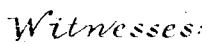


EXPRESSION DEVICE FOR MECHANICAL MUSICAL INSTRUMENTS.
APPLICATION FILED DEC. 10, 1908.

Patented Mar. 25, 1913.

1,056,820.



Inventor

James O'Connor
By *Wm H Honies* Att'y

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2 SHEETS-SHEET 2.

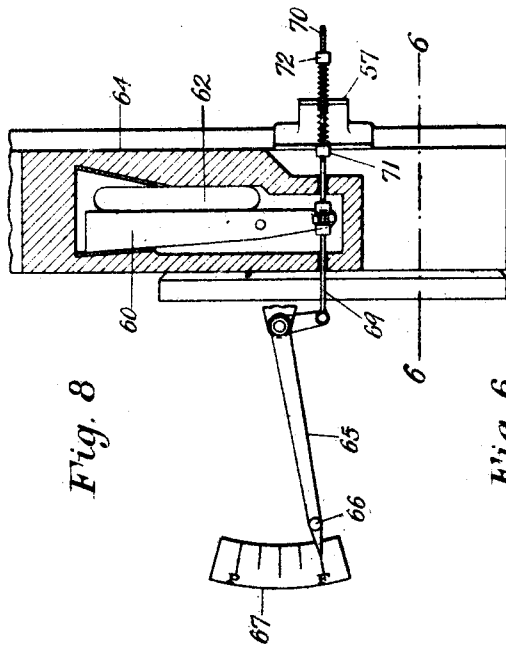


Fig. 8

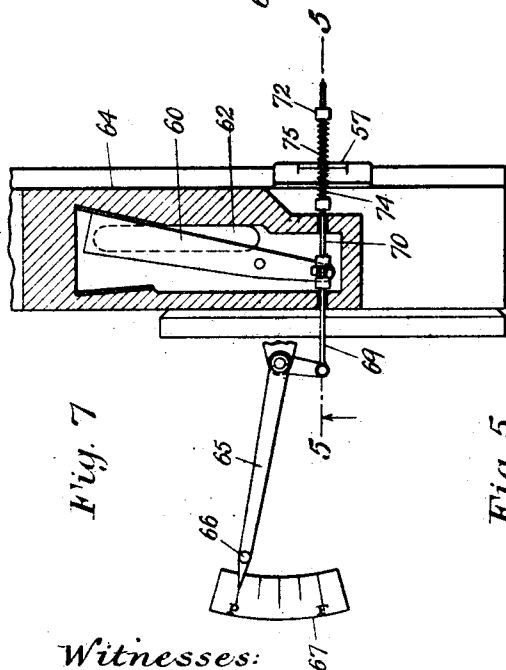


Fig. 7

Witnesses:
 H. Mallner
 Janice L. Ellsworth

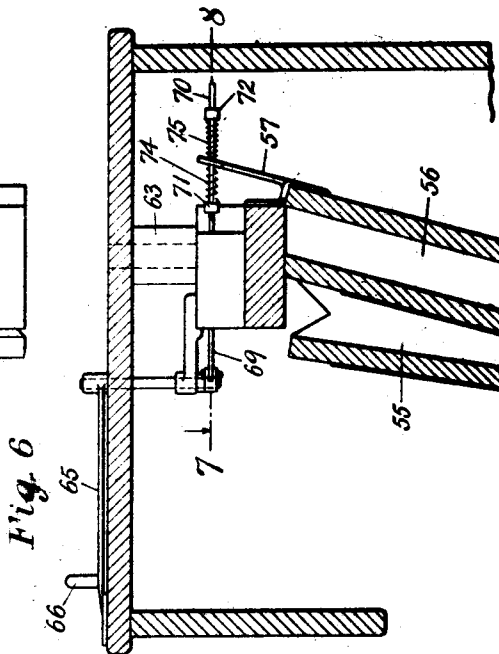


Fig. 6

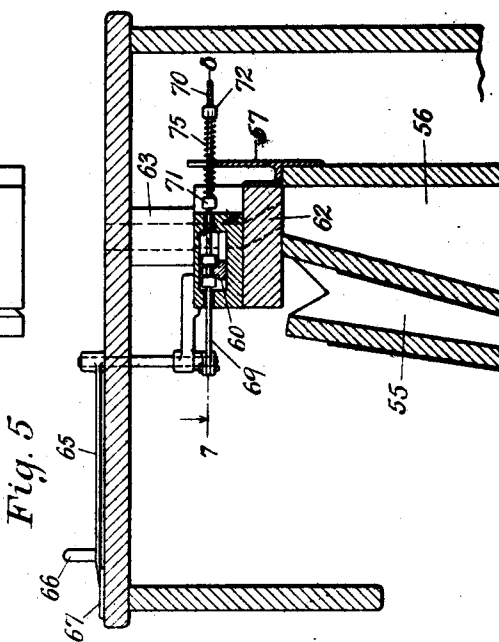


Fig. 5

Inventor
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 By W. H. Thomas, Atty.

UNITED STATES PATENT OFFICE.

JAMES O'CONNOR, OF NEW YORK, N. Y.

EXPRESSION DEVICE FOR MECHANICAL MUSICAL INSTRUMENTS.

1,056,820.

Specification of Letters Patent.

Patented Mar. 25, 1913.

Application filed December 10, 1908. Serial No. 466,754.

To all whom it may concern:

Be it known that I, JAMES O'CONNOR, a citizen of the United States, and resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Expression Devices for Mechanical Musical Instruments, of which the following is a full, clear, and exact specification.

This invention relates to improved means for varying the force of operation of pneumatic motors. It is herein shown as being particularly adapted for controlling the operation of the class of percussion bellows motors now generally employed in automatic piano players and similar instruments.

Figure 1 is a side view, in section taken on the line 1—1 of Fig. 2, showing an end view of an instrument embodying this invention. Fig. 2 is a rear view in section taken on the line 2—2 of Fig. 1. Figs. 3 and 4 are plan views in section taken on the line 3—4 of Fig. 2, showing the construction and operation of the valve controlling