J. J. WALKER.

SELF PLAYING MUSICAL INSTRUMENT.

APPLICATION FILED AUG. 24, 1905.

993,479.

Patented May 30, 1911.

3 SHEETS—SHEET 1.

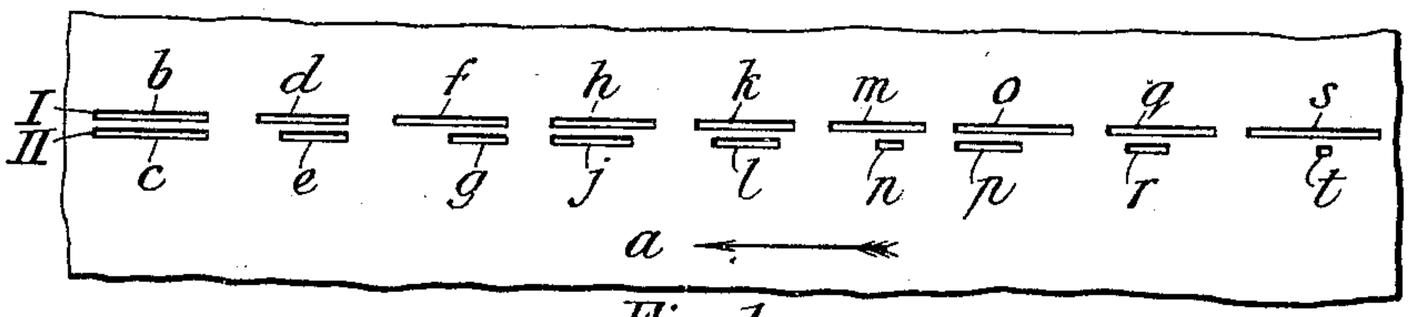

Fig. 1.

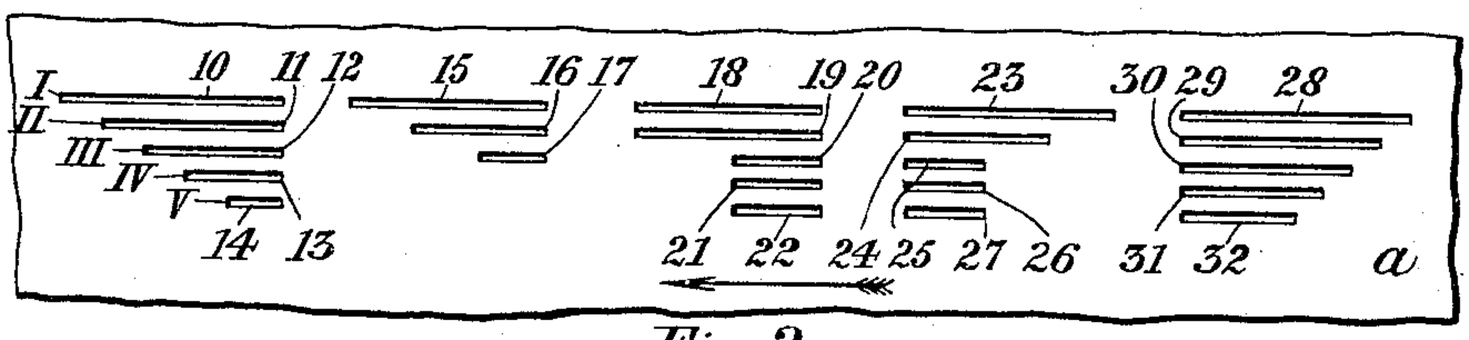

Fig. 2.

