No. 754,886. PATENTED MAR. 15, 1904.

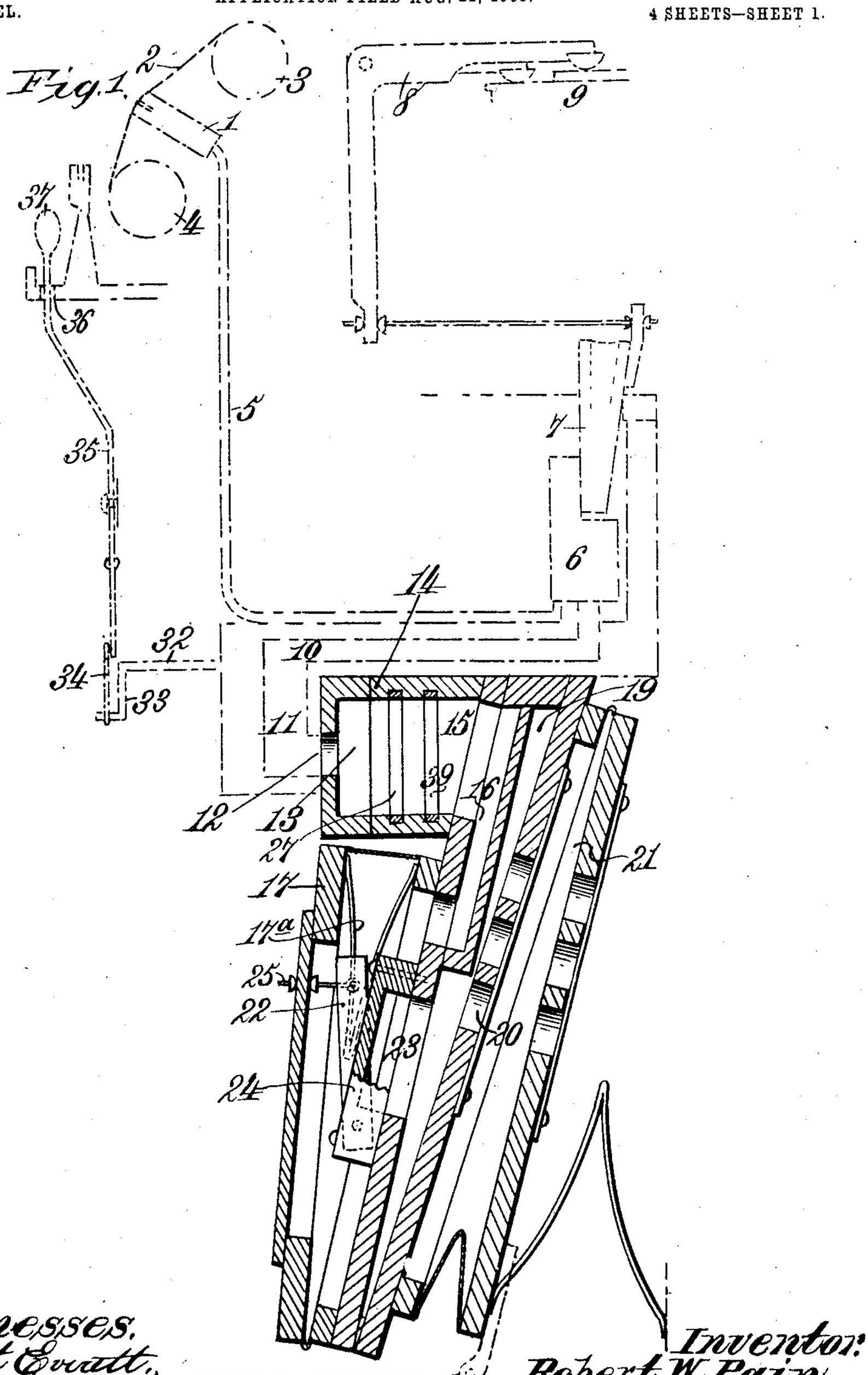
R. W. PAIN.

MEANS FOR REGULATING THE EXPRESSION OF MECHANICAL MUSICAL INSTRUMENTS.

APPLICATION FILED AUG. 21, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
Robt. Evatt.
Geo. W. Rea

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NO MODEL. 4 SHEETS—SHEET 2.

