

T. CAHILL.  
PIANOFORTE ACTION.

No. 520,667.

Patented May 29, 1894.

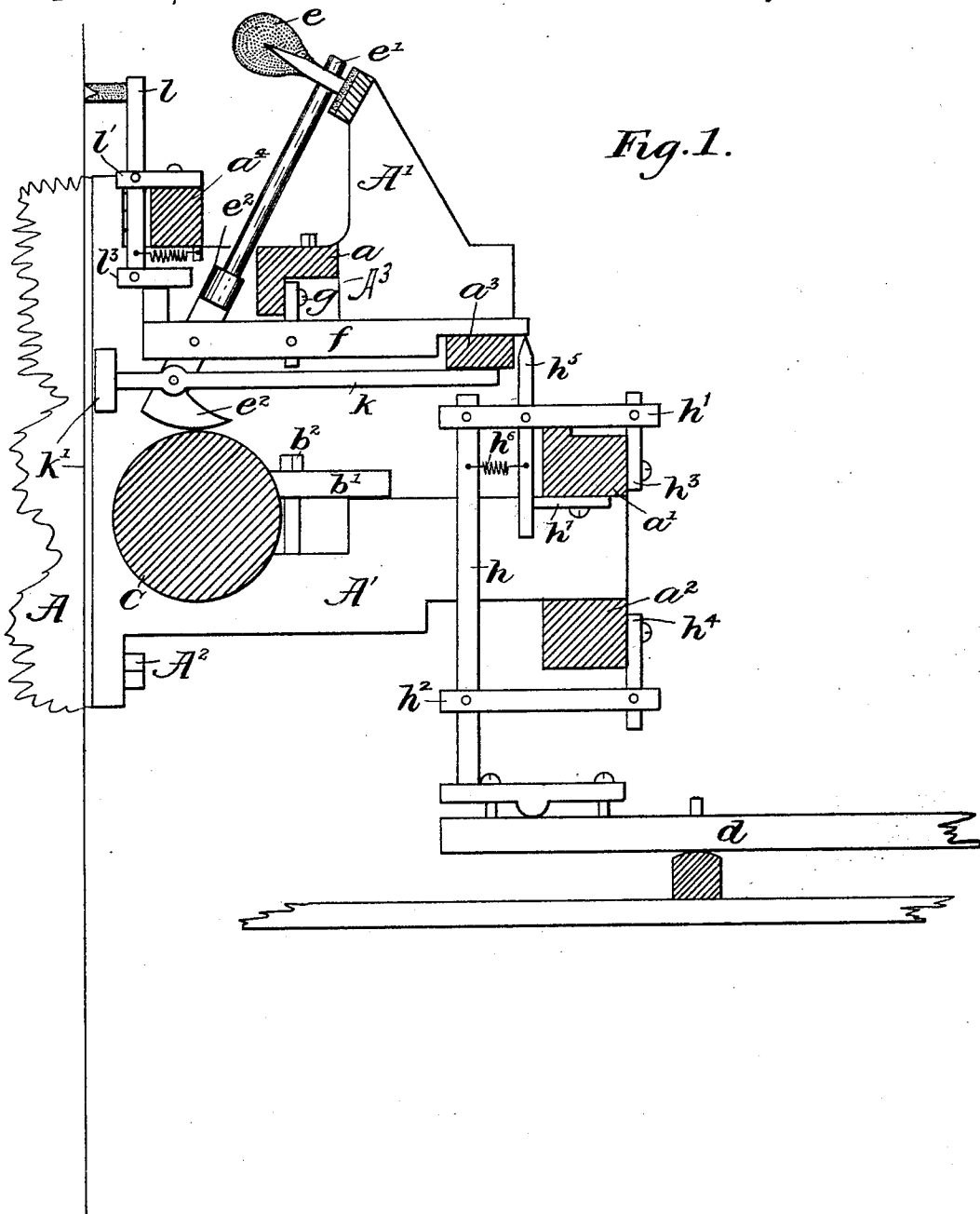


Fig. 1.

Witnesses  
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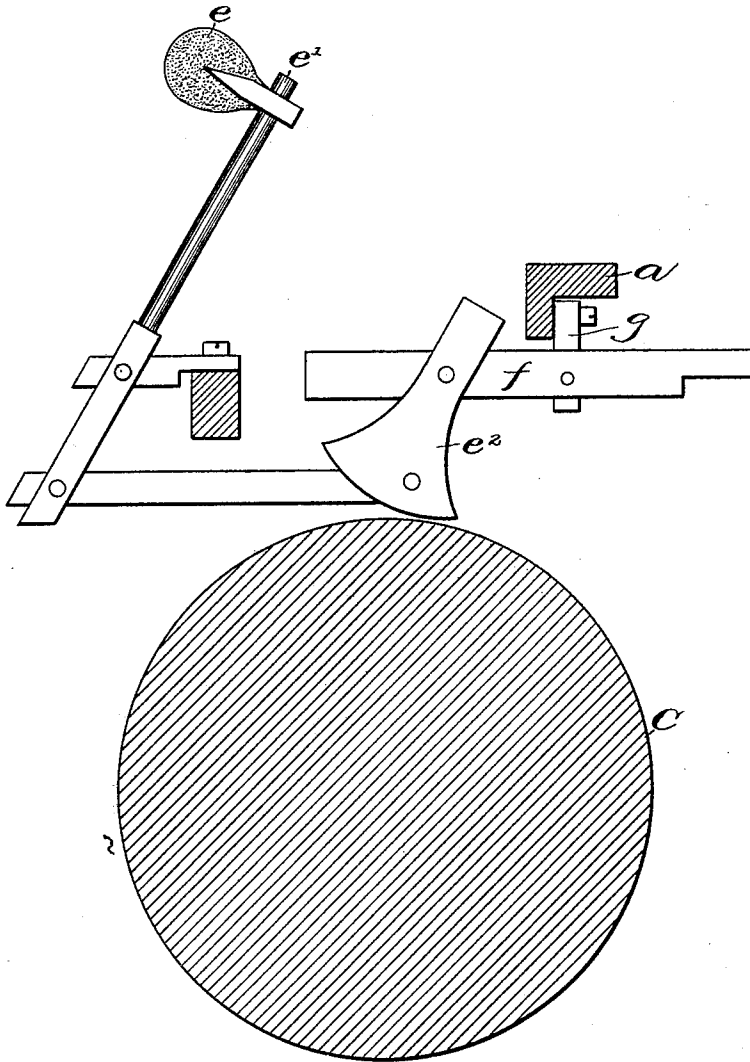


