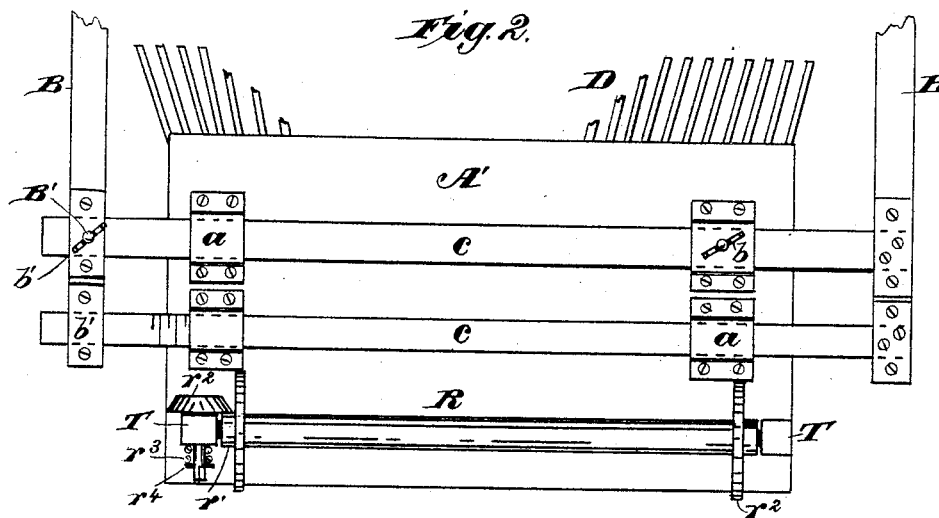
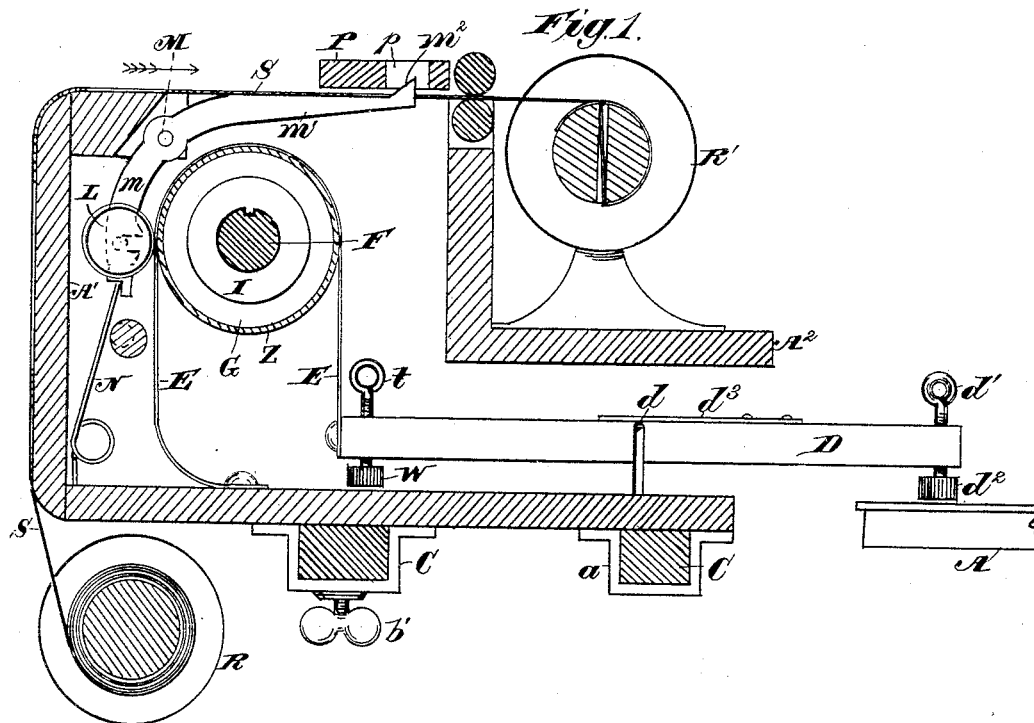


R. T. SMITH.

KEY BOARD PLAYER FOR MUSICAL INSTRUMENTS.

