No. 887,199 PATENTED MAY 12, 1908.

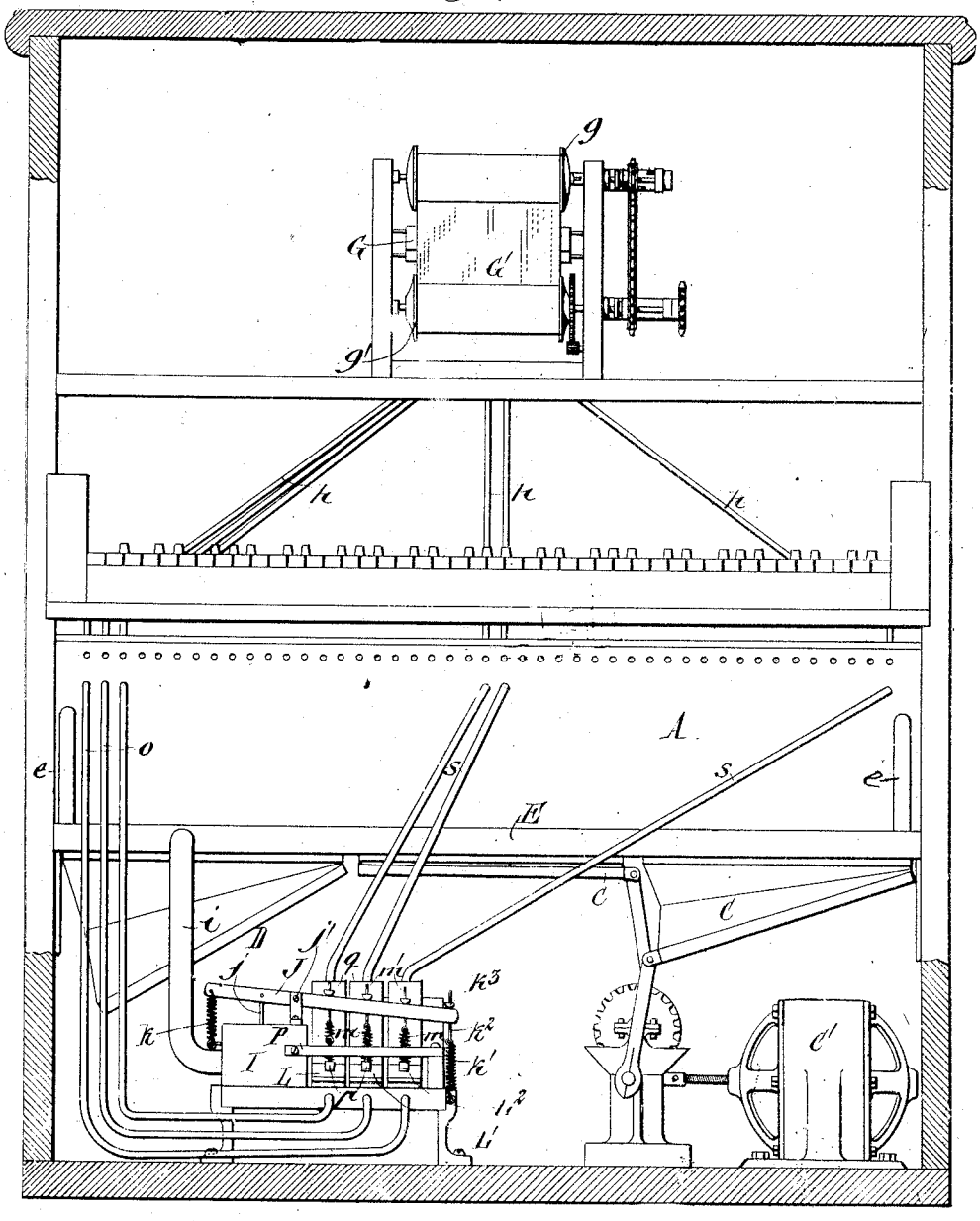
E. DE KLEIST.

EXPRESSION DEVICE FOR PNEUMATIC MUSICAL INSTRUMENTS.

APPLICATION FILED JUNE 11, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
Louis W. Gratz
Richard Sommer

Eugene de Kleist, Inventor
by Geyer & Popp
Attorneys

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3 SHEETS—SHEET 2.

Fig. 2.