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*Fig. 3.*



Witnesses

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M. H. Cahill

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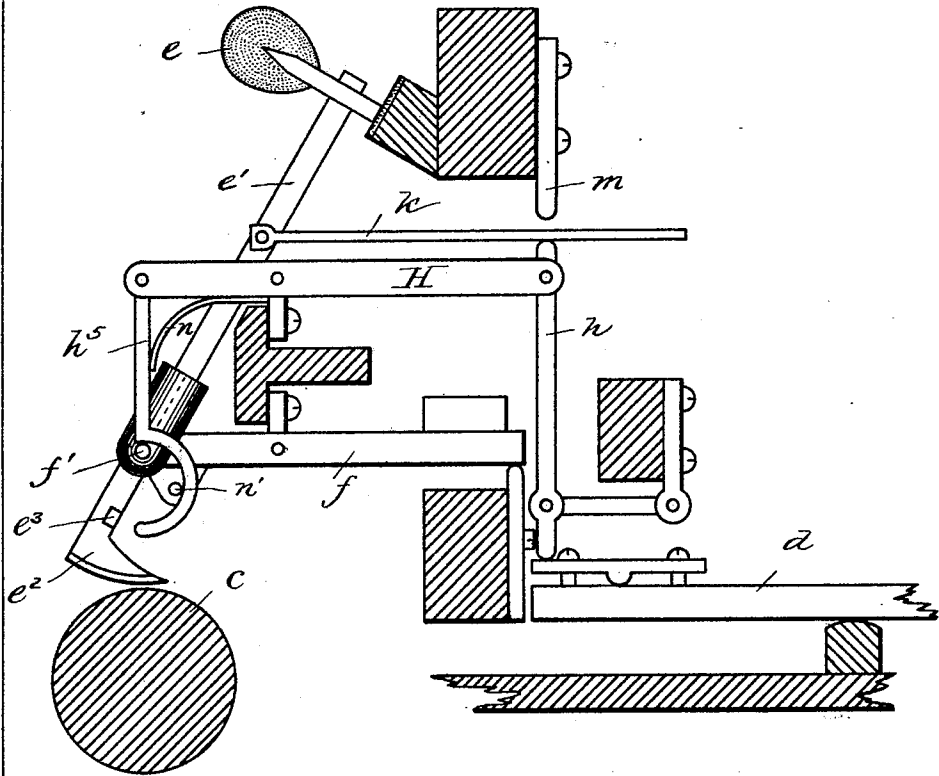
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*Fig. 4.*



Witnesses—

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# UNITED STATES PATENT OFFICE.

THADDEUS CAHILL, OF NEW YORK, N. Y.

## PIANOFORTE-ACTION.

SPECIFICATION forming part of Letters Patent No. 520,667, dated May 29, 1894.

Application filed March 21, 1893. Serial No. 467,096. (No model.)

*To all whom it may concern:*

Be it known that I, THADDEUS CAHILL, a citizen of the United States, and a resident of the city, county, and State of New York, residing temporarily at Washington, in the District of Columbia, have invented certain new and useful Improvements in Actions for Pianofortes and other Keyboard-Instruments, of which the following is a specification.

The object of my invention is to construct a simple, durable and perfect power action. And my invention consists in the parts, improvements and combinations hereinafter described and claimed.

The concrete structure figured in the drawings in illustration of my invention consists of (a) a rotating, circular friction-driver, suitably mounted and suitably rotated, and serving to furnish power for the impelling of the hammers; (b) a hammer, and a pivoted hammer-butt, connected with the hammer, and having a curved surface lying normally in close proximity to the friction-driver, said hammer-butt serving as a contact-piece to take power from the friction-driver for the impelling of the hammer; (c) a lever, upon which the before mentioned hammer-butt or contact-piece is mounted, the parts being connected with the key in such a manner that the curved surface of the contact-piece is pressed against the friction-driver, when the key is depressed, with a force proportional to that with which the key is pressed down—that is, with a force which is great or small, according as the pressure upon the key is great or small; (d) escapement mechanism, whereby the contact-piece is released from the traction of the friction-driver, at or about the instant the hammer strikes the string, and the hammer left free to retreat from the string; and (e) checking mechanism, serving to oppose a frictional resistance to the movement of the contact-piece and hammer at or about the instant the hammer strikes the string, thus breaking the rebound of the hammer, and preventing it from striking the string (or strings) more than once for each depression of the key. The escapement and checking mechanism mentioned are formed by means of (a) a fly connected with the key and arranged to press upon the lever before mentioned, so as to press the contact-piece-

hammer-butt against the friction-driver and (b) a releaser, connected with the contact-piece in such a manner that the contact-piece, as it moves under the influence of the friction-driver, acts through the releaser upon the fly, moving it from its normal position, thus freeing the contact-piece from the friction-driver; the pressure theretofore transmitted from the fly to the contact-piece being thereupon transferred to the releaser, the releaser being pressed by a check-piece connected with the key against a fixed check-piece or check-bar, so that a frictional resistance is opposed to the movement of the releaser, and thus to the movement of the contact-piece and hammer connected therewith, so that the hammer is checked upon its retreat from the string, and prevented from rebounding thereon.

In the accompanying drawings, Figure 1 is a sectional view in elevation illustrating my improved action, the friction-driver and action-rails being seen in section, and the other parts in elevation. Fig. 2 is a view similar to the preceding figure, illustrating the action-frame. Fig. 3 is a detail view, illustrating a modified construction in which the contact-piece is made separate from the hammer-butt. Fig. 4, which is a view similar to Fig. 3, represents another modified construction, in which the releaser is dispensed with, and the contact-piece itself arranged to move the fly, and free the escapement; and Fig. 5, which is also a view similar to Fig. 3, represents still another modified construction, in which a cord- or pull-piece is used as a releaser, and in which, also, the part employed as a releaser, and the part employed as a check-piece connected with the contact-piece, are separate parts.

My present action, as the drawings show, is in the nature of an improvement upon the action described in the specification of Letters Patent No. 458,219, granted to me on August 25, 1891, for improvements in piano-forte actions, to which specification, and the drawings thereto annexed, reference is hereby had and made for a full description of my original power piano-forte action.

The objects of my improvement are (a) to make a powerful action, with but one friction-driver; (b) to arrange all the parts in

such a manner that the contact-pieces, when not in action, are effectually held away from the friction-driver, without interfering with either the delicacy or the power of the action;

5 (c) to improve the escapement mechanism; (d) to improve the checking mechanism; and (e) to make a direct and fast connection between the contact-piece and the pivoted hammer.

10 My present improved action, and the original action upon which it is an improvement, each alike includes a key, a hammer, a friction-driver, a contact-piece connected with the hammer, a pressure connection interposed

15 between the key and the contact-piece, controlled by the key, and serving when the key is pressed upon to press the contact-piece against the friction-driver, an escapement for the contact-piece, and an escapement and a check for the hammer. In each the same escapement feature serves both for the contact-piece, to free it from the traction of the friction-driver, and for the hammer to leave it free to retreat from the string, after it has

20 delivered its blow thereon; and the check in each case is made by a key-controlled pressure brought to bear upon a part connected with the hammer and the contact-piece, so that a frictional resistance is created to oppose

25 the movement of said parts. Such are the points of resemblance between the old action and the new. The principal points of difference relate (a) to the form and arrangement of the contact-piece; (b) to the manner of connecting the contact-piece with the hammer;

30 (c) to the construction and arrangement of the escapement; and (d) to the construction and arrangement of the check. Of these in their order.

