

(No Model.)

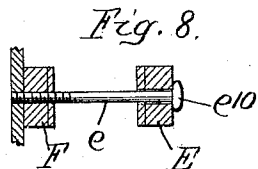
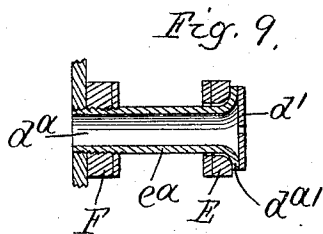
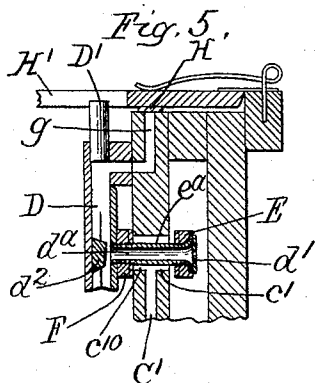
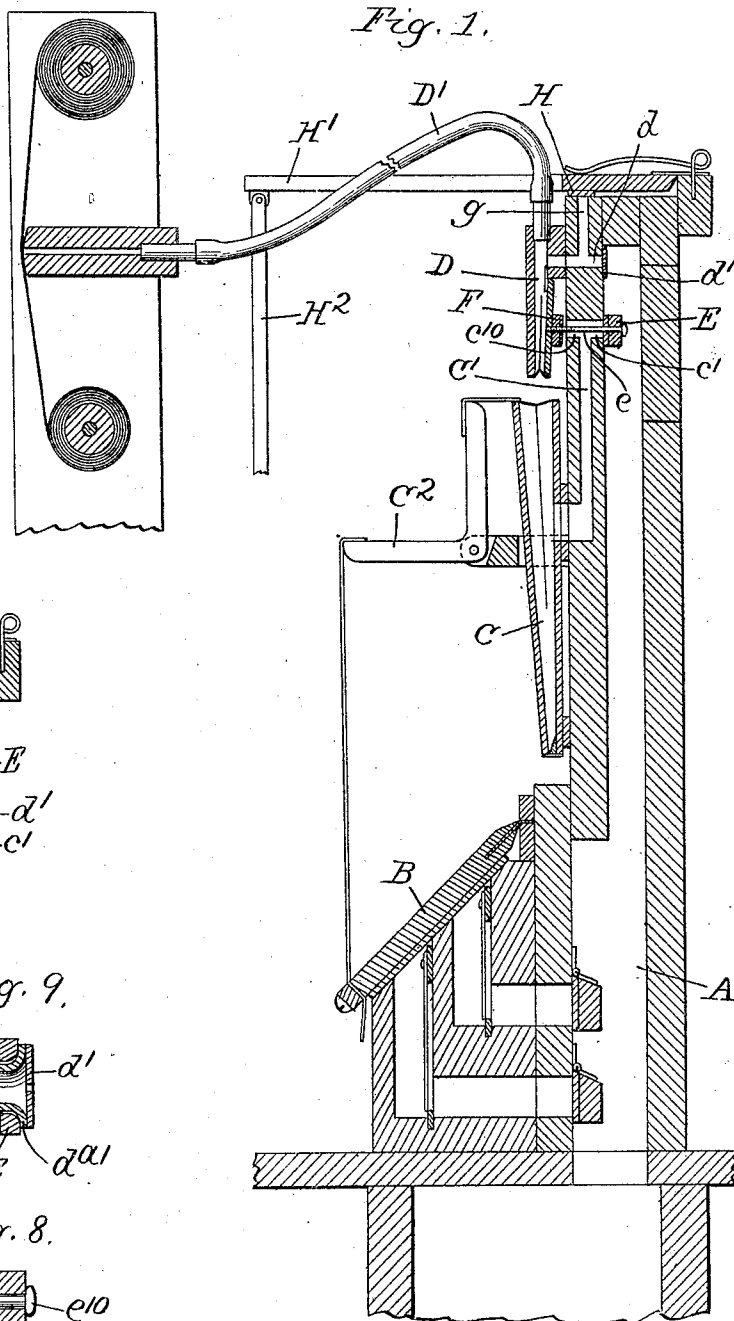
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M. CLARK.  
PNEUMATIC MUSICAL INSTRUMENT.

No. 576,032.

Patented Jan. 26, 1897.

Fig. 1.



Witnesses.

