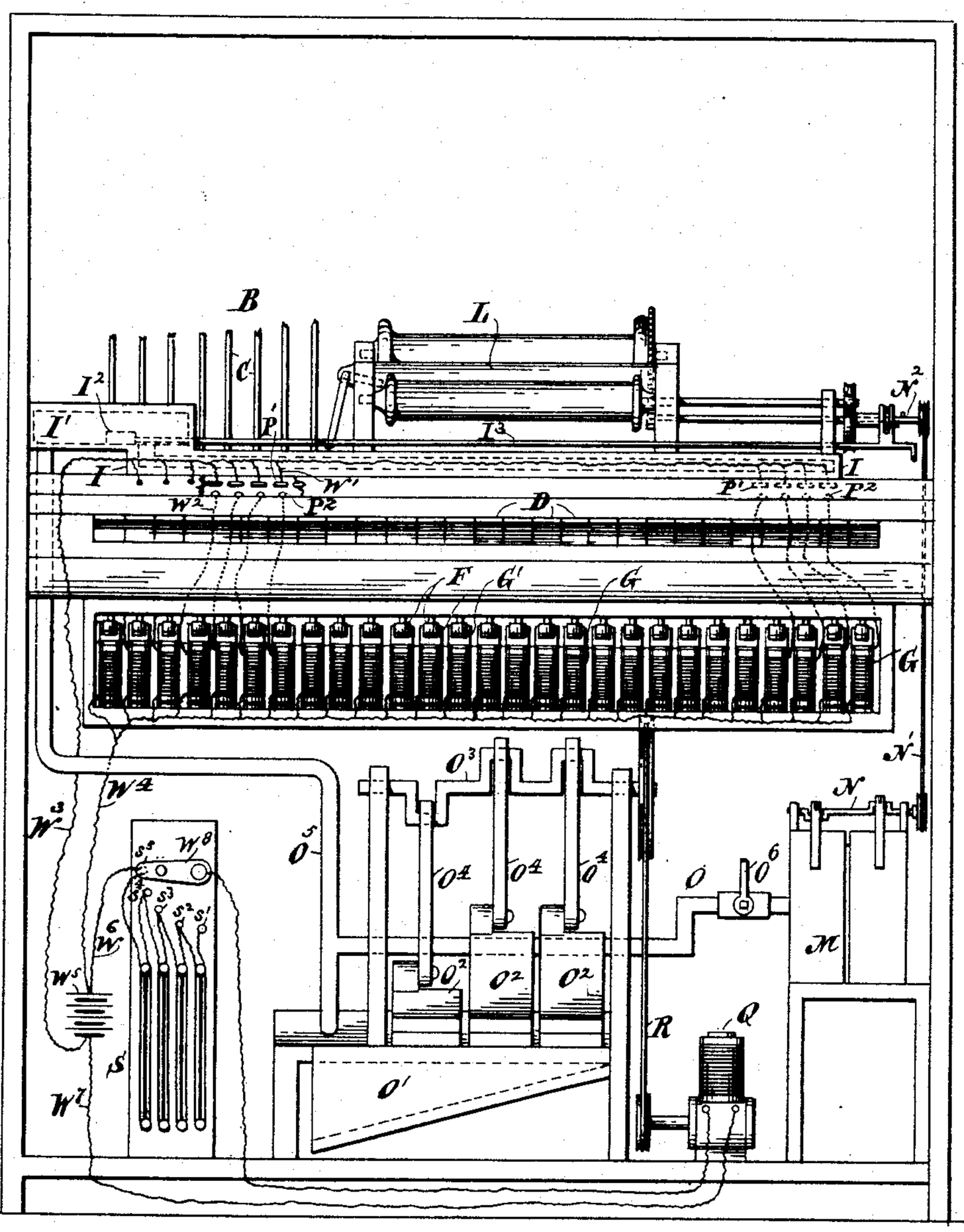
(No Model.) 3 Sheets—Sheet 1.

R. W. PAIN.

AUTOMATIC MUSICAL INSTRUMENT.

No. 412,657. Patented Oct. 8, 1889.

Fig. 1



Witnesses
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A. C. Ferguson

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(No Model.) 3 Sheets—Sheet 2.

