

UNITED STATES PATENT OFFICE.

EDWIN WELTE AND KARL BOCKISCH, OF FREIBURG, GERMANY.

MECHANISM FOR REGULATING THE EXPRESSION IN APPARATUS FOR PLAYING MUSICAL INSTRUMENTS.

1,008,291.

Specification of Letters Patent.

Patented Nov. 7, 1911.

Application filed August 17, 1904. Serial No. 221,034.

To all whom it may concern:

Be it known that we, EDWIN WELTE and KARL BOCKISCH, both subjects of the Grand Duke of Baden, and residents of Freiburg, in the Grand Duchy of Baden, German Empire, have invented certain new and useful Improvements in Mechanism for Regulating the Expression in Apparatus for Playing Musical Instruments, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a section through the main bellows, the expression bellows and the regulating bellows of the present invention. Fig. 2 is a vertical longitudinal section through a portion of the pneumatics for controlling the pressure of the fingers or levers upon the keyboard of the piano. Fig. 3 is a diagrammatic view showing the connection and relative arrangement of the main operating parts, the expression actions and tone-producing actions being shown in vertical longitudinal section, one regulating bellows and one pumping bellows being omitted. Fig. 4 is a vertical transverse section on the line 4—4 of Fig. 3. Fig. 5 is a detail view of means that may be employed for operating the slide or valve *c* by hand. Fig. 6 is an end view of the parts shown in Fig. 5.

Similar letters of reference indicate corresponding parts in the different figures of the drawings.

This invention relates to that character of mechanical devices for playing pianos and other musical instruments wherein the tones of the piece of music are produced through the medium of air currents controlled by a perforated note sheet. These currents are described herein as produced by lowering the pressure within the instrument below atmospheric pressure, and it is usually better to produce them in this way rather than by raising the pressure in the instrument above atmospheric pressure. The invention more especially relates to the expression means of such devices.

The principal object of the invention is to provide such devices with means whereby the piece may be reproduced with more accurate or artistic expression than at present, which expression is automatically controlled by the note sheet.

In the accompanying drawings we have shown the mechanism of the player mounted

in a casing A outside of and separate from the piano or other musical instrument X, but we wish it understood that this is merely exemplificatory and that the invention is not restricted to such arrangement, it being within the spirit and scope of the invention to arrange the mechanism of the player within the casing of the piano or other instrument to operate upon the inner ends of the keys thereof or upon any other suitable part of said instrument. In the form shown in the drawings, the casing A has within its interior a tracker board A' which is formed with a series of ducts *a'* which communicate with the pneumatic actions B. The actions whereby the sound is produced we herein term "tone-producing actions" to distinguish them from the actions which control the expression. These tone-producing actions in the present exemplification of the invention operate the strikers of the keys of the piano, but considered in its broad aspect, the invention is not restricted to such specific relation of parts.

Any suitable pneumatic actions for the strikers may be employed, but we prefer the construction shown in the accompanying drawings, wherein each of a series of compartments 1 is connected with a strike pneumatic C having a finger lever C', by means of a passage 2 which leads from said compartment 1 to the interior of said strike pneumatic, as shown best in Fig. 4. It will be understood that there is a different compartment 1 for each strike-pneumatic C and that there is one of such strike-pneumatics and fingers for each key of the instrument within the range of the player. As indicated in Fig. 3, each compartment 1 is provided at bottom and top, respectively, with air ducts 3 and 4, and with a pair of valves 5 and 6 for opening and closing said ducts. The valves 5 and 6 are connected so as to operate in unison, each closing its duct while the other is open. Through the duct 3 the interior of the compartment 1 communicates with the wind trunk 10, while the duct 4 affords communication of the interior of said compartment with the atmosphere. Each pair of valves 5 and 6 is controlled by a diaphragm 7 which is mounted in said wind trunk above a chamber 8. Air conducting tubes 9 lead to the respective air ducts *a'* in the tracker board A' from these chambers 8.

60

65

70

75

80

85

90

95

100

105

110

For the purpose of producing the necessary air currents through the apparatus, we preferably provide an air chamber and advantageously employ therefor a main suction bellows *a* having strong springs *a'*, from which the wind is pumped by means of bellows *B* which are operated by foot power, or by a motor or the like. The tone producing actions are connected by a suitable air passage or passages with the means for producing the air currents, and means for varying or governing this passage as well as operating means therefor are provided.

It being understood that the note sheet is caused to travel over the tracker board and the main bellows *a* is pumped out and maintained constantly in a highly exhausted condition, and it being further understood that the tracker board has channels or passages and that the note sheet is formed with corresponding openings for said channels or passages, the operation of the parts thus far set forth will readily be seen to be as follows:—When a note opening is brought into registration with a duct or passage in the tracker board, atmospheric air will be admitted to the chamber 8 connected with said duct, which air raises the diaphragm 7 in said chamber, thus raising from and elevating to their respective seats the valves 5 and 6 connected with said diaphragm 7. Communication of the particular compartment 1 containing said valves with the strike-pneumatic *C* connected therewith and with the wind trunk 10 is established whereby said strike-pneumatic *C* is exhausted by the suction produced in said wind trunk and controlled by the regulating bellows *d*, hereinafter described, causing its striking device *C'* to strike the corresponding key of the instrument hard or soft according to the position of the movable board *d'* of said regulating bellows, that is to say, according to the degree of vacuum produced therein by the main bellows *a*. When said note opening has passed out of registration with said duct or passage in the tracker board, the admission of atmospheric air through the latter is cut off, the diaphragm 7 and the valves 5 and 6 connected therewith return to their former positions, thus cutting off communication of the strike-pneumatic *C* with the wind trunk and establishing communication of said strike-pneumatic with atmospheric air, which enters the compartment 1 through the duct 4 and passes thence through the passage 2 to said strike-pneumatic *C* and inflates the same, thus raising the striking device *C'* from the key of the instrument *X*.