35 In the old action above mentioned, (or, more correctly speaking, in the preferred form of the old action, *i. e.*, the form having an escapement for the contact-piece, as illustrated in Figs. 10, 10<sup>A</sup> and 10<sup>B</sup>, of the aforesaid Letters

40 Patent,) the contact-piece was made in the form of a bar, and was moved by the friction-driver in a right line, sliding on the part by which it was pressed against the friction-driver. Such a contact-piece, arranged to operate with two friction-drivers, as illustrated

45 in Figs. 10 and 10<sup>A</sup> of the before mentioned Letters Patent, makes a powerful action. But when arranged to operate with a single friction-driver, as in Fig. 10<sup>B</sup> of the before mentioned Letters Patent, the action is very much

50 less powerful; for, in the first place, if the leverage of the pressure-transmitter or reach-up upon the bar-contact-piece be great, (that is, if the distance from the reach-up, measuring on the bar contact-piece, to the point of contact of said contact-piece with the friction-driver be great in comparison with the distance from the last mentioned point to the point at which the bar-contact-piece is connected with the hammer-shank,) then the

55 tilting motion of the bar-contact-piece on its point of contact with the friction-driver as a

center, resulting from the angular motion of the hammer-shank with which the bar-contact-piece is connected, tends to move the key somewhat while it is held down, and so becomes an annoyance to the performer. On this account, the power of the action with a single friction-driver, as illustrated in Fig. 10<sup>B</sup> of the before mentioned Letters Patent cannot be increased by giving the reach-up or pressure-transmitter any very large leverage upon the contact-piece. And if, on the other hand, the leverage of the reach-up or pressure-transmitter upon the bar-contact-piece be small, (as it should be, to avoid disturbance of the key during the movement of the contact-piece,) then the fact that the pressure at the point where the reach-up acts upon the contact-piece is almost as great as that with which the contact-piece is pressed against the friction-driver, causes a waste of power, and tends to rapid wear of the parts. And when the bar-contact-piece is used with the two friction-drivers of the old action, unless there is a careful adjustment of the contact-piece, it is liable, when the key is in its normal position, to just touch the friction-drivers (or one of them), causing a slight loss of power, and a slight rubbing sound, both of which it is important to avoid. All these difficulties are avoided in my improved action, and a powerful action made with a single friction-driver, by employing a segmental contact-piece, pivoted to a lever, upon which the pressure-transmitter acts to press the contact-piece against the friction-driver, the fulcrum of the lever being arranged at such a point that a proper leverage is given for pressing the contact-piece against the friction-driver with all necessary force, and the lever being arranged in such a manner that when released from pressure, it promptly and effectively withdraws the pivoted contact-piece from the reach of the friction-driver so that any slight touching, with the consequent friction, and accompanying rubbing sound, which might occur in the old action, when not well adjusted, are entirely avoided.

In the old action, the contact-piece and the hammer-butt were separate parts, the contact-piece being, as above mentioned, a bar rectilinearly moving, while the hammer-butt was pivoted in the usual manner, and the parts connected in such a manner that the movement of the contact-piece moved the hammer-butt or hammer-shank, and impelled the hammer. In the new action, the contact-piece is itself made to serve as a hammer-butt, or to state the matter in another way, the hammer-butt is made to serve as a contact-piece, whereby the action is simplified, and a direct and fast connection secured between the contact-piece and the pivoted hammer—a connection, moreover, which will neither wear nor require readjustment.

In the old action, the escapement is formed by the rectilinearly-moving contact-piece sliding over the top of the reach-up or pressure-

transmitter, through which the key presses the contact-piece against the friction-driver, until a thinned, weakened or hollowed-out part of the contact-piece comes over the top  
 5 of the pressure-transmitter—in other words, until the contact-piece slides off of the pressure-transmitter. In the new action, an escapement pressure-transmitter is employed, intermediate the key and the contact-piece,  
 10 arranged in such a manner that the key when pressed upon moves it (said pressure-transmitter), for an instant, so that a pressure connection is established between the key and the contact-piece for pressing the contact-  
 15 piece against the friction-driver, said pressure-transmitter being also arranged in such a manner that when moved in another direction different from that in which it was moved by the depressing of the key, it (said pressure-  
 20 transmitter), breaks the pressure connection between the key and the contact-piece, the contact-piece being arranged in such a manner that when moved by the friction-driver, it (the contact-piece), moves the pressure-transmitter above mentioned, and by so  
 25 moving it breaks the pressure-connection between the key and the contact-piece. In brief, in the old action, the contact-piece slides gradually over the top of the reach-up  
 30 or pressure-transmitter, and so gets free; and the escapement takes place and the contact-piece is freed from the friction-driver independently of any movement of the pressure-transmitter, the reach-up or pressure-transmitter being at rest at the time of the  
 35 escapement, and the escapement being effected not by any movement of the pressure-transmitter but by the movement of the contact-piece over and off of the pressure-transmitter. In the new action, on the contrary, the  
 40 escapement is effected by the movement of the escapement-pressure-transmitter, which movement is effected (preferably, but not necessarily), by the movement of the contact-piece. The pressure-transmitter is arranged,  
 45 as above stated, in such a manner that when moved in a certain direction (different from that in which it was moved by the depressing of the key), it frees the escapement, and  
 50 leaves the contact-piece free to escape from the traction of the friction-driver, and the hammer free to rebound from the string; and the contact-piece and hammer are arranged in such a manner that by their movement, they  
 55 act upon the pressure-transmitter, moving it and effecting the escapement at the right instant. In the old action, the contact-piece does not, properly speaking, act upon the pressure-transmitter to produce the escapement—it  
 60 simply slides off of the pressure-transmitter, and so escapes. In the new action on the contrary, the contact-piece acts positively upon the escapement pressure-transmitter and moves it, and by this movement of the  
 65 escapement frees itself from the traction of the friction-driver. In the old action, the

mode of producing the escapement involves the forcible sliding of the contact-piece over the reach-up or pressure-transmitter, with  
 70 which it is in contact, during the whole time that it is being moved by the friction-driver. In the improved action, when well constructed and adjusted, the pressure-transmitter remains at rest with relation to the part upon  
 75 which it acts to transmit its pressure to the contact-piece, until the instant of the escapement, and then slides under pressure for a very short distance indeed; and thus the wear and noise due to the forcible sliding of the  
 80 contact-piece over and in contact with the reach-up or pressure-transmitter, during the whole period of its movement under the influence of the friction-driver, of the old action, are avoided.

In the old action, the check is formed by  
 85 the reach-up or pressure-transmitter that presses upon the contact-piece pressing a check-piece (let into and connected by a pin-joint with the rectilinearly-moving contact-piece), against a fixed check-piece or check-  
 90 bar.

In the new action, the check is formed by a check-piece controlled by the key and arranged to move under the influence of the  
 95 key, and to operate substantially free from other motion, pressing a bar or other part connected with the pivoted contact-piece, and through that with the hammer, (and preferably, arranged to serve as the releaser, for freeing the escapement,) against a fixed check-  
 100 piece or check-bar. In the old action, the same key-controlled part that is subjected to the pressure, rubbing and wear resulting from the operation of the escapement, is subjected also to the pressure, rubbing and wear re-  
 105 sulting from the operation of the check. In the new action, on the contrary, the part which bears the pressure, rubbing and wear resulting from the operation of the check is a different part from that which bears the pressure,  
 110 rubbing and wear of the escapement. And as we have already seen, the escapement of the new action has but little rubbing and wear in comparison with the escapement of the old. And the part which bears the  
 115 rubbing and wear of the check is much larger and stronger in the new action, than the part which bears the combined rubbing and wear of the escapement and the check in the old  
 120 action.

