C. FREBORG.

AUTOMATIC EXPRESSION CONTROLLING DEVICE.

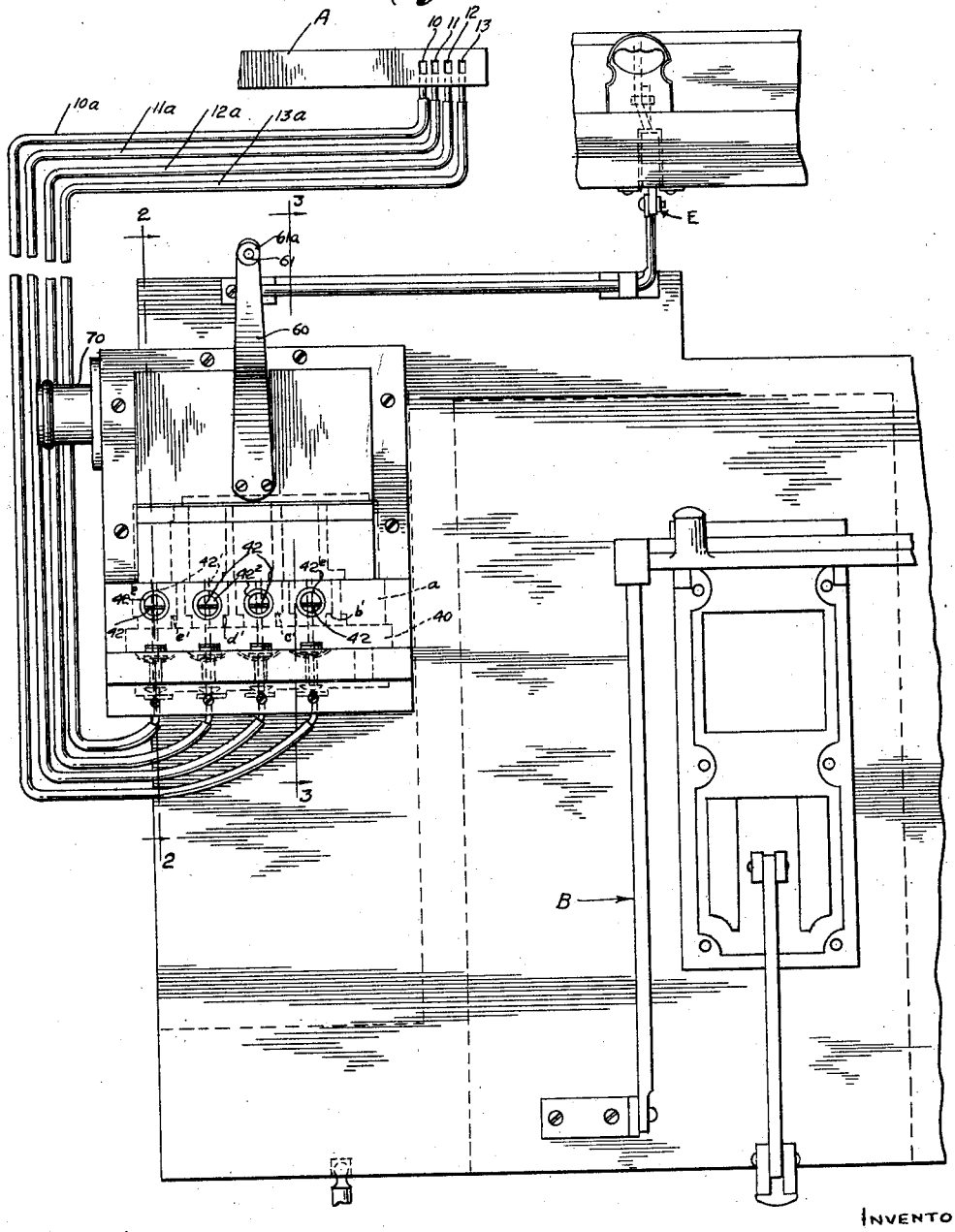
APPLICATION FILED JULY 24, 1918.

