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G. P. BRAND.

MECHANICAL MUSICAL APPARATUS.

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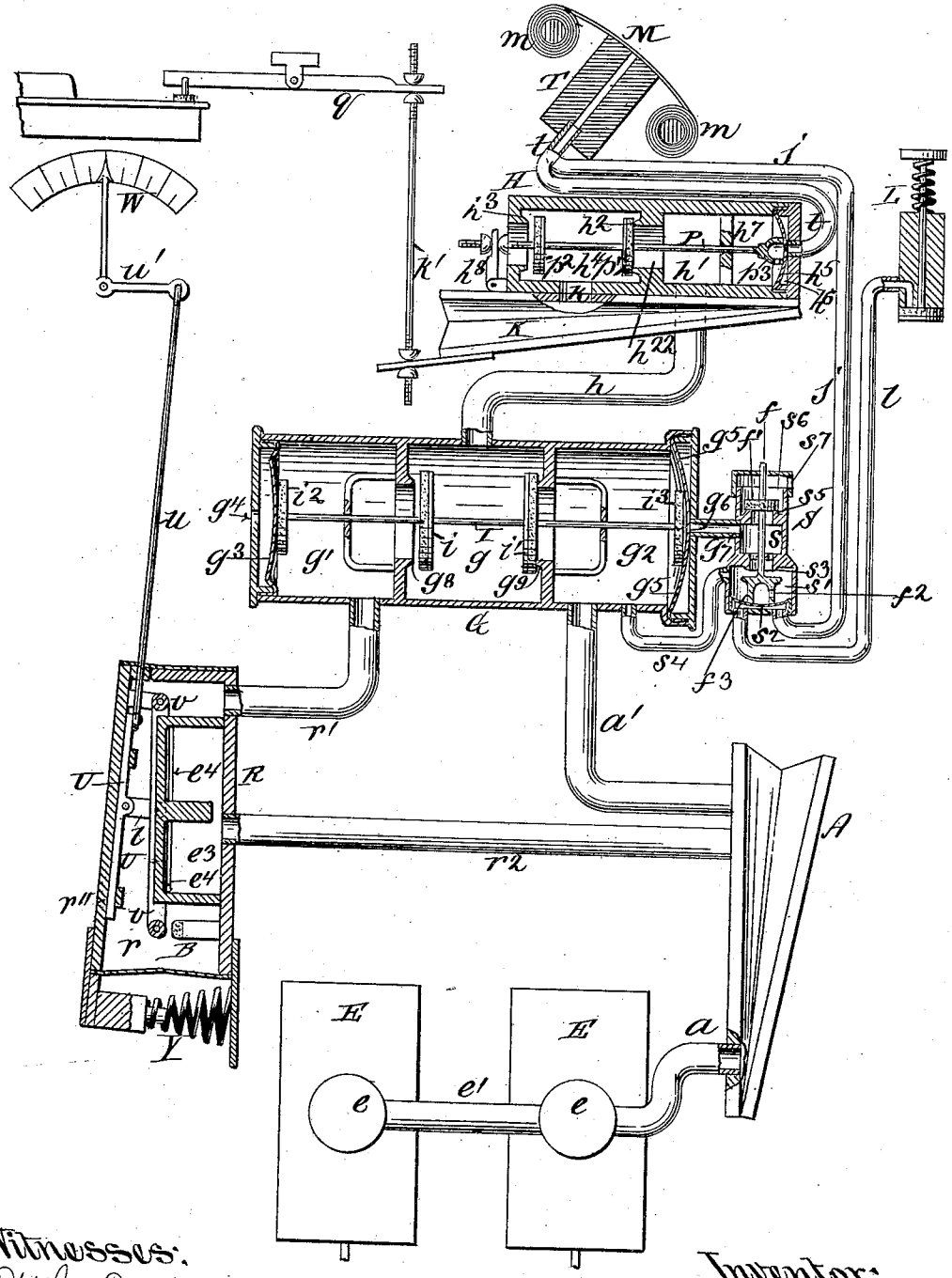

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MECHANICAL MUSICAL APPARATUS.

No. 847,895. Specification of Letters Patent. Patented March 19, 1907.

Application filed April 14, 1904. Serial No. 203,137.

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 Mechanical Musical Apparatus, 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 invention relates to pneumatic apparatus for automatically actuating keys of musical instruments, substantially as set forth in my concurrent application, Serial No. 182,449, filed November 24, 1903, and consists, essentially, in substituting for the normal-tension reservoir and connections therein described a normal-tension reservoir provided with mechanism for regulating and varying such normal tension, substantially as described in my concurrent application, Serial No. 202,543, filed April 11, 1904, whereby certain advantageous results are attained, as hereinafter set forth.

