

Jan. 4, 1927.

**1,613,501**

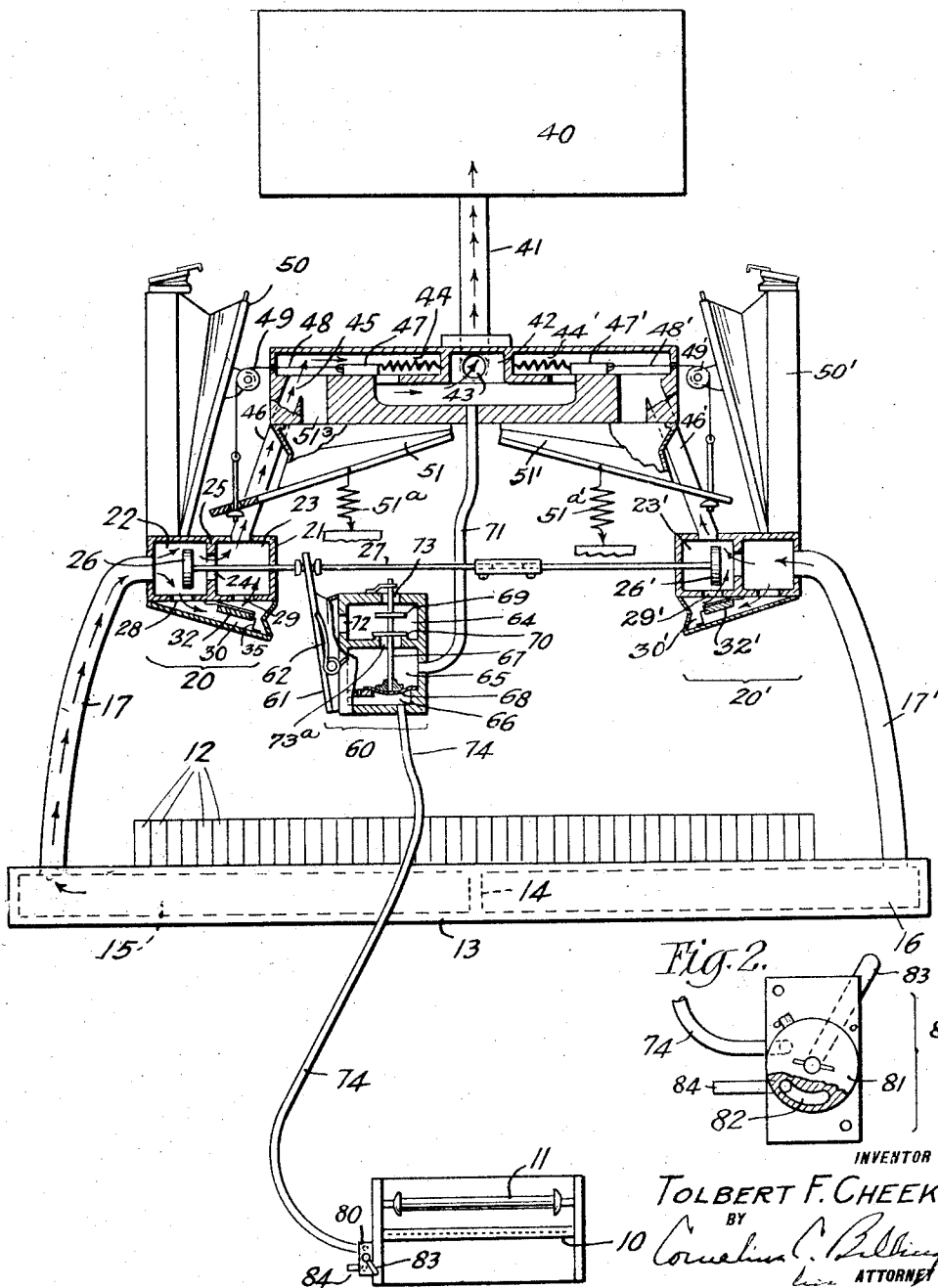
T. F. CHEEK

## RECORD CONTROLLED MUSICAL INSTRUMENT

Filed Nov. 5, 1920

2 Sheets-Sheet 1

Fig. 1.