1,383,920.

Patented July 5, 1921.

4 SHEETS—SHEET 1.

Fig. 1.



WITNESS:

C. C. Burnap

INVENTOR:

Charles Freborg

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4 SHEETS—SHEET 2.

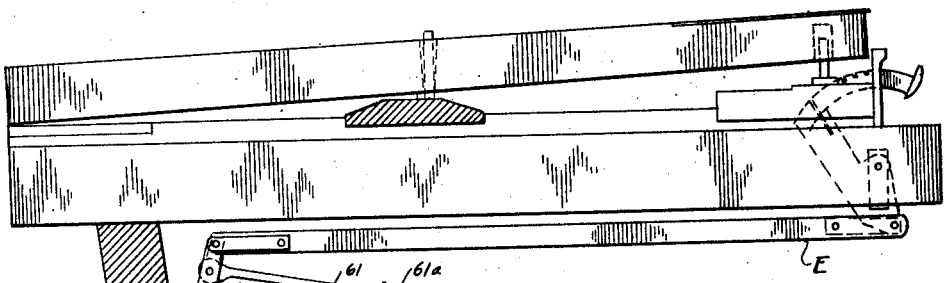


Fig. 2.

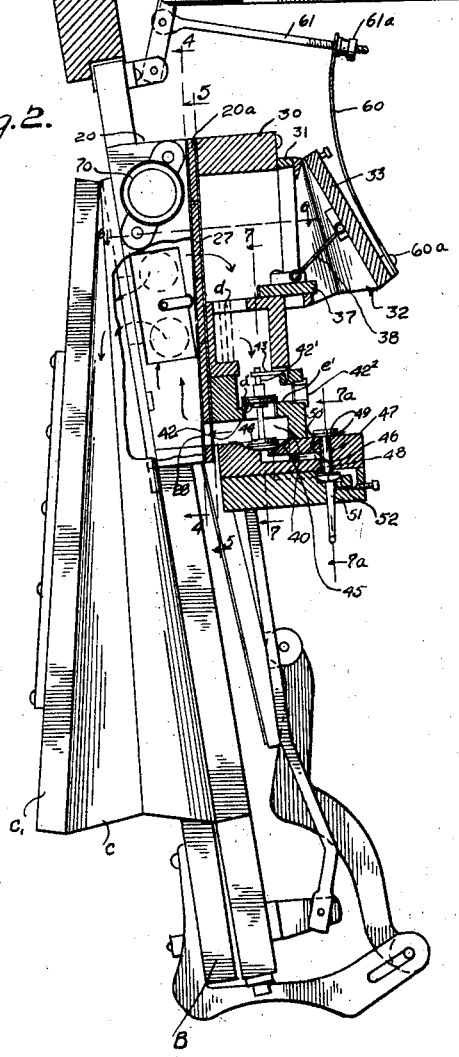
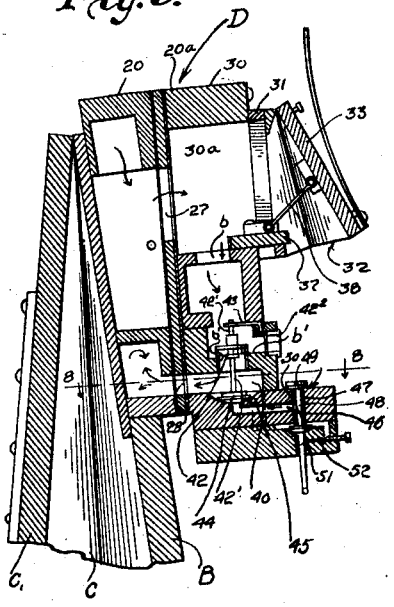


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 4.

