No. 832,571. PATENTED OCT. 2, 1906.

W. F. COOPER.

CRESCENDO AND DIMINUENDO APPARATUS FOR MECHANICAL MUSICAL INSTRUMENTS.

APPLICATION FILED JUNE 10, 1905.

4 SHEETS—SHEET 1.

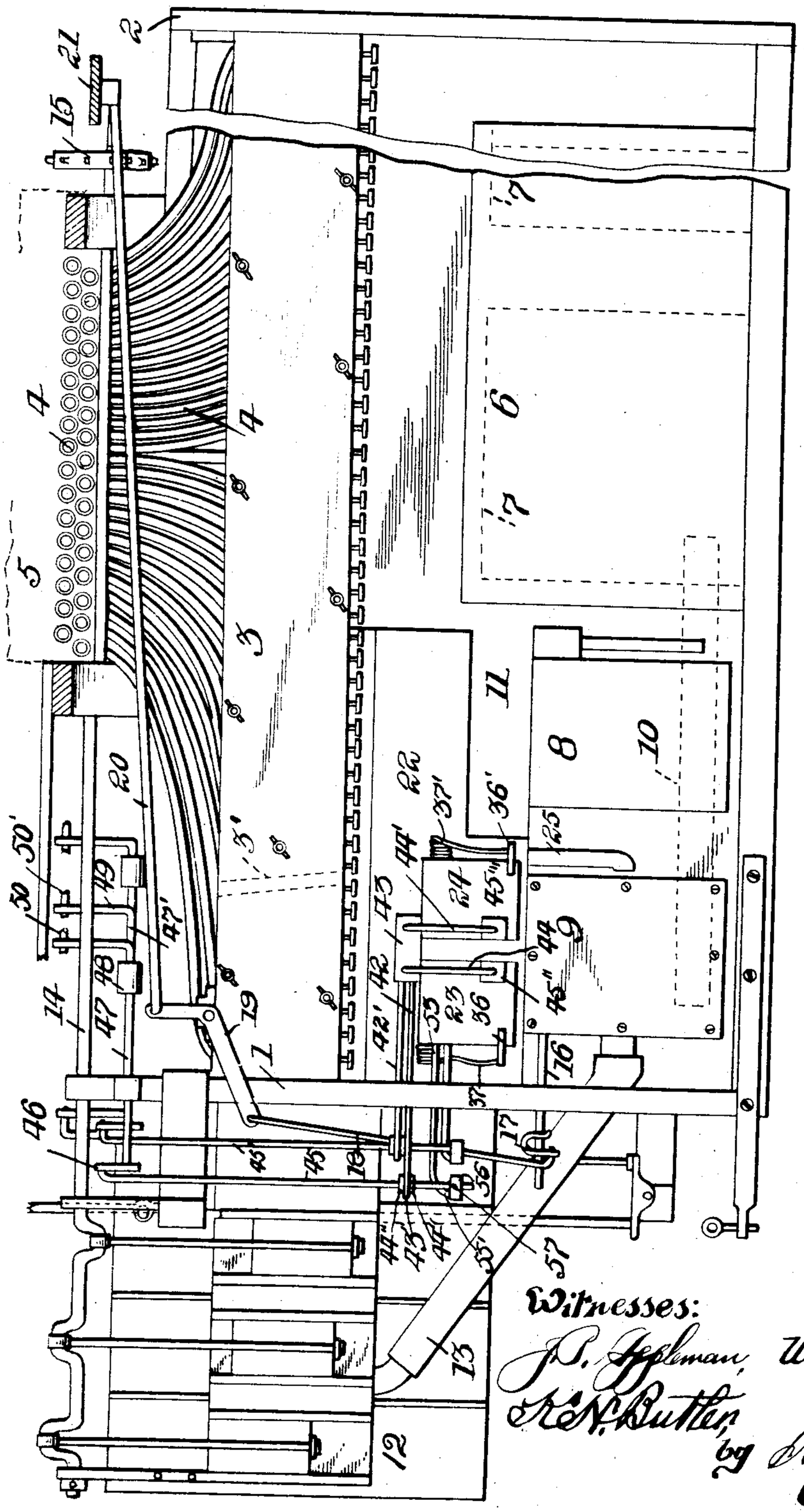

Fig. 1.