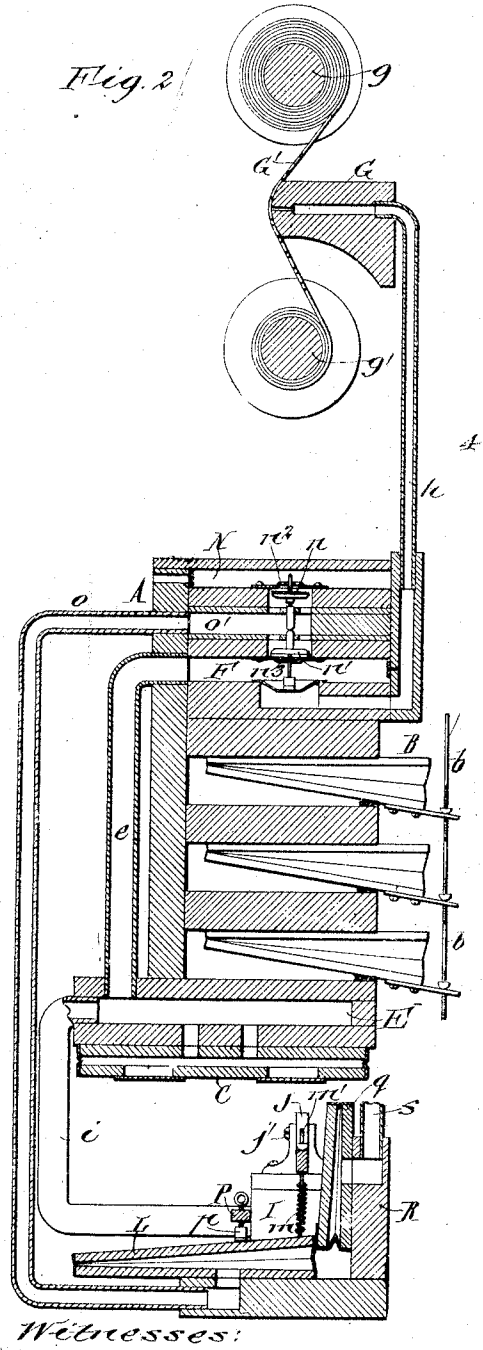


Fig. 3.

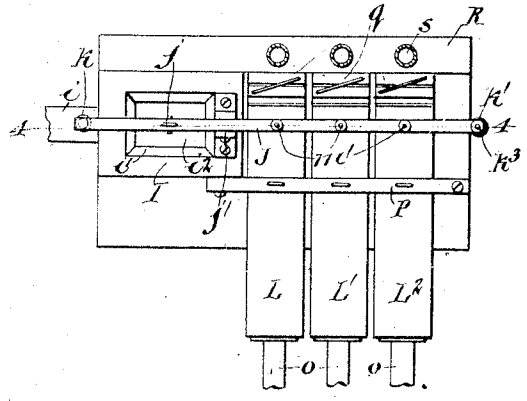


Fig. 4.

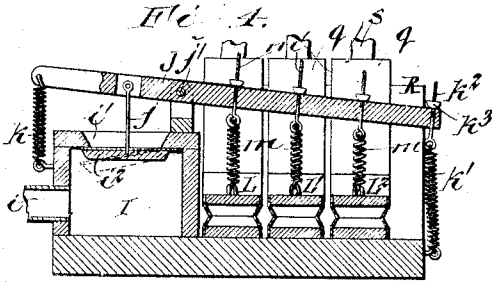
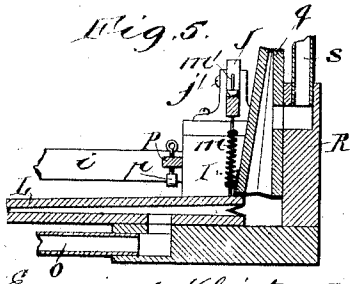


Fig. 5.



Witnesses:

Louis W. Gratz.

Richard Sommer.

Eugene de Kleist, Inventor

by Geyer & Pfaff

Attorneys

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3 SHEETS—SHEET 3.