E. T. Wray,

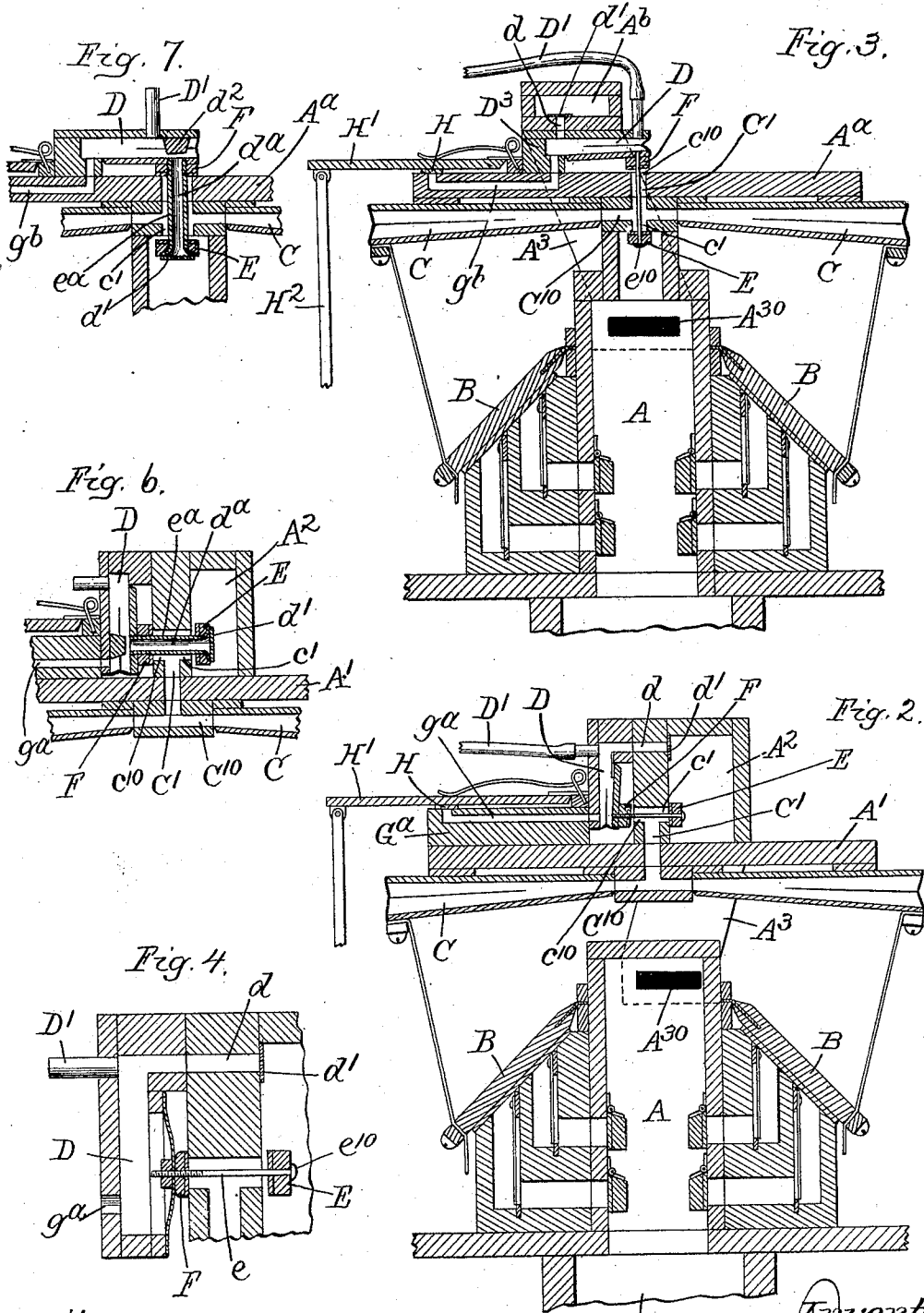
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# UNITED STATES PATENT OFFICE.

MELVILLE CLARK, OF CHICAGO, ILLINOIS.

## PNEUMATIC MUSICAL INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 576,032, dated January 26, 1897.

Application filed July 27, 1896. Serial No. 600,654. (No model.)

*To all whom it may concern:*

Be it known that I, MELVILLE CLARK, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Pneumatic Musical Instruments, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

10 This invention relates to improvements in musical instruments in which the sound-producing devices are caused to speak by means of so-called "pneumatic motors;" and it consists in improvements in a construction

15 by which the pneumatic is made much more sensitive than heretofore—that is, adapted to respond to less suction or pressure in the wind-chest, and, specifically, adapted to respond to less suction or pressure than is necessary to cause the sound-producing devices

20 themselves to speak. It is therefore peculiarly adapted to reed or pipe instruments in which the suction or pressure of air in the wind-chest, producing a current of air past

25 or through the sound-producing device, is the means of making the latter speak, the same suction or pressure being the means of operating the pneumatics. In such instruments it is very important that a minimum quantity of air should be used to operate the pneumatic devices, so that the work imposed upon

30 the bellows in respect to the quantity of air which they shall pump shall not be excessively increased by the employment of the pneumatics beyond what would be required for the sound-producing devices themselves. This consideration has led to the employment of what may be termed "primary" pneumatics—that is, pneumatics which are primarily