Witnesses:
J. P. Appleman,
R. N. Butler,

Inventor
W. F. Cooper,
by A. C. Eversbo
Attorneys

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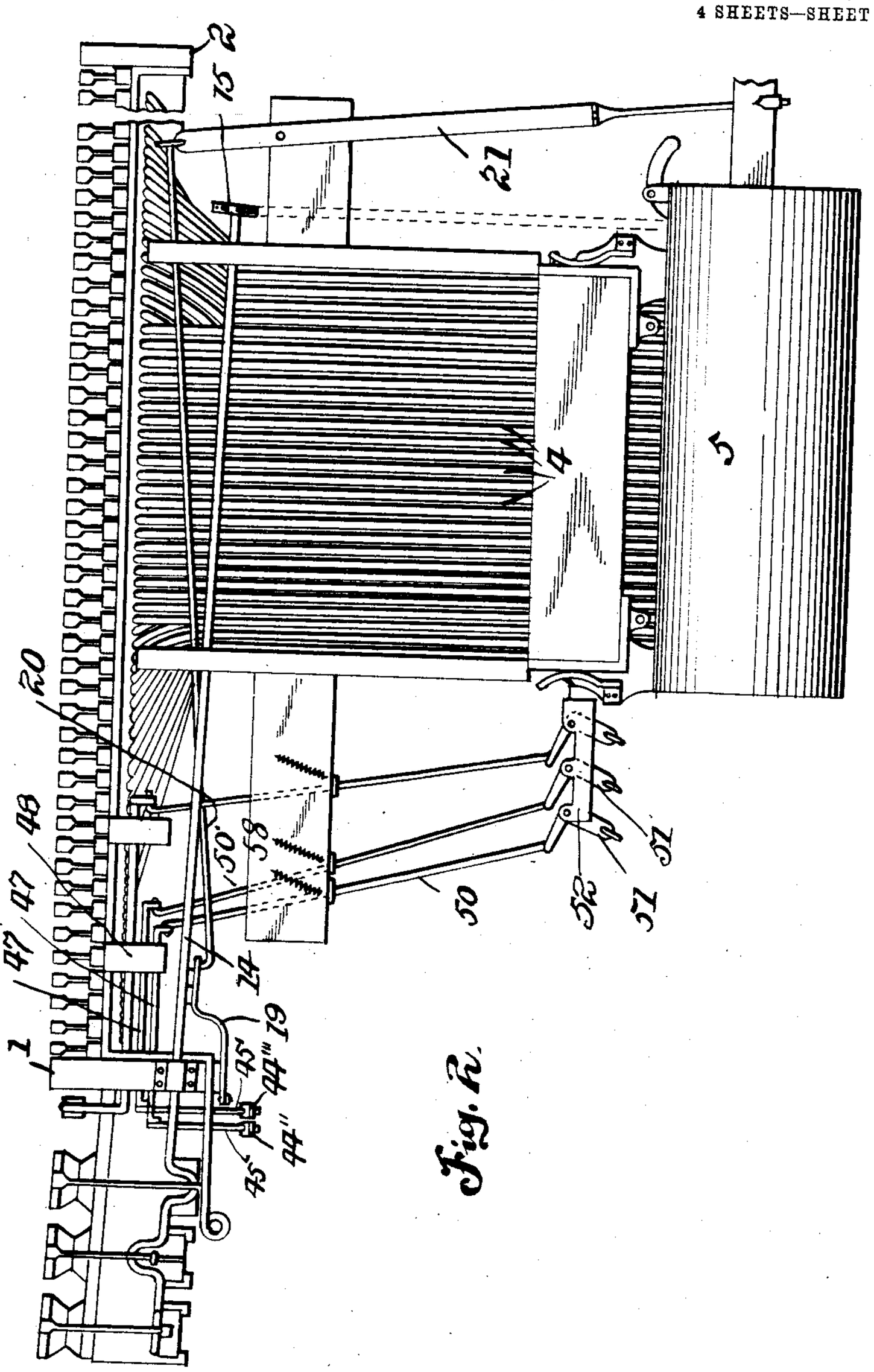

Fig. 2.

Witnesses:
J. S. Appleman
R. F. Butler,

Inventor.
W. F. Cooper,
by A. C. Everett & Co
Attorneys.