Through very small passages 11^a (Fig. 4) the chambers 8 are placed under slight suction to facilitate the downward movement of the diaphragm 7 and consequently of the valves 5 and 6.

It will be understood that the strength of the touch of the fingers or other striking devices *C'* on the keys or other parts of the piano or other instrument being played depends on the intensity of the suction to which their pneumatics are subjected, and in order that this may be varied without varying the degree of vacuum or the suctional force within the main bellows *a* the latter is employed to deflate the regulating bellows or other suitable air chamber *d* which has communication with the wind trunk 10 through the wind passages *b* and pipes or other suitable ducts 11. Each regulating air chamber or bellows is connected by an air passage *b'* with the main bellows, and suitable means is provided for varying or governing this passage, as a slide or other valve *c*. This valve, in the form illustrated, is arranged in the air passage *b'* between the main and regulating bellows and is connected to the movable board *d'* of said regulating bellows and to a movable device *e'*. This movable device *e'* in the specific arrangement illustrated supports the connection *c'* between the valve *c* and the regulating bellows. A pulley *g* or other suitable anti-friction device is preferably provided to engage said connection and said pulley is preferably carried by said movable device. The connection is preferably a wire or other flexible means, and, for reasons which will hereinafter appear, the movable device *e'* is preferably the movable part or board of an expression chamber or bellows *e*. The regulating bellows *d* is provided with a spring *f* the power of which increases to an extent corresponding to the extent of deflation of the regulating bellows.

The words "lower" "raise," etc., in the following description are used for convenience and clearness and with especial reference to the relative arrangement of the various parts of the apparatus as illustrated in the drawings, and not as limiting the invention to the said arrangement.

When the expression bellows *e* is out of action—that is, when it is fully inflated—its board *e'* is in its lowest position and the slide *c* is adjusted to nearly close the passage through the wind channel *b'* between the main bellows *a* and the regulating bellows *d*. This position of the parts is shown in Figs. 1 and 3, and is the pianissimo position. If now suction is produced in the main bellows *a*, the regulating bellows becomes somewhat deflated, its movable board *d'* rises and moves the slide *c* to further restrict the passage *b'* and practically cut off the main bellows. The movable board *d'* of the regulating bellows is now, however, raised but little, so that the tension of the spring *f* is weak, and there is a low degree of tension in the regulating bellows. The movable board of this regulating bellows

falls according to the demand made upon the suction by the pneumatics of the tone-producing actions, and in so doing correspondingly moves the slide to open the passage from the main bellows; but the low degree of suction is maintained at the tone-producing actions, because the expression bellows *e* has already set the valve or slide *c* to very much restrict the passage *b'*. Thus though the slide *c* is moved, in accordance with the demands made by the pneumatics of the tone-producing actions, the tension of air to produce the pianissimo volume of tone is maintained by the action of the regulating bellows *d*.

To produce a stronger tone volume the section in the regulating bellows has to be brought to a higher tension. This is accomplished by moving the movable device *e'* upward, thus correspondingly raising the slide *c* and opening the channel *b'*. Consequently the regulating bellows becomes somewhat deflated, lowering, at the same time, the slide *c*, and again allowing, as soon as the movement of the movable device *e'* ceases, only the passage of the suction used to produce tones of the desired volume, whereby the movable board *d'* is kept in this predetermined raised position. In this position the spring *f* is under stronger tension than before, whereby the increased power of the suction in the regulating bellows is maintained.

To change a stronger volume of tone to a softer one, the movable device *e'* is moved downward; the slide *c* more nearly closes the channel *b'* and, consequently, the suction consumed in the striking of the keys is not so rapidly renewed. The regulating bellows likewise becomes inflated and the degree of suction in it becomes reduced. When the movement of the movable device *e'* ceases the movement of the regulating bellows *d* also is stopped and said regulating bellows by reason of its connection with the slide *c* and also its free communication with the pneumatics of the tone-producing actions is enabled to replace the suction consumed in the striking of the keys.

Thus it will be seen that upon the position of the movable device *e'* depends the momentarily normal position of the movable board of the regulating bellows and that upon the latter depends the quantity of the tone volume produced and the maintenance of that volume.

One of the purposes of the present invention is to provide means for raising said movable device *e'* to produce the tone volume desired automatically under the control of the note sheet. It is obviously advantageous to provide means operable to produce the expression automatically and the structure herein shown embodies this advantageous feature. The mechanism shown is adapted

to produce automatically all the various expressions, pianissimo, piano, mezzo forte, forte, fortissimo, forzando, crescendo, decrescendo, etc. and to permit the same to be produced manually. For purposes of automatic regulation, the movable device *e'* is preferably, the bottom board of an expression bellows *e* which bellows is controlled by pneumatic expression-actions, which, in turn, are controlled by special openings in the note sheet and special ducts in the tracker board.

