

H. C. COLDMAN & C. F. WEBB.
 APPARATUS FOR MECHANICALLY OPERATING MUSICAL INSTRUMENTS.
 APPLICATION FILED JULY 2, 1910.

1,035,534.

Patented Aug. 13, 1912.

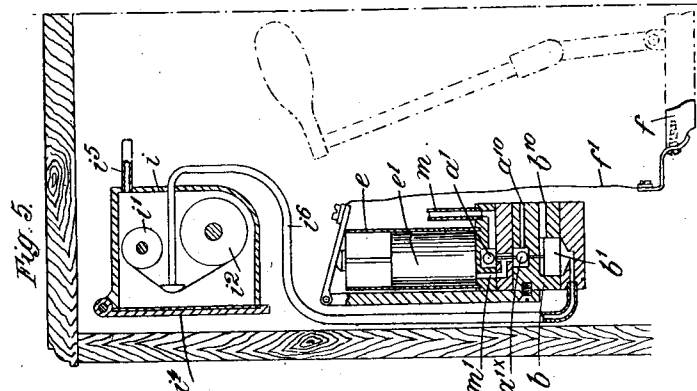


Fig. 5.

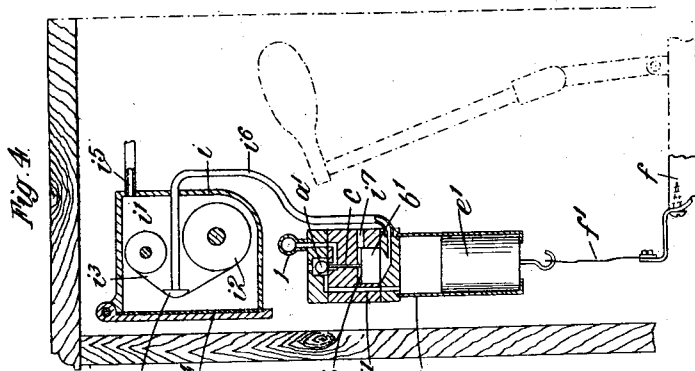


Fig. 4.

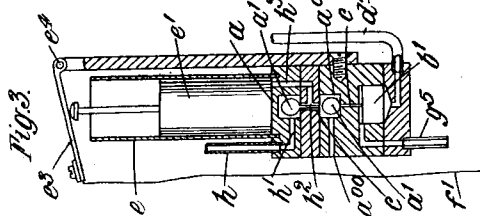


Fig. 3.

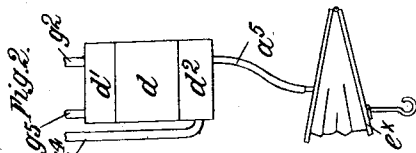


Fig. 2.

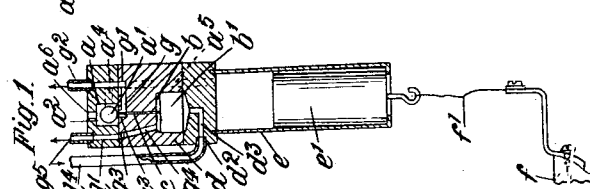


Fig. 1.

Witnesses:
 J. M. Hunt
 J. M. Hunt

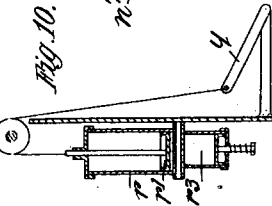
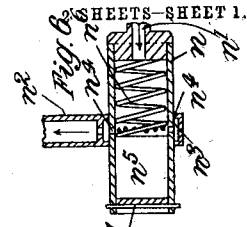


Fig. 10.

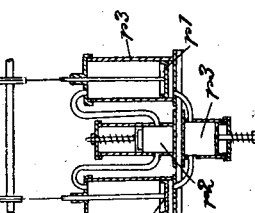


Fig. 9.

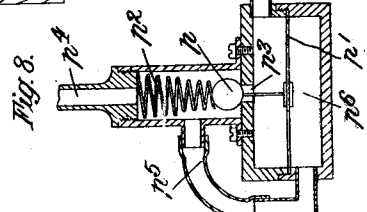


Fig. 8.

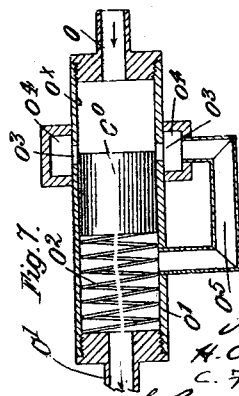


Fig. 7.

