

J. J. WALKER.  
RECORDING MUSIC.  
APPLICATION FILED APR. 30, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

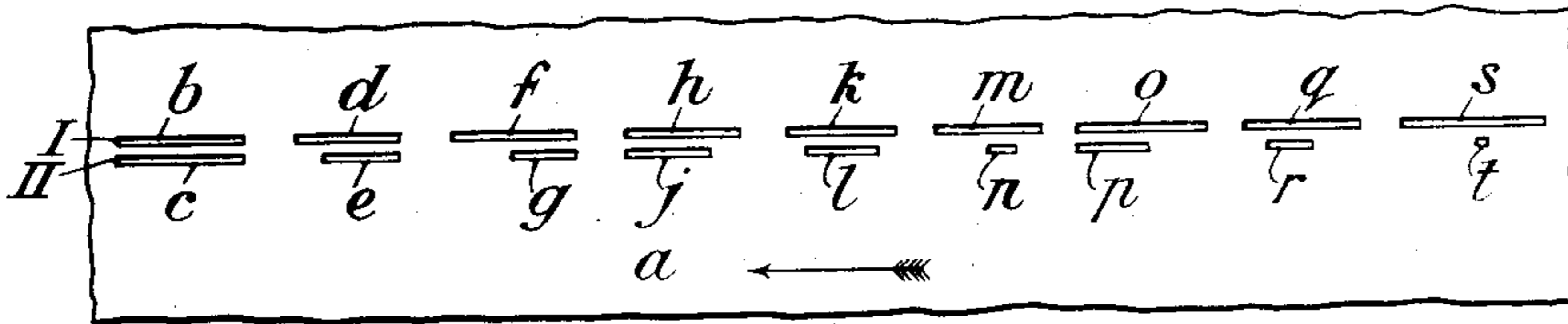


Fig. 2.

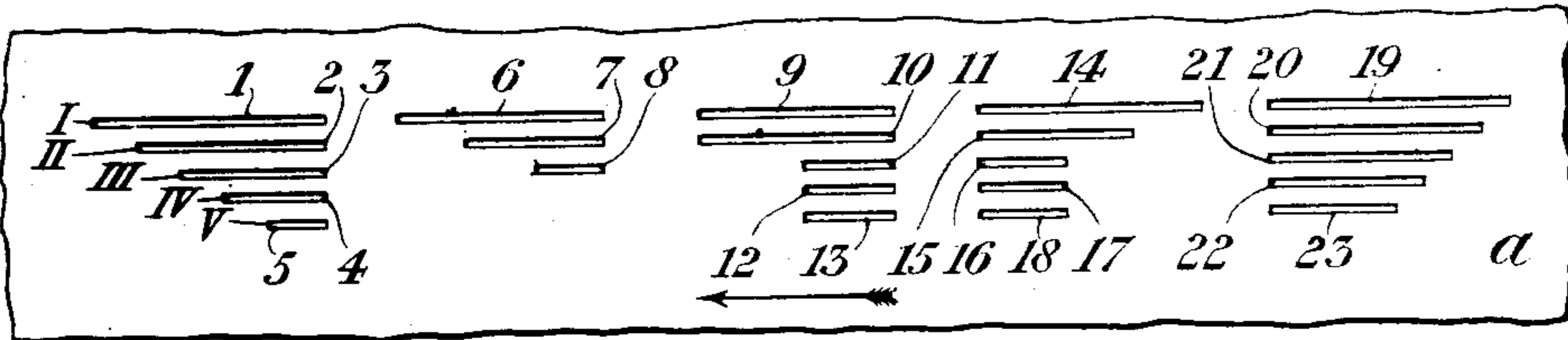


Fig. 4.

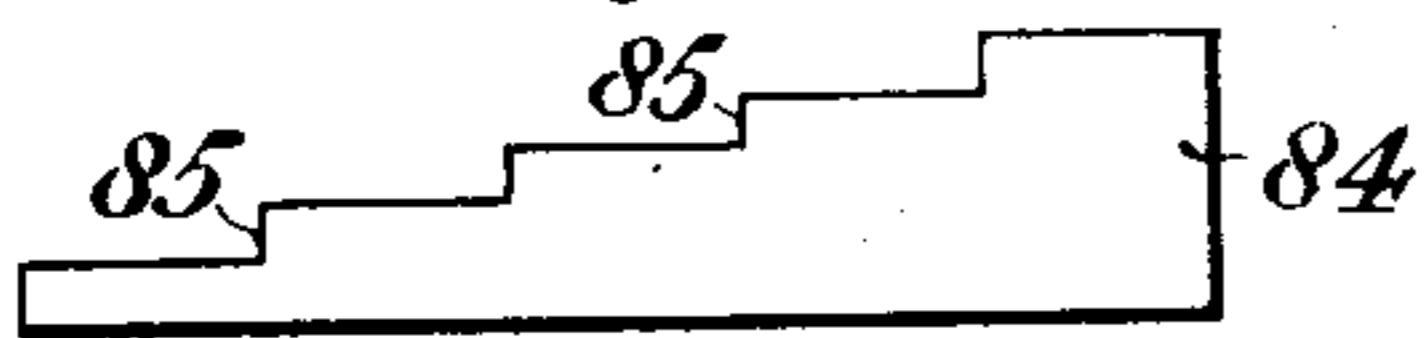


Fig. 5.