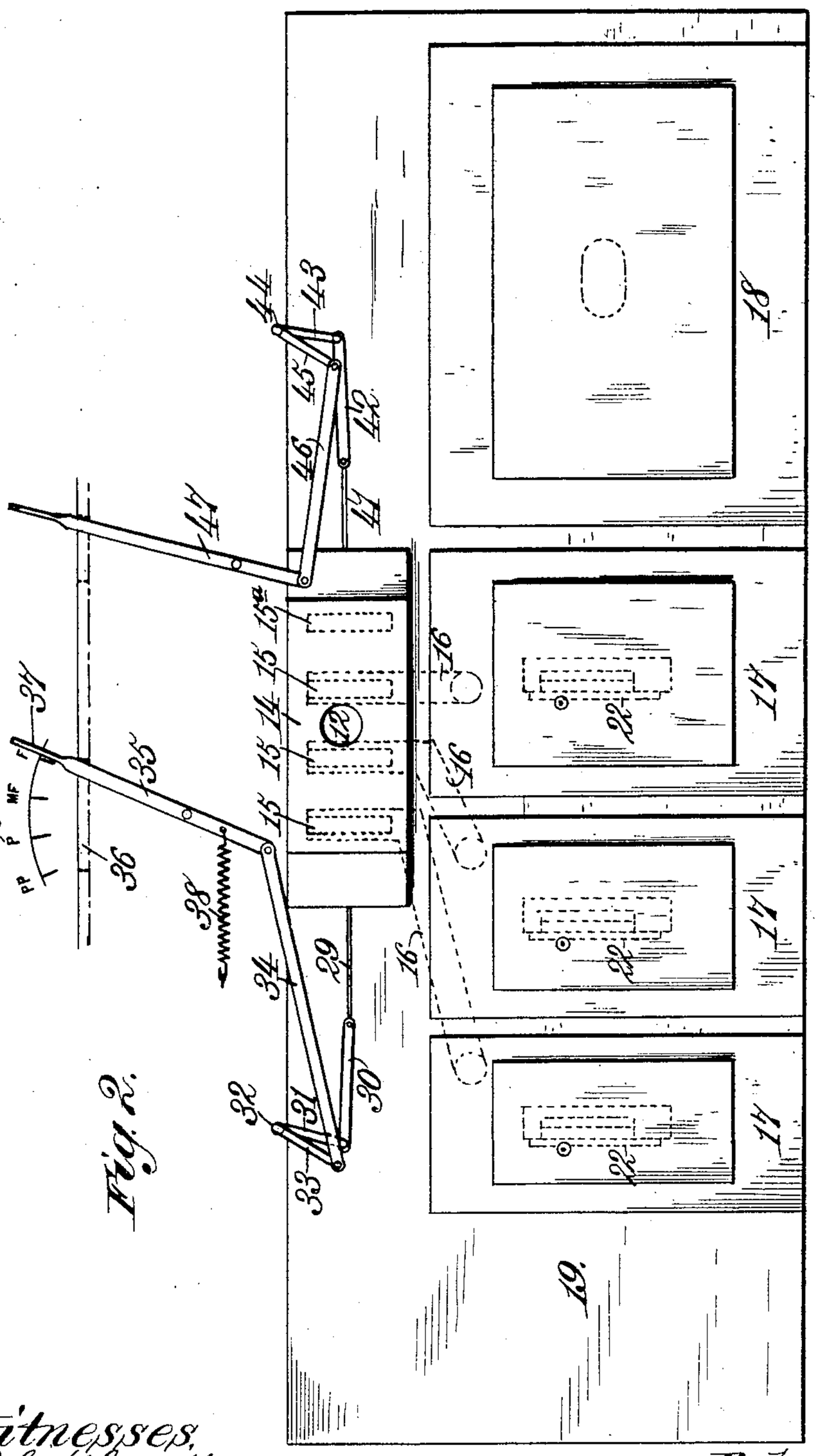

Fig. 2.

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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 4.

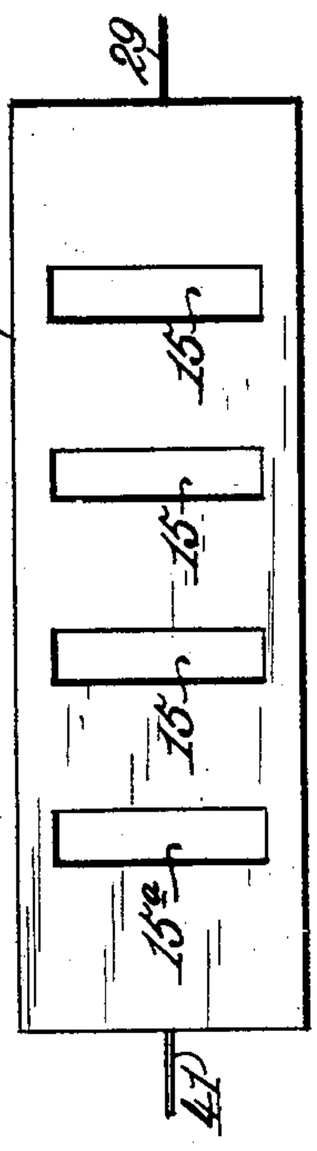


Fig. 5.

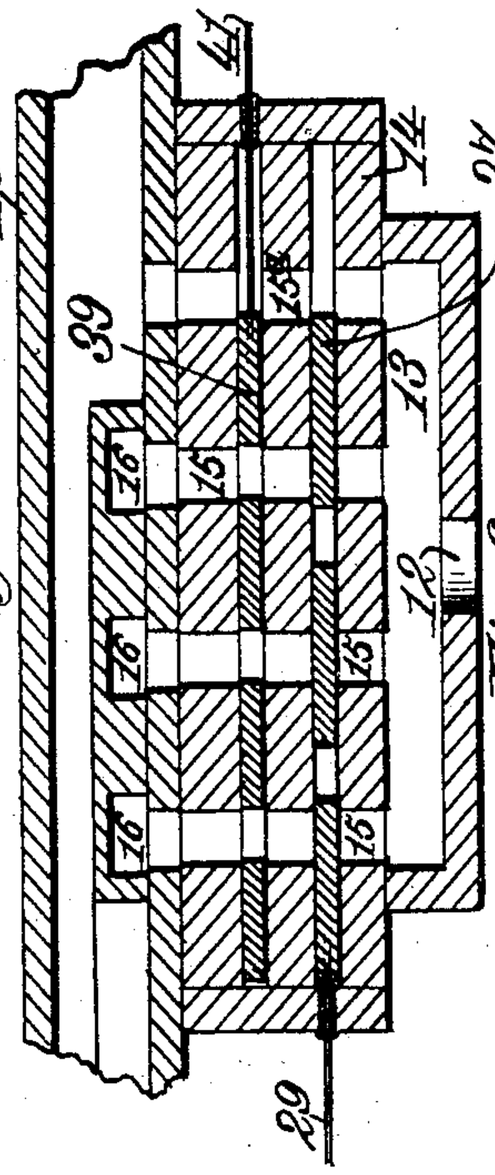


Fig. 6.

