-cells, and within the solid head of the casing A, is formed a continuous exhaust-chamber, I , coextensive with the double series of air-cells G' , and communicating with each by means of apertures i , pierced through the wall inclosing the exhaust-chamber, and opening into the ducts g' . The chamber I is connected in any suitable manner with an air-exhaust—such, for example, as a common exhaust-bellows. (Shown in Fig. 4.) When used with an organ, it may be exhausted by the air-pump of the instrument. In either case the exhaust-chamber may be conveniently supplied with a pipe-elbow, J , adapted to receive a flexible tube, K' , as shown in Fig. 3, and this tube may have a splicing-thimble, K^2 , constructed to engage with a valved spout, I^2 , attached to either the bellows or to the organ-pump.

It will readily be seen that by closing the air-ducts g' and exhausting or partly exhausting the air from the chamber I atmospheric pressure will be exerted upon the outer surfaces of the two diaphragms F' . This pressure will overcome the tension of the springs f and draw the outer extremities of the plates F apart, this operation being readily accomplished by each diaphragm, which is given a little slackness over each air-cell. This movement, effected by the partial exhaustion of the cells, although slight in degree, is sufficient to remove all the idle-rolls E^4 from contact with the pulleys and their belts, in which position they will be retained as long as the exhaust continues, or until one or more of the air-ducts leading to the cells are opened. This admission of air instantly restores the normal conditions. The spring or springs f , attached to the plate overlying the cell to which air has been admitted, exerts its tension and draws the idle-roll against the belt and pulley, which immediately operate the key-striker. It is

evident, therefore, that out of the whole series of strikers such selections may be made as are necessary to strike a given chord by merely admitting air to the proper cells simultaneously, and in like manner, by a proper consecutive selection of cells and admission of air thereto in the proper order and combination, the mechanism may be made to operate the keys of a musical instrument and render any given musical composition. This selection is effected by a music-sheet, M, in which perforations are formed corresponding in their relative length and arrangement with the value of the several notes and their harmonious combinations as expressed upon the musical staff or score. This sheet is drawn, with a properly-regulated feed, over the end of the casing A, which is rounded in order to accommodate its movement.

As already mentioned, the mouths g' of the air-ducts are arranged in a limited space on the end of the casing, the intervals between them being made to correspond with the distance between the longitudinal lines of openings or note-perforations cut in the paper sheet. In this manner the several longitudinal series of such openings pass over the open ends of the several ducts, each opening admitting air to the corresponding air-cell throughout the period of time required for the passage of the note-opening over the mouth of the duct leading thereto, permitting the spring f , attached to the corresponding plate F, to effect an operative engagement of the roll E' with the belt C, and to maintain such engagement during the time occupied by the passage of the note-opening over the mouth of the duct. The result of this engagement of the idle-roll with the belt and the pulley is the instantaneous striking and the holding of the proper key during the time necessary to express the value of the note sounded, the key being struck the instant the note-perforation reaches and opens the mouth of the air-duct, and being held during the time the latter remains open, or, in other words, during the period occupied by the note-opening in passing over the mouth of the duct.

The holding of the note to give it its true relative value is accomplished by the slip of the friction-disks B² upon the parallel faces of the pulleys B'. This operation will be clearly understood from Figs. 1 and 3, from which it will be seen that when any one of the idle-rolls E' makes engagement with and binds the belt C upon the continuously-revolving pulley the latter will instantly operate the key-striker D and depress the key of the manual to its lowest point. As this point is reached the resistance of the key overcomes the frictional hold of the washers B², and the pulley slips between them, holding the key down, but without obstructing the rotation of the shaft B as long as the air-duct g' remains open. In this manner the key is held by a constant and continuous tension of the belt so long as the note-opening in the music-sheet is travers-

ing the open end of the air-duct. The instant the imperforate portion of said sheet closes the duct the exhaust again draws the diaphragm inward and the operative engagement between the belt C and its pulley is terminated, whereupon the spring of the key restores both it and the key-striker to their original position.

