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PATENTED JULY 24, 1906.

W. F. COOPER.

PNEUMATIC ACTION FOR MECHANICAL MUSICAL INSTRUMENTS.

APPLICATION FILED JUNE 10, 1905.

2 SHEETS—SHEET 1.

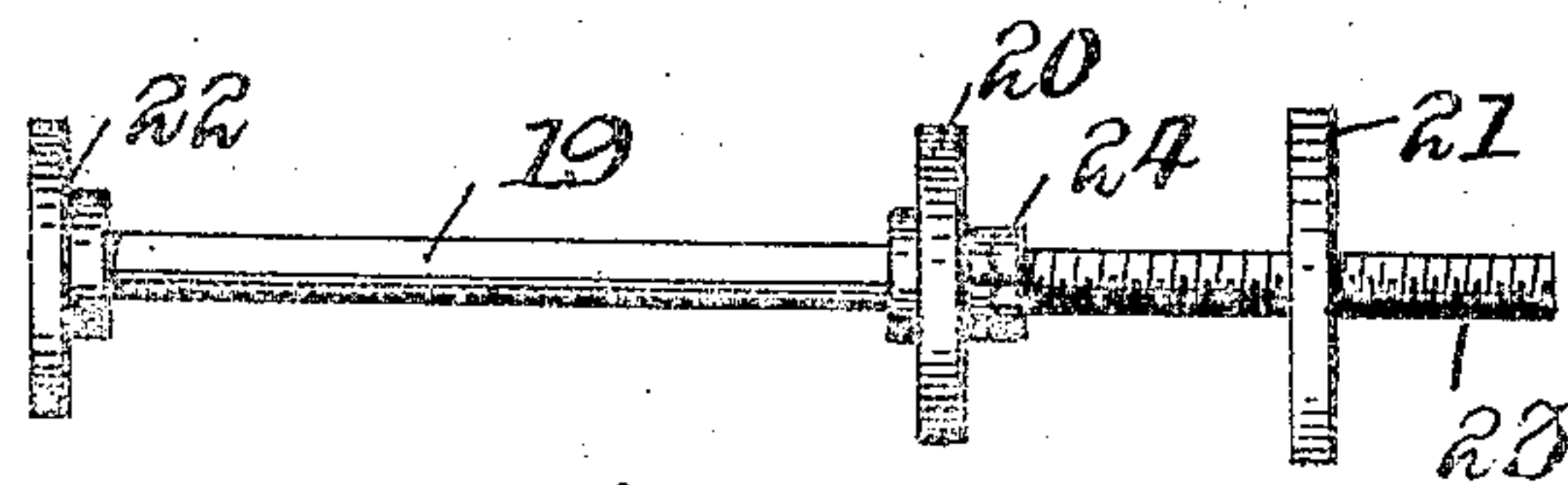
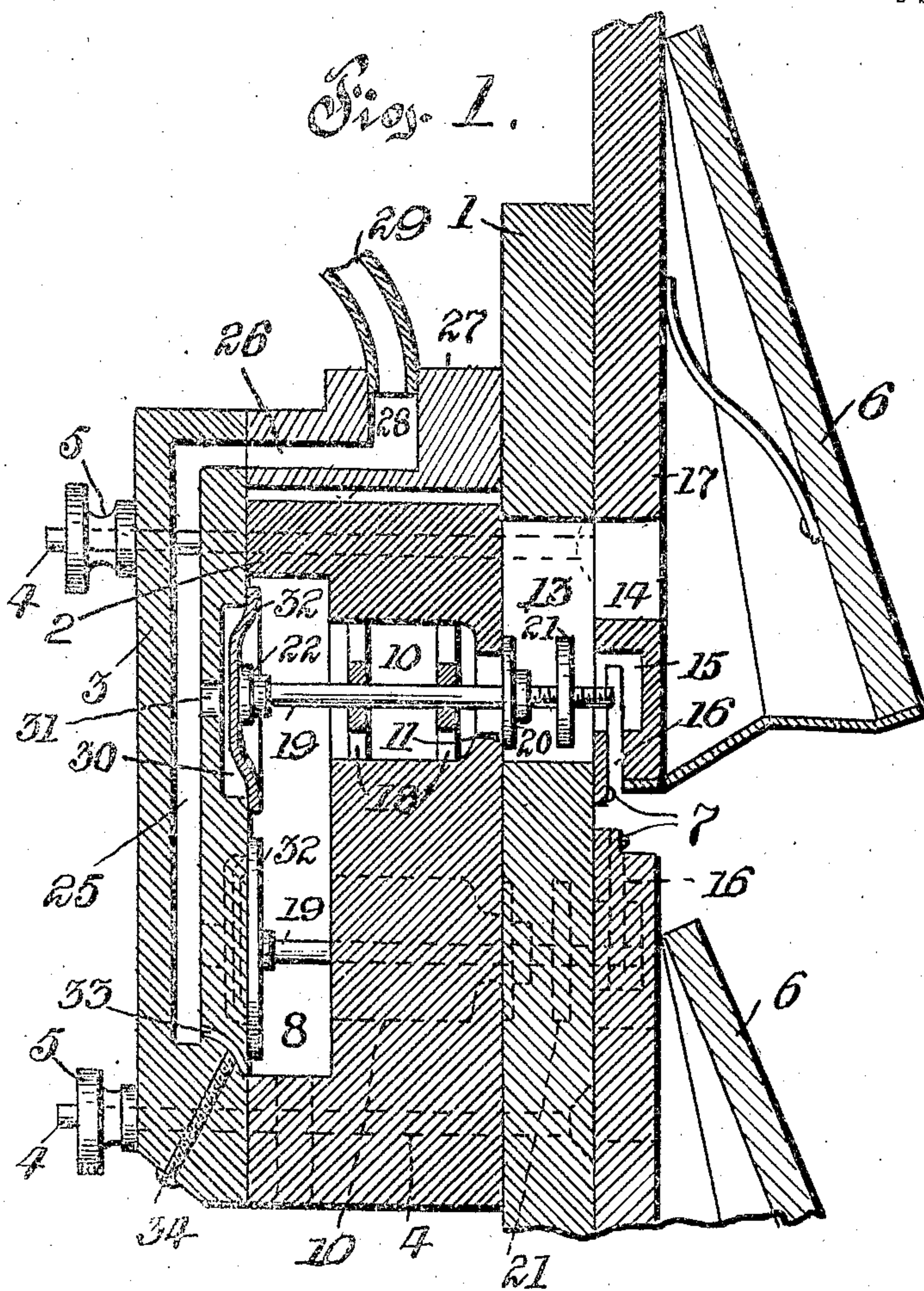