No. 346,236.

Patented July 27, 1886.



Witnesses.
 Clara L. Loveland
 Nettie A. Wheeler.

Inventor.
 By Roswell T. Smith.
 Charles B. Fildes *Att'y.*

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Fig. 3.

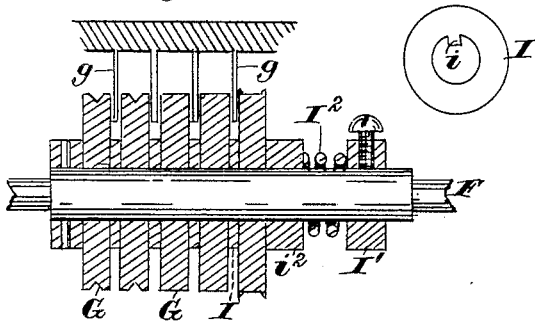


Fig. 4.

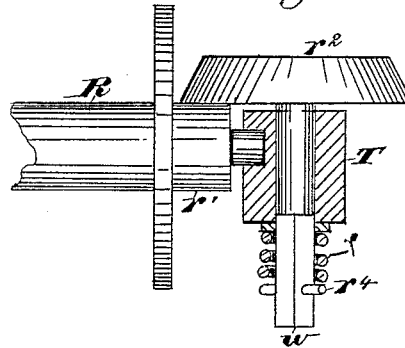
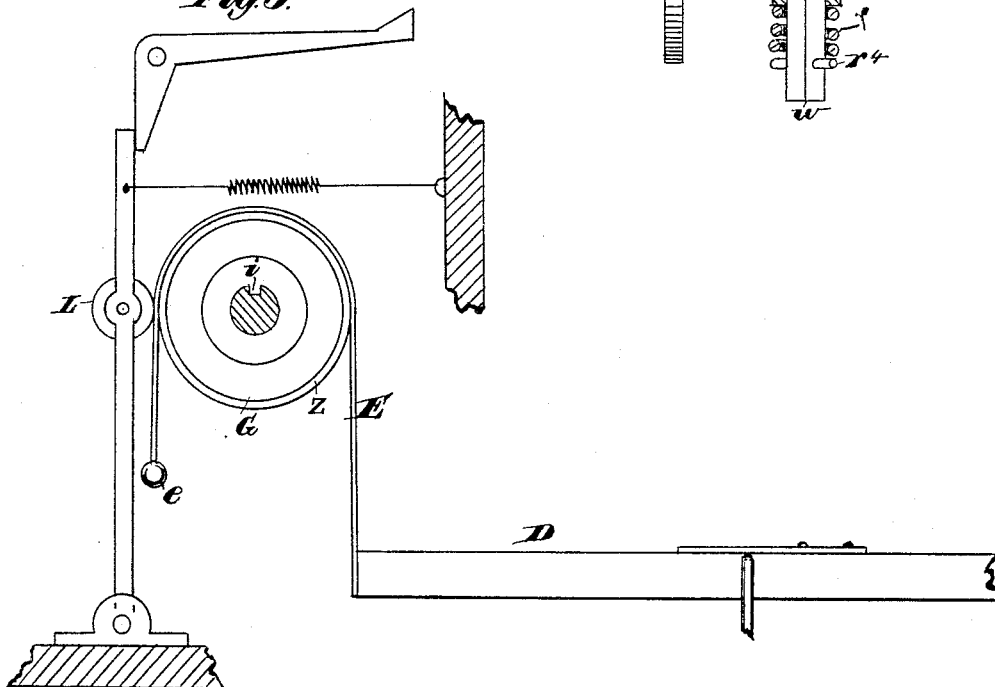


Fig. 5.