Fig. 6

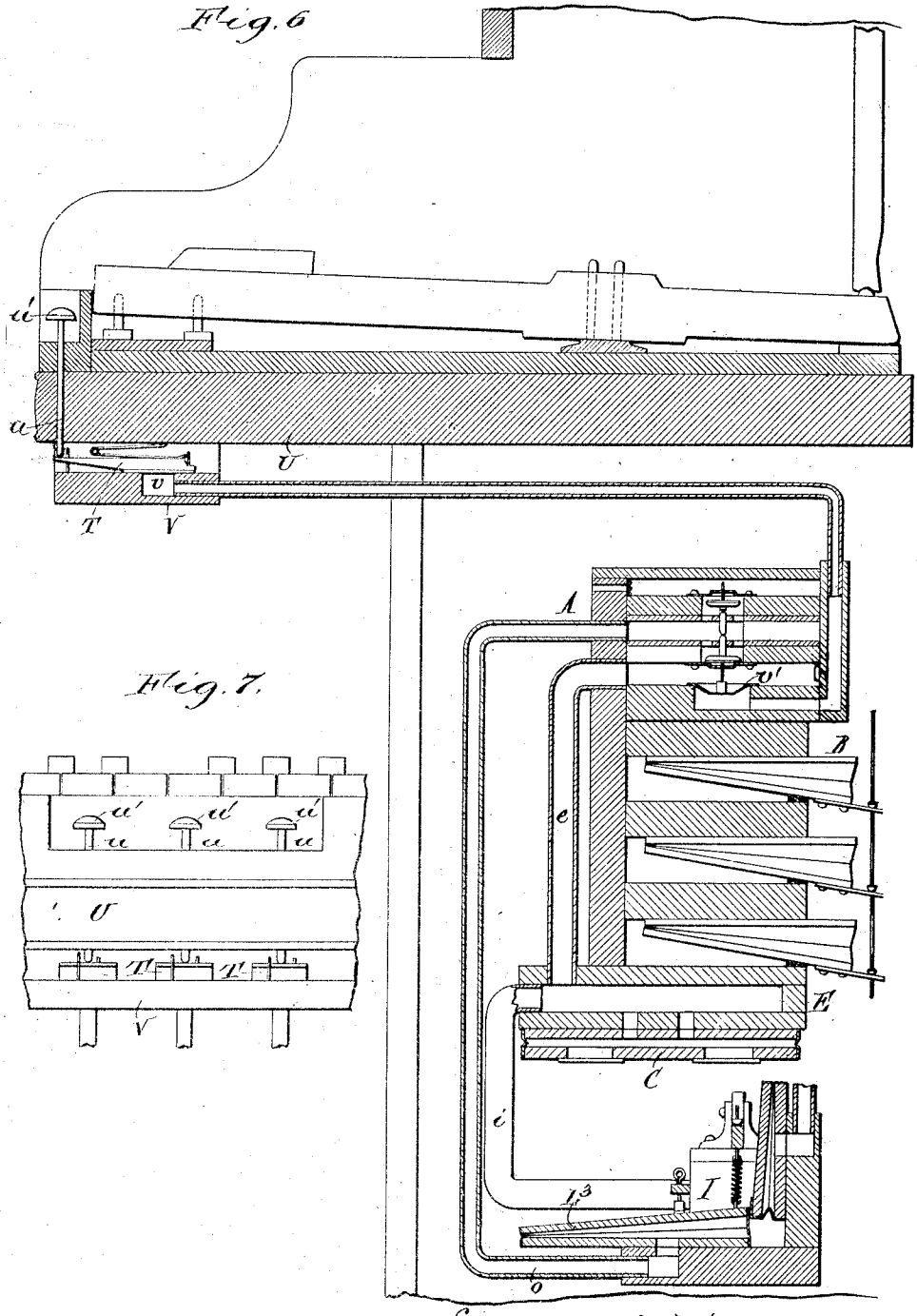

Fig. 7.

Witnesses:
Louis W. Gratz
Richard Sommer.

Eugene de Kleist, Inventor
by Goepel & Popp
Attorneys

UNITED STATES PATENT OFFICE.

EUGENE DE KLEIST, OF NORTH TONAWANDA, NEW YORK.

EXPRESSION DEVICE FOR PNEUMATIC MUSICAL INSTRUMENTS.

No. 887,199. Specification of Letters Patent. Patented May 12, 1908.

Application filed June 11, 1906. Serial No. 321,165.