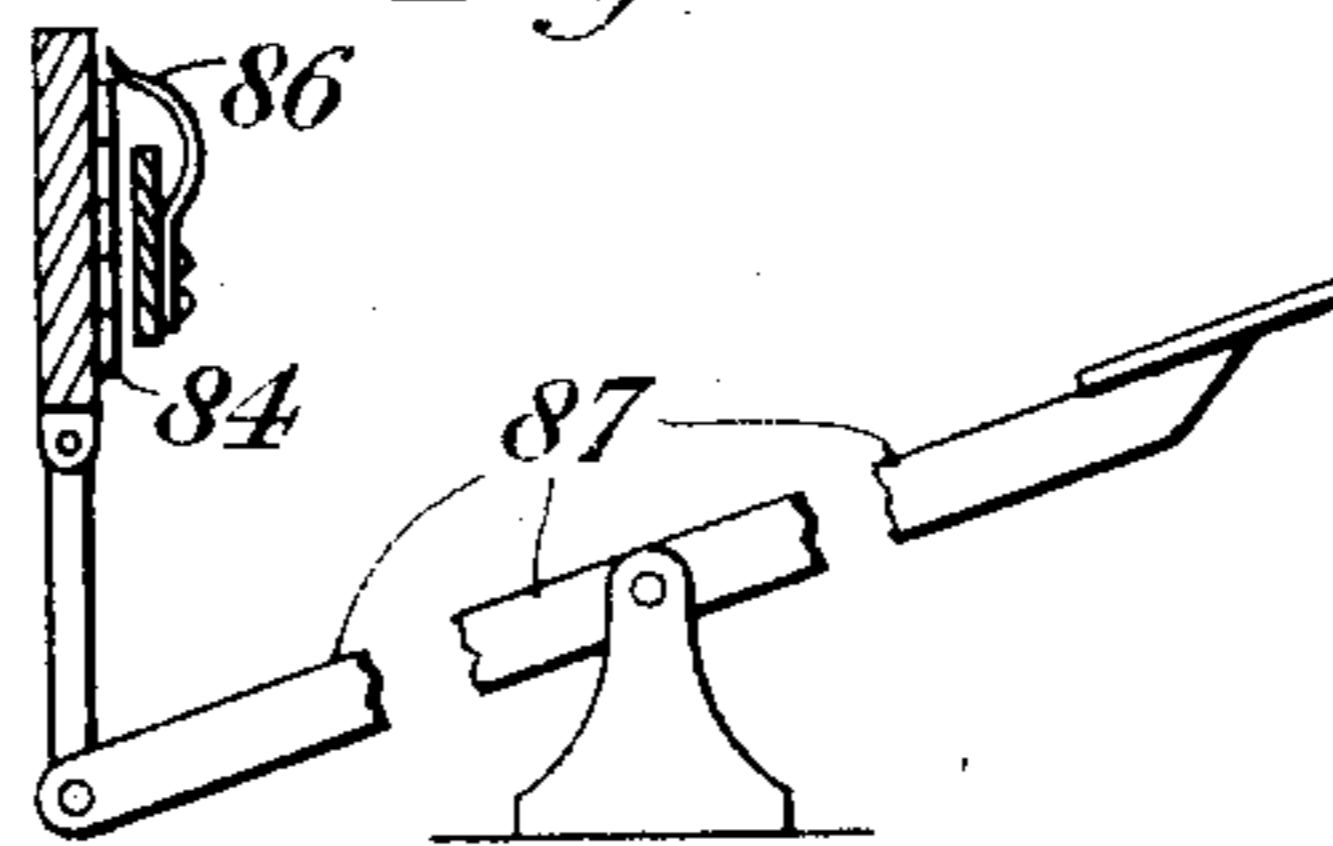


Fig. 6.