Fig. 4.

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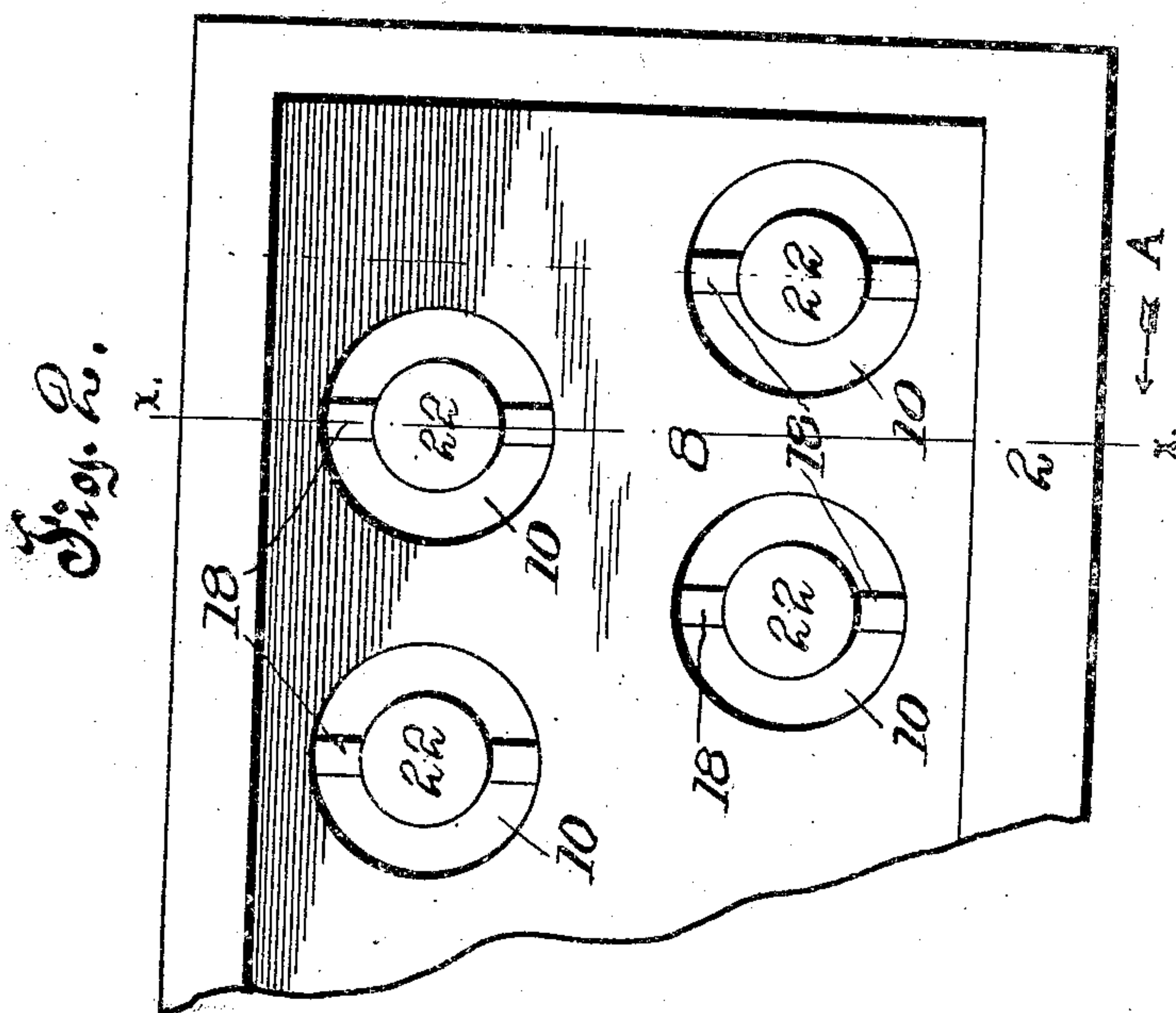