Any suitable construction of expression actions may be employed without departing from the spirit of the invention, but we prefer that shown in the accompanying drawings, wherein there is one set of expression actions for each expression bellows *e* and each set of such actions, in the form herein shown, comprises one action, *r'*, for sudden forte effect, another *r''*, for sudden piano effect, a third, *r'''*, for crescendo effect and a fourth *r''''*, for releasing the crescendo effect. Each set of expression actions, furthermore, preferably comprises actions *r⁵* and *r⁶* to actuate a bellows *h* having a stop *i* adapted to engage a stop *i'* carried by the expression bellows *e*, said compartments *r⁵* being connected with the bellows *h* by a pipe *h'*.

Each expression action (*r'*, *r''*, *r'''*, *r''''*, *r⁵* and *r⁶*), like those of the tone producing-actions above described, comprises a chamber (*k*, *k'*, *k²*, *k³*, *k⁴* and *k⁵*, respectively,) arranged at one side of the wind trunk *10^a* and having valves *q'* which control communication of said chambers with said wind trunk and the atmosphere; and each also has, at the other side of said wind trunk, a chamber *8^a* having a diaphragm-pneumatic *q²*, said chambers *8^a* thus corresponding to the chambers *8* above described, and having ducts *9^a* from which passages lead to the tracker board *A'* which tracker board, as stated, has special perforations or air inlets therefor.

Each of the expression-actions *r'* and *r''* for forte and crescendo effects respectively, and *r⁵* for operating the bellows *h*, is provided with a chamber *s* within which is arranged a membrane *q* connected with the valves *q'* and membrane *q²* of said action. The portions of said chambers *s* above the membranes *q* are connected, respectively, with the valve-chambers *k*, *k²* and *k⁴* by bores or passages *t*. In practice, the passage *t* for the forte action may be omitted. The valve chamber *k'* of the action for producing a "piano" volume of tone is connected with the portion *u* of the chamber *s* below said membrane of the forte action by a passage *v*; and similarly the valve chamber *k³* of the action *r''''* for releasing the crescendo effect is connected with the portion of the chamber *s* below the membrane *q* of the crescendo action *r⁵*; which likewise is

true as to the valve chamber k^5 of the action r^6 and the lower portion of the chamber s of the action r^5 . Thus, when the valve chamber k , for example, is evacuated by the quick rising of the valve, the space above the membrane q is placed under suction so that the valve cannot return to its seat. Even when the original force which has raised the valve ceases to work, the valve is kept raised until the neighboring action allows exhaust to operate by means of the channel v on the membrane q from below. In this manner short openings only need be provided in the music sheet in order to produce sustained tones or a series of tones of the same quantity.

The communication between the expression actions and the expression bellows e controlled thereby is shown best in Fig. 3, upon reference to which it will be seen that from the valve chamber k of the forte action r^1 a comparatively large duct or pipe l leads into said expression bellows; from the similar chamber of the piano action r^2 a smaller duct or pipe m leads to a small expression bellows n which is provided with and actuates a valve o which normally closes a passage o' in the expression bellows e , through which passage said expression bellows has communication with the atmosphere, whereby it is quickly inflated when it is desired to pass suddenly from a stronger to a weaker volume of tone; and from the valve chamber of the crescendo action r^3 extends a very small duct or pipe p to said expression bellows e .

The wind trunk 10^a of the expression actions is connected by means of a pipe 12 with the main bellows a , whereby said expression actions are controlled directly by said main bellows instead of by the regulating bellows d .

In practice, it is preferred to have two regulating bellows, one for the treble and the other for the bass, and to correspondingly duplicate the distributing bellows and other expression devices. The expression actions may be arranged at any suitable place, without departing from the spirit of the invention. In the drawings, they are shown as arranged at opposite ends of the series of compartments 1 of the tone producing actions with their respective wind trunks 10^a divided from the wind trunk 10 by means of walls w .

In the operation of the expression pneumatics:—When a sudden forte is to be produced, the forte action (r^1) comes into operation and, through the air passage l , quickly deflates the expression bellows e , thus causing the slide c to be raised quickly and the regulating bellows d to be forcibly sucked by the main bellows a . At the same time with forte the crescendo is always produced, so that if the forte-hole in the note

sheet has passed, the expression bellows is kept by the crescendo action in forte position.

If piano is to be produced, the piano action r^2 is actuated whereby the small valve bellows n is evacuated by means of the channel or pipe m . The opening o' in the expression bellows is then opened and the latter quickly returns from the forte position into the piano position. Simultaneously with piano the decrescendo action r^4 is actuated, so that the crescendo which up to now kept the expression bellows in the forte position, is released.

If crescendo effect is to be produced, the crescendo action comes into operation and gradually evacuates the expression bellows e by means of the small pipe p . If decrescendo is to be produced the crescendo effect is released by the action r^4 and the expression bellows e is gradually filled with atmospheric air through the pipe p and slowly returns to the piano position.