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Fig. 4.

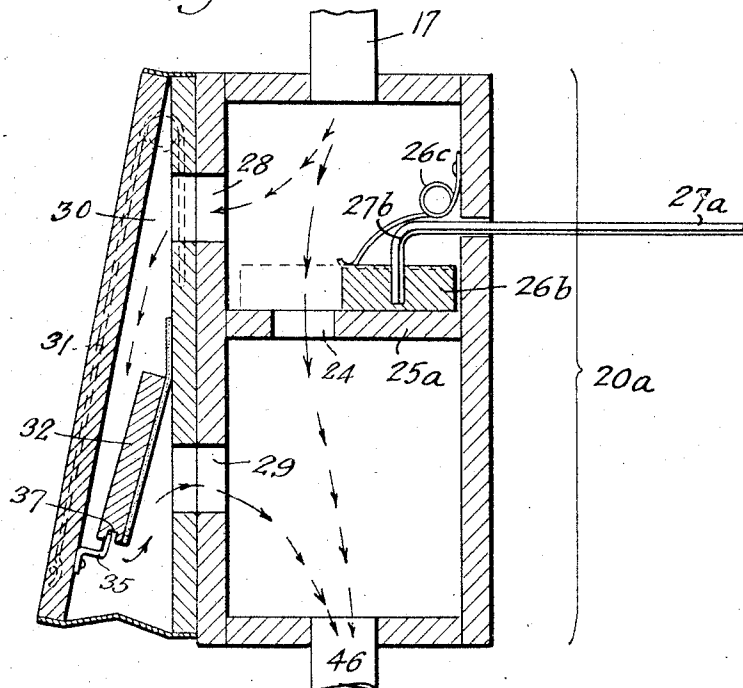
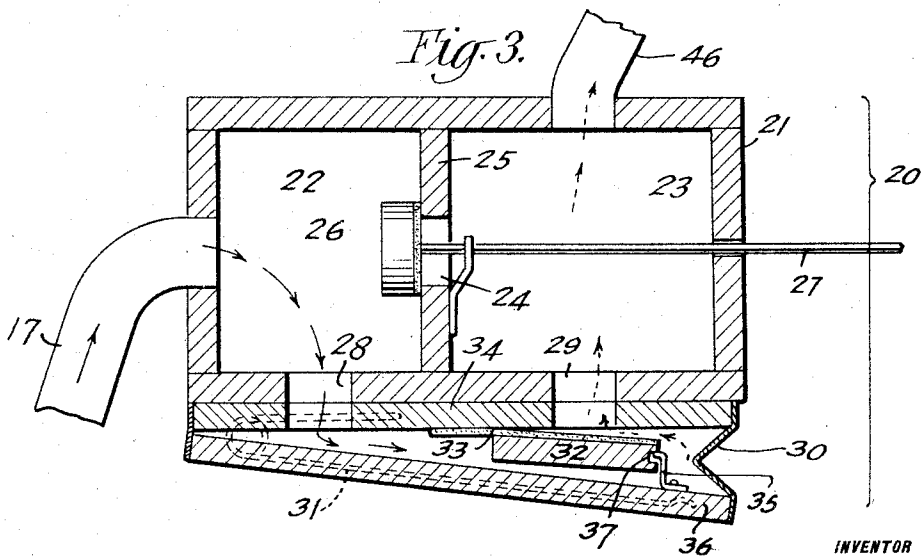


Fig. 3.



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## UNITED STATES PATENT OFFICE.

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## RECORD-CONTROLLED MUSICAL INSTRUMENT.

Application filed November 5, 1920. Serial No. 421,821.

This invention relates generically to means for controlling the volume or pressure of air acting on the devices which produce the tones in mechanically operated musical instruments and more particularly to certain improvements in that type of record-controlled musical instruments which has pressure controlling mechanism comprising elements correlated to permit the tension of the air at the striker action to be varied in accord with the dynamic force with which the striker pneumatics are to be operated at any time and to maintain said tension whether one pneumatic is operated alone or any number of pneumatics are operated together.