In Fig. 5 of the drawings I have shown substantially the same mechanism as that I have described combined with a key-striker of different form and arrangement, and with what may be termed "expression mechanism." In this figure, which shows a full-sized section of my key-board instrument, the casing is extended over the manual K, and instead of levers fulcrumed upon and extending from the casing, as shown in Fig. 1, I employ vertical striker-bars D², moving in suitable sockets in the casing and connected directly to the belts C. The ends of these bars are shod with rubber or felt, d , and rest directly upon the keys of the instrument, as shown. The construction of the operative parts being the same, with the above exception, as that already described, I mount in recesses N, formed in the walls of the casing, rock-shafts P, having fingers or lugs n projecting from one side and engaging with cams T, carried by a cam-shaft, T', which is provided at one end with a knob, crank, or other device, t , by which the shaft may be rotated. Upon the side opposite the fingers n the shafts P have arms P', which project toward the front, the interval between said arms being such as to bring them between the plates F in the adjacent series and opposite the plates in the opposite and more distant series. The springs f , connected to the latter, have their ends carried through the wall of the casing and connected to the extremities of the arms P'. By giving the cam-shaft T' a partial revolution the arms P' will be thrown outward, thereby increasing the tension of all the springs f throughout the series. The result of this increase in tension of said springs is, that as the air rushes into the air-cells through the ducts g' the rolls E' will be thrown more sharply and forcibly against the belts C, thereby insuring the instantaneous action of the key-strikers and giving a sharply-defined staccato effect, which may be more or less increased by increasing the speed of the main shaft. On the other hand, by modifying the force with which the rolls E' bear against the pulleys B', the expression may be modified, as it is evident that if the rolls have but slight bearing the belts will not at once and sharply respond when pressed upon the constantly-revolving pulleys, and the stroke of the bars D² will be light.

In the form of instrument shown in Fig. 5 the shaft B is revolved by miter-gears, motion being communicated from a shaft, O'. (Shown in Fig. 6.) A belt and pulley or any other suitable device may be substituted therefor, if desired. The perforated sheet M is fed from a roll, R, journaled under the casing A, to a

take-up roll, R', above and in rear of the forward portion of the case. In passing from one roll to the other the paper is drawn over the rounded front of the casing, and over the open ends g^2 of the air-ducts, with which the longitudinal series of note-openings registers. The take-up roll R' may be rotated from the main shaft B by gearing of any kind, or in any desired manner.

I propose to attach the instrument shown in Fig. 5 to the manual by means of clamps of the pattern illustrated in Fig. 6. These consist, essentially, of an angle-plate, S, adjustable upon the casing by means of a set-screw, s , which engages with a slotted portion, s' , of the clamp, the latter being faced with rubber or cloth to prevent marring of the varnish. Upon the other end of the casing I mount an adjustable block, S^2 , through which is tapped a set-screw, S^2 , having a clamp-plate, S' , swiveled upon its end. This plate is, like the other, faced with any suitable material—such as rubber or felt—and said clamps are adapted to bear against the finish at each end of the manual. By the adjustment of the parts by means of the set-screws s and the slotted parts s' and s^2 , I adapt the instrument to manuals of different range.

In Fig. 2 of the drawings I have shown a modified construction, which consists in the substitution of a rack-bar, t' , or any other suitably-roughened strip, in place of the belt C. This strip or bar is pivotally connected to the striker D, and is guided or laterally supported by lugs l , projecting from the ear-plates E^2 , which carry the idle-roll E^1 . As the latter moves toward the pulley B it presses the rack or roughened strip t' against the rubber tire of the pulley, the operation of parts being substantially similar with that already described. I may use a similar device in connection with the vertical striker shown in Fig. 5 by simply interposing a lever between the striker D² and a rack-bar, t' , similar to that described.

In constructing the instrument shown in Fig. 5 I make the head X in one or in two solid portions, in each of which are formed the alternating air-ducts, g' , separated from each other by solid strips of the wood. These ducts are grooved out upon the converging surfaces of a V-shaped space formed centrally in the head X, and which receives the exhaust-chamber I, the walls whereof lie against and are glued to the wooden septa lying between the air-ducts. In other respects the construction of the casing is obvious and requires no description.

The diaphragms F' may each be formed of a continuous strip of leather or other material, or they may be composed of separate pieces, one to each air-cell. In either case the flexible material is attached by glue or nails to the solid septa g , lying between the cells.

In the form of apparatus shown in Figs. 1 and 3, I place a double-cam shaft, F^2 , between the two alternating series of pivoted plates

F. By turning this shaft the double cam is brought into contact with the edges of the plates, rocking them apart against the tension of the springs f . This withdraws all the rolls E^1 from the pulleys, and enables the main shaft to be turned to reroll the paper, and for other purposes. A crank-arm, F^3 , is attached to the end of this shaft, as shown in Fig. 3.

In my application filed April 23, 1884, Serial No. 129,014, I have shown a slipping motor-gear held by a friction-clutch and engaging with rack-bars, by which the keys of the instrument are operated. In my application filed March 7, 1884, Serial No. 123,444, I have shown a pulley driven by a similar clutch and operating a belt connected with the key-striker. I do not, therefore, broadly claim said devices in this application.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a key-board instrument, the combination, with a series of key-strikers acting upon the manual, of a series of belts and pulleys actuating said strikers, a corresponding series of rolls effecting operative engagement between the belts and pulleys, and a series of pneumatics covered by a flexible diaphragm or diaphragms, upon which said rolls are mounted, substantially as and for the purpose described.

