No. 887,376. PATENTED MAY 12, 1908.

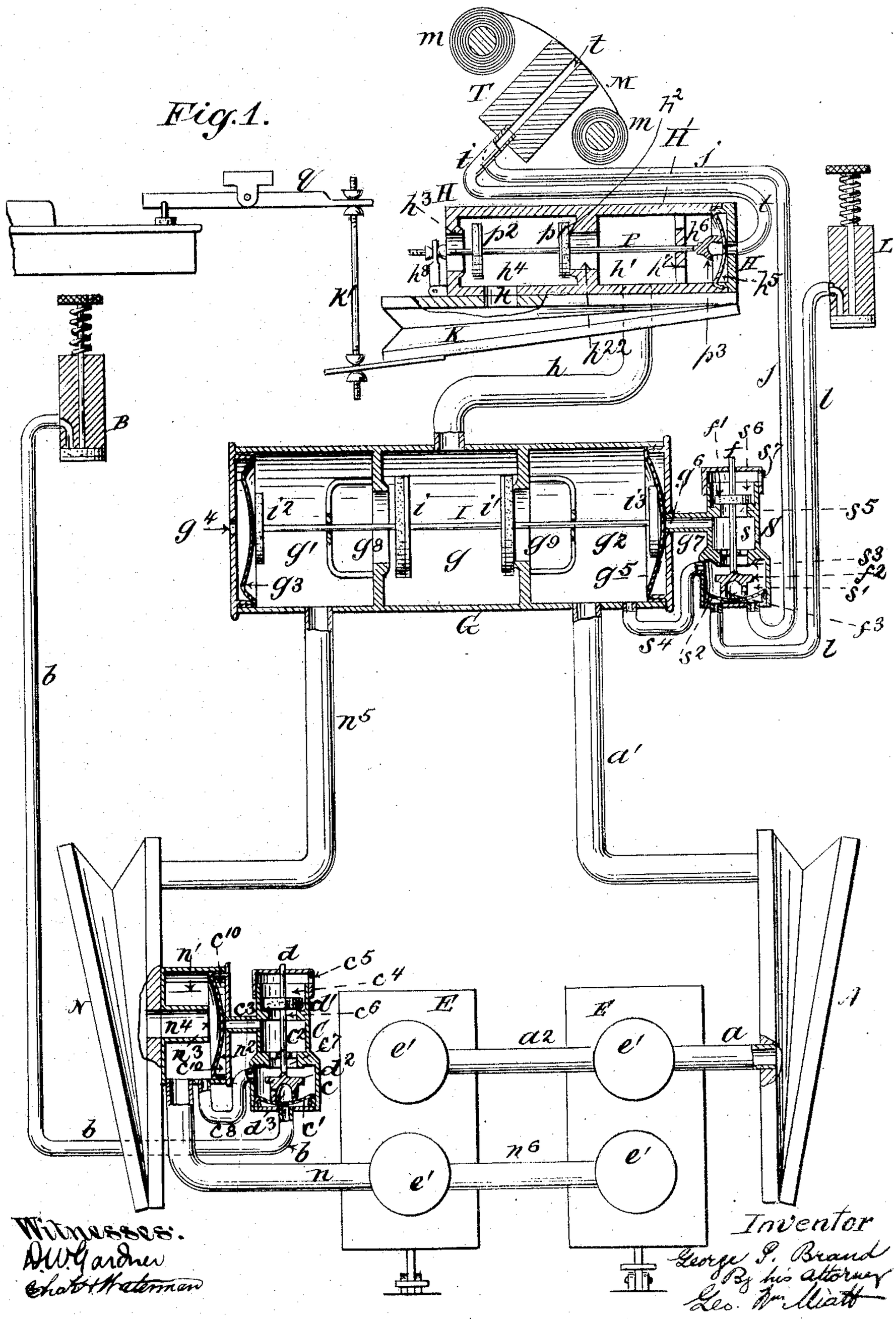
G. P. BRAND.

MEANS FOR CONTROLLING THE EXPRESSION OF AUTOMATIC MUSIC PLAYERS.

