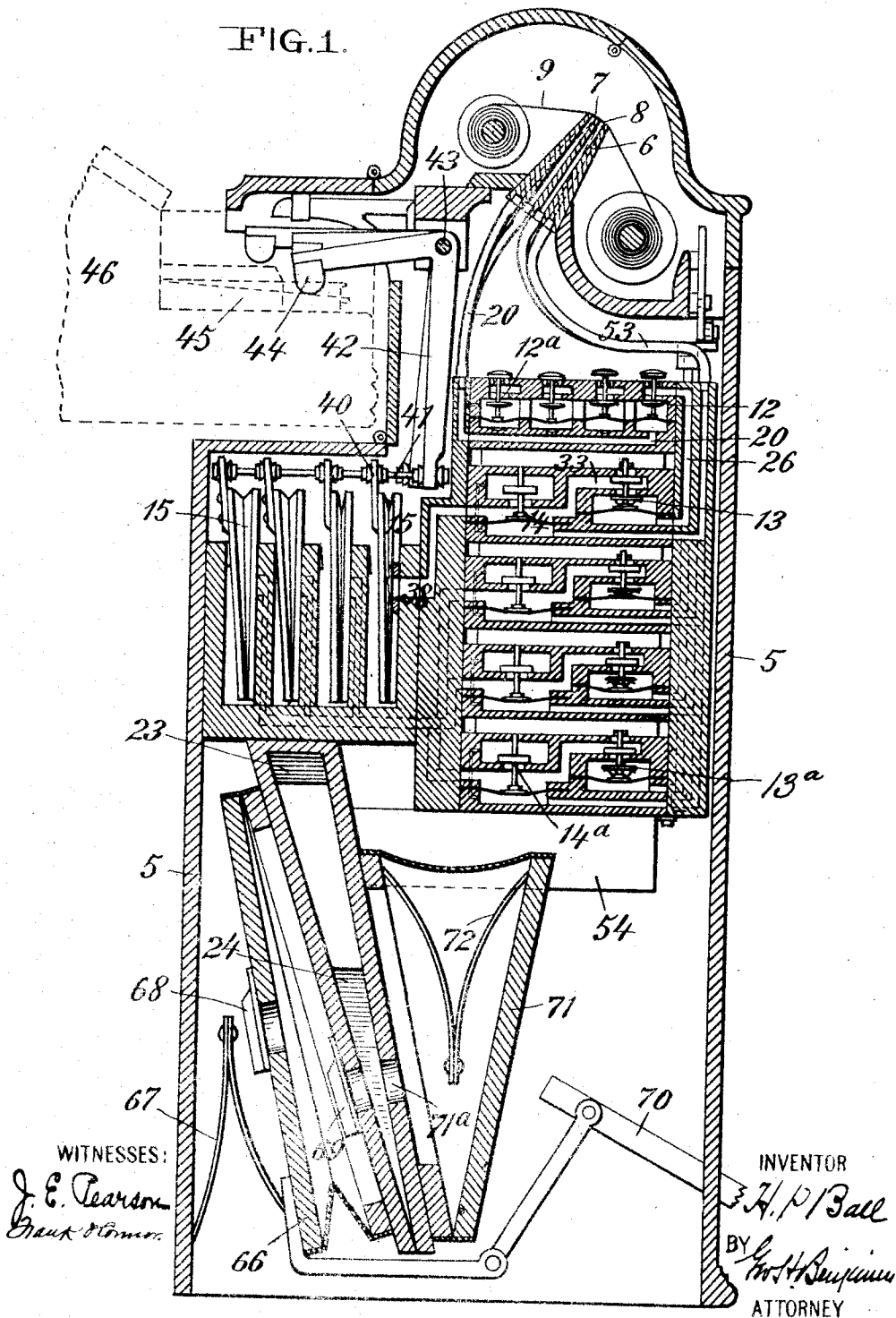


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4 SHEETS—SHEET 1.

FIG. 1.