the air passage leading from the pumping devices to the motor pneumatics. Fig. 3 shows the valve in its open position while Fig. 4 shows it in its closed position. Fig. 5 is an end view in section taken on the line 5—5 of Fig. 7; and Fig. 6 is an end view in section taken on the line 6—6 of Fig. 8. Figs. 7 and 8 are plan views in section taken on the lines 7—8 of Figs. 5 and 6, showing the controlling valve and its manual connection at the two extremes of their movement. Fig. 7 shows the valve in its closed position, while Fig. 8 shows it in its open position.

The percussion bellows motors herein referred to, for which the present embodiment of this invention is more particularly adapted, are commonly employed in mechanical piano players for actuating the hammers which strike against the strings of the piano. The loudness or softness of the resulting tone is dependent upon the force and rapidity with which the bellows operate; and in the case of the so-called vacuum motor bellows, in which the blow is struck by the closing movement of the bellows, the force of the blow obviously depends upon two factors, namely the tension of the inducing vacuum, and the size or area of the opening through which the air passes from

the motor bellows to the inducing vacuum. With a low tension or with a small aperture, or both, the closing movement of the motor bellows would be relatively slow, thus producing a soft tone, whereas with a high tension and ample aperture, the closing movement would be rapid, thus striking a sharp blow and producing a loud tone. By varying either or both of these factors, corresponding variations may be made between the loudest and softest effects. In the present invention means are provided for thus varying either or both of these two factors.