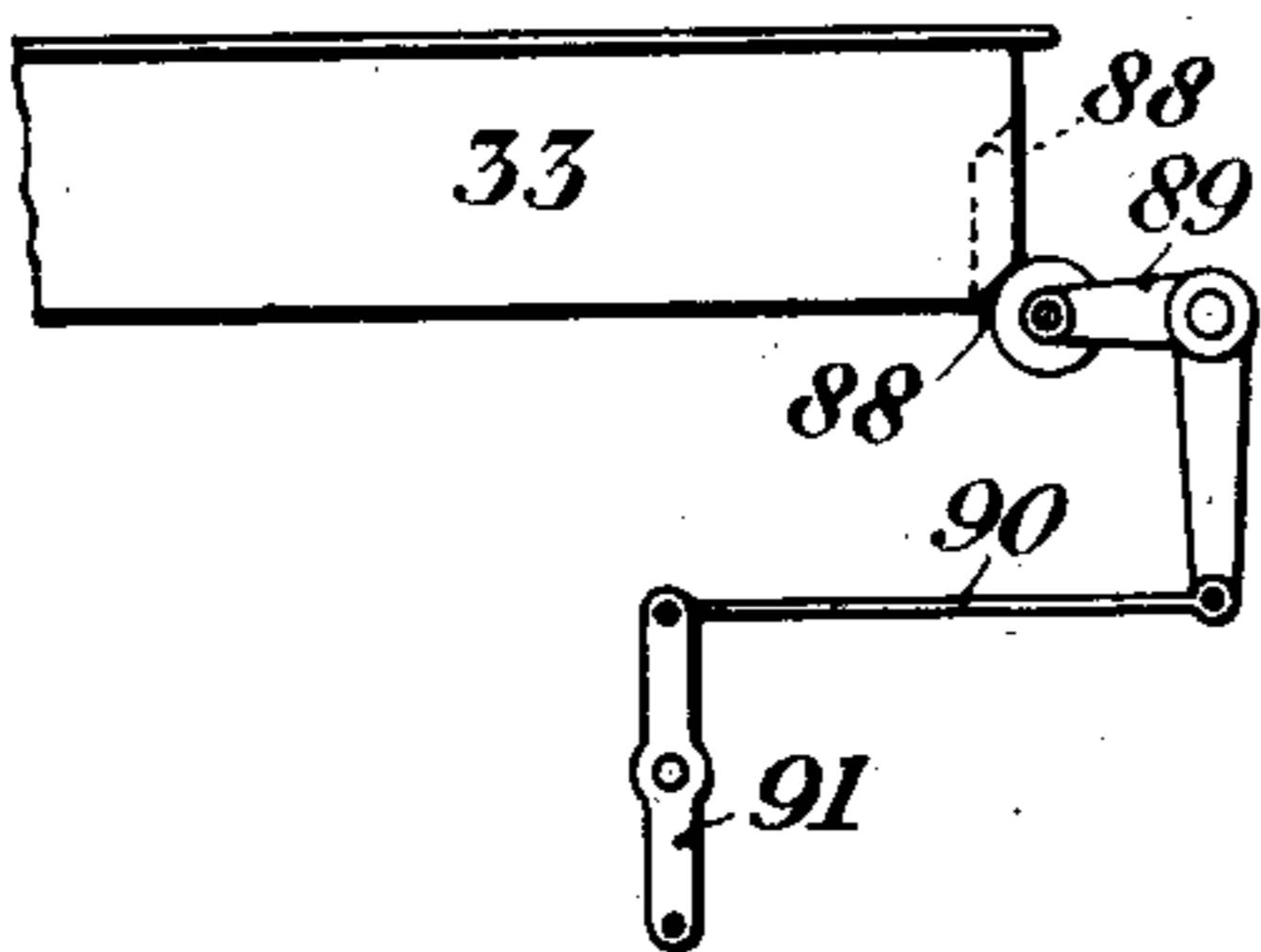
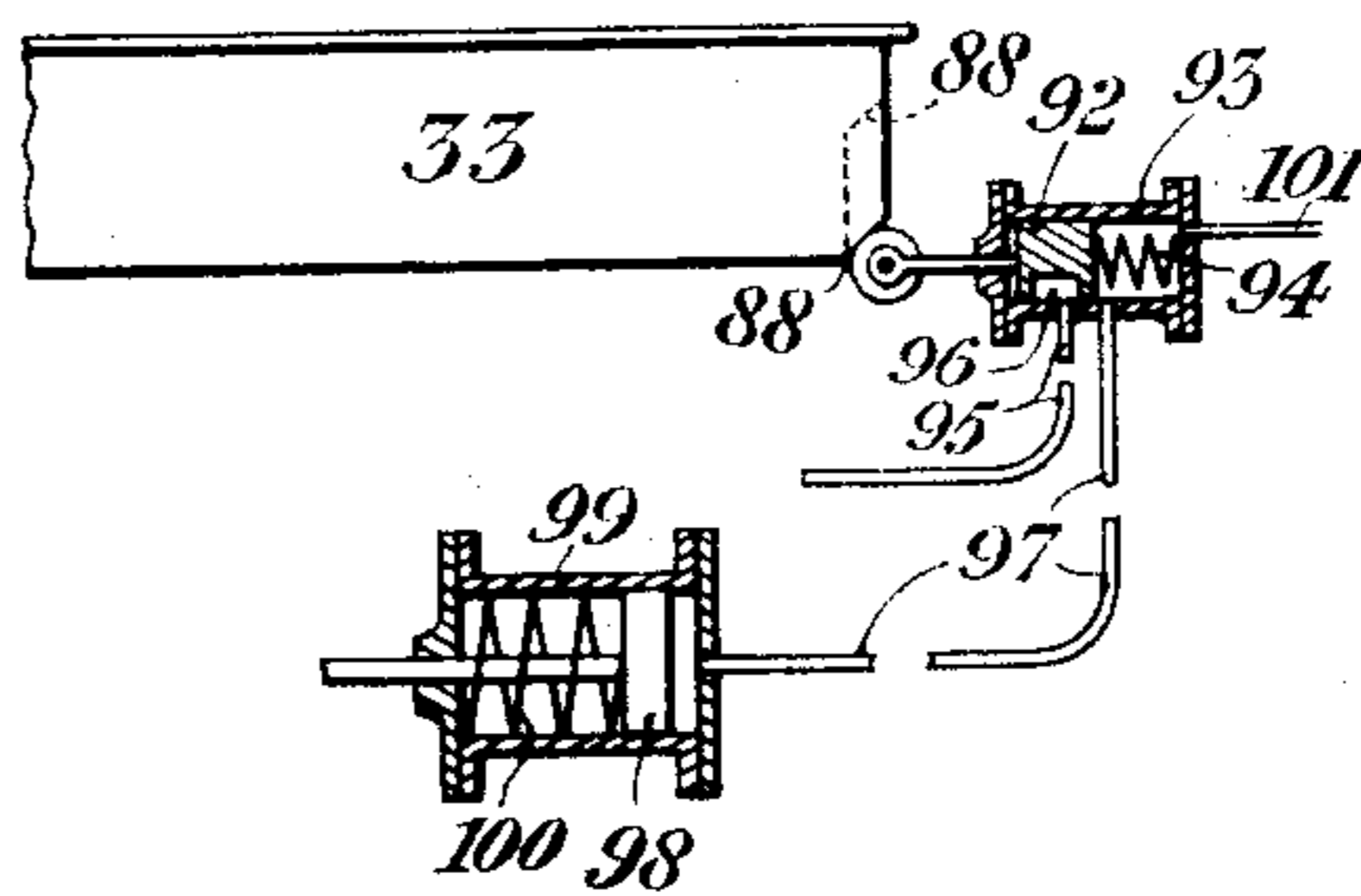