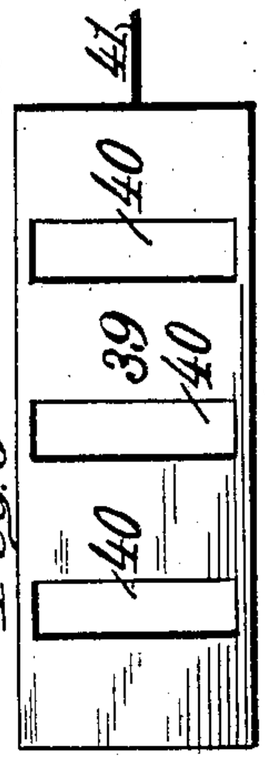


Fig. 7.

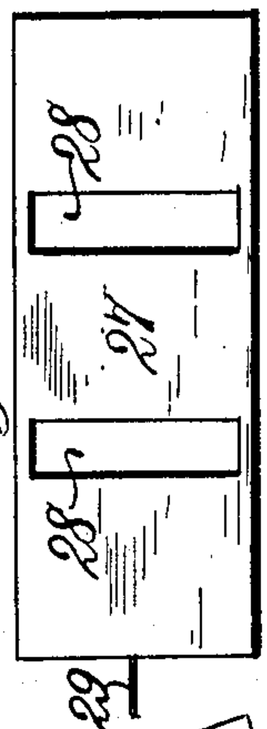
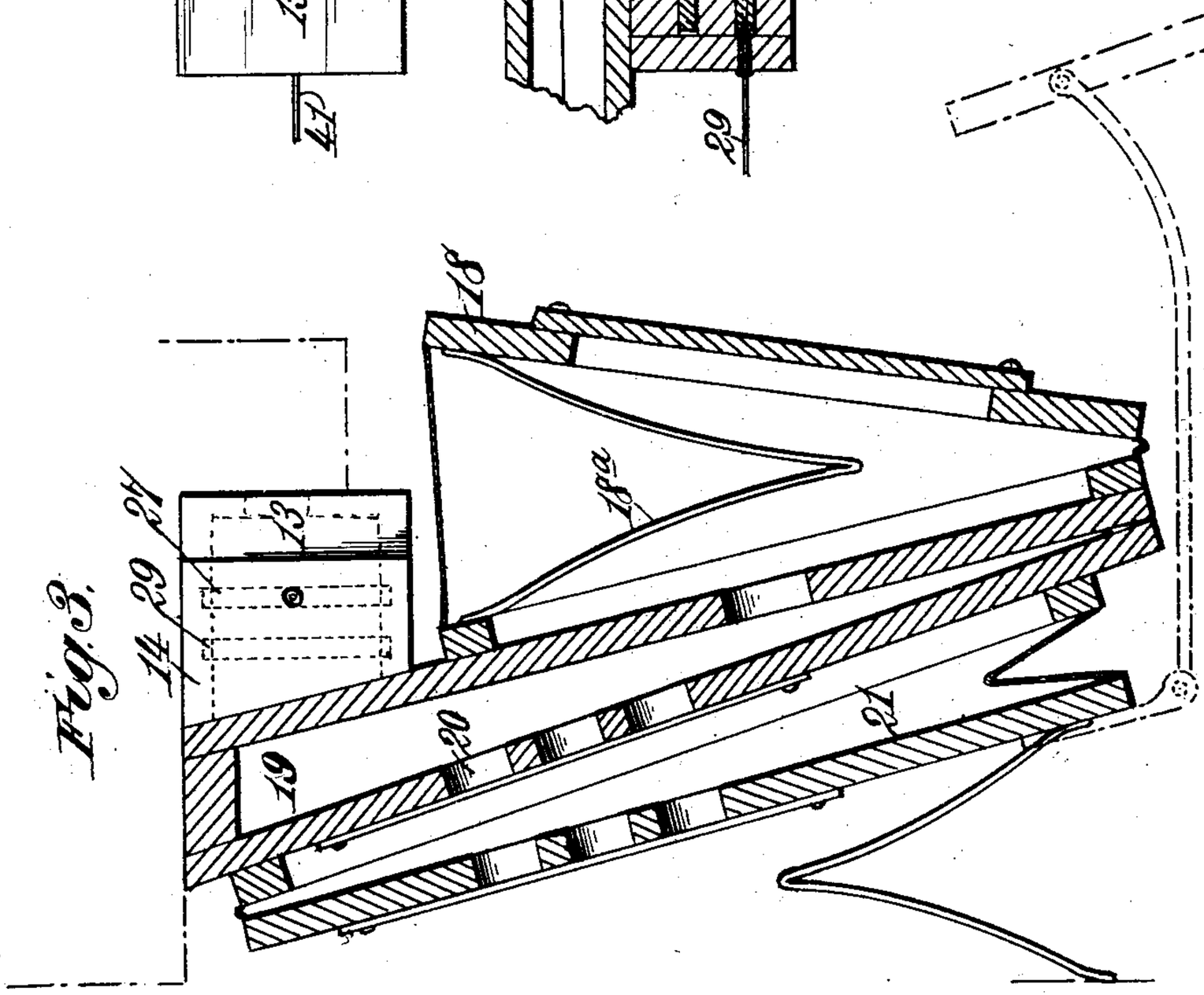


Fig. 8.