In the embodiment of this invention represented in Figs. 1 to 4 inclusive, 10 represents the casing for the instrument, merely to show some supporting means for the contained devices, it being understood that the said devices may be mounted in casings like those commonly employed for mechanical piano players, or when applied to what are known as internal piano players, they may be attached to the casing or frame of the piano itself. The vacuum inducing device herein shown consist of the pumping bellows 11 connected in any well-known way with the treadle 12. The regulating or equalizing bellows 13 may also be of well-known construction and may be mounted in direct connection with the pumping bellows 12, as shown in Figs. 5 and 6. But in the embodiment shown in Figs. 1 and 2 there is an additional chamber 15, herein termed the accenting chamber, interposed between the pumping bellows 11, and the equalizer 13. This chamber is resiliently contractible but non-collapsible, the front and rear walls 16 and 17 being joined at their ends and at the bottom by the more or less flexible walls 18 and 19, as best shown in Fig. 2, so as to permit the side walls 16 and 17, and in the present construction more particularly the latter, to spring inwardly and outwardly toward and away from each other under the influence of the varying pressures, while in operation. To prevent the chamber 15 from collapsing, one or more blocks 20 are employed, placed so as to permit the aforesaid springing movement of one or both of the walls 16 and 17.

Air is drawn by the pumpers 11 from the accenting chamber 15 through apertures 21 covered by a flap of leather, serving as check valves to prevent the return flow of the air

from the pumper or pumpers 11 to the chamber 15. Air communication between the accenting chamber 15 and the equalizing bellows 13 is by means of the opening 23, which is provided with a flap valve 24, on the outer side of the wall 17 from the chamber 15. This flap valve is yieldingly held in its closed position by a suitable spring 25, so that the valve 24 when otherwise unrestrained serves as a check valve for the opening 23, allowing the air to flow freely from the chamber 15 to the equalizing bellows 13, when the air comes in from the motor bellows faster than it is drawn out by the pumpers, but preventing the flow in the opposite direction when the air is pumped out faster than it enters the chamber 15 from the motor bellows. Means, however, are provided by which the operation of the flap valve 24 may be manually controlled to interrupt and restore the action of the equalizing bellows 13 at the will of the operator. In the present instance this manual control is effected by means of a wedge 26 which engages with an arm 27 appurtenant to the valve 24, the wedge being provided with a stem 28, which extends through the wall of the apparatus, and is connected to the lever 29, pivoted in any convenient way to the casing as by the bracket 30. The lever reaches, or is extended by suitable connections to a position convenient to the hand of the operator, where it may be provided with a button 31. In the present arrangement the pressing down of the button 31 operates through the intermediate connections to withdraw the wedge 26 from the valve 24, thereby enabling it to serve as a check valve. The parts are yieldingly held in position shown in Fig. 1 by means of a spring 32, thereby holding the valve 24 out of operation and enabling the equalizing bellows to perform its ordinary well-known function of equalizing to an approximate extent the tension of the vacuum, thus preventing the extreme and rapid variations which are liable to occur either by variations in the operation of pumping devices, or in the number of notes sounded at different periods. When the wedge 26 is withdrawn by pressing the button 31 the valve 24 is allowed to close and thereby practically cuts the equalizing bellows 13 out of operation, or at least prevents it from responding, with any effect, to the action of increased tension in the accenting chamber 15. Thus the increased tension is enabled to take effect instantly upon the motor bellows 35 with which the accenting chamber 15 is connected by means of a passage 36. In the present instance only one of these motor bellows is shown, since their arrangement and operation is so well understood, it being sufficient to remark that any desired number of these bel-

lows may be employed, being connected with the passage 36 by means of a wind chest or wind trunk 37.

In order to preclude the possibility of the bellows 13 ever being fully expanded, even when cut off by the closing of the valve 24, so as to be inoperative when wanted, a small bypass 40 between the pumpers 11 and the equalizing bellows 13 is preferably provided, through which the pumpers 11 will always act to some extent on the equalizer 13, since their action is entirely independent of the chamber 15 and the valve 24. This bypass is large enough to counteract the effect of ordinary leakage of the bellows 13, but should not be large enough to enable the latter to respond too promptly or to any appreciable extent to the varying tensions induced by the pumpers. Thus the bellows 13 is always being slowly exhausted, even during the time that the valve 24 is closed, thereby being always held in readiness to assume its customary function automatically whenever the tension falls to the degree for which the equalizer bellows is adjusted, or whenever the valve 24 is opened. By this provision the movable leaf of the bellows will generally be maintained at some position between the ends of its range of movement, ready either to open or to close upon the opening of the valve 24, according to the tension then existing in the chamber 15. In the absence of such a bypass or its equivalent, the equalizing bellows 13 would generally become fully expanded under the pressure of its spring 14, whenever the valve 24 was in its closed position; and in this fully expanded position of the valve it could not respond to a low tension in the chest 15, occurring when the valve 24 might be opened either by hand, or automatically by the very relaxation of the tension in the chamber 15. But with the pumping action constantly operating through the bypass 40 to hold the equalizing bellows 13 in a partly contracted condition, it is enabled either to contract further under increased tension in the accenting chest 15 upon the forced opening of the valve 24, or to expand in response to lessened tension in the chamber 15 whenever the valve 24 is forced open, or opens automatically because of the said lessened tension in the chamber 15.

