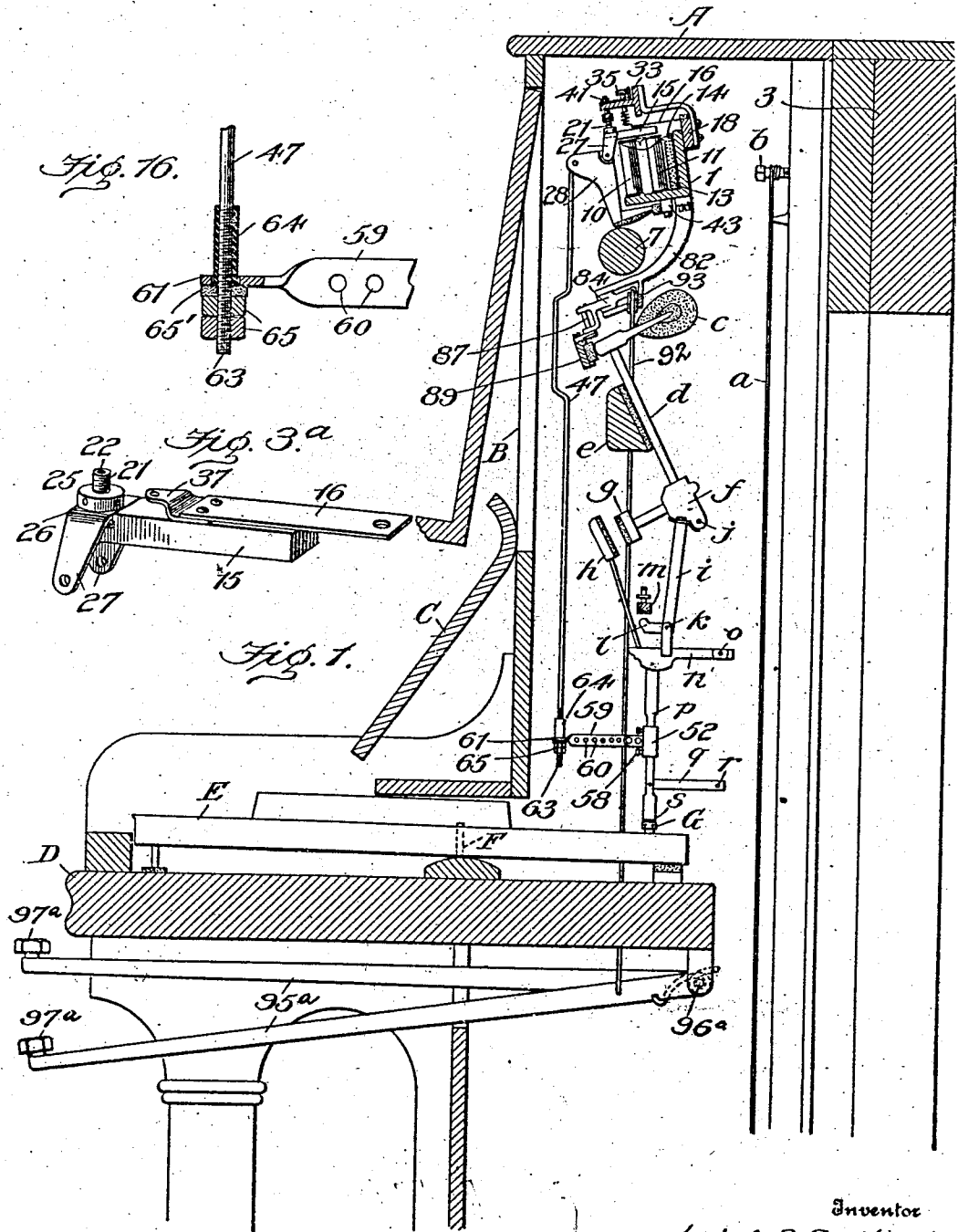


I. B. SMITH.
ELECTRICAL SELF PLAYING ATTACHMENT FOR PIANOS.
APPLICATION FILED MAY 19, 1905.

959,032.

Patented May 24, 1910.

5 SHEETS—SHEET 1.



Witnesses

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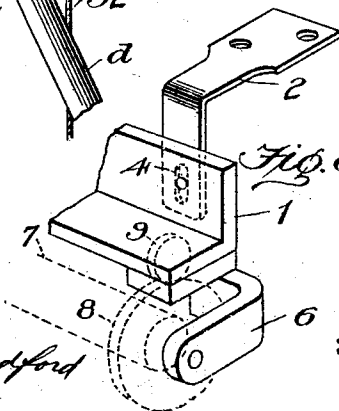
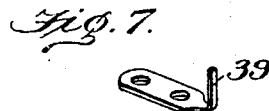
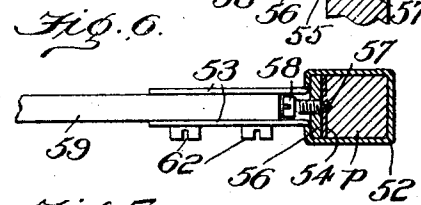
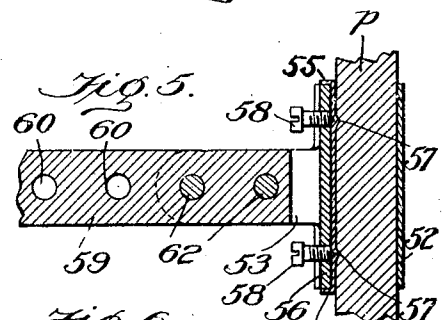
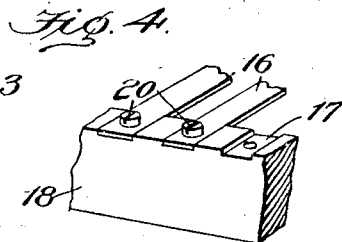
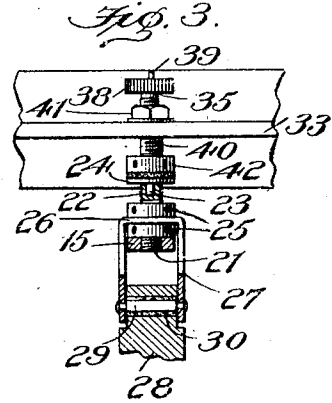
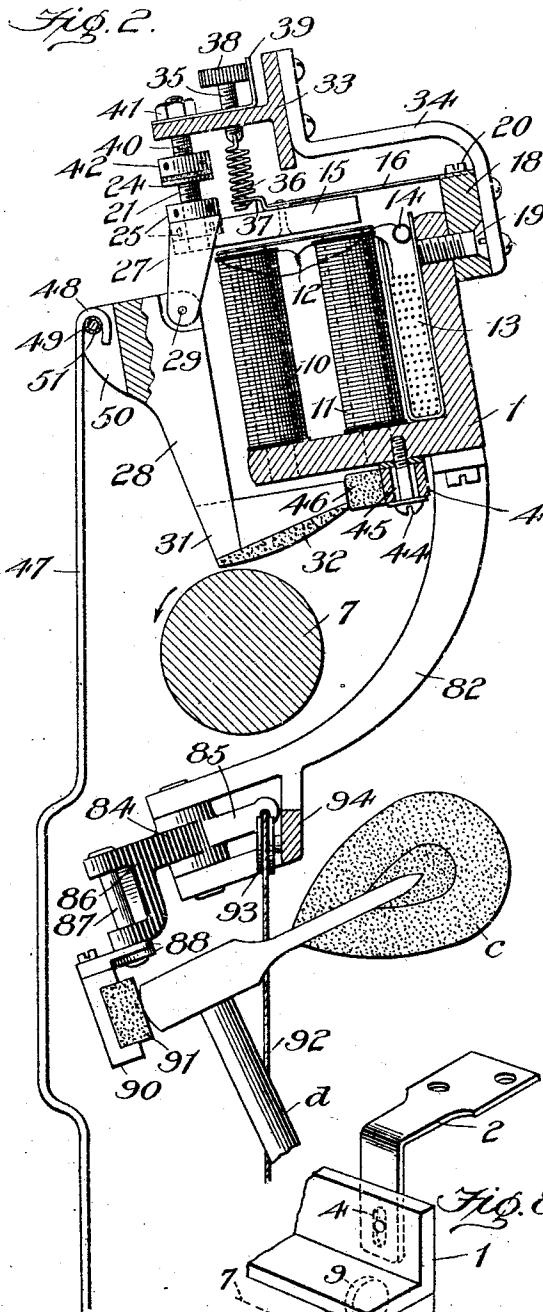
By *J. G. Truitt* Attorney

