Jan. 2, 1923.

1,440,662

L. B. DOMAN.
SELF PLAYING MUSICAL INSTRUMENT.
FILED FEB. 28, 1918.

2 SHEETS-SHEET 1

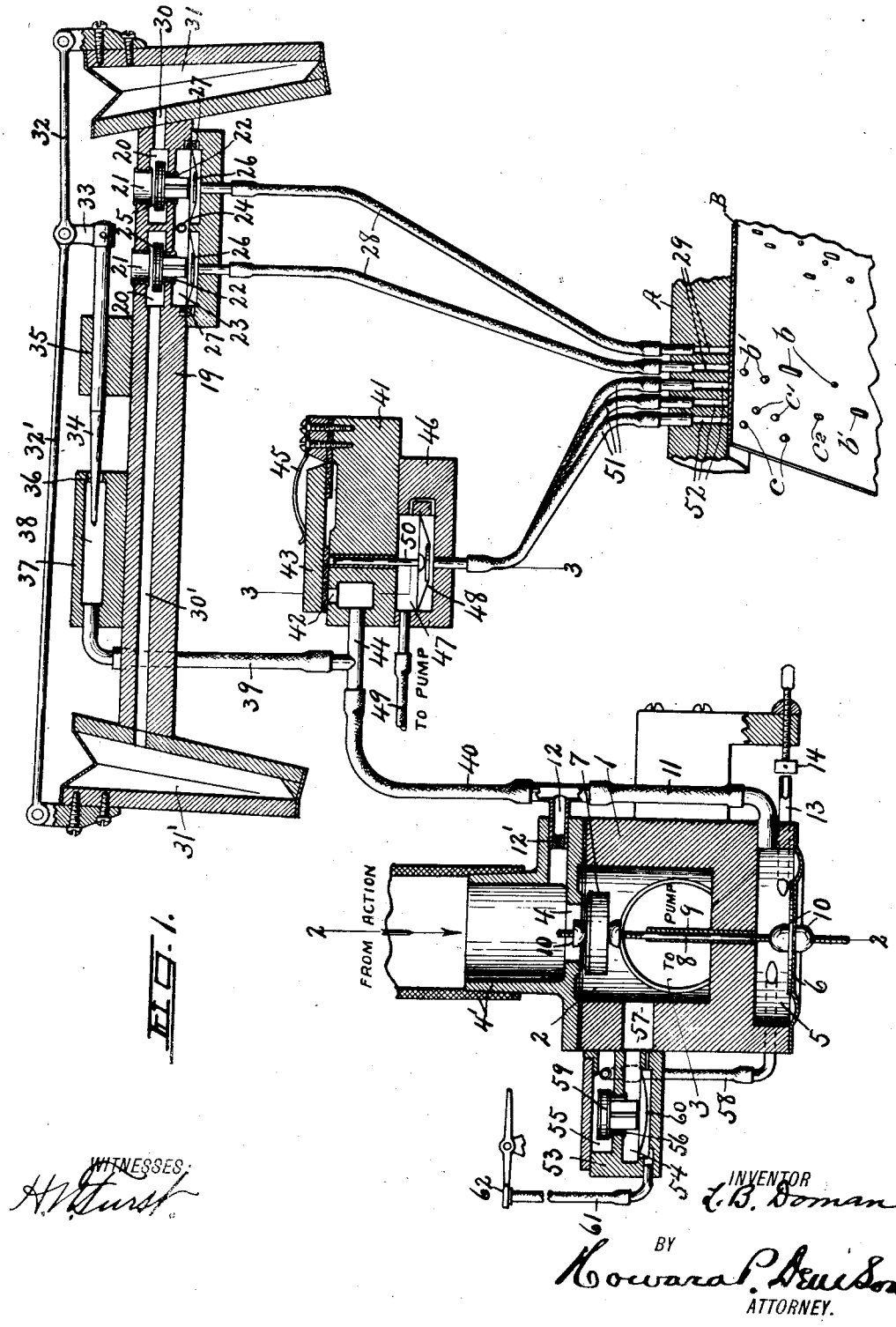

FIG. 1.