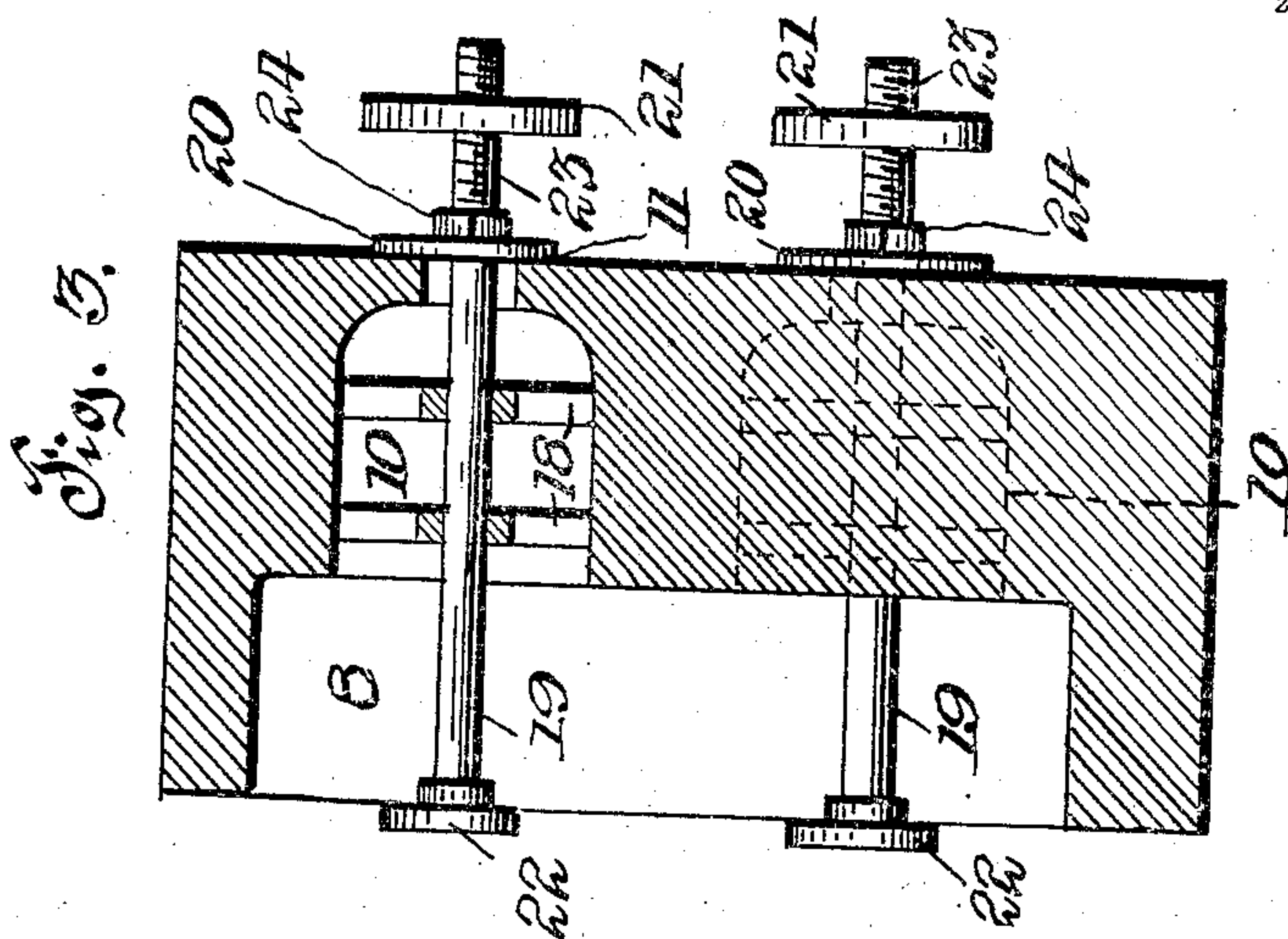
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2 SHEETS—SHEET 2.