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NO MODEL. APPLICATION FILED AUG. 21, 1903.

4 SHEETS—SHEET 4.

Fig. 8.

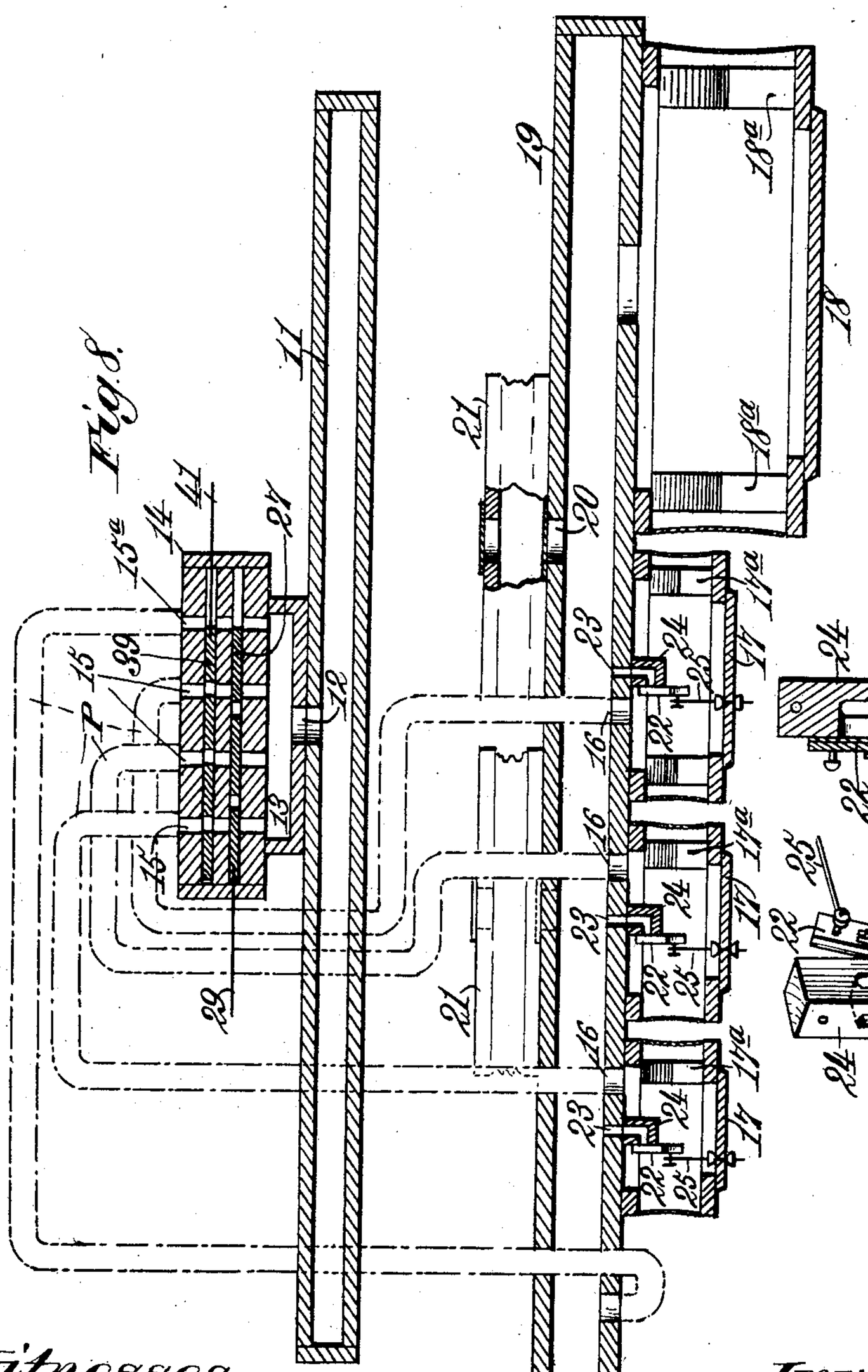
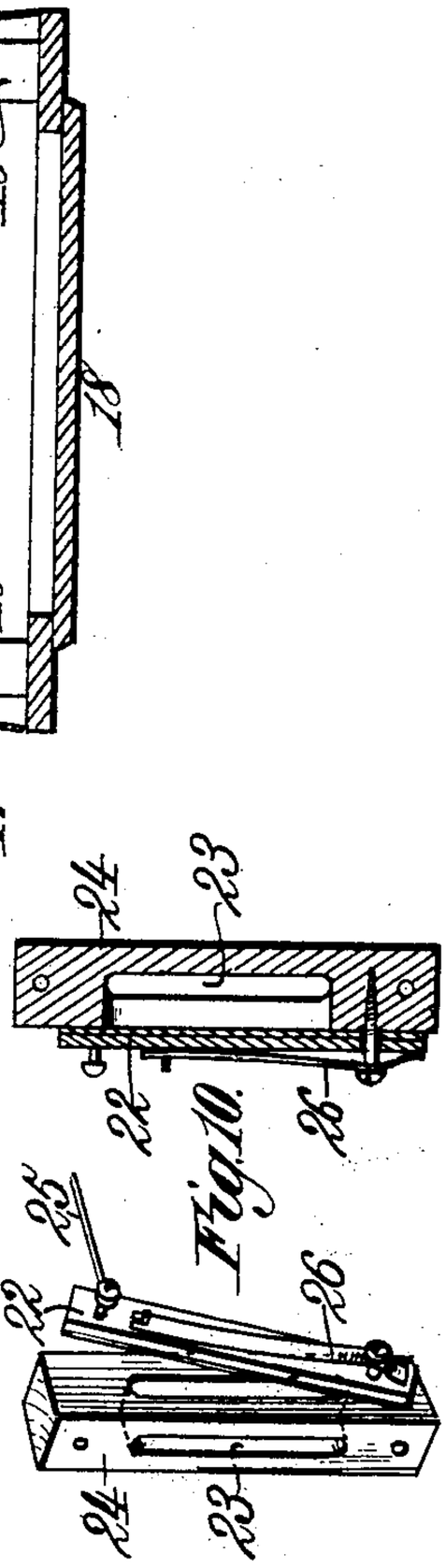