APPLICATION FILED NOV. 24, 1903. RENEWED MAY 2, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



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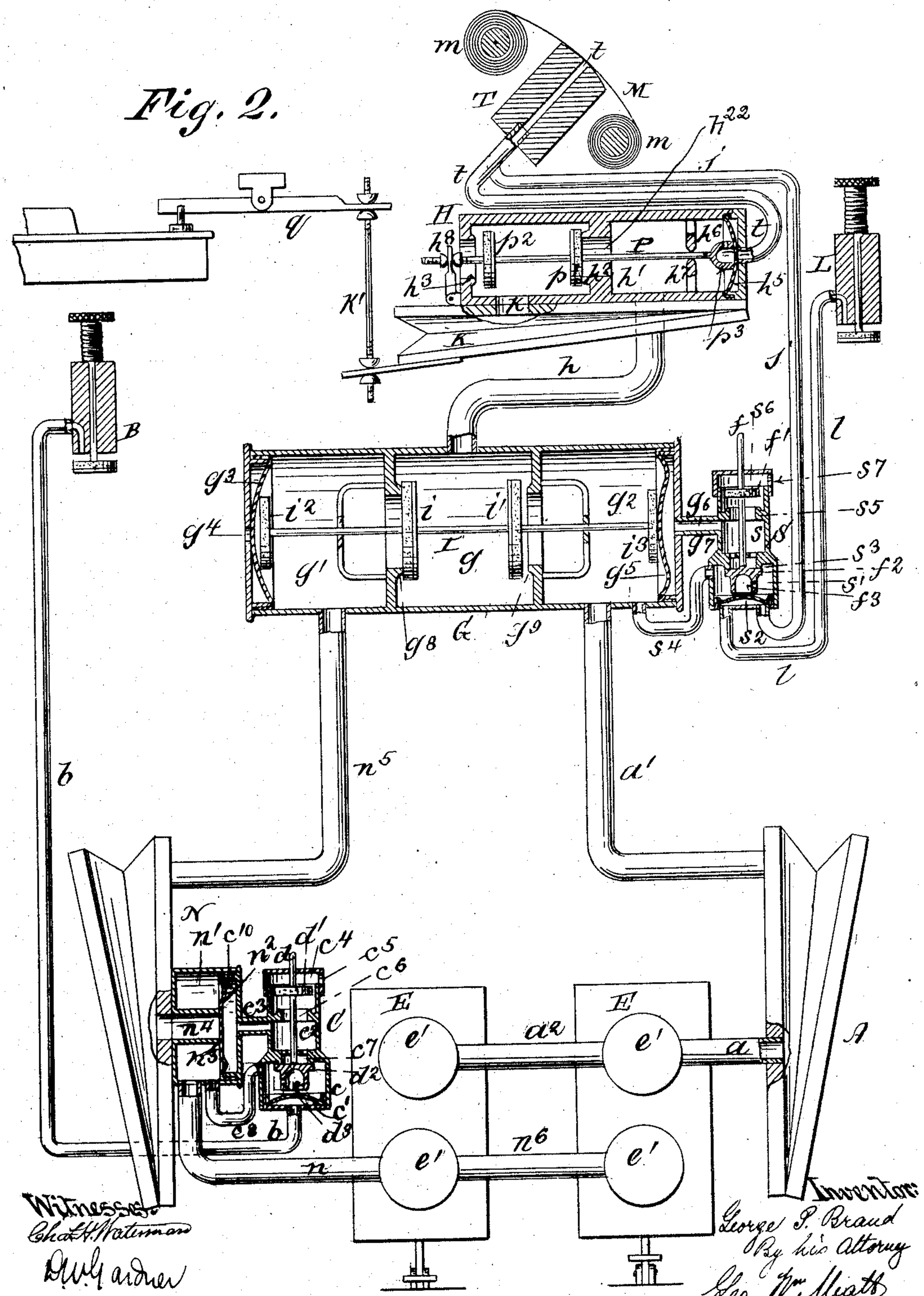
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