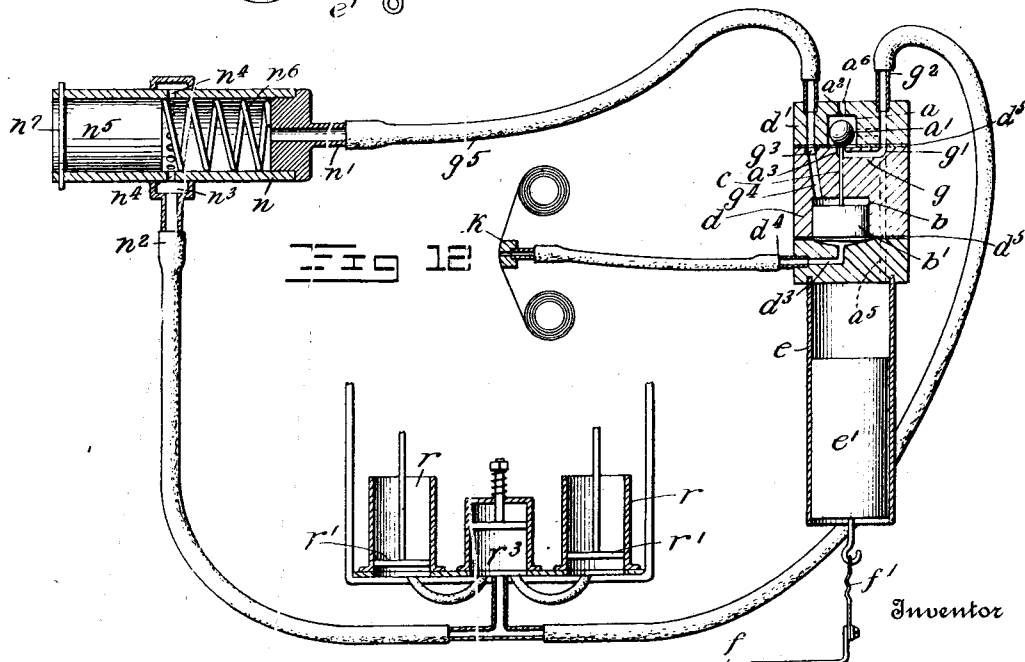
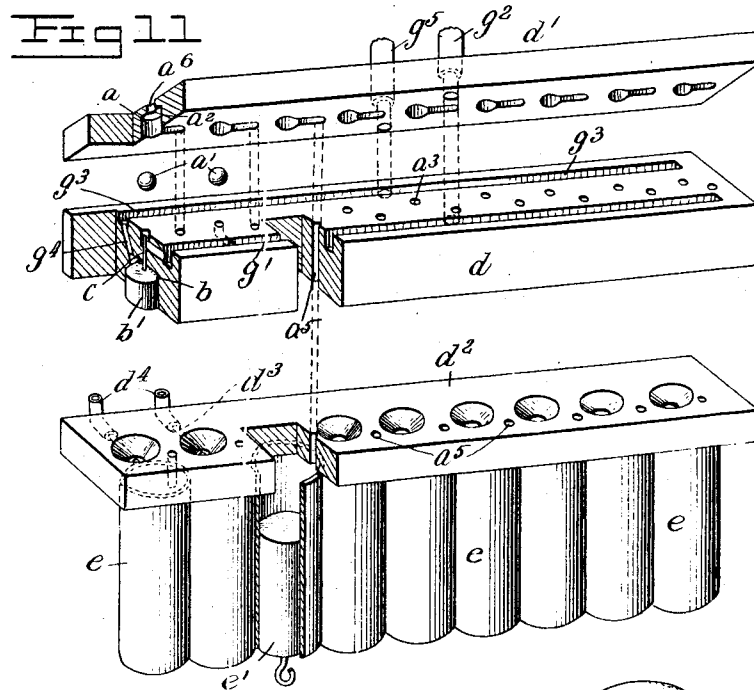
Inventors
 H. C. Coldman
 C. F. Webb
 By *James H. Holsinger*
 Attorney

H. C. COLDMAN & C. F. WEBB.
 APPARATUS FOR MECHANICALLY OPERATING MUSICAL INSTRUMENTS.
 APPLICATION FILED JULY 2, 1910.

1,035,534.

Patented Aug. 13, 1912.

2 SHEETS-SHEET 2.



Witnesses
 N. M. Donnell
[Signature]

Inventor
 Henry C. Coldman
 Christopher F. Webb
 By *[Signature]* Attorney

UNITED STATES PATENT OFFICE.

HENRY CHARLES COLDMAN AND CHRISTOPHER FREDERICK WEBB, OF LEWISHAM,
ENGLAND.

APPARATUS FOR MECHANICALLY OPERATING MUSICAL INSTRUMENTS.

1,035,534.

Specification of Letters Patent.

Patented Aug. 13, 1912.

Application filed July 2, 1910. Serial No. 570,090.

To all whom it may concern:

Be it known that we, HENRY CHARLES COLDMAN and CHRISTOPHER FREDERICK WEBB, subjects of the King of Great Britain, residing, respectively, at 15 Albacore Crescent and 107 Gilmore road, both in Lewisham, in the county of Kent, England, have invented certain new and useful Improvements in or Relating to Apparatus for Mechanically Operating Musical Instruments, of which the following is a specification.

This invention relates to apparatus for mechanically operating or playing musical instruments, such as pianos and similar keyed instruments.

Mechanical players for pianos and the like as ordinarily constructed are usually operated by a comparatively slight vacuum, corresponding to a pressure which is only a few ounces per square inch less than the pressure of the atmosphere. This necessitates the use of comparatively large pneumatics or other actuating devices for the note sounding mechanism, the size of such devices usually being sufficient to preclude their installation in a piano case of ordinary size.

The object of the present invention is to provide an improved mechanical playing mechanism in which an air tension of high actuating power may be used for operating the note sounding devices, so that the actuators of the several elements of the piano action will each occupy a very small space, whereby the mechanism as a whole may be installed in a piano case of ordinary size. Our improved mechanism also has the advantage that while the actuators of the several elements of the action are operated directly from a source of high air tension, provision is made for insuring a delicate and flexible control of the expression; and moreover, the ordinary thin perforated music sheets can be used satisfactorily in view of the fact that a very much lower air tension is used at the tracker than is employed for operating the sounding devices. The tension at the tracker corresponds in power to that usually employed in the ordinary playing mechanism, but the tension for operating the sounding devices is of a

very much higher degree, at all times differing from atmospheric pressure to the extent of several pounds to the square inch. The designation "high tension," as employed in connection with the present invention, will therefore be understood to mean a tension differing from atmospheric pressure by pounds as contradistinguished from the "low tension" air at the tracker, and also generally employed to actuate the power pneumatics of the ordinary type of mechanical players, which "low tension" air differs from atmospheric air pressure by a few ounces only.