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2 SHEETS-SHEET 2

FIG. 2.

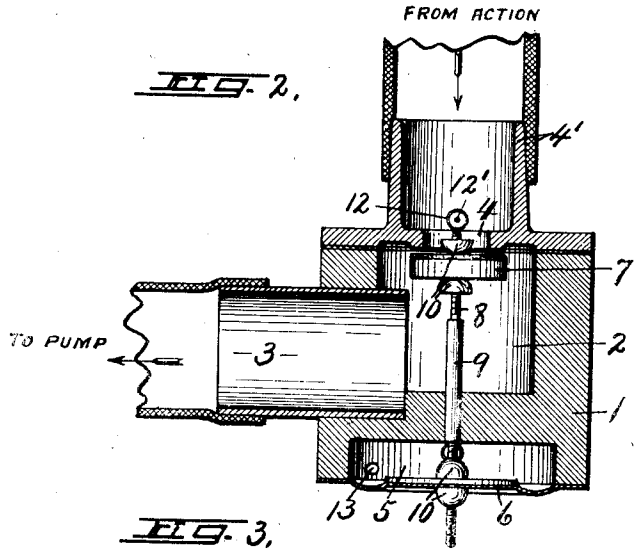


FIG. 3.

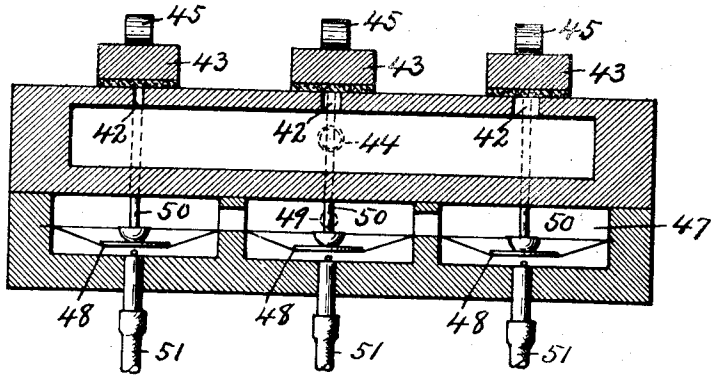
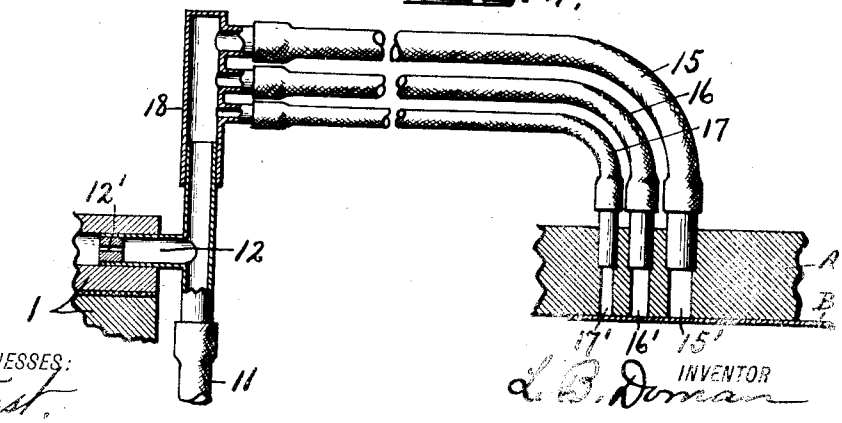


FIG. 4.



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Patented Jan. 2, 1923. 1,440,662

UNITED STATES PATENT OFFICE.

LEWIS B. DOMAN, OF EAST SYRACUSE, NEW YORK, ASSIGNOR TO THE AMPHION PIANO PLAYER COMPANY, OF SYRACUSE, NEW YORK, A CORPORATION OF NEW YORK.