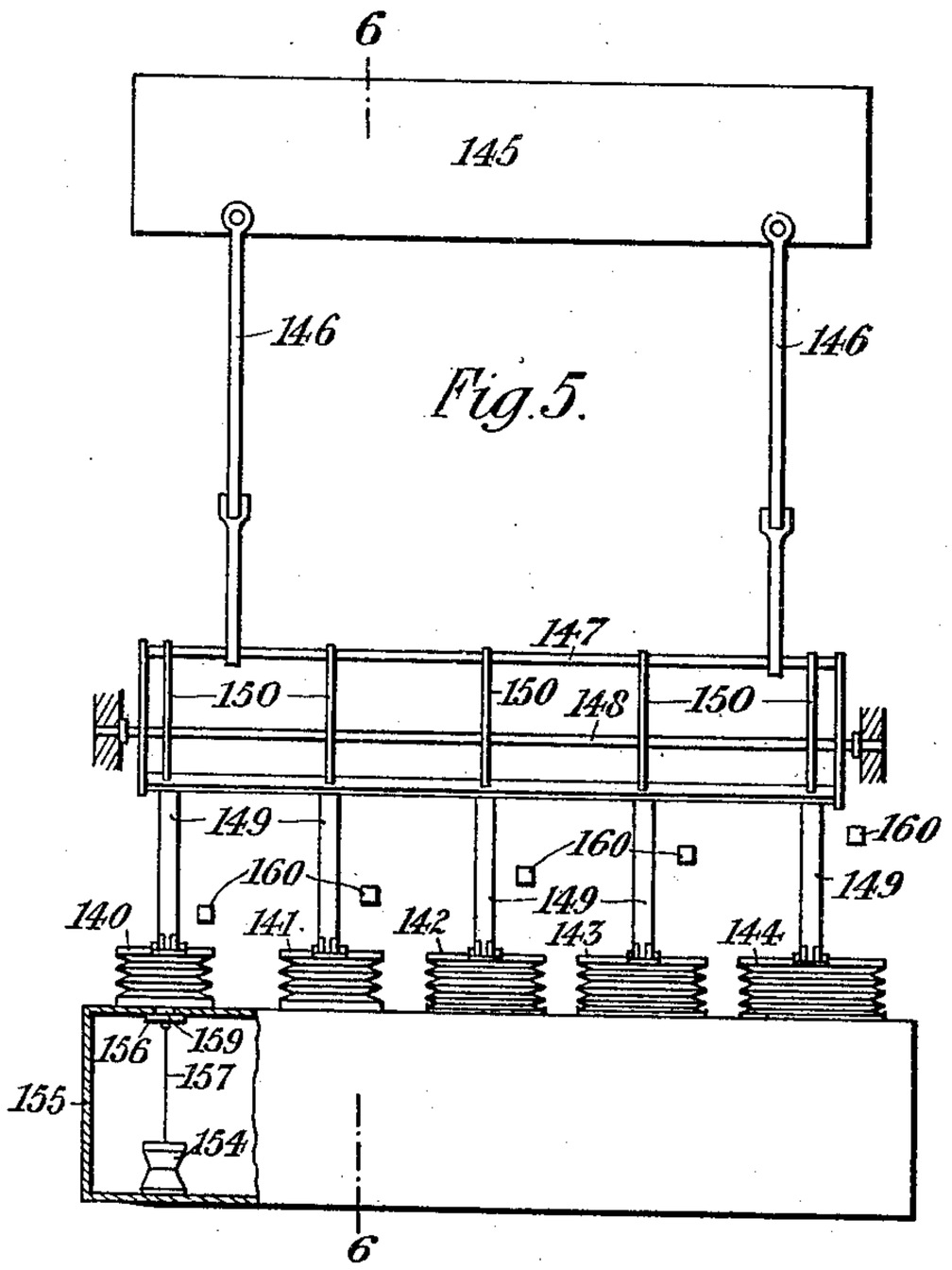

Fig. 5.

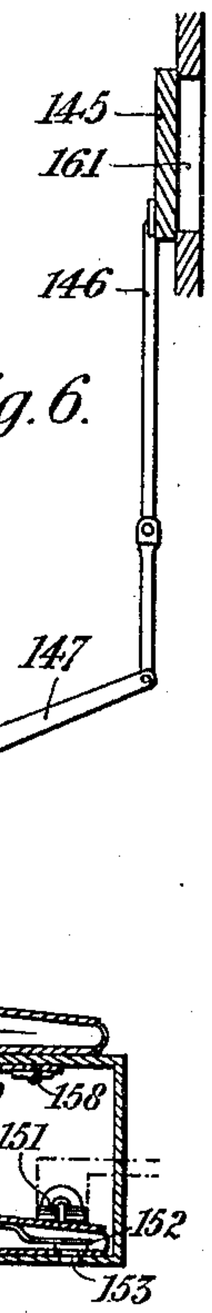

Fig. 6.

Witnesses
H. A. Lemo.
T. J. Baker.

Inventor
James John Walker.
per Henry Hart.
Attorney

J. J. WALKER.

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3 SHEETS—SHEET 2.