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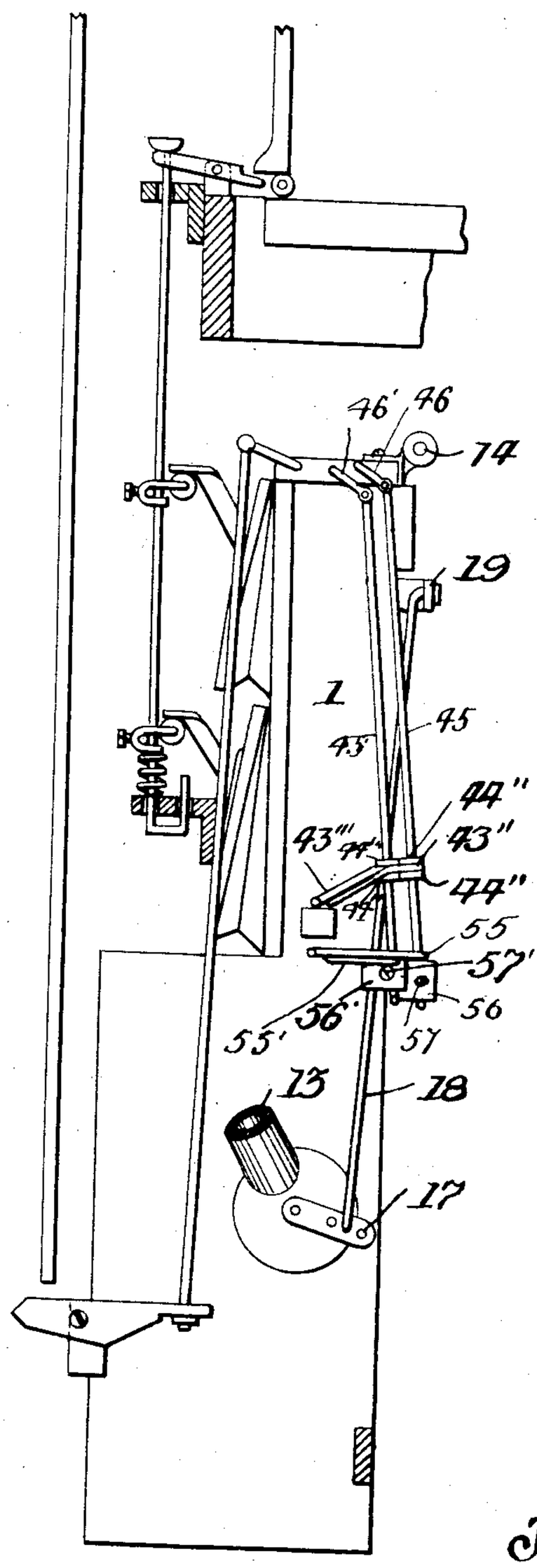
4 SHEETS—SHEET 3.

Fig. 3.



Witnesses:
J. P. Appleman
R. N. Butler.

Inventor
W. F. Cooper,
by
A. C. Ewart & Co
Attorneys.