In the old action, the check-piece connected  
 125 with the contact-piece rubs on the fixed check-piece against which it is pressed, but does not rub on the pressure-transmitter by which it is pressed against the fixed check-piece; the pressure-transmitter tilts and with the check-piece connected with the contact-piece. In the  
 130 new action, however, the check-piece connected with the contact-piece rubs both on the fixed check-piece against which it is pressed, and on the check-piece connected with the key, by which it is pressed against the other.

Thus the power of the check is increased, and at the same time the wear is reduced by being divided between two pairs of surfaces.

In the old action, on account of the form of the contact-piece and the arrangement of the friction-drivers, and the escapement, the contact-piece was necessarily of considerable weight and inertia. By the use of the segmental contact-piece of the new action, and the improved escapement, the weight and inertia of the contact-piece are greatly reduced, whereby the delicacy of the action is increased.

With this preliminary description of my new action, and its relation to my original action, described in the Letters Patent above named, and upon which the present action is an improvement, I shall now proceed to describe in detail the structure figured in the drawings, with reference by letters to all the various parts. And first I shall describe the structure illustrated in Figs. 1 and 2, which is the preferred form.

A represents the main-frame of the instrument, the greater portion of which is broken away.

A' is one of the action-brackets, attached to the main-frame by bolts A<sup>2</sup>, A<sup>2</sup>. There is one of these brackets at the lower or bass side of the instrument, and another at the upper or treble side. Action-rails, a, a', a<sup>2</sup>, a<sup>3</sup> and a<sup>4</sup>, extend across the instrument from one action-bracket to the other. The rails a', a<sup>2</sup>, a<sup>3</sup> and a<sup>4</sup>, are firmly attached to the brackets A', A', by screws or bolts. The rail a is in like manner attached to projections A<sup>3</sup>, A<sup>3</sup>, cast integral with the brackets A', A'. The action-rails may be stiffened by being connected with each other at one or more convenient points intermediate the aforesaid action brackets. Each of the action-brackets, A', carries a box, b. The box carried by one action-bracket is in line with that carried by the other action-bracket, and in these boxes the friction-driver c, is mounted. Each of the boxes, b, is held in place by means of a keeper, b', and a bolt b<sup>2</sup>, as shown in Fig. 2.

d is the key.

e is the hammer; e', the hammer-shank, e<sup>2</sup>, the pivoted hammer-butt and contact-piece, which is attached by its center-pin or pivot to the lever, f, which latter is attached by a flange, g, to the action-rail, a. The part, e<sup>2</sup>, which is both hammer-butt and contact-piece, (and which is sometimes referred to hereinafter as a "hammer-butt," and sometimes as a "contact-piece," according as it is considered in respect of its function as a hammer-butt or in respect of its function as a contact-piece,) serves to take power from the friction-driver, c, for the impelling of the hammer. The lower surface of said part, e<sup>2</sup>, is curved, the center from which the curve is described being the center of the pivot by which said part e<sup>2</sup> is connected with the lever, f.

h is the reach-up and check-piece, and it is sometimes referred to hereinafter by the one

term and sometimes by the other, according as it is considered with relation to its office of a reach-up, or with relation to its office of a check-piece. It is pivoted to bridle-levers, h' and h<sup>2</sup>, which are attached by flanges, h<sup>3</sup> and h<sup>4</sup>, respectively, to the action-rails a' and a<sup>2</sup>, respectively. A fly, h<sup>5</sup>, is also pin-jointed to the lever h'. An expansive spring, h<sup>6</sup>, holds the fly, h<sup>5</sup>, normally in contact with an adjustable stop, h<sup>7</sup>, which is attached to the rail, a', by a screw passing through an elliptical slot in said stop, h<sup>7</sup>, whereby facility is furnished for the adjustment of said stop. In its normal position, the fly, h<sup>5</sup>, lies under the end of the lever, f, in close proximity thereto. A push-bar, k, serving as a releaser and as a check-piece, is pin-jointed to the contact-piece, e<sup>2</sup>, below the center of attachment of said part, e<sup>2</sup>, to the lever, f. The push-bar, k, is sometimes referred to hereinafter as a releaser, and sometimes as a check-piece, according as it is spoken of with reference to its function as a releaser, or with reference to its function as a check-piece. A weight, k', serves to balance the push-bar, k, on the pin by which it is connected with the contact-piece, e<sup>2</sup>. The lever, f, rests normally in contact with the action-rail, a<sup>3</sup>, and holds the curved surface of the contact-piece, e<sup>2</sup>, in close proximity to, but free from contact with, the friction-driver, c. The front part of the push-bar, k, lies between the lower surface of the action-rail, a<sup>3</sup>, and the upper surface of the check-piece, h, in close proximity to both. The damper-lever, l, is attached by a flange, l', to the rail, a<sup>4</sup>. A spring, l<sup>2</sup>, holds the damper normally in contact with the string, m, to which it corresponds. A push-bar l<sup>3</sup>, is connected with the damper-lever, and arranged in the path of motion of the hammer-butt, so that the hammer's movement toward the string withdraws the damper from contact with the string. The shaft, c, is rotated in a suitable manner. Means of rotating it will be obvious to any one skilled in the art, or to any skilled mechanic. In some situations, a small electric motor may be most conveniently employed. An ordinary foot-pedal, connected with the shaft by a crank and pitman, or otherwise, may be used; or a water-motor may be employed. This shaft must be in some manner rotated; but the mode of rotating it forms no part of my present invention. An improved arrangement for rotating it by foot power, specially adapted to the peculiar requirements of piano-forte playing, is described in another application of mine for Letters Patent for improvements in piano-forte actions, of even date herewith, and Serial No. 467,098.

When the key, d, is depressed by the performer, it raises the reach-up, h, lever h', and fly h<sup>5</sup>, a short distance. The fly h<sup>5</sup>, in consequence, comes in contact with the lever, f, moves said lever from its normal position, and moves on, until its farther movement is prevented by the contact-piece, e<sup>2</sup> coming in con-

tact with the friction-driver, *c*, against which it is pressed with a key-controlled pressure. The parts, *h*, *h'*, and *h<sup>5</sup>*, and lever, *f*, at once cease to move, and the contact-piece, *e<sup>2</sup>*, begins to move, under the influence of the traction of the friction-driver, and throws the hammer, *e*, toward the string, more or less forcibly according to the pressure upon the key. As the contact-piece moves the hammer, *e*, toward the string, it also moves the releaser, *k*, toward the fly, *h<sup>5</sup>*; and the parts are arranged in such a manner that, at or about the instant the hammer strikes the string, the contact-piece, *e<sup>2</sup>*, acts through the releaser, *k*, upon the fly, *h<sup>5</sup>*, moving it from its normal position under the end of the lever, *f*, and freeing said lever, which immediately returns to its normal position, and withdraws the contact-piece, *e<sup>2</sup>*, from contact with friction-driver, *c*, so releasing the contact-piece from the traction of the friction-driver, and leaving the hammer free to retreat from the string. At the same time, the reach-up check-piece, *h*, under the influence of the pressure upon the key, rises a short distance, and presses the check-piece, *k*, (which has already been seen is connected with the contact-piece, and through the contact-piece with the hammer,) against the action-rail, *a<sup>3</sup>*, (which serves as a fixed check-piece,) by which it is arrested. The hammer now rebounds and retreats from the string a distance; the force of the rebound being broken by the friction of the part, *k*, against the top of the key-controlled check-piece, *h*, and the bottom of the rail, *a<sup>3</sup>*, against which it is pressed by the part, *h*. In this position the hammer is held, until the key is released, when the parts return to their normal positions.