It will now be understood that by the operation of the devices thus far described, a greatly increased tension may be obtained at the will of the operator, by increasing his pumping action, and at the same time pressing down the button 31, thus approximately cutting out the equalizing bellows 13, the natural effect of which would otherwise be to contract quickly under the increased pumping action, thereby equalizing the tension and thus preventing the desired accenting effect.

The devices so far described and shown at the lower portion of Figs. 1 and 2 in connection with the equalizing bellows, are shown, described and claimed in my Patent No. 927587 of July, 13, 1909, to which reference may be made for more complete and detailed operation and adaptation of this mechanism. The present invention relates, however, to other expression modifying devices, which although perhaps most advantageously used as shown in Figs. 1 and 2, in conjunction with the expression devices of my said patent, may also, as shown in Figs. 5 and 6, be used advantageously without the devices of my said patent, in conjunction with the ordinary form of equalizing bellows.

I will now describe one form of my improved devices shown in Figs. 1 to 4 for varying the area of the passage 36 through which the air flows from the wind trunk 37 leading to the associated motor bellows 35.

At any convenient point between the pumping devices and the wind trunk 37, the passage 36 passes through a valve chest 43, best shown in Figs. 3 and 4. The valve chest is provided with a valve 44, which is mounted to move, preferably by a swinging movement, from its open position shown in Fig. 3 to the position shown in Fig. 4, in which it cuts off a considerable portion of the area of the passage 36. A spring 45 is preferably employed for moving the valve in one direction preferably its closing direction, as shown herein. The movements of this valve are controlled automatically by the movement of the equalizing bellows 13, and also manually by the operator. For its automatic control the valve is connected as by means of a rod 46 to the moving leaf of the equalizing bellows 13, being in the present case shown to be connected to an arm 47 appurtenant to the swinging leaf. The connections are arranged so that the closing movement of the leaf of the bellows 13 serves to open the valve 44. Hence the direct effect of increasing the tension in the motor bellows is further augmented by increasing the area of the passage 36 through which the vacuum takes effect upon the motor bellows, thereby in a degree utilizing and applying both of the factors above referred to. In other words, a more powerful action of the motor bellows is obtained: first, by the increase of tension due to the more rapid pumping, and second, by enlarging the size or capacity of the passage 36, whereby that increased tension takes fuller and prompter effect upon the bellows. It will be recognized that the increase of tension, due to the more rapid pumping function, will be modified more or less by the closing movement of the equalizing bellows 13, in response to that increased tension, in all cases where the equalizing bellows is allowed to

operate and exercise its accustomed function, as in Figs. 5 and 6, and also in Figs. 1 and 2, when the valve 24 is left in its normal open position. But nevertheless a very useful effect is thereby produced. Moreover, the effect being under the automatic control of the equalizing bellows is smooth and connected. Where, however, a sudden and pronounced emphasis is desired, it may be obtained by the manual connection with the valve 44, consisting of the rod 49, which connects the valve with the arm 50, appurtenant to the lever 29. By depressing the button 31 the valve 44 is thrown wide open as in Fig. 3 and at the same time the wedge 26 is withdrawn, permitting the flap valve 24 to close, thus immediately cutting out the action of the equalizing bellows, thereby utilizing to their fullest degree both of the factors above referred to, namely the high tension and the full opening of the passage 36.