A fundamental object of the invention is to provide means whereby a whole musical selection or any part or parts of a selection may be rendered louder or softer at will.

Another important object of the invention is to provide a tension governing and regulating means for a record-controlled musical instrument, which tension governing and regulating means will include a governing and regulating valve and means for rendering said valve effective and ineffective, at will.

Another of the important objects of the invention is to provide a record-controlled musical instrument with means having a plurality of valves for controlling the pneumatic tensions in different portions of the striker action, respectively, and a common humanly controllable operating means for said valves.

Another of the important objects of the invention is to provide a record-controlled musical instrument with a plurality of co-operative means for governing or regulating the tension of the air at the striker pneumatics, one of said means being humanly operable and acting to change or modify the volume of sound which otherwise would be produced under control of the other means, without at the same time changing the relative strengths of the tones.

A further important object of the invention is to provide a record-controlled musical instrument of the type employing a valve settable in different positions with relation to its port to correspondingly regulate the tension of the air at the striker action and also provided with a governing means acting with relation to the valve to maintain

said tension regardless of the number of notes sounded simultaneously, with a humanly controllable means whereby the dynamic force consequent upon the setting of the regulating valve at any position may be varied without altering the position of said valve with relation to its port.

Another object is to combine and co-ordinate the several elements herein disclosed so they effectively perform the functions set forth.

In the drawings in which like references refer to like parts in the several views:

Fig. 1 is a diagrammatic view showing one embodiment of my invention.

Fig. 2 is a detail of the control valve.

Fig. 3 is an enlarged detail showing one of the pneumatics for controlling the volume of air which actuates the player action.

Fig. 4 is a similar view showing an alternative construction of a pneumatic for controlling the volume of air which actuates the player action.

Referring first to Fig. 1, the instrument is provided with the usual tracker bar 10 over which the perforated music sheet travels as it is wound up on the feed roller 11. The tracker bar is connected by suitable conduits (usually eighty-eight in number) not shown, with the usual strike pneumatics indicated conventionally at 12. There is one pneumatic 12 corresponding to each conduit leading from the tracker bar and they are selectively operated according to the perforations in the music sheet in a manner well known in this art. The pneumatics 12 are all operatively connected with the common windchest 13 which in the structure illustrated is divided by a wall 14 into two chambers 15 and 16. The chamber 15 communicates with the set or group of strike pneumatics in the "bass" section and the chamber 16 communicates with the set or group of strike pneumatics in the "treble" section. Conduits 17 and 17' communicate with my improved volume control or tension varying members indicated generally by 20 and 20'. The construction and operation of the members 20 and 20' is identical and the description of one will apply to both. The parts on the treble side will bear the same reference characters with a prime mark added.

The member 20 is formed with a box like portion 21 having two chambers 22 and 23

formed therein and communicating with each other by a port 24 in the dividing wall 25. A valve 26 carried by a slidable rod 27 is adapted to close the port 24 as hereinafter described. On the under side of the box portion 21 is a bellows 30 the interior of which is connected by ports 28 and 29 respectively with the chambers 22 and 23. A spring 31 (shown dotted in Fig. 3) tends normally to keep the bellows 30 expanded, and the suction in chambers 22 and 23 tends to collapse said bellows when the valve 26 closes the port 24, as hereinafter set forth. The movement of the bellows 30 actuates a regulating valve 32 which is hingedly secured at 33 to an interior wall 34 of the bellows. A clip 35 secured to the wall 36 of the bellows has a finger engaging a kerf 37 in the valve 32 as shown best in Fig. 3.

40 is a conventional representation of a suitable source of power for producing the necessary air-currents within the system. This source of power may be of any suitable nature and construction, those which operate upon the suction principle—i. e. to reduce the pressure of the air in the system to below that of the atmosphere being preferred. It is customary for this purpose to employ a suitably operated suction pump, usually a plurality of bellows, together with a main reservoir in communication with said pump, and as this invention does not essentially deviate from the custom, it is not necessary to illustrate the source of power or to refer to it in further detail.