For producing mezzo forte the action r^5 is arranged, which deflates the bellows h , whereby the stop i comes into the path of the expression bellows e . A short time later the forte action is operated by which the expression bellows e is deflated in such a manner that stop i' is engaged with stop i and the expression bellows is therefore prevented from being fully collapsed. It is kept in this position by the crescendo action actuated at the same time. If piano is to again enter, the mezzo-forte and crescendo are released by the actions r^6 and r^4 and the piano action r^2 is actuated. For passing from mezzo-forte through decrescendo to piano, mezzo-forte and crescendo are released and the expression bellows e slowly returns into its piano position. For passing from mezzo-forte through crescendo to forte only mezzo-forte is released and the crescendo sucks the distributing bellows up to the forte position. If it is desired suddenly to pass from forte to mezzo-forte, mezzo-forte is inserted and the stop i is thereby moved into the path of the contact piece i' of the expression bellows e . Thereby crescendo is released and the piano action is put into operation.

For passing from forte through decrescendo to mezzo-forte mezzo-forte is inserted, crescendo is released; then the expression bellows e gradually returns up to the stop i of the bellows h .

It will not be a departure from the scope or spirit of the present invention to embrace novel features thereof in a construction wherein the operation of the bellows e is effected manually, by a hand or foot lever, for example. The expression bellows e may be omitted (in such case for example) and the adjustable supporting device for the valve c , in this case the board e' and pulley

g , may be directly actuated manually, by hand or foot operated means for instance. Furthermore, means for manual operation may be embodied in a machine which also has means for automatically controlling the expression, whereby provision is made for either individual or automatic control of the expression, at the will of the operator. In the latter event, and with a machine having automatic expression regulating means, like those hereinbefore described for example, the manually operable means should be of such character that atmospheric air will be admitted below the membrane or diaphragm of the "piano" action r^2 , for example, as long as the manually-operable device is in action, thereby preventing the forte pneumatic from being actuated by the note sheet. To exemplify this feature of the invention we have illustrated one form of means which may desirably be employed for the purpose, but to the details of which we do not restrict ourselves, nor do we claim said details in the present case. In the form shown means are provided for manually operating the expression bellows e , or rather for raising and lowering the pulley g of the latter. Those shown are operated by hand and comprise a shaft 100, which is journaled in suitable bearings and provided with a conveniently accessible handle 101 by which it is turned. A cord or other suitable means 102 leads to the movable support of the valve c , from a pulley 103 which is fastened on said shaft 100. Thus, when the shaft is turned the means which supports the valve c will be moved accordingly, and such manual movement will obviously cause the same movement of the regulating bellows d that would be effected by similar movement of the said support produced automatically through the automatic expression means aforesaid.

The shaft 100 has a flat portion 104, or is otherwise suitably formed to make it cam shaped or eccentric, and bears upon the upper ends of a series of plates or valves 105 which are arranged in juxtaposition to openings 106 in a casing 107. Said openings are in communication with passages 108 which in turn communicate, through ducts 109, with the chambers 8^2 of the expression actions r^2 , r^4 , and r^6 , whereby, when the shaft is turned it also presses said plates 105 and uncovers said openings 106, thus establishing communication of said chambers with the atmosphere. Thus the valves in said actions r^2 , r^4 and r^6 are elevated, and held in elevated position, as long as the hand operated device is in operation, thereby, through the passages v , preventing the forte pneumatic from being operated by the note sheet while the hand operated device is in use, and said hand operated device then can be manipulated by the player to

produce various changes of expression corresponding to his own idea or interpretation.

From the above description it will be apparent that by reason of the reciprocal action of the valve and the regulating air chamber or bellows, the valve tends to seek at all times during the operation of the instrument, some one of a number of mean positions, each representing a particular pressure in the regulating chamber and in the air passages leading to the tone producing actions.

The particular mean position which the valve seeks and thus the particular pressure maintained, is determined by the position of the expression air chamber or bellows, which in turn is controlled by the selective action of the expression actions, or by the manual operating device. This results in obtaining and retaining for the period desired any particular pressure in the regulating chamber and in the air passages referred to.

The relation between the valve, the regulating air chamber or bellows, and the expression air chamber or bellows is such that, the valve is moved to a degree equal to the resultant of the forces of the two air chambers referred to. The parts may be so arranged that the movement of the valve may be the resultant of the movement of the two chambers, though this is not necessarily the case. By resultant is meant the algebraic sum of the movements of the two chambers or other corresponding elements, giving to motion of either element tending to move the valve in one direction that + sign, and to motion of either element tending to move the valve in the other direction the - sign.

As already stated, the expression actions are connected directly with the main air chamber without the intervention of the regulating air chamber, while the tone producing actions are connected with the regulating air chamber and thus indirectly with the main air chamber. It follows that the expression air chamber is operated independently of the regulating air chamber, and that the expression air chamber makes effective immediately any selection by the expression actions.

Having thus fully described the nature of our invention, what we desire to secure by Letters Patent of the United States, is:—

1. In a musical instrument, the combination of striker pneumatics, a main source of power for actuating them, expression-controlling means arranged to control the degree of pressure at the striker pneumatics accordingly as such means are set, automatic actions for setting the expression-controlling means for high, low or intermediate pressure, and pressure-maintaining means operatively connected with the said expression-controlling means for maintaining substantial uniformity of that pressure for

which the said controlling means may at any time be set whatever number of striker pneumatics be simultaneously operated.