The invention also includes incidentally the specific construction, combination, and arrangement of parts herein described and claimed.

The accompanying drawing is a diagram in sectional elevation of parts essential in carrying out my invention without regard to their exact relative positions in the apparatus.

E E are exhausters of any desired construction, those shown being provided with pallet-valves opening into external chambers *e e*, as in my concurrent application first referred to herein, said chambers being connected by a duct *e'*. Any desired number of exhausters E E may be used in conjunction, each being connected through the chambers *e e* with the accentuating-reservoir A by means of a duct *a*, which opens directly into the accentuating-reservoir A.

G is the intermediate-tension chest interposed between the normal reservoir and regulator R 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 *r'* connects the normal-tension regulator R with the chamber *g'*, and in like manner the accentuating-reservoir 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 larger diaphragm g^5, separating the rest of the chamber from the end 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 valve-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^3 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 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 end of the valve-stems are also perforated or formed to admit of the circulation of air.

Under normal conditions the music-sheet M, traveling between the rollers $m\,m$, 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 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 tension-regulator R, since communication is unobstructed through the conduit r', between said tension-regulator R and the variable-tension chamber g, this being the relation of the parts as shown in the accompanying drawing. The tension in the chamber g^2 is made greater than in the chambers g' and g to cause accentuation by the efforts of the performer with the assistance of the regulator R, it being understood that the exhausters E continue to exhaust freely from the reservoir A without check, the exhaust from chambers g' and g being throttled through the regulator R instead of direct, as is the exhaust from the chamber g^2 to the reservoir A.

Accentuation is accomplished either by an accent-perforation in the music-sheet passing 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 either case in that air is admitted underneath the diaphragm s^3 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 g^5. 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 through the equalizing-duct s^4. As a consequence the tension in the chamber g^2 being greater than in the chambers $g\,g'$, the said diaphragm g^5 on the abutment i^3 being larger than the diaphragm g^3 acts and 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 chamber g and the chamber g', and opening communication between the chamber g^2 and said variable-exhaust chamber g.

At the end of the accentuation the air-pressure valve L is released, cutting off atmospheric pressure beneath the diaphragm s^3 of the shunt-controller S, and thereby lowering the spindle f, seating the valve f', unseating the valve f^2 and opening communication between the interior of the controller S and chamber g^2 through the medium of the duct s^4, thereby equalizing the pressure 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 positions," so called, as shown in the drawing, with the tension-regulator R in indirect communication with the exhaust-chamber h' in the action-chest H.

My normal-tension regulator consists, essentially, of a pneumatic r, communicating, through the conduit r', with the normal-tension chamber g' in the intermediate chest G and with the accentuating-reservoir A through the conduit r^2, as hereinbefore intimated, the essential feature of its use being the interposition between said accentuating-reservoir and said normal-tension chamber g' by way of conduit r^2 of a throttle-valve actuated by a pneumatic controlled indirectly by the air-tension in the exhaust-chamber h' of the action-chest H. For this reason the particular form of throttle-valve used is of secondary importance, and I do not confine myself to the identical construction and arrangement of valve and ports, since various mechanical expedients may be substituted with like result.

It will be seen that the normal-tension chamber g' is in communication with the interior of the pneumatic r through the medium of the conduit r', while the interior of the accentuating-chamber A is in communication, through the conduit r^2, with the port-chamber e^3 of the regulator R, into which the valve port or ports e^4 open and through which communication is had with the interior of the pneumatic r. The available area of this communication through the valve port or ports e^4 is

governed by the position of the valve-blade v, pivotally supported at one extremity and connected by a link l with a slide U, mounted upon the movable member r'' of the pneumatic r, the slide itself being controlled manually or otherwise by means of a rod u, connected with a bell-crank lever u', arranged in conjunction with an indicator W.

It is obvious that the thrust of the valve-blade v with relation to the valve port or ports e^4 when the movable member r'' of the pneumatic r is drawn inward will be governed by the position of the slide U upon said movable member. Thus if the slide is pushed downward the extent of variable thrust will be diminished, and vice versa.