A further and important object of the invention is to provide a pneumatic action of the type referred to, which is so compact in the structural organization of its parts that it may very conveniently be placed in the heretofore unoccupied space in the upper part of the casing of an ordinary upright piano, where suitable operative connections between the power pneumatics and certain units of the hammer action of the piano may be readily and quickly made and where these connections as well as the entire pneumatic action are always accessible for adjustment and repair.

For the purpose of accomplishing the objects aimed at, a pneumatic action having a valve of improved construction and operation is provided, which action is adapted for operation with air tensions of different values; the power pneumatics of the action being operable by or under the direct influence of high-tension air or high vacuum, and the valves which control said high-tension air being operated by means actuated by or under the direct influence of low-tension air, and which valve actuating means is controlled in its operation through the medium of an ordinary tracker bar and the usual thin perforated music sheet. By this construction, we are enabled to employ high tension air for controlling or influencing the operation of the power pneumatics, which high tension air however has no effect whatever upon the thin perforated music sheet passing over the tracker.

In order that the said invention may be clearly understood and readily carried into effect we will proceed to describe the same

with reference to the accompanying drawings, in which:—

Figure 1 illustrates in transverse section a construction of pneumatic action adapted to operate according to this invention from a suction tracker bar; the power pneumatic being of the cylinder and piston suction type, Figure 2 is a plan view showing a similar arrangement in which the power pneumatic is of the bellows type, Fig. 3 is a transverse section of an arrangement of the pneumatic action adapted for working with a suction tracker bar and pressure operated power pneumatic of the cylinder and piston type, Fig. 4 is a transverse section showing the invention with suction operated cylinder and piston power pneumatic and compressed air tracker bar, Fig. 5 illustrates an arrangement in which both the cylinder and piston power pneumatic and the tracker bar operate by means of compressed air, Fig. 6 is a section illustrating a construction of pneumatic regulator whereby a weaker exhaust or suction may be employed, Fig. 7 illustrates a construction of pneumatic regulator adapted for use with the apparatus when operated by compressed air, Fig. 8 is a view illustrating an alternative construction of pneumatic regulator, Figs. 9 and 10 are respectively a face view partly in section and a transverse section of a construction of pump adapted to produce both suction or vacuum and pressure. Fig. 11 is a perspective view of a section of one form of our improved pneumatic action, the parts being separated and partly broken away to more clearly illustrate the construction and the various chambers and ports or passages. Fig. 12 is a diagrammatic view of a complete action, the operative parts being shown in section.

According to the form of invention illustrated in Figs. 1 and 11 the pneumatic action comprises two chambers *a* and *b* conveniently arranged the one above the other, the upper or high tension chamber containing a valve in the form of a ball *a'* which operates between two seatings *a²* *a³* and the lower or low tension chamber containing a valve actuator which in the instance shown is in the form of a plunger *b'* which is freely and bodily movable in the chamber *b*. The valve *a'* and plunger *b'* are in operative connection by means of a loose wire or similar device *c* which is adapted to present a long or comparatively long distance of separation between the valve and its actuator, and, owing to its small cross sectional area and the consequent small diameter of the passage in which the said connection works, at the same time insures the air tight working thereof. The ball and plunger are therefore independent of the wire or other connection which serves to convey the movement of the one to the other as and when the one or the

other is caused to move by the action of the air or exhaust. The wire or other connection *c* is free to move without affording any leakage of air between the chambers *a* and *b* or from the one chamber to the other. For convenience in manufacture, the aforesaid chambers *a* and *b* are formed in a block which may be of metal such as brass. Or as more clearly shown in Fig. 11 the low pressure chamber *b* may be formed in a central block *d* and the high pressure chamber *a* in a face plate *d'* attached to the said central block *d*, the chamber *b* being covered by another face plate *d²*. The plate *d'* is formed with a lateral passage *a⁴* which leads from the chamber *a* to the passage *a⁵* formed through the block *b*, as shown in dotted lines Fig. 1; the said passage *a⁵* leading to the cylinder *e* wherein works the piston *e'*, said cylinder and piston constituting the power pneumatic. In the arrangement shown in Fig. 1 the piston *e'* is connected with the piano action *f* by means of the wire or flexible connection *f'*. It will be understood however, that the piston may be connected with any convenient unit or part of the action so as to effect the operation thereof. The upper side of the chamber *a* is formed with an aperture *a⁶* whereby the chamber is placed in communication with the atmosphere the valve at times sealing this aperture against the ingress of air. The ball or valve *a'* is also adapted to seal a passage *g* formed in the central block *d* the said passage having a lateral portion which leads into a chamber *g'* arranged longitudinally in relation to the block. The longitudinal chamber is in communication by a pipe or tube *g²* with the suction or pressure creating pumps. The lower pressure chamber *b* communicates with the suction chamber *g³* by way of a passage *g⁴* in the block. It will be understood that all the chambers *b* communicate with the longitudinal chamber *g²* while all the valve chambers *a* similarly communicate with the longitudinal chamber *g'*. The chamber *g³* is in communication with the lower pressure or weaker exhaust by way of a pipe or tube *g⁵*. The lower side of the central block *d* is covered by the plate *d²* which is formed with an aperture beneath the ball or plunger and the said aperture is extended laterally as indicated at *d³* so as to communicate with a pipe *d⁴* or other suitable connection with the tracker bar or board shown in Fig. 12. The blocks are formed so as to contain the requisite number of valves and valve actuators for use in the working of the playing mechanism, and the said block may be constructed as a single piece or be composed of sections, each section carrying a plurality of valves and valve actuators, one of which sections is illustrated in Fig. 11. In order to render the joints between the block *d* and the

upper and lower plates d' d^2 air tight, there may be interposed between the adjacent surfaces a layer of paper or other similar or suitable material d^6 containing the necessary openings.