40 operated by the suction or pressure in the wind-chest—to operate the valves which control the communication with the wind-chest of secondary pneumatics, such secondary pneumatics being the means of causing the sound-producing devices to speak. This permits the use of a very small primary pneumatic and of a secondary pneumatic of any necessary size to operate the sound-producing device, the quantity of air required to be

50 pumped or drawn by the bellows being determined by the size of the primary pneumatic, independently of the size of the sec-

ondary or motor pneumatic. In such combinations of primary and motor pneumatics which have been commonly employed the

55 primary pneumatic has been generally located within the wind-chest, so that its area might be subject to the tension of air in the wind-chest. In organs or other musical instruments operating by exhaust action in

60 the wind-chest, producing suction thereinto through all passages communicating with the interior of such wind-chest, this construction has been found to necessitate the employment of a spring whose function is to col-

65 lapse the primary pneumatic when the communication of that pneumatic with the exterior air is closed by the controlling devices, such collapse being permitted by a very restricted vent-aperture with which the pneumatic is provided inside the wind-chest. Obviously the inflation of the pneumatic by exterior air, when the controlling devices admit

70 such air, will be effected against the resistance of this spring, and the degree of rarefaction necessary in the wind-chest in order to produce the action of a pneumatic must be such as to afford, by the difference between the

75 tension of the air within the bellows and that of the external air, at least sufficient force to overcome the spring, and since the collapse of the bellows effected by the reaction of this spring must be practically instantaneous, in order that the response of the reeds to the action shall be prompt and that the tones shall

80 not overlap each other, and since the collapse must be effected by the discharge of the air through a very small vent-aperture in the primary pneumatic, the spring requires considerable power in order thus to drive the air

90 out through the small orifice instantaneously. The result is that in practice the minimum degree of rarefaction in the wind-chest which will cause the lightest reeds to speak is utterly insufficient to operate the pneumatics. For

95 this reason the finer modulations of intensity of tone of organs operated pneumatically cannot be produced except by muffling devices in the nature of swells—that is, the tension in the wind-chest, being the least which is sufficient to operate the pneumatic devices, is sufficient to produce a very loud tone from the reeds, and softer tones are only producible by muffling such loud tones. Such organs,

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therefore, as hitherto constructed are not capable of fine gradations of tone, which, in an organ operated from the keyboard and by strictly mechanical connections from the keys to the reed valves, are effected by the operator modifying the action of the bellows to produce the expression desired from the reeds. The advantage, therefore, of reducing the force necessary to operate the pneumatics to and below the degree of force necessary as a minimum to cause the reeds to speak is that thereby it becomes possible to modulate the intensity of the tone produced and so to vary the expression at the will of the operator who controls the bellows, and thereby to vary it in every degree, and not merely with such step-by-step modifications as can be effected by means of swells. The means which I employ for this result consist, primarily, in locating both the primary and the motor pneumatics outside the wind-chest in such relation that springs in connection with such pneumatics may be dispensed with.

In the drawings, Figure 1 is a vertical fore-and-aft section of a portion of the wind-chest and pneumatic action of an organ having my improvements. Fig. 2 is a similar section of like parts of an organ having duplex arrangement of motor-pneumatics, reed-chambers, and valves cooperating with each primary pneumatic. Fig. 3 is a similar vertical fore-and-aft section of a pneumatic action resembling that seen in Fig. 2, but having the primary pneumatic placed horizontally instead of vertically. Fig. 4 is a detail section showing a modification of the primary pneumatic. Figs. 5, 6, and 7 are detail sections representing a modification of the primary pneumatic in respect to its connections with the wind-chest, said figures corresponding, respectively, to Figs. 1, 2, and 3. Figs. 8 and 9 are magnified detail sections of the valves operated by the primary pneumatics corresponding to two forms of such valves shown, respectively, in Figs. 1, 2, and 3 and in Figs. 5, 6, and 7.

A is the wind-chest. In Fig. 1 I have shown one reed-block thereon having two reed-chambers controlled by a single valve B. This valve is operated by a motor-pneumatic C, mounted upon the forward vertical side of the wind-chest and operating the reed-valve by means of a bell-crank lever C<sup>2</sup> and suitable flexible connections from its arms, respectively, to the pneumatic C and the reed-valve B.

I do not limit myself in any respect to the specific situation of the motor-pneumatic or of the reed-valve.