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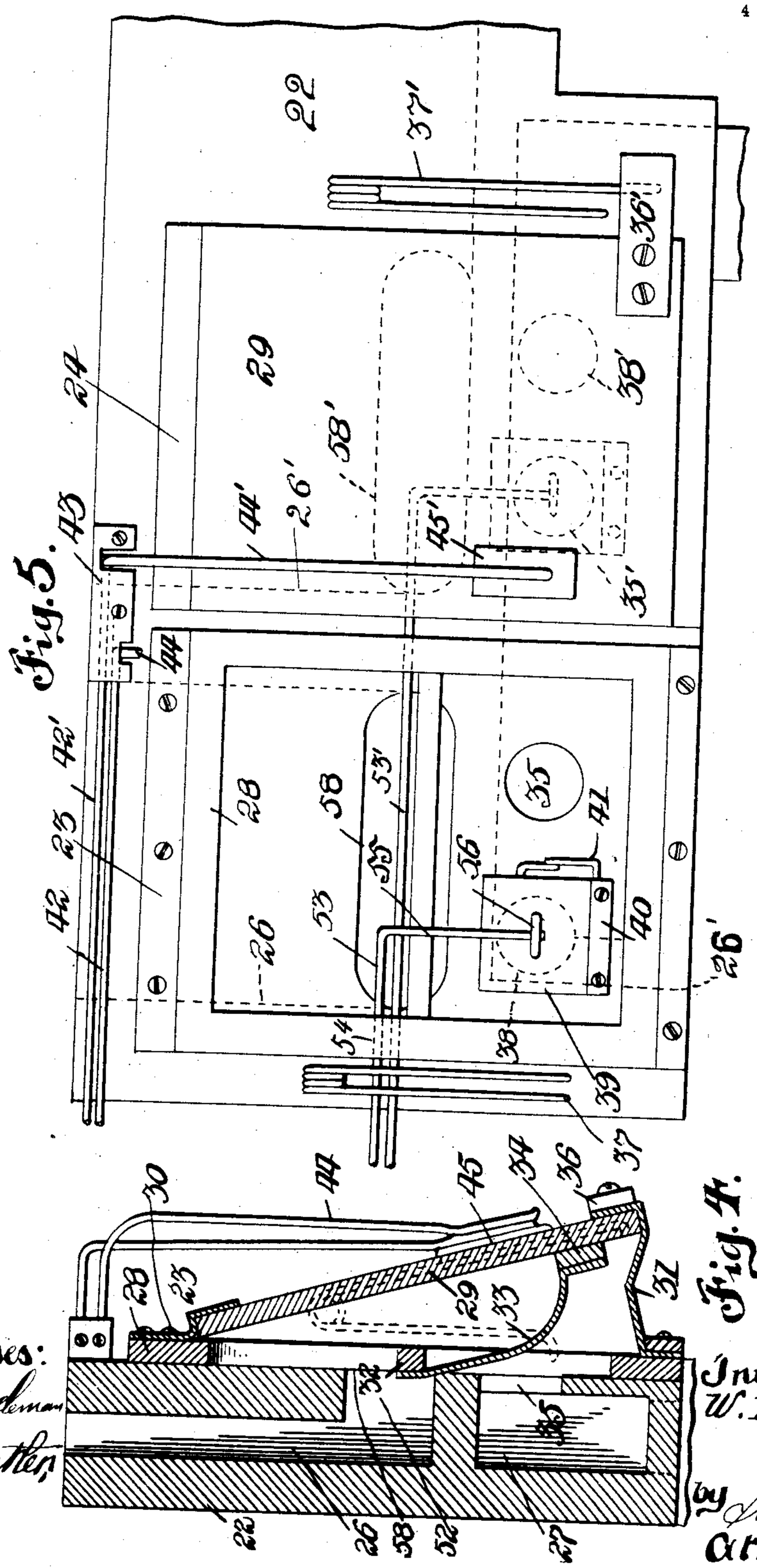

Fig. 5.

Fig. 4.

Witnesses:
J. P. Appleman
H. A. Butler,

Inventor
W. F. Cooper,
by A. C. Eversfield
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM F. COOPER, OF NORWALK, OHIO, ASSIGNOR OF ONE-HALF TO THE A. B. CHASE CO., OF NORWALK, OHIO, A CORPORATION OF OHIO.

CRESCENDO AND DIMINUENDO APPARATUS FOR MECHANICAL MUSICAL INSTRUMENTS.

No. 832,571. Specification of Letters Patent. Patented Oct. 2, 1906.

Application filed June 10, 1905. Serial No. 264,673.

To all whom it may concern:

Be it known that I, WILLIAM F. COOPER, a citizen of the United States of America, residing at Norwalk, in the county of Huron and State of Ohio, have invented certain new and useful Improvements in Crescendo and Diminuendo Apparatus for Mechanical Musical Instruments, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention has relation to crescendo and diminuendo apparatus for mechanical musical instruments, and relates in particular to apparatus to be employed in connection with that class of stringed instruments in which the hammers which strike the strings are actuated by pneumatic appliances the operation of which is produced and controlled by means of a moving strip or sheet of perforated paper.

The function which is designed to be performed by my present improvements is that of governing the suction by means of which the movements of the action of the instrument are produced, so as to cause the action to be operated with more or less force or power, according to the will of the operator, whereby beautiful and desirable effects, known to musicians as "phrasing" or "shading," can be obtained.

My invention has for its object the provision of novel means whereby in instruments of the character to which my improvement is applicable the person operating the instrument can shade or phrase the sound effects from pianissimo to forte, or vice versa, and throughout any desired range between the loudest and softest tones of which the instrument is capable.