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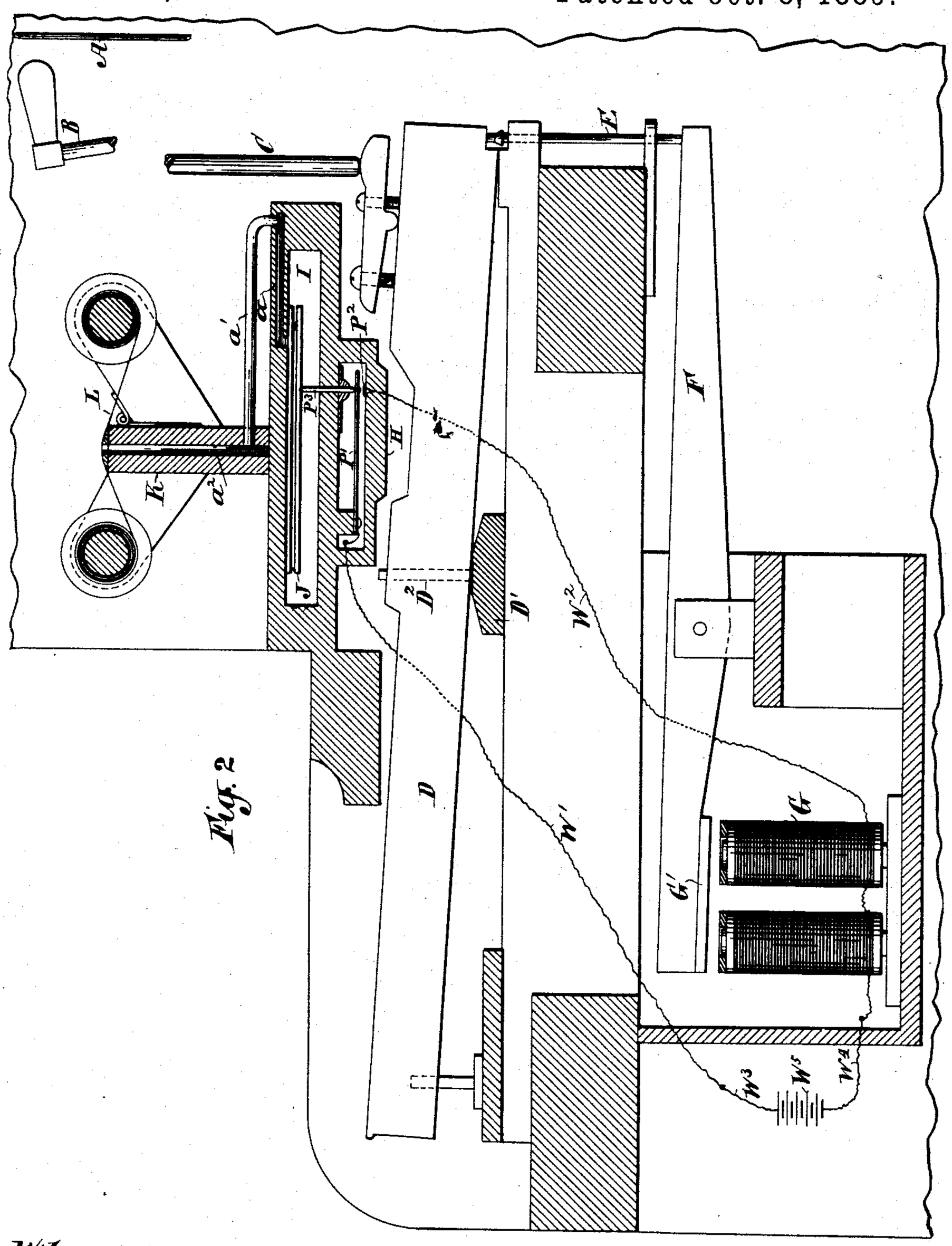

Fig. 2

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(No Model.) 3 Sheets—Sheet 3.