SELF-PLAYING MUSICAL INSTRUMENT.

Application filed February 28, 1918. Serial No. 219,650.

To all whom it may concern:

Be it known that I, LEWIS B. DOMAN, a citizen of the United States of America, and resident of East Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Self-Playing Musical Instruments, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in self-playing musical instruments, and refers more particularly to means for controlling the expression or modulating the tone, as may be desired, during the playing of a musical selection.

The main object is to obtain a closer and wider range of gradation of tone or expression control with a fewer number of parts than has heretofore been practiced so as to increase the general efficiency of the device and enable it to be installed in a relatively small compact space.

One of the specific objects is to render the governing pneumatic for the main expression-controlling valve more quickly responsive to the slightest variations of air tension therein when playing, and to cause said pneumatic and valve to automatically assume a balanced open condition under an air tension just sufficient to overcome the minimum load or resistance of the player action and piano action operated thereby.

Another specific object is to control the air tension in the player action for different tone effects by simply admitting atmospheric air in regulated quantities to the valve-operating pneumatic so that the tone may be held to any degree or varied through infinitesimal gradations from pianissimo to fortissimo and vice versa, or, when playing under a tension below that sufficient to produce fortissimo effects, may be accented as desired.

A further object is to provide simple means whereby the main controlling valve may be positively closed by the same pneumatic to cut off communication between the wind-inducing device and sound-producing action during the reroll of the music sheet or web.

Other objects and uses relating to specific parts of the device will be brought out in the following description.

In the drawings—

Figure 1 represents, in section, various parts of an expression controlling device embodying the features of my invention as automatically controlled by a tracker bar and music sheet, also shown in section, said parts being arranged diagrammatically for clearness of illustration.

Figures 2 and 3 are sectional views taken respectively on lines 2—2 and 3—3, Figure 1.

Figure 4 is a sectional view of a modified means for venting the operating pneumatic for the main controlling valve for different degrees of accent or tone expression.

In carrying out the objects stated, I provide a valve chest —1— having a chamber —2— adapted to be connected by a port —3— to a wind-inducing device or pump, not shown, and also adapted to be connected by a port —4— to a sound-producing action, not shown.

The lower side of the valve chest —1— is provided with a chamber —5— having a movable side —6— consisting of a diaphragm which, together with the chamber forms a pneumatic for operating a valve —7— through the medium of a connecting rod —8—.

The valve —7— is movable in the chamber —2— to and from a seat on the under side of the top wall of said chamber to control the passage of air through the port —4— and thereby control communication between the wind-inducing device and sound-producing action.

The valve rod or stem —8— is movable through a tubular guide —9— in the bottom wall of the chamber —2— and has its opposite ends threaded and each provided with a pair of nuts —10— for securing the diaphragm and valve, respectively, thereto so that both may move in unison.

When the instrument is at rest, the valve —7— normally drops away from its seat, thereby opening the port —4— to establish communication between the wind-inducing device and sound-producing action, permitting the distention of the pneumatic —6—.

Automatic control of main governing pneumatic.

The pneumatic —6— is connected by a pipe —11— and branch —12— to a con-

nection, as —4'—, between the port —4— and sound-producing action and above the port in the top wall of the chamber —2— so as to constitute a by-pass leading from the pneumatic to a point in the connection between the valve and action, thereby establishing communication between the wind-inducing device and pneumatic through the normally open port —4—, branch —12— and pipe —11—, and rendering said pneumatic directly susceptible to influence by varying tensions in the wind-inducing device.

The passage through the branch —12— is restricted at —12'— to a relatively small area as compared with that of the conduit —11— leading to the pneumatic —6— so that when atmospheric air is admitted to the pneumatic through the conduit —11— in a manner hereinafter described it will tend to reduce the air tension in said pneumatic to a degree proportionate to the volume of atmospheric air admitted, thereby causing a corresponding further opening of the valve —7— for increasing the tone effects produced by the player action.