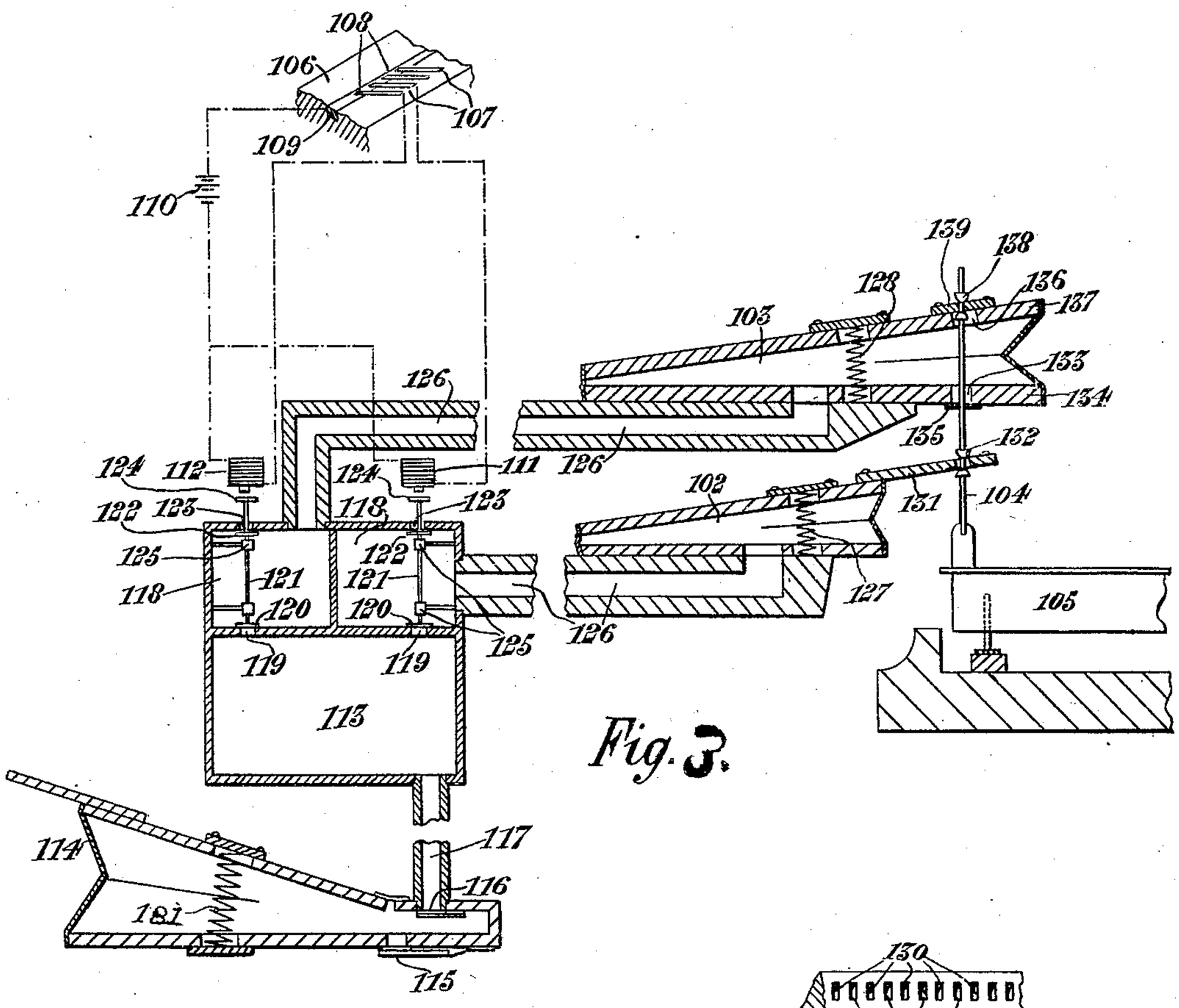

Fig. 3.

Fig 4.

Witnesses

W. Sutherland Robertson

Warwick Thy. Williams.

Inventor.

James John Walker

per Henry Hart

Attorney.