D is the primary pneumatic. In the form shown in Fig. 1 it is also mounted on the forward vertical side of the wind-chest and is in the form of a bellows whose movable side is suspended at its upper end and oscillates between the fixed side and the forward side of the wind-chest. The primary pneumatic communicates with the wind-chest through a duct *d*, which is restricted at its mouth-open-

ing into the wind-chest by a disk *d'*, through which a very small puncture is made. The primary pneumatic also communicates with the outer air through a duct, (represented by the tube D'.) This tube may extend to a tracker-range where the access of air will be controlled by the traveling perforated strip in a manner well understood, and it may be controlled in any other manner at will, and in some of the forms of my invention herein shown the primary pneumatic has double communication with the outer air, one communication being controlled by a perforated strip at a tracker-range and the other being controlled by a valve operated by a key of the manual. The motor-pneumatic communicates by means of the duct C', formed in the forward wall of the wind-chest, both with the interior of the wind-chest at *c'* and with the exterior air at *c*<sup>10</sup>. Valves E and F, mounted on the same stem *e*, control these two openings, respectively, the valve F being formed on or secured to the oscillating side of the bellows which constitutes the primary pneumatic, so that the movement of that side of the pneumatic in one direction or the other seats one valve or the other and puts the motor-pneumatic in communication either with the interior of the wind-chest or with the exterior air. Said oscillating wall of the primary pneumatic, pendent, as described, hangs, normally—that is, when free from the influence of the wind-chest or any extraneous force—with the valve F in contact with its seat at the orifice *c*<sup>10</sup>.

It will be understood that when the air in the wind-chest is rarefied by the pumping action of the bellows the primary pneumatic, being in communication with the wind-chest through the duct *d*, is virtually a continuation of the wind-chest and is subject to the same rarefaction of its contents and is therefore collapsed, and its oscillating side is held away from the side of the wind-chest, carrying the valve F off its seat and seating the valve E, thus giving the motor-pneumatic communication with the exterior air and cutting off its communication with the wind-chest. This condition of affairs continues so long as the communication of the primary pneumatic with the exterior air through the duct *d'* is closed, but when said duct is uncovered at its outer end, as by the registration of an aperture of the traveling perforated paper strip with the mouth of the duct at the tracker-range, atmospheric pressure being admitted freely to the pneumatic and the exhaust through the punctured disk *d* being very restricted, the primary pneumatic becomes inflated normally and the valve E comes to its seat, the valve E being opened, thus cutting off communication of the motor-pneumatic with the outer air and establishing communication of the same with the wind-chest and causing collapse of the motor-pneumatic under exterior atmospheric pressure, the connections from the motor-pneumatic being such that the movement of its oscillat-

ing wall involved in such collapse causes the sound-producing devices to speak, as in the case of a reed-organ, by lifting the reed-valve D. This condition continues so long as the mouth of the duct, which admits atmospheric air to the primary pneumatic, remains uncovered, but ceases, the parts returning to the original positions, whenever that duct is closed, since then the suction from the wind-chest collapses the primary pneumatic. In this construction it will be observed that all the valves and both the pneumatics operate without springs, and, furthermore, that the oscillating parts of the pneumatics being pendulous the operation involves the minimum resistance, even by the weight of the moving parts.

In practice, the bellows-walls of the primary pneumatic, which must be practically air-tight, because these pneumatics are, as stated, practically a continuation of the wind-chest, have a slight elasticity, and this elasticity is taken advantage of to insure the normal seating of the valve F against the side of the wind-chest, since without care in this respect the slight stiffness and elasticity of material employed for this purpose might sometimes operate to hold the valve off its seat, even contrary to the action of gravity, by which it will be normally seated, but this precaution is only taken because it is not practicable to construct these small pneumatics so that invariably the bellows-walls at their normal condition shall tend to hold the valve F in the same position in which it is held by gravity—that is, just barely resting at the outer surface of the wall of the wind-chest. By thus dispensing with all devices exerting pressure to seat the valves or collapse the pneumatics I produce an instrument in which the pneumatics will act upon the very slightest suggestion of rarefaction in the wind-chest, and long before the rarefaction has reached a degree sufficient to make the reeds speak. It thus becomes possible to moderate the intensity of the tone of the instrument precisely as if the reeds were being manipulated by hand or by strictly mechanical connections with the manual, the lightest tone of which the reeds are capable being producible when the reed-valves are operated by pneumatics, and all variations from the lightest to the most intense being effected by varying the operation of the bellows.

In Fig. 2 I have shown my invention applied in a reed-organ in which each primary pneumatic controls the action of two motor-pneumatics, such motor-pneumatics operating the valves of independent sets of reeds, the motor-pneumatics being placed horizontally instead of vertically, and overhanging the reed-valves which they respectively operate, the construction in respect to the arrangement of the motor-pneumatics and the reed-valves being that which is shown in my application Serial No. 573,592, filed December 28, 1895. The reed-valves B B, operating