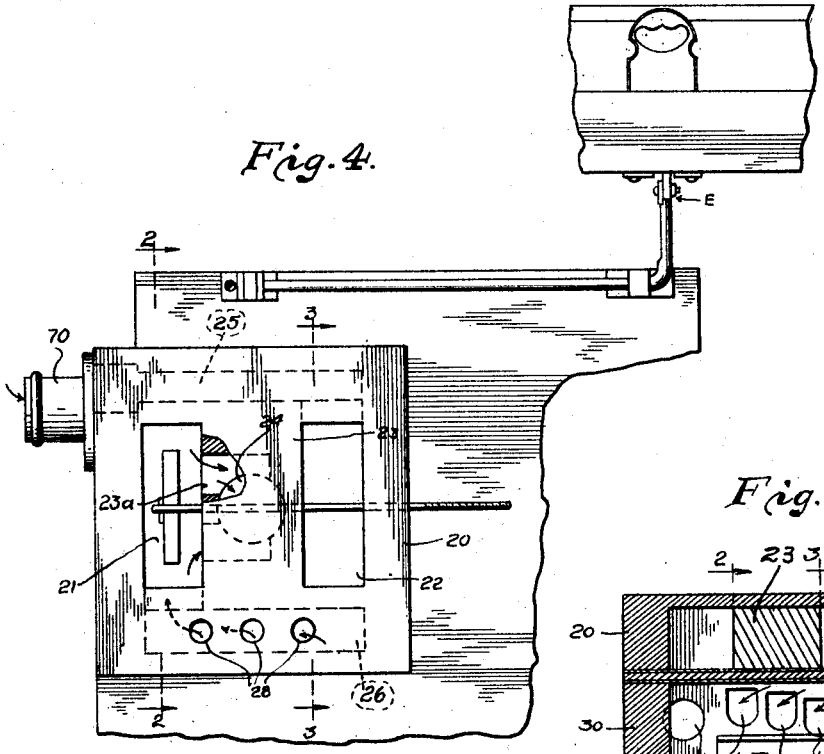
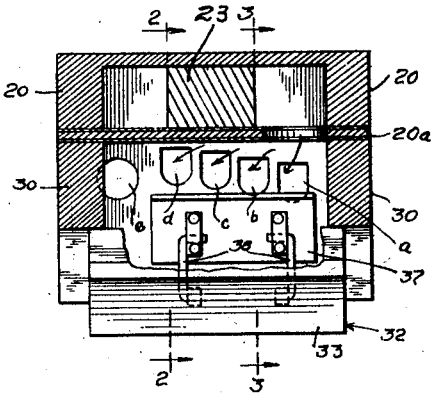


Fig. 6.



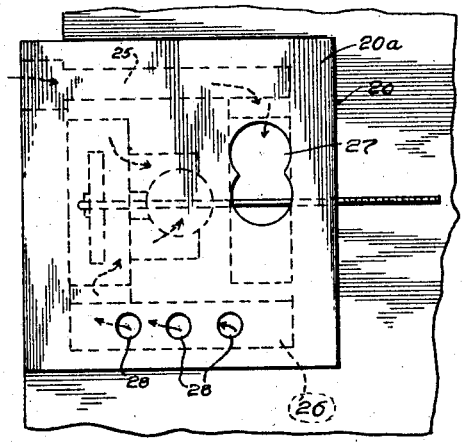


Fig. 5.

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4 SHEETS—SHEET 4.

Fig. 7.