The respective connections of the manual button 31 and equalizer bellows with the valve 44 permit either of the former to be operated without interfering with the other, thus to this extent making the operation of the manual and automatic features independent of each other. For example, starting with the parts in the position shown in Fig. 1, the closing of the leaf of the equalizing bellows 13 pushes against the nut or collar 51, thereby opening the valve 44 without moving the arm 50, inasmuch as the connecting rod 49 is mounted to slide freely through the end of that arm. On the other hand, when the device is operated manually by pressing down the button 31, the lever 50 pushes against the nut or collar 53, thus opening the valve 44 without affecting the arm 47 of the bellows, since the rod 46 is fitted to slide through that arm when thus moved.

The mode of operation of this device is as follows:—The operator, by means of the treadle 12 and bellows 11, induces a vacuum approximately suited to the general character of the piece being played, modifying the tension for particular passages by means of the press button 31. During the playing of ordinary and softer passages the button remains in its raised position shown in Fig. 1, which leaves the valve 44 in its partially closed position shown in Fig. 4, and also leaves the check valve 24 of the equalizing bellows open, as shown in Fig. 1, thereby leaving that equalizing bellows in communication with the pumpers, whereby it automatically opens and closes the valve 44 in response to variations in the tension. Upon reaching a note which should be accented the operator depresses the button 31, thereby opening the valve 44 to or toward the position shown in Fig. 3, and closing the valve 24 by the withdrawal of the wedge 26 correspondingly increasing the air carrying capacity of

the wind passage 36 and cutting out the equalizer 13, and thereby enabling the motor bellows to be exhausted more promptly. At the same time the pumping movement is increased, which, in the absence of the equalizing action of the bellows, correspondingly increases the tension of the vacuum. Thus the rapidity, and hence the force of action of the motor bellows is increased by the two factors hereinbefore mentioned, namely, increase of tension and increase of area of the wind passage, through which the air rushes from the motor bellows in response to the higher tension. After the accented note or passage has been played, the press button is again released, thus opening the valve 24 and restoring the equalizing action of the bellows 13, which again resumes control of the movements of the valve 44, and continues its automatic control of that valve until again cut out of action by the use of the button 21.

The button need not be depressed far enough to cut out the action of the equalizing bellows 13, excepting for those notes or passages which require the highest possible emphasis. It may be depressed to any desired degree for varying the position of the valve 44, meanwhile taking it out of the control of the equalizer 13.

In Figs. 5 to 8 inclusive is shown a modified form of the invention, the modifications including a different form of manually operated lever and a form of connection with the expression valve which is positive in both directions of movement, and a yielding connection between that valve and the equalizing bellows for both directions of movement. In this modification as here shown the resiliently contractible but non-collapsible wind chest hereinbefore termed "the accenting chamber" is shown to be omitted, although it may obviously be employed in this modified form of the invention as well as in that shown in the preceding figures. The pumper or pumpers 55 in this case communicate directly with the equalizing bellows 56, the movable leaf of which is provided as before with an arm 57 operatively connected with the expression valve 60, so that the closing movement of the equalizing bellows, under the action of increased tension or vacuum serves to open the valve 60 and increase the area of the passage 62, which in this case communicates between the interior of the equalizer bellows and the windtrunk 63, which leads in the usual way to the motor pneumatics (not shown in these figures). In this embodiment the valve 60 is wholly contained within the valve chest 64 instead of projecting through the side wall thereof as in the previous figures, the connecting rods for operating the valve extending through properly bushed openings in the opposite side walls of the chest. The

manual controlling device is herein shown to consist of a pivotally mounted indicator lever 65 provided with a knob 66 for convenient handling, and serving also in connection with a graduated dial 67 to show to the eye of the operator the relative positions of the indicator lever 65 and consequently the positions of the valve 60. The indicator lever 65 is positively connected as by means of a rod 69 with the valve 60. Therefore the position of the lever 65 constitutes an accurate index of the position of the valve. In Fig. 7 the valve 60 is shown in its closed position, thereby locating the indicator at the position P of the dial, this being the position in which the softest effects are secured. On the other hand, in Fig. 8 the valve is shown in its wide open position, carrying the indicator lever to the opposite extreme of its movement at the position F of the dial, and indicating the strongest and loudest action.