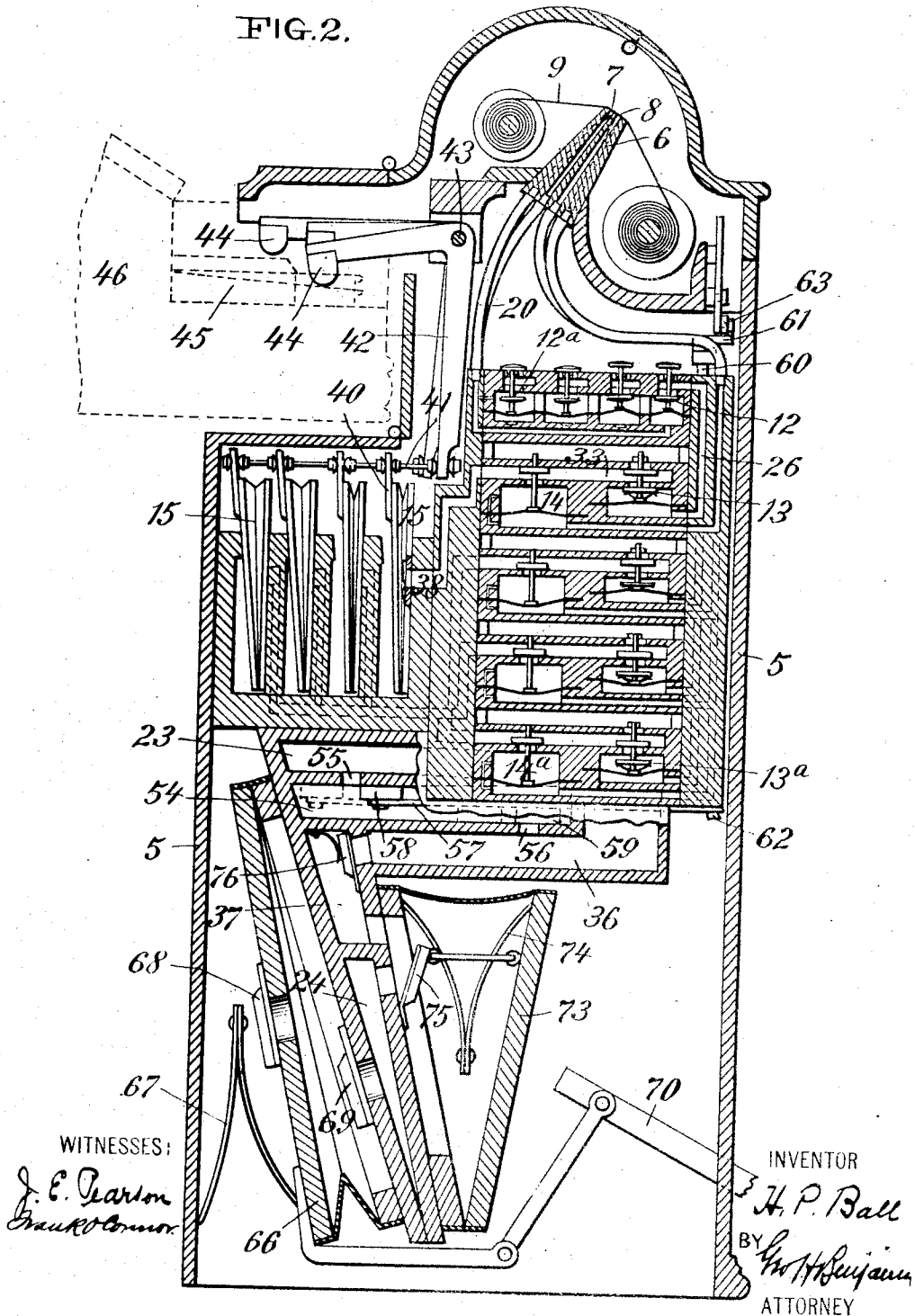
984,256.

H. P. BALL.
MECHANICAL MUSICAL INSTRUMENT.
APPLICATION FILED FEB. 20, 1903.

Patented Feb. 14, 1911.

4 SHEETS—SHEET 2.