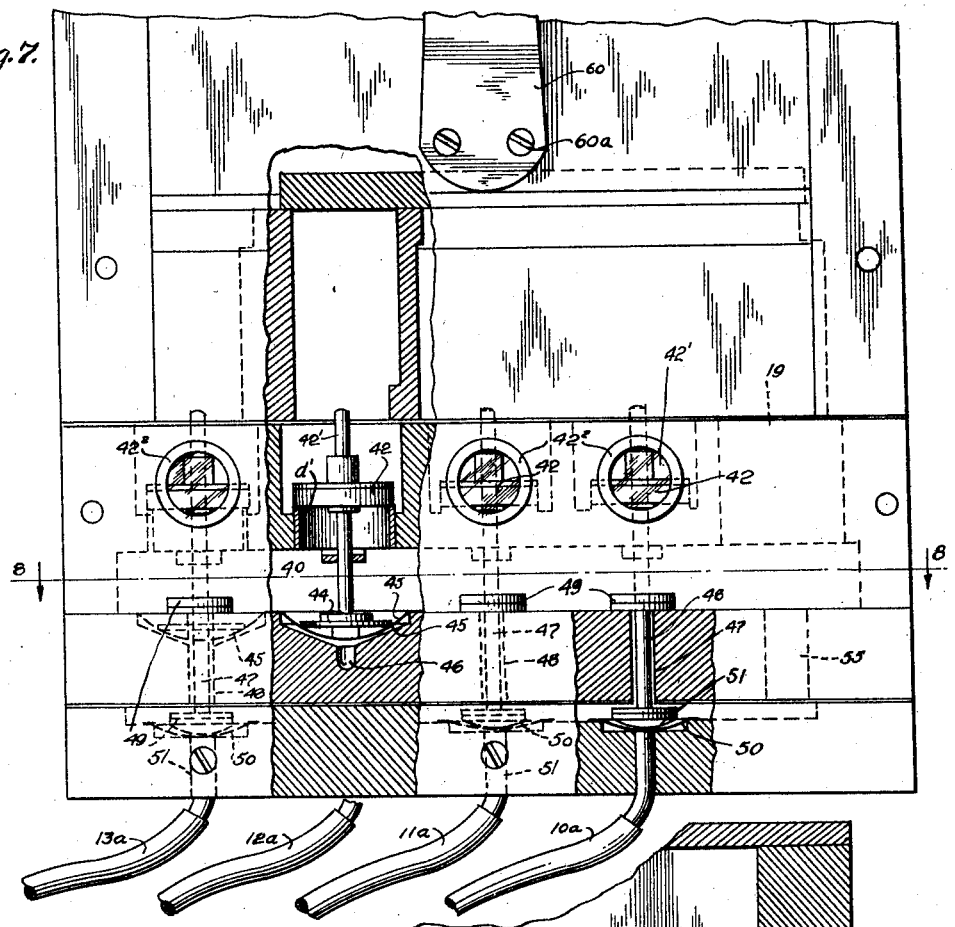
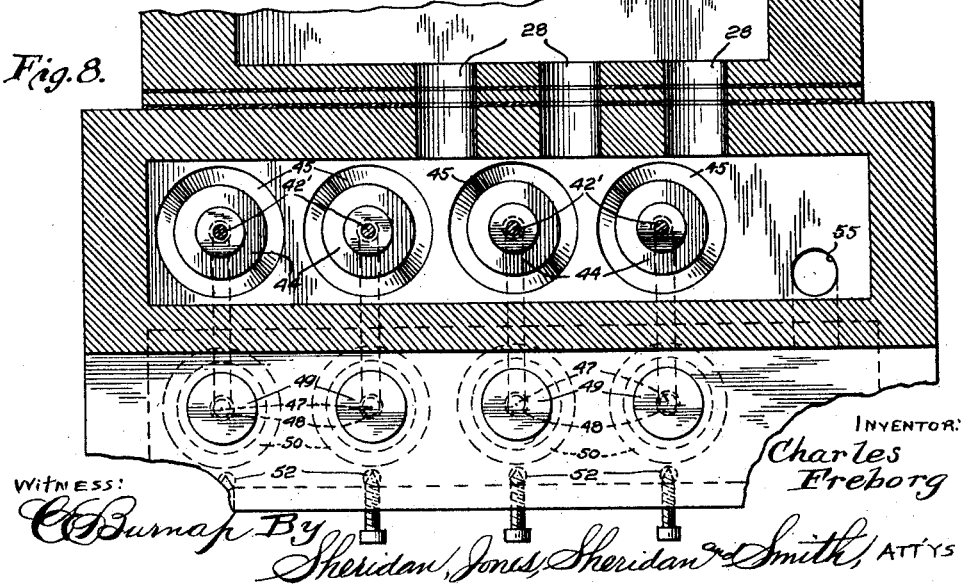


Fig. 8.