All the parts are arranged and adjusted in such a manner that the hammer, when recoiling from the string, does not rebound so far as to allow the damper to return to the string, until the parts are freed by the releasing of the key. The points to be taken into account in making this adjustment, are (a) the strength of the frictional resistance opposed to the retreat of the hammer, which depends upon the leverages, upon the point of connection of the check-piece, *k*, with the contact-piece, *e<sup>2</sup>*, and upon the nature of the checking surfaces—whether of felt, leather, wood, or other substance; and (b) upon the relation established between the rapidity of the approach of the hammer to the string, and the rapidity of the retreat of the damper therefrom. The more powerful the check, the less the distance the hammer will retreat from the string; and the nearer the approach of the rapidity of the retreat of the damper from the string to the rapidity of the approach of the hammer to the string, the further the hammer can retreat without allowing the damper to come upon the string. The further the hammer is allowed to retreat from the string, the more perfect will the repetition qualities of the instrument be. As to

the relative motions of the damper and hammer, it will probably be found that about one-fourth to one-eighth the movement of the hammer will be sufficient for the damper, according to the place in the scale; a larger ratio being required at the bottom of the instrument than is required above.

Many modifications may be made without departing from the essentials of my invention, which are set forth in the statement of claim at the end hereof.

In the particular structure hereinbefore described in illustration of my invention, and represented in Figs. 1 and 2 of the drawings, the part *e<sup>2</sup>* serves as a contact-piece, to take power from the friction-driver, and as a hammer-butt, whereon the hammer is mounted; and this I consider as one of the important features of my invention, as applied to a piano-forte. It reduces the weight and inertia of the parts, simplifies the construction, and provides a direct and fast connection between the contact-piece and the pivoted hammer—a connection, too, that is not subject to wear, and which, when once well made, will not require adjustment. But it is not necessary to the carrying out of other features of my invention that the same part that serves as a contact-piece serve also as a hammer-butt. It may serve as a contact-piece only, and be suitably connected with the hammer, the last-mentioned part having its own independent hammer-butt. Such an arrangement is represented in the detail, Fig. 3. This modification gives room for a larger friction-driver, and leaves the adjustment of the striking-point of the hammer on the string practically unaffected by any relation existing between the hammer-butt and the friction-driver; but it is disadvantageous in that it increases the number of parts, and of joints subject to wear. It is essential that the contact-piece be in some manner so connected with the hammer that it transmits power to the hammer; but the manner of making the connection is not indispensable. In the before mentioned Letters Patent a modification is illustrated in which the hammer is mounted fast upon the contact-piece itself. It will be obvious that the same thing might be done in the present action, by modifying it somewhat, but with similar disadvantages to those pointed out in the patent before mentioned with reference to the construction there illustrated. The connection between the hammer and the contact-piece may be made in many ways; but I know of none so good as that illustrated herein.

A friction-driver is an important element of some of the combinations herein described and claimed, not that there is anything novel in the friction-driver herein illustrated. By a "friction-driver," I mean a part arranged to impart motion by friction to another part pressed against or in contact with, the part first named, so that the driving part exerts a greater or less traction upon the driven part,

according to the force with which they are pressed together. A rotating, circular friction-driver, with its axis transverse to the keys, is the form and arrangement of friction-driver that I consider best, and the one, in consequence, that I have illustrated; but I do not limit myself thereto; for other forms or arrangements of friction-drivers might be used instead.

I have illustrated in the drawings, a pivoted contact-piece having a curved surface for contact with the friction-driver, the center on which the curve is described being the center of the pivot on which the contact-piece moves under the influence of the friction-driver. I consider it best to provide the contact-piece with a curved surface for contact with the friction-driver. But it should be borne in mind, first, that it is not indispensable that the curve be described on the pivot as a center. All that is important in this connection is that the contact-piece have a surface for contact with the friction-driver, curved in such a manner that the contact-piece, when pressed against the friction-driver, and held in contact therewith, moves without substantial disturbance of the position of the pivot. Disturbance of the position of the pivot, during and by the motion of the contact-piece under the influence of the friction-driver, would result in disturbance of the position of the key, while held down by the finger. Some small disturbance of this kind may exist without serious consequences; but any substantial or very material disturbance would be an annoyance, and should be avoided by properly shaping the contact-piece. The best way to do this, is to curve the contact-piece on its pivot as a center. But it will be obvious that if the contact-piece were curved on a point some little distance vertically above or even below the pivot, or a little to one side or the other of the pivot, it would make no very material difference, the arc of movement being small. And the more the arc of movement of the contact-piece is reduced, the less important the question of shaping the contact-piece becomes, and I wish it to be understood that a pivoted contact-piece, (as I use the term in this specification, when a "pivoted contact piece," is spoken of, without further qualification or limitation,) does not necessarily mean a segmental or curved contact-piece.

Secondly, it should be borne in mind that certain portions of my invention, relating to the escapement and checking mechanism, while in my opinion best carried out in connection with a pivoted contact-piece, having a curved surface for contact with the friction-driver, may, nevertheless, be carried out with various other forms of contact-piece; and that, so far as the escapement and checking mechanism described and claimed are concerned, I do not (unless expressly stated), limit myself to any particular form of contact-piece, but any suitable form of contact-piece may be

used with the other elements of the combination. And on the other hand, I may say here, that while a certain form of escapement, and a certain checking arrangement are described herein, and form important parts of my present invention, and are the forms of escapement and of check that I prefer to use, it should nevertheless be understood that other form of escapement and of check might be used in connection with the segmental contact-piece, or the pivoted contact-piece, herein described. This will be readily understood.

An escapement is an important element of some of the combinations herein described and claimed, not that I make any claim to an escapement by itself and apart from combination with other elements.

I use the word "escapement," in this specification, sometimes as *nomen generalissimum* for a device or arrangement of parts whereby the contact-piece is freed from the traction of the friction-driver after it (said contact-piece), has received the required motion from the friction driver, and while the key is still held down; and sometimes I use the word "escapement," as *nomen generalissimum* for a device or arrangement of parts by which the hammer is freed at or about the instant it strikes the string, from the power that impelled it upon the string, and left free to retreat a sufficient distance from the string. Whether the word is used in the one sense or the other will be clear from the context. Of course, if the escapement is spoken of as arranged intermediate the key and the contact-piece, it will be understood that it is an escapement for the contact-piece. And if the parts are arranged in all respects as they are arranged in the drawings, the escapement for the contact-piece will be also an escapement for the hammer. The arrangement of a fly acted upon by the contact-piece through a releaser, as illustrated in the drawings, is a very convenient escapement; and it is an escapement whereby both the contact-piece and the hammer are freed at the same time. But it is only one of the various forms of escapement that may be used. And while it is advantageous to have the same arrangement of parts serve as an escapement both for the contact-piece and for the hammer, it is by no means indispensable.

The most important point of the escapement mechanism illustrated in the drawings, and hereinbefore described, consists in the relation established between the escapement and the contact-piece, and particularly in the fact that the contact-piece is arranged in such a manner that it, by its movement under the influence of the friction-driver, acts upon the fly, *h*<sup>5</sup>, or other escapement pressure-transmitter, moving such part, and thereby freeing itself from the traction of the friction-driver. This arrangement of escapement has several advantages over that employed in my original action, described in the Letters Patent above referred to.