It will be understood that the above described construction comprises two chambers g' and g^2 each extending the length of the block or block sections d' , containing the valves a' and with which all the valve chambers therein communicate. Assuming the apparatus to be working under vacuum or exhaust, the chambers are partially exhausted of air by the pumps or other vacuum creating apparatus. The degree of vacuum in the one chamber is however ordinarily below that in the other chamber, obtained by the use of a suitable pneumatic governor or other means, as more clearly illustrated in Fig. 12. The high pressure air in the chamber g' is communicated to the ball or valve chamber a and when the valve is in position to close the atmospheric air admission aperture a^6 the air is exhausted from the power pneumatic by way of the aforesaid passage a^4 and connecting passage a^5 .

Upon the music sheet opening the aperture in the tracker board atmospheric pressure passes to the chamber b and effects the lifting of the valve actuator or plunger b' therein. This latter works freely in the chamber b as a piston. When the said plunger is lifted it in turn by means of the wire c lifts the ball a' in the valve chamber a and thereby closes the air admission aperture a^6 . Thus the upper or high vacuum chamber is placed in communication with the power pneumatics and a note is sounded. Upon the music sheet closing the aperture in the tracker board, the air which is imprisoned in the tube d^4 and passage d^3 which leads to the chamber b leaks past the plunger b' which is arranged to work therein with a suitable clearance in the said chamber b , hence a specially provided bleed opening, such as usually employed, is not necessary; thus the pressure upon either side of the valve actuator or plunger b' is equalized and the atmospheric pressure on the ball a' in the chamber a asserts itself, with the result that the ball opens the air admission aperture a^6 and admits atmospheric air to the passages a^4 , a^5 leading to the power pneumatic.

A result of the present invention is the economy in the amount of air used in operating the plunger owing to the small dimensions of same and the passages connecting therewith.

The above pneumatic action with its improved valve mechanism has been described as operating by suction or exhaust. It is obvious that by inclosing the music rolls and tracker bar in an air-tight casing and

using compressed air therein the valves would be similarly operated as illustrated in Fig. 4, and also that by reversing the mechanism the valve can be used to operate compressed air pneumatics while still retaining the weak and strong degrees of either vacuum or compressed air in the two chambers, as illustrated in Fig. 5. Thus a suction tracker can be used to operate compressed air pneumatics and vice versa, as will presently appear.

The degree of suction or compressed air in the lower chamber may be, by means of a suitable pneumatic governor or pressure regulating valve, as shown in Figs. 6, 7 and 8, arranged to be weaker than that in the other chamber in a fixed proportion or it may be constant while the other is variable for the purpose of soft or loud playing. The latter is preferable on account of the music sheet having an unvarying pressure on the tracker-bar which results in uniform working and also a uniform quantity of air is used at each operation of the valve. It will be understood, however, that in both cases the air tension for operating the actuators of the piano action is never approached in actuating power by the tension at the tracker-bar.

By reason of the limited amount of space required for the entire pneumatic action it may be very readily installed in the casing of already existing upright pianos without enlarging or cutting them, or in any way altering the construction of the piano action itself.

As will be seen by referring to the drawing, the power pneumatics, which in the preferred form of the invention, comprise the vertically disposed cylinders and pistons, are all arranged in a single horizontal row or series transversely of the piano case, and this affords a construction so small and compact that the whole attachment may be very readily incorporated in the heretofore unoccupied space in the upper part of an ordinary upright piano case anywhere above the rear ends of the piano-keys and forward of the hammer action, and the operative connections may then be conveniently made between the pistons and an operative part or unit of the hammer action. By this construction the whole playing mechanism may be arranged in the upper part of the piano case just in rear of the usual removable front or panel board where all the parts are readily accessible for the purposes of installation, adjustment and repair.

Owing to the difference in the pressure in the two tension chambers a sufficient variation is provided between the area of the valve actuator or plunger in the lower chamber and the seatings for the ball in the upper valve chamber to insure its ready action so soon as the aperture in the music sheet

opens the aperture in the tracker board. Referring to Fig. 2 this will be readily understood as it is inserted with the object of illustrating the above described valve in connection with a bellows type of power pneumatic ex . The moving part of the bellows is suitably connected by means of the connection f' with the piano action f . The operation is similar to that hereinbefore described with reference to Fig. 1.

With regard to Fig. 3 which shows an arrangement designed for use with a suction tracker bar and pressure operated cylinder and piston power pneumatic the valves a' and a'' are conveniently of the ball type and adapted for operation by a plunger b' . The arrangement however shows an inversion of the pneumatic cylinder and piston. The operation is as follows:—Assuming a hole in the tracker bar to be opened by an aperture in the music sheet arriving in coincidence therewith, air is admitted to the underside of the plunger b' , by way of the tube or pipe d' , lifting the same and causing the valve a'' to rise and also the valve a' by means of the wire or stem c' so that compressed air which is normally in the chamber a by way of the tube or pipe h and passage h' , passes into the passage h'' and thence to the passage h''' to the cylinder e to operate the piston e' . This piston is provided with an extension in the form of a rod e'' which is adapted to turn the arm or lever e''' about its pivot e''' and thereby operate the flexible connection f' and by means of the latter the other part f of the piano action. In this arrangement the plunger b' operates the ball a'' in a manner similar to that described with reference to Fig. 1 but this latter valve is connected by the wire c' with the valve a' . The ball a'' works in a chamber a''' which is open to the atmosphere by way of the passage a'''' . The suction or exhaust is applied to the tube or pipe g'' so that while a hole in the tracker bar is covered the suction action exhausts any air from the pipe d' and plunger chamber b and by establishing an equal pressure on either side of the plunger b' the latter gravitates to the bottom of the chamber b thereby enabling the valve a' to seat and shut off the supply of pressure to the cylinder e , and at the same time allowing venting of existing pressure under the piston e' , through the passage a'''' thus effecting the return of the piston.