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PNEUMATIC ACTION FOR MECHANICAL MUSICAL INSTRUMENTS.

No. 826,833.

Specification of Letters Patent.

Patented July 24, 1906.

Application filed June 10, 1905. Serial No. 264,674.

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 Pneumatic Actions for Mechanical Musical Instruments, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention has relation to pneumatic actions for mechanical musical instruments, and has for its object to provide novel means whereby the operation of the pneumatics or small bellows by means of which the movement of the sound-producing devices is effected will be rendered certain, rapid, strong, and otherwise effective for the intended purpose.

A further object of my invention is to simplify the construction and reduce the number of parts heretofore considered necessary in apparatus of this character.

A still further object of my invention is to so construct apparatus relating to the pneumatic appliances of mechanical musical instruments as to render all parts of the same easy of access, so as to facilitate cleaning, regulation, and necessary repairs.

Other objects of my invention will be developed in the course of describing the same; and my invention consists in the novel construction, combination, and arrangement of parts hereinafter described, and specifically set forth in the claims.

My present invention has been particularly designed for application to that class of mechanical musical instruments in which stretched wires are struck by hammers that are actuated by small bellows and in which the bellows are caused to operate by means of suction and atmospheric pressure, governed and controlled in their operation upon the bellows by a moving strip of perforated paper; but it will be obvious to those skilled in the art that the devices hereinafter described are applicable without material change in construction or mode of operation to musical instruments of other character than that above referred to—such, for instance, as melodions, organs, and other keyed wind instruments.

My improvements are illustrated in the ac-

companying drawings, to which I will now refer, and in the several figures of which like numerals designate corresponding parts, and in which—

Figure 1 is a vertical transverse sectional view taken through the primary board, the pneumatic-board, the valve-board, and one of the pneumatics or small bellows hereinbefore referred to. Fig. 2 is a front view of a portion of the valve-board. Fig. 3 is a transverse sectional view of the valve-board on the line $x\ x$ of Fig. 2 looking in the direction of the arrow A, and Fig. 4 is an enlarged elevation of one of the valves detached from the valve-board.

