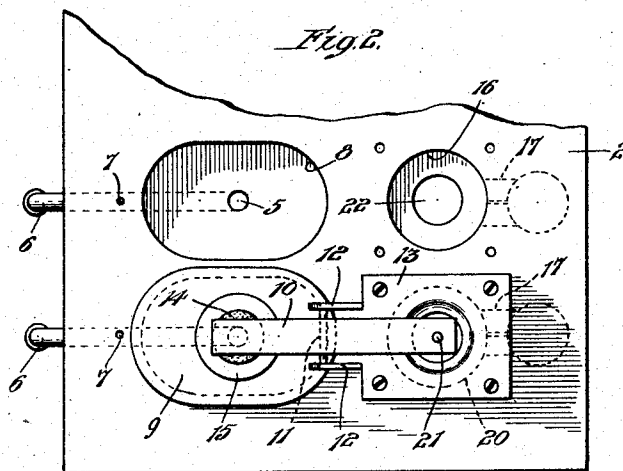
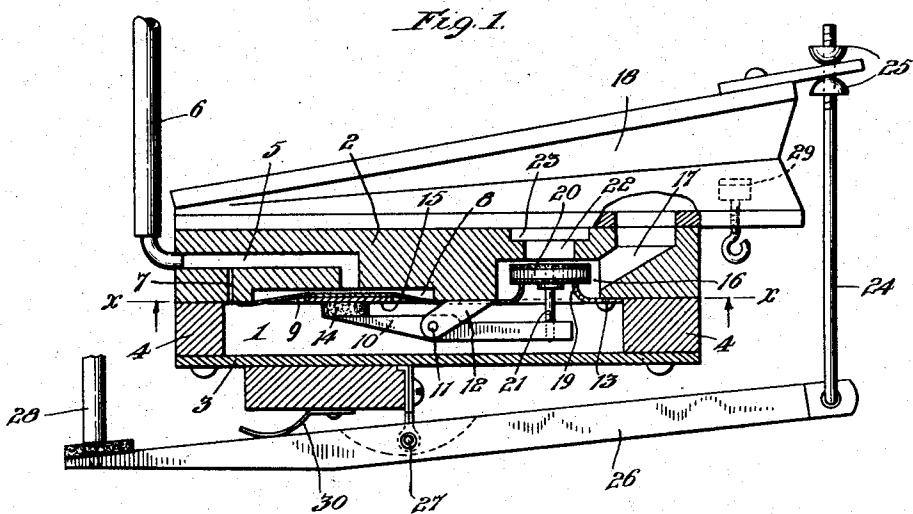


W. G. BETZ.
 PNEUMATIC ACTION.
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1,174,807.

Patented Mar. 7, 1916.



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PNEUMATIC ACTION.

1,174,807.

Specification of Letters Patent.

Patented Mar. 7, 1916.

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To all whom it may concern:

Be it known that I, WILLIAM G. BETZ, a citizen of the United States, and a resident of the city of Buffalo, county of Erie, and State of New York, have invented certain new and useful Improvements in Pneumatic Actions, of which the following is a specification.

My invention relates to improvements in pneumatic actions especially adapted for use in piano players, and has for its object the production of a pneumatic action which will be of simple and economical construction, sensitive and quick-acting in operation, and of high efficiency in use.

Other objects will appear hereinafter.

The invention consists in the combinations and arrangements of parts hereinafter described and claimed.

The invention will be best understood by reference to the accompanying drawing forming a part of this specification, and in which,

Figure 1 is a central section through a pneumatic action embodying my invention, and Fig. 2 is a section taken on substantially line *x-x* of Fig. 1.

The preferred form of construction as illustrated in the drawing comprises a main vacuum chamber 1 which, when the action is installed in a piano, extends the entire width of the instrument. This chamber is formed by an upper member 2, a lower member 3, and spacing strips 4 arranged at the edge portions of the members 2 and 3. This main vacuum chamber, when the action is in use, is connected with a suitable suction mechanism for constantly maintaining a partial vacuum in said chamber, as will be readily understood by those skilled in the art.