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Fig. 4

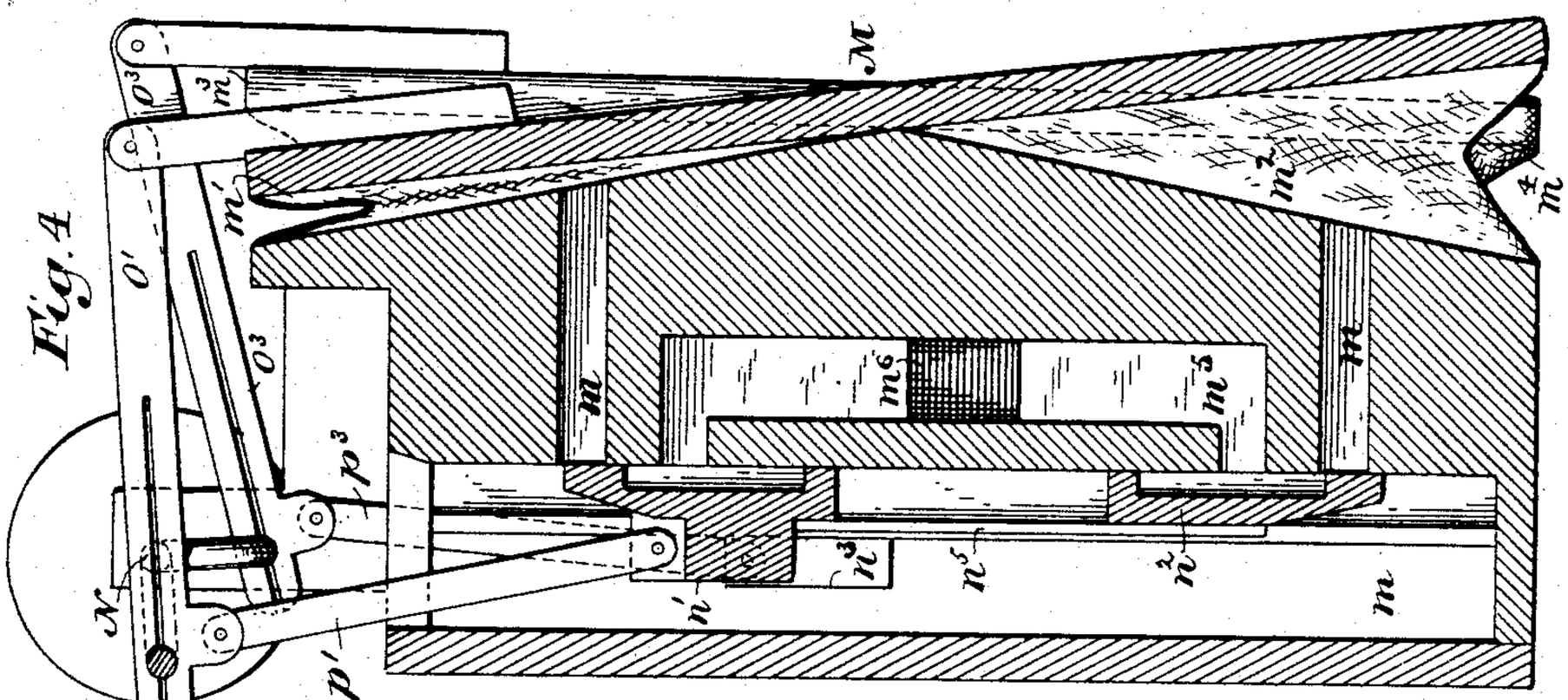
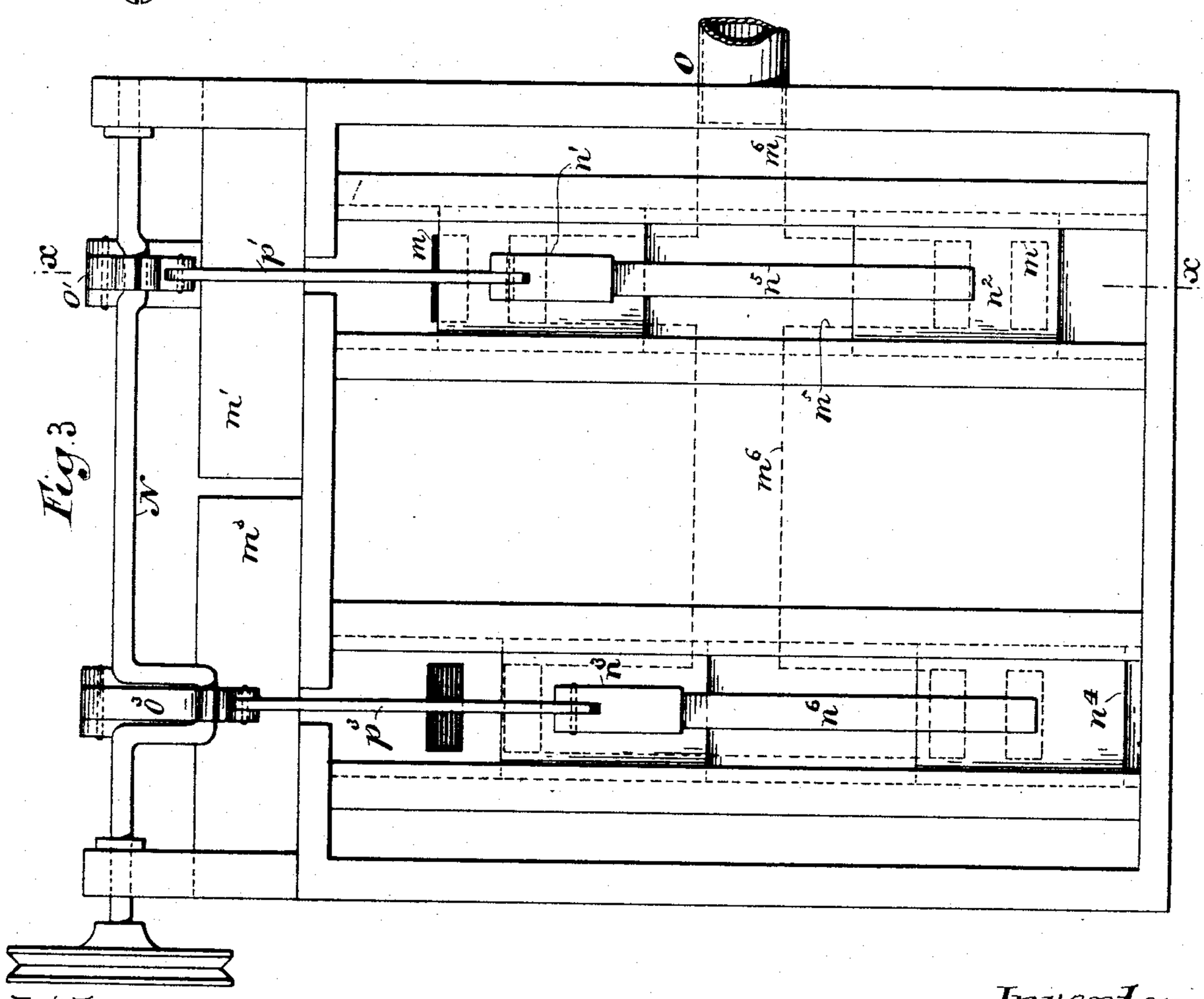