INVENTOR:
Charles Freborg

WITNESS:
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UNITED STATES PATENT OFFICE.

CHARLES FREBORG, OF KANKAKEE, ILLINOIS, ASSIGNOR TO PRICE & TEEPLE PIANO COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC EXPRESSION-CONTROLLING DEVICE.

1,383,920. Specification of Letters Patent. Patented July 5, 1921.

Application filed July 24, 1918. Serial No. 246,429.

To all whom it may concern:

Be it known that I, CHARLES FREBORG, a citizen of the United States, residing at Kankakee, in the county of Kankakee and State of Illinois, have invented certain new and useful Improvements in Automatic Expression-Controlling Devices, of which the following is a specification.

This invention relates to improvements in pneumatic expression-controlling devices, and has for its object to provide a comparatively simple structure which, coacting with suitable perforations in a music sheet or roll, will automatically govern the tone strength or expression during the execution of the piece of music on said sheet or roll.

Still another object of this invention is to provide such a device in which the usual and desired tone strength, such as pianissimo, piano, forte, etc., may be automatically obtained, and, in addition, different tone shadings lying between the ordinary tone strength may be also obtained.

My invention relies upon the fact, known to those skilled in the art, that the tone or expression in the operation of a player piano may be varied by increasing or decreasing the suction applied at the pneumatic action. I provide a governing or controlling member, which, in conjunction with ports corresponding to various tones desired, controls the flow of air therethrough and the suction obtaining at the pneumatic action, as will be clear upon a reading of the following specification.

These and other objects will be more fully explained and set forth in the following specification and shown in the accompanying drawings, in which—

Figure 1 is a front elevation of the expression-controlling member;

Fig. 2 is a transverse vertical section through the same of a portion of the board, taken along line 2—2 of Figs. 1, 4, and 6.

Fig. 3 is a transverse vertical section taken along the line 3—3 of Figs. 1, 4, and 6;

Fig. 4 is a front elevation of the expression-controlling member showing the pneumatic, valves, etc. removed;

Fig. 5 is a view similar to Fig. 4 with the diaphragm superimposed upon the structure shown in Fig. 4;

Fig. 6 is a transverse horizontal section along the line 6—6 of Fig. 2;

Fig. 7 is a detail view, drawn to a large scale, of a portion of the structure shown in Fig. 1, part thereof being drawn in section as along the line 7—7 of Fig. 2; parts thereof being shown in section, as along the line 7^a—7^a of Fig. 2; and

Fig. 8 is a transverse horizontal section along the line 8—8 of Fig. 3 and Fig. 7.

Like numerals refer to like elements throughout the drawings.