Fig. 7.



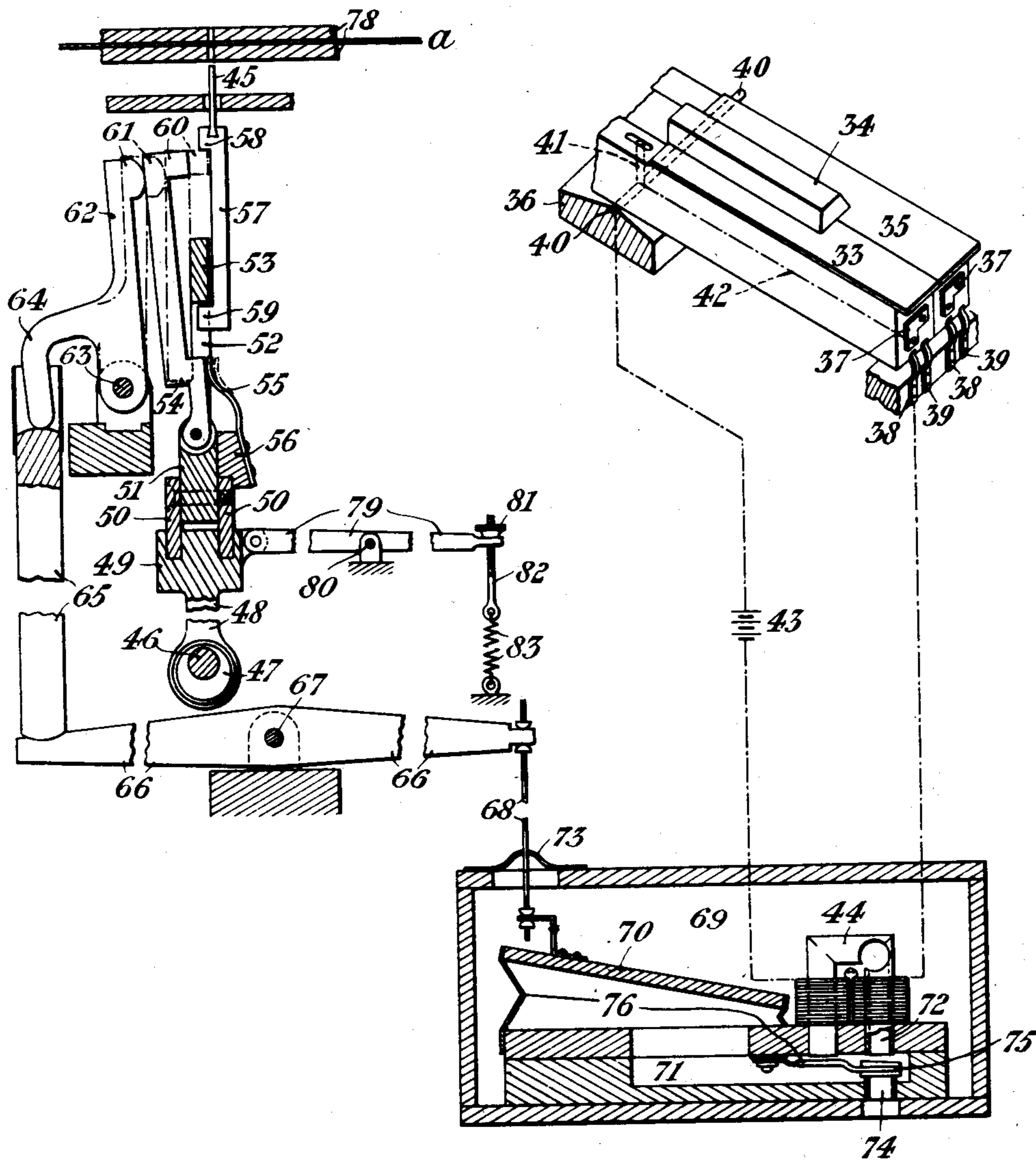
Witnesses  
W. Cuthbertson  
Warwick H. Williams

Inventor  
James John Walker  
per Henry Hart  
Attorney

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2 SHEETS—SHEET 2.

Fig. 3.



Witnesses  
W. S. Sullivan and Roland  
Warwick Hyatt Williams

Inventor  
James John Walker  
per Henry Hart  
Attorney

# UNITED STATES PATENT OFFICE.

JAMES JOHN WALKER, OF LONDON, ENGLAND.

## RECORDING MUSIC.

No. 872,267.