2. In a musical instrument, the combination of striker pneumatics, a main source of power for actuating them, means for controlling the air supply located between the said pneumatics and the main source of supply, a pneumatic in free communication with the striker pneumatics connected with and arranged to move the air controlling means to maintain substantial uniformity of pressure at the striker pneumatics whether many or few of these are simultaneously brought into operation, and operable at whatever pressure the said controlling means may be set to maintain, expression-controlling devices also operatively connected with the air-supply-controlling means arranged to change the position of the latter to vary the degree of pressure at the striker pneumatics accordingly as the expression-controlling devices are set, and automatic actions for setting the expression-controlling means.

3. In a musical instrument, striker pneumatics, a main source of power, a regulating motor intermediate the striker pneumatics and the main source of power, having means for automatically maintaining constant condition of action between the main source of power and the striker pneumatics including a valve in the connection between the regulating motor and the main source of power, and an automatically actuated device arranged in the connections of the valve for changing to any degree the operative effect of the main source of power upon the key pneumatics through the regulating motor.

4. In a musical instrument, striker pneumatics, a main source of power for actuating them, means for maintaining at the striker pneumatics uniformity of pressure from the main source of power, as the said pneumatics are operated, devices cooperating with the said pressure-maintaining means for varying the degree of pressure, whether high, low, or intermediate, which the said means will maintain, and automatic actions for setting said pressure varying means.

5. In a musical instrument, striker pneumatics, a main source of power for actuating the same, means for maintaining uniformity of pressure of the main source of power at high, low and various intermediate pressures with reference to the striker pneumatics, and means cooperating with the first named means for automatically varying such pressures at varying speeds.

6. In a musical instrument, striker pneumatics, a main source of power for actuating the same, a valve controlling the action of the main source of power upon the striker pneumatics and two automatically actuated

valve-operating devices for maintaining and producing numerous operative effects of the main source of power upon the striker pneumatics.

7. In a musical instrument, striker pneumatics, a main source of power, a regulating device for automatically maintaining predetermined pressures upon the striker pneumatics, and an automatically actuated device connected therewith for varying the operative effect of said automatic device and for producing and maintaining any predetermined degree of pressure of the main source of power upon the striker pneumatics.

8. In a musical instrument, striker pneumatics, a main bellows, a regulating bellows connected with the main bellows and the striker pneumatics, a valve situated in the passage between said main and regulating bellows so as to regulate the same, a flexible device connected with said valve and regulating bellows, a pulley over which said device runs, and means for adjusting said pulley to vary the action of the flexible device with respect to the valve.

9. In a musical instrument, pneumatic tone producing actions and expression actions, a main bellows, a regulating bellows in communication with said tone producing actions and main bellows, a valve arranged in the passage between said main and regulating bellows, said valve being connected with and moved by the regulating bellows, and an automatically adjustable device interposed in the connections for moving said valve, independently of or in conjunction with the regulating bellows, said automatically adjustable device controlled by said expression actions.

10. In a musical instrument, pneumatic tone producing actions and expression actions, a main bellows, a regulating bellows in communication with said tone producing actions and main bellows, a valve arranged in the passage between said main and regulating bellows and connected with said regulating bellows, and an expression bellows controlled by said expression actions and connected with said valve, and adapted to actuate the valve independently of its movement by the regulating bellows.

11. In a musical instrument, pneumatic tone producing actions and expression actions, a main bellows, a regulating bellows in communication with said tone producing actions and main bellows, a valve arranged in the passage between said main and regulating bellows and connected with said regulating bellows, an expression bellows having connection with said valve and ducts connecting different expression actions with said expression bellows, whereby the latter is controlled for various positions to vary the movement of the valve independently of its movement by the regulating bellows.

12. In a musical instrument, a main bellows, a regulating bellows, striker pneumatics connected therewith, a valve situated in the passage between the main and regulating bellows so as to regulate said passage, said valve being mechanically connected with the regulating bellows, an expression bellows mechanically connected with said valve interposed in the connection of the valve and regulating bellows, and automatic expression actions, acting upon the expression bellows and comprising compartments provided with actuating and releasing valves, one of said actions also provided with a chamber having a membrane dividing the same into spaces above and below said membrane, means connecting one of said spaces with the compartments of one of said actions, and means connecting the other of said spaces with the compartment of the other of said actions.

13. In a musical instrument, in combination, striker pneumatics, a regulating bellows in connection therewith, a main source of power connected with the regulating bellows, means intermediate the regulating bellows and the main source of power for maintaining a predetermined action of the main source of power upon the striker pneumatics, and automatic means in operative relation with the first named means for increasing and decreasing the operative effect of the main source of power and regulating bellows upon the striker pneumatics.

14. In a musical instrument, pneumatic tone producing actions, a main bellows, a regulating bellows in communication with said tone producing actions and main bellows, a valve arranged in the passage between said main and regulating bellows, a flexible means connecting said valve with said regulating bellows, a pulley over which said flexible means runs, means for adjusting said pulley, and means for holding the same in different positions of adjustment.

15. In a musical instrument, pneumatic tone producing actions, a main bellows, a regulating bellows in communication with said tone producing actions and main bellows, a valve arranged in the passage between said main and regulating bellows, a flexible means connecting said valve with said regulating bellows, an automatically actuated device over which said flexible means runs, means for automatically adjusting said device, and means for holding the same in different positions of adjustment.

16. In a musical instrument, pneumatic tone producing actions and expression actions, a main bellows, a regulating bellows communicating with said main bellows and tone producing actions, a valve arranged in the passage between said main and regulating bellows, means for connecting the valve to the regulating bellows, an expression bellows

controlled by said expression actions and connected with the last mentioned means, and stop devices for said expression bellows, said stop devices comprising a projection from said expression bellows, and a bellows connected with one of the expression actions and arranged contiguous to the expression bellows and having a stop to engage said projection.