10, 11, 12, and 13 indicate apertures in the tracker bar A, see Fig. 1, from which lead tubes 10^a, 11^a, 12^a, and 13^a for expression control operation. Carried by suitable framework B is the compensating bellows C in communication with main air exhausting means, or the like, not shown. So far as the operation of my invention is concerned, bellows C may be considered as the exhauster bellows. The framework B includes the fixed wall of the bellows C, which has a movable wall C_1. Carried by the frame B is the expression-controlling member, generally indicated by D. This means comprises a main chest or box 20, upon which is mounted or attached a suitable diaphragm 20^a, see Figs. 5 and 6, for example. The box 20 is provided with two chambers 21 and 22, and between these chambers lies a dividing wall or partition 23. Provided in the partition 23 are the conduits or passages 23^a leading from the chamber 21. Leading from the conduits 23^a through the back of the chest 20 is a port 24 in communication with the interior of the bellows C. Located in the upper portion of the chest 20, extending partially across the same above chambers 21 and 22, is the duct or passage 25, see Fig. 4 for example, leading to and communicating with chamber 22. Leading partially across the bottom of chest 20 is a passage 26 in communication with chamber 21. In the diaphragm or partition 20^a are provided ports 27 and 28, the former providing communication between chamber 22 and the expression-controlling pneumatic to be described hereinafter—see Figs. 3, 4, and 5.

Superimposed upon the diaphragm 20^a and the chest or box 20 is a valve box, as I term it, 30, see Figs. 2, 3, and 6, for example, provided with a chamber 30^a therein, around which is mounted the apertured fixed wall 31 of the main expression-controlling pneumatic or bellows, generally indicated by numeral 32, and comprising in addition to the fixed wall 31 a moving wall 33. Leading

downwardly through the lower portion of the valve box 30 are ports *a*, *b*, *c*, *d*, and *e*. Ports *a*, *b*, *c*, and *d* are relatively offset with respect to a vertical plane, as clearly shown in Fig. 6.

A slide valve 37 is slidably mounted to coact with and control the flow of air or operating fluid through these ports, said slide valve being connected by a bail 38 with the movable wall 33 of the bellows. It will be apparent from an examination of Fig. 6, for example, that collapsing of the bellows 32 will successively cut down and cut off communication through the ports *a*, *b*, *c*, and *d*. All of the ports *a*, *b*, *c*, *d*, and *e* lead downwardly to and communicate with a cross chamber 40, see Figs. 2 and 3, for example, which cross passage is in communication with the passage 26, see Figs. 4 and 5, in the chest 20 through the medium of the small ports 28. Valve seats *b'*, *c'*, *d'*, and *e'* are provided adjacent the juncture of ports *b*, *c*, *d*, and *e* with the cross passage 40, see Fig. 1. Weighted valves 42 coact with each of the above-mentioned valve seats and normally maintain the same in closed position, being weighted to maintain such closing position. Each of the valves 42 is carried upon a stem 42', which is guided with its upper end in eyed guides 43 extending into the passage above the valve. The valve stems 42' at their lower ends rest upon buttons 44 carried upon flexible diaphragms 45, see Figs. 2 and 3, for example. Ducts 46 lead from beneath the diaphragms 45 to the vertical ducts 47 extending upwardly in the lower portion of the valve box 30 to communication with the open air. Mounted in these vertical ducts 47 are stems 48 carrying valve disks 49 normally resting upon the upper surface of the valve box 30 to close the vertical ducts 47. The lower ends of stems 48 rest upon buttons 49 which are carried upon flexible diaphragms 50 in a well known manner. Ducts 51 lead from beneath the flexible diaphragms 50 to communication with the tubes or ducts 10^a, 11^a, 12^a, and 13^a. Suitable restricted or bleed passages 52 lead from beneath the diaphragms 50 to above the same in the customary manner in the case of such pneumatic actuating units.