Fig. 10.



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No. 754,886. Patented March 15, 1904.

UNITED STATES PATENT OFFICE.

ROBERT W. PAIN, OF NEW YORK, N. Y., ASSIGNOR TO THE AEOLIAN COMPANY, OF NEW YORK, N. Y., A CORPORATION OF CONNECTICUT.

MEANS FOR REGULATING THE EXPRESSION OF MECHANICAL MUSICAL INSTRUMENTS.

SPECIFICATION forming part of Letters Patent No. 754,886, dated March 15, 1904.

Application filed August 21, 1903. Serial No. 170,362. (No model.)

To all whom it may concern:

Be it known that I, ROBERT W. PAIN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Means for Regulating the Expression of Mechanical Musical Instruments, of which the following is a specification.

This invention relates to improved means for regulating the expression of mechanical musical instruments—that is to say, improved means whereby, according to the will of the performer, such instrument shall produce, for example, forte (loud) or mezzo-forte (medium loud) or piano (soft) or pianissimo (very soft) expression in an efficient satisfactory manner and with good technique. Other modulations between forte and pianissimo or otherwise may be provided for by an extension of the idea expressed in this invention, as hereinafter described.

The invention is intended for use particularly, though not exclusively, in mechanical piano-players, and while the invention will be hereinafter referred to with particular reference to such mechanical piano-players it will be understood that the invention is not by reason thereof restricted to such use, the illustrated example and description being directed merely as the statute requires to the best known embodiment of the invention.

By this invention I provide a means for regulating or controlling the expression that has been found practical, efficient, and eminently satisfactory.

To the end stated the invention resides in the novel combination and arrangement of elements hereinafter described, and set forth in the claims.

In the accompanying drawings, illustrating the preferred embodiment of my invention, Figure 1 is a vertical sectional view of so much of a mechanical musical instrument (in this instance shown as an automatic piano-player) as necessary to illustrate my invention. Fig. 2 is an elevation showing the series of selectively-operable exhausters and their coöperative relation to the selecting-gate. Fig. 3 is a sectional view illustrating one of the series of exhausters expanded and the adjacent correlated elements. Fig. 4 is a face view of the grid-like box or casing in which the selecting and rewinding gates operate, showing the arrangement of the passages therein. Fig. 5 is a horizontal sectional view of said box or casing and the selecting and rewinding gates operatively arranged therein. Fig. 6 is an elevation of the rewinding-gate. Fig. 7 is a similar view of the selecting-gate. Fig. 8 is a diagrammatic view illustrating the series of selectively-operable exhausters of different tension and a grid-like box or casing with the selecting and rewinding gates therein, the ports of the exhausters and the ports of the grid-like box or casing being connected, for sake of graphic illustration, by pipes or conduits. Fig. 9 is a detail perspective view of one of the valves with which those of the series of exhausters which will be hereinafter termed "supplemental" exhausters are provided. Fig. 10 is a sectional view of such valve.

In the following specification a description of the best-known embodiment of my invention—to wit, that adapted for operation in a mechanical musical-instrument player organized on the vacuum or exhaust system—will be referred to, without, however, restricting the invention to such particular embodiment, because said invention resides in the improved means for regulating or modifying the expressional function of automatic musical instruments, whether embodied in an automatic musical-instrument player or otherwise and whether embodied in an instrument of the vacuum or exhaustion or pressure system.

In the said drawings the reference-numeral 1 designates the usual or any suitable tracker-board, and 2 a perforated music-sheet which is caused to operatively pass said tracker-board—for example, from a roll 3 to a roll 4—as shown. The ducts of the tracker-board communicate in any suitable manner, as by means of flexible tubes 5, with an action-box 6, (which may be of any approved or known construction,) that has independent valved communication with a predetermined number of motor-pneumatics 7, (these motor-pneu-

matics are shown in the drawings as key-striker-actuating pneumatics, but it will be understood that they may instead of operating fingers to strike keys of a musical instrument be actuated to cause the operation of other sound-producers,) the latter having operative connection with fingers 8, that are caused to actuate the keys 9 of the musical instrument—for instance, the keys of a piano—the arrangement being such, for example, and as is usual wherein atmospheric pressure admitted through the note-perforations of the music-sheet, the ducts of the tracker-board, and the conduits to the action-box, so disposes the controlling-valves of the motor-pneumatics that the latter are in a state to be exhausted of their contained air, by which exhaustion they are collapsed, and in collapsing cause their respective key-actuating fingers to operate.