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UNITED STATES PATENT OFFICE.

ROSWELL T. SMITH, OF NASHUA, NEW HAMPSHIRE.

KEY-BOARD PLAYER FOR MUSICAL INSTRUMENTS.

SPECIFICATION forming part of Letters Patent No. 346,236, dated July 27, 1886.

Application filed March 7, 1884. Serial No. 123,444. (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 certain new and useful Improvements in Key-Board Players, of which the following is a specification.

My invention relates to automatic mechanism for executing musical compositions upon keyed instruments, such as pianos, pipe and reed organs, and the like; and it consists in certain improvements upon the invention shown and described in an application for Letters Patent of the United States, filed by me upon the 25th day of January, 1884, numbered in serial 129,014.

My invention consists more specifically in the combination, with a key-striker fulcrumed upon a supporting-frame, of a cord or belt attached to the end of the striker-bar and passing thence loosely over a continuously-revolving pulley, an idle-roll journaled upon a swinging arm and adapted to be thrown at intervals against the cord or belt and press it against the periphery of the pulley, and a lever engaging with a perforated music-sheet and vibrating the arm carrying the idle-roll, whereby the pulley is made to draw upon the cord or belt and the striker is operated to depress the key and sound the note.

It also consists in the combination, with a series of key-strikers having their fulera upon a supporting-frame, and each provided with a cord or belt attached to its end, of a corresponding series of pulleys over which said cords or belts pass loosely, a series of hanging arms carrying idle-rolls and normally impelled toward the pulleys, a series of levers connected with or forming part of said arms, a perforated music-sheet by which the action of the arms is controlled, and friction-collars splined upon the shaft carrying the pulleys and holding each by a frictional contact, which may be adjusted to yield to a resistance a little in excess of that which each striker must overcome in order to operate the key upon which it acts, whereby, after the note is sounded, the key is held and the sound prolonged during a time representing the relative value of the note.

It also consists in the combination, with a perforated music-sheet having a continuous

feed, of a series of levers engaging with said sheet, a series of vibrating arms actuated by said levers in one direction and by springs in the other, a series of pulleys arranged in the same vertical planes with said arms and loose upon a continuously-rotating shaft, adjustable collars splined upon the shaft and having frictional bearing upon the vertical faces of each pulley, cords or belts having one end carried over said pulleys and hanging loosely between them and the vibrating arms, and the other end attached to a key-striker having its free extremity projecting over the keys of the instrument, and suitable devices attached to the vibrating arms, whereby the levers, as they enter the perforations in the music-sheet, allow the said arms to swing toward the pulleys and bring said devices in contact with the cords or belts, causing such draft upon the latter as to operate the strikers to which they are attached, the pulleys slipping between their friction collars after the key is struck and holding it with a constant and equal pressure until the advance of the music-sheet draws the lever out of the perforation and removes the vibrating arm from the pulley, thereby allowing the key to rise.

Referring to the drawings, forming part of this application, Figure 1 is a vertical section taken from front to rear of the machine. Fig. 2 is a plan view of the machine-frame with its supports inverted. Fig. 3 is a central longitudinal section of the pulley-shaft and its attachments. Fig. 4 is a detail elevation of the pay-off roll, showing the device for rewinding the music-sheet. Fig. 5 is a detail elevation illustrating a modified construction.

A in said drawings represents the key-board or "manual" of a piano, organ, or similar instrument. At any suitable point upon the case I apply supporting-bars B B, arranged at a distance apart about equal to the length of the key-board, and fastened in place by hooks and sockets of the ordinary construction, or by other suitable devices. The supporting-bars are connected by bars C C, which are parallel with the key-board, and upon these I mount the frame or casing, within or upon which the operative parts are arranged. This casing, which is designated in the drawings by the letter A', may be attached to the supporting-bars by means of

straps *a*, which should fit closely upon said supports, while at the same time they permit a longitudinal adjustment of the casing *A'* between the bars *B*. The straps are bolted to the casing, and through one of them is tapped a set-screw, *b*, having its end bearing against the bar *C*, by which the casing may be firmly secured at any point to which it is adjusted. The specific purpose of this construction and the means for determining the adjustment mentioned will be described hereinafter.