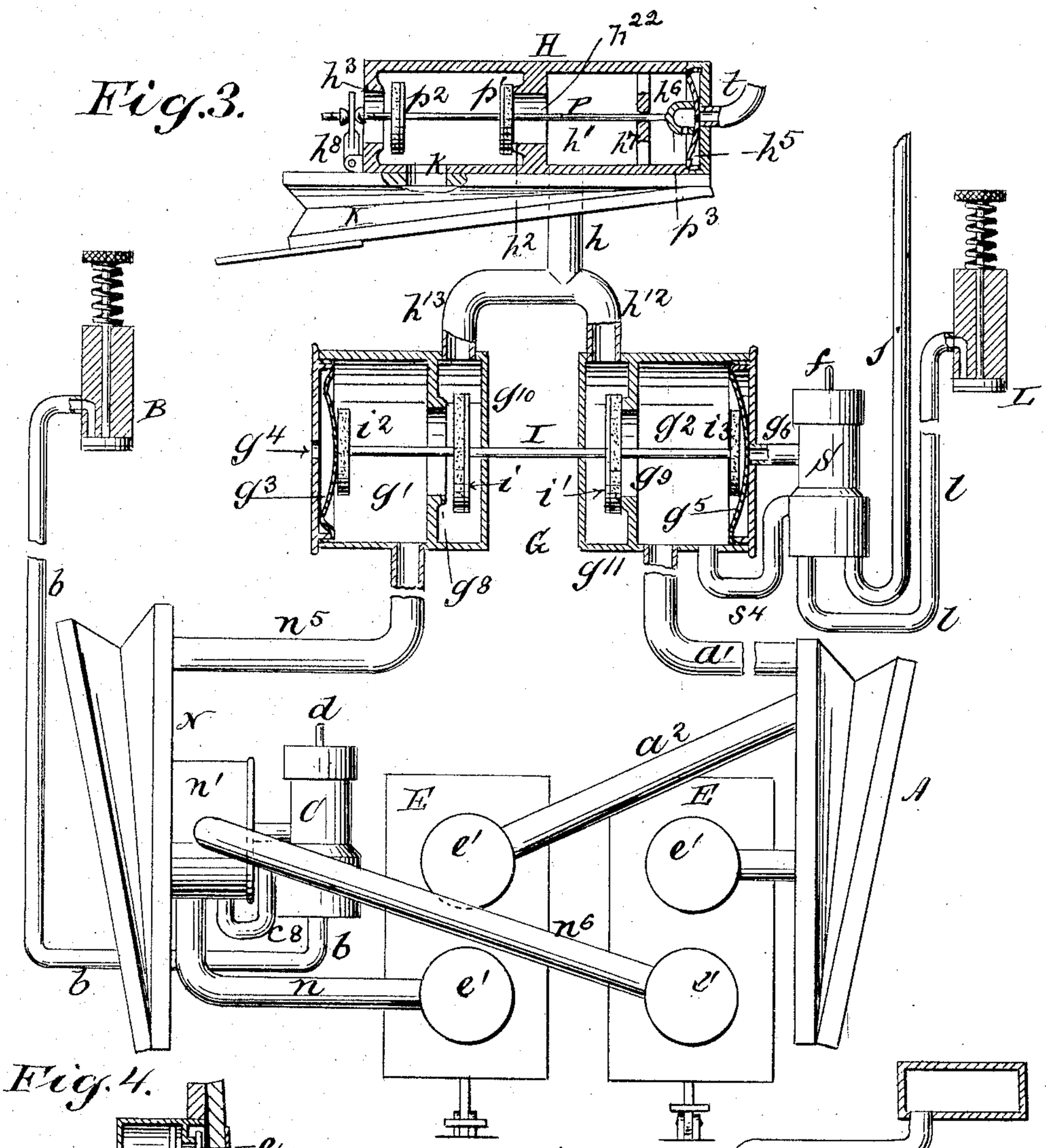


Fig. 4.

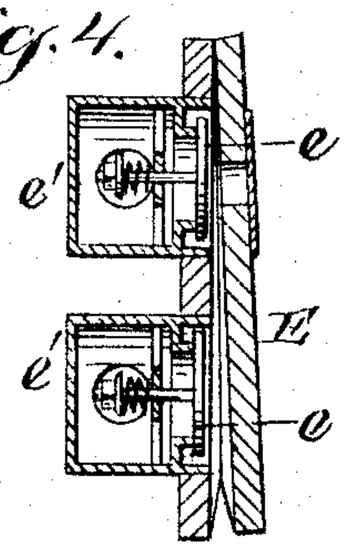
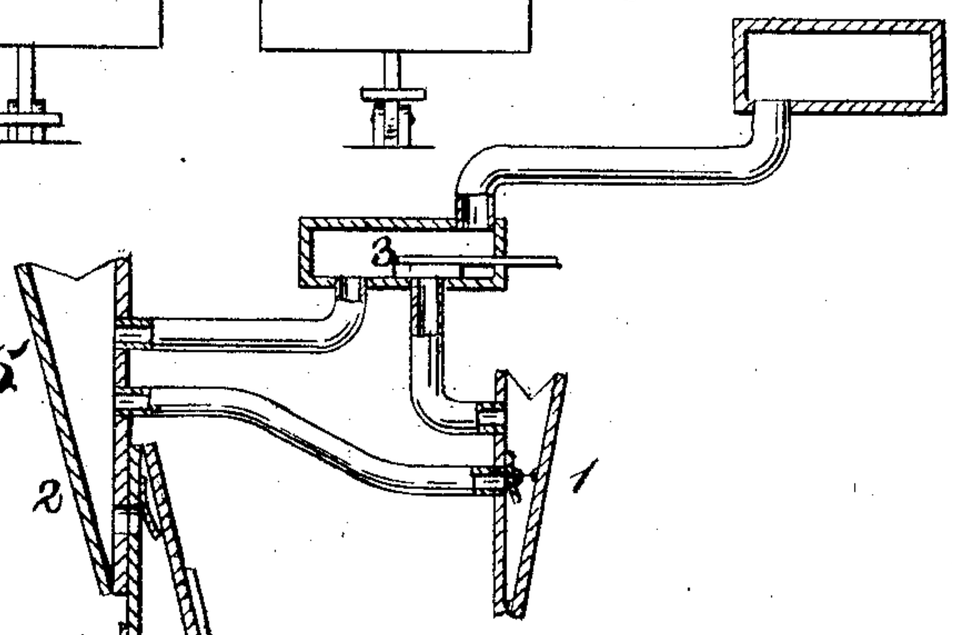