The action-box 6 has communication—such, for instance, as illustrated at 10 in the drawings—with a chamber 11, communicating by a port 12 with a chamber 13, common to all the motor-pneumatics and which, as shown, is within and common to all the passages of a grid-like box or casing 14, interposed in the operative circuit between the motor-pneumatics and the hereinafter-described exhausters and as best shown connectedly in Figs. 1 and 5 of the drawings and diagrammatically in Fig. 8, in which diagrammatic view the pipes P are used arbitrarily to illustrate the communication between the passages of the box or casing 14 and the exhausters.

A series of passages 15, (see Figs. 2, 4, 5, and 8,) equal in number with the selectively-operable exhausters next referred to, lead from this common chamber 13 through the grid-like gate box or casing to a corresponding series of independent conduits 16, which lead to and into the several independent selectively-operable exhausters 17, which in the illustrated example of my invention are of the usual bellows form. The passage 15[a] from the said grid-like box or casing to what is hereinafter designated the "main" or "controlling" exhauster 18 consists in part of a vacuum or what is commonly termed a "wind" chest 19. This vacuum or wind chest communicates by valved ports 20 of any usual or known arrangement and construction with the usual vacuum-maintaining device or pumps 21.

The main exhauster 18 of the series is, as shown, permanently in communication with the vacuum or wind chest 19 and that passage 15[a] in the gate box or casing which forms part of the circuit from the motor-pneumatics or action-box 6 to said main or controlling exhauster is normally open, so that normally this exhauster is the active one—that is to say, the one which will operate unless the performer wills otherwise. The supplemental exhausters 17 of the series are normally cut out of circuit by means of the selecting-gate, which normally is adjusted to close the corresponding passages 15 through said gate box or casing and normally are also cut off from communication with the vacuum or wind chest 19 by means of valves 22, that close the passages 23, through which communication of the supplemental exhausters with the vacuum or wind chest is established. So normally they are not under the exhausting or collapsing influence of the vacuum in the chest 19 or the action of the main or controlling exhauster 18, but are free when brought into circuit by manipulation of the selecting-gate to expand under the influence of hereinafter-referred-to appurtenant tension-imparting devices or springs and exhaust the motor-pneumatic in the circuit of action with the appropriate predetermined degree of tension or force. The valves 22 are operated by the movement of the movable element of the respective supplemental exhausters and preferably and as shown are of the following arrangement: The mouths of the passages 23, by which the said supplemental exhausters communicate with the wind or vacuum chest, are disposed within said exhausters and are formed in suitable blocks 24 or otherwise. The valves 22 are pivoted at one end to these blocks and are connected at their free ends with the movable element of said exhausters by means of rod-and-button connections 25, whereby they are caused to open and close the passages to the wind or vacuum chest, according to the direction of movement of the said movable element of the exhausters, as in expanding or collapsing. These valves, as shown at 26, are spring-pressed against the face of the blocks 24 to close the mouths of said passages air-tight.

The passages 15 through the grid-like gate box or casing are selectively opened or closed by means of a selecting-gate 27, provided with ports 28, so disposed in the gate that when one of the ports is opened the others are closed. It will be observed that in the drawings but two ports 28 are shown. In this embodiment of the gate, however, to which detail the invention is not restricted, the gate is so proportioned that when adjusted to one extreme or the other one of the end passages will be open and the other closed. This gate may be moved by the performer by means of any suitable manipulating mechanism, a preferable and novel though not exclusive arrangement being illustrated in the drawings and consisting of a rod 29, connected by a link 30 with a crank-arm 31 of a rock-shaft 32, suitably mounted in any desired manner. The rock-shaft 32 is also provided with a crank-arm 33, connected by a link 34 with a pivoted operating-handle 35, movable in a slot 36 in the casing of the instrument, with its handle 37 exposed and in convenient position for manipulation by the performer. The op-

erating-handle is normally held in position to maintain the selecting-valve in that position which opens the passage 15ª in the gate box or casing to establish communication between the motor-pneumatics and the main or controlling exhauster 18 by means of a spring 38. The operating-handle may by the performer be so moved that it will open selectively either of the passages 15 through the gate box or casing, bringing into circuit the selected exhauster and closing the passages of the other exhausters. As shown, the operating-handle is movable in front of a scale S, provided with suitable indicia—such, for instance, as "PP," "P," "MF," and "F"—to designate, respectively, pianissimo, piano, mezzo-forte, and forte. By moving the operating-handle until it comes opposite the designation "MF" on the scale the selecting-valve will be moved to open communication with that supplemental exhauster which in the example of my invention shown in the drawings operates to impart a mezzo-forte touch to the key-actuating fingers, and by moving it opposite the designation "P" that exhauster which operates to impart a piano touch to the key-actuating fingers is brought into operation, and likewise the exhauster which causes the fingers to actuate the keys of the pianissimo touch is brought into operation when the handle 35 is moved opposite the designation "PP." Said handle is normally maintained by the spring 38, as before stated, in position opposite the designation "F" of the scale, in which position thereof the main or controlling exhauster 18 is in circuit to cause the key-actuating fingers to impart a forte touch. Of course the indicia of the scale may be varied or added to, according to the make-up of the machine in respect of the number of supplemental exhausters embodied therein. The exhausters so interposed between the motor-pneumatics and the pumps or vacuum-maintaining device, as described, are of different tension, the difference in tension being obtained in the example of my invention illustrated by means of springs 17ª and 18ª, of any suitable description, arranged within said exhausters, normally tending and operating when free so to do to expand them.