Fig. 3



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UNITED STATES PATENT OFFICE.

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AUTOMATIC MUSICAL INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 412,657, dated October 8, 1889.

Application filed January 23, 1889. Serial No. 297,232. (No model.)

To all whom it may concern:

Be it known that I, ROBERT W. PAIN, of New York, in the county and State of New York, have invented a certain new and useful Improvement in Mechanical or Automatic Musical Instruments, of which the following is a specification.

My improvement relates to those musical instruments which are commonly known as "mechanical" or "automatic" musical instruments, and in which the sound-producing devices are controlled by a music sheet, card, or tablet, which is usually perforated to represent the notes of a musical composition.

My improvement is especially intended for use in a piano-forte, although as to some features it is applicable to other musical instruments.

I will describe a musical instrument embodying my improvement in detail, and then point out the novel features in claims.

In the accompanying drawings, Figure 1 is a front view of a musical instrument embodying my improvement, the front of the case being removed and certain of the parts being omitted. Fig. 2 is a vertical section of a portion of this musical instrument upon a larger scale, the plane of the section being transversely to the length of the instrument. Fig. 3 is an enlarged back view of a wind-motor comprised in said instrument, the back of said wind-motor being removed. Fig. 4 is a vertical section of the wind-motor, taken on the plane of the dotted line *x x*, Fig. 3.