I prefer to make the contact-piece act upon the escapement through some other part, such, for instance, as the releaser, *k*; but I wish it to be understood that that is not an indispensable feature of construction, for the contact-piece and the fly or other escapement may be so arranged, and brought into such a relation of juxtaposition, that the contact-piece will act directly upon the escapement to move it.

Such an arrangement is illustrated in Fig. 4, in which *e* is the hammer, *e'* the hammer-shank; *e<sup>2</sup>* the hammer-butt and contact-piece; *h* the reach-up; *f* the lever by which the contact-piece is mounted for movement against and away from the friction-driver; *H* a reversing lever, by which the key and reach-up are connected with the fly *h<sup>5</sup>*. The fly, it will be seen, is made to bear upon the center-pin *f'*, by which the contact-piece *e<sup>2</sup>* is connected with the lever, and is arranged in such a manner that a projection, *e<sup>3</sup>*, formed on the contact-piece, strikes the end of the fly *h<sup>5</sup>*, and knocks the fly off of the pin *f'*, freeing the contact-piece from the traction of the friction-driver, just as the hammer strikes the string. The check-piece, *k*, is connected with the hammer-shank *e'*, above the center, and is pressed by the part *h* against the adjustable stop *m*, after the freeing of the contact-piece from the traction of the friction-driver, so that a frictional resistance is opposed to the movement of the hammer and contact-piece. The fly *h<sup>5</sup>* is held by a spring *n*, normally in contact with a stop-pin, *n'*, set fast in a downward-extension of the lever *f*. The arrangement illustrated in Fig. 4 is more complicated than that illustrated in Fig. 1, which latter I consider preferable. The great point in this connection is, that the contact-piece be arranged to act upon the fly or other pressure-transmitter (whether mediately or immediately), in such a manner that it (the contact-piece), frees itself from the traction of the friction-driver at the point in the movement of the hammer which requires that it be so freed, whatever point of the movement of the hammer that may happen in any particular case to be.

The push-bar, *k*, which serves as the means by which the contact-piece acts upon the escapement to break the pressure-connection between the key and the contact-piece, is a very convenient releaser (and has the merit of serving also as a check-piece); but it is not the only form of releaser that can be used. The action may be modified, and a cord or other pull-piece, for example, used instead of the push-bar of the preferred device, to fulfill the functions of a releaser. Such an arrangement is illustrated in Fig. 5, in which *e* is the hammer; *e'*, the hammer-shank; *e<sup>2</sup>* the hammer-butt serving as a contact-piece; *f* the lever whereby such contact-piece is mounted for movement against and away from the friction-driver; *h* the reach-up; *h<sup>5</sup>* the fly; *h<sup>6</sup>* a light upright, firmly attached to the fly; and *o* a cord, connecting the hammer-shank (and thus the contact-piece and hammer),

with the upright *h<sup>6</sup>* and fly *h<sup>5</sup>*, whereby the fly is moved from under the downwardly-curved end of the lever *f*, and the pressure-connection between the key and the contact-piece broken, and the contact-piece freed from the traction of the friction-driver, at or about the instant the hammer strikes the string. *k* is the check-piece connected with the hammer, which it will be observed is not in this case a releaser. *p* is a stop that serves to limit the movement of the part *h<sup>5</sup>*, and to afford facility for adjusting the position of said part *h<sup>5</sup>* under the nose of the lever *f*; and *p'* is an expansive spring serving to return the part *h<sup>5</sup>* to its normal position. The operation of this device will be readily understood from the description heretofore given. The arrangement of parts, it will be observed is somewhat more complicated than that illustrated in Fig. 1, which last is as before stated, the form that I deem best.

A check, whereby the hammer is arrested on retreating or recoiling from the string, is an important element of some of the combinations herein described and claimed. The particular arrangement of check illustrated in the drawings, consists in the arrangement of the part, *k*, connected with the hammer and contact-piece, and the part, *h*, connected with the key, and arranged to press the part, *k*, against the rail, *a<sup>3</sup>*. The essential feature of this check is, that the pressure of the key is employed to create a checking friction upon a part connected with the contact-piece and hammer, after the freeing of the contact-piece from the friction-driver, and on the retreat of the hammer from the string. But other forms of check might perhaps be used. In the arrangement illustrated in Figs. 1 and 2 the same part that serves as a check-piece, connected with the hammer, serves also as a releaser to free the escapement. This is a very convenient arrangement; but I wish it to be understood that it is not indispensable. A different part may be used as a check-piece, if desired, from that which is used as a releaser; as illustrated, for example, in Fig. 5, in which the bar *k* serves as a check, while the cord *o* serves as a releaser; and indeed, as already seen, the releaser might be entirely dispensed with.

The novel features of my present checking arrangement, as distinguished from the checking arrangement described in the specification of the before mentioned Letters Patent, No. 458,219, consist (a) in the fact that the check-piece moved by the key in the new action, and subjected to the pressure, rubbing and wear resulting from the operation of the check, is a different part from that which is subjected to the pressure, rubbing and wear resulting from the operation of the escapement; and (b) in the fact that the check-piece moved by the key in the new action operates substantially free from other motion, and does not move with the check-piece connected with the hammer, on the retreat of the ham-

mer from the string, so that the check-piece connected with the hammer moves under a double friction, that is, a friction with the check-piece connected with the key, and a friction with the fixed check-piece, against which it is pressed by the check-piece connected with the key, whereby the power of the check is increased, and the wear reduced by being divided between two pairs of surfaces.

In various places in this specification, I speak of the key pressing the contact-piece against the friction-driver, or of the key pressing the hammer-butt against the friction-driver; and in other places I speak of a pressure connection being established between the key and the contact-piece. When in the statement of claim I speak of the key, in a piano-forte, pressing the contact-piece against the friction-driver, or pressing the hammer-butt against the friction-driver, or of a pressure connection being established between the key of a piano-forte and the contact-piece, I mean that the key is in some suitable manner, and by some suitable means, so connected with the contact-piece or hammer-butt, that the pressing of the contact-piece or hammer-butt against the friction-driver is the result ensuing from the depressing of the key. And so long as the key is so connected with the contact-piece that the pressing of the contact-piece against the friction-driver results from the depressing of the key, (and so long as, in a piano-forte action, a relation is maintained between the pressure upon the key and the pressure upon the contact-piece, so that the power with which the contact-piece moves depends upon, and is governed by, the pressure upon the key,) it is not material how the connection between the key and the contact-piece is made, whether by parts few or many, whether by means involving only the use of the power transmitted from the key, or by means involving the use of other power than that exerted by the performer upon the key.

In some parts of this specification, I speak of breaking the pressure connection between the key and the contact-piece. By breaking the pressure connection between the key and the contact-piece, I mean causing the relation of pressure upon the key and resulting pressure of the contact-piece against the friction-driver to cease, so that, although the pressure upon the key is maintained, it no longer results in pressing the contact-piece against the friction-driver.