My invention has for its further object the provision of novel means whereby the tones of the instrument belonging to the bass portion of the scale and the tones of the instrument belonging to the treble portion of the scale may be separately shaded, phrased, or increased and diminished in power and whereby these effects may be simultaneously produced in the tones of the bass and treble portions of the scale of the instrument at will.

Still further objects of my invention will be developed in the following specific description of the same; and my invention consists in the novel construction, combination, and arrangement of parts hereinafter described and claimed.

In the accompanying drawings, illustrating my improvement, in the several figures of which like numerals designate corresponding parts, Figure 1 is a front elevation of the principal operating parts of a mechanical musical instrument having my improvements applied thereto. Fig. 2 is a top plan view of the same. Fig. 3 is an end elevation looking at the left-hand end of Fig. 1, the motor devices being omitted. Fig. 4 is a vertical transverse sectional view through a portion of the apparatus shown in Fig. 1, but on an enlarged scale, this portion of the apparatus being known as the "expression-controller." Fig. 5 is a front elevation of a portion of the expression-controller board on the same scale as Fig. 4, the top or movable side of one of the expression-controllers being removed to show the interior construction of the expression-controller.

In the following description I will first describe, generally, but without entering unnecessarily into particulars, the construction of the mechanical musical instrument to which my improvement is applied and will then specifically describe my improvement and the manner in which the same operates in conjunction with the other apparatus of a mechanical musical instrument.

Referring first to Fig. 1, which shows in front elevation all the principal and essential parts of a mechanical musical instrument, 1 and 2 designate the end frames or boards, which serve as the supports for the entire apparatus. Between the end frames 1 and 2 is arranged the primary board 3, into which lead the ducts 4, proceeding from the tracker-box 5, which latter is shown in dotted lines, so as not to obstruct the view of the parts behind the same.

6 designates the main reservoir, behind which are located the main bellows 7 7, that are actuated by means of pedals or other suitable devices. (Not shown.) Adjacent to the main reservoir 6 is located the motor pressure-regulator 8, and adjacent to the latter is arranged the controller-box 9. The motor pressure-regulator and the controller-box 9 are in communciation with the main reservoir through a passage 10 in the bellows foundation-board 11, and the controller-box is in

communication with the motor-bellows 12 by a conduit 13. Motion is communicated to the tracker-box mechanism from the motor-bellows through a motor-shaft 14, that carries a sprocket-wheel 15 on its end and by means of which sprocket-wheel and a drive-chain motion is communicated to the moving parts of the tracker-box 5. Certain valves and other movable parts are contained within the controller-box 9 and are actuated by a rocker-shaft 16, to which motion is communicated through a crank 17, a rod 18, a bell-crank 19, and a rod 20 from a tempo-lever 21, that is mounted adjacent to the tracker-box 5; but as the mechanism within the controller-box 9, as well as all the parts which I have so far enumerated, may be of any desired construction and form no part of my present invention specific description of the same will not be herein given.

The apparatus which constitutes the subject-matter of the present invention will now be more specifically described, reference being incidentally and necessarily made throughout the description to those other portions of the apparatus of a mechanical musical instrument which have been referred to in general terms in the foregoing description.

Above the controller-box 9 I arrange an expression-controller board 22, which board is formed with certain ports, channels, and passages that will be hereinafter more particularly described, and this board carries upon its outer side two expression-controllers, (designated, respectively, 23 and 24,) and the board 22 is in communication with the controller-box 9 by a conduit 25 and in communication with the primary board 3 through certain channels or passages that will be presently referred to.

Referring now to Fig. 4 of the drawings, which is a vertical sectional view taken through the board 22 and one of the expression-controllers, the expression-controller 23 being the one shown in section in this view, it will be observed that the board 22 is provided with an upper channel 26 and a lower vertical channel 27, the channel 26 leading to the primary board and the channel 27 being in communication with the conduit 25, leading to the controller-box. The expression-controller is in the form of a small bellows that is composed of a rectangular open frame 28, a movable bellows-board 29, hinged to the frame 28 at 30, and a flexible air-proof integument 31, that forms the sides and one end of the bellows structure, which, with its appurtenant parts, constitutes one of the expression-controllers. The frame 28 has at one side an inwardly-projecting bar 32, and to this bar is attached a flap 33 of flexible material, that is attached at its other end to a block 34, mounted on the inside of the bellows-board 29, this flap being designed to control a port 35, leading from the channel 27 to within the controller. The bellows-board 29 carries a small plate 36, that projects laterally beyond the side of the bellows-board, and a spring 37 is arranged alongside the expression-controller 23, the free end of the spring extending under the plate 36 and the spring tending to press the bellows-board 29 outwardly to the position shown in Fig. 4.