When operating the pistons by suction or exhaust with the tracker bar under pressure the arrangement may be as shown in Fig. 4 in which i represents an air-tight case or box for containing the music roll and the necessary mechanism. The music rolls are indicated at i' i'' and the music sheet at i''' ; i''' is a door to the case or box i which is rendered

other suitable material. Compressed air is admitted to the said box or case by way of the pipe z . The tracker bar indicated at k communicates with the chamber b of the valve by way of the pipe z' so that upon a hole in the tracker bar k being opened pressure enters and passes to the under side of the plunger b' raising the latter and operating the ball a' whereupon the suction or exhaust action from the pipe l is communicated to the cylinder e by way of the passage l' . Upon the music roll closing the aperture in the tracker bar the compressed air in the tube z' escapes past the plunger b' and out into the atmosphere by way of the passage l' . The depletion of the pressure on the under side of the plunger is counterbalanced by the atmosphere which enters by the passage l' and so while the hole in the tracker bar is closed the plunger b' rests in the bottom of the chamber b and the ball or valve a' is inoperative to place the cylinder e in connection with the exhaust.

In Fig. 5, the arrangement is such as to admit of both the valve and the pneumatic cylinder and piston device being operated by compressed air. The air-tight music roll or case i is in communication with the compressed-air supply by way of the tube z . The pipe or tube z' from the tracker bar k is ordinarily filled with atmosphere and is in communication with the lower side of the plunger b' so that upon a hole in the tracker bar being opened the compressed air admitted to the box i will enter the said pipe z' and lift the plunger b' thereby operating the valves a' and a'' to admit compressed air to the cylinder e for operating the piston e' therein. The chamber containing the valve a'' is open to the atmosphere by way of the passage a'''' and the chamber b is open to the atmosphere by way of the passage b'' . Compressed air for operating the piston e' is admitted by way of the pipe m the air passing by way of the chamber a and passage m' to the cylinder e .

In order to enable a weaker suction or exhaust to be employed, instead of using extra reservoirs and automatic valves as heretofore, a pneumatic governor or regulator is employed as shown in Fig. 6 consisting of a cylinder n connected by a tube n' to the pipe g'' in Figs. 1 to 3 and 12, and by a tube n'' to the main reservoir r'' of the pump r . The passage n'' from the reservoir connects with the inside of the cylinder n preferably by an annular chamber n''' which surrounds and connects with the cylinder by means of the perforations n'''' . The cylinder n contains a loose piston or plug n^5 constructed of some light material, such, for instance, as carbon, and this plug is maintained by a spring n^6 in contact with a transversely arranged pin n^7 or a suitable cap. The inner end of the plug may be just short

and clear of the ring of apertures or perforations n^4 . When, for instance, notes are in operation, air is drawn from the cylinder n through the apertures n^4 and tube n^2 thereby inducing a partial vacuum in the cylinder, this degree of vacuum depending upon the adjustment of the spring n^6 , whereby the plug or piston n^5 is caused to move in slightly and more or less cover the apertures n^4 ; the flow between the pneumatic action and the reservoir being thereby shut off. The piston n^5 is adapted to move inward or outward according to the degree of exhaust in the cylinder n , and to maintain a steady degree of exhaust in the plunger chambers of the action.

Referring to Fig. 7, which represents a construction of pressure reducing valve or regulator for use with the above described method of working, o is a nozzle for connection by means of a tube or pipe with the main reservoir while o' is a nozzle for connection by means of a pipe or tube with the air tight roll box. The operation of this valve is such that the pressure from the main supply reservoir moves the piston o^2 in the barrel or cylinder o^x against the resistance of the spring o^2 uncovering the port or ports o^3 so as to admit the said pressure to the annular chamber o^4 whence the pressure passes by way of the passage o^5 to the part of the cylinder in which the spring o^2 is situated. Upon the pressure in this latter part of the cylinder o^x increasing, its action is to balance the pressure on the other side of the piston whereupon the spring causes the same to move toward the end of the cylinder which is furnished with the nozzle o and so cover the port or ports o^3 completely or to a certain extent and so shut off the supply of compressed air to the passage o^5 . In the event of a hole in the tracker bar being opened the pressure passes from the cylinder o^x by way of the nozzle o' and so reduces the pressure on the piston o with the effect that the latter is operated by the full pressure and again opens the port or ports o^3 .

The modified construction of reducing valve shown in Fig. 8 is adapted to effect the same purpose as that just described with reference to Fig. 7 but the valve consists of a ball p operatively connected with the diaphragm p' . The ball p is controlled by the spring p^2 and is kept on its seating p^3 partly by the said spring and partly by the pressure from the main reservoir which is admitted at p^4 . The said pressure passes by way of the passage p^5 to the chamber p^6 beneath the diaphragm p' and upon the same accumulating in the said chamber it raises the diaphragm and lifts the ball p off its seating, with the effect that the pressure is admitted to the upper side of the diaphragm whereupon the spring p^2 again presses the ball p on its seat. Weaker pressure is thus

maintained in the chamber above the diaphragm according to the adjustment of the spring, this chamber being in communication with the air-tight roll box by a connection from the nozzle p^7 .

In Figs. 9 and 10 an arrangement of pumps for operating the player is shown adapted for being actuated by pedals q (one for each cylinder r). The arrangement of the pump is such that when the pedals are depressed the pistons r' move upward and the air is compressed above the pistons while vacuum is formed below the said pistons. Each piston rod works in an air-tight gland or similar device in the end of the cylinder the latter being closed to the atmosphere when the pistons rise. It will be seen that in operation as the pistons move the air will be compressed on the one side and rarefied on the other. Should the degree of say suction be required to be less than that of the compression, this may be accomplished by varying the power applied to the pump by means of the pedals. Two reservoirs are used in this arrangement, the one r^2 being for compressed air and the other r^3 for suction or vacuum.