In some places in this specification, I speak of the pressure employed in pressing the hammer-butt against the friction-driver, or the pressure employed in pressing the contact-piece against the friction-driver, being transferred to a check-piece connected with the hammer, or connected with the contact-piece, or to the releaser. By these expressions, I do not mean that all the pressure employed in pressing the hammer-butt or the contact-

piece against the friction-driver is necessarily transferred to the releaser or other check-piece. I only mean that some sufficient part of the pressure which was before used in pressing the hammer-butt or other contact-piece against the friction-driver, is after the escapement of such part, employed in pressing upon the check-piece, so that a frictional resistance is opposed to the movement thereof. This will be readily understood.

The fly or other escapement pressure-transmitter is I think, most conveniently arranged to act directly upon the lever *f*, as shown in the drawings; but it may be placed at any point between the key and the lever *f*, or indeed at any point between the key and the contact-piece. And it will be understood that many other modifications may be made in the details of construction, and in the adaptation of my action to the peculiarities of different instruments, without departing from the essentials of my invention.

It will be obvious that many of the combinations and sub-combinations herein described may well be used in other instruments than piano-fortes and for other purposes than impelling hammers, the contact-piece being arranged to impel whatever part is to be moved by the depressing of the key, so that a power connection is interposed between the key and such part. This is so obvious as to require no explanation. I desire full protection for all uses to which my invention can be applied, and wish it to be distinctly understood that I dedicate no part of my invention to the public.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A piano-forte action including a key; a hammer; a friction-driver; a pivoted contact-piece connected with the hammer and an escapement intermediate the key and the contact-piece, through which the contact-piece is pressed against the friction-driver, on the depressing of the key, more or less forcibly according to the pressure upon the key, and whereby facility is afforded for breaking the pressure connection between the key and the contact-piece.

2. A piano-forte action including a key; a hammer; a friction-driver; a pivoted contact-piece connected with the hammer, an escapement intermediate the key and the contact-piece; and a check; the parts being constructed, arranged and connected in such a manner that the key when pressed upon, presses the contact-piece against the friction-driver through the intervention of the escapement; the contact-piece being arranged in such a manner that when moved by the friction-driver, it acts upon the escapement and frees itself from the traction of the friction-driver, the pressure theretofore employed in pressing the contact-piece against the friction-driver being transferred at or about the instant the hammer strikes the string to the before men-

tioned check, whereby the hammer is arrested upon its retreat from the string, and prevented from rebounding thereon.

3. In a piano-forte action and in combination, a key; a hammer; a friction-driver; a pivoted contact-piece and an escapement intermediate the key and the contact-piece, whereby a key-controlled pressure is transmitted to the contact-piece, and the contact-piece pressed against the friction-driver, upon the depressing of the key, more or less forcibly according to the pressure upon the key, and whereby facility is afforded for freeing the contact-piece from the traction of the friction-driver, the pivoted contact-piece and the hammer being connected together in such a manner that they move upon the same axis or center.

4. In a piano-forte action and in combination, a key; a hammer; a friction-driver; a pivoted contact-piece an escapement intermediate the key and the contact-piece; and a key-controlled check; the parts being constructed and arranged in such a manner that the key, when pressed upon, presses the contact-piece against the friction-driver through the intervention of the escapement; the hammer and contact-piece being so arranged that, as they move under the influence of the friction-driver, they act upon the escapement, freeing the contact-piece from the traction of the friction-driver, and leaving the hammer free to retreat from the string, the pressure theretofore employed in pressing the contact-piece against the friction-driver being transferred, at or about the instant the hammer strikes the string, to the check before mentioned, so that a frictional resistance is opposed to the movement of the hammer upon its rebound from the string, the pivoted contact-piece and the hammer being connected together in such a manner that they move upon the same axis or center.

5. In a piano-forte action, and in combination, a key; a hammer, a friction-driver; a contact-piece connected with the hammer; and an escapement pressure-transmitter intermediate the key and the contact-piece, arranged in such a manner that the key, when pressed upon, moves said pressure-transmitter for an instant, so that a pressure connection is established between the key and the contact-piece, said pressure-transmitter being arranged in such a manner, also, that when moved in another direction different from that in which it was moved by the depressing of the key, it breaks the pressure connection between the key and the contact-piece; the contact-piece being arranged in such a manner that it (the contact-piece), gives to the pressure-transmitter the movement last above mentioned as it (said contact-piece), moves under the influence of the friction-driver, thereby breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the traction of the friction-driver.

6. In a piano-forte action, and in combination, a key; a hammer; a friction-driver; a contact-piece connected with the hammer; a check for the hammer; and an escapement pressure-transmitter intermediate the key and the contact-piece, arranged in such a manner that the key, when pressed upon, moves said pressure-transmitter for an instant, so that a pressure connection is established between the key and the contact-piece, said pressure-transmitter being arranged in such a manner, also, that when moved in another direction different from that in which it was moved by the depressing of the key, it breaks the pressure connection between the key and the contact-piece; the contact-piece being arranged in such a manner that it gives to the pressure-transmitter the movement last above mentioned, as it (the contact-piece), moves under the influence of the friction-driver, thereby breaking the pressure connection between the key and the contact-piece and freeing the contact-piece from the traction of the friction-driver, the pressure theretofore employed in pressing the contact-piece against the friction-driver being transferred, at or about the instant the hammer strikes the string, to the check before mentioned, so that a frictional resistance is opposed to the movement of the hammer upon its rebound from the string.

7. In a piano-forte action, and in combination, a key; a hammer; a friction-driver; a contact-piece connected with the hammer; an escapement intermediate the key and the contact-piece, whereby, on the depressing of the key, a pressure connection is established between the key and the contact-piece, so that the contact-piece is pressed against the friction-driver; and a part intermediate the contact-piece and the escapement, whereby the contact-piece as it moves under the influence of the friction-driver acts upon the escapement, breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the traction of the friction-driver.

8. In a piano-forte action and in combination, a key; a hammer; a friction-driver; a contact-piece connected with the hammer; an escapement intermediate the key and the contact-piece, whereby, on the depressing of the key, a pressure connection is established between the key and the contact-piece, so that the contact-piece is pressed against the friction-driver; and a part intermediate the contact-piece and the escapement, whereby the contact-piece, as it moves under the influence of the friction-driver, acts upon the escapement, breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the traction of the friction-driver; the parts being arranged in such a manner that the pressure theretofore transmitted to the contact-piece is transferred, at or about the instant the hammer strikes the string, to the part before

mentioned as being intermediate the contact-piece and the escapement, so that a frictional resistance is opposed to the movement of the hammer upon its rebound from the string.

5 9. In a piano-forte action, and in combination, a key; a hammer; a friction-driver; a contact-piece connected with the hammer; an escapement intermediate the key and the contact-piece; a check-piece connected with  
10 the key; a check-piece connected with the hammer; and a fixed check-piece or check-bar; the parts being constructed and arranged in such a manner that upon the freeing of the escapement, the check-piece connected  
15 with the key presses the check-piece connected with the hammer against the fixed check-piece, so that the check-piece connected with the hammer is subjected to a double friction, to-wit, a friction with the check-piece  
20 connected with the key, and a friction with the fixed check-piece, whereby the hammer is arrested upon its rebound from the string.

10. In a piano-forte action and in combination, a hammer; a friction-driver; a pivoted  
25 contact-piece connected with the hammer; a lever whereby the contact-piece is mounted for movement against and away from the friction-driver; and an escapement pressure-transmitter, whereby the contact-piece  
30 is pressed against the friction-driver, and whereby facility is afforded for freeing the contact-piece from the traction of the friction-driver.