Alongside the port 35 a second port 38 is provided, this port also affording communication between the channel 27 and the inside of the controller 23, and over this port 38 is placed a flap-valve 39, that is pivoted to a bar 40, fastened to the expression bellows-board 22. A small spring 41 is connected at one end to the valve 39 and at the other end to the board 22, and this spring tends to maintain the valve 39 in closed position—that is, closed relatively to the port 38.

A rock-shaft 42, that is journaled in the end frame 1 and in a block 43, mounted on the expression bellows-board 22, carries a downwardly-extending curved spring-arm 44, that bears upon a friction-plate 45″, mounted on the outside of the bellows-board 29, and the rock-shaft 42 has an arm 43″ on its outer end, which arm seats between two nuts 44″ 44″, carried by a rod 45, that extends upwardly on the outside of the frame 1 to a point near the top thereof and is there connected to a crank 46, carried on the end of a rock-shaft 47, which is journaled in the frame 1 and in a block 48 and has an upturned end 49, to which is pivotally connected a rod 50, that is in turn pivotally connected to a bell-shaped lever 51, pivotally mounted on an arm 52, extending from the side of the tracker-box 5. A rock-shaft 53 passes through a groove 54 in the board 22, and this rock-shaft is provided with a downwardly-extending end 55, that is attached to the valve 39 by means of an eye 56, and the rock-shaft 53 extends through the frame 1 and has an arm 55′ on its outer end that bears upon the top of a block 56, that is adjustably mounted on the rod 45, said block being held in its adjusted position by a screw 57.

The parts above described as appertaining to the expression-controller 23 are all repeated in expression-controller 24, the two controllers being identical in construction and provided with the same appurtenant parts; but where the parts appertaining to the expression-controller 24 appear in the drawings I have distinguished them by applying the same numerals with the addition of a prime-mark to each. It will be thus easy to distinguish between the parts belonging to the expression-controller 23 and the expression-controller 24.

The expression-controller 23 controls that portion of the scale of the instrument that contains the bass notes, while the expression-controller 24 controls that portion of the in-

strument that contains the treble notes, and the channel 26 is in communication with the interior of the controller 23 by a port 58, this channel leading to that portion of the channel of the primary board that is connected to the pneumatics which operate the hammers of the bass strings of the instrument, while a similar channel 26′, that communicates by a port 58′ with the expression-controller 24, leads to that portion of the channel of the primary board which is connected to the pneumatics which operate the hammers of the treble strings of the instrument. The channel 27 in the lower portion of the expression-controller board 22 is in communication with the interior of the expression-controller 24 by two ports 35′ and 38′, similar to the ports 35 and 38, that lead from the channel 27 into the controller 23. The main channel of the primary board 3 is divided into two sections, one appertaining to the bass pneumatics and the other to the treble pneumatics, this partition being designated 3′ and shown in dotted lines of Fig. 1 of the drawings.