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Patented May 24, 1910.

5 SHEETS—SHEET 2.



Witnesses

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5 SHEETS—SHEET 3.

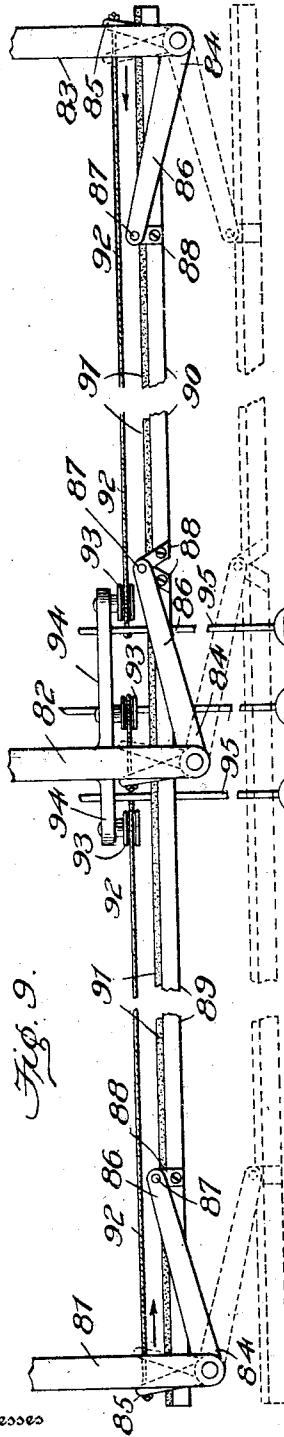


Fig. 9.

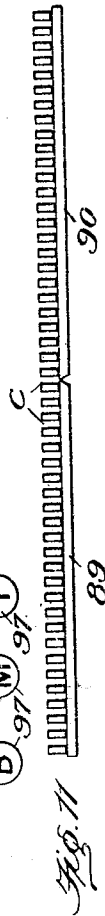


Fig. 11.



Fig. 12.

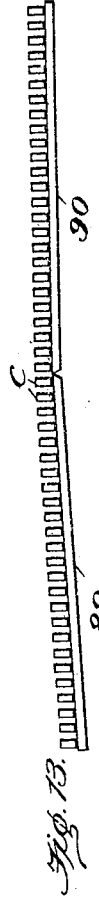


Fig. 13.

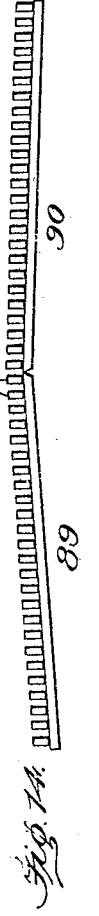


Fig. 14.

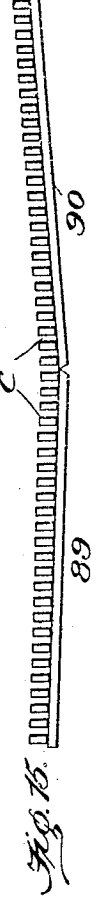


Fig. 15.

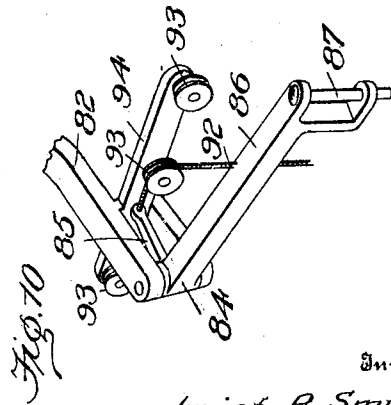


Fig. 10.

Witnesses
Edwin L. Bradford
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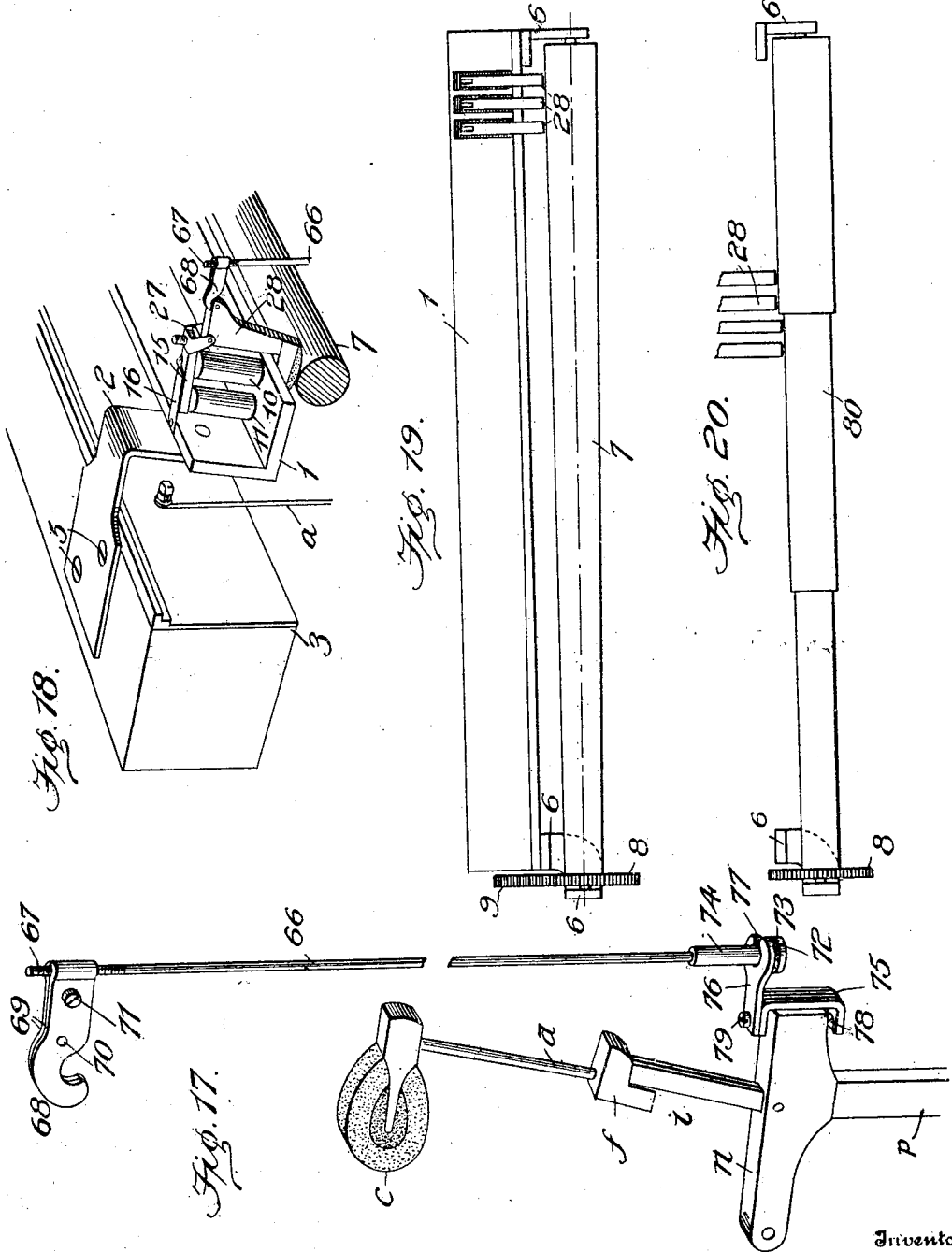
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ELECTRICAL SELF PLAYING ATTACHMENT FOR PIANOS.
APPLICATION FILED MAY 19, 1905.