To all whom it may concern:

Be it known that I, EUGENE DE KLEIST, a citizen of the United States, residing at North Tonawanda, in the county of Niagara and State of New York, have invented a new and useful Improvement in Expression Devices for Pneumatic Musical Instruments, of which the following is a specification.

This invention relates to the expression devices of pneumatic musical instruments and has more particular reference to a device of this kind in which the desired shading effects are produced by varying the tension or degree of vacuum in the wind chest.

The object of my invention is to provide a regulating or expression mechanism of this character which is simple in construction and reliable in action and which affords a wide range of expression.

In the accompanying drawings consisting of three sheets: Figure 1 is a sectional front elevation of a self playing pneumatic piano embodying the invention, the piano action and other members not constituting a part of the improvement being omitted. Fig. 2 is a diagrammatic cross section of the wind chest, the tracker board and the expression mechanism, on an enlarged scale. Fig. 3 is an enlarged top plan view of the expression mechanism. Fig. 4 is a vertical section thereof in line 4—4, Fig. 3. Fig. 5 is a section similar to Fig. 2, showing one of the expression pneumatics locked in its collapsed position by its retaining pneumatic. Fig. 6 is a diagrammatic cross section similar to Fig. 2, showing a modified construction of the means for controlling the expression mechanism. Fig. 7 is a fragmentary front view of the last named construction.

Similar letters of reference indicate corresponding parts throughout the several views.

A indicates the wind chest containing a pneumatic action of any suitable construction and B the motor pneumatics which operate the customary abstracts or stickers *b* which in turn act upon the piano action, not shown.

C indicates the pumps or main suction bellows, which are operated by an electric motor C^1 or other suitable means, and D is the usual collapsible reservoir. In the construction shown in the drawings, the pumps are connected with a horizontal wind board or chamber E. Tubes *e* lead from this wind board to the main exhaust channel F of the wind chest, as shown in Figs. 1 and 2.

G indicates a tracker board of ordinary construction, G^1 the traveling music sheet wound upon the rolls *g*, g^1, and *h* the usual tubes or conduits leading from the ducts of the tracker board to the wind chest.

I is a valve box or case connected with the chamber of the wind board E by a tube *i* and having an air or flushing port i^1, controlled by an inwardly-opening regulating valve i^2, so that when this valve is opened more or less the outer atmosphere is admitted to the case I and the wind board E and the main exhaust channel F of the wind chest communicating therewith, diminishing the tension or degree of vacuum in the wind chest, operating the motor pneumatics less forcibly and causing the piano-hammers to strike the strings more lightly.

The regulating valve i^2 is connected by a rod *j* with the short arm of a lever J fulcrumed upon the valve case at j^1. To the ends of the lever are connected springs *k*, k^1 which are attached at their lower ends to the valve case and its base, as shown, or to any other fixed parts. One of these springs, preferably that connected with the long arm of the lever, is attached to an adjusting screw k^2 passing through a smooth hole in the lever and having a nut k^3 which bears upon the latter. These springs counteract each other, and the spring k^1 which tends to keep the regulating valve closed is so tensioned that it opens under a comparatively small degree of suction in the valve case, reducing the air tension to the proper degree to produce the softest or pianissimo effects.

L, L^1, L^2 indicate a plurality of expression pneumatics or bellows arranged side by side below the long arm of the lever J. The upper movable board of each of these pneumatics is connected with the lever J by a spring *m* having an adjusting screw m^1, like the screw k^2, for regulating its tension. When one of these pneumatics is collapsed, its movable board strains or distends the corresponding spring *m*, increasing the resistance offered to the opening movement of the regulating valve, such resistance augmenting the resistance of the spring k^1. The movable boards of these pneumatics have a practically uniform stroke, but the coöperating springs *m* are adjusted to different tensions, so that the regulating valve is held closed with varying degrees of resistance whereby the tension in the valve case and the wind chest is increased more or less according to the particular ex-

pression pneumatic which is collapsed. The tension of these springs is so graded that when strained they respectively exert the necessary resistance upon the regulating valve to produce different air tensions corresponding, for example, to piano, forte, and double forte.