The pneumatic-board, the valve-board, and the primary board are in my improvement composed of relatively long and narrow sections of wood formed with a large number of channels, ports, and passages formed in the body of the wood, and the pneumatics consist each of a small bellows provided with a spring that tends to open the same, these "pneumatics," as they will be hereinafter termed, being arranged in regular order and in two rows upon the back of the pneumatic-board. In the drawings, 1 designates the pneumatic-board, 2 the valve-board, and 3 the primary board, these principal parts being arranged in the order just mentioned, one in front of the other with their abutting surfaces in air-tight contact and being secured together by bolts 4 4, which carry thumb-nuts 5 5 on their outer ends.

Upon the back of the pneumatic-board 1 a plurality of pneumatics 6 are arranged in two rows, one row over the other, but with the pneumatics of one row in staggered relation to the pneumatics of the other row, the pneumatics being secured to the pneumatic-board in any suitable manner, but preferably by means of small screws 7, so that the pneumatics may be, if desired, each separately removed from the pneumatic-board. The valve-board 2 is secured upon the front or face of the pneumatic-board by means of the bolts 4, and the valve-board is formed with a main channel 8 in its outer face, which channel is a rectangular recess that extends from near one end to near the other end and from near one side to near the other side of the valve-board and which is in communication by a port with suitable suction apparatus

when the devices which constitute my improvement are placed in position in a mechanical musical instrument.

The construction and operation of the suction apparatus which is used in connection with my improvement are not shown in the drawings and need not be described, as they are well known to those skilled in the art.

The valve-board 2 is provided with valve-chambers 10, terminating in valve-seats 11, these chambers being arranged in two parallel rows, one over the other, but with the chambers of one row in staggered position relatively to the chambers of the other row, as clearly illustrated in Fig. 2 of the drawings.

The pneumatic-board 1 is formed with valve-chambers 13, equal in number to the valve-chambers 10 of the valve-board 2 and similarly disposed, so that each valve-chamber in the valve-board will be when the parts are joined together in communication with the similarly-positioned chamber in the pneumatic-board. The valve-chambers 13 in the pneumatic-board are in communication each with the interior of one of the pneumatics 6 by a port 14, and each chamber 13 is also in communication with the outer air through a recess 15 and a slit or saw-kerf 16, extending from the outer end of the bottom board 17 of the pneumatic and into the recess 15.

The valve-chambers 10 in the valve-board are each provided with two spiders 18 18, and in the spiders of each chamber is mounted a valve-rod 19, this valve-rod extending completely through the valve-board and into the recess 15 in the pneumatic-board. Each rod 19 carries two valves 20 and 21 and a head 22, the end of the valve-rod which extends into the pneumatic-board being threaded, as shown at 23 in Fig. 4, and the valves 20 and 21 being held in fixed position on the valve-rod, the one—that is, the valve 20—by a nut 24 and the other, the valve 21, by screwing it onto the valve-rod, the friction between the parts being sufficient to maintain the valves at the position to which they may be adjusted on the valve-stem.

The valve 21 seats on the face of the bottom board 17 of the pneumatic 6 and serves at a certain position of the valve-rod to close the recess 15 against the passage of air from outside through the kerf or slit 16 and at another position of parts is moved out of contact with the bottom board of the pneumatic and permits of the entrance of air through the slit or kerf 16 into the valve-chamber 13 and thence through the port 14 into the interior of the pneumatic 6.

The valve 20 at one position of the valve-stem—that is, the position when the valve 21 is off its seat—rests on the valve-seat 11 of the valve-chamber 10 and shuts off communication between the valve-chamber 13 and

said valve-chamber 10, and in another position of parts—that is, when the valve 21 is seated on the bottom board 17 of the pneumatic and is closing the recess 15—the valve 20 is lifted from its seat and affords communication between the chambers 10 and 13.

The primary 3 is provided with a number of vertically-disposed channels 25 equal to the whole number of valve-chambers 10 in the valve-board, and each channel 25 has a horizontal branch in its upper end, these branches registering with an equal number of horizontal ports 26 in a horizontally-disposed board 27, that is a portion of or an adjunct of the pneumatic-board and may be formed integral with or attached thereto, as desired. The ports 26 are each formed with a vertical branch 28, and with the vertical branches 28 ducts 29 are connected, these ducts leading to the tracker-bar of a tracker-box, by means of which communication with the outer air may be afforded with each of the ducts 29 separately, simultaneously, or in any required sets of groups through the medium of a traveling sheet of perforated paper.