959,032.

Patented May 24, 1910.

5 SHEETS—SHEET 4.



Witnesses
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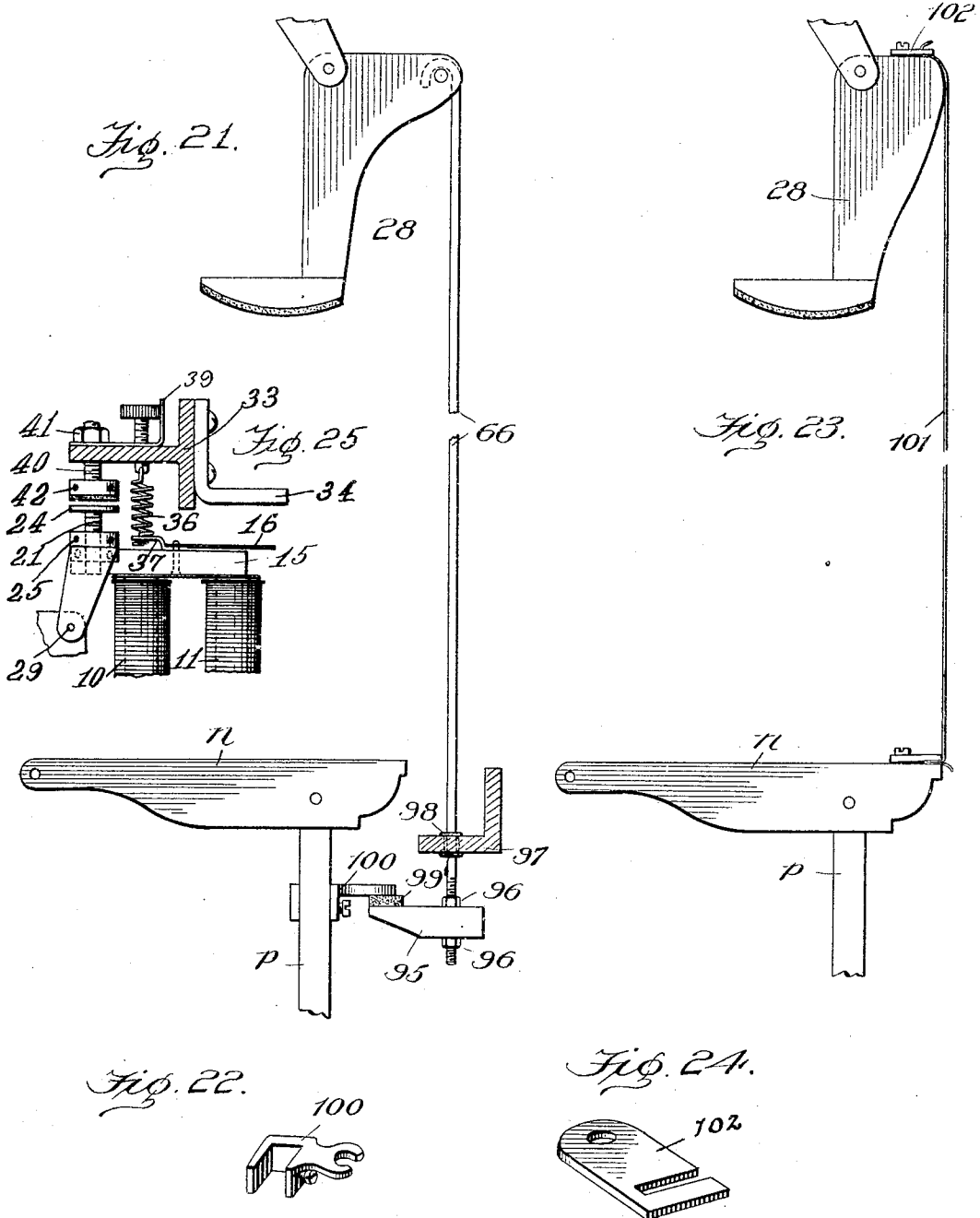
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I. B. SMITH.
ELECTRICAL SELF PLAYING ATTACHMENT FOR PIANOS.
APPLICATION FILED MAY 19, 1905.

959,032.

Patented May 24, 1910.

5 SHEETS—SHEET 5.



Witnesses
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UNITED STATES PATENT OFFICE.

IRVING B. SMITH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ELECTRELLE COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELECTRICAL SELF-PLAYING ATTACHMENT FOR PIANOS.

959,032.

Specification of Letters Patent.

Patented May 24, 1910.

Application filed May 19, 1905. Serial No. 261,121.

To all whom it may concern:

Be it known that I, IRVING B. SMITH, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Electrical Self-Playing Attachments for Pianos, of which the following is a specification.

My present invention relates to certain new and useful improvements in self-playing attachments for pianos, of the type wherein the actuating mechanism for the sound producing devices is controlled by a perforated music sheet or web.

The improvements now sought to be protected relate more particularly to actuating mechanism of the well known "shoe and roller" type. Heretofore and prior to my invention, it has been the practice to locate this actuating mechanism in the lower part of the piano case; or, more properly speaking, below the key-board. This arrangement has always given more or less trouble and is open to many objections which preclude that nicety and delicacy of operation essential to a highly perfected mechanism, chief among which may be noted the fact that considerable cutting of the piano frame and case is necessary, and adjustment of the various parts is not only very difficult, but, in some cases, impossible, unless the piano is taken to the factory and jacked. Moreover, in prior electrical self-playing attachments for pianos, the electrical appliances have been arranged in the lower part of the piano casing below the keyboard, and in such prior arrangements a load is imposed upon the electro-mechanical devices which is more than they can take care of, and at the same time take care of in that instantaneous manner which is essential to a perfect instrument.