A buffer B is used to stop the valve-blade v when the latter nearly or completely closes the port or ports e^4, a resilient spring or equivalent device Y being arranged to tend constantly to expand the pneumatic r and force its movable member outward against the resistance of the internal tension. Thus the spring Y or other retractile device tends constantly to retract the valve-blade v away from the valve port or ports e^4, while the external atmospheric pressure tends to close the said port or ports e^4, owing to the partial vacuum created internally by the exhaust mechanism acting through said ports. While I do not restrict myself to a spring as a means of retracting the valve-blades v, I find the use of a coiled conical spring such as shown advantageous in that it affords a gradual increasing resistance to the closing of the ports e^4 as the slide U is lowered.

The object being to maintain a prescribed degree of working tension within the normal-tension chamber g' and exhaust-chamber h', it is obvious that air admitted to the latter through the note-sounding pneumatics, be the same more or less in quantity in a given time, should be withdrawn from said wind-chest immediately and automatically without increasing the working tension above that desired and prescribed by the operator. Thus the slide U being set to represent a prescribed degree of tension in the normal-tension chamber g', any excess of air admitted from the note-sounding pneumatic into the exhaust-chamber h' and normal-tension chamber g' will inflate the pneumatic r of the regulator R and thereby cause the valve-blade v to open the port or ports e^4 more or less to allow the quick withdrawal of such excess of air.

My normal-tension-regulating reservoir R thus practically protects the normal-tension chamber g' against an increase of tension above the normal prescribed by the position of the slide U, since the exhausters can only take through the throttle the excess of air admitted into the exhaust-chamber h' from the note-actuating mechanism. It also acts automatically to maintain and preserve the prescribed degree of tension in the chamber g' when the said chamber is closed during accentuation, as hereinbefore described, so that the normal tension may be immediately restored by the shifting of the valve mechanism upon the release of the air-valve L.

By my present combination and arrangement of parts I enable the operator to control, regulate, and vary by hand the normal or accompaniment tension, a result heretofore accomplished largely through the exhaust mechanism by the feet of the operator. I thus render the control of the apparatus more direct and simple and facilitate its operation by learners and unskilled players. At the same time I simplify and cheapen the apparatus, since I dispense with the normal reservoir and connections described in my concurrent application, Serial No. 182,449, and by substituting my manually-controlled tension-regulator attain like results and advantages.

By my invention it will be seen that I afford means for varying the so-called "normal" or "accompaniment" tension by hand and independent of the means for accentuation or melody, and this is a distinguishing and important practical feature as compared with the prior state of the art.

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

1. In automatic players, the combination of an action-chest controlling the key-pneumatics, a normal-tension regulator and reservoir connected indirectly therewith and directly with a high-tension reservoir, adjustable means for prescribing the degree of tension in said normal-tension regulator and reservoir together with said high-tension reservoir connected directly with the exhaust mechanism and indirectly with said action-chest, means for opening and closing connection between said normal-tension-reservoir and said action-chest, and means for opening and closing connection between said high-tension reservoir and said action-chest for the purpose set forth.

2. In automatic players, the combination of an action-chest controlling the key-pneumatics, a normal-tension regulator and reservoir connected indirectly therewith and directly with a high-tension reservoir, adjustable means for prescribing the degree of tension in said normal-tension regulator and reservoir together with said high-tension reservoir connected directly with the exhaust mechanism and indirectly with said action-chest and means for simultaneously closing communication between said normal-tension reservoir and said action-chest and opening communication between the latter and said high-tension reservoir, and vice versa, for the purpose set forth.

3. In automatic players, the combination of an action-chest controlling the key-penu-

matics, a normal-tension reservoir connected indirectly therewith and directly with a high-tension reservoir, means for varying and controlling the tension in said normal-tension reservoir, said high-tension reservoir connected directly with the exhaust mechanism and indirectly with the said action-chest, an intermediate variable-tension chest interposed in the conduits between the said action-chest, valves in said variable-tension chest arranged to simultaneously close communication between one of the said tension-reservoirs and the said action-chest and to open communication between the latter and the other tension-reservoir, and vice versa, and means for operating said valves for the purpose described.

4. In automatic players, the combination of an action-chest controlling the key-pneumatics, a normal-tension regulator connected indirectly therewith and directly with a high-tension reservoir, means for varying and controlling the tension in said normal reservoir, said high-tension reservoir connected directly with the exhaust mechanism and indirectly with the said action-chest, a variable-tension chest formed with three chambers the central one of which is connected with said action-chest, and the end chambers of which are connected respectively with the said normal-tension regulator and the high-tension reservoir, valves in said middle chamber arranged to alternately open and close communication between it and said end chambers, and means for actuating said valves.