Fig. 5.



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Geo. Wm. Miatt

UNITED STATES PATENT OFFICE.

GEORGE P. BRAND, OF NEW YORK, N. Y.

MEANS FOR CONTROLLING THE EXPRESSION OF AUTOMATIC MUSIC-PLAYERS.

No. 887,376. Specification of Letters Patent. Patented May 12, 1908.

Application filed November 24, 1903, Serial No. 182,449. Renewed May 2, 1906. Serial No. 314,869.

To all whom it may concern:

Be it known that I, GEORGE P. BRAND, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Means for Controlling the Expression of Automatic Music-Players, of which the following is a specification, sufficient to enable others skilled in the art to which the invention appertains to make and use the same.

My improvements are applicable generally to pneumatic apparatus for automatically actuating musical key instruments; and the invention consists, in the use of the means hereinafter set forth for controlling and applying different tensions, whereby I am enabled not only to attain instantaneously a change from the maximum to the minimum volume of sound, or vice versa, but also to attain any intermediate degree of tension between the two extremes, thus increasing the scope of expression and admitting of delicate shadings in tone as well as forceful accentuation.

In the accompanying drawings, I show diagrammatically an arrangement and combination of parts and devices whereby my invention may be operated practically, although I do not limit myself strictly thereto since it is obvious that various changes and mechanical expedients may be resorted to without departing from the spirit and intent of my invention. In fact some of the parts and devices herein shown and used symbolically are new in themselves and form the subject matter of concurrent applications, and while preferable for use in this connection might be supplanted by other and well known devices performing like functions, without altering materially the results attained.

Figure 1, is a diagram in sectional elevation of parts essential in carrying out my invention, without regard to their exact relative positions in the apparatus; Fig. 2, is a similar view illustrating the operation of certain parts; Fig. 3, is a diagrammatic view showing a modification in the arrangement of parts; Fig. 4, is a section through one of the exhausters; Fig. 5, is a diagram illustrating the general arrangement of tension devices heretofore used.

E, E, are air exhaust pumps or devices of any suitable form and construction, those shown in the drawings being provided with pallet valves *e*, *e*, similar to that shown in detail in Fig. 4. Any desired number of the exhaust devices E, may be used in conjunction, each being connected with the normal tension reservoir N by a duct *n*, and with the accentuating reservoir A, by a duct *a*,—the air duct *n*, opening into the diaphragm chamber *n'*, of the normal reservoir N, while the duct *a*, opens into the body of the accentuating reservoir A.

It is to be understood that I hereinafter use the term "exhauster" as designating the device as a whole, including the puppet or other valves forming part thereof, or connected therewith. Thus the exhausters E, E, though of special construction in that they are formed with external chambers *e'*, *e'*, covering the pallet valve openings, are nevertheless used symbolically.

C is a cut off by which the diaphragm n^2, is actuated with relation to its seat n^3, the latter being formed by the edge of the exhaust port n^4. The cut off itself is formed with a diaphragm chamber *c*, and diaphragm *c'*, under which opens the air pressure conduit *b*, leading from the inlet valve B, which latter is adapted to be operated manually, and may be of any desired or well known construction. The central chamber c^2, of the cut off C communicates through a conduit c^3, with the space c^{10}, in the casing back of the diaphragm n^2, and the valve chamber c^4, communicates through the opening c^5, with the atmosphere. The valve stem *d*, carries two valves *d'*, d^2, engaging respectively and alternately with the seats c^6, c^7, and its lower end is formed with an open cup-shaped bearing d^3, which rests against the upper side of the diaphragm *c'*. An equalizing tube c^8, connects the diaphragm chamber *n'*, of the controller C with the diaphragm chamber *n'*, of the normal tension reservoir N.