Specification of Letters Patent.

Patented Nov. 26, 1907.

Original application filed August 24, 1905, Serial No. 275,611. Divided and this application filed April 30, 1906. Serial No. 314,596.

*To all whom it may concern:*

Be it known that I, JAMES JOHN WALKER, a subject of the King of Great Britain, residing at Francis street, Tottenham Court Road, London, England, have invented new and useful Improvements in Recording Music; 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 the production of a record of music having a companion record representing expression whereby an exact record of the manipulation or actuation of each individual key, lever, or controlling device of the recording device is obtained, such record enabling both the period and speed of actuation of such controlling members of an instrument to be automatically recorded without the intervention of human agency beyond the manipulation of the controlling members; this record, however, forms no part of the present invention.

In the accompanying drawings:—Figures 1 and 2 are plans of portions of two different forms of perforated or slotted sheets or bands to the production of which the present invention is applicable; Fig. 3 is a general view of a recording mechanism according to this invention, partly in perspective, and partly in sectional elevation and such as is applicable to the production of the record shown in Fig. 1; Fig. 4 is an elevation of a modified form of contact plate which may be used to control the transmission of impulses for the production of a record such as is shown in Fig. 2; Fig. 5 is a view of a swell lever carrying the contact plate shown in Fig. 4, for successively engaging a series of electrical contacts; Fig. 6 is a side elevation of a mechanical impulse transmitter for operating punch selectors in place of the electrical means shown in Fig. 3, and Fig. 7 is a sectional elevation of a hydraulic or pneumatic device for operating punch selectors.

The band or sheet *a* in Fig. 1, for the production of which the present invention provides, is provided with a series of perforations intended to represent a note which is to be played in various ways, by a pneumatically actuated instrument, all as fully described in the specification of a separate ap-

plication for Letters Patent Serial Number 275611 filed August 24th 1905 and from which case the present one is a divisional application.

The slots in the row marked I are the ordinary tune slots and may control one of the motors or pneumatics connected with the key of the particular note represented by the slot, or one degree of power to be applied to such key, and the slots in the row marked II are what may be termed "accelerator" slots, and these may control the other one of the pneumatics or motors connected with the key, or, of course, the perforations in the row marked II might control the augmentation of the power for operating the key in any other manner, as for instance by controlling a higher degree of power than that controlled by the tune slots.

The companion slots *b* and *c* are seen, in Fig. 1, to be cut abreast of one another, both at their front and rear ends; they, according to this invention, represent a loud staccato note for, as the band travels in the direction of the arrow, both motors or pneumatics will be put into action simultaneously, or, the maximum power will be at once applied, and the key in the reproducer being thus caused to rapidly descend, the corresponding note will be loudly struck. The slots *b*, *c* terminating together, the actions of the two motors or pneumatics will terminate simultaneously and the lever is permitted to rise quickly, thereby giving a staccato effect. The slots *d*, *e* terminate together, but the slot *d* is cut somewhat in advance of the slot *e*, therefore the motor or pneumatic or particular degree of power which the slot *d* controls is brought into action upon the key, somewhat in advance of the pneumatic, motor, or particular degree of power controlled by the slot *e*. The maximum power not being applied at once, the resultant descent of the key of the reproducer will be at only a medium speed and the note produced will be say a note of average loudness, the staccato effect is again obtained, however, by the simultaneous termination of the slots. The slot *f* at its forward end is far in advance of the slot *g*; the maximum power, in this instance, may therefore not be effectively applied for sounding the note, for, the pneumatic or motor, or degree of power, con-

trolled by the slot *f* may have depressed the lever so far as to sound the note, or nearly so, before the power is augmented by the slot *g*; the key is therefore depressed comparatively slowly and the resultant note is soft but the staccato effect is obtained in this instance also by the rear ends of the slots *f* and *g* being cut abreast of one another. The slot *h* commences abreast of the slot *j*, but terminates somewhat in arrear thereof, therefore the note will be struck loudly but the power applied by the slot *j*, being removed from the key in advance of that controlled by the slot *h*, the note will not be staccato but of the ordinary character. The slot *l* commences somewhat in arrear of the slot *k* but terminates somewhat in advance thereof and, as will now be well understood, such a combination represents a note of the ordinary character. The slot *n* commences some distance in arrear of the slot *m* but terminates slightly in advance thereof, this combination represents a note of ordinary character softly struck. The slots *o* and *p* commence abreast of one another but the slot *p* terminates far in advance of the slot *o*; the note represented by this combination will therefore be loudly struck, but as the power controlled by the slot *p* is removed from the key at an early moment, say at or about the moment at which the note is sounded and the power controlled by the slot *o* continues to act, the note, although loudly struck will be of the legato type. The slot *r* commences slightly in arrear, but terminates some distance in advance of the slot *q*; this combination represents a note, say, of medium intensity and of the legato type. The slot *t* is seen to be very short, this is owing to the fact that it is required to augment the power controlled by the slot *s* very late in the action of the key to produce a soft note, the augmentation being quickly removed in order to produce the legato effect as before described.