The frame *A'* of the apparatus consists, essentially, of a pulley-chamber having a lower extension, *A²*, projecting toward the keyboard, in which the key-strikers are arranged. The parts last named consist of rods or bars *D*, having support at or near their middle upon a fulcrum, *d*, attached to the floor of the casing *A'*. These striker-bars are arranged side by side within the extension-chamber *A²*, and as closely together as is consistent with their operation. As they emerge from the casing they diverge, as shown in Fig. 2, so that their extremities lie just above the keys of the instrument upon which they are to act, covering a range upon the manual of considerably greater length than the length of the casing *A'*. The whole number of strikers contained within the casing may vary according to circumstances; but in no case is it necessary that this number shall correspond with the number of keys upon the instrument. By far the greater part of all musical compositions are written for and executed within a range of four or five octaves, the lower and the two upper octaves being seldom employed. I construct this apparatus, therefore, with such a number of key-strikers *D* as will meet all the ordinary requirements, the longitudinal adjustment of the casing *A'* enabling the operator to easily and quickly shift the entire series of strikers to bring them into engagement with that portion of the manual upon which the piece is to be executed.

To the extremity of each striker-bar is attached, by a set-screw, *d'*, a striker-block, *d²*, having a cushion, of felt, leather, or other suitable material, which rests upon the key. By turning the screw *d'* the block may be so adjusted that it will remain during operation in practical contact with the key. The fulcrum *d*, upon which each striker is hung, may consist of a rod or of a staple lying in a half-round groove in the upper surface of the striker, a leaf-spring, *d³*, being fastened to the bar with its end resting upon the fulcrum *d*. By giving the proper tension to this spring it will support the weight of the bar and render it easily detachable, forming an extremely cheap and convenient mounting for these parts.

The inner ends of the strikers enter the lower part of the pulley-chamber, and to each one is attached a short cord or belt, *E*. Within the said chamber is placed a shaft, *F*, extending from end to end, and having its bearings in the walls of the casing *A'*. Upon this shaft are

placed pulleys *G*, corresponding in number to the striker-bars, and so arranged that the cord or belt *E* upon each bar may be passed upward and carried over the corresponding pulley above it, the end being allowed to hang loosely down, as shown in Fig. 1, or, if desired, being provided with a light weight, *e*, as shown in Fig. 5. A light spring may be substituted for the weight, if preferred. The pulleys *G* are slipped loosely upon the shaft, and are held between collars *I*, which are caused to rotate with the shaft by splines *i*, which enter a longitudinal groove, *i'*, in its surface. The construction and arrangement of these parts are shown in Fig. 3, and are substantially similar to that shown and claimed in my application named above, filed the 25th day of January, 1884. The collars *I* separate the pulleys *G* from each other and have a friction-bearing upon each vertical face of each pulley. One end of the shaft *F* is threaded to receive a nut, *I'*, by turning which a spring, *I²*, coiled upon the shaft, is compressed. This spring bears upon a collar, *i²*, splined upon the shaft and bearing against the outer pulley. Increasing the tension of the spring *I²* in this manner increases the frictional contact between the collars and the pulleys, the increase being distributed in equal increments along the whole series. It will be seen that any draft upon the cord or belt *E* will be resisted by the mutual cohesion of the friction-surfaces, and that when the tension upon the belt equals this resistance the pulley will slip between the collars *I*. The friction also being proportionate to the pressure, the latter may be so adjusted that the pulley shall have just sufficient draft upon the belt or cord to depress the key and sound the note, after which the least increase in the tension will cause the pulley to slip. While this slip continues the belt will remain taut and the draft of the pulley upon it will be continuous and equal, or substantially so, to the draft required to overcome the frictional resistance of the collars *I*.