By the present invention a new arrangement and a new location of the electro-mechanical actuating mechanisms are provided; these are the result of long study and experiment to find out just what was the difficulty with instruments in which the electro-mechanical devices were arranged beneath the piano keyboard, and to find a way to remedy the difficulty. This problem, in its broadest sense, has been completely solved

by arranging and locating the electro-mechanical devices in the upper as contradistinguished from the lower portion of the piano casing, and so arranged that the load, or the work which the electro-magnets and associated mechanisms have to do, is reduced to a minimum, and the instrument thus responds quickly, certainly, and with all the delicacy and force which the operator desires to put into it.

It is one purpose of this invention, therefore, to overcome the above noted objections, and this is accomplished by mounting the entire electrically controlled actuating mechanism in the upper part of the piano case and preferably above and clear of the hammer action of the instrument in such manner that all parts may be exposed to view and readily gotten at for purposes of adjustment and repair, access being gained thereto by simply removing the upper front board of the piano.

A further and important feature of the invention resides in the provision of pull-rods, tapes or cords, for operating the sound-producing devices, (in the present instance, the piano hammers) said pull-devices each having a detachable connection with a part of each hammer action, a certain amount of free or lost motion being provided in each connection whereby the hammers may be actuated directly from the manual keys without operating or affecting the pull-devices, or may be operated through the medium of the pull-devices without operating or affecting the manual keys.

Another object of the invention resides in the peculiar manner of mounting the friction shoes and in the devices associated therewith for effecting, in an easy and quick manner, the various necessary adjustments of the several parts.

A still further purpose of the invention is to provide a novel construction of expression operating means that is so combined with the actuating mechanism as to provide what may be termed a complete self-contained attachment.

A further purpose of the invention resides in a novel construction of shaft or roller with which the friction shoes cooperate and by which said shoes are actuated; the nov-

elty residing in so constructing the shaft or roller that the shoes will be actuated with a gradually increased force from the lowest bass to the highest treble, the purpose being
 5 to obviate the great objection now present in all known types of players wherein the bass notes are actuated to such an extent, or with such a degree of force, as to drown out the middle and treble notes.
 10 The invention has in view other more or less important features of construction and combinations and arrangements of parts, all as will more fully hereinafter appear.
 In the annexed drawings forming a part
 15 of this specification—Figure 1 is a vertical sectional view of the upper part of a piano showing my improved playing attachment applied thereto. Fig. 2 is an enlarged sectional view of the actuating mechanism for
 20 the sound-producing devices. Fig. 3 is a front elevation of one of the saddle mountings for the shoes and the adjusting means therefor. Fig. 3^a is a detail perspective of one of the armatures. Fig. 4 is a detail perspective view showing the manner of mounting
 25 the armatures. Fig. 5 is a vertical sectional view of one form of clamp for the hammer action. Fig. 6 is a transverse sectional view of the same. Fig. 7 is a detail perspective view of a screw lock. Fig. 8 is
 30 a detail perspective view of one end of the magnet rail, the view also showing the attaching bracket for supporting the entire actuating mechanism. Fig. 9 is a top plan
 35 view of the expression mechanism. Fig. 10 is a detail perspective view of a part of the expression actuating mechanism. Figs. 11 to 15, inclusive, indicate, conventionally,
 40 some of the positions assumed by the piano hammers in obtaining various musical expressions. Fig. 16 is a sectional view of the lower end of one of the pull-rods. Fig. 17
 45 is a perspective view of a slightly modified form of pull-rod and attaching clamp, the latter being shown as attached to the wippen. Fig. 18 is a perspective view showing one
 50 manner of attaching the playing mechanism to a piano. Fig. 19 is a plan view of one form of shaft or roller for actuating the friction shoes. Fig. 20 is a slightly modified
 55 form of shaft or roller. Fig. 21 shows another form of connection between the shoes and hammer action. Fig. 22 is a detail perspective view of the clip shown in Fig. 21.
 60 Fig. 23 shows one manner of employing a flexible connection between the shoes and hammer actions. Fig. 24 is a detail perspective view of the tape-attaching plate. Fig. 25 is a view in part similar to Fig. 2,
 showing the position of the parts when the magnet is energized.

Before proceeding with the detailed description of the improvements sought to be covered herein, I will recite in a brief manner the general operation of a self-playing

attachment constructed in accordance with the present invention.

A rotary drum or shaft is provided and a suitable motor employed to drive the same at a constant and rapid speed. A plurality
 70 of friction shoes (one for each key of the piano) are arranged adjacent to, but normally held out of contact with the drum or shaft, the shoes being suitably connected to the armatures of electro-magnets. A pull
 75 device is attached at one end to each shoe and at its other end said device has a detachable connection with a part of the hammer-action of the piano. A note selecting
 80 device is employed to control the operation of the playing mechanism, said note selecting device usually consisting of a contact bar or roll and a plurality of selector
 85 fingers, one for each of the before-mentioned electro-magnets. A perforated sheet or web is caused to travel between the contact roll
 90 and selector fingers, and whenever one or more of the latter enter the perforations in the sheet or web and make contact with the said roll the corresponding electro-magnets
 95 with which the selector fingers are in circuit, are energized, thus attracting their armatures and moving the shoes into frictional contact with the continuously rotating
 100 shaft or roll. These contacting shoes are thus thrust forward imparting a quick or sudden upward pull upon the pull-devices which, owing to their connection with the
 several hammer actions cause the hammer to strike the strings of the piano in the same
 105 manner as when the piano is being played manually.

As the note selecting device forms no part of the present invention and as such devices are common and well known in the art, I do
 105 not deem it necessary to either show or more specifically describe the same herein.

Referring first to the piano proper, A designates the top of the case; B the front board; C the fall board; D the key base; E the manual
 110 keys pivoted at F, and provided at their rear ends with the ordinary capstan screws G. *a* designates one of the piano strings; *b* the tuning pegs; *c* the hammer head; *d* the hammer shank; *e* the rest rail, *f* the butt; *g* the
 115 counter check; *h* the back-check, *i* the jack; *j* the pivot upon which the hammer butt rotates; *k* the pivot upon which the jack rotates; *l* the jack portion that engages with the knock-out stop to release the jack from
 120 the butt; and *m* the rail for supporting the said stop. *n* is the wippen pivoted at *o*; *p* the extension pivoted to the wippen; *q* the extension guide pivoted at *r*; and *s* the felted end of the extension which rests upon the
 125 capstan screw G carried by the rear end of the manual key E.

The reference numeral 1 designates a magnet rail, which supports substantially the entire attachment. This rail is of angle iron
 130

and as shown in Figs. 8, 16 and 18, is adjustably and detachably connected by means of two or more angle brackets 2, to the stationery part 3 of the piano frame. Each bracket is provided at its free end with a slot 4, through which a screw entering the magnet rail is passed. By means of the slots 4 the rail may be adjusted vertically as will be apparent.

An important feature of this construction resides in the fact that the attachment may be placed in position in the piano and attached without in any way injuring or cutting the tin plate or other part of the piano, which, practice has demonstrated, should not be interfered with. The only holes that are necessary, are for the wood screws 5, which pass through the brackets into the bolster and these in no way weaken the more delicate parts of the piano frame.