The record band seen in Fig. 2 has five rows of slots and is chiefly applicable for the operation of the heavier levers or controlling devices such as a swell lever. For instance, supposing each slot in either of the rows I to V controls a source of power sufficient for operating the swell lever, to open the swell box either partially or completely, slightly in the case of the row I and more and more in the case of the other rows, the row V providing for the complete opening of the said swell box, then the slots 1 to 5 represent a more or less ordinary manipulation of the swell pedal, commencing slowly and gradually accelerating in speed as the power for operating the lever is augmented by the successive registrations of the forward ends of the slots 2, 3, 4 and 5 with the tracker, or other power controlling device.

The slots 6, 7 and 8 may represent a par-

tial opening of the swell at a rather slow rate of speed, the forward end of the slot 7 commencing some distance in arrear of the front end of the slot 6 and the slot 8 in arrear of the slot 7, so that, the augmentation of power being slow, a slow operation of the lever results and only part of the available power being employed, as only three slots are used out of five, the swell box may not be completely opened. The slots 9 and 10 are cut with their forward ends abreast of one another and they will thus effect the application of say two-fifths of the available power to the swell lever, which will commence to operate rather quicker than with the preceding example. Some time afterwards, say when the swell has been half opened, the slots 11, 12, 13, having their front ends cut abreast of one another, bring into operative effect the total amount of power, the result being a quick completion of the movement of the swell lever.

It will be seen by reference to Fig. 2 that in each of the three foregoing examples the rear ends of all the slots in each group representing an operation of the swell lever, have been cut abreast of one another, thus, in operation the maximum power is suddenly cut off, thereby permitting the swell lever to rise quickly and suddenly to close the swell box. The slots 14, 15, 16, 17, and 18 having their front ends all in the same straight line transversely of the band, the swell lever in this case will be suddenly and perhaps completely opened. The slots 16, 17, 18 terminate in the same transverse straight line, while the slot 15 terminates some distance in arrear of these slots, and the slot 14 some distance in arrear of the slot 15, thus, after the slots 16, 17, 18 have been moved away from the tracker, the swell will be allowed to close gradually. In the last example shown in Fig. 2, the slots 19 to 23 have their forward ends cut in the same transverse straight line, and in operation, the swell lever will be quickly operated to suddenly and fully open the swell, in order, it may be, to give a dramatic effect to a passage of music; after the termination of the slot 23 the swell lever is gradually allowed to close, as will be seen and understood from the relative positions of the rear ends of the slots 22, 21, 20 and 19.

The present invention enables any records of tune and expression, such as those previously described (or others having different numbers of perforations for each of the respective operations recorded) to be simultaneously effected by one operation of a recording key or lever as next to be described—instead of the tune record requiring to be gone through a second time for the insertion of the expression slots or markings as has hitherto been necessary.

According to one method of recording,

each key or operating lever of the instrument used for playing the music to be recorded, as for instance the piano keys, parts of which 33, 34, 35 are shown in Fig. 3 pivoted to the bar 36 in the usual manner, is provided with a device capable of transmitting a series of successive impulses (two are generally considered sufficient in the case of a key of a piano or carillon) during each actuation of such key. In Fig. 3 such a device comprises an inverted L-shaped or stepped contact plate 37, or there might be two or more separate plates or contacts fixed at different heights on each key, capable, when a key is depressed, of making two successive contacts with spring blades or fingers 38, 39, to complete two electrical circuits as follows: A conductor 40 may be laid along the bar 36 in contact with pins 41, which, as shown by the dotted line 42, may be connected electrically with each of the plates 37. The conductor 40 is connected to one pole of a battery 43 whose other pole is connected through the windings of an electro magnet 44 to each contact finger 38, 39. To avoid complication, only one of the electro magnets 44 is shown in the drawing, but it will readily be understood that there is one in connection with each of the contact fingers 38, 39. Each key 33, 34, 35 and so on, completes first one electrical circuit at the commencement of its depression, by means of the corresponding contact finger 38 engaging the lowermost part of the appropriate contact plate 37, and then a second electrical circuit at a later part, or at the completion of such depression, by means of the companion contact finger 39 engaging the uppermost part of the same contact plate 37, both of such circuits are thereafter maintained closed until the key, in its ascent, again passes through the parts of its stroke at which the two circuits were previously closed, the said circuits being now broken in the reverse order of their completion, by the plate 37 leaving the contact fingers.

The sheet marking apparatus may be one that provides for either the mere marking of the sheet, which could afterwards be embossed, or perforated, in a separate machine, or for the embossing or perforation of such sheet; as an example a perforating apparatus is illustrated as being controlled by the electrical circuits made and broken by the depression of the keys 33, 34, 35, as hereinbefore described. The apparatus illustrated is shown more or less diagrammatically for the sake of simplicity; it comprises for each key 33, 34, 35, and so on, of the instrument on which the original music is played, a number of punches 45 corresponding to the number of electrical contacts 38, 39 (for more than two such contacts may be used as will be hereinafter seen) and these