The source of power 40 is connected by a conduit 41 with a chamber 42 which is in communication with a chamber 43 formed in a gate-box. The chamber 43 of said gate-box has communication through a duct 71 with a chamber 65 in a control member, which is indicated as a whole by 60 and is further provided with chambers 64 and 66. The chamber 66 is separated from the chamber 65 by a pouch or diaphragm 68 which is engaged with one end of a valve stem 67 having valve disks 69 and 70 in the chamber 64. This chamber 64 has an atmospheric port 73 to be opened and closed by the valve disk 69 and a suction port 73<sup>a</sup> to be opened and closed by the valve disk 70. It also has a port 72 through which it communicates with the interior of a pneumatic 61 having a spring 62 tending to expand it. The movable board of this pneumatic is connected to the valve stem 27, so that said stem will be moved to close the valve 26 when the pneumatic 61 is collapsed and to open said valve when the pneumatic 61 is expanded.

It will be noted that when the parts are in the position shown in Fig. 1, the chamber 64 is open to the atmosphere and is closed against the suction in chamber 65. Pneumatic 61 is in consequence subjected to equal pressure, (atmospheric) acting upon oppo-

site sides of its movable board and is held expanded by its spring 62. At this time, the valve 26 is open, as shown.

In order to close said valve the stem 67 is lifted by the diaphragm 68 thereby opening the suction port 73<sup>a</sup> and closing the atmospheric port 73. This is accomplished by the admission of atmospheric air to chamber 66. This chamber is connected by a tube 74 to a control valve 80 which is humanly controlled, i. e. is under control of an operative (as contradistinguished from the record which controls the striker pneumatics). It is here shown as adapted for hand operation. This valve includes a disc 81 with a port 82 formed therein. The disc 81 is shown in closed position in Fig. 2. When it is moved by turning the handle 83 to which it is secured, the port 82 will come into register with the aperture 75 in the duct 74 thus establishing communication of the duct 74 with the pipe 84 which is open to atmosphere.

It will be noted that the valve 26 of the member 20 and the valve 26' of the member 20' are connected with each other by the stem 27 and that said valves are so arranged with relation to their respective ports that they are opened simultaneously and closed simultaneously under control of the described humanly controlled means common thereto.

In Fig. 4 I have shown a slightly modified form of volume control unit 20<sup>a</sup> which is adapted to be installed with its longitudinal axis vertical instead of horizontal as in Fig. 1. With this arrangement the operating rod 27<sup>a</sup> is bent at right angles as at 27<sup>b</sup> forming a short vertical arm as shown, to which is secured the valve 26<sup>b</sup> which in this case slides on the upper surface of the wall 25<sup>a</sup>. A spring 26<sup>c</sup> serves to hold the valve yieldingly in working contact with the wall 25<sup>a</sup>. The lateral movement of the rod 27<sup>a</sup> will move the valve to close or open the port 24<sup>a</sup> as desired, this rod being adapted to be moved in the same manner as the rod 27 shown in Fig. 1. The construction and operation of the other parts of this control unit 20<sup>a</sup> are the same as the unit 20 and the parts are correspondingly designated.

From the foregoing it will be clear that if the player wishes to render a portion of a selection softer when the parts are in the position shown in Fig. 1, he can shift the handle 83 to its other position. This turns the valve 81 so that port 82 connects pipes 74 and 84, the latter being open to atmosphere and the former being connected to the chamber 66. Atmospheric pressure on the diaphragm 68 then lifts the valves 69 and 70, thus closing port 73 and opening communication between chambers 65 and 64 and permitting the suction from pump 40 through pipes 41 and 71 to collapse the bel-

lows 61 and thereby move the rod 27 to the right thereby moving the valves 26 and 26' from the open position shown in Fig. 1 to the closed position shown in Fig. 3.

5 This cuts off the communication between chambers 22 and 23 by way of the port 24 and all air exhausted by the pump 40 now passes through the ports 28 and 29 and 28' and 29' causing the bellows to partially col-  
10 lapse against the action of the spring 31.