Journalled in suitable bracket bearings 6, suspended from the angle bar or rail 1, is a roll or shaft 7, to be more specifically referred to hereinafter, said roll or shaft being driven in any suitable manner, as by gears 8 and 9, shown in dotted lines in Fig. 8, said gears deriving their motion from a motor, not shown.

Supported on the substantially horizontal member of the magnet rail 1, is a plurality of electro-magnets, said magnets being in circuit with a suitable source of E. M. F., each magnet consisting of two iron cores having reduced ends, which are inserted in suitable holes in the said rail, the said ends being then swaged over to hold the cores securely in place. On each pair of cores are wound the wire coils 10, 11, which are in series, by connecting together their inner ends as at 12. The outer ends of the coils 11 are attached to lead wires 13, going to the selector fingers of the note-selecting device (not shown), while the outer ends of the coils 10 are attached to a common lead wire 14 going to one battery terminal after passing through a suitable line switch (not shown).

The reference numeral 15 designates an armature for the electro-magnets, said armatures being each mounted upon a flat blade spring 16, the outer end of each spring being seated in a cross slot or recess 17, in the rail 18, secured by means of screws 19 to the upright member of the magnet rail 1, all as more clearly shown in Figs. 2 and 4. After being seated in the said cross slots or recesses in the rail 18, the springs are secured by means of screws 20. By this construction the springs are prevented from turning or twisting by reason of the walls of the cross slots or recesses lying close to the edges of the springs 16. A threaded stud 21 is tapped in the outer end of each armature 15, and each stud has a socket 22 in its upper end in which is fitted the stem 23 of a disk 24 as shown in Figs. 2 and 3,

said disk serving to abut against a capstan head 42, presently to be described in order to limit the upward movement of the armature and the shoe suspended therefrom.

Two capstan nuts 25 are mounted upon each threaded stud 21 and between each two nuts is mounted the base portion 26 of a U-shaped saddle 27, the said base portion being provided with an aperture through which the threaded stud 21 is passed. A friction shoe 28 is suspended between the depending legs of each saddle, connection between the shoes and saddle being effected by means of pins 29, covered with felt 30, to prevent noise, all as more clearly shown in Fig. 3. The shoes 28 are preferably made of wood, such as maple, and are formed of two pieces mortised together at 31, so as to have the grain of the wood in the direction of length of each piece. Each shoe has its sole faced with cork 32, or other suitable friction material. As will be seen by referring to Fig. 2 of the drawing, the friction shoes are suspended above and normally held out of contact with the roll or shaft 7, but they will be brought into contact therewith whenever the electro-magnets are energized, as before referred to.

It is very important and necessary that some means be provided for accurately adjusting the position of the friction shoes relatively to the roll or shaft 7, and also for adjusting the armature relatively to the magnet poles, and to effect these adjustments I have provided the following means: The reference numeral 33 designates a T-bar arranged above and parallel with the line of armatures 15, said T-bar being attached to two or more bracket arms 34, the latter in turn being attached to the magnet rail 1, as shown in Fig. 2. A plurality of thumb screws 35 (one for each armature) are tapped in the T-bar 33, the free end of each screw being provided with an opening through which one end of a coil spring 36 is passed, the other end of said spring being bent laterally as shown, and passing loosely through an aperture in a metal clip 37 attached to the upper face of the armature. Each thumb screw 35 has a milled head 38 and a spring lug 39, shown in detail in Fig. 7, and in operative position in Fig. 2, is caused to bear against the periphery of the head 38 to hold the same in the position to which the screw is adjusted. By this means it will be seen that the position of the armatures relative to their magnet cores may be always maintained in proper position, notwithstanding the condition of the blade springs 16, upon which the armatures are mounted, which springs have a tendency to weaken through wear. By reason of the fact that the lower end of the coiled spring 36 is bent laterally and extended loosely through the opening in the clip 37, it will be seen that said spring

will be rotated freely when the thumb screw 35 is adjusted, and such rotation will not, therefore, place the coiled spring under torsional strain. Located in front of each thumb screw 35, is a screw stud 40, said studs being held against turning by means of a nut 41. These screw studs extend through the T-bar and upon each is a capstan head 42 faced with felt, as shown. These capstan heads lie directly above the disks 24 carried by the screw studs 21, and form stops or abutments therefor, which limit the upward movement of the armatures. By this means it will be apparent that by proper adjustments of the various capstan heads, and screw studs, the position and movement of the friction shoes relatively to the shaft or roll, and also the position of the armatures relatively to the magnet cores, may be quickly and effectively adjusted.

An adjustable stop rail is provided for the friction shoes, said stop rail consisting of a bar 43 which is attached to the underside of the magnet rail 1, by means of screws 44, passing through elongated slots 45 in the said bar 43. By this means the stop rail may be adjusted toward and from the friction shoes 28. The front face of the bar 43 is provided with a felt strip or cushion 46, against which the shoes normally rest, this construction being provided to prevent noise.

I will now proceed to describe the connection between the friction shoes and hammer action, it being understood that such connection according to the present invention is made by means of a pull rod, cord or tape attached directly to the shoe and to a part of the action itself. I will first describe the construction illustrated in Figs. 1, 2, 5 and 6, in which the reference numeral 47 designates a pull rod having a hook 48 at its upper end, which rides over a transverse pin 49, carried by a channeled portion 50 of the friction shoe 28. The pin 49 has a covering 51 of felt, or the hook 48 may be so covered to prevent noise in operation. The lower end of the pull rod 47 has a connection with the extension p of the hammer action, by means of a sheet metal clamp 52, which embraces said extension, said clamp having outwardly extending arms 53, provided with two or more openings for a purpose presently to be made apparent. A thin steel strip 54, preferably has its ends 55 turned forward over a block 56, so that the parts will be held together, and the said strip 54 is provided with penetrating points or prongs 57, which, when the said parts 54 and 55 are placed in position and in facial contact with the extension p of the hammer action, as shown in Figs. 5 and 6, and secured by means of the screws 58, the said clamp will be firmly attached to the extension p . An arm 59, provided with a plurality of openings 60, and a twisted end

61, as shown in Figs. 1 and 16 has its rear end located between the two arms 53 of the clamp 52, and these parts are connected together by means of two screws 62. The arm 59 is provided with a plurality of openings 60, along its length, so that a portion of the arm may be cut off when desired to shorten the same, and thus adapt it for use in connection with various makes of hammer actions. The twisted end 61 of the arm 59, is provided with an aperture through which the lower threaded end 63 of the pull rod freely passes, making what I term a lost-motion connection between the rod and arm, as more clearly shown in Fig. 16, and over the said threaded end 63 of the rod is snugly fitted a brass or rubber sleeve 64. Two nuts 65, separated from end 61, of arm 59, by means of felt washer 65', are screwed upon the lower end of the pull rod 47, and serve to adjust the operative length of said rod. The sleeve 64 serves to cover the threads on the end of the pull rod where the latter passes through the aperture in the twisted end of the arm 61, so that the threads will not cause the extension to bind when the piano key E is thrust upward in manual playing. In the latter case therefore, it will be seen that the striker rods are not moved or actuated when the piano is played manually, and this I consider one of the salient features of the present invention.