11. In a piano-forte action, and in combination, a hammer; a friction-driver; a pivoted  
35 contact-piece connected with the hammer; a lever whereby the contact-piece is mounted for movement against and away from the friction-driver an escapement pressure-transmitter; and a part intermediate the contact-piece and the escapement, whereby the contact-piece, as it moves under the influence of  
40 the friction-driver, acts upon the escapement, freeing the contact-piece from the traction of the friction-driver.  
45

12. In a piano-forte action, and in combination, a hammer; a friction-driver; a pivoted  
50 contact-piece connected with the hammer; a lever whereby the contact-piece is mounted for movement against and away from the friction-driver; an escapement pressure transmitter whereby the contact-piece is pressed against the friction-driver; a part intermediate the contact-piece and the escapement,  
55 whereby the contact-piece, as it moves under the influence of the friction-driver, acts upon the escapement, freeing the contact-piece from the traction of the friction-driver; and a check-piece connected with the same source  
60 of pressure as the escapement pressure transmitter, and arranged in such a manner that upon the freeing of the escapement it (said check-piece), presses upon a part connected with the hammer so that a frictional resistance  
65 is opposed to the movement of the hammer upon its rebound from the string.

13. In combination, a key; a friction-driver;

a pivoted contact-piece; and an escapement for the contact-piece, the key being connected with the contact-piece in such a manner that  
70 it (the key), when pressed upon, presses the contact-piece against the friction-driver, the friction-driver serving to move the contact-piece, and the escapement serving to afford  
75 facility for breaking the pressure connection between the key and the contact-piece while the pressure upon the key is maintained.

14. In combination, a key; a friction-driver; a pivoted contact-piece; an escapement intermediate the key and the contact-piece; and a check; the parts being constructed and  
80 arranged in such a manner that the key, when pressed upon, presses the contact-piece against the friction-driver through the intervention of the escapement; the contact-piece  
85 being so arranged that, as it moves under the influence of the friction-driver, it acts upon the escapement, freeing the contact-piece from the traction of the friction-driver; the pressure theretofore employed in pressing the  
90 contact-piece against the friction-driver being transferred to the before mentioned check, whereby a frictional resistance is opposed to the movement of the contact-piece.

15. In combination, a key; a friction-driver; 95 a contact-piece; and an escapement pressure-transmitter intermediate the key and the contact-piece, arranged in such a manner that the key, when pressed upon, moves said pressure-transmitter for an instant, so that a pressure  
100 connection is established between the key and the contact-piece, said pressure transmitter being arranged in such a manner, also, that when moved in another direction different from that in which it was moved by the  
105 depression of the key, it breaks the pressure connection between the key and the contact-piece; the contact-piece being arranged in such a manner that it (the contact-piece), gives to the pressure transmitter the movement  
110 last above mentioned, as it (the contact-piece), moves under the influence of the friction-driver, thereby breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the  
115 traction of the friction-driver.

16. In combination, a key; a friction-driver; a contact-piece; a check; and an escapement pressure transmitter intermediate the key  
120 and the contact-piece arranged in such a manner that the key, when pressed upon, moves said pressure transmitter for an instant, so that a pressure connection is established between the key and the contact-piece, said  
125 pressure transmitter being arranged in such a manner, also, that when moved in another direction, different from that in which it was moved by the depressing of the key, it breaks the pressure connection between the key and the contact-piece; the contact-piece being arranged  
130 in such a manner that it (the contact-piece), gives to the pressure-transmitter the movement last above mentioned, as it (the contact-piece), moves under the influence of

the friction-driver, thereby breaking the pressure connection between the key and the contact-piece and freeing the contact-piece from the traction of the friction-driver, the pressure theretofore employed in pressing the contact-piece against the friction-driver being transferred to the check before mentioned, so that a frictional resistance is opposed to the movement of the contact-piece.

17. In combination, a key; a friction-driver; a contact-piece; an escapement intermediate the key and the contact-piece whereby, on the depressing of the key, a pressure connection is established between the key and the contact-piece, so that the contact-piece is pressed against the friction-driver; and a part intermediate the contact-piece and the escapement, whereby the contact-piece, as it moves under the influence of the friction-driver, acts upon the escapement, breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the traction of the friction-driver.

18. In combination, a key; a friction-driver; a contact-piece; an escapement intermediate the key and the contact-piece whereby on the depressing of the key, a pressure connection is established between the key and the contact-piece, so that the contact-piece is pressed against the friction-driver; and a part intermediate the contact-piece and the escapement, whereby the contact-piece as it moves under the influence of the friction-driver acts upon the escapement, breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the traction of the friction-driver; the pressure theretofore transmitted to the contact-piece being thereupon transferred to the part before mentioned as being intermediate the contact-piece and the escapement, so that a frictional resistance is opposed to the movement of the contact-piece.

19. In combination, a key; a friction-driver, a contact-piece; an escapement intermediate the key and the contact-piece; a check-piece connected with the key; a check-piece connected with the contact-piece; and a fixed check-piece or check-bar; the parts being constructed and arranged in such a manner that upon the freeing of the escapement the check-piece connected with the key presses the check-piece connected with the contact-piece against the fixed check-piece, so that the check-piece connected with the contact-piece is subjected to a double friction, to-wit, a friction with the check-piece connected with

the key, and a friction with the fixed check-piece, whereby the contact-piece is arrested after it has been freed from the traction of the friction-driver.

20. In a key-board musical instrument and in combination, a key; a friction-driver; a pivoted contact-piece; a lever whereby the contact-piece is mounted for movement against and away from the friction-driver; and an escapement pressure-transmitter intermediate the key and the lever, whereby the contact-piece is pressed against the friction-driver, and whereby facility is afforded for breaking the pressure connection between the key and the contact-piece, and freeing the contact-piece from the traction of the friction-driver.

21. In a key-board musical instrument, and in combination, a key; a friction-driver; a pivoted contact-piece; a lever whereby the contact-piece is mounted for movement against and away from the friction-driver; an escapement pressure-transmitter, intermediate the key and the lever; and a part intermediate the contact-piece and the escapement, whereby the contact-piece, as it moves under the influence of the friction-driver, acts upon the escapement, freeing the contact-piece from the traction of the friction-driver.

22. In a key-board musical instrument and in combination, a key; a friction-driver; a pivoted contact-piece; a lever whereby the contact-piece is mounted for movement against and away from the friction-driver; an escapement pressure-transmitter intermediate the key and the lever; and a part intermediate the contact-piece and the escapement, whereby the contact-piece, as it moves under the influence of the friction-driver, acts upon the escapement, freeing the contact-piece from the traction of the friction-driver; and a check-piece connected with the key and arranged in such a manner that upon the freeing of the escapement it (said check-piece), presses upon the part before mentioned as being intermediate the contact-piece and the escapement, so that a frictional resistance is opposed to the movement of the contact-piece upon its being freed from the traction of the friction-driver.

In testimony whereof I have hereunto set my hand, at Washington, in the District of Columbia, this 17th day of March, in the year of our Lord, 1893.

THADDEUS CAHILL.

Witnesses:

M. H. CAHILL,  
C. S. DRURY.