17. In a musical instrument, pneumatic tone producing actions and expression actions, a main bellows, a regulating bellows communicating with said main bellows and tone producing actions, a regulating device arranged in the passage between said main and regulating bellows, means for connecting the regulating device to the regulating bellows, an expression bellows controlled by said expression actions and interconnected with the means connecting the regulating device and regulating bellows, and stop devices for said expression bellows, said stop devices comprising a supplemental bellows and interengaging parts between the expression bellows and supplemental bellows connected with one of the expression actions.

18. In a musical instrument, pneumatic tone producing actions, a main bellows, a regulating bellows, an expression bellows, a pulley connected with the expression bellows, a valve between the regulating bellows and the main bellows, and means extending over the pulley of the expression bellows and having one end secured to said valve and its other end connected with the regulating bellows.

19. In a musical instrument, pneumatic tone producing actions, a main bellows, a regulating bellows, an expression bellows, a movable device connected with the expression bellows, a valve between the regulating bellows and the main bellows, and means extending over the movable device of the expression bellows and attached at one end to said valve and at its other end connected with the regulating bellows.

20. In a musical instrument, key pneumatics, a main bellows, a regulating bellows in communication with said main bellows and key pneumatics, expression actions, an expression bellows controlled by said expression actions, a valve arranged between the main bellows and the regulating bellows, operating means for said valve including a connection from the valve to the regulating bellows whereby the former is operated by the latter, and a connection from the expression bellows to the valve whereby the latter may be operated by the expression bellows in conjunction with or independent of the operation of the regulating bellows, and stop devices for said expression bellows, comprising an auxiliary bellows controlled by one of said expression actions and interengaging projections on

said expression bellows and auxiliary bellows.

21. In a musical instrument, the combination of striker pneumatics, a main source of power for actuating them, means for maintaining uniformity of pressure from the said main source of power for actuating the striker pneumatics whether many or few of these be operated at once, a tracker board, automatic actions controlled from the tracker board, and means controlled by the said automatic actions, operatively connected with the said pressure-maintaining means for varying the degree of pressure supplied to the striker pneumatics.

22. In a musical instrument, in combination, striker pneumatics, a main source of power, a regulating bellows interposed between the striker pneumatics and main source of power, means including the regulating bellows for maintaining varying operative conditions of the main source of power with relation to the striker pneumatics, a music roll, and automatic means interconnected therewith and with the regulating bellows for controlling to various degrees the operative effect of the main source of power upon the striker pneumatics at any position of the regulating bellows.

23. In a musical instrument, in combination, striker pneumatics, a regulating bellows connected therewith, a main source of power connected with the striker pneumatics through the regulating bellows, a regulator intermediate the regulating bellows and main source of power and controlled in part by the regulating bellows for maintaining predetermined constant actions of the main source of power upon the striker pneumatics, and a mechanism automatically actuated by the main source of power and connected with the regulator for varying the operative effect of the main source of power to any degree and at varying positions of the regulating bellows, substantially as described.

24. In a musical instrument, in combination, striker pneumatics, an expansible bellows in connection therewith, means for exhausting the air from said bellows, means for expanding the bellows against the action of the exhaust, a wind-trunk connecting the bellows and the exhaust, a valve controlling said wind-trunk, connections inter-

mediate the bellows and valve for operating the valve, and automatic means actuated by the exhaust and interconnected with the means for controlling the valve for moving said valve during its control by the regulating bellows.

25. In a musical instrument, tone producing actions, a main air chamber, a regulating air chamber in communication with said tone producing actions and main air chamber, means governing the communication between said chambers and connected with said regulating chamber, an expression air chamber connected with said governing means, and means for increasing or decreasing the pressure in said expression chamber abruptly or gradually.

26. In a musical instrument, pneumatic tone producing actions, expression actions, a main air chamber, a regulating air chamber in communication with said tone producing actions and main air chamber, a valve governing the communication between said chambers and connected with said regulating chamber, an expression chamber to change the position of the valve, and ducts of different capacities connecting different expression actions with said expression chamber.

27. In a musical instrument, pneumatic tone producing actions, pneumatic expression actions, a main air chamber, a connection between the tone producing actions and the main air chamber, a valve governing the said connection, an expression bellows provided with an opening, means controlled by an expression action or actions for evacuating said expression bellows, and an auxiliary expression bellows connected to an expression action and controlling said opening to permit the sudden expansion of the expression bellows on the actuation of the said expression action.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

EDWIN WELTE.

KARL BOCKISCH.

Witnesses as to Edwin Welte:

JULIUS MULLUCK,

LAMBERT E. WALTHER.

Witnesses as to Karl Bockisch:

LUDWIG ZINBAL,

BENJAMIN F. LIEFELD.

E. WELTE & K. BOCKISCH.
 MECHANISM FOR REGULATING THE EXPRESSION IN APPARATUS FOR PLAYING MUSICAL
 INSTRUMENTS.

1,008,291.

APPLICATION FILED AUG. 17, 1904.

Patented Nov. 7, 1911.