In some cases it may be preferable to attach the pull rods to some other part of the hammer action and I have therefore shown in Fig. 17 a modified form of pull rod and clamp. In this instance, the pull rod 66 has its upper end threaded at 67, and the hook 68 for the friction shoe is formed of two parts 69, riveted together at 70, the rear ends of the parts 69 being shaped to provide a threaded opening with which the threaded end 67 of the pull rod engages. A screw 71, passing through the two parts 69 of the hook serves to cause them to exert a clamping action on the threaded portion of the pull rod so that the hook may be firmly locked to the rod when once properly adjusted. Adjustments may be easily made by simply loosening screw 71, and turning the pull rod after which the screw is again tightened.

The pull rod 66 has a head 72 on its lower end, upon the upper face of which is placed a felt washer 73, and the said rod also has on its lower end a rubber sleeve 74, for a purpose presently to appear. In the construction shown in Fig. 17, I employ a very light but stiff U-shaped clip 75, which is attached directly to the wippen n of the hammer action, or this same clip may be so modified in an obvious manner as to be adapted for attachment to the extension p of the action. The clip 75 is provided with an offstanding arm 76, having an open slot 77, through which the pull rod may freely pass, the head

on the end of the pull rod being arranged to impinge the underside of the arm to actuate the hammer action whenever the said rod is pulled upward through the movement of its friction shoe. The clip 75 is provided with a sharp point or edge 78, to embed in the underside of the wippen and a screw 79 is employed to otherwise hold the clip in place and against movement. By this construction it will be seen in manual playing as the wippen rises and carries the clip 75 with it, perfect freedom of motion is permitted because of the loose connection between the pull rod and the open slot 77 in the offstanding arm 76. When it is desired to remove the pull rod for any purpose, this may be quickly and conveniently done by simply lowering the said rod until the sleeve 74 comes below the arm 76, when the rod will pass out of the open slot 77.

In Fig. 21 I have shown another form of means for actuating the hammer action through the medium of a pull rod connection with a friction shoe. In this arrangement each pull rod 66 is hooked at its upper end to a shoe 28, and is provided at its lower end with an adjustable head 95, clamped between two nuts 96, threaded upon the said rod, the latter being guided in its vertical movements by means of an apertured rail 97, the apertures therein being bushed with felt 98. The end of the head 95, is faced with felt 99, and is caused to engage a clip 100, attached to the stem *p* of the hammer action whereby to force the hammer *c* into contact with its string *a*. The clip 100 is shown in perspective in Fig. 22. If desired, the clip may be dispensed with and the head 95 caused to engage the wippen *n* direct.

It will be quite obvious that instead of employing a "rod" connection between each shoe and hammer action, I may employ a flexible connection between these two elements, and in some cases this flexible connection is preferable since it has its advantage over a rigid connection. In Fig. 23 I have shown the last mentioned connection, and in this figure the numeral 28 designates the friction shoe as usual, the rear upper edge of which, it will be seen, is curved on increasing radii for a purpose presently to appear. The connection between the shoe and hammer action consists of a flexible linen or other tape or cord 101 secured to the upper edge of the shoe by means of a clamp plate 102, or otherwise, the lower end of said tape or cord being attached to the wippen *n*, or to any other part of the action. The flexible connection provides the necessary lost motion between the hammer action and shoe required in manual playing, and the increasing shoe radius permits of grading the blow perfectly. The chief advantage in this is that the shoe starts to pick up its load on a short radius. It is at this time that the inertia of the piano ac-

tion is most felt and therefore the short radius is easier both on the piano and playing attachment.

In all self-playing attachments of which I am aware, all the piano hammers of the bank are actuated with the same degree of force and in practice it is found that owing to the greater freedom of vibration of the bass strings, the tones given off thereby drown out the tones of the other strings and this is especially true with respect to the treble. It is a salient feature therefore, of the present invention, to remedy this defect and I accomplish the end by causing the hammers in some parts of the action to act with greater force than others, for example, to gain greater force in the treble than in the bass. In Figs. 19 and 20, I have shown by way of examples, two ways of carrying out this part of the invention, which is accomplished by simply altering the construction of the rotary roll or shaft 7, from one of the same diameter throughout its length, as is common in the art, to a roll or shaft made conical in form as shown in Fig. 19. I prefer to mount the roll or shaft as shown in this figure, in which it will be seen that what may be termed the treble end is of larger diameter than the bass end. To enable this construction to properly drive the friction shoes 28, the axis of rotation of the shaft or roll 7, is inclined with respect to the bottom line of shoe faces to such an extent that the uppermost face of the shaft or roll is parallel to the bottom line of shoe faces. By making one of the brackets in which the roll or shaft is journaled, a trifle longer than the other bracket, the proper position of the roll or shaft is secured. It will be apparent of course, that the shaft or roll 7, could be mounted on an axis parallel with the magnet rail, but this would require that the friction shoes be accordingly graduated in length depending upon the pitch of the conical shaft or roll.

Instead of making a conical shaft or roll, I may make the same in stepped form as shown at 80, in Fig. 20, and the same result will be accomplished, except that there will not be a regular and uniform increase of hammer force from the treble to the bass, as is the case with the conical form of roll or shaft.

The operation of this part of the invention will be readily understood from the foregoing description when taken in connection with the drawing. As the roll or shaft is always driven at a constant speed of rotation, it will be apparent that the friction shoes and their attached pull-rods will be actuated with a gradually varying force from the treble to the bass, which is due to the fact that the roll or shaft varies in diameter from end to end and the fact that different shoes engage different portions of the shaft or roll, where the surface speed

varies. It will be apparent that the novel forms of rolls or shafts herein set forth, may be employed in all types of attachments of the shoe and roller class.

5 I will now describe my improved expression mechanism, but will preface the description with the statement that this part of the invention operates on the same principle as the mechanism shown and described in my
10 prior Letters Patent, No. 777,226, dated Dec. 13, 1904, wherein the piano hammers are moved on oblique lines toward and from the plane of the strings to gradually increase or decrease to different extents the length of
15 stroke of the hammers. The improvements sought to be protected herein relate more particularly to the means for shifting the position of the hammers, and said means will now be described.

20 Attached to the underside of the magnet rail 1, as shown in Figs. 1, 2 and 9, are three brackets 81, 82 and 83; one near each end of said rail and one at or near the middle. At the lower end of each bracket is journaled a
25 bell crank lever 84, the shorter arm 85 of which has an eye and the longer arm 86 carries a pin 87, free to rotate in said arm but not to move endwise therein. On each of the pins 87 is journaled a plate 88, said
30 plates being screwed respectively to the two sections 89 and 90; of a channel bar, which bar sections carry a felt strip 91. These bar sections are arranged in rear of the hammers and constitute a rest therefor. As will
35 be seen by referring to Fig. 9, the bar sections 89 and 90 are made in abutting sections, the abutting ends each carrying one of the plates 88, which latter are journaled over the pin 87 on the long arm of the bell
40 crank lever carried by the middle bracket 82. The extreme ends of the bar sections 89 and 90, each have a similar plate 88, one of which is journaled on the pin 87, of the bell crank lever carried by the bracket 81,
45 and the other journaled on the like pin of the bell crank lever carried by the arm 83. It will be evident from the foregoing if the shorter arm of either of the bell crank levers is pulled in the direction of its ar-
50 row, as indicated in Fig. 9; the longer arm will travel outward carrying with it the bar section or sections, as the case may be, and permitting the hammers *c* to recede from the strings whereby to vary the length
55 of travel thereof.