G is what may be designated as the intermediate tension chest, interposed between the normal reservoir N and accentuating reservoir A, and the action box or chest H. This intermediate tension chest G is partitioned off into three compartments *g*, *g'*, g^2, the central one of which *g*, constitutes a variable tension chamber communicating with the action chest H, through the exhaust conduit *h*. A conduit n^5, connects the normal tension reservoir N with the chamber *g'*, and in like manner the accentuating reservior A, is connected by the conduit *a'*, with the chamber g^2.

In the chamber g', is situated a diaphragm g^3, separating the rest of the chamber from the end formed with the opening g^4, into the atmosphere. In like manner the chamber g^2, is provided with a diaphragm g^5, separating the rest of the chamber from the end formed with the aperture g^6, but in this case the aperture g^6, instead of opening directly into the atmosphere, communicates through the duct g^7, with the shunt controller S, opening into the central chamber s, thereof. The partitions in the intermediate chest G, are formed with valve seats g^8, g^9, with which engage alternately valves i, i', upon the valve stem I, the latter being also formed with end abutments i^2, i^3, which bear against the diaphragms g^3, g^5, respectively.

The shunt controller S, is formed with a diaphragm chamber s', in which is situated the diaphragm s^2, interposed between the valve seat s^3, and the open end of the air pressure ducts l, and j, the former connecting with the air pressure valve L, or other manually operated air inlet device, and the latter with the tracker board T.

s^4, is an equalizing duct connecting the chamber g^2, with the diaphragm chamber s', of the shunt controller S. The latter is also formed with a seat s^5, and chamber s^6, the latter communicating with the atmosphere through the opening s^7.

The valve stem f, carries the two valves f', and f^2, and is formed at its lower end with the open cup-shaped bearing f^3, for contact with the diaphragm s^2.

The conduit h, from the variable tension chamber g, enters the vacuum chamber h', of the action box or chest H. Said vacuum chamber h', communicates through a series of ports h^{22} with a series of chambers h^4, each coincident with and individual to one of the series of key pneumatics K. Each of said chambers h^4 is formed with two valves seats h^2, h^3, one h^3, opening to the atmosphere, and the other h^2 through the port h^{22}, into the vacuum chamber h'. The valve seats h^2 are closed normally by valves p', on rods P which also carry valves p^2, for engagement with the seats h^3, opening to the atmosphere. In these chambers h^4, between the valve seats h^2, h^3, are situated the openings k, into the key pneumatics K. The end of each valve rod P is formed with an open cup-shaped bearing p^3, for contact with the diaphragm h^5, situated in the space h^6, and interposed between the seat h^2, and the air duct t, leading to the tracker board T.

The valve rod P is supported near its inner extremity by the cross arm or bearing h^7, and at its outer extremity by a rock lever h^8, which allows it to adapt itself easily and quickly to motion in either direction.

Each key pneumatic K is connected by a rod k', with an actuating lever q, by which a particular key of the musical instrument is depressed whenever its pneumatic K is deflated, and released when said pneumatic K is again inflated under the conditions hereinafter set forth.

It is to be noted that I not only couple the exhausters E, E, together but also connect each reservoir N, A, with each exhauster. This may be done as shown in Fig. 1 and 2, or as shown in the modification Fig. 3. In the first two figures named short pipes or conduits a^2, n^6, connect the chambers e', e', on the adjoining exhausters E, E, so that each reservoir is in connection directly with both exhausters.

In Fig. 3, the conduit n^6, enters the diaphragm chamber n', of the normal tension reservoir N, and the conduit a^2, enters directly into the auxiliary reservoir A, the result being the same in either case, namely, that both the normal tension reservoir N, and the auxiliary reservoir A are connected together indirectly through the exhausters E, E, so that unless the normal tension reservoir N is cut out by the seating of the diaphragm n^2, on the edge of the duct n^4, the same degree of tension will prevail in both reservoirs.

It is to be understood that the diaphragms shown are formed with bleed holes, or that provision is otherwise made for their retraction. The cup-shaped bearings on the ends of the valve stems are also perforated or formed to admit of circulation of air.

Under normal conditions the music sheet M traveling between the rolls m, m, admits air to the duct t, whenever a perforation comes into coincidence with the corresponding opening in the tracker board T, thereby forcing the diaphragm h^5, forward, opening the valve p', and seating the valve p^2, and causing the collapse of the pneumatic K. The force and speed of the downward stroke thus imparted by the pneumatic K to the key of the musical instrument through the medium of the rod k', and lever q, will obviously depend upon the degree of vacuum or tension in the vacuum chamber h', of the action chest H, and this in turn, in the arrangement shown in Figs. 1 and 2, on the degree of tension in the variable tension chamber g, of the intermediate chest G. Playing without interference or hand manipulation of the parts, this degree of tension will equal that existing at the time in the normal reservoir N, since communication is unobstructed through the conduit n^5, between the said reservoir N and the variable tension chamber g.