Assuming now that the conduit —11— is closed to the atmosphere and that the instrument is in operation, then it is evident that as the air tension in the chamber —2— and sound-producing action connected thereto through the open port —4— is increased, a corresponding increase of tension will take place in the pneumatic —6— through the branch —12— and conduit —11—, thereby causing a partial collapse of said pneumatic and resultant movement of the valve —7— towards its seat around the port —4—, tending to close said valve which is prevented from being closed by reason of the by-pass connection with the pneumatic.

For example, assuming that as the air tension in the pneumatic increases and it should momentarily close the valve —7—, then communication between the exhaust chamber —2— and pneumatic would be instantly cut off by the closing of the port —4— which would, at the same instant, allow the valve and pneumatic to recede to again open said communication, the effect of these two forces being to balance the valve in an open position.

This opening movement of the valve is also aided by the air current moving in the same direction through the port —4— and in order that the operation of the valve by the pneumatic may be more positive and responsive to varying air tensions therein, its area is somewhat larger than that of the port —4— and valve —7—, as clearly shown in Figures 1 and 2.

This by-pass comprising the conduit —11— and its branch —12— constitutes the means whereby the pneumatic —6— automatically controls the operation of the valve —7— for maintaining any degree of tone from and including pianissimo to and including fortissimo, but it is obvious that these tones may be readily increased or diminished from either extreme to the other by simply varying the air tension in the pneumatic —6— which may be accomplished by admitting atmospheric air in varying quantities thereto in any suitable manner.

It is evident, however, that the restricted passage —12'— may be positioned at other suitable points in the connection between the valve port —4— and sound-producing action, or directly in the action chest itself, without departing from the spirit of this feature of my invention.

Low tension regulator for main governing pneumatic.

It is well-known that various pianos as well as different player actions operate under varying degrees of resistance which, for convenience of description, may be termed the load actuated by the air tension produced by the wind-inducing device, and in order to obtain a maximum range of expression or tone modulation, it is important that the pneumatic —6— respond to the lowest air tension which will operate the player action and piano action, and for this purpose in addition to making the pneumatic of greater area than that of the port —4— and valve —7—, I have provided a vent tube —13— opening into the pneumatic —6— and adapted to cooperate with an adjustable valve —14— to regulate the amount or rate of flow of air entering the pneumatic to that which is just sufficient to operate said pneumatic and valve —7— to produce the lowest tones or pianissimo effects desired, as will be hereafter more fully described.

Vent grading means for tone modulation.

In Figure 4 is shown a particularly simple and effective means for producing the desired variations of air tension in the pneumatic —16—, previously referred to, with the resultant tone modulations, said means consisting of a series of, in this instance three, pipes —15—, —16— and —17—, of different interior cross sectional areas connected at one end to corresponding ports —15'—, —16'— and —17'— in a tracker bar, as —A—, the other ends of said pipes being connected to an extension —18— of the pipe —11— preferably above the branch —12—, the ports —15'—, —16'— and —17'— being controlled by suitable perforations in the music sheet or web —B—, it being understood that through the medium of these perforations atmospheric air may be admitted to either one of the tubes or simultaneously to different combinations of tubes for producing a wide range of different tone effects.

For example, assuming that the instrument is playing under a relatively low tension, such as would produce pianissimo effects, and it is desired to slightly increase the tone, under which conditions the music sheet would be provided at the proper place with a perforation adapted to register with one or the other of the tracker ducts, as —17′—, which would allow atmospheric air to enter the pneumatic —6— through the tube —11—, thereby lowering the air tension in said pneumatic and causing a correspondingly greater opening of the valve —7— and consequent increase of air tension in the player action.

In like manner, the tone could be further increased by admitting air through the duct —16′— or —15′— and their respective pipes —16— and —15—, or through any combinations of said ducts and pipes.