over reed-chambers which are mounted, respectively, upon the front and rear sides of the wind-chest A, are respectively operated by horizontal motor-pneumatics C C, placed heel to heel, overhanging the reed-valves, respectively. These motor-pneumatics are mounted upon the under side of a board A', upon the upper side of which is a supplement A<sup>2</sup> of the wind-chest, which is supported above the wind-chest A proper by hollow standards, affording communication through ports A<sup>30</sup> from the wind-chest proper to said wind-chest supplement A<sup>2</sup>. The primary pneumatic D is mounted upon the forward side of the wind-chest supplement A<sup>2</sup> in precisely the same manner as in Fig. 1, the duct d', restricted by the perforated disk d', being the means of air communication from the wind-chest to the interior of the pneumatic, D' being the duct leading to the tracker-range. The duct C', which leads from the interior of the motor-pneumatics, extends from the cross-passage C<sup>10</sup> up through the board A' on the forward side of the wind-chest supplement A<sup>2</sup> into the cross-duct which at the port c' opens into the wind-chest supplement and at the port c<sup>10</sup> opens to the exterior air, said ports being closed by the valves E and F, respectively, operated, as in Fig. 1, by attachment to the oscillating side of a primary pneumatic D. It will be understood, therefore, that the operation is precisely the same in this structure as that shown in Fig. 1.

In Fig. 3 I have shown the primary pneumatic placed horizontally instead of vertically and having its moving side overhanging the port c<sup>10</sup>, so that it operates more positively by gravity to seat the valve F than in the construction in which it is pendulous. I have shown this arrangement and position of the primary pneumatic in connection with the duplex construction and arrangement of motor-pneumatics which is shown in Fig. 2. For the purpose of such an arrangement of the pneumatics the wind-chest supplement A<sup>b</sup> is supported by the hollow standard A<sup>3</sup> in such manner as to leave its under side, instead of its forward side, exposed for the purpose of mounting thereon the primary pneumatic D, and in this construction the fixed wall of the primary pneumatic is mounted directly against the under wall of the wind-chest supplement and protrudes beyond the wind-chest supplement at the rear to afford convenient means of connecting with the primary pneumatic the duct D', which leads from the tracker-range. The passage C', having the cross-passage C<sup>10</sup> for the two motor-pneumatics, in this construction leads from the wind-chest proper, A, up through the board A<sup>a</sup>, on the under side of which the motor-pneumatics are mounted. The valves E and F operated by the moving side, which is the under side, of the pneumatic control the ports c' and c<sup>10</sup>, as in the construction shown in the other figures.

In all of these forms provision may be made for operating the instrument by a manual instead of by means of the perforated sheet traveling over the tracker-range, and in all the forms this may be done in either one of two ways—to wit, either by mechanical connections from the keys of the manual to the reed-valves B, making a mechanical action entirely independent of the pneumatic action, or by providing the primary pneumatic with a communication with the exterior air, in addition to that which it obtains through the pipe which leads to the tracker-range, and controlling such additional communication by a valve operated by means of connection with a manual-key. The latter means is illustrated in the drawings. In the form shown in Fig. 1 the second air communication for the primary pneumatic is afforded by means of the duct *g* in the board which forms the side of the wind-chest, such duct leading into the duct *d*. In the form shown in Fig. 2 the same function is performed by the duct *g*<sup>a</sup>, formed in the board G<sup>a</sup>, mounted on the top of the board A' and having the fixed side of the primary pneumatic mounted against its rear edge, the duct *g*<sup>a</sup> extending on through the fixed wall and thus leading into the pneumatic-chamber. In the form shown in Fig. 3 the same function is performed by the duct *g*<sup>b</sup>, which is made in the board A<sup>a</sup>, on which the primary pneumatic is supported, said duct continuing up through the block D<sup>a</sup>, which forms the heel of the primary pneumatic. In each case the outer end of the duct which thus affords the second outer air connection of a primary pneumatic is controlled by a valve II on a lever II', suitably fulcrumed at its rear end upon any convenient fixed part and having at its forward end suitable means for mechanical connection with a manual-key, as the link II<sup>2</sup>.

The specific means by which mechanical connection from the manual-key, either to the valve II or to the reed-valve B, is made constitutes no part of the present invention, and I have therefore not illustrated any means for making the connection with the valve B, since many obvious modes and means for this purpose will occur to those familiar with the art.

In the principal figures I have shown the primary pneumatic as of the bellows form; but I do not limit myself to this form. Other well-known forms of pneumatics may be employed, such, for example, as the form shown in Fig. 4, in which a diaphragm from behind or under which a duct leads to the wind-chest is substituted for the oscillating side bellows. This form has one advantage over a bellows form in that it is more easily made air-tight, as it is essential the primary pneumatic should be when it is exterior to the wind-chest. In the diaphragm form of pneumatic the valve F, mounted on the diaphragm, will be held normally—that is, by virtue of its structure and the action of gravity upon it without the influence of the wind-chest—in contact with its

seat by the diaphragm at its normal position. The easiest action is obtained by making the diaphragm so that normally when free from the influence of the wind-chest it bulges slightly outward, as seen in Fig. 4, and does not fluctuate far enough to reverse the direction of its curvature or fullness, but is stopped by the seating of the valve F before it has moved far enough to have a tendency to bulge the other way. This outward-bulging tendency of the diaphragm thus normally seats the valve with the same effect as in the pendulous form. The valve is seated by gravity without sensible pressure upon its seat. The same result as to normal seating of the valve by the diaphragm at its normal position would be attained if the diaphragm were normally straight and sufficiently elastic to be depressed by the suction experienced from the wind-chest; but this would require tensile elasticity, and the diaphragm so constructed cannot be made so delicately sensitive to slight rarefaction in the wind-chest as a diaphragm applied with a little fullness, causing it to bulge toward the valve-seat.