It will be apparent that upon a slot in the music sheet passing over one of the apertures 10, 11, 12, or 13, a pressure of the outside atmosphere will obtain beneath the corresponding diaphragm 50. Assuming suction or reduced pressure to exist in the space above the diaphragm 50, it will be apparent that the diaphragm will lift, pushing button 49 against the lower end of the vertical duct 47. This will operate to allow the outside air to flow in from the upper end of the passage 47 under the button 49, as indicated by the arrows in Figs. 2 and 3, for example, and atmospheric pressure will obtain beneath the diaphragm 45. It should be explained now that suction or reduced pressure obtains in the cross passage 40, since the same is in communication through apertures 28 (Figs. 2, 4, and 5) with passage 26 in the valve chest 20, which in turn is in communication with chamber 21, and through ports 23^a and 24, see Fig. 4, with the main bellows C. Suction obtains above the diaphragm 50 by virtue of the fact that the spaces thereabove are in communication (see Fig. 7) and form a continuous cross passage which is in communication with the cross passage 40 by means of a vertical duct shown in dotted lines and designated by numeral 55 in Fig. 7, and shown in full lines in Fig. 8. The action described just above, after the lifting of diaphragm 50, will result in raising of the weighted valve 42, which will open communication between the corresponding port *b*, *c*, *d*, or *e* and the main bellows C, as described above, causing suction to obtain in chamber 30^a, and in the bellows 32. Glass or other transparent side openings 42^2 are provided in front of the weighted valve 42, whereby the action of the latter may be observed when desired.

Collapsing of the bellows is resisted by a flexible leaf spring 60 attached at 60^a to the movable wall 33 of the bellows, and connected at its other end to the rod 61 which is threaded and provided with a threaded cap 61^a, by means of which the tension in the spring 60 may be increased or decreased for purposes of regulation.

This rod 61 is connected to a manual-control apparatus generally indicated by letter E, the description of which is not necessary in this application. I might state that so far as the operation of the structure shown and described in this application is concerned, I consider the manual-control apparatus as set at the position normally bringing the softest expression, so that the automatic control may be considered as being operative between its extreme limits; although, if the manual control be set for an expression louder than pianissimo—its lower limit—the corresponding lower limit of the automatic control will be correspondingly raised, as will be obvious.

It will be noted in the apparatus that port *a* is provided with no valve 42, but is in direct communication with the passage 40, see Fig. 1, for example, and this passage *a* corresponds in a sense to the normal soft playing tone. It is also to be noted that port *a* is the one first completely closed on inward movement of the valve 37. The port or passage *e* is not subject to control by the valve 37, and might be said to correspond to the loudest playing tone, and is also used to obtain what is known as a "crash" or sudden fortissimo expression.

Assuming the apparatus to be in opera-

tion without any expression-control aperture in the music sheet passing over the tracker bar openings 10, 11, 12, or 13, all of the valves 42 are in seated position, and the whole flow of air from the wind chest of the action pneumatics (not shown) passes through tube 70 and hence into cross passage 25, from such cross passage to chamber 22 to the chambers 30^a, from thence downwardly to port *a*, to cross passage 40, through ports 28 to cross passage 26 in the valve chest 20, and from there through chamber 21, ports 23^a and 24 to the exhauster bellows C.

As was explained at the beginning, the whole principle of this device relies upon the fact that the degree of tone or expression increases with an increase in the flow of air through the apparatus; or, in other words, the greater the suction—*i. e.* the lower the pressure—the sharper and heavier the blow struck by the action, and the louder the resulting tone. Bearing this fact in mind, it will be seen that with only port *a* providing communication between the pneumatic action and the exhausting bellows C, partial closing of the aperture *a* will prevent sufficient flow of air therethrough to greatly decrease the pressure in the action chest. Furthermore, the movable wall 33 of the bellows, being affected by the obtaining of reduced pressure in such bellows, will operate to slightly collapse the bellows, cutting off more or less the passage of air through port *a*. This movement is adjusted by means of the spring adjusting means coacting with springs 60 when the apparatus is properly tuned up.