It will be obvious, however, to those skilled in this art that the means for controlling and varying the quantity of atmospheric air admitted to the main governing pneumatic —6—, either for grading the tone modulation or for accenting purposes, may be modified in many ways without departing from the spirit of this invention, it being preferable to provide separate devices, one for producing an infinitesimal gradation of tone modulation from one extreme to the other, and vice versa, and another for producing different gradations of accent in a manner somewhat similar to the construction shown in Figure 1, or the equivalent thereof.

Tone-grading controller.

For example, in Figure 1 I have shown a tone-grading device for producing a maximum number of tone variations through the medium of a minimum number of, in this instance two, atmosphere ports which, as illustrated, are controlled by a corresponding number of lines in the music sheet, while in the same figure is shown a device for producing a relatively large number of degrees of accent through the medium of a relatively small number of atmosphere ports.

The air-grading device comprises a valve board —19— having, in this instance two, separate valve chambers —20—, each having an atmosphere port —21— and connected by a port —22— to an exhaust chamber —23— which in turn is provided with an exhaust pipe —24— adapted to be connected to the wind-inducing device or other exhaust chamber, not shown.

Suitable valves —25— are mounted in their respective valve chambers —20— and are adapted to be operated by primary pneumatics —26— having the usual bleed holes —27— communicating with the exhaust chamber —23—.

These pneumatics —26— are connected by pipes —28— to separate tracker ducts —29— in the tracker bar —A—, said ducts being controlled by suitable perforations *b* and *b′* in the music sheet —B—.

The valve chambers are connected by separate relatively small passages —30— and 30′— to separate opposed pneumatics —31— and —31′—, the movable sides of which are connected by links —32— and —32′— to the head —33— of a sliding tapered valve —34—.

This valve —34— is guided in a suitable way —35— and cooperates with a port —36— in a valve block —37— to control the entrance of air to a chamber —38— therein.

The chamber —38— is connected by a pipe —39— to an extension —40— of the by-pass pipe —11—, preferably above the branch —12— so that atmospheric air which may enter the chamber —38— will pass through the pipes —39— and —40— and thence through the pipe —11— into the pneumatic —6— for positioning the latter and its valve —7— to give the desired tone effect.

The object in tapering the valve —34— is to produce a closer regulation of the quantity of air admitted to the pneumatic —6— and by opposing the pneumatics —31— and —31′— in the manner shown, it is evident that when one of them, as —31—, is operated under a reduction of air tension, it will move the valve —34— toward its closed position for reducing the amount of air admitted to the pneumatic —6—, while on the other hand a reduction of tension in the pneumatic —31′— causes it to open the valve for increasing the amount of air admitted to the main governing pneumatic —6—.

It is equally evident that if the air tension in both pneumatics —31— and —31′— is the same, they will hold the valve —34— in a definite central or neutral position.

In the operation of this air-grading device, assuming that the instrument is playing under relatively low tension for producing correspondingly low tones, such as pianissimo effects, and that it is desired to increase the tone, in which case the music sheet would be provided at the proper place with a perforation as *b′* adapted to register with the duct —29— corresponding to the pneumatic —31′—, thereby operating the corresponding primary pneumatic —26— and adjacent valve —25— to close communication between said pneumatic —31′— and the atmosphere and open communication between that pneumatic and exhaust chamber —23—, thus causing a partial collapse of the pneumatic —31′— and corresponding opening movement of the valve —34—, which admits an increased amount of air to the pneumatic —6—, causing a further opening of the valve —7— and resultant increase of air tension in the player action.

In reverse manner, the pneumatic —31— and valve —34— may be operated by registering a perforation as *b* in the music sheet with the corresponding duct —29— for reducing the amount of air admitted to the pneumatic —6— and causing a similar reduction of the air tension in the player action.