The operation is as follows: The main bellows 7 7 being actuated will create a partial vacuum in the main reservoir 6, and the air being exhausted from the motor-bellows 12 through the conduit 13 the controller-box 9, the port 10, and the motor pressure-regulator 8 the motor-bellows will be set in motion and will impart motion to the motor-shaft 14, through which and the sprocket-wheel 15 motion will be communicated to the tracker-box mechanism. The perforated sheet of paper in the tracker-box mechanism in passing over the tracker-bar will admit air through the perforations in the paper into the ducts 4, and this admission of air to the several ducts will of course depend upon the positions of the perforations in the paper. The pneumatics by means of which the hammers are operated are caused to collapse, and thus actuate the hammers by reason of the abstraction of air from the pneumatics by the suction created by the main bellows, and this action takes place as soon as air has been admitted through the ducts 4 by the movement of the paper in the manner above described. This action of the tracker-box and the pneumatics is old and well known, and I have only referred to it in order to render clear the function and mode of operation of my improvements. It being understood that the pneumatics are operated by the extraction of air therefrom, it will be readily understood that the amount of air abstracted in a given time will determine the force with which the pneumatics will operate. Thus, for instance, if all the air is abstracted very suddenly from a pneumatic the latter will collapse suddenly and with very great force, whereas if a less quantity than the maximum quantity of air is extracted from the pneumatics by the main bellows in the same period of time the pneumatic will collapse without an appreciable difference in the time consumed in the operation, but with less force, and the hammer will therefore strike the strings a softer blow than in the first instance. The abstraction of air from the pneumatics necessarily involves a flow of air through the primary-board channel, through the channels 26 26′ of the expression-controller board, and through the expression-controllers 23 and 24. The tendency of the springs 37 37′ of the controllers 23 and 24 is to maintain the bellows-board 29 at its maximum forward position, and in this position the flap 33 stands at a considerable distance from the port 35, and therefore the passage through this port is unobstructed, and the maximum amount of force is imparted to the action of the pneumatics. In the normal position of parts the spring-arm 44 is out of contact with the plate 45″ on the bellows-board, and the first movement of the expression-lever has the effect of closing the valve 39, this closing being effected gradually or rapidly at the will of the operator. A further movement of the expression-lever brings the arm 44 into contact with the plate 45, and thereafter the further movement of the expression-lever will cause this spring-arm to bear with increasing strength against the plate on the bellows-board, and this action being opposed to the resilient action of the spring 37 the atmospheric pressure upon the bellows-board will gradually increase in power according as the spring-arm 44 is pressed with increasing force against the bellows-board, and the bellows-board will therefore swing inwardly and bring the flap 33 gradually closer to the port 35, which action will have the effect of throttling the suction, and thereby decreasing the force which will be exerted by the pneumatics when they are thrown into operation to cause the hammers to strike the strings. A reverse movement of the expression-lever will of course result in a reversal of the action of the parts, and the reverse movement of the expression-lever is effected by means of a suitable retracting-spring 58, connected to the rod 50, and an arm extending from the side of the tracker-box-supporting frame.

I claim—

1. In apparatus of the character described, a spring-expanded bellows arranged in the suction-circuit of the apparatus, a valve carried by a movable part of said bellows and adapted to partially close a port constituting a portion of the suction-circuit, an arm normally out of contact with the bellows and adapted to be brought to bear against the bellows in opposition to the expanding-spring thereof, and a lever connected to and adapted to move said arm.

2. In apparatus of the character described,

the combination with the air-channel of the instrument of a bellows in communication with said channel, a spring arranged to expand said bellows, a flap carried by the bellows and extending over a port constituting a portion of said air-channel, a second valve arranged adjacent to a second port, also communicating with said channel, means for overcoming the resiliency of said spring, means for closing said valve and a lever by which both said means are operated.

3. In an apparatus of the character described, the combination with pneumatically-operated action appliances, of a plurality of expression-controllers, each controller comprising a bellows, an air-channel having two ports communicating with the bellows, a valve carried by the bellows and extending over one port, said valve being attached to a movable part of the bellows, a second valve arranged adjacent to the second port, said controllers being each adapted to control a portion of said pneumatically-operated action appliances and means for separately operating each controller.

4. An expression-controller for mechanical musical instruments comprising a bellows, a spring adapted to expand the bellows, a valve operable by the movement of the bellows and adapted to govern the passage of air through a port opening into the bellows a second valve located adjacent said first-named valve and governing a separate port, means for operating said second valve and manually-operable means for closing the bellows in opposition to the expanding action of said spring.

5. In apparatus of the character described, an expression-controller adapted to control the flow of air through the apparatus, a plurality of ports communicating with said controller, a plurality of valves arranged adjacent to said ports and maintained normally in open position, and means for gradually and successively closing both said valves.

6. An expression-controller for mechanical instruments comprising a bellows, a spring adapted to expand said bellows, a flexible strip attached to the movable portion of the bellows and attached to the stationary portion thereof, said flap being arranged adjacent to a port opening into the bellows, a rock-shaft arranged adjacent to the bellows and a spring-arm carried by said rock-shaft and adapted to bear against the bellows for overcoming the resiliency of said spring.

In testimony whereof I affix my signature in the presence of two witnesses.

WILLIAM F. COOPER.

Witnesses:
Jos. B. Connolly,
L. L. Dowd.