The pulley *G* takes the cord or belt *E* upon the side next the strikers, and upon its opposite side, at or near the point where the loose end of the belt leaves its periphery, I place an idle-roll, *L*, which is carried by the depending arm *m* of a bell-crank lever, *M*, pivoted in the upper part of the casing *A'*. The other arm, *m'*, extends forward over the series of pulleys *G*, and its extremity *m²* is inclined or beveled upward, as shown in Fig. 1. A spring, *N*, attached to the casing, bears against the lower end of the arm *m*, and normally throws the idle-roll *L* against the pulley *G*, binding the belt or cord *E* upon its periphery, and causing it to draw sufficiently to actuate the key-striker and slip the pulley after the key is depressed to its lowest point. A comparatively slight pressure of the idle-roll upon the cord or belt is sufficient to cause a strong draft of the pulley, and a very limited range of movement of the arm *m* will bind the belt and release it. The roll *L* being thrown against the

pulley by the spring N, it is disengaged therefrom by a slight movement of the arm *m* away from the pulley and against the tension of the spring N. This movement is effected in the following manner: The bell-cranks M are pivoted in the upper wall of the casing A' and below its outer surface, but in such a manner that their upwardly inclined or beveled extremities *m*² project above it. Above the arms *m*¹, and arranged transversely thereto, I mount a strip, P, bolted to the casing, space being left for the passage of the perforated music-paper between it and the arms *m*¹. In this strip is formed a longitudinal slot or channel, *p*, into which the ends *m*² of the arms may pass, and between the edge of the strip and the vertical wall of the casing is left space *s* for the passage of the perforated sheets.

The music-paper used upon this machine is similar to that described in my pending application, the musical notation being represented by openings cut in a paper sheet, the value of each note being represented by the length of the perforation indicating it, and the harmony depending upon the relative arrangement of such openings. There may be as many longitudinal lines of such cuttings as there are key-strikers, or there may be a less number; but in any case the sheet is cut in such a manner that as it passes under the strip P the longitudinal lines in which the cuttings are made shall coincide substantially with the points *m*² of the arms *m*¹. The sheet being drawn under the strip and fed steadily forward by suitable mechanism, the operation is as follows: Those of the arms *m*¹, which have their points *m*² resting upon the imperforate portions of the sheet S will be depressed, drawing the arm *m*¹ toward the front of the casing and removing the idle-roll L from the pulley G. While in this position there is no draft upon the cord or belt E, which merely slips upon the continuously-revolving pulley. As the paper advances until a note-opening comes over one of the points *m*², the latter, under the action of the spring N, is instantly thrown through the cutting into the channel *p*, and the roll L is brought against the belt E. The revolving pulley G at once operates the striker D until the key is depressed to its lowest point, when the pulley slips between its friction-collars, holding the key down with a steady pressure during the time the point *m*² is traveling from end to end of the perforation in the sheet. The paper being fed in the direction indicated by the arrow in Fig. 1, when the end of the note-opening reaches the inclined point *m*², it will draw said point out of the cutting by the advance of the sheet, thereby causing the arm *m* to withdraw the roll L from the pulley G, releasing the belt and allowing the key of the instrument to rise and restore the striker D to its original position. Practically this disengagement of the roll L takes place the instant that the end of the note-opening has impinged upon the inclined or beveled point *m*² far enough to effect an appreciable movement of the arm *m*¹. The