I have illustrated a series of four exhausters of different tension, the main or controlling exhauster being provided, for instance, with two springs each having a fourteen-pound tension or pull, the supplemental exhausters being provided, respectively, for example, one with two springs each of six-pound tension or pull, the second with a spring of seven-pound tension or pull, and the third with a spring of six-pound tension or pull. Additional supplemental exhausters may be employed, if desired, to obtain degrees of expression other than those referred to, if desired, and such will be merely an extension of the principle of my invention. The result of the provision of this series of selectively-operable exhausters of different tension is, speaking with reference to the particular embodiment of the invention shown in the drawings, that the pressure or stroke of the key-actuating fingers may be regulated to impart a maximum force or pressure, or a minimum pressure or stroke, or a pressure or stroke of intermediate force, dependent upon which of the selectively-operable exhausters is brought into operation by manipulation of the selecting-gate.

For the purpose of illustration let it be supposed that a particular piece of music, perforated in the music-sheet, requires that some particular part thereof be played pianissimo. The performer being guided by his knowledge of the piece of music or in the exercise of his individual interpretation thereof or by means of well-known indicators with which music-sheets are provided will by manipulation of the selecting-gate cause a port thereof to register with that passage in the grid-like gate box or casing that connects the chamber 13 with the passage 15, leading to and communicating with the exhauster of least tension, bringing said exhauster into operative circuit from the key-pneumatic to the pumps and at the same time cutting out all other exhausters. Now when a perforation in the music-sheet passes one of the ducts in the tracker-board atmospheric pressure is admitted through said duct and the corresponding conduit 5 to the action-box 6, whereby in the well-known or any suitable way the valves controlling the corresponding key-pneumatic are so disposed that the said pneumatic is in proper state to be exhausted. The exhauster of least tension which is operatively in circuit thereupon acts and exhausts or collapses the key-pneumatic, exerting a tension or pull of, say, six pounds in so doing and causing the key-actuating finger to actuate the key of the musical instrument with a soft, light, or pianissimo touch. The operation of exhausting the pneumatic described is of course accomplished with great rapidity and when my invention is embodied in a machine organized as particularly shown by an expanding movement of the exhauster less than its full capacity of expansion. In the pneumatic exhausting or expanding movement of the exhauster the movable element thereof opens the valve 22 just at the time the exhaustion or collapsing of the key-pneumatic has been accomplished, thus placing said exhauster in communication with the vacuum or wind chest 19 and the high-tension main or controlling exhauster, whereupon said exhauster is itself immediately exhausted, and in collapsing the valve 22 closes the passage to the wind-chest and the said exhauster is in condition for further operation when called upon. Precisely the same operation takes place when either of the other supple-

mental exhausters are selected or brought into the circuit by manipulation of the selecting-gate, except that the action of such other supplemental exhausters is, according to the tensional value thereof, exerted with greater tension or pull, causing the key-actuating fingers to perform their function with a more forceful touch to cause the piano or forte or other expression, according to which thereof is brought into operation.

It will be understood, of course, that the action of the main exhauster is similar to that of the supplemental exhausters, except that it produces a greater pull or tension on the key-pneumatics and causes a louder or fortissimo touch of the fingers upon the keys of the instrument. The main exhauster is, as stated above, normally in circuit and will normally act, but may be cut out and its place taken by one of the supplemental exhausters at the will of the performer.

I consider it preferable to provide what has been herein termed a "main" or "controlling" exhauster, which is always in communication with the pumps or vacuum-maintainer, as it constitutes, as it were, a reservoir, which without any possibility of hesitation collapses the supplemental exhausters. In the broader aspects of the invention, however, the controlling character of this exhauster is not absolutely essential, because the pumps or vacuum-maintaining device of the apparatus will act to exhaust such supplemental exhausters. I have found, however, that it is preferable, though not absolutely essential, that a main or controlling exhauster such as above described be utilized, as it acts instantaneously and always to collapse the supplemental exhausters when they have performed their functions. The regulating means, however, of my invention will be operative if this so-called "main" or "controlling" exhauster had communication with the vacuum or wind chest 19 in the same manner as what are termed the "supplemental" exhausters, in which arrangement the pumps or vacuum-maintainer would operate to exhaust and collapse each of the series of exhausters forming the subject of my invention.

In the foregoing description and in the claims appended hereto I use the term "series" as comprehending a number of exhausters greater than two.

According to my invention each of the series of exhausters is in communication with all of the series of motor-pneumatics, the communication of each of said exhausters with the series of motor-pneumatics is independent of the communication of the others of said exhausters therewith, and means are provided for selectively cutting part of said exhausters into and the others out of operation, to the end that any note either in the treble or bass or any other subdivision of scale may be accentuated, and the same accentuation in any degree of force may be imparted to simultaneously-played notes in any or all subdivisions of scale.