Formed in the member 2 is a passage 5, the outer end of which is adapted to be connected by means of a pipe 6 with one of the openings in the tracker bar of the instrument in which the mechanism is installed. Said passage 5 is in constant communication with the vacuum chamber 1 by means of a restricted passage, generally known as a vent, 7. The inner end of the passage 5 terminates in a port 8 over which is arranged a flexible diaphragm 9 of rubber cloth, leather or other suitable material. The port 8 is enlarged in cross sectional area with regard to the passage way 5, but is quite shallow, having only sufficient

depth to permit of proper play of the diaphragm, thereby rendering the device extremely sensitive, as will be obvious as the description proceeds.

Coöperating with the diaphragm 9 is a lever 10, pivoted intermediate its extremities as at 11 between ears 12 formed integral with and depending from one end of a plate 13 secured, as shown, to the under side of member 2. The end of lever 10 coöperating with the diaphragm 9 is provided with a felt pad or cushion 14 which engages against the under side of a plate 15 arranged at the under side of said diaphragm. The arrangement is such, as will be seen, that flexing of said diaphragm effects oscillation of the lever 10. The plate 13 is arranged over a port or chamber 16 from which leads a passage 17 in open communication with a pneumatic 18 which is fixed to the upper side of member 2. The plate 13 is provided with a central opening registering with the port 16 and said plate, surrounding said opening, is bent upwardly to form a valve seat 19. Coöperating with said valve seat is a valve 20 which is carried at the upper end of a stem 21, the lower end of said stem being threaded in the adjacent end of the lever 10. The arrangement is such, as will be seen that, when the diaphragm 9 is in upwardly flexed position, as shown in Fig. 1, the valve 20 will be at its lower terminal of movement resting upon the valve seat 19 so as to prevent communication between the chamber 1 and the passage 17 leading to pneumatic 18. Arranged in the member 2 above the valve 20 is a port 22 which communicates with a passage 23 extending longitudinally of member 2 which is in open communication with the outside atmosphere. The port 20 is so positioned that, when the valve 20 is in closing position, relative to the valve seat 19, as just described, a communication will be established between said port and the passage 17, or in other words, between the pneumatic 18 and the outside atmosphere. Upon elevation of the valve 20, caused by downward flexing of the diaphragm 9, said valve will be moved to close the port 22 and to open communication between chamber 1 and passage 17, or in other words, between said chamber and the pneumatic 18.

The movable side of the pneumatic 18 is connected by means of a rod 24 and coöp-

erating nuts 25 with one end of a lever 26 rockingly mounted at 27 at the under side of the member 3. The opposite end of the lever 26 engages with a vertically extending rod 28 which is connected with the striker of one of the keys of the instrument in conjunction with which the device is used. Cooperating with the movable side of the pneumatic 18 is an adjustable stop 29 which serves, as seen, to limit the amplitude of movement of said pneumatic side. A leaf spring 30 cooperating with the lever 26 serves to normally hold one end of said lever at its lower terminal of oscillation and the pneumatic in distended condition. The spring 30 may perhaps be dispensed with inasmuch as the weight of the rod 28 and the parts cooperating therewith would serve the function of said spring.

In the use of the action, a plurality is employed; one action cooperating with each note or key of the instrument in conjunction with which the mechanism is used. By reason of the constant partial vacuum maintained in the chamber 1 and the communication between said chamber and the passage 5 and pipe 6, a corresponding partial vacuum will be normally maintained in said pipe and passage. This will result in equalizing the pressure at opposite sides of the diaphragm 9 which will be normally in an upwardly flexed condition, as shown by reason of the suction in the chamber 1 drawing downwardly upon the valve 20. As a perforation or opening in the note sheet which passes over the tracker bar of the instrument, when the latter is in use, registers with the opening in said tracker bar corresponding with the pipe 6, air will be admitted to the latter, and hence to the passage 5 which will destroy the condition of equilibrium at opposite sides of the diaphragm 9, resulting in the latter being flexed downwardly, as will be readily understood, it being clear that the restricted vent 7 will not afford a passage through which the air, thus admitted to the passage 5 will pass with sufficient velocity to immediately equalize the pressure at opposite sides of said diaphragm. Upon downward flexing of said diaphragm, the valve 20 will be moved upwardly, opening communication between the vacuum chamber 1 and the pneumatic 18, and closing the port 20 leading to the outside atmosphere. Immediately upon communication being established between vacuum chamber 1 and said pneumatic, the air will be exhausted from the latter, being drawn into the vacuum chamber, causing collapsing of said pneumatic and hence rocking of the lever 26 with the resulting operation of the key-striker cooperating with the member 28. Upon the opening in the note sheet moving out of registration with the opening in the tracker bar with which