J. J. WALKER.

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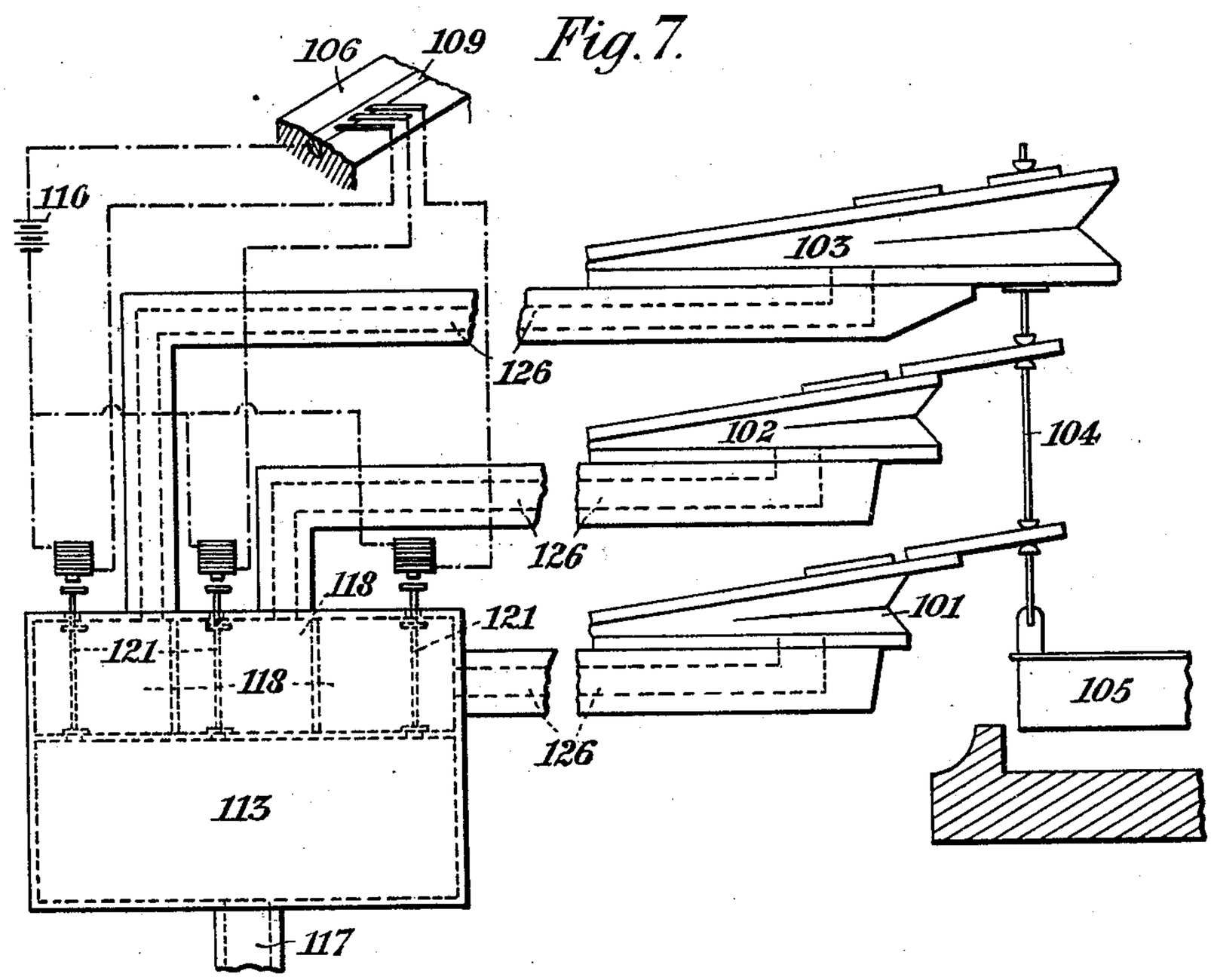
3 SHEETS—SHEET 3.

Fig. 7.