A designates the strings of a piano-forte. B designates one of the hammers. The hammers may form part of any suitable piano-forte action. For this reason I have not deemed it necessary to illustrate the action. It will be sufficient to add that the hammers are actuated through rods C, which are here shown as capable of being moved upwardly by keys D. The keys D may be of the kind usually employed in piano-fortes. They are fulcrumed between their ends upon a rail D′ and held in position thereon by pins D^2. The forward ends of these keys are normally raised, as usual.

What I have thus far said applies only to the operation of the instrument manually. The instrument can also be operated automatically. In the present instance the automatic operation is effected through the keys D, rods E being arranged under the rear ends of the keys, and being adapted, when moved upwardly, to raise the rear ends of the keys, and in that manner force upwardly the rods C just as these rods C would be forced up under the action of the keys D if the latter were operated manually.

The rods E are impelled upwardly by levers F, arranged beneath the key-block and extending in the same or substantially the same direction as the keys. These levers F are fulcrumed between their ends. At the rear end they extend under the rods E. At the forward end they have attached to them armatures G′ of electro-magnets G. There will be one of these electro-magnets G, a corresponding armature G′, a lever F, and a rod E for each of the keys D. It will be readily seen that when any electro-magnet G attracts its armature G′ the forward end of the corresponding lever F will be depressed and the rear end of such lever raised, and that through this action of this lever the corresponding rod E will be moved upwardly and will cause the elevation of the corresponding rod C, and consequently the operation of a hammer B.

I will hereinafter describe the manner in which an electric current is supplied to the magnets G.

I will first make clear how any one of the hammers may be operated mechanically or automatically.

In Fig. 2 I have represented a battery in circuit with the electro-magnet and electric-circuit wires W′ W^2 extending to metallic contact-pieces P′ P^2. Of course there need not be a separate battery for each circuit which includes a magnet. The contact-pieces P′ P^2 are shown as arranged in a chamber H. From the chamber H pins P^3 extend upwardly into a wind-chest I. In this wind-chest I are a number of pneumatic motors J. Ducts *a* in the top of the wind-chest communicate with the interior of these motors, and pipes *a′* extend from the ducts *a* to ducts a^2 in a tracker-board K. It must be understood that there will be a pneumatic motor

for each magnet G, and hence for each hammer B, and that each pneumatic motor operates in conjunction with one duct a, pipe a', and duct a^2 of the tracker-board K. Over the tracker-board K a music-sheet L passes. This is provided with perforations representing a musical composition. When a perforation passes over one of the ducts a^2 in the tracker-board, air is admitted through such duct of the tracker-board, the corresponding pipe a', and communicating duct a to the corresponding pneumatic motor J. On the admission of air in this manner to such pneumatic motor the latter will expand and move the corresponding pin P^3 downwardly, so that it will force the adjacent contact-piece P' against the opposite contact-piece P^2. The electric-circuit wires W' W^2, connecting with these contact-pieces, will thus be put into electrical communication. The electric current will then flow through the coils of the magnet G, with which such circuit-wires are in communication. The magnet, being energized, attracts its armature, oscillating the corresponding lever F, moving its rod E, and the corresponding key D, so as to actuate one of the hammers B. The music-sheet, before playing, is wound upon what is called a "music-roller" and is attached to what is termed a "take-up roller." During the playing it is unwound from the music-roller and wound upon the take-up roller after it is unwound from the music-roller. Motion is imparted to the music-sheet by a wind-motor M, consisting of a number of bellows-like chambers connected to a crank-shaft N. From this crank-shaft motion is transmitted by a belt N' to a shaft N^2, which is so connected with the rollers of the music-sheet as that motion may be imparted by it to them in reverse directions. The mechanism for transmitting motion from the shaft N^2 to the music-sheet rollers is of ordinary kind, and hence I will not further describe it.

I will defer a detailed description of the wind-motor for the present, as it is my aim now to give a general understanding of the instrument as a whole. I will merely add at the present time that the chambers of the motor are collapsed by establishing communication through a pipe O with an equalizer O'. This equalizer has combined with it a number of suction-bellows O^2. These suction-bellows are operated by a shaft O^3, which is provided with cranks that are connected by pitman-rods O^4 with the movable boards of the said bellows O^2. The equalizer O' communicates through a pipe O^5 with a chamber I', which is in communication with the wind-chest I.