Each of the expression pneumatics is controlled by a row of perforations in the music sheet and a corresponding valve mechanism of the wind chest, like the valve mechanisms which control the motor-pneumatics of the piano hammers. In Fig. 2 is shown one of these valve mechanisms, which comprises the customary double puppet valve n, n^1, controlling the usual air and exhaust ports n^2, n^3 which communicate respectively with the air chamber N and the exhaust chamber F of the wind chest, the pneumatic being connected by a tube o with the exhaust and flushing channel o^1 of the corresponding valve mechanism. When a perforation of the music sheet registers with the tracker duct corresponding to one of the expression pneumatics L, L^1, L^2 the corresponding puppet valve is elevated or reversed in a well known manner, placing said pneumatic in connection with the exhaust chamber of the wind chest and collapsing it and straining the companion spring m while when an imperforate portion of the music sheet passes over said duct, the puppet valve descends, placing the pneumatic in connection with the air chamber N of the wind sheet, allowing it to expand and relaxing the companion spring m. It will be understood that the music sheet has a separate row of perforations for each of the expression pneumatics. In the preferred arrangement shown in the drawings, the springs m are graded to increase in resistance from the fulcrum of the lever J toward the end of its long arm. The upward stroke of the movable boards of the expression pneumatics is limited by adjustable stops or screws p carried by a horizontal bar P extending across the upper sides of said pneumatics, as shown in Figs. 2 and 3.

With each expression pneumatic L, L^1, L^2 preferably coöperates a retaining pneumatic or bellows q which locks the movable board of the expression pneumatic in its depressed position during the period it is to remain collapsed, thereby avoiding the necessity of providing the music sheet with long slots for this purpose. These retaining pneumatics are secured vertically to a wall or board R rising from the supporting base of the expression pneumatics and the movable board of each of the same is so arranged that it is collapsed and bears against the adjacent end of the movable board of the corresponding expression pneumatic when the latter is expanded as shown in Fig. 2. By this construction, when an expression pneumatic is collapsed, the movable board of the corresponding retaining pneumatic expands and overlaps the movable board of the expression pneumatic as soon as the latter board descends below the lower end of the retaining pneumatic, as shown in Fig. 5. When the retaining pneumatic is collapsed, its movable board is withdrawn from engagement with that of the expression pneumatic, allowing the latter to expand to its former position. These retaining pneumatics are controlled by separate rows of perforations in the music sheet and coöperating valve mechanisms in the wind chest, identical with those which control the motor pneumatics and the expression pneumatics, the letter s indicating the tubes which connect the retaining pneumatics with the corresponding exhaust and flushing channels of the wind chest.

The operation of the expression mechanism is as follows: The pumps C are of such size and operated at the proper rate of speed to produce an air tension or degree of vacuum in the wind chest sufficient to give a maximum force of stroke to the greatest number of piano hammers actuated at a time. So long as none of the expression perforations of the music sheet register with the tracker ducts, the expression pneumatics L, L^1, L^2 remain expanded and the companion springs m remain relaxed. Under these conditions, the primary spring k^1 furnishes the only resistance upon the regulating valve acting in opposition to the atmospheric pressure against the outer side of the valve. As before stated, that resistance is comparatively small and the atmospheric pressure therefore opens the valve to the greatest extent, reducing the air tension to the necessary degree to cause the instrument to play very softly or pianissimo.

When a perforation in the music sheet controlling say the first expression pneumatic L registers with the corresponding tracker duct, the pneumatic is collapsed, straining the companion spring m and correspondingly increasing the resistance of the regulating valve. The latter is therefore opened by the atmospheric pressure to a less extent than when the valve is under the resistance of the primary spring k^1 alone, thus increasing the air tension accordingly and causing the instrument to play somewhat louder, say piano. When the next expression pneumatic L^1 is collapsed, the regulating valve is placed under the increased resistance of the corresponding spring m allowing the valve to open to a less degree and producing say, a mezzo forte effect; while when the expression pneumatic L^2 is collapsed, the outer atmosphere is opposed by the still greater resistance of the most highly tensioned spring m, thus increasing the air tension sufficiently to cause the instrument to play rather loud or forte. When all of the expression pneumatics are collapsed, the combined resistance of their springs m is added to that of the

primary spring k^1, producing the highest air tension and the loudest effect. Other shades of expression between the softest and loudest may be obtained by causing two of the expression pneumatics to be actuated simultaneously, it being possible to obtain eight different degrees of air tension or shades of expression by the use of the primary spring k^1 and by different combinations of the three pneumatics with said spring.