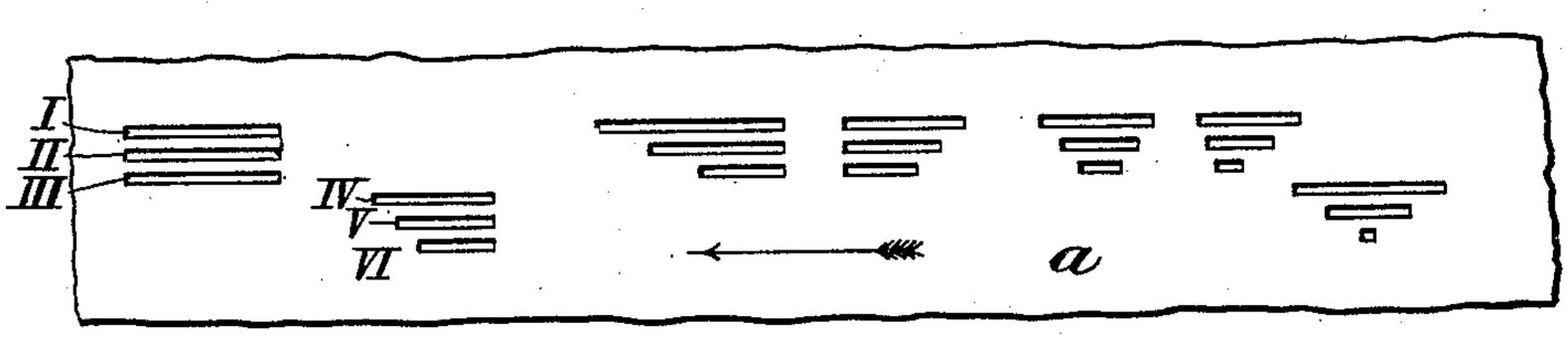


Fig. 8.

Witnesses
H. B. Lemo.
J. J. Baker

Inventor
James John Walker
per Henry Hart
Attorney

UNITED STATES PATENT OFFICE.

JAMES JOHN WALKER, OF LONDON, ENGLAND.

SELF-PLAYING MUSICAL INSTRUMENT.

993,479. Specification of Letters Patent. **Patented May 30, 1911.**

Application filed August 24, 1905. Serial No. 275,611.

To all whom it may concern:

Be it known that I, JAMES JOHN WALKER, a subject of the King of Great Britain, residing at No. 27 Francis street, Tottenham Court Road, London, England, have invented a new or Improved Self-Playing Musical Instrument; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a new or improved self-playing musical instrument and has for its object to provide an instrument which will exactly reproduce automatically manipulations of the keys and levers of a musical instrument.

According to the present invention an instrument is provided which, in combination with a record tune sheet having generally one or more complementary perforations for each of the note perforations thereof (such a record for example as that forming the subject of a separate application for Letters Patent S. N. 331910 filed August 24th 1906) is capable of producing in a practically exact manner such a performance as has been above indicated and of automatically synthesizing the various elements or components appearing on the said record and causing the result to be audibly and automatically reproduced upon an instrument similar to that on which the music was originally played.

According to this invention each key, expression or swell lever, or other operating device, in an automatic music reproducing instrument, is provided with means for producing one or more variations in power during the operation of such key, expression or swell lever or other operating device, the effects produced or controlled by which are dependent upon the speed at which such keys or devices are operated. One convenient way of carrying out this portion of the invention consists in connecting two or more motor devices to each such key or controlling device. If two motors be used then each of the two motors controlling a key or other lever or operating device has a separate connection to the tracker board and is therefore independently controlled. The record sheet possesses in this case two perforations for each note the ordinary or relatively non-variable one of which may be termed the note perforation and the other relatively variable one the complementary perforation as described in the specification of my above-named separate application.

In the accompanying drawings:—Figure 1 is a plan of part of a perforated or slotted sheet or band adapted for effecting the control of one construction of the improved reproducer when the latter is constructed for pneumatic control or operation. Fig. 2 is a plan of part of a perforated sheet or band having perforations or slots for controlling say a pneumatically operated organ swell. Fig. 3 is a sectional view of the improved reproducing mechanism applied to say a piano, of which latter only a portion of one of the keys is shown. Fig. 4 is a perspective view of portion of a tracker board having ports. Fig. 5 is a front elevation, partly broken away, of a mechanism for reproducing the recorded movements upon, say, an organ swell. Fig. 6 is a vertical section on the line 6—6 of Fig. 5. Fig. 7 is a sectional view of a modification of the apparatus shown in Fig. 3, and Fig. 8 is a plan of part of a perforated sheet or band for effecting the control of the apparatus shown in Fig. 7.