This causes the regulating valve 32 to partially close the port 29 resulting in cutting down its area and consequently cutting down the volume of air exhausted from the player  
15 action 15 with the result that less force is exerted on the striker pneumatics and therefore softer tones are produced. To render the selection louder the player shifts the handle 83 to the other position thereby closing the  
20 pipe 74 and permitting the bellows 61 to move the rod 27 and operate the valves 26 and 26' so that the normal full volume of air will be exhausted from the player action by the pump as will be understood from the  
25 drawings and the above description.

The foregoing sets forth preferred embodiments of one part of this invention. An additional, but a very important feature of the invention is in the use of the described  
30 volume-control means in conjunction with an expression-mechanism and in a relationship between the said expression mechanism and the volume-control means such that the musical composition being played, or any  
35 selected section thereof, may be rendered with the full strength primarily intended or softened, at the will of the operative, without effecting the relative strength of the various tones which result in giving expression.  
40 In other words, an important feature of this invention is the employment of the described volume-control means as a part of a tension-regulating and pressure-maintaining system which system includes, in addition to the  
45 said volume-control means, mechanism operative under control of the record to so control the tension of the air at the striker pneumatics that the resulting tones will bear the expressive relationship to each other called  
50 for by a proper and artistic rendition of the composition being played, and which system, moreover, by reason of its inclusion of the described volume-control means may, at the will of the operative, be controlled to vary  
55 the volume of the tones emitted, with relation to the entire composition being played or with relation to any selected part thereof, while still retaining the relative strengths of tones controlled by the record.

60 It will be understood that the statement made with relation to the mechanism in conjunction with which the herein described volume-control means is employed has reference to that type of player mechanisms in  
65 which not only are the notes sounded in their

proper sequence but also with their expressive relation to each other, all under control of the record. Many such mechanisms, alike in principle but differing in details, are known in the art and this invention is not  
70 confined to the use of any particular detail form of such mechanism. In a general way they may be described as including a valvular member which is settable to various positions with relation to a windway between  
75 the striker pneumatics and the source of power to thereby variably determine the tension of the air at the striker pneumatics and the resulting volume of tone emitted; an expression member which is operated under  
80 control of the record (through the medium of expression apertures in the tracker board and an expression action connected with said apertures and with the expression member) to set the valve in its various positions to  
85 vary the strength of the tones accordingly; and a tension-regulating member which is operative with relation to the valve to maintain the strength of the tones predetermined by the setting of the valve, regardless of the  
90 number of notes played simultaneously. An example of such mechanism is found in Patent No. 1,008,291 issued November 7, 1911 to E. Welte and H. Bockisch and the one herein illustrated is substantially identical  
95 therewith, the Welte-Bockisch mechanism having been selected for illustration for the reason that it has been found to be eminently satisfactory in use and also because it is very well adapted for use in the present  
100 system which includes, in addition to mechanism of the type exemplified by the Welte-Bockisch patent referred to, a volume control means so correlated with the said mechanism that the two will constitute a single system  
105 having a plurality of regulating means individually usable in the system at the will of the operator.

Referring to Fig. 1 of the drawing which illustrates an expression mechanism substantially identical with the said Welte-Bockisch mechanism, it will be noted that  
110 for each group or set of striker pneumatics—as the bass scale and treble scale, for example—there is a slide valve, (47 or 47') an expression bellows, (50 or 50') and a tension maintaining (regulating) bellows, (51 or 51') and that each slide valve is connected  
115 with the movable board of the corresponding regulating bellows by a cable (48 or 48') which passes over a sheave (49 or 49') carried by the movable board of the corresponding expression bellows. In such a construction, as is well known, the expression members  
120 50, 50' are controlled by the record, through the medium of an expression action (not shown) and primarily control the tension of the air at the corresponding set or group of striker pneumatics by setting the valvular members 47, 47' in such relation  
125  
130