Assuming an aperture in the music sheet to pass over aperture 12 in the tracker bar, the corresponding valve 42 on valve seat *b'* will be raised in the manner described above, and the port *b* will provide an additional passage for flow of air from the action chest to the exhauster bellows C. This results in a greater degree of suction, or a more reduced pressure obtaining in the line and in the bellows 32, and, as explained above, a louder tone results corresponding preferably to a "piano" tone. An increased suction may further collapse the bellows 32, although further collapsing is more strongly resisted by the springs 60, and the latter, coacting with the movable wall 33 of the bellows, in a sense stores potential energy; or, if the bellows be sufficiently collapsed to substantially decrease the resultant opening through ports *a* and *b*, still the pressure obtained in the bellows is so much reduced that flow of air through the ports *a* and *b* is increased, notwithstanding the reduction of area. In other words, although the effective discharge area is decreased, the suction is so increased as to more than compensate for it, and produces a louder or piano tone. As the music aperture actuates valve 42 seated on seat *d'*, port *d* will coact with port *a* to increase the suction at the action chest, and, owing to the further advanced position of port *d* relative to the direction of movement of the valve 37, closing of such port *d* will not take place until after a considerable movement of the valve 37, such movement being more and more strongly resisted by the springs 60. In short, as either of the ports *b*, *c* and *d* is opened it presents a greater area of discharge opening when the resisted movement of the valve 37 is considered.

When a very loud or "crash" tone is desired, the valve controlling flow through port *e* is actuated by passage of an aperture in the music sheet over the tracker bar aperture 10, and this port *e*, being uncontrolled by the valve 37, presents a maximum of discharge conduit.

Combinations of the ports may be obtained by the simultaneous passage of two or more of the music apertures over the tracker bar apertures 10, 11, 12, and 13, and the resultant tones obtained provide additional variations, and enable a finer gradation in expression-control by providing more or less discharge area, as will be obvious.

It will be apparent that my invention is susceptible of many modifications and improvements, and I do not wish to be restricted to the form shown or described, beyond the scope of the appended claims.

What I claim is:

1. In a structure of the class described, an air-exhausting means, means to convey air thereto, a plurality of ducts providing communication between said air-conveying means and said exhausting means, a valve normally closing each of said ducts, means to open each of said valves upon passage of a corresponding aperture in a sheet of music over a tracker board, said ducts being each provided with a port, and a main valve member for regulating flow of air through said ports, said ports being located in different positions relative to the direction of movement of said main valve.

2. In a device of the class described, an exhausting means and an air conveying means, a plurality of ducts providing communication between said means, said ducts being provided each with a port, a valve slidable relative to said ports to control flow through said ducts, said ports being successively advanced relative to the movement of said valve, a bellows having a movable wall, means connecting said valve to said wall, and separate valve means for each of said ducts controlled by passage of an aperture in a music sheet over a corresponding tracker bar aperture.

3. In a device of the class described, an exhausting means and an air conveying

means, a plurality of ducts providing communication between said means, said ducts being provided each with a port, a valve slidable relative to said ports to control flow through said ducts, said ports being successively advanced relative to the movement of said valve, a bellows having a movable wall, means connecting said valve to said wall, separate valve means for each of said ducts controlled by passage of an aperture in a music sheet over a corresponding tracker bar aperture, yielding means to resist closing movement of said bellows wall and valve, and means to vary the resistance of said yielding means.

4. In structure of the class described, an exhausting means, an air conveying means, an expression control means interposed between said air conveying means and said exhausting means comprising a chest having a compartment in communication with said air conveying means and a compartment in communication with said exhausting means, a chest having ducts providing communication between said compartments, and means to control flow through said ducts, said last named means comprising a common control valve, a bellows having a movable wall connected to said valve and independent valves permitting or preventing flow through each of said ducts.

5. In structure of the class described, an exhausting means, an air conveying means, an expression control means interposed between said air conveying means and said exhausting means comprising a chest having a compartment in communication with said air conveying means and a compartment in communication with said exhausting means, a chest having ducts providing communication between said compartments, and means to control flow through said ducts, said last named means comprising a control valve, a bellows having a movable wall connected to said valve, and independent valves permitting or preventing flow through each of said ducts, said ducts being progressively advanced relative to the movement of said control valve.

In testimony whereof, I have subscribed my name.

CHARLES FREBORG.