3 SHEETS-SHEET 1.

Fig. 1

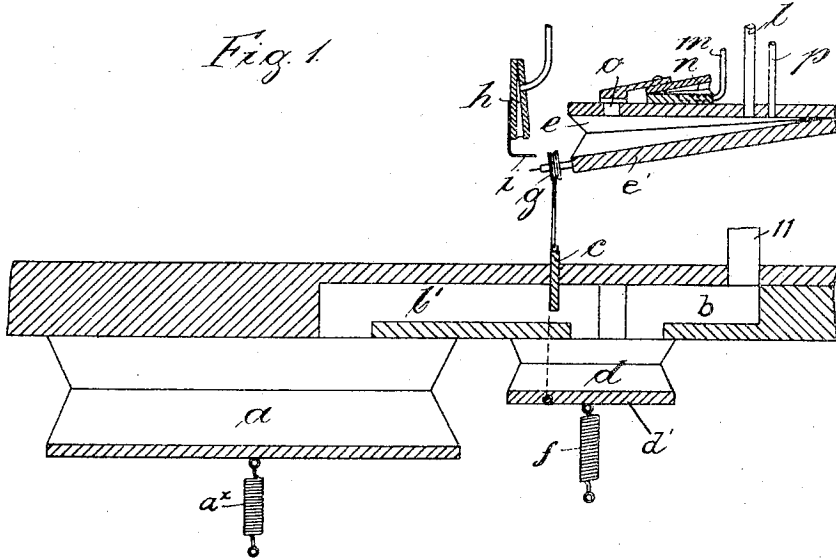
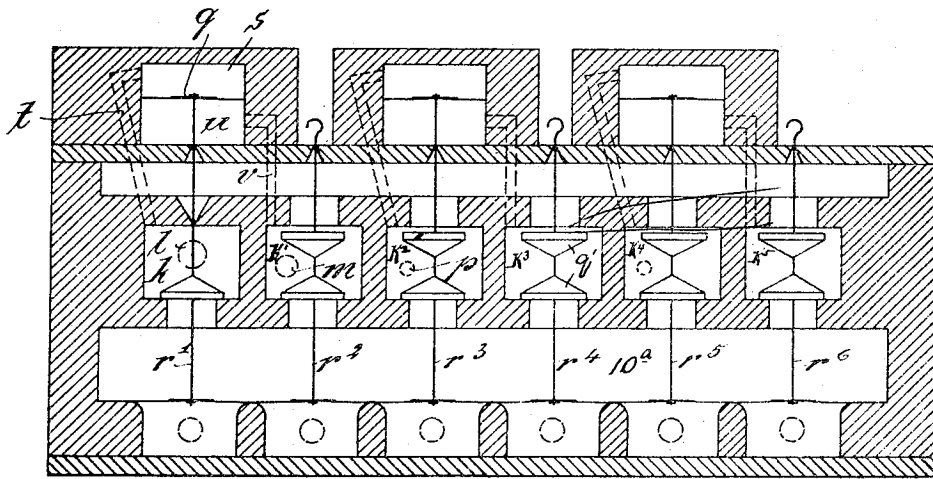


Fig. 2



Witnesses:

*Otto Scholz
 Paul Wollenberg*

Inventors

Edwin Welte and Karl Bockisch

*by Robert Kipley
 Attorney*

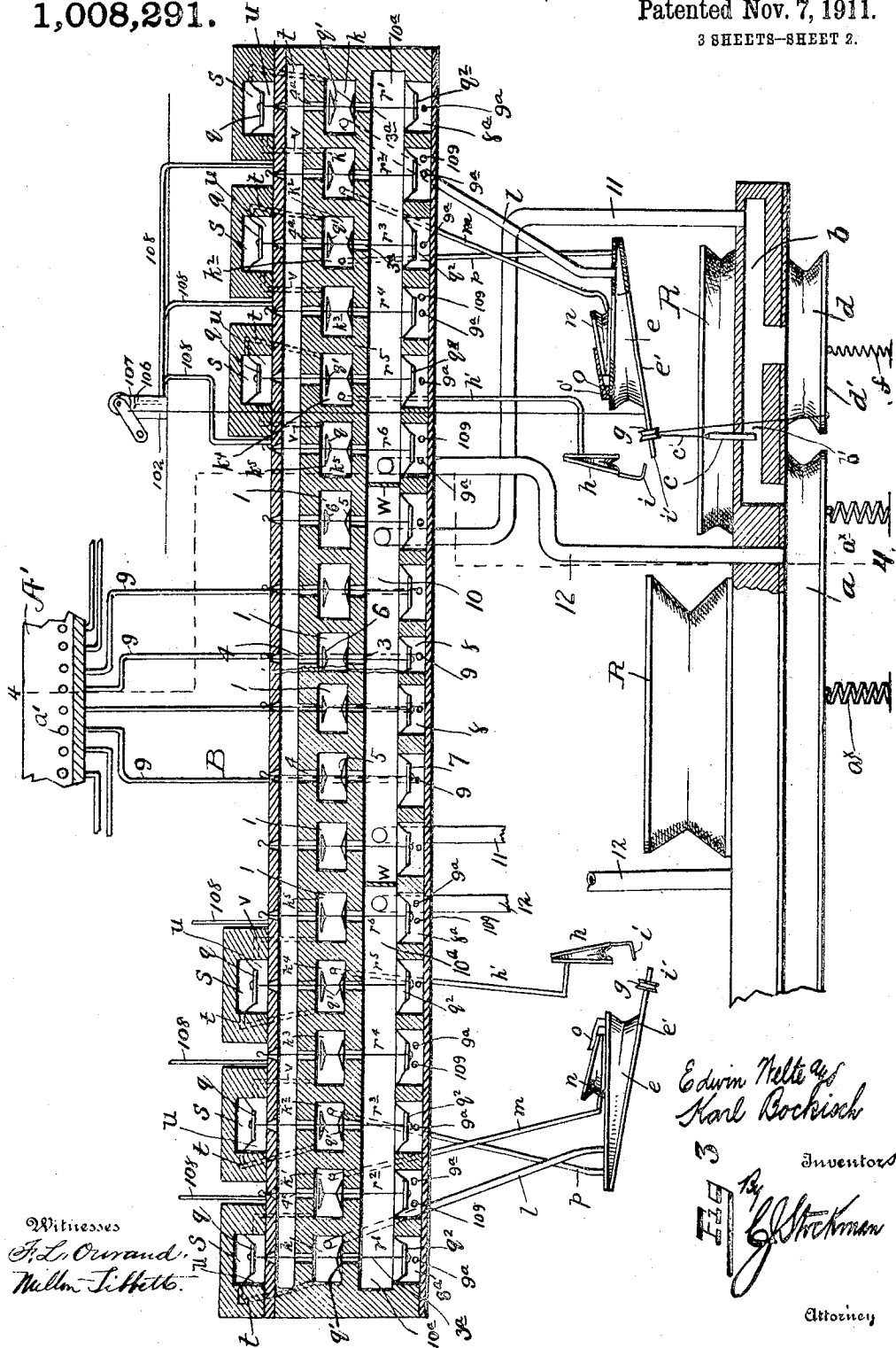
E. WELTE & K. BOCKISCH.
 MECHANISM FOR REGULATING THE EXPRESSION IN APPARATUS FOR PLAYING MUSICAL
 INSTRUMENTS.