For reproducing music recorded as shown in Fig. 1, which record comprises a row I of note-slots and a row marked II of what may be termed complementary slots, as explained in the specification filed in the before-mentioned separate application for Letters Patent, the improved reproducer (which may form part of a musical instrument or which may form part of a piano player) shown in Fig. 3, is employed. This reproducer comprises two sets of pneumatics, one of each principal set 102 and one of each complementary set 103 being seen in

Fig. 3. These two pneumatics 102 and 103 are both operatively connected with one and the same sticker 104, the latter operating for instance one of the keys 105 of the piano. Similarly the remainder of the keys are connected to two such pneumatics and the operation of each of these motors 102, 103 is conveniently controlled by a separate electric or pneumatic circuit, the making and breaking of which is, in turn, controlled by the before-mentioned perforated record sheet *a*. A convenient way of controlling the motors is to provide a tracker board 106 with a series of electric contacts or readers, as for instance 107, 108, 107, 108 in Fig. 3, those marked 107 in line with the rows marked I of the perforations shown in the record sheet, being for controlling the operation of the motor 102, the others, indicated by the number 108 which are in line with the rows marked II of perforations, being for controlling the operation of the second motor 103. Whenever a slot comes beneath a reader 107, 108 the latter is permitted to make electrical contact with the conductor 109 laid along the tracker board 106 and connected to one pole of a battery 110, each reader 107 and 108 being connected respectively through the winding of a magnet 111 and 112 to the opposite pole of the battery 110. These magnets 111 and 112 may control the operation of the motors 102 and 103 respectively as follows: The chamber 113 is exhausted during the operation of the reproducer by power, or, as shown, by a foot operated bellows 114, which, upon being depressed, forces the air which it contains out through the valve 115, the valve 116 meanwhile automatically closing the duct 117 leading to the chamber 113. The spring 181 then reëxpands the bellows 114, when the pressure of the atmosphere closes the valve 115 and exhaustion of the chamber 113 takes place by way of the duct 117 and valve 116. Subsidiary chests 118 communicate with the chamber 113 by way of ports 119, which are automatically closed by valves 120, upon the stem 121 of each of which is a second valve 122 which, when the valve stem is raised to open the port 119 closes a port 123 leading to the atmosphere. Armatures 124 are fixed upon the stems 121 for raising them in their guides 125 to operate the valves as described. When the magnets 111, 112 are deënergized, as they are under normal conditions, the valves 120, 122 are in the positions shown in Fig. 3, *i. e.*, the chests 118 are open to the atmosphere by way of ports 123 and are closed to the vacuum chamber 113. The pneumatics 102, 103 which communicate with their respective chambers 118, 118 by ducts 126 can thus receive air and be maintained in the expanded condition by means of their springs 127, 128. When however either of the magnets 111, 112 is energized, its armature 124 is attracted, thereby raising the stem 121 to which such armature is fixed, and, by the lifting of the corresponding valve 122, closing the corresponding port 123 to the atmosphere, and, by the lifting of the corresponding valve 120 opening the corresponding port 119 to the vacuum chamber 113. The particular pneumatic 102 or 103 is thus exhausted by way of its duct 126 and will impart a downward motion to the sticker 104 and therefore to the key or lever 105 connected therewith. When, according to this invention, the pneumatic 102 is working alone, the pneumatic 103 is acting as a retarder, the said pneumatic 103 continuing to act in this capacity until such moment as its valves are actuated to cause it to operate as an accelerator. When a slot passes away from beneath its reader, the electric circuit is broken and the corresponding motor ceases to operate.

The pneumatic 102 is connected to the sticker 104 by means of an arm 131 taking over the sticker 104 and engaging between adjustable buttons 132, 132 on the sticker 104. The pneumatic 103 preferably projects out beyond, and is larger than, the pneumatic 102, and the sticker 104 passes through a hole 133 in the base 134, a diaphragm 135 preventing ingress of air at that part. The sticker also passes through a hole 136 in the upper board 137 of the pneumatic or bellows 103 and adjustable buttons 138, 138 on the sticker 104 are caused to bear on either side of a diaphragm 139 fitted over the hole 136. As hereinbefore stated, the slots in the rows marked I on the record strip *a* control motors such as 102, and the slots in the rows marked II control motors such as 103; it will be easily understood therefore that the speed of depression of the keys 105, and therefore the character of the note sounded, will depend upon the interval between the commencement of collapse of the two pneumatics 102 and 103. When, therefore, one of the before-mentioned note or tune perforations of a row I, is presented to its respective electric contact, or registers with its respective port, in a piano or other reproducer, an electric or pneumatic impulse is transmitted, which causes the respective motor to actuate the sounding device appertaining to the particular circuit completed. If the note or tone to be sounded by this operation be a loud one, as represented by the slots or perforations *b*, *c*, Fig. 1, then, as the forward ends of these slots are cut abreast, or nearly so, of one another, the motors 102 and 103 will operate together, or so nearly together that before the sounding device has had time to become tonally effective by reason of the operation of the motor 102 the power of the latter is augmented by the action of motor 103 and the note is thus sharply struck and a loud note produced. The slots