I^2 designates a valve, which may be operated to control communication between the chamber I' and the wind-chest I. This valve is intended to cut off communication between the equalizer O' and the wind-chest I while the music-sheet is being rewound upon the music-roller, so that the sound-producing devices will be prevented from speaking during this time. The rod I^3, which is connected with this valve, is also connected with the mechanism which changes the driving of the rollers, so as to reverse the traveling of the music-sheet.

The shaft O^3, which operates the bellows, is driven by an electro-magnetic motor Q, a belt R being employed to connect the shaft of this motor with said shaft O^3.

It will be seen by reference to Fig. 1 that the electro-magnets G are connected in multiple arc, and that the wires W' W^2 are branches from main wires W^3 W^4, which connect them with a battery W^5 or other source of electricity.

It may be found most convenient to employ a primary charging or secondary storage battery. It will also be seen that the electric motor Q is in communication with the source of electricity W^5 by means of two wires W^6 W^7, and that these wires are so arranged with relation to the wires which are in communication with the magnets as to be connected in multiple arc therewith.

S designates resistances. I have shown four of them. The first is connected at one end with a contact-piece s' and at the other end with a contact-piece s^2. The second is connected at one end with the contact-piece s^2 and at the other end with a contact-piece s^3. The third is connected at one end with the contact-piece s^3 and at the other end with a contact-piece s^4. The fourth is connected at one end with the contact-piece s^4 and at the other end with a contact-piece s^5. The wire W^6 is interrupted, one end being connected to the contact-piece s^5 and the other end to a metallic switch-lever W^8. Therefore by shifting the switch onto the different contact-pieces s' s^2 s^3 s^4 s^5 the resistance in the circuit extending to the electric motor may be varied. For instance, if the switch-lever contacts with the piece s^5, none of the resistances S will be in circuit. If the switch-lever be shifted into contact with the piece s', all the resistances will be in circuit, and if the switch-lever be shifted onto any of the intermediate contact-pieces more or less of the whole number of resistances may be introduced into the circuit of the electric motor. In this way the operation of the electric motor may be regulated.

The wind-motor may be regulated by any suitable valve—as, for instance, by a valve O^6, combined with the pipe O, and serving to enlarge or diminish the communication of the wind-motor with the equalizer.

The switch-lever W^8 and the valve O^6 may be operated by the application of the hand directly to them, or they may be connected with suitable pull-pieces arranged in the position of the stops of an organ, if this be deemed more convenient.

The combination of the electric motor and the wind-motor is very advantageous in an instrument of this kind, as the electric

motor will supply abundant power for the proper operation of the hammers, and will also effect the operation of the hammers with that alacrity which is desirable, and the wind-motor will operate the music-sheet with such facility for regulation as will afford abundant opportunity for giving expression to the playing.

I will now add to the description of the wind-motor M. It is composed, as here shown, of four collapsible and expansible bellows-like chambers m' m^2 m^3 m^4. These chambers have no valves, but in other respects are like an ordinary bellows. The chamber m^2 is below and in line with the chamber m', and the movable appurtenances of these two chambers are integral; hence when one is rocked by the collapsing of the bellows the other will be rocked in the reverse direction. The chambers m^3 m^4 bear the same relation to each other as do the chambers m' m^2. The chambers m' m^2 m^3 m^4 communicate severally through a port m with a chamber m^5, which is connected with a port m^6, that is in communication with the pipe O. Valves n' n^2 n^3 n^4 control the communication of the chambers m' m^2 m^3 m^4 with the chamber m^5. The valves n' n^2 are connected together by a piece n^5, and the valves n^3 n^4 are connected together by a piece n^6. The movable boards of the chambers m' m^3 are connected by pitman-rods o' o^3 with the cranks of the shaft N. These cranks are reversely set. The pitman-rod o' is connected by a link p' with the valve n'. The pitman-rod o^3 is connected by a link p^3 with the valve n^3. A glance at the ducts m, the chamber m^5, the chambers m' m^2 m^3 m^4, the valves n' n^2 n^3 n^4, the cranks of the shaft N, and the connections between the cranks and said valves will show that communication will be established successively between the different chambers m' m^2 m^3 m^4. Thus successive impulses will be imparted to the crank-shaft N.

It will be observed that the metallic contact-pieces P′ support pins P^3, which extend between them and the bellows. These contact-pieces P′ are made of springs.