In order to swing the bell crank levers as described, I attach to the short arm of each a steel wire or cord 92, said cords or wires each passing over a separate pulley 93
60 loosely journaled on a cross arm 94, carried by the middle bracket 82, and from thence they pass downward and each is attached to a separate lever arm 95^a, pivoted at 96^a, to the underside of the piano key-board base
65 D. Each lever arm extends forward be-

yond the front edge of the key-board as shown in Fig. 1, and is provided at its free end with a finger key 97^a, said keys bearing the letters B. M. T. indicating the bass, middle and treble parts of the piano action. 70

It will be apparent from the foregoing that by depressing the lever bearing the letter T, the bar section 90 of the hammer rest will be moved outward in the oblique position indicated in Fig. 12, the said section
75 swinging on the pivot 87. This will cause the hammers in the treble part of the piano to assume a corresponding oblique position relatively to the plane of the piano strings
80 *a*, so that the extent of movement of the several hammers of the bank or series in the treble equal to the length of the bar section 90, will be gradually or progressively in-
85 creased or decreased from end to end thereof. The same is true with respect to the hammers of the bass, when the lever having the letter B is depressed. In this case the bar section 89 and the hammers *c* of the
90 bars will assume a position corresponding to that shown in Fig. 13. If the lever having the letter M is depressed, then the pivoted or abutting ends of the two bar sections 89 and 90, and all the hammers of the treble and bass will be moved on opposite oblique
95 lines as indicated in Fig. 14. When the two outer levers bearing the letters B and T are simultaneously depressed, the bar sections and hammers of the treble and bass will be caused to assume a position corresponding
100 to that shown in Fig. 15. It will be obvious that the extent of movement of the bar sections will depend upon the distance the levers are depressed, hence great variation in tone volume may be secured. By oper-
105 ating the three levers in the manner indicated the operator may accent a single note; a run, or a group of notes; bring out the melody of the musical composition and at the same time subdue the accompanying
110 parts; and also obtain many other artistic and pleasing effects.

From the foregoing description, it will be seen that the playing and expression mechanisms are all mounted upon a common supporting element, and the entire attachment
115 is, therefore, self-contained, and may be applied and removed as a whole, which is a decided improvement over those types of attachments wherein the playing mechanism is in one part of the piano and the expression
120 mechanism in another part.

One of the most important and distinguishing features of the present invention resides in locating and arranging "electrically" controlled actuating elements in the
125 upper part of the piano case above the key-board and in the employment of "pull" devices each having a direct connection with a part of the hammer action, as distinguished from those mechanisms located be- 130

low the key-board and having push-rods acting directly upon the manual keys from below; and also as distinguished from "pneumatic" and essentially "mechanical" actuating means for the hammer actions located above the key-board all of which constructions are old and well known in the art, but which are objectionable for the reasons heretofore pointed out.

Another important feature of the invention resides in the employment of a loose or lost motion connection between the friction shoes and the hammer action and in the means for detachably connecting the pull rods to a part of the said action.

I do not specifically claim herein the "flexible" pull connection between the friction shoes and hammer actions as shown in Fig. 23, as this particular connecting means is described and claimed in my co-pending application Serial No. 276,189, filed August 29, 1905.

What I claim as new and desire to secure by Letters Patent is:—

1. In an electrical piano-playing attachment, the combination with the hammer action, of a clip on a unit of the action, a pull device having a head adapted when raised to engage a part of the clip to operate the action, and electro-mechanical means located in the upper part of the piano above the key-board for actuating said pull device.

2. In an electrical piano-playing attachment, the combination with the hammer action, of a clip, means for detachably connecting said clip to a unit of the action, a pull device having a head adapted to engage a part of the clip, and electro-mechanical means located in the upper part of the piano case above the hammer heads for actuating said pull device.

3. In an electrical piano-playing attachment, the combination with a hammer action, of a clip, means for detachably connecting said clip to a unit of the action, a pull rod having a free connection with the clip, and electro-mechanical means located in the upper part of the piano case above the hammer heads for actuating said pull rod.

4. In an electrical piano-playing attachment, the combination with the piano string plate, the keyboard and the hammer action, of electrically controlled shoe and roller actuating mechanism located in the upper part of the piano opposite the string-plate and above the key-board, electro-magnets for causing said shoe to engage said roller, and a pull connection between said shoe and a unit of the action for actuating the latter.

5. In a piano-playing attachment, the combination with the piano case, the string plate and the hammer action, of electro-magnetically controlled shoe and roller actuated mechanism located in the upper part of the piano case opposite the string-plate

and above the hammer heads and a pull device connected at one end with the shoe and having at its other end a lifting connection with a unit of the hammer action.

6. In an electrical piano-playing attachment, the combination with the hammer action, of electro-magnetically controlled shoe and roller actuating mechanism located in the upper part of the piano above the key-board, a clip, means for attaching said clip to a unit of the action and a pull device having a connection at one end with the shoe and a lifting connection at its opposite end with said clip.

7. In an electrical piano-playing attachment, the combination with the hammer action, of electro-magnetically controlled shoe and roller actuating mechanism located in the upper part of the piano above the key-board a clip, means for detachably connecting said clip to a unit of the action and a pull rod connected at one end to the shoe and having its opposite end arranged to engage a part on the said clip.

8. In an electrical self-playing attachment for pianos, the combination with a sound-producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of contact with said shaft, an electro-magnet and armature therefor, a saddle carried by said armature, a pivotal connection between the saddle and shoe, and means operated by the shoe for actuating the sound producing device.

9. In a self-playing attachment for pianos, the combination with a sound-producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of contact with said shaft, an electro-magnet and armature therefor, a saddle adjustably mounted on said armature, a pivotal connection between the saddle and shoe, and means operated by the shoe for actuating the sound producing device.

10. In a self-playing attachment for pianos, the combination with a sound-producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of contact with said shaft, an electro-magnet and armature therefor, a saddle carried by said armature, a pivotal connection between the saddle and shoe, a stop for limiting the upward movement of the shoe and armature, and means operated by the shoe for actuating the sound-producing device.

11. In a self-playing attachment for pianos, the combination with a sound-producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of contact with said shaft, an electro-magnet and armature therefor, a saddle carried by said armature, a pivotal connection between the saddle and shoe, an adjustable stop for limiting the upward movement of the shoe and armature, and means operated by the

shoe for actuating the sound producing device.

12. In combination with a piano, a playing attachment comprising a supporting rail 5 located in the upper part of the piano case above the hammer heads and opposite the string plate, means for removably attaching said rail in position, a plurality of electrically controlled actuating elements carried by 10 said rail, and an independent connection between each of said elements and the several units of the hammer actions.

13. In combination with a piano, a playing attachment comprising a supporting 15 rail, means for supporting said rail in the upper part of the piano case above and free of the hammer heads and opposite the string-plate, a plurality of electrically controlled actuating elements supported from 20 said rail, and an independent connection between each of said elements and a unit of the hammer action.