b, *c* terminate together and so cut off their respective motors 102, 103 simultaneously, the key can thus fly back quickly and produce a more or less staccato effect. In the second example represented by the slots *d* and *e* in Fig. 1, the slot *e* will not bring about the operation of the motor 103 until some time after the commencement of operation of the motor 102, the key 105 will therefore have been appreciably depressed by the time the power is augmented by the opration of the motor 103, thus the note will not be so forcibly struck and a softer note will be produced. The slots *d* and *e* terminate together and thus cut off the motors 102 and 103 simultaneously, so that a more or less staccato effect is produced in this instance also. The slots *o* and *p* having their forward ends abreast of one another will cause the motors 102 and 103 to commence working simultaneously to produce a loud note, the slot *p* however terminates ahead of the slot *o* so that the motor 103 will be cut off some time in advance of the motor 102 and the release of the key 105, being, under these circumstances, more gradual than in the two former examples, the note will be of a more or less legato character. The perforation *t* commences far in arrear of the companion note slot *s* and terminates some distance in advance thereof, the operation of the motor 103 therefore is so late and of such short duration that it may not be effective in augmenting or varying the power applied to the key 105 and therefore the tone represented by the note slot *s*.

According to Fig. 4, a number of ports 129 and 130 are formed in the tracker corresponding respectively to the readers 107 and 108. The note or tune slots in the rows marked I in Fig. 1 are adapted to register with the ports 129 to control the working of the motors 102, the companion or complementary slots in the rows marked II, Fig. 1, being adapted to register with the ports 130 to control the working of the motors 103. The manner in which the operation of the respective motor is brought about whenever a slot registers with a port and permits air to enter therethrough and is caused to cease when such slot passes away from over this port, may be accomplished in any known manner.

In the case of the successive impulses transmitted through the medium of the perforations for operating the swells of organs, each of such impulses causes one of the series of five swell controlling motors 140, 141, 142, 143 and 144 shown in Figs. 5 and 6, to vary the swell 145 to a particular degree. In the example illustrated, the motors are of gradually increasing size from the principal motor 140 to the last motor 144 of the complementary motors 141, 142, 143, 144, and the swell 145 is supposed to be a simple sliding cover for a swell box. The cover is supported by rods 146 linked to an oscillatory frame 147 movable about a shaft 148. Each of the five pneumatics 140 to 144 has a sticker 149 engaging by a pin 150 the front part of the frame 147. The pneumatics 140 to 144 are shown as pressure or expansible bellows and may be governed by the record shown in Fig. 2, which completes or breaks the circuits of magnets 151 as described with reference to the magnets 111, 112 Fig. 3. The magnets 151, when thus energized, raise their respective valves 152 from exhaust ports 153 and their respective pneumatics 154 are then collapsed by the pressure within the chest 155. The pneumatics 154 thus pull down flap valves 156 to which they are connected by cords or wires 157. The valves 156 turn about the hinges 158, and compressed air is thus admitted from the chest 155 by way of the ports 159 to the respective pneumatics 140 to 144, to expand the latter until arrested by their respective stops 160 and cause the swell box cover 145 to descend and uncover the opening 161 in the swell box. It will be easily understood that the swell will be actuated according to the number and position of the slots in the record governing the magnets 151; to give only three instances; if all five slots start abreast of one another, as occurs with slots 23—27 Fig. 2, the swell will open abruptly and completely, as the full power will be at once applied, but supposing all five slots have their forward ends successively in arrear of each other, as occurs with the slots 10—14 Fig. 2, then the opening of the swell will be a more or less gradual one until the maximum is reached. It depends upon the relative position of the forward ends of the slots whether or not each motor coming into operation, will overlap the preceding one, and it is easy to see that the amount of overlapping determines the speed of actuation. Further, supposing only three out of the five slots are employed, and are arranged with their forward ends successively in arrear of one another, as occurs with the slots 15, 16, 17, then the motors 140, 141, and 142 only will operate successively, and the swell 145 will only partially uncover the opening 161 at a greater or less speed depending upon the intervals between the coming into operation of the motors 140, 141, and 142. It will be readily understood moreover that if all of the motors be cut off simultaneously by the simultaneous termination of the five companion slots, as occurs with the slots 10 to 14 and 18 to 22 Fig. 2, the swell will be quickly closed, whereas if the motors be successively cut out by the companion slots terminating more or less in advance of one another, as occurs with the slots 23 to 27 and 28 to 32, the speed of the closing will be more or less slow. The swell may of course be operated