It will be observed that one, though by no means the only characteristic of my invention, and to which characteristic in other respects the invention is not restricted, is that the exhausters are independent each of the other and that the selective mechanism for cutting into and out of operation such exhausters is of such character that when one exhauster is brought into operation the others are cut out.

The rewinding-gate is designated by the reference-numeral 39. It is movably disposed in the grid-like gate-box or casing 14 and is provided with ports 40, which while the piece of music is being played are adjusted into register with the passages 15 15^a in said box or casing, so that any one of said passages may be by adjustment of the selecting-gate opened. When, however, it is desired to rewind the music-sheet, it will not ordinarily be desired that the instrument operate, and the rewinding-gate may be adjusted to close all the passages through the gate-box or casing, thus cutting out all operation of the exhausters.

A convenient manner of manipulating the rewinding-gate is shown in the drawings and consists of mechanism similar to that hereinbefore described in connection with the selecting-gate—that is to say, the rewinding-gate is connected by a rod 41 and a link 42 with a crank-arm 43 to a rock-shaft 44. A second crank-arm 45 on the rock-shaft is provided, being connected with a link 46, to which a pivoted operating-handle 47 is connected.

Having thus described my invention, what I claim is—

1. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension having independent communication with said chamber, and means for selectively cutting part of said exhausters into and the others out of circuit with all the motor-pneumatics.

2. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension having independent communication with said chamber, and manually-operable means for selectively cutting part of said exhausters into and the others out of circuit with all the motor-pneumatics.

3. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension having independent communication with said chamber, and means comprising a gate to control such communication and adapted to be operated to selectively open and close communication between each of said exhausters and said pneumatics.

4. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension, a valve-box located in the circuit of communication between said pneumatics and said exhausters and provided with a series of independent passages leading to said exhausters and to said chamber, and means comprising a gate in said valve-box to selectively open and close said passages.

5. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension, having independent communication with said chamber, means comprising a gate to selectively open and close communication of each of said exhausters with said pneumatics, and a vacuum-maintainer in communication with said exhausters.

6. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension comprising a main or controlling exhauster, said series of exhausters having independent communication with said chamber, and means for selectively cutting part of said exhausters into and the others out of circuit with said motor-pneumatics.

7. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension comprising a main or controlling exhauster, said series of exhausters having independent communication with said chamber, and manually-operable means for selectively cutting part of said exhausters into and the others out of circuit with said motor-pneumatics.

8. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension comprising a main or controlling exhauster, said series of exhausters having independent communication with said chamber, and means comprising a gate to selectively cut part of said exhausters into and others out of communication with said pneumatics.

9. In a mechanical musical instrument, the combination with motor-pneumatics, a chamber common to all of said pneumatics, and a vacuum-maintainer, of a series of exhausters of different tension having independent communication with said chamber and with said vacuum-maintainer, means comprising a gate to selectively open and close the communication of each of said exhausters with said motor-pneumatics, and valves to control the communication of said exhausters with the vacuum-maintainer.

10. In a mechanical musical instrument, the combination with motor-pneumatics, a chamber common to all of said pneumatics, and a vacuum-maintainer, of a series of exhausters of different tension having independent communication with said chamber and also having independent communication with said vacuum-maintainer, means comprising a gate to selectively open and close the communication of each of said exhausters with the motor-pneumatics, and valves located in said exhausters to control the communication of the latter with the vacuum-maintainer.

11. In a mechanical musical instrument, the combination with motor-pneumatics, a chamber common to all of said pneumatics, and a vacuum-maintainer, of a series of exhausters of different tension having independent communication with said chamber, and also having independent communication with said vacuum-maintainer, means comprising a gate to selectively open and close the communication of each of said exhausters with the motor-pneumatics, and valves located in and operated by a movable element of said exhausters to control the communication of the latter with the vacuum-maintainer.

12. In a mechanical musical instrument, the combination with motor-pneumatics, a chamber common to all of said pneumatics, and a vacuum-maintainer, of a series of exhausters of different tension having independent communication with said chamber, and comprising a main or controlling exhauster and supplemental exhausters, means comprising a gate to selectively open and close the communication of each of said exhausters with the motor-pneumatics, and valves to control the communication of the supplemental exhausters with the vacuum-maintainer.

13. In a mechanical musical instrument, the combination with motor-pneumatics, a chamber common to all of said pneumatics, and a vacuum-maintainer, of a series of exhausters of different tension having independent communication with said chamber, means comprising a gate to selectively open and close the communication of said exhausters with said chamber, and a gate to cut the series of exhausters out of operation.

14. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension having independent communication with said chamber, means comprising a gate and a device connected to and operating said gate to selectively cut part of said exhausters into and others out of circuit with all the motor-pneumatics, and a guide-scale coöperating with said gate-operating device to guide the performer in manipulating the gate.

15. In a mechanical musical instrument, the combination with motor-pneumatics and a chamber common to all of said pneumatics, of a series of exhausters of different tension having independent communication with said

chamber, means comprising a gate, and a handle connected to and operating said gate to selectively cut part of said exhausters into and others out of circuit with all the motor-pneumatics, and a guide-scale coöperating with said handle to guide the performer in manipulating the gate.

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

ROBERT W. PAIN.

Witnesses:
W. C. MANSFIELD,
W. H. ALFRING.