14. In a self-playing attachment for pianos, the combination with a sound producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of 25 contact with said shaft, an electro-magnet and armature therefor, a flat blade spring rigidly secured at one end to a suitable support, and having its free end attached to the 30 armature, a saddle carried by the free end of the armature, a pivotal connection between the saddle and shoe, and means operated by the shoe for actuating the sound 35 producing device.

15. In a self-playing attachment for pianos, the combination with a sound producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of 40 contact with said shaft, an electro-magnet and armature therefor, a blade spring upon which said armature is mounted, a coiled spring for resisting the movement of the armature, a pivotal connection between the 45 armature and shoe, and means operated by the shoe for actuating the sound producing device.

16. In a self-playing attachment for pianos, the combination with a sound producing device, of a rotary shaft, a friction shoe located adjacent to but normally out of 50 contact with said shaft, an electro-magnet and armature therefor, a blade spring upon which said armature is mounted, an adjustably mounted coiled spring, for resisting the 55 movement of the armature, a pivotal connection between the armature and shoe, and means operated by the shoe for actuating the sound producing device.

17. In a self-playing attachment for pianos, the combination with a sound producing device, of a rotary shaft, a friction shoe located adjacent to but normally out 60 of contact with said shaft, an electro-magnet and armature therefor, a flat blade spring

upon which said armature is mounted, an adjusting screw, a coiled spring having a connection with said screw and with the armature, a pivotal connection between the armature and shoe, and means operated by 70 the shoe for actuating the sound producing device.

18. In a self-playing attachment for pianos, the combination with the sound producing device, of a rotary shaft, a friction shoe located adjacent to but normally out 75 of contact with said shaft, an electro-magnet and armature therefor, a flat blade spring upon which said armature is mounted, an adjusting screw, a coiled spring connected 80 at one end to said screw, and having a loose connection at its other end with the armature, whereby the same may be freely rotated on said connection, a pivotal connection between the friction shoe and armature, and 85 means operated by the shoe for actuating the sound producing device.

19. A piano having a playing attachment comprising a plurality of electrically controlled hammer actuating elements located 90 in the upper part of the piano case opposite the string-plate and above the hammer heads, a support common to all said elements and a pull connection between each individual element and a unit of the hammer action. 95

20. In a self-playing attachment for pianos, the combination with a sound producing device and actuating mechanism therefor located thereabove and comprising 100 a rotary shaft, a friction shoe located adjacent to but normally out of contact with said shaft, an electro-magnet and armature therefor, an adjusting screw, a coiled spring connected at one end to said screw and having its opposite end loosely connected to the 105 armature, a saddle carried by the armature, a pivotal connection between the saddle and shoe and a pull device operated by the shoe for actuating the sound producing device.

21. In an electrical self-playing attachment for pianos, the combination with a sound-producing device of a clip detachably connected thereto, electro-mechanical actuating means arranged in the upper part of the piano casing above the key-board, and a 115 pull connection between said means and said detachable clip, whereby the parts may be readily connected or disconnected.

22. In a self-playing attachment for pianos, the combination with a sound producing device, of a rotary shaft, a friction shoe, an electro-magnet and armature therefor, a stud adjustably mounted on said 120 armature, a saddle having an aperture through which said stud passes, nuts adjustably mounted on said stud, and between which a part of the saddle is located and a pivotal connection between the saddle and shoe. 125

23. In a self-playing attachment for 130

pianos, a rotary shaft, a friction shoe, an electro-magnet and armature therefor, a threaded stud carried by said armature, a saddle having an aperture through which said stud passes, nuts threaded upon said stud and located upon opposite sides of said saddle, a disk on the end of the stud, an abutment for the disk, and a pivotal connection between the saddle and shoe.

24. In a self-playing attachment for pianos, a rotary shaft, a friction shoe, an electro-magnet and armature therefor, a threaded stud carried by said armature, a saddle having an aperture through which said stud passes, nuts threaded upon said stud and located on opposite sides of said saddle, a disk on the end of the stud, an adjustable abutment for the disk, and a pivotal connection between the saddle and shoe.

25. In a self-playing attachment for pianos, the combination with a sound producing device, of a clip detachably connected to a part of said device, an extension on the clip having an aperture, a pull rod passing through the said aperture in the extension, a head on the end of the pull rod adapted to abut the extension, and an operative element having a connection with the pull rod.

26. In a self-playing attachment for pianos, the combination with a sound producing device, of a clip detachably connected to a part of said device, an extension on said clip having an aperture, a pull rod extending through said aperture, and having a head at one end adapted to abut the extension, and a hook on the other end of said pull rod.

27. In a self-playing attachment for pianos, the combination with a sound producing device, of a clip connected to a part of said device, an extension on said clip having an aperture, a pull rod extended through said aperture, a sleeve inclosing that part of the rod passing through the aperture, and a head on the lower end of the rod adapted to abut the extension.

28. A piano having a playing attachment comprising a magnet rail, means for detachably supporting said rail in the upper part of the piano case above the hammer heads and opposite the string-plate, a plurality of electro-magnets carried by said rail, a plurality of friction shoes pivotally connected to the armatures of said magnets, a rotary shaft journaled in brackets on the magnet rail, and a pull device suspended from each shoe.

29. A piano having a playing attachment comprising a magnet rail, means for detachably supporting said rail in the upper part of the piano case above the piano hammers, a plurality of electro-magnets carried by said rail, a plurality of friction shoes pivot-

ally connected to the armatures of said magnets, a rotary shaft journaled in brackets below the shoe faces, and an adjustable stop bar for the shoes carried by the magnet rail.

30. A piano having a playing attachment comprising a magnet-rail, means for detachably supporting said rail in the upper part of the piano case above the piano hammers, a plurality of electro-magnets carried by said rail, a plurality of friction shoes pivotally connected to the armatures of said magnets, a rotary shaft journaled in brackets on the magnet rail, a pull rod suspended from each shoe, a movable hammer rest rail, and means suspended from the magnet rail for supporting the said rest rail.

31. A piano having a playing attachment comprising a magnet rail, means for detachably supporting said rail in the upper part of the piano case above the hammers, a plurality of electro-magnets carried by said rail, a plurality of friction shoes pivotally connected to the armatures of said magnets, a rotary shaft journaled in brackets on the magnet rail, a pull rod suspended from each shoe, a movable hammer rest rail made in two alined sections, supporting brackets carried by the magnet rail, and movable arms journaled on said brackets and constituting the supporting means for the said rest-rail.

32. A piano having a playing attachment comprising a magnet-rail, means for detachably supporting said rail in the upper part of the piano case above the hammers, a plurality of electro-magnets carried by said rail, a plurality of friction shoes pivotally connected to the armatures of said magnets, a rotary shaft journaled in brackets on the magnet rail, a pull rod suspended from each shoe, a movable hammer rest rail made in two alined sections, supporting brackets carried by the magnet rail, bell crank levers journaled on said brackets, and a pivotal connection between each bell crank lever and a part of the said rest rail.

33. In electrical self-playing mechanism for pianos, the combination with the piano case and the hammer action of the piano, of a pull rod, electro-mechanical means located in the upper part of the piano case above the hammer heads for actuating the pull rod, a clip detachably connected to a unit of the hammer action, and a lost motion connection between the clip and lower end of the pull rod.

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

IRVING B. SMITH.

Witnesses:

CHARLES BOWMAN, Jr.,
HARRY R. CROCKFORD.