It is to be particularly noted that the term tension, as employed herein and in the claims relates broadly to pneumatic power, whether the same be produced by exhausting the air, as practised in the so-called suction or vacuum action; or by the application of compressed air, and correspondingly the expressions high tension and low tension are to be understood as applying to different degrees of pneumatic power, whether the same be developed by exhausting the air below atmospheric pressure, or compressing the air above atmospheric pressure.

In the several constructions herein shown and described wherein different degrees of vacuum or compressed air are employed in the high and low tension chambers respectively, to control the operation of the power pneumatics, it will be understood that in each case the tensions are of the same character although differing in degree; that is to say, in the constructions described as operating under the vacuum or exhaust system, the high and low tensions employed are both below atmosphere; while in the systems operating under compressed air, the tensions employed are both above atmosphere, although they differ in degree. Thus the expression "Tensions of like character, but of different degree" is to be understood as signifying two air tensions differing from one another in degree, but of like character, in that both are either above or below atmospheric pressure, as the case may be. It is to be noted, however, that we do not claim in this application a playing mechanism operated by differential air tensions of opposite character, as the system in which

air tensions of opposite character are employed is to form the subject matter of a separate application.

What we claim is:—

- 5 1. In a pneumatic action, the combination with a power pneumatic and tracker, of a high-tension chamber having no communication with the tracker, a valve controlled-port affording communication between said chamber and the power pneumatic, a low-tension chamber in communication with the tracker, and means in said low-tension chamber for actuating the said valve to control the communication between the high-tension chamber and the power pneumatic to effect the operation of the latter, the tensions in said chambers being of like character but differing in degree.
- 10 2. In a pneumatic action, the combination with a power pneumatic and a tracker, of an air chamber containing air always under high tension and constituting the sole actuating power for the pneumatic, means affording communication between said chamber and the power pneumatic, a low-tension air chamber in communication with said tracker, and means actuated by the low-tension air and the air passing through the tracker for controlling the communication between the high-tension air chamber and the power-pneumatic for effecting the operation of the latter the air in said high and low tension chambers being alike in character but differing in degree.
- 15 3. In a pneumatic action, the combination with a power pneumatic, of means for controlling the same in its operation, comprising a low-tension chamber and a high-tension chamber, the latter chamber furnishing the sole actuating power for the pneumatic, the tensions in said chambers being alike in character but differing in degree, a valve-actuator in the low-tension chamber, a valve in the high-tension chamber for controlling the operation of said power pneumatic, and means operable by said actuator for controlling the operation of said valve.
- 20 4. In a pneumatic action, the combination with a power pneumatic and a tracker over which a perforated music-sheet is adapted to travel, of an air supply at all times under high-tension for furnishing the sole actuating power for the pneumatic, and means controlled by a perforated music-sheet for placing the power pneumatic under the influence of high-tension air from said supply to effect each and every actuation of the pneumatic, said means embodying a low-tension air supply and an actuator continuously under the influence of the low-tension air, and periodically under the influence of atmospheric air passing through the tracker.
- 25 5. In a pneumatic action, the combination of a power pneumatic, and means for controlling its operation, comprising a low-tension vacuum chamber and a high-tension vacuum chamber, a bodily movable plunger in the low-tension chamber, a valve in the high-tension chamber for controlling the operation of said power pneumatic, and means operable by said plunger for actuating said valve.
- 30 6. In a pneumatic action, the combination of a power pneumatic, and means for controlling its operation, comprising a tracker over which a perforated music sheet is adapted to travel, a low-tension chamber in communication with the tracker, a high-tension chamber adapted to have communication with said power pneumatic, a plunger bodily movable in the low-tension chamber, a ball valve in the high-tension chamber, and means operated by said plunger for operating said valve to establish communication between the high-tension chamber and the power pneumatic.
- 35 7. In a pneumatic action, the combination of a power pneumatic, and means for effecting its operation, comprising two air chambers, one located above the other, means for maintaining said chambers under different degrees of exhaust, a bodily movable plunger in one chamber, a communicating passage between the other chamber and the power pneumatic, a valve located in the said other chamber for controlling said passage, and means operable by but having no direct connection with said plunger for actuating said valve to admit the higher degree of exhaust to the power pneumatic.
- 40 8. In a pneumatic action, the combination with a cylinder and piston power pneumatic and a tracker for controlling its operation, of two air chambers, means for maintaining said chambers under different degrees of exhaust, a valve actuator in the chamber whose tension differs the least from atmosphere, a communicating passage between the other chamber and the cylinder of the power pneumatic, a valve in said other chamber for controlling said passage, and means operable by said actuator for operating said valve to admit the higher degree of exhaust to the cylinder of the power pneumatic.
- 45 9. A pneumatic action for musical instruments, comprising a plurality of power pneumatics each consisting of a vertically arranged cylinder and a piston freely movable therein, and pneumatic means for effecting the operation of said power pneumatics, said means embodying two horizontally arranged superposed rows of air chambers, said chambers being located in vertical alignment with said cylinders, means for maintaining said chambers under different degrees of exhaust, a freely movable valve actuator in each of the air chambers of one row, a separate passage leading from each of

the air chambers of the other row to the several cylinders of the power pneumatics, a separate valve for controlling each such passage, and means operated by each actuator for actuating its associated valve, for the purpose described.

10. In a pneumatic action, the combination with a power pneumatic, a tracker and a pump, and means controlled from the tracker for controlling the operation of the power pneumatic, comprising two air chambers, a valve actuator in one chamber, a valve operated by said actuator for controlling the passage of air from the other chamber to the power pneumatic, separate conduits leading from the pump to the two air chambers respectively, and a pressure reducing valve in one of said conduits.