punches 45 are caused, by the making of the electrical circuits; to perforate the sheet or band *a* as it is moved through the apparatus at a uniform rate and preferably continuously, as will be now described. A quickly rotating shaft 46 has fixed to it an eccentric 47 which, by means of the eccentric rod 48, shown broken away, rapidly reciprocates in a vertical direction a frame which may consist, for example, of a bar 49 and plates 50 between which latter a bar 51 is carried; or, instead of a single eccentric 47 and eccentric rod 48 being employed for reciprocating the said frame, a plurality of such devices may be provided for the purpose. Uprights 52, on the bar 51, support a second bar 53, and a number of selectors 54 corresponding in number to the number of punches 45, are pivotally mounted upon the bar 51 and are maintained in the position shown in full lines by means of, say, blade springs 55 suitably fixed to a block or bar 56 carried upon the frame 49, 50. Each punch 45 is carried by a slider 57 which may be suitably supported and guided in the vertical direction, each slider having projecting shoulders 58, 59, the latter for engaging the bar 53 whenever the latter descends, and the former for engaging the nose or projection 60 on the corresponding selector 54, under circumstances to be now explained. In the full line position shown in Fig. 3, each selector 54 bears against a nose 61 upon the end of one arm 62 of a two-armed lever which is pivoted to the fixed framing at 63, and whose other arm 64 is in operative connection with a vertical rod or stick 65. Rocking levers 66, pivoted at 67 upon the fixed framing, support, at one end, the stickers 65 and at the other end are connected to the upper ends of pull-downs or trackers 68 passing to the interior of a pressure chamber 69 wherein they are connected in a well-known manner, each to a bellows or motor 70 whose interior is normally in open communication with the interior of the chamber 69 through a channel 71 and tubular leg 72 of the corresponding electro magnet 44. The pull-downs or trackers 68 are in air-tight connection with the pressure chamber 69 by a flexible membrane 73.

Each channel 71 is provided with an outlet 74 open to the atmosphere but normally closed by a valve 75 carried on a hinged lever 76 which constitutes the armature of the respective magnet 44, this valve, when the magnet is energized, serving to break the above-named communication between the chamber 69 and motor 70, and establish communication between the interior of the said motor and the atmosphere, the pressure in the chamber 69 acting upon the motor 70, then causing the latter to collapse.

The operation is as follows:—When either of the recording keys, as for instance the one

33, one of whose corresponding circuits and mechanisms alone are shown, is depressed, the plate 37 makes contact first with the contact finger 38 and then, after an interval dependent upon the speed at which the key is depressed, with the contact finger 39. All that thereafter takes place in the circuit and mechanism appertaining to the finger 38 must be assumed to take place with the circuit and mechanism connected with the finger 39 also, only more or less later according to the force exerted upon the key 33. A circuit being closed by the plate 37 engaging the finger 38, electricity flows from the battery 43 to the conductor 40, thence to the plate 37 by way of conductor 42 arranged on or in the key, as shown by the dotted line, through the finger 38 to the windings of the magnet 44 and back to the opposite pole of the battery 43. The magnet 44 being thus energized, for so long as the key is depressed sufficiently to make contact between 38 and the plate 37 (the same remark of course applying to the contact between 39 and 37) the magnet 44 attracts its armature 76 thereby lifting the valve 75 from the outlet port 74. The pneumatic 70 will now be collapsed by the pressure in the chamber 69, exhaustion taking place by way of the duct 71 and port 74, and will cause the appropriate arm of the lever 66 to descend, thus raising the opposite arm and therewith the sticker 65. The lifting of the sticker 65 causes the two-armed lever 62, 64, to turn about its pivot 63 to the dotted position, the nose 61 of the said lever forcing the corresponding selector 54 into the vertical position, also shown in dotted lines, in which the nose 60 takes beneath the projection 58 on the punch slider 57. It must be remembered that the selector 54 and bar 53 are being rapidly reciprocated by the eccentric 47 as hereinbefore described, the consequence is that the punch slider 57 will now also reciprocate rapidly, being forced upwards by the selector 54, and downwards by the bar 53 engaging the projection 59. The band or sheet *a* being preferably uniformly and continuously traversed between the two punch dies 78, will receive a number of perforations during the time of contact between 37 and 38, or between 37 and 39. The relative speed of the sheet and punches is such that each succeeding stroke of a punch during the same depression of the respective key serves to elongate the perforation produced by the immediately preceding stroke or strokes. A lever or levers 79 pivoted at 80 to the fixed framing, may be jointed at one end to the frame 49 and may be adjustably connected by means of a nut 81 and screw 82 to a tension spring 83, so that the latter always assists in the raising of the frame 49.

In the case of a key, as for instance the key 33, whose action has been described, receiving a blow of maximum strength, as in a fortissimo passage, the two before-mentioned circuits are closed between the plate 37 and fingers 38 and 39 practically simultaneously, or nearly so, and consequently their respective perforating mechanisms will act practically simultaneously, and the accelerator perforation, as in the first and fourth examples from the left marked *c* and *j* respectively in the row marked II Fig. 1, commences abreast, or almost abreast, of the commencement of the corresponding first perforations marked *b* and *h* respectively in the row marked I. As the blow is less violent for producing notes of less intensity, so will the distances between the forward ends of the two perforations be greater, as in the second and third examples from the left in Fig. 1; or it may be possible for a key to be struck so gently that the second circuit will not be closed, or closed for such a short time, that a second perforation will not be produced, or, as shown in the ninth example from the left in Fig. 1 marked *s* and *t*, the accelerator slot, if produced, may be of negligible length, for, in this case the second perforation is so far in arrear of the first one that it will not be effective in augmenting the power applied to the sticker by the first perforation when the record is passed through a reproducer. In the case of a key being quickly released, as in a staccato movement; the terminations of the two relative perforations will be abreast or nearly abreast, as in the first, second and third examples from the left in Fig. 1, and as the key is released more slowly, as in more or less legato passages, so will the termination of the second or accelerator perforation in the row marked II Fig. 1, be more or less in advance of the termination of the respective first perforation as seen in the fourth to the ninth examples from the left in Fig. 1.