to the ducts forming parts of the windways between the source of power and the sets or groups of striker pneumatics, respectively, that the passage of the air will be restricted to a greater or less extent in accordance with the strength of the tones to be emitted. It is also well known that in such mechanism the regulating pneumatics (51 or 51'), respectively, are deflated more or less in accordance with the tension existing in the corresponding windways, whereby their springs (51<sup>a</sup> or 51<sup>a'</sup>) are put under correspondingly greater or less tension and thereby become effective to open the valves 47, 47', respectively, when the tension is reduced by the operation of the striker pneumatics and to an extent which accords with the number of striker pneumatics operated simultaneously, the valves, however, always returning to the positions predetermined by the extent of deflation of the expression bellows, respectively. The expression mechanism described is completely operative as a pressure controlling and tension maintaining means and the results obtainable from its use are accurate reproductions of the interpretation of the artist, which interpretation has been embodied in the record: but since musical taste vary, there are certain renditions, either of an entire composition or of certain portions thereof, which some listeners would prefer to soften, without, however, changing the relative strengths of the tones predetermined by the record, and to this end a volume-control means, such as that hereinbefore described, has been provided as an additional or supplemental part of the air-controlling system, and the volume control means has been placed under control of the operative so that he may, at will, by adjustment of a control element, render said volume-control means effective, as for soft playing, or ineffective as for loud playing.

Thus it will be noticed that the chambers 22, 22' of the volume control members 20, 20' are connected with the wind passages 15, 16 of the striker action by ducts 17, 17'; that the chambers 23, 23' of said volume control members are connected with the source of power 40, by ducts 46, 46', chambers 44, 44', a chamber 43, a chamber 42 and a duct 41, all opening one into the other, and forming parts of the windways between the striker pneumatics and the source of power. It will also be noticed that the valves 47, 47', respectively, control these windways and that the regulating pneumatics 51, 51' and also the pneumatics 30, 30' are operatively related to the windways. The correlation of parts accordingly is such that the air drawn from either section 15 or 16 of the wind chest 13 will be restricted by the corresponding valve 47 or 47' in accordance with the extent to which the corresponding bellows

50 or 51, has been collapsed and that when the control valves 26, 26', are closed, the pneumatics 30, 30' will be under the tension which exists in the respective wind passages and will be collapsed more or less in accordance with the particular positions to which the valves 47, 47' have been set under control of the record. Collapse of either of these pneumatics 30, 30' correspondingly moves its valve 32 or 32' toward a closing position with relation to the corresponding ports 29, 29' so that the valve thus moved now acts to further cut down the flow of the air in the corresponding windway, and hence to reduce the volume of sound below that which occurs when the windways are controlled only by the valves 47, 47' without, however, affecting the relative strength of the tones, since the valves 47, 47' are still operative to control such relative strengths. On the other hand, when the valves 26, 26' are open the flow of the air will be by-passed, or will pass by, the pneumatics without substantially acting upon the same, so that the tension to which the latter is subjected will be substantially ineffective to collapse them. Hence, the volumes of tones will be those predetermined by the settings of the valves 47, 47' without further restriction. Since the regulating pneumatics 51 and 51' depend for their operation upon the tension of the air in the windways, respectively, and since proper regulation calls for an instantaneous response to every change in tension, it is undesirable to rely upon these pneumatics (51, 51') to effect the regulation when the flow of air has been further restricted. It will be noted, however, that the pneumatics 30, 30', are much smaller and hence correspondingly weaker, than the pneumatics 51, 51' and when the valves 26, 26' are closed will, in conjunction with their valves 32, 32', be operative to effect the necessary regulation with relation to the weakened tension existing at this time.

While I have illustrated a typical embodiment of the invention, and while I have shown and described a particular application thereof in which there are a plurality of groups or sets of striker pneumatics, one comprising the bass scale and the other the treble scale, it will be apparent that these are to be considered as being merely suggestive, and that the invention may be otherwise and variously embodied, and that the number of notes in a group or set is not material, since there may be only one such—in fact, that all the notes of the piano may be regarded as a group or set—and since there may be more than two groups or sets. It is common practice, however, to separate the treble scale from the bass scale and to provide separately controlled expression mechanisms therefor, and hence I have so illustrated the invention without, however, in-

tending by the use of the term "group or set" of striker pneumatics, or any equivalent term, in this description or in any of the claims, unless such term is otherwise qualified therein, to restrict to any particular member or scale of striker pneumatics included in such term.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a record controlled musical instrument, a source of power, striker pneumatics, an expression pneumatic under control of the record, a regulating valve, a regulating pneumatic having a flexible connection therewith, a mechanical connection between said expression pneumatic and the flexible connection connecting the regulating pneumatic and the regulating valve, an additional regulating pneumatic, a valve controlled by the latter, means under control of the operator to render the latter valve effective or ineffective at will, and means, including the said regulating pneumatics, forming a windway which connects the source of power with the striker pneumatics and is controlled by the said valves.