By the term "primary pneumatic" as employed in the above specification and in my claims I mean a pneumatic whose action immediately caused by the difference between the tension of the air within the wind-chest and that of the external air is the initial action in a train which comprises a secondary pneumatic or pneumatics whose ultimate action causes the sound-producing devices to speak. This term thus used therefore excludes pneumatics which mechanically operate the means for causing the sound-producing devices to speak and which are included in the term "motor-pneumatics" as used in this specification. The importance of these distinctions will be understood when it is remembered that in constructions in which a pneumatic is caused or permitted to operate in a musical instrument for any purpose by admitting atmospheric pressure to it, as in all constructions in which a perforated sheet or equivalent device is the means employed, there is unavoidably a constant waste of air while the pneumatic is kept thus exposed to the atmospheric pressure—that is to say, while the sound-producing device is being caused to speak. The pneumatic which operates the sound-producing device, as by operating the reed-valve in the case of a reed-organ, termed the "motor-pneumatic," must have sufficient area to afford the necessary power to operate the valve or equivalent device, and if such motor-pneumatic is also the primary pneumatic (whose action is caused by admitting atmospheric pressure to it) in order that such pneumatic should act promptly both in opening and closing the reed-valve or performing whatever function depends upon its action for commencing and terminating the speaking of the sound-producing device the vent or orifice through which the air is wasted or drawn in in the action of the pneu-

matic, which continues while the exterior air communication is open, must be proportioned properly to the size of the pneumatic and must therefore be larger in proportion as the pneumatic is larger. If the primary pneumatic therefore be made to serve also as the motor-pneumatic, the waste of air will be very great, and the duty thus imposed upon the bellows is liable to become excessive, necessitating either very large or very rapidly-acting pumping devices. These considerations have led to the almost universal practice of interposing between the pneumatic which is operated by a perforated strip or other means for admitting external air through such pneumatic and the means for immediately operating the sound-producing devices a secondary pneumatic, whose action, either inflation or collapse, shall be caused by changing its communication from the external air to the wind-chest, or vice versa, so that each action (inflation and collapse) shall consume only the quantity of air which the pneumatic requires for inflation or expels in collapse.

My present invention has to do strictly with structures in which there is a primary pneumatic in the sense above defined and a secondary pneumatic in the sense above indicated, since only when both are employed for the purpose for which the employment of both is useful does the occasion arise for discriminating between the interior and exterior location of such pneumatics with respect to the wind-chest.

In Figs. 5, 6, and 7 I have shown a modification of the primary pneumatic in respect to the connection thereof with the wind-chest, the modification being designed for the purpose, primarily, of accomplishing, in respect to the initial seating of the valve F, the same thing that is accomplished by the mounting of the pneumatic so that by the action of gravity alone said valve normally reaches its seat. The same thing also is accomplished by the construction of the pneumatic shown in Fig. 4, in which the bulging of the diaphragm tends to hold the valve normally at its seat. In the form shown in these figures there is one passage leading through the wall of the wind-chest in place of two passages shown in the principal figures.

In place of the duct  $d$  shown in the principal figures I employ, in the form shown in Figs. 5, 6, and 7, a duct  $d^a$  through the stem of the valves E and F, said stem indicated by the letter  $e^a$ , being thereby rendered tubular. The disk  $d'$  is then applied over the inner side of the valve E, through which the duct in the stem  $e^a$  opens, as in the other construction it is applied over the inner end of the duct  $d$ . This change in structure of the primary-pneumatic connection, when applied to the form shown in Fig. 3, dispenses entirely with the supplemental chamber  $A^b$  and the standards  $A^3$ , leading thereto. The action of the modified device is that when the communication of the primary pneumatic with

the outer air is opened, admitting atmospheric pressure within the pneumatic and causing it to be drawn in through the puncture in the disk  $d'$ , the in-rush of air through the tubular stem  $e^a$  and against the under side of the punctured disk  $d'$  tends to pull the valve-stem inward to unseat the valve E and seat the valve F, precisely as in the form shown in Fig. 1, for example, and the pendulous position of the moving side of the pneumatic under the action of gravity tends to cause the valve F to move toward its seat as the moving side of the pneumatic swings pendulous-like when released from the suction which holds the pneumatic collapsed. In all the forms shown the valve E, being exposed to atmospheric pressure at the outer side and to diminished pressure at the inner side, tends to move inward as soon as the force exerted upon it by the primary pneumatic ceases by the admission of atmospheric air into the latter.