5. In automatic players, the combination of an action-chest controlling the key-pneumatics, a normal-tension regulator consisting of a pneumatic indirectly connected with said action-chest and formed with a port-chamber connecting directly with a high-tension reservoir, and an adjustable valve in said pneumatic arranged to control communication between it and the said port-chamber, said high-tension reservoir connected directly with the exhaust mechanism and indirectly with said action-chest, means for opening and closing communication between said normal-tension regulator and said action-chest, and means for opening and closing communication between said high-tension reservoir and said action-chest, for the purpose described.

6. In automatic players, the combination of an action-chest controlling the key-pneumatics, a normal-tension regulator consisting of a pneumatic indirectly connected with said action-chest and formed with a port-chamber connecting directly with a high-tension reservoir and an adjustable valve in said pneumatic arranged to control communication between it and the said port-chamber, means for controlling said adjustable valve manually, said high-tension reservoir connected directly with the exhaust mechanism and indirectly with said action-chest, means for opening and closing communication between said normal-tension reservoir and said action-chest, and means for opening and closing communication between said high-tension reservoir and said action-chest, for the purpose described.

7. In automatic players, an action-chest, an accentuating-reservoir connected with said action-chest, an interposed valved chest in said connection, an automatic variable-pneumatic-tension regulator in addition to and connected with said reservoir and embodying a pneumatic and a slide-valve within said pneumatic, said regulator being also connected with said action-chest through said valved chest, and means for exhausting the air from said reservoir.

8. In automatic piano-players the combination of an action-chest, an accentuating-reservoir, a variable-tension regulator controlling automatically said desired tensions, means for setting the same at any desired tension while in operation, exhausters for said regulator and reservoir and means for cutting off communication between the variable-tension regulator and action-chest and simultaneously putting the reservoir in communication with said action-chest.

9. In automatic piano-players, the combination of an action-chest, means therein for controlling a plurality of power-pneumatics, an accentuating-reservoir, a variable-tension regulator controlling automatically the desired tensions, means for setting the same at any desired tension while in operation, exhausters for said regulator and reservoir, a shunt-controller and coöperating means for cutting off communication between the variable-tension regulator and action-chest and simultaneously putting the reservoir in communication with said action-chest whereby the action-chest is connectible with the exhauster direct or with the regulator so that one is cut off when the other is on.

10. In automatic piano-players, the combination of an action-chest, means therein for controlling a plurality of power-pneumatics, an accentuating-reservoir, a variable-tension regulator controlling automatically the desired tensions, means for setting the same at any desired tension while in operation, exhausters for said regulator and reservoir, pneumatically-actuated means for cutting off communication between the variable-tension regulator and action-chest and simultaneously putting the reservoir in communication with said action-chest.

11. In automatic piano-players, the combination of an action-chest, means therein for controlling a plurality of power-pneumatics, an accentuating-reservoir, a variable-tension regulator controlling automatically the desired tensions, means for setting the same

at any desired tension while in operation, exhausters for said regulator and reservoir, manually-actuated means for cutting off communication between the variable-tension regulator and action-chest and simultaneously putting the reservoir in communication with said action-chest.

12. In an automatic piano-player, the combination with an action-chest containing means for controlling a plurality of power-pneumatics, a variable-tension regulator, means for exhausting air from said regulator, said regulator embodying means for expanding said regulator and also mechanism adapted to control communication between said regulator and the exhaust means, said mechanism being actuated by the contraction and expansion of the regulator, an accentuating-reservoir, a shunt-controller and means interposed between said controller and reservoir and regulator for cutting off communication between the variable-tension regulator and action-chest and simultaneously putting the reservoir in communication with said action-chest.

13. In automatic piano-players, the combination of an action-chest containing means for controlling a plurality of power-pneumatics, a variable-tension regulator, means for exhausting air from said regulator, a shunt-controller controlled automatically or by hand for controlling communication between said action-chest and said regulator, an accentuating-reservoir, and means for cutting off communication between the variable-tension regulator and action-chest and simultaneously putting the reservoir in communication with said action-chest.

14. In automatic musical instruments, the combination of an action-chest, an accentuating-reservoir connected with said action-chest, a variable-tension regulator, means situated between said action-chest and regulator for cutting off communication between said regulator and the action-chest and simultaneously putting the reservoir into communication with the action-chest, said controlling means being controlled automatically or by hand, and means for exhausting air from said reservoir and regulator.

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