In the absence of the means shown in the preceding figures, or of other means for putting the equalizing bellows out of operation when manually operating the expression valve, the equalizing bellows continues its movement, and in order to allow of that movement without interfering with the manual operation, the connection between the valve 60 and the equalizer bellows arm 57 is made yielding and resilient. The connecting rod 70 which is appurtenant to the valve 60 is provided with collars 71 and 72, which are fitted upon the rod 70 so as to be longitudinally adjustable thereon; as for example by means of set screws; or the rod 70 may be threaded and the collars 71 and 72 may be fitted upon those threads as nuts, and adjusted by turning them. Between the collar 71 and the arm 57 is a spring 74, and between the collar 72 and the arm 57 is another spring 75. The tension of these springs is made sufficient to carry the valve 60 and the lever 65 with the movements of the arm 57. The adjustable collars 71 and 72 enable the tension to be accurately adjusted and also enables the valve 60 to be set in proper relation to the movements of the equalizing bellows 56, so as to obtain the desired movement of each relative to the other.

The operation of this modified form of this invention is in many respects similar to that described in connection with the form shown in Figs. 1 to 4, inclusive, excepting that in this modification the equalizer is not at any time cut out of operation. The flexible or elastic connection formed by the springs 74 and 75 enable the valve 60 to be moved by the lever 65, as may be desired by the operator. That valve and lever return at once to the positions determined by the equalizer bellows as soon as the lever is released by the operator.

The wind trunk or chest herein referred to

is not necessarily any particular conduit or reservoir now technically thus designated, but may obviously be any air duct or passage leading to the percussive motor bellows.

5 The proportion between the increase and decrease of the vacuum inducing action on the one hand, and the increase and decrease of the communicating capacity on the other hand, may be varied to any desired extent
10 by varying the sizes and shapes of the various chambers and openings, and by suitably adapting the lengths and angular relations of the various arms, levers, and connections.

15 It will be understood that this invention may be employed either in conjunction with the apparatus of my said prior Patent No. 927,587, as shown in Figs. 1 and 2, or may be used without that apparatus, in connection
20 with ordinary pumping and equalizing bellows, as shown in Figs. 5 and 6. Obviously also the connections between the valve 44 or the valve 60 and the equalizing bellows, may be positive as shown in Figs. 1 and 2,
25 or may be yielding, as shown in Figs. 5 and 6. The manually operated connection with the valve 44 or the valve 60 in any case may be like that shown in Fig. 1, or like that shown in Figs. 5 to 8 inclusive. The adoption of the best form and combination is a
30 matter of judgment and selection on the part of the constructor or manufacturer to suit the purposes to be served; it being obvious that these devices may be modified in various
35 ways to suit various conditions or purposes.

I claim as my invention:—

1. Pneumatic motor bellows apparatus, including in combination a wind chest, means communicating with the wind chest
40 for inducing varying degrees of vacuum therein, means for increasing the total capacity of the communication from the wind chest to the vacuum inducing means in proportion to the increase of the vacuum inducing
45 action.

2. Pneumatic motor bellows apparatus, including in combination a wind chest, means communicating with the wind chest for inducing varying degrees of vacuum therein,
50 means for decreasing the total capacity of the communication from the wind chest to the vacuum inducing means in proportion to the decrease of the vacuum inducing action.

3. Pneumatic motor bellows apparatus, including in combination a wind chest, means in communication with the wind chest for inducing varying degrees of vacuum therein, and means for increasing and decreasing the total capacity of the communication from
60 the wind chest to the vacuum inducing means in proportion to the increase and decrease of the vacuum inducing action.

4. Percussion motor bellows apparatus, including in combination a wind chest, means
65 in communication with the wind chest, for

inducing varying degrees of vacuum therein, and means controlled by the vacuum for increasing and diminishing the total capacity of the communication with the wind chest in proportion to the increase and diminution
70 respectively of the tension of the vacuum.