In the form shown in Figs. 5, 6, and 7 an additional influence of the same nature operates through the tubular stem  $e^a$  upon so much of the area of the disk  $d'$  as covers the duct in the stem  $d^a$ —that is, the area equal to that of the duct less that of the puncture in the disk  $d'$ . This influence, tending to move the valves in the same manner as they tend to move by gravity, is independent of the influence first above mentioned, due to the frictional action of the air as it moves inward through the duct in the stem  $d^a$ .

Since the primary pneumatics are constantly, during the operation of the instrument, exposed to suction, being in communication interiorly with the wind-chest and being exteriorly exposed to atmospheric pressure, some waste is liable to occur through the tissues or diaphragms of such pneumatics, and the employment of the tubular stem for the valves E and F, as illustrated in Figs. 5, 6, and 7, affords an opportunity to reduce this possibility of waste at least one-half by providing within the primary pneumatic a cushion or seat  $d^2$ , secured to the inner wall of the fixed side of the pneumatic on which the inner end of the tubular stem  $d^a$  shall seat when the pneumatic is collapsed, thus closing the communication between the interior of the pneumatic and the wind-chest after the partial vacuum necessary to cause the collapse of the pneumatic has been produced therein. This partial vacuum will be gradually diminished by the leakage until the pressure of the end of the tube upon the seat relaxes sufficiently to permit the air to be drawn past the seat into the wind-chest by the suction operating from the latter, thus restoring the vacuum again, but never permitting sufficient movement of the valves E and F to operate to reverse the connection of the motor-pneumatic and cause it to operate. The loss by leakage is diminished by this means, because the partial vacuum in the

pneumatic which causes such leakage is a steadily-diminishing force until it becomes so far diminished as to permit its restoration in the manner described. Such restoration occurs instantly when the pressure on the cushion permits the air to pass, so that the average vacuum is therefore about one-half the maximum, and the aggregate leakage is therefore reduced about one-half.

Since the motion of the stem of the valves E and F when attached to an oscillating or hinged bellows side is not directly longitudinal with respect to the stem, the two valves require to have their seating-surfaces not exactly parallel, in order that they may each in turn seat properly at the ports which they respectively control. To avoid the necessity of the very accurate adjustment which will be necessary to insure perfect seating in view of this feature, I prefer to make the valve E loose on its stem, so that it may adjust itself to its seat when it strikes it. This feature cannot be recognized by the eye in the actual construction nor in drawings of actual size, but I have shown in Figs. 9 and 10 magnified details from which it may be understood. When the solid stem such as shown in Figs. 1, 2, and 3 is employed, such stem extends loosely through the valve E and is provided with a head  $e^m$  to stop the valve and adapted to pull it onto its seat at whatever slight angle thereto it may strike it. In the tubular form shown in Figs. 6, 7, and 8 the tubular stem is flanged at the end for the same purpose and with the same effect, the disk  $d'$  being made fast to the outer surface of the flange represented by  $d^m$ . In all the forms the necessary adjustments of the valves E and F to each other in respect to their distance apart may be made by screwing their stem more or less through the valve F, and, if necessary, into or through the side of the bellows to which the valve F is attached.

I claim—

1. In a pneumatic organ, in combination with an exhaust wind-chest, a primary pneumatic and a motor-pneumatic both exterior to the wind-chest and communicating therewith for exhausting and with the outer air for venting said pneumatics; the valves which control the exhaust and vent ports of the motor-pneumatic being connected to and operated by the primary pneumatic to exhaust the motor-pneumatic when the primary pneumatic is vented, and to vent said motor-pneumatic when the primary pneumatic is exhausted; connections from the motor-pneumatic by which the sound-producing devices are caused to speak when said motor-pneumatic is collapsed, and suitable means for uncovering the vent of the primary pneumatic; the vent-valve of the motor-pneumatic being at its seat normally under the influence of gravity when free from any influence proceeding from the wind-chest.

2. In a pneumatic organ, in combination with an exhaust wind-chest, a primary pneu-

matic and a motor-pneumatic both exterior to the wind-chest and communicating therewith for exhausting and with the outer air for venting said pneumatics; the valves which control the exhaust and vent ports of the motor-pneumatic being connected to and operated by the primary pneumatic to exhaust the motor-pneumatic when the primary pneumatic is vented, and to vent said motor-pneumatic when the primary pneumatic is exhausted; connections from the motor-pneumatic by which the sound-producing devices are caused to speak when said motor-pneumatic is collapsed, and suitable means for uncovering the vent of the primary pneumatic; the vent-valve of the motor-pneumatic and its connection to the primary pneumatic being exterior to the wind-chest, said primary pneumatic being adapted normally under the influence of gravity and when free from any influence proceeding from the wind-chest to stand expanded and in position to hold said valve at its seat.