11. In a pneumatic action, a power pneumatic, a tracker, a supply of air under tension for operating said pneumatic, a valve-controlled port affording communication between said air tension supply and pneumatic, a second supply of air under lower tension coacting with the tracker and music sheet, and means actuated by the low tension air for opening the said valve-controlled port to place the pneumatic under the influence of the high tension air supply, the said air tensions being of like character but differing in degree.

12. In a pneumatic action, a pneumatic, a tracker, a supply of air at all times under high tension for operating said pneumatic, said supply having no communication with the tracker, and a second supply of air under lower tension co-acting with the tracker and the music sheet, means for affording communication between said first named supply and the power pneumatic, and means governed by the low tension air for controlling the communication between said first named supply and the power pneumatic, said air tension is being of like character but differing in degree.

13. In a pneumatic action, a tracker, a hammer-actuating pneumatic, a supply of air at all times under high tension for operating said pneumatic, said supply having no communication with the tracker, means affording communication between said air tension supply and said pneumatic, and a supply of air under tension of less power than the first but of the same character, and means normally under the influence of the low tension air supply and controlled by the music sheet and tracker to connect said first-named supply with said pneumatic.

14. In a pneumatic action, a tracker, a hammer-actuating pneumatic, a supply of air at all times under high tension for directly actuating the said actuating pneumatic, said supply having no communication with the tracker, means affording communication between said air tension supply and

said pneumatic, and a second supply of air tension of the same character, but of less power than the first, co-acting with the tracker and music sheet, and means normally under the influence of the second tension supply and coöperatively associated with said communication-affording means to connect said first-named supply with said pneumatic as the music sheet perforations register with those of the tracker.

15. The method of operating a power pneumatic of a pneumatic piano having a tracker, which consists in placing said pneumatic in communication with a source of air at all times under high tension, controlling said communication by means of a source of air tension, of lower power but of the same character and controlling said source of lower power by the music sheet in passing over the tracker.

16. The method of operating a power pneumatic of a pneumatic piano having a tracker, which consists in placing said pneumatic in direct communication with a source of air at all times under high tension, controlling said communication by means of a source of air tension of lower power but of the same character and controlling said air tension of lower power by the passage of the music sheet perforations over the tracker.

17. The method of operating a power pneumatic of a pneumatic piano having a tracker, which consists in generating operating air tensions of the same character but of different values, one tension being high at all times and the other tension practically uniformly low, placing the source of high actuating power in communication with the pneumatic, controlling said communication by means of the source of less power, and controlling said last-named source from the tracker.

18. In a pneumatic action, the combination with a power pneumatic, a tracker and a pump, and means controlled from the tracker for controlling the operation of the power pneumatic, comprising two air chambers, one of said chambers containing air at all times under high tension and the other containing air under substantially uniform low tension, a valve-actuator freely movable in the low tension chamber, a valve influenced in its operation by the movements of the actuator for controlling the passage of air from the high-tension chamber to the power pneumatic, separate passages leading from the pump to the two air chambers respectively, and means for reducing the tension of the air passing through the passage that leads to the valve-actuator chamber.

19. A pneumatic playing mechanism comprising superposed blocks each block having suitable ducts and a row of chambers formed therein, the chambers of one row

being located above and in alinement with those of the other row, a valve in each chamber of the upper row, a valve actuator in each chamber of the other row, a plurality of cylinders connected to and supported from one of the said blocks, and a weighted piston freely movable in each cylinder.

20. A pneumatic playing mechanism comprising superposed blocks, each block having suitable ducts and a row of chambers formed therein, the chambers of one row being located above and in alinement with those of the other row, a valve in each chamber of the upper row, a valve actuator in each chamber of the other row, a plurality of cylinders connected to and supported from one of said blocks, and a piston freely movable in each cylinder, each cylinder and its associated chambers being arranged in linear order.

21. A pneumatic action for musical instruments, comprising a plurality of power pneumatics each consisting of a cylinder and a piston freely movable therein, and means for effecting the operation of said power pneumatics, embodying two horizontally arranged rows of air chambers, the chambers of one row being located above and in alinement with the chambers of the other row, means for maintaining said chambers under different degrees of air tension, a bodily movable valve actuator in each of the lower row of chambers, a separate passage leading from each of the chambers of the other row to the cylinder of its associated power pneumatics, a valve in each chamber of the upper row of chambers, and means operated by each actuator for actuating its associated valve, for the purpose specified.

22. An upright piano having a pneumatic hammer-action operating mechanism wholly inclosed in the upper part of the piano case, said mechanism comprising a row of vertically disposed cylinders and pistons freely movable therein, a pull connection between each piston and its associated wippen, and valve mechanism for controlling the operation of the pistons, said valve mechanism embodying duct and valve-chamber blocks, with which blocks the said cylinders are directly connected and by which they are supported, and said blocks and cylinders being located transversely of the piano case, forward of the action and between the hammer heads and wippens.

23. An upright piano having a pneumatic action operating mechanism wholly inclosed in the upper part of the piano case, said mechanism comprising a row of vertically disposed cylinders and pistons freely movable therein, said cylinders arranged transversely of the piano case, forward

ward of the hammers and above the wippens, a pull connection between each piston and its associated wippen, and valve mechanism for controlling the operation of the pistons, said valve mechanism embodying duct and valve chamber blocks, with which blocks the said cylinders are directly connected, and which blocks are also located transversely of the piano case and forward of the piano hammers.