5. Pneumatic motor bellows apparatus, including in combination a wind chest, pumping devices in communication with the wind chest for inducing vacuum therein, a valve
75 for varying the total capacity of the communication between the pumping devices and the wind chest, and means controlled by the pumping devices for operating the valve to increase and lessen the said total
80 capacity in direct proportion to the increasing and decreasing tension of the vacuum produced by the said pumping devices.

6. Percussion motor bellows apparatus, having in combination a wind chest, pump-
85 ing devices in communication with the wind chest, a valve for varying the total capacity of the communication, and a bellows connected with the said valve and operating under the control of the pumping devices for increas-
90 ing and lessening the said communication in proportion to the increase and diminution respectively of the vacuum produced by the pumping devices.

7. Percussion motor bellows apparatus,
95 including in combination a wind chest leading to motor bellows, pumping devices in communication with the wind chest for inducing a vacuum therein, a valve for varying the total opening of said communication to correspondingly vary the flow of
100 air therethrough, and an equalizing bellows communicating with the pumping devices and operatively connected with the valve to increase and diminish the capacity of said
105 communication in proportion to the increase and diminution respectively of the vacuum induced by the pumping devices.

8. Percussion motor bellows apparatus, including in combination a wind chest for
110 the motor bellows, pumping devices, a passage between the pumping devices and the wind chest, a valve for reducing the total area of said passage, an equalizing bellows communicating with the pumping devices,
115 an arm appurtenant to the movable leaf of the equalizing bellows, and a connection between the said arm and the valve all arranged and operating to vary the area of the said passage in proportion to the degree of
120 vacuum induced by the pumping devices.

9. Pneumatic apparatus, including in combination a wind chest, means in communication with the wind chest for inducing vacuum therein, means controlled by the
125 vacuum for automatically increasing and diminishing the capacity of the said communication with the wind chest in proportion to the increase and diminution, respectively, of the tension of the vacuum, and
130

manually operated means for modifying the automatic control.

10. Pneumatic apparatus, including in combination a percussion motor bellows, means in communication with the said bellows for inducing vacuum therein, means controlled by the vacuum for automatically increasing and diminishing the capacity of the communication with the bellows in proportion to the increase and diminution, respectively, of the tension of the vacuum, and manually operated means for modifying the automatic control of the said communication.

11. In pneumatic apparatus, the combination of a wind chest, means including a passage communicating with the wind chest for inducing vacuum therein, means including an equalizing bellows for automatically varying the communicating capacity of the said passage, and manually operated means for putting the said equalizing bellows into and out of communication with the vacuum inducing means.

12. In pneumatic apparatus, the combination of a wind chest, means including a passage communicating with the wind chest for inducing vacuum therein, means including an equalizing bellows controlled by the vacuum for automatically varying the communicating capacity of the said passage in accordance with the vacuum inducing means, and manually operated means for interrupting and restoring the automatic control by putting the equalizing bellows out of and into communication with the vacuum inducing means.

13. In pneumatic apparatus, the combination of vacuum inducing means, a passage connecting the said means with the pneumatic devices to be operated, a valve controlling the air capacity of the said passage, automatic means including regulating bellows communicating with the vacuum inducing means for operating the said valve to automatically vary the said capacity in accordance with the variation in the vacuum, and manual controlling devices therefor including means for putting the said equalizing bellows out of communication with the vacuum, and including means for operating the said valve.

14. The combination in pneumatic apparatus, of vacuum inducing devices, a passage connecting the said devices with the pneumatic devices to be operated, a valve controlling the air capacity of the said passage, automatic means for controlling the movements of the valve including a regulating bellows communicating with the vacuum space, and having a connection with the valve, and means for manually controlling the valve, including means positively connected with the said valve, and means for putting the regulating bellows out of communication with the vacuum space.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES O'CONNOR.

Witnesses:

ARTHUR CONRON,

KATHERYNE M. SCHWEIGER.