If the movement of the valve —34— and resultant variation of air tension in the player action is to be only slight, the controlling perforations *b* or *b'* in the music sheet —B— would be relatively short or not greater than that of the corresponding tracker ducts, thereby causing only a slight movement of the corresponding pneumatic —31— or —31'—, due to the relatively small passages —30 and 30'— as compared with the pneumatic —31 and 31'— whereby any sudden tendency of short duration of either pneumatic to collapse is partially resisted by the tendency of the other pneumatic to create a less pressure within than without its movable side owing to the inability of the atmospheric air to enter the last named pneumatic through the restrictive passage —30 and 30'— as fast as its movable side tends to move under the action of the first named pneumatic through the medium of the links —32 and 32'—, but if the movement of the valve and resultant variation of air tension in the player action is to be considerable, then the controlling perforations in the music sheet would be correspondingly long, and may be sufficiently long to cause a complete collapse of either pneumatic and consequent complete closing or full opening of the valve —34—.

For accenting purposes, I have provided a valve board —41— with a series of, in this instance three, vent ports —42— of different sizes and a corresponding number of valves —43— controlling said ports, all of which are connected by a branch pipe —44— to the extension —40— of the by-pass pipe —11— so that by opening either valve against the action of its individual retracting spring, as —45—, atmospheric air will be admitted to the pneumatic —6—, resulting in the further opening of the valve —7— and consequent increase of air tension in the player action.

Secured to the under side of the valve board —41— is a block —46— having an exhaust chamber —47— and a plurality of primary pneumatics —48—, one for each of the valves —43—, the exhaust chamber —47— being adapted to be connected by a pipe —49— to the wind-inducing device or other exhaust chamber, not shown.

The pneumatics —48— are adapted to operate their respective valves —43— through the medium of rods —50— which are guided in suitable openings in the valve board —41—, as shown in Figure 1, said pneumatics being connected by separate tubes or pipes —51— to individual ducts —52— in the tracker bar —A—.

These ducts —52— are controlled by the music sheet or web —B— having perforations properly positioned to register with said ducts when it is desired to operate any one or more of the pneumatics —48— and valves —43— to admit atmospheric air to the main governing pneumatic —6—.

By making the ports —42— of different sizes, as shown in Figure 3, it is evident that the amount of air admitted to the pneumatic —6— and resultant variation in the air tension in the action may be varied by opening different valves or different combinations thereof, and that when this accenting device is controlled by the music sheet, the perforations in the latter are relatively short, thus causing a sudden opening and closing of the corresponding valve or valves, and consequent sudden variation of the tone produced by the player action.

If any part of the musical selection is to be played with crescendo or diminuendo effects, the perforations in the music sheet controlling the action of the pneumatics —31— and —31'— will be relatively short, thus causing a step by step movement of one or the other of said pneumatics, according to the tone required.

It is evident, however, that the admission of air to the main expression governing pneumatic may be controlled by other automatic devices than those herein shown and described, or by any suitable form of manually operated devices, and that instead of varying the size of the ducts —15'—, —16'— and —17'— in the tracker bar, as shown in Figure 4, they may be of the same size and the perforations in the music sheet registering therewith varied in size to accomplish substantially the same results without departing from the spirit of my invention.

When it is desired to produce the softest tones possible with just sufficient tension to overcome the resistance of the actions, the valves —34— and —43— might be closed thereby causing an increased tension in the pneumatic —6— through the passages —12'—, 12 and 11 which, unless such tension was reduced might result in moving the valve —7— sufficiently near its seat to reduce the air tension in the player action below that which would be required to overcome of the resistance of the player and piano actions.

In order to obviate that result I have provided the vent tube —13— and adjustable valve —14— which may be set to allow the entrance of a sufficient amount of atmospheric air into the pneumatic —6— to cause it to position the valve —7— so that the tension in the action will be just sufficient to over-

come the combined resistance of both the player and piano actions.

Action cut-out.