The tracker-bar, the traveling sheet of perforated paper, and the mechanism for actuating the same are well-known and understood adjuncts of apparatus of this character, and I have not shown and need not describe the same, as their function and operation is well understood and, so far as the operation of my present improvement is concerned, involves merely the successive opening and closing of the terminals of the ducts 29.

The inner face of the primary board 3 is provided with a plurality of circular recesses 30, arranged in similar manner to the valve-chambers 10 in the valve-board, one of said recesses being located opposite each of said valve-chambers. Each recess 30 is in communication with one of the channels 25 by a port 31, and each recess 30 is covered by a diaphragm 32, that is fastened at its edges to the inner face of the primary board and is free to move at its center. The head 22 of each of the valve-rods 19 bears against one of these diaphragms 32, and consequently the movement of the diaphragm in one direction will be imparted to the valve-stem, and vice versa. At the lower end of each of the channels 25 a "bleed" or very small port 33 is provided that leads from the channel 3 into the channel 8, and the size of the opening through this bleed or port is regulated by means of a screw 34, that penetrates through the primary board 3 and into said bleed or port. This screw 34 should be provided with a tapered point, so that the size of the passage through the bleed or port can be nicely regulated by turning the screw.

The parts being constructed in the above-described manner are operated as follows: Under normal operating conditions and until one or more of the pneumatics is to be

thrown into active condition the parts are in a position shown in Fig. 1 of the drawings, and while in this position a partial vacuum is constantly maintained in the channel 8 in all the valve-chambers 10 of the valve-board and in all of the channels 25, the communication of the channels 25 with the open air through the ducts 29 being, it is understood, cut off. The valves 20 are in this position of parts at rest upon the seats 11 of the chambers 10, and hence communication is cut off between the chambers 10 and the chambers 13, while at the same time the valves 21 are off their seats and the pneumatics are in communication with the outer air through ports 20, chambers 13, recesses 15, and slits or kerfs 16, the pneumatics being then held open by means of springs 35. While I have spoken of a vacuum as existing in the channel 8 and the channels and ports communicating therewith, it will be understood that this term is used in a relative sense to indicate a difference in pressure between that of the outer air and that existing in the channel 8. In the position of parts above described the valve 20 is held to its seat by the pressure of air in the chamber 13, which is of course the same as that of the outer air, and the diaphragm 32 is projected into the recess 30. If now by reason of the movement of the paper strip hereinbefore referred to air is permitted to enter one of the ducts 29, a difference in pressure will be immediately established between the air in channel 8 and the air in the particular channel 25, to which air has been admitted. The result of admitting air into the channel 25 is that the diaphragm 32 will be forced outwardly from the recess 30 and will impel the valve-stem 19 longitudinally and cause the valve 22 to leave its seat and immediately thereafter cause the valve 21 to seat over the recess 15. The seating of the valve 21 over the recess 15 cuts off communication between the pneumatic and the open air, and the unseating of valve 20 places the interior of the pneumatic in communication with channel 8, and the suction created in channel 8 by the suction apparatus will exhaust the air from within the pneumatic, which will thereupon close under the atmospheric pressure on the outside of the same, thereby through the closing movement actuating a hammer that belongs to the particular pneumatic which has been thrown into operation and sounding a tone. As soon as the passage of the air through the particular duct 29 which has been opened is shut off by the movement of the traveling strip of paper the suction in the channel 8 begins to exhaust the air from the channel 25, and as soon as the equilibrium of pressure is reestablished between channels 8 and 25 the valve 20 will be resealed and the valve 21 unsealed, the reverse movement of the diaphragm 32 necessary to this operation being

effected by the pressure of the air on the outer face of valve 21 and to some extent by the friction of the air flowing past the edges of valve 20.