24. An upright piano having a pneumatic action operating mechanism wholly inclosed in the upper part of the piano casing adjacent to and forward of the piano hammers, said mechanism comprising a plurality of vertically disposed cylinders and pistons freely movable therein, valve mechanism for controlling the operation of said pistons, comprising two rows of air chambers, the chambers of one row being located above and in alinement with the other row, and said chambers being arranged transversely of the piano case and parallel with the said cylinders, means for maintaining said chambers under different degrees of air tension, separate passages leading respectively from the several high tension chambers to the said cylinders, a valve controlling each passage, means in the low tension chambers for actuating said valve to control the communication between the high tension chambers and pneumatics, and an independent connection between each piston and a unit of the hammer action.

25. An upright piano having a pneumatic action operating mechanism wholly inclosed in the upper part of the piano case adjacent to and forward of the piano hammers, said mechanism comprising a plurality of vertically disposed cylinders and pistons freely movable therein, said cylinders arranged transversely of the piano case and parallel with the piano hammers, a pull connection between each piston and its associated wippen, and valve mechanism for controlling the operation of the pistons, comprising two rows of air chambers, the chambers of one row being located above and in alinement with the chambers of the other row, and said chambers being arranged transversely across the piano case and constituting the supporting means for the cylinders with which the latter are directly connected, means for maintaining the said chambers under different degrees of air tension, separate passages leading respectively from the several high-tension chambers to the said cylinders, a valve in each passage, and means in the low-tension chambers for actuating said valve to control the communication between the high tension chambers and pneumatics.

26. In a pneumatic action, the combination with a power pneumatic comprising a cylinder and a piston freely movable there-

in, a tracker, of a high tension chamber and means controlled by a perforated music-sheet passing over the tracker for placing the power pneumatic under the influence of high tension air from said high tension chamber, said means embodying a low tension chamber and a bodily movable valve-actuator fitting loosely therein and having a clearance around the same, a low tension source leading directly to the low tension chamber independent of the tracker, a separate port or passage leading from the tracker to the low tension chamber, a valve in the high tension chamber, and means influenced by the movements of the valve actuator for operating said valve.

27. In a pneumatic action, the combination with a power pneumatic and a tracker, of a high-tension chamber and means controlled by a perforated music sheet passing over the tracker for placing the power pneumatic under the influence of high tension air from said high-tension chamber, said means embodying a low tension chamber and a bodily movable valve actuator fitting loosely therein and having an air clearance around the same, a low tension source leading directly to the low tension chamber independent of the tracker, and a separate port or passage leading from the tracker to the low tension chamber.

28. In a pneumatic action, the combination with a power pneumatic and a tracker over which a perforated music sheet is adapted to travel, of a high tension chamber having no communication with the tracker and means controlled by a perforated music sheet passing over the tracker for placing the power pneumatic under the influence of high tension air from said high-tension chamber, said means embodying a low tension chamber and a bodily movable valve actuator therein, a low tension source in normal open communication with the said low tension chamber on one side of the said actuator, and a port or passage leading from the tracker to the said low tension chamber on the opposite side of said actuator.

29. In a pneumatic action, the combination with a power-pneumatic and a tracker, of valve means for controlling the operation of the said pneumatic, comprising superposed blocks each having a chamber therein, the one chamber located above and in alinement with the other, a bodily movable valve-actuator loosely fitted in the lower chamber and having an air clearance around the same, a valve in the upper chamber, and a stem interposed between the said actuator and valve, said stem moving freely in an aperture in one of the blocks, with which aperture the said stem has a substantially close fit.

30. In a pneumatic action and in combi-

nation, a tracker over which a music sheet is adapted to travel, a power pneumatic comprising a cylinder and a piston freely movable therein, and means controlled from the tracker for controlling the operation of said pneumatic, said means embodying two chambers, one of which is in communication with the tracker and the other adapted to have communication with the cylinder of the power pneumatic, a valve in one chamber and a valve actuator in the other chamber, and an air tension source common to both chambers, for maintaining said chambers under air tensions of like character but differing in degree, the air tension in the valve actuator chamber being less than the tension in the valve chamber.

31. In a pneumatic action, the combination with a power pneumatic and a tracker, of valve means for controlling the operation of the pneumatic, comprising superposed blocks each having a chamber therein, the one chamber being located above and in alinement with the other, a bodily movable plunger loosely fitted in the lower chamber and having an air clearance around the same, a ball-valve in the upper chamber, and a stem interposed between the said plunger and valve and adapted to contact with each but disconnected therefrom, said stem being freely movable in an aperture in one of the blocks, with which aperture the said stem has a substantially close fit.

32. In a pneumatic action, a power pneumatic, comprising a cylinder and a piston freely movable therein, and valve means for controlling the operation of said pneumatic, embodying superposed blocks each having a chamber therein, one chamber located above and in alinement with the other, means for maintaining said chambers under different degrees of air tension, a bodily movable valve-actuator in the low tension chamber, a ball valve in the high tension chamber, a stem interposed between the said valve actuator and ball, said stem being freely movable in an aperture formed in one of the blocks, with which aperture the said stem has a substantially close fit, and a port or passage leading from the high tension chamber to the cylinder of the power pneumatic.

33. In a pneumatic action, a power pneumatic comprising a cylinder open at one end to the atmosphere and a piston freely movable therein, and means for controlling the operation of the piston, comprising a tracker over which a perforated music-sheet is adapted to travel, a low tension chamber in communication with the tracker, a high tension chamber adapted to be placed in communication with the closed end of said cylinder, a bodily movable valve-actuator freely slidable in the low-tension chamber, a ball valve in the high tension chamber,

means operated by said valve actuator for
lifting said valve to establish communica-
tion between the high tension chamber and
cylinder, and an air-power source common
5 to the said high and low tension chambers,
the air from the said power source acting
under different tensions below that of the
atmosphere in the respective chambers.

In testimony whereof we affix our signa-
tures in presence of two witnesses.

HENRY CHARLES COLDMAN.
CHRISTOPHER FREDERICK WEBB.

Witnesses:

T. SELBY WARDLE,
WALTER J. SKERTEN.

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