the pipe 6 communicates, communication between the latter and the outside atmosphere will be discontinued, whereupon the increased pressure in the passage 5 and pipe 6, above mentioned, will be immediately reduced and equilibrium established at opposite sides of the diaphragm 9 through the communication afforded by the vent 7 between the vacuum chamber 1 and the passage 5. At the same time, the vacuum in chamber 1 will cause the valve 20 to move downwardly to discontinue the communication between said chamber and the pneumatic 18, the lever 10, in the downward movement of said valve, being rocked to return the diaphragm 9 to its upwardly flexed position. Upon the valve 20 moving downwardly, the port 22 will be opened, establishing communication between the pneumatic and the outside atmosphere which, together with the influence of the spring 30 and the weight of the member 28 upon the lever 26, results in said pneumatic being distended to its normal position.

With the arrangement set forth, it will be seen that the passage leading from the main vacuum chamber to the pneumatic is extremely short and so that in the operation of the mechanism, when the valve 20 is open, the immediate collapsing of the pneumatic 18 will be accomplished since, with this arrangement, it becomes unnecessary to exclude or withdraw a large quantity of superfluous air before the withdrawal of air from the pneumatic takes place, as would be the case were said passage 17 of greater length. This results in quick action and sensitiveness which is of great importance in instruments of the class under consideration. Also, with the arrangement set forth, it will be seen that the plate 13 serves a double function, namely, that of a valve seat and of a fulcrum for the lever 10, resulting in a construction which is simple and economical and therefore capable of manufacture at a low cost. Furthermore, with the arrangement set forth, it will be seen that all of the operating parts of the valve mechanism are mounted upon or connected with the under side of the member 2 so that access may be readily gained thereto in order to effect repair or adjustment by simply removing the member 3, it being clear that, upon such removal of said member, the entire operating mechanism is exposed and accessible. Further, with the arrangement set forth, the valve stem 21 may be made very short so as to render it unnecessary to employ guides or keepers to cooperate with said stem to guide the same in its reciprocatory movement. This results in the elimination of friction which is necessarily incidental to the employment of guiding means and hence conduces to a greater freedom and ease of operation. The

threading of the stem 21 in the lever 10 affords means for readily adjusting the latter relative to said lever in order to secure proper positioning of the valve 20 relative to the seat 19 and the port 22.

While I have illustrated and described the preferred form of construction for carrying my invention, into effect, this is capable of variation and modification without departing from the spirit of the invention. I, therefore, do not wish to be limited to the exact details of construction set forth, but desire to avail myself of such variations and modifications as fall within the scope of the appended claim.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

A pneumatic action comprising a vacuum chamber; a passage leading to said chamber; a diaphragm closing said passage; a passage leading from said chamber; a pneu-

matic in open communication with said last mentioned passage; a valve plate arranged about said open communication provided with a central perforation and having the edges of said perforation turned into said communication to constitute a valve seat; ears formed integrally with the sides of said plate and projecting at right angles thereto; a lever pivoted in said ears and operatively connected at one end with said diaphragm; a valve stem on the other end of said lever projecting through said valve; and a valve on said valve stem seating on said valve, substantially as described.

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

WILLIAM G. BETZ.

Witnesses:

JOSHUA R. H. POTTS,
HELEN F. LILLIS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."