Now it is one of the pecularities of my apparatus and of my system of accentuation, that under these so called normal conditions, which are usually only temporary during ordinary use, the degree of tension in the accentuating reservoir A, and connections is essentially and substantially that existing in

the so called normal reservoir and connections,—the cross connections between the exhausters E, E, equalizing the internal tension of the two reservoirs, and an excess of tension being created in the accentuating reservoir only when required for immediate use. Hence to change the reservoir A from a simple auxiliary tension chamber into a high tension reservoir, I temporarily depress the valve B, by hand, thereby admitting air through the duct b, to the underside of the diaphragm c', in the cut off C. This raises the valve stem d, thereby seating the valve d^2, cutting off communication with the diaphragm chamber n', and at the same time raising the valve d', from its seat and admitting air through the opening c^5, valve seat c^6, and duct c^3, to force the diaphragm n^2, to its seat on the end of the port n^4, thus cutting off communication between the reservoir N, and the exhausters E, E. As a result the exhausters E, E, act temporarily on the accentuating reservoir alone, one or two pulsations of the exhausters being sufficient to increase the tension in the reservoir A to a degree that will insure a sudden and marked increase in tension in the vacuum chamber h', of the action chest H, immediately upon the shifting of the valves i, i', in the intermediate trunk G. This is accomplished either by the passage of an accent perforation in the music sheet over the mouth of the opening in the tracker board leading to the conduit j, or by the depression of the air pressure valve L, the result being the same in that air is admitted underneath the diaphragm s^2, in the shunt controller S, thereby raising the valve stem f, and valve f' admitting air through the opening s^7, valve seat s^5, chamber s, and duct g^7, to the rear of the diaphragm. At the same time the valve f^2, is seated, cutting off communication between the chamber s', of the shunt controller S, and the chamber g^2, of the intermediate chest G. As a consequence the pressure in the end of the chamber g^2 to the right of the diaphragm g^5 being greater than in the chambers g, g' the said diaphragm g^5, acting on the abutment i^3, throws the valve rod I, over until the valve i, rests against its seat g^8, at the same time withdrawing the valve i', from its seat g^6, thus closing communication between the variable tension chamber g, and the chamber g', and opening communication between the chamber g^2, and said variable extension chamber g, as shown in Fig. 2, which also shows the normal reservoir N cut off by the diaphragm n^2, from communication with the exhausters E, E. It must be said in explanation of Fig. 2, however that while it illustrates clearly the operations attendant upon and essential to accentuation, it dose not necessarily indicate the actual relative positions of the parts during accentuation, since as a matter of fact the cutting off of the normal reservoir N from the exhausters E, E, is only a preparatory measure whereby the reservoir A, is changed temporarily from an auxiliary reservoir into an accentuating reservoir, and since it is not designed to reduce the tension materially or perceptibly in the normal reservoir N, and connections, communication may almost immediately be reëstablished between the said normal reservoir and exhausters without impairing or interfering with action of the accentuating reservoir A. In practice the air pressure valve B, is depressed for a moment only and may then be released even before the air pressure valve L is depressed to actuate the shunt controller as before described. The release of the air pressure valve B, cutting off the pressure of the atmosphere from the under side of the diaphragm c', causes the latter to collapse and return the valve d', to its seat c^6, thereby cutting off atmospheric pressure from the diaphragm n^2, the simultaneous opening of the valve d^2, providing for the equalization of tension between the chamber c^2, in the cut off C and interior of the diaphragm chamber n'.

It is only designed to maintain communication between the accentuating reservoir A and the vacuum chamber h', of the action chest H for a comparatively short period of time, since the accentuating reservoir A may thus be quickly and conveniently turned into a high tension medium and thrown in and out of communication with the vacuum chamber in the action chest as often as desired, and at comparatively short intervals of time if necessary, the parts, owing to the coupling together of the exhausters E, E, and the connection of the latter with both the normal reservoir N and the auxiliary reservoir A, responding readily upon the depression of the air pressure valve B, so that the auxiliary reservoir A, is instantly transformed into a high tension reservoir. It is to be noted however that it is only while the exhausters are in operation, and then only when the tension in the normal reservoir N is raised to the same degree as that in the auxiliary or accentuating reservoir A, that there is actual communication between the said reservoirs through the exhausters,—the pallet valves on the latter under other conditions preventing such communication.