In devices of this character, it is desirable to cut off communication between the wind-inducing device and sound-producing action during the reroll of the music sheet so that the full energy of the wind-inducing device may be transmitted to the winding and rewinding motor, not shown, and for this purpose a valve block —53— is secured to one side of the valve chest —1— and is provided with separate chambers —54— and —55— connected by a port —56—, one of said chambers, as —54—, being connected by a passage —57— to the exhaust chamber —2— of the valve chest —1—, while the other chamber —55— is connected by a pipe —58— to the pneumatic —6—.

A valve —59— normally closes the passage —56— to cut off communication between the chambers —54— and —55— and is adapted to be opened by a primary pneumatic —60— having a vent —61— by which atmospheric air may be admitted thereto when desired by opening a valve —62—, or by automatic means if desired.

For example, when it is desired to reroll the music sheet, the valve —62— may be opened to admit atmospheric air to the primary pneumatic —60—, which in turn opens the valve —59—, and thereby connects the main governing pneumatic —6— with the exhaust chamber —54— through the medium of the pipe —58—, resulting in the operation of said governing pneumatic to completely close the valve —7— and cut off communication between the wind-inducing device and sound-producing action so that the full tension of the wind-inducing device may be diverted to the rerolling motor, it being understood that the relatively large area of the pneumatic —6— as compared with that of the port —4— and valve —7— aids materially in effecting a positive closing of the valve when placed in direct communication with the exhaust chamber —2— through the medium of the pipe —58—, and that the valve —7— performs the double function of regulating the air tension in the player action during the playing of a musical selection and also for cutting off communication between the wind-inducing device and sound-producing action when it is desired to divert the full tension of the wind-inducing device to the winding and rewinding motors.

It will be noted that when the communication between the wind-inducing device and sound-producing action is cut off by the closing of the valve —7— for diverting the full tension of the wind-inducing device to the rerolling motor, the action chest will then be under atmospheric pressure which causes a reverse flow of air through the restricted passage —12'— and branch —12— to automatically clean the same from any dust or lint which may tend to lodge therein.

It will also be evident that many devices other than those illustrated may be employed for regulating the amount of air admitted to the pneumatic —6— for accenting purposes, such as varying the degree of opening of one or more of the valves —43—, or varying the size of one or more of the ports —42—, may be used without departing from the spirit of this invention, it being understood that the perforations in the music sheet for controlling the accenting device may be of any length. It is also to be understood that the term "tension regulating pneumatic" and "tension governing pneumatic" or "tension regulator" as used throughout the claims defines a construction by which the air tension in the sound-producing action is automatically maintained at a lower degree than that produced by the sound-producing action and that by admitting extra air to the tension regulator enables the latter to be used for the double purpose of automatically maintaining a lower tension in the action than that produced by the wind-inducing device and also of controlling the expression through the various grades.

What I claim is:

1. In a self-playing musical instrument, the combination of a tension-regulating pneumatic and means for admitting and varying the rate of flow of air under atmospheric pressure to said pneumatic.

2. In a self-playing musical instrument, the combination of a tension regulating device including a valve and a pneumatic actuator therefor communicating with the windway in which the valve is located, said actuator being provided with an atmosphere-port for receiving air under atmospheric pressure and means for varying the effective capacity of said port.

3. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with a wind-way at a point between the valve and action, separate atmospheric ports communicating with said pneumatic, means for adjusting the rate of flow of air through one of said ports, and means for opening and closing the other port.

4. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a valve operating pneumatic communicating with the windway be-

tween the valve and action through a restricted passage, separate atmosphere-ports communicating with said pneumatic, means for adjusting the rate of flow of air through one of said ports, and means for opening and closing the other port.

5. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with the windway at a point between the valve and action and controlling said valve, a plurality of vent ports of different sizes communicating with said pneumatic, and separate devices for opening and closing said ports.

6. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with the windway at a point between the valve and action and controlling said valve, a plurality of vent ports of different areas communicating with said pneumatic, separate normally closed valves for said ports, and means for opening said valves individually or in combinations.

7. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with the windway between the valve and action and controlling said valve, a vent communicating with said pneumatic, a tapered valve cooperating with the vent to vary the rate of flow of atmospheric air therethrough, and means for operating the tapered valve.

8. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with the windway between the valve and action and controlling said valve, a vent communicating with said pneumatic, a valve cooperating with the vent to vary the rate of flow of atmospheric air to the pneumatic, and pneumatic devices for moving the valve in reverse directions.

9. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic for operating said valve communicating with the wind-inducing device, and means for placing said pneumatic in additional communication with the wind-inducing device for completely closing the valve.

10. In a self-playing musical instrument, the combination with a wind-inducing device and a sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with the windway between the valve and action and controlling said valve, and means for placing said pneumatic in additional communication with the wind-inducing device to cause complete closing of the valve.

11. In a self-playing musical instrument, the combination of a tension regulating device including a valve, a pneumatic actuator therefor a plurality of atmosphere-ports of different effective capacities communicating with said actuator and means for opening and closing said ports.

12. In a self-playing musical instrument, a valve chest having an exhaust chamber and separate ports for connection, respectively, with a wind-inducing device and a sound-producing action, a valve controlling one of said ports, a pneumatic communicating with the exhaust chamber when the valve is open, and separate means for connecting the pneumatic with the exhaust chamber to close the valve.

13. In a self-playing musical instrument, a valve chest having an exhaust chamber and separate ports for connection, respectively, with a wind-inducing device and a sound-producing action, a valve controlling the action-port, a pneumatic communicating with the action-port around the valve, and means for connecting the pneumatic with the exhaust chamber to close the valve.

14. In a self-playing musical instrument, a valve chest having an exhaust chamber and separate ports for connection, respectively, with a wind-inducing device and a sound-producing action, a valve controlling the action-port, a pneumatic controlling the valve, a passage leading from the action side of the action-port to the pneumatic and having a portion thereof restricted to less size than that portion which opens into the pneumatic, and means for admitting atmospheric air to said passage between said restricted portion and the pneumatic for tone-modulating purposes.

15. In a self-playing musical instrument, the combination of a tension regulating device including a valve and a pneumatic actuator therefor, said actuator communicating with the low tension side of the wind-way in which the valve is located, and means for placing said actuator in communication with the high tension side of the wind-way to cause the closing of the valve.

16. In a self-playing musical instrument, the combination of a tension regulating device including a valve and a pneumatic actuator therefor, said actuator communicating with the low tension side of the wind-way in which the valve is located, means for placing said actuator in communication with

the high tension side of the wind-way to cause the closing of the valve, an atmosphere-port communicating with the actuator and means for varying the effective capacity of the last named port.

17. In a self-playing musical instrument, a valve chest having an exhaust chamber and separate ports for connection, respectively, with a wind-inducing device and a sound-producing action, a valve controlling the action-port, a pneumatic of greater area than that of the port controlled by said valve, a by-pass leading from the action side of the action-port to said pneumatic, and means separate from the by-pass for connecting the pneumatic with said exhaust chamber for completely closing the valve.

18. In a self-playing musical instrument, the combination of a wind-inducing device and sound-producing action communicating therewith, of a valve controlling said communication, a pneumatic communicating with the wind-way at a point between the valve and action and connected to said valve; and means for admitting and varying the rate of flow of extra air to said pneumatic.

19. In a self-playing musical instrument, a valve chest having an exhaust chamber and separate ports for connection respectively with the wind-inducing device and sound-producing action, a valve controlling the action port, a pneumatic controlling the valve, a passage leading from the action side of said action port to the pneumatic, and means for admitting and varying the rate of flow of air from the outside to the inside of said pneumatic.

In witness whereof I have hereunto set my hand this 13th day of February, 1918.

LEWIS B. DOMAN.

Witnesses:
GUY M. RUSSELL,
J. O. REDMOND.