light cord or belt E being released, the key rises, restoring the striker to its position, the belt slipping upon the periphery of the pulley without producing any sensible resistance. The music-paper is taken from a pay-off roll, R, which is mounted in suitable bearings beneath the pulley-chamber. The sheet passes from this roll over the front and top of the casing and beneath the strip P to a take-up roll, R', journaled behind the pulley-chamber, and over the extension A² of the casing. The latter roll may be operated to give the proper feed to the paper by a belt from a pulley on the shaft F or by gearing. This arrangement of the rolls not only effects a considerable reduction in the bulk of the apparatus, but it removes them from danger of injury, and enables me to use extremely simple feeding mechanism. When the paper has been all wound upon the take-up roll R', I reroll it upon the pay-off R by the following means: The roll being journaled in any suitable bearings, I place upon one end of the roll-shaft, outside the spool, a small friction-gear, *r*¹, covered with rubber or a similar cohesive substance. A larger gear, *r*², carried by a shaft, *w*, has bearing upon this roll and is drawn against it by a spiral spring, *r*³, coiled upon the shaft of the gear *r*², and compressed between a cross-pin, *r*⁴, and the bearing block or post T, in which both shafts are supported. The end of the shaft *w* is fitted to receive a crank by which the gear *r*² may be turned and the roll R rotated, thereby drawing the music-sheet off the take-up roll R' and rewinding it upon the pay-off. The crank by which the apparatus is actuated, and which is applied for that purpose to the pulley-shaft F, may be removed and used in rerolling.

By reference to Fig. 2 it will be seen that the bars C C, upon which the casing A' slides, may be provided with an index or guide to aid the operator in adjusting the apparatus to that portion of the key-board upon which the machine is to operate. This index may consist of symbols or figures marked upon the bar, with or without a pointer attached to the case A', and sliding over said figures. By marking upon the music-sheet the proper symbol the operator may be aided in adjusting the apparatus, which may easily be done at the same time that the music roll is placed in its bearings. It must be borne in mind that this adjustment is solely for the purpose of so placing the apparatus that the series of key-strikers shall cover the range upon the manual of the piece to be executed. In the majority of cases no special adjustment will be necessary, as the number of key-strikers in the apparatus will be sufficient to include the average range of musical composition.

It is evident that by making the case adjustable I accomplish a great reduction in bulk and effect a proportionate economy in the cost of manufacture. By making a sufficient number of strikers to cover the whole key-board I might avoid the necessity for such

adjustment; but the highest and the lowest notes are so seldom used that they are practically dead elements, and such a machine would be increased largely in bulk and in cost without any compensating advantage resulting therefrom.

Upon the inner ends of the strikers I mount stop-cushions W, having adjustment by means of a set-screw, *t*, passing through the bar. This cushion, which is faced with rubber, felt, or other material, limits the return movement of the bar, and may be so adjusted that throughout the operation of the machine the striker-block *d'* will remain in practical contact with the key of the instrument.

The supporting-frame for this apparatus may be rendered applicable to instruments of different sizes by making one of the bars B adjustable toward and from the other. A simple construction for effecting this purpose is shown in Fig. 2, one of said bars being provided with straps *b' b'*, to receive the ends of the bars C C. By tapping a set-screw, *B'*, through one of these straps, so that its end will bear against the bar, the supporting-frame may be attached to an instrument of any size having a key-board of sufficient range to admit the series of key-strikers.

When a cord is used upon the pulley G, instead of a flat belt the periphery should be grooved, as shown upon one or more of the pulleys in Fig. 3. The idle-roll also may in this case be grooved, though it is not absolutely essential. In order to prevent all danger of either cord or belt becoming unshipped or thrown off the pulley, I propose to use guards *g*, attached to any suitable support, and projecting over the edges of the several pulleys, as shown in Fig. 3.

In the present case, as well as in my application filed January 25, 1884, and numbered in serial 129,014, one prominent feature of the invention is that there is no fixed point where the slip of the pulley takes place, and, as this slip can only occur after the key has been depressed by the striker to its utmost limit, it is evident that I secure a fullness of tone and a uniformity of action which can only be obtained by a machine operating upon this principle.