At the end of the accentuation the air pressure valve L is released, cutting off atmospheric pressure from beneath the diaphragm s^2, of the shunt controller S, and thereby lowering spindle f, seating the valve f', and unseating the valve f^2, and opening communication between the interior of the diaphragm chamber s' of the controller S, and chamber g^2, through the medium of the duct s^4 thereby equalizing the tension on both sides of the diaphragm g^5. Atmospheric pressure being

thus cut off at this end of the intermediate chest G, and the tension neutralized on opposite sides of the diaphragm g^5, the pressure of the atmosphere upon the diaphragm g^3 through the port g^4, at the opposite end of the chest G, effects the retractile movement of the valve rod I, and restores the parts to their normal condition, so called, as shown in Fig. 1.

It is to be understood that the term "normal" is herein used in a relative sense only, and for convenience of description, since as a matter of fact when the music is properly accentuated the tension is varied constantly, not only by the use of the air pressure valves B and L, but also by variations in the manipulation of the exhausters E, E. Thus the auxiliary reservoir A connected directly with the exhausters E, E, and indirectly through them with the normal reservoir N, affords means whereby the most delicate shading of tone may be attained at any degree or degrees of tension between the minimum and maximum capacity of the apparatus, at the same time providing for instantaneous changes from maximum to minimum, or vice versa, or to and between intermediate degrees of tension. These results are attained mainly by the use of an auxiliary reservoir for purpose of accentuation which is related only indirectly to the normal tension reservoir, and which while connected with exhausters common to both reservoirs, is actuated and controlled by independent means. These two features of direct connection with the exhausters, and independent manipulation of the high tension or accentuating reservoir, mark a new and important development in the state of the art, as I have proved by actual experimental use.

As is well known it has heretofore been customary to connect a normal or low tension bellows 1 Fig. 5, directly with a high tension bellows 2, the high tension being maintained continuously, and the low tension being attained by means of a throttle or valve 3, controlling communication between the two bellows substantially as shown by way of illustration in said diagram Fig. 5, by which it will be seen that the exhausters have no direct control over the low tension bellows 1, and that the latter is relatively small, and subordinate to the high tension bellows 2. In other words the degree of low tension is fixed or limited in the old method by the throttle 3, whereas in my arrangement both tensions are unrestricted, are of equal capacity, and are exhausted and controlled independently. Furthermore in my apparatus the "normal" tension is relatively low although it may vary considerably in degree, the higher tension being created only as wanted, and independent of the normal tension. Both tensions being directly created and controlled by the pedals or other means of actuating the exhausters, there can be no wire-drawing or throttling of air through valves as heretofore to increase resistance and retard action. By thus decreasing resistance and dispensing with the need of maintaining a constant high tension I greatly economize in the power requisite to operate the apparatu., and at the same time, by tension created as needed and applied directly, insure instantaneous results, and more perfect control thereof. This direct control and quick response enables me to attain with accuracy variations and effects of accentuation not heretofore possible. For instance, I can drop from FFF to PPP, and immediately thereafter change to FF, and then to P or mF, as may be desired,—the changes being effected either gradually or instantaneously as desired, since the two tensions are created, exist, and are controlled independently, and may have any desired relation to each other as regards degree of tension,—results that cannot be attained where one degree of tension is dependent on another, and where the change has to be effected through a throttle valve. In other words, I can effect any desired combination or contrast that may be attained by difference in tension, or rather by shifting from one tension to another, for the reason that I am able to create any desired tension in either reservoir, so that the transitions may be great or slight, and in any part of the whole field covered by the capacity of the instrument from and between minimum to maximum tensions.

The variable tension chest G, interposed between the high and low tension reservoirs A, N, though not indispensable, is an advantageous feature in that it affords a single shunting device common to both reservoirs. The same result may be attained by running each of the conduits n^5, a', to the vacuum chamber h', in the action chest H, or what amounts to the same thing, into its conduit h, provided provision for shutting off each conduit n^5, a', therefrom is made, either by independent valve mechanism, or by a modification of the variable tension chest G, as shown in Fig. 3, in which the middle chamber g, is dispensed with, and valve chambers g^{10}, g^{11}, are added to the high and low tension chambers g', g^2, said valve chambers g^{10}, g^{11}, being connected with the action box conduit h, by branches g^{12}, h^{13}, in which case a single valve actuating device, as the shunt controller S, will answer the purpose. Where it is preferred however the valves i, i', may be independently controlled by a duplication of parts, or the substitution of well known mechanical expedients.

What I claim as my invention and desire to secure by Letters Patent is,

1. In automatic music players, the combination of a normal tension reservoir in com-

munication with the exhaust mechanism and with the action chest which controls the key pneumatics, said action chest, an auxiliary tension reservoir independently and directly connected with the said exhaust mechanism and indirectly with the said action chest, means for opening and closing communication between the normal tension reservoir and the exhaust mechanism, means for opening and closing communication between said normal tension reservoir and said action chest, and means for opening and closing communication between said auxiliary reservoir and the action chest, whereby the latter may be used as a high tension reservoir for the purpose of accentuation.