In addition to the foregoing recording devices, other similar devices are, or may be, provided for recording the manipulation of pedals, whether expression pedals of a piano-forte, or the swell pedal of an organ, or for recording the manipulation of any lever or device if the effect of such pedal lever or device is dependent upon the speed at which it is operated. In Figs. 4 and 5 for instance, is shown a contact plate 84 having five steps for making and breaking contact with five spring contacts 86 and linked to one end of a swell operating lever 87, only one of the contacts 86 being visible. The method of recording is the same as that described with reference to Fig. 3, and the result is that a maximum of five parallel slots may be produced, as seen in Fig. 2, the number and rela-

tive position of which, determine the extent and speed of operation of a similar lever in a reproducer. The number of contacts 86 and circuits and mechanisms employed with each lever depends upon the character of the lever operated and the degree of exactitude required in the reproduction of its movement.

If desired the selectors 54 may be operated by mechanical devices upon the keys either directly or indirectly. For instance, cams or inclined projections 88, Fig. 6, may take the place of the contact plate or plates 37, Fig. 3. When the key is depressed these projections 88 will depress the short arms of their respective bell crank levers 89, which, by connecting rods 90, move levers 91 about their pivots, to directly, or, through the medium of suitable mechanism, operate the selectors 54 as will now be well understood. In Fig. 6 the bell-crank lever which is operated by the upper of the cams 88 cannot be seen, it being wholly obscured by the corresponding lever appertaining to the lower of such cams which said lever is immediately in front of the other one. The lower one of the cams 88 conjointly with the end of the key must be formed so as to retain its lever depressed until the other or upper of such cams has depressed and again released its lever. Or the cams 88 may, as shown in Fig. 7, effect the sliding of valves 92 in their casings 93 against the action of springs 94. A pressure reservoir may supply the pipe 95 which, in the position of the valve shown, is closed. When however a cam moves the corresponding valve 92 back, the port 96 in the valve, opens the pipe 95 to the pipe 97, thereby admitting pressure behind a piston 98 and moving it in its cylinder 99 against the action of a spring 100. This movement of the piston 98 may be used directly, or indirectly, to effect the movement of a corresponding selector 54. When the key 33 is permitted to rise, the springs 94, 100 effect the return to normal position of their respective pistons 92, 98, and any surplus pressure fluid in the cylinder 99 and pipe 97 is free to pass through the exhaust pipe 101.

The punches are preferably of square form so that the edges of the resultant elongated perforations or embossed portions of the records may be straight and parallel with the direction of motion of such records, as shown.

I claim:—

1. Apparatus comprising a plurality of recording instruments one of which is operated to produce a record of the operations of the controlling members of a musical instrument said record being adapted for the purpose of controlling a reproducer and another of which is simultaneously therewith operated to produce a companion record of the speed of each of such operations said com-

panion record being adapted for the purpose of controlling accelerators in the reproducer. 65

2. Apparatus for producing simultaneously a record of the operations of controlling members of a musical instrument and a companion record of the speed of each of such operations, comprising in combination 70 controlling members, a plurality of recorders for each such member, a plurality of impulse-transmitters governing the action of such recorders and means for successively energizing such transmitters during one operation of a controlling member. 75

3. Apparatus for producing simultaneously a record of the operations of controlling members of a musical instrument and a companion record of the speed of each of such operations, comprising in combination a plurality of recorders for each key, a sliding carrier for each recorder, a normally free reciprocating selector adapted to operatively engage said carrier, and a plurality of im- 85 pulse-transmitters connected with each controlling member for controlling the engagement of said selectors with said carriers.

4. Apparatus for producing simultaneously a record of the operations of controlling members of a musical instrument and a companion record of the speed of each of such operations, comprising in combination 90 controlling members, a plurality of recorders for each such member, a plurality of impulse-transmitters governing the action of such recorders and on each said member a stepwise arrangement of energizing devices for the impulse transmitters.

5. Apparatus for producing simultaneously a record of the operations of controlling members of a musical instrument and a companion record of the speed of each of such operations comprising in combination 100 controlling members, a plurality of recorders for each such member, a sliding carrier for each recorder, a normally free reciprocating selector adapted to operatively engage said carrier, a plurality of impulse-transmitters governing the engagement of said selectors 110 with said carriers and on each said member a stepwise arrangement of devices for energizing said impulse-transmitters.

6. Apparatus for producing simultaneously a record of the operations of controlling members of a musical instrument and a companion record of the speed of each of such operations comprising in combination 115 controlling members, a plurality of recorders for each such member, a sliding carrier for each recorder, a reciprocating selector adapted to operatively engage said carrier, means for maintaining said selectors normally free of said carriers, means for normally main- 120 taining said carriers in their lower position, a plurality of impulse-transmitters for engag- 125

ing said selectors with said carriers and on each said member a stepwise arrangement of devices for energizing said impulse-transmitters.

- 5 7. In apparatus of the class described the combination with an element arranged to be moved in the production of musical sounds, of music-record-sheet perforating means, and means controlling the operation of said

perforating means in accordance with the 10 length of time in which the said element is caused to make a complete movement.

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

JAMES JOHN WALKER.

Witnesses:

FREDK. L. RAND,  
HENRY HART.