Experience has shown that in order to avoid all danger of imperfect action, whether resulting from those changes caused by long use, by the weather, or by any other cause, it is desirable to face the pulley G with rubber or a similar material. This facing I have shown in the drawings at Z. It should be understood that this feature is not absolutely essential to the practical operation of the mechanism, but it is a valuable factor in securing permanent accuracy and uniformity of action upon the part of all the elements of the mechanism.

In my application filed April 23, 1884, Serial No. 129,014, I have shown and claimed a motor carried by a friction-clutch, in combination with a device actuating the key, and I do not, therefore, broadly claim the same in

this application, except in combination with the special devices shown.

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

1. In an automatic apparatus for playing key-board instruments, the combination, with a striker-bar acting upon a key of the instrument, of a cord or belt attached to the end of the bar, a continuously-revolving pulley over which the end of said belt or cord is drawn, an idle-roll journaled in one end of a spring-actuated lever-arm, and a perforated music-sheet with which the other end of said lever-arm engages, substantially as specified.

2. In an automatic apparatus for playing keyed instruments, the combination, with a striker-bar acting upon a key of the instrument, of a cord or belt attached to the end of the bar, a continuously-revolving pulley having a rubber tire or periphery over which one end of said belt or cord is drawn, an idle-roll journaled in one end of a spring-actuated lever-arm fulcrumed between its ends, a perforated music-sheet with which the other end of said lever-arm engages, and mechanism, substantially as described, for feeding said music-sheet, as specified.

3. In an automatic key-board apparatus, the combination, with a striker-bar and a pulley loose upon a continuously-revolving shaft, of a belt fastened to one end of the bar and carried partly around the pulley, friction-collars splined upon the shaft and having bearing upon the opposite vertical faces of the pulley, and means for binding the belt upon the periphery of the pulley at suitable intervals, the frictional resistance of the collars being adjusted to a degree somewhat in excess of the resistance to be overcome by the striker, substantially as and for the purpose described.

4. In an automatic key-board apparatus, the combination, with a bell-crank lever having an extremity beveled or inclined and engaging with a perforated music-sheet, of an idle-roll journaled in the other end of said lever, a pulley carried by friction-collars splined upon a continuously-revolving shaft and bearing upon the vertical faces of said pulley, a belt or cord carried loosely over said pulley and attached to one end of a key-striking bar, and a spring by which the idle-roll is normally thrown against the belt as it lies over the pulley, substantially as and for the purpose set forth.

5. In an automatic key-board apparatus, the combination, with a continuously-fed music-sheet, of a series of pivoted levers having beveled or inclined points which engage with said sheet, idle-rolls journaled in said levers and normally impelled toward a series of pulleys loose upon a continuously-revolving shaft, collars splined upon the shaft and having frictional bearing upon the vertical faces of said pulleys, and belts or cords carried over said pulleys and attached to the ends of a corresponding series of key-strikers having their

opposite ends extending over the key-board, substantially as and for the purpose described.

6. In an automatic key-board apparatus, the combination, with a series of key-strikers
5 having their fulcra between their ends, of short belts or cords attached to one end of said strikers, a series of pulleys having adjustable friction-bearings by which they are revolved, and over which said belts or cords are carried,
10 with the ends left loose, and a series of devices normally impelled against said pulleys at or near the point where the loose ends of the belts leave their peripheries, whereby increased friction is caused between the belts
15 and the pulleys and the key-strikers operated, substantially as and for the purpose described.

7. The combination, with the pivoted key-strikers and the loose belts attached to their inner ends, of the pulleys with which said belts engage, each pulley having a facing of rubber 20 or equivalent material, and the spring-actuated selecting-arms, each having an idle-roll journaled in one end and adapted to be brought into contact with said pulley, substantially as specified. 25

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROSWELL T. SMITH.

Witnesses:

C. E. P. SMITH,

CLARA L. LOVELAND.