Having described my invention, I claim—

1. In a device of the character described, the combination of a pneumatic-board, a plurality of pneumatics attached to said board, and arranged in two rows, the pneumatics of one row being in staggered relation to the pneumatics of the other row, said pneumatic-board being formed with a plurality of valve-chambers each communicating with one of the pneumatics and each communicating with the outer air, a valve-board secured to the pneumatic-board and provided with a channel, a plurality of valve-chambers registering with the valve-chambers of the pneumatic-board and communicating therewith and with said channels, a primary board formed with a plurality of ducts equal in number to the valve-chambers of the valve-board, each said duct being connected by a separate conduit to means for opening connection between the ducts of the primary board and the open air and each duct in the primary board being formed with a bleed leading into the channel of the valve-board and with means for regulating the capacity of said bleed, said means, said primary board being formed with a plurality of recesses equal to the number of valve-chambers in the valve-board, said recesses each communicating with one of the ducts in the primary board, a diaphragm arranged over each said recess in the primary board, a valve-rod arranged in each valve-chamber of the valve-board and extending through each valve-chamber of the pneumatic-board, two valves carried by each said valve-rod, said valves being so disposed on the valve-rod as to alternately open and close, one the communication between the valve-chambers in the pneumatic-board and the valve-board, and the other the communication between the chamber in the pneumatic-board and the open air.

2. In an apparatus of the character described, the combination of a pneumatic-board formed with a plurality of valve-chambers, a plurality of pneumatics attached to said board, each pneumatic being formed with a recess communicating with one of the valve-chambers in the pneumatic-board, and with an air-inlet leading from the said recess to the open air, and each pneumatic being provided with a port leading from the interior of the pneumatic to the said valve-chamber, a valve-board attached to said pneumatic-board and provided with a plurality of valve-chambers, each communicating with one of the valve-chambers in the pneumatic-board, a plurality of valve-rods each extending through the valve-chambers in the valve-board and the pneumatic-board, and

valves carried by said rods, said valves being so disposed on the valve-rod as to alternately open and close, one the communication between the valve-chambers in the pneumatic-board and the valve-board, and the other the communication between the chamber in the pneumatic-board and the recess in the pneumatic.

3. In an apparatus of the character described, the combination of a pneumatic-board, a valve-board, and a primary board arranged in juxtaposition and secured together, said pneumatic-board and said valve-board being formed with a plurality of registering valve-chambers and said primary board being formed with a plurality of ducts, and with a plurality of recesses, each recess communicating with one of said ducts, a diaphragm arranged over each said recess, a valve-rod extending through each chamber in the valve-board, and bearing against the diaphragm opposite said chamber, a valve carried by each valve-rod and governing the passage of air from the chamber in the pneumatic-board to the chamber in the valve-board and pneumatics mounted on the back of said pneumatic-board, each pneumatic being in communication with one of the chambers in the pneumatic-board.

4. In an apparatus of the character described, the combination of a pneumatic-board, pneumatics attached to said board, valve-chambers therein, a valve-board having valve-chambers registering with the valve-chambers in the pneumatic-board, and a channel in communication with said valve-chambers, the valve-chambers in the pneumatic-board being in communication with the interior of the pneumatics and with the open air, two valves arranged and adapted to alternately close the communication between the valve-chamber in the pneumatic-board and the valve-chamber in the

valve-board and a passage leading from the valve-chamber in the pneumatic-board to the open air, and means arranged adjacent the channel in the valve-board and adapted to be operated by variations of air-pressure to move said valves.

5. In an apparatus of the character described the combination with a plurality of pneumatics, a pneumatic-board, on which said pneumatics are mounted, said pneumatic-board being provided with chambers in communication with the interiors of the pneumatics and with the open air, a valve-board having a plurality of chambers communicating with the chambers in the pneumatic-board and having a channel, a primary board having a plurality of ducts and a recess communicating with each duct, a diaphragm covering each said recess, and means whereby when different degrees of pressure are established in the channel in the valve-board and the ducts in the primary board communication between the chamber in the pneumatic-board and the open air will be cut off and communication between the chambers in the pneumatic-board and the channel in the valve-board will be simultaneously established.

6. In apparatus of the character described, the combination of a pneumatic-board, an outwardly-extending portion carried by said pneumatic-board, and having a plurality of ports, a valve-board arranged on the face of the pneumatic-board below said projecting portion, a primary board arranged in contact with the valve-board and in contact with said projecting portion.

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

WILLIAM F. COOPER.

Witnesses:

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