APPLICATION FILED AUG. 17, 1904.

1,008,291.

Patented Nov. 7, 1911.

3 SHEETS—SHEET 2.



Witnesses
J. L. Orvand.
William Liffelle.

*Edwin Melle and
 Karl Bockisch*
 Inventors
E. W. Stockman
 Attorney

E. WELTE & K. BOCKISCH.
 MECHANISM FOR REGULATING THE EXPRESSION IN APPARATUS FOR PLAYING MUSICAL
 INSTRUMENTS.

APPLICATION FILED AUG. 17, 1904.

Patented Nov. 7, 1911.

3 SHEETS—SHEET 3.

1,008,291.

Fig. 4

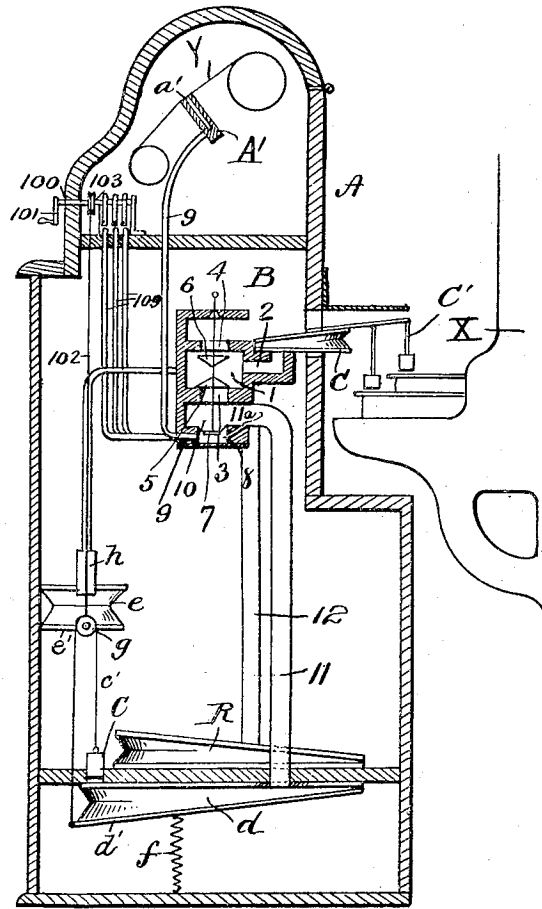
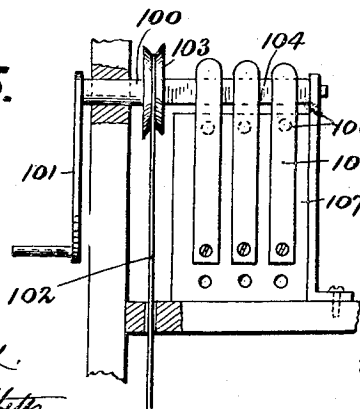
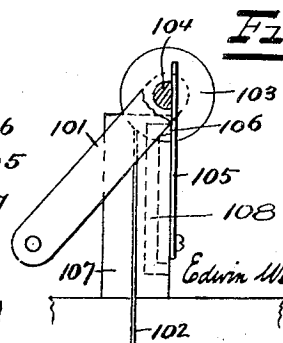


Fig. 5.



Witnesses
F. L. Ormand.
William Tibbets.

Fig. 6



Inventors
Edwin Welte *Karl Bockisch*

334

L. J. Strickman
 Attorney