by two motors as described with reference to Fig. 3; it will be seen however that with five motors a greater number of gradations can be produced. If desired, a greater number than five could be employed with equally good or better effect. It is thus apparent that a swell can be automatically operated in a manner practically identical with the manner in which the swell was operated by the performer in the execution of the piece for the production of the record.

The arrangement shown in Fig. 7, is similar to that hereinbefore described with reference to Fig. 3, the only material difference being that the reproducer represented in Fig. 7 comprises three sets of pneumatics 101, 102 and 103 and a corresponding number of sets of subsidiary chests 118 and controlling valves and circuits. For controlling the apparatus shown in Fig. 7 a tune sheet or band such as that represented in Fig. 8, would be used, such sheet having for each of the keys 105 to be operated, three rows I, II, III or IV, V, VI, of perforations or slots; it is however believed that the operation of this apparatus will be sufficiently well understood from the foregoing description of Fig. 3, to render special description thereof unnecessary, it being explained that like reference numerals are used to indicate like or corresponding parts in Figs. 3 and 7.

I claim:—

1. A reproducer of a music record and complementary expression record, comprising in combination sound emitters, levers for actuating said sound emitters, a plurality of independently governed motive power means operatively connected with each of the said levers, a record reader corresponding to each of said motive power means and operative means controlled by said readers for putting said motive power means into and out of action independently of one another substantially as set forth.

2. A reproducer of a music record and complementary expression record, comprising in combination sound emitters, levers for actuating said sound emitters, principal motive power means operatively connected with each of said levers, complementary motive power means operatively connected with each of said levers, said means being operative independently of one another, a record reader corresponding to each of said principal motive power means, a record reader corresponding to each of said complementary motive power means, operative means controlled by said readers for putting said principal and complementary means respectively into and out of action independently of one another, said complementary means, when not active during the operation of said principal means, being operative to retard the action of said principal means, substantially as set forth.

3. A reproducer of a music record and complementary expression record, comprising in combination sound emitters, levers for actuating said sound emitters, principal motive power means operatively connected with each of said levers, a plurality of complementary motive power means operatively connected with each of said levers, a record reader corresponding to each of said principal motive power means, a record reader corresponding to each of said complementary motive power means, and operative means controlled by said reader for putting said principal and said complementary means respectively into and out of action, independently of one another substantially as set forth.

4. A reproducer of a music record and complementary expression record comprising in combination sound emitters, levers for actuating said sound emitters, principal motive power means operatively connected with each of said levers, a plurality of complementary motive power means operatively connected with each of said levers, a record reader corresponding to each of said principal motive power means, a record reader corresponding to each of said complementary motive power means, and operative means controlled by said readers for putting said principal and said complementary means into and out of action, independently of one another, each of said complementary means when not active during the operation of said principal means, being operative to retard the action of said principal means, substantially as set forth.

5. A reproducer of a music record and complementary expression record comprising in combination sound emitters, levers for actuating said sound emitters, principal motive power means operatively connected with each of said levers, complementary motive power means of greater capacity than said principal means operatively connected with each of said levers, a record reader corresponding to each of said principal motive power means, a record reader corresponding to each of said complementary motive power means, and operative means controlled by said readers for putting said principal and complementary means respectively into and out of action independently of one another substantially as set forth.

6. A reproducer of a music record and complementary expression record comprising in combination sound emitters, levers for actuating said sound emitters, principal motive power means operatively connected with each of said levers, a plurality of complementary motive-power means operatively connected with each of said levers, said complementary motive power means constituting a series in which the dimensions of the said means gradually increase from one end

of the series to the other, a record reader corresponding to each of said motive power means and operative means controlled by said readers for putting said principal and complementary means respectively into and out of action independently of one another, substantially as set forth.

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

JAMES JOHN WALKER.

Witnesses:
MARGARET ANN HOSKINS,
GEORGE HARRIS.