2. In a key-board instrument, the combination, with a key-striker, of a device whereby said striker is operated, a pulley actuating said device, an idle-roll journaled in bearings carried by a flexible diaphragm, and means for exhausting the air from and admitting it to a space behind said diaphragm, substantially as and for the purpose described.

3. In a key-board instrument, the combination, with a flexible diaphragm having an air-space behind it, of an idle-roll journaled in supports carried by said diaphragm, a pulley carried by friction-disks rigidly mounted upon a continuously-revolving shaft, a spring normally drawing said roll against an actuating device interposed between it and the pulley, and means for varying the tension of said spring, substantially as and for the purpose described.

4. In a key-board instrument, the combination, with a key-striker, of a continuously-revolving shaft, a pulley loosely mounted thereon, a shoe or tire upon said pulley, formed of rubber or other adhesive material, an actuating device connected with the key-striker, and a vibrating bracket or bearing carrying a roll which is by the action of the corresponding pneumatic thrown against the pulley, for increasing the contact between said actuating device and the pulley, substantially as and for the purpose described.

5. In a key-board instrument, the combination, with a continuously-revolving pulley, of an idle-roll journaled in plates rocking upon a fixed support, an actuating device between

the roll and the pulley, a flexible diaphragm connected with the plates carrying the idle-roll, means for exhausting the air from behind said diaphragm, a spring normally drawing the idle-roll toward the pulley, and a perforated sheet moving over the mouth of a duct leading to an air-cell behind said diaphragm, substantially as and for the purpose described.

6. In a key-board instrument, the combination, with a series of idle-rolls journaled in plates mounted upon a flexible diaphragm or diaphragms, of a series of air-cells behind said diaphragm, springs drawing said plates in one direction, exhaust mechanism for moving them in the opposite direction, and means for increasing and decreasing the tension of said springs, substantially as and for the purpose described.

7. In a key-board instrument, the combination, with a key-striker, of a belt directly connected therewith, a continuously-revolving pulley, over which said belt is carried, a spring-actuated support carrying an idle-roll, which is adapted to engage with the belt and pulley and increase the frictional contact between them, and means for varying the tension of the spring actuating such support, substantially as described.

8. In a key-board instrument, the combination, with a series of plates rocking upon a fixed support, of idle-rolls journaled in said plates, springs connected to the latter and rocking them in one direction, a rock-shaft carrying arms, to which the ends of said springs are fastened, and a cam actuating said rock-shaft, to increase or diminish the tension of the springs, substantially as and for the purpose described.

9. In a key-board instrument, the combination, with a series of vertical key-strikers resting upon the manual, of belts connected thereto and carried over continuously-revolving pulleys, friction-disks, between which said pulleys are clutched, and vibrating brackets carrying rolls which are by the action of the corresponding pneumatics thrown against the pulleys, for increasing the frictional contact between the pulleys and belts, for the purpose set forth.

10. In a key-board instrument, the combination, with a continuously-revolving shaft, of

washers splined thereupon, spring-bushings surrounding said shaft between the washers, and pulleys loosely mounted upon said bushings and clutched by the washers, substantially as and for the purpose described.

11. In a key-board instrument, the combination, with a continuously-revolving pulley, and a roll journaled in a rocking support adjacent to said pulley, of an intermediate bar or strip connected with the key-striker, and a bracket pivoted upon a rigid support and connected with the expanding and collapsing diaphragm covering the adjacent and corresponding pneumatic, for throwing the roll against said strip and effecting an operative engagement between the latter and the pulley, substantially as and for the purpose described.

12. In a key-board instrument, two alternating series of pivoted plates carrying idle-rolls, two diaphragms underlying said plates, two correspondingly-alternated series of air-cells arranged behind the diaphragms, and air-ducts leading from said cells and converging from both series to a common line upon the end of the casing, substantially as and for the purpose described.

13. In a key-board instrument, a double series of alternating air-cells formed within the body of the casing, a double series of air-ducts leading from said cells through the solid detachable end of the casing and converging to a common line, and an exhausting-chamber contained within triangular walls and set within the angle of convergence of the ducts, with each of which it communicates by a suitable opening, substantially as described.

14. In a key-board instrument, the combination, with idle-rolls journaled in a double series of alternating supports, each pivoted to a fixed base, of springs attached to and drawing said supports toward each other, and a double-cam shaft between the two series of supports, whereby they are rocked upon their pivots against the tension of the spring, substantially as described.

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

ROSWELL T. SMITH.

Witnesses:

JEROME A. BLANCHARD,

Mrs. J. A. BLANCHARD.