2. In automatic music players, the combination of a normal tension reservoir in communication with the exhaust mechanism and with the action chest which controls the key pneumatics, said action chest, an auxiliary tension reservoir directly and independently connected with the said exhaust mechanism and directly with the said action chest, means for opening and closing communication between the normal tension reservoir and the exhaust mechanism, and means for simultaneously closing communication between the normal tension reservoir and the action chest and opening communication between the latter and the said auxiliary reservoir, and vice versa, for the purposes of accentuation.

3. In automatic music players, the combination of a normal tension reservoir in communication with the exhaust mechanism and with the action chest which controls the key pneumatics, said action chest, an auxiliary tension reservoir directly and independently connected with the said exhaust mechanism and indirectly with the said action chest, an intermediate variable tension chest interposed in the conduits between the said tension reservoirs and the said action chest, valves in said variable tension chest arranged to simultaneously close communication between one of the said tension reservoirs and the action chest and open communication between the latter and the other tension reservoir, and vice versa, and means for operating said valves for the purpose set forth.

4. In automatic music players, the combination with the action chest, of two tension reservoirs connected therewith, and with exhaust mechanism common to both, said exhausters, means for opening and closing communication between said exhaust mechanism and one of the said tension reservoirs, and means for alternately opening and closing communication between said action chest and each of said reservoirs, for the purpose set forth.

5. In automatic music players, the combination of an action chest, key pneumatics, a normal tension reservoir, an auxiliary tension reservoir, a variable tension chest formed with a plurality of chambers, one of which is connected with said action chest and others connected respectively with said normal tension reservoir and auxiliary tension reservoir, valves in said first named chamber arranged to alternately open and close communication between it and the other chambers and means for actuating said valves.

6. In automatic players, the combination of an action chest, a normal tension reservoir and an auxiliary tension reservoir both connected with said action chest, exhausters each formed with two inlet valve chambers and valves, an independent channel connecting the normal tension reservoir with an inlet valve chamber on each exhaust, and an independent channel connecting the auxiliary tension reservoir with the other inlet valve chamber on each exhaust.

7. In automatic music players, the combination of an action chest and key pneumatics, a variable tension chest formed with three chambers, the central one of which is connected with the said action chest, and the end chambers of which are connected respectively with a normal tension reservoir and an auxiliary tension reservoir, valves in said middle chamber arranged to alternately open and close communication between it and said end chambers, means for actuating said valves, said normal tension reservoir, said auxiliary tension reservoir, exhaust mechanism connected with the said tension reservoirs, and means for opening and closing communication between said normal tension reservoir and the exhausters, for the purpose set forth.

8. In automatic music players, the combination of an action chest, key pneumatics, a normal tension reservoir, an auxiliary tension reservoir, a variable tension chest formed with a plurality of chambers, one of which is connected with said action chest and others connected respectively with said normal tension reservoir and auxiliary tension reservoir, valves in said first named chamber arranged to alternately open and close communication between it and the other chambers, means for actuating said valves, exhaust mechanism, and means for opening and closing communication between said normal tension reservoir and the exhaust mechanism.

9. In automatic music players, the combination of an action chest, key pneumatics, a normal tension reservoir, an auxiliary tension reservoir, a variable tension chest formed with a plurality of chambers, one of which is connected with said action chest and others connected respectively with said normal tension reservoir and auxiliary tension reservoir, valves in said first named chamber arranged to alternately open and close communication between it and the

other chambers, means for actuating the valves, and means for exhausting the air from the auxiliary tension reservoir.

10. In automatic music players, the combination of an action chest and key pneumatics, a variable tension chest formed with three chambers, the central one of which is connected with the said action chest and the end chambers of which are connected respectively with a normal tension reservoir and an auxiliary tension reservoir, valves arranged to alternately open and close communication between the said variable tension chest and the said end chambers, means for actuating said valves, said normal tension reservoir, said auxiliary tension reservoir and means for exhausting said normal and auxiliary tension reservoirs.

11. In automatic music players, the combination of an action chest and key pneumatics, a variable tension chest formed with three chambers the central one of which is connected with the said action chest and the end chambers of which are connected respectively with a normal tension reservoir and an auxiliary tension reservoir, valves arranged to alternately open and close communication between the said variable tension chest and the said end chambers, means for automatically actuating said valves, said normal tension reservoir, said auxiliary tension reservoir, and means for exhausting said normal and auxiliary tension reservoirs.

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