While I have herein shown and described automatic and pneumatic means for controlling the graduated resistance springs of the regulating valve, I do not wish to be limited to that construction, as such springs could be strained or tensioned by manual means and the device could be otherwise modified without departing from the scope and spirit of the invention. For example Figs. 6 and 7 show a modified construction in which the expression pneumatics are controlled by hand-operated valves T, instead of a traveling music sheet. These valves may be arranged under the key-table U and operated by individual rods u, extending through said table and terminating at their upper ends in buttons or keys u^1. These valves normally close ducts v formed in an auxiliary tracker board V and leading respectively to the diaphragms v^1 of the valve mechanisms in the wind chest which control the expression pneumatics L^3. In the closed position of the hand valves T the expression pneumatics are expanded, but when one of these valves is opened, the corresponding expression pneumatic is collapsed in an obvious manner, straining the companion regulating spring and exerting greater resistance upon the regulating valve, as hereinbefore described.

It is not essential that the regulating valve should be arranged in a separate valve box or case as shown. It may be applied to a flushing port of any chamber or passage leading to or connected with the main exhaust chamber or channel of the wind chest so that when the valve is opened more or less, the tension in the wind chest is varied accordingly.

I claim as my invention:

1. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a plurality of resistance devices of different tension operating to close said valve against the atmospheric pressure, and means for bringing said resistance devices into action, substantially as set forth.

2. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a plurality of springs of different grades of resistance operating to close said valve, and means for individually tensioning said springs, substantially as set forth.

3. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a plurality of springs of different grades of resistance operating to close said valve, and pneumatics connected with said springs for tensioning the same, substantially as set forth.

4. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a plurality of springs of different grades of resistance connected with said valve and tending to close the same, and means for individually straining said springs, substantially as set forth.

5. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a plurality of springs of different grades of resistance connected with said valve and tending to close the same, means for individually straining said springs, and means for regulating the tension of the springs, substantially as set forth.

6. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a primary resistance spring connected with said valve, a supplemental resistance spring also connected with said valve, and means for straining said supplemental spring, substantially as set forth.

7. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a primary resistance spring connected with said valve, a plurality of supplemental springs of different grades of resistance also connected with said valve, and means for straining said supplemental springs, substantially as set forth.

8. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a lever connected with said valve, a plurality of expression pneumatics, springs of different grades of resistance connecting said lever with said pneumatics, and means for operating said pneumatics, substantially as set forth.

9. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a lever connected with said valve, a plurality of expression pneumatics, springs of different grades of resistance connecting said lever with said pneumatics, and means for regulating the tension of said springs, substantially as set forth.

10. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a lever connected with said valve, a pair of springs connected with the lever and acting in opposition to each other, the spring which tends to close said valve having means for regulat-

ing its tension, supplemental springs of different grades of resistance also connected with said lever and tending to close said valve, and pneumatics for straining said supplemental springs, substantially as set forth.

11. The combination of a wind chest, a regulating valve controlling the ingress of the outer atmosphere into the wind chest, a lever having one of its arms connected with said valve, oppositely acting springs connected with the arms of said lever, the spring which tends to close said valve having means for regulating its tension, a plurality of expression pneumatics, means for operating said pneumatics, and supplemental springs of different degrees of resistance connecting said lever with said pneumatics respectively, substantially as set forth.

12. A device for controlling the air tension of pneumatic musical instruments, comprising a regulating valve, springs of different grades of resistance operating to close said valve, expression pneumatics connected with said springs for tensioning the same, retaining pneumatics for locking said expression pneumatics in their collapsed position, and means for actuating said pneumatics, substantially as set forth.

13. The combination of a wind chest, a box or case connected with the wind chest and having a flushing port, a regulating valve controlling said port, springs of different grades of resistance connected with said valve, and means for straining said springs, substantially as set forth.

14. The combination of a wind chest, a box or case connected with the wind chest and having a flushing port, a regulating valve controlling said port, a lever connected with said valve, springs of different grades of resistance connected with said lever and tending to close said valve, pneumatics connected with said spring for straining the same, and means for actuating said pneumatics, substantially as set forth.

Witness my hand this 31st day of May, 1906.

EUGENE DE KLEIST

Witnesses:
C. F. GEYER,
E. M. GRAHAM.