It will be understood that the resistance-coils and switch which I have described constitute a regulator for the electro-magnetic motor Q.

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

1. In an automatic or mechanical musical instrument, the combination of electric circuits, electro-magnets serving to produce notes, opposite contacts for said electric circuits, pneumatic motors coacting with certain of the contacts, a tracker communicating with said motors, and a music sheet, card, or tablet, substantially as specified.

2. In an automatic or mechanical musical instrument, the combination of electric circuits, electro-magnets serving to produce the notes, opposite contacts comprised in such electric circuits, pneumatic motors, pins extending between the pneumatic motors and certain of the contacts, the last-named contacts serving to support the motors, a tracker communicating with said motors, and a music sheet, card, or tablet, substantially as specified.

3. In an automatic or mechanical musical instrument, the combination of electric circuits, electro-magnets serving to produce the notes, pairs of contact-pieces comprised in such electric circuits, pneumatic motors, a wind-chest in which such pneumatic motors are arranged, pins extending between and supported by the contact-pieces of the pairs, pneumatic motors contacting with said pins, a tracker communicating with said motors, and a music sheet, card, or tablet, substantially as specified.

4. In an automatic or mechanical musical instrument, the combination of electric circuits, electro-magnets serving to produce the notes, pairs of contact-pieces comprised in such electric circuits, pneumatic motors, pins extending between the pneumatic motors and certain contact-pieces of the pairs, such contact-pieces serving to support the pins and collapse the motors when these are not otherwise actuated, a tracker communicating with said motors, and a music sheet, card, or tablet, substantially as specified.

5. In an automatic or mechanical musical instrument, the combination of a tracker-board, a music sheet, card, or tablet, pneumatic motors communicating with the tracker-board, a wind-chest in which such motors are arranged, exhaust-bellows communicating with such wind-chest, electric circuits, pairs of contact-pieces for the several electric circuits, pins extending from the motors to certain contact-pieces of the several pairs, and electro-magnets in the circuits and serving to produce the notes, the said pins being moved in one direction by the extension of the motors through the admission of atmospheric air to them and moved in the other direction by the contact-pieces upon which they rest, substantially as specified.

6. In an automatic or mechanical musical instrument, the combination of sound-producing devices, manual keys for operating the same, electro-magnets, levers carrying the armatures of said magnets and arranged beneath the keys, pins extending between the levers and the keys, electric circuits connected to the magnets, pairs of contact-pieces for the several circuits, pneumatic motors arranged above the keys, a tracker-board, and a music sheet, card, or tablet, also arranged above the keys, the said motors operating the said contact-pieces, substantially as specified.

7. In an automatic or mechanical musical instrument, the combination of sound-producing devices, electro-magnets for operating the same, electric circuits connected with the magnets, contact-pieces connected with the circuits, pneumatic motors for operating the contact-pieces, bellows for effecting the operation

of the pneumatic motors, an electro-magnetic motor for operating the bellows, a tracker communicating with the pneumatic motors, a music sheet, card, or tablet for controlling the pneumatic motors, and a wind-motor operated by the bellows and effecting the travel of the music-sheet, substantially as specified.

8. In an automatic or mechanical musical instrument, the combination of sound-producing devices, electro-magnets for operating the same, electric circuits connected with the magnets, contact-pieces connected with the circuits, pneumatic motors for operating the contact-pieces, bellows for effecting the operation of the pneumatic motors, an electro-magnetic motor for operating the bellows, a regulator for the electro-magnetic motor, a tracker communicating with the pneumatic motors, a music sheet, card, or tablet for controlling the pneumatic motors, and a wind-motor operated by the bellows and effecting the travel of the music-sheet, substantially as specified.

9. In an automatic or mechanical musical instrument, the combination of sound-producing devices, electro-magnets for operating the same, electric circuits connected with the magnets, contact-pieces connected with the circuits, pneumatic motors for operating the contact-pieces, bellows for effecting the operation of the pneumatic motors, an electric motor for operating the bellows, a tracker communicating with the pneumatic motors, a music sheet, card, or tablet for controlling the pneumatic motors, a wind-motor operated by the bellows and effecting the travel of the music-sheet, and a regulating-valve for controlling the wind-motor, substantially as specified.

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