2. In a record controlled musical instrument, a source of power, a group or set of striker pneumatics, means forming a windway between the source of power and said group or set of striker pneumatics, a plurality of regulators of different characteristics both connected to said windway, and a humanly controlled means operative with relation to the windway to by-pass the air around one of the regulators.

3. In a record controlled musical instrument, a plurality of wind chests and a source of power, a duct connection leading from the source of power and having branches to each wind chest, a plurality of regulators of different characteristics connected to and arranged to control the duct connection to each wind chest, pneumatic means and a humanly controlled means for by-passing the air around one of the regulators of one of the ducts.

4. In a record controlled musical instrument, a plurality of groups or sets of striker pneumatics; a source of power for the groups or sets of striker pneumatics; a plurality of members for the groups or sets of striker pneumatics, respectively, each member having a plurality of chambers and provided with an opening through which its chambers have direct communication with each other and a valve operatively related to said opening, and also having a regulator pneumatic, ports through which said pneumatic has communication with both of said chambers and a regulator valve operatively related to one of the latter ports; a connection between the first mentioned valves of the members; a motor pneumatic operatively

related to said connection and operative thereon to open said valves simultaneously and to close them simultaneously; and humanly operative control means for said motor pneumatic.

5. The combination with a source of power, groups or sets of striker pneumatics, and separate record controlled expression devices for each of the groups or sets of striker pneumatics, respectively, of a plurality of volume regulating control members operatively related to each of the expression devices respectively, an operating means common to one of said members of each set, and a humanly operative control means operatively related to said operating means.

6. The combination with a source of power, groups or sets of striker pneumatics, means forming a windway between the source of power and the groups or sets of striker pneumatics, respectively, and record controlled expression devices for the groups or sets of striker pneumatics, respectively, and operatively related to the windway: of a plurality of volume regulating control members for each expression device, one member of each set having a plurality of chambers and provided with an opening through which the chambers have direct communication with each other and a valve operatively related to said opening, and also having a regulator pneumatic, ports through which said pneumatic has communication with both of said chambers and a regulator valve operatively related to one of said ports; a connection between the first mentioned valves of the members; an operating means operatively related to said connection and operating thereon to open said valves simultaneously and to close them simultaneously; and humanly operative control means for said operating means.

7. In a record controlled musical instrument, a source of power, striker pneumatics, a plurality of chambers, means through which the chambers have communication with the source of power and the striker pneumatics, respectively, a valvular member, an expression member under control of the record and operating to set the valvular member in accordance with the tension to be produced at the striker pneumatics, a regulating pneumatic operative with relation to said valvular member to maintain the tension for which the same has been set, regardless of the number of striker pneumatics operated simultaneously, a second regulating pneumatic, ports through which the latter pneumatic has communication with said chambers, respectively, a valve under control of the second pneumatic and controlling one of said ports, a port through which the chambers have communication with each other outside the second regulat-

ing pneumatic, and means under control of the operative to open and close the latter port.

8. In a record controlled musical instrument, a plurality of groups or sets of striker pneumatics; a source of power for the same; a plurality of members, each having a plurality of communicating chambers, a regulating pneumatic having communication with both chambers and a valve controlled by the pneumatic and in turn controlling communication of the pneumatic with both chambers; each member also having a valve to control communication of its chambers with each other outside its pneumatic; means to simultaneously open and simultaneously

close the last mentioned valves to render the regulating pneumatics simultaneously ineffective or simultaneously effective, means through which one chamber of each said member has connection with the source of power and the other chambers of the respective members have communication with the corresponding sets or groups of striker pneumatics; and additional regulating means which are operative when the first regulating means are ineffective.

In witness whereof I have hereunto set my hand at the borough of Manhattan, city, county and State of New York, this 21st day of October, 1920.

TOLBERT F. CHEEK.