3. In a pneumatic organ, in combination with an exhaust wind-chest, a primary pneumatic and a motor-pneumatic both exterior to the wind-chest and communicating therewith for exhausting and with the outer air for venting said pneumatics; the valves which control the exhaust and vent ports of the motor-pneumatic being connected to and operated by the primary pneumatic to exhaust the motor-pneumatic when the primary pneumatic is vented, and to vent said motor-pneumatic when the primary pneumatic is exhausted; connections from the motor pneumatic by which the sound-producing devices are caused to speak when said motor-pneumatic is collapsed, and suitable means for uncovering the vent of the primary pneumatic; said primary pneumatic being adapted normally when vented and thereby relieved from the influence of the wind-chest, to expand by the action of gravity on its moving wall to the extent necessary to hold the exhaust-valve of the motor-pneumatic off its seat and the vent-valve of said pneumatic at its seat.

4. In a pneumatic organ, in combination with an exhaust wind-chest, a primary pneumatic and a motor-pneumatic both exterior to the wind-chest and communicating therewith for exhausting and with the outer air for venting said pneumatics; the valves which control the exhaust and vent ports of the motor-pneumatic being connected to and operated by the primary pneumatic to exhaust the motor-pneumatic when the primary pneumatic is vented, and to vent said motor-pneumatic when the primary pneumatic is exhausted; connections from the motor-pneumatic by which the sound-producing devices are caused to speak when said motor-pneumatic is collapsed, and suitable means for uncovering the vent of the primary pneumatic; the exhaust communication of the primary pneumatic with the wind-chest being restricted relatively to the vent of said primary pneumatic,

and the vent-valve of the motor-pneumatic being adapted normally, under the influence of gravity, when the primary pneumatic is vented, to stand at its seat.

5 5. In a pneumatic organ, in combination with an exhaust wind-chest, a primary pneumatic and a motor-pneumatic both exterior to the wind-chest and communicating therewith for exhausting and with the outer air  
10 for venting said pneumatics; the valves which control the exhaust and vent ports of the motor-pneumatic being connected to and operated by the primary pneumatic to exhaust the motor-pneumatic when the primary pneu-  
15 matic is vented, and to vent said motor-pneumatic when the primary pneumatic is exhausted; connections from the motor-pneumatic by which the sound-producing devices are caused to speak when said motor-pneu-  
20 matic is collapsed, and suitable means for uncovering the vent of the primary pneumatic; the moving wall of the primary pneumatic being pendulous and at normal position under the influence of gravity, when said  
25 pneumatic is vented and freed from the influence of the wind-chest, adapted to hold the motor-pneumatic vent-valve at its seat.

6. In combination with the wind-chest, a primary pneumatic and a motor-pneumatic  
30 whose communication with the wind-chest is controlled by the primary pneumatic; the valve which effects such control having its stem tubular and constituting a communicating duct between the wind-chest and the pri-  
35 mary pneumatic.

7. In combination with the wind-chest, a primary pneumatic and a motor-pneumatic having its communication with the external air controlled by the primary pneumatic, the  
40 valve which effects such control having its stem tubular and constituting the communicating passage between the wind-chest and the primary pneumatic.

8. In combination with the wind-chest, the  
45 primary pneumatic exterior thereto and a mo-

tor-pneumatic whose communication is controlled by the primary pneumatic; the valve which effects such control having a stem tubular and constituting a communicating duct between the wind-chest and the primary pneu- 50  
matic.

9. In combination with the wind-chest, a primary pneumatic exterior thereto; a motor-pneumatic also exterior thereto; valves which control the communication of the motor-pneu- 55  
matic with the wind-chest and with the external air being operated by the primary pneumatic and being mounted on a common stem, said stem being tubular and constituting the communication between the wind- 60  
chest and the primary pneumatic.

10. In combination with the wind-chest, and an exterior primary pneumatic, a tube which is attached to the fluctuating wall of the pneumatic and which extends into the wind- 65  
chest and constitutes the means of communication between the wind-chest and the pneumatic; and a pallet or valve within the pneumatic adapted to be seated over the inner port of said tube when the pneumatic is col- 70  
lapsed.

11. In combination with the wind-chest, a primary pneumatic exterior thereto and a motor-pneumatic whose communication with the wind-chest and with the outer air is controlled by the primary pneumatic; the valve which effects such control having its stem tubular and constituting the communicating duct between the wind-chest and the pneu- 80  
matic; and a pallet or seat within the primary pneumatic on which the inner port of said duct seats when the pneumatic is collapsed.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at 85  
Chicago, Illinois, this 24th day of July, 1896.

MELVILLE CLARK.

Witnesses:

CHAS. S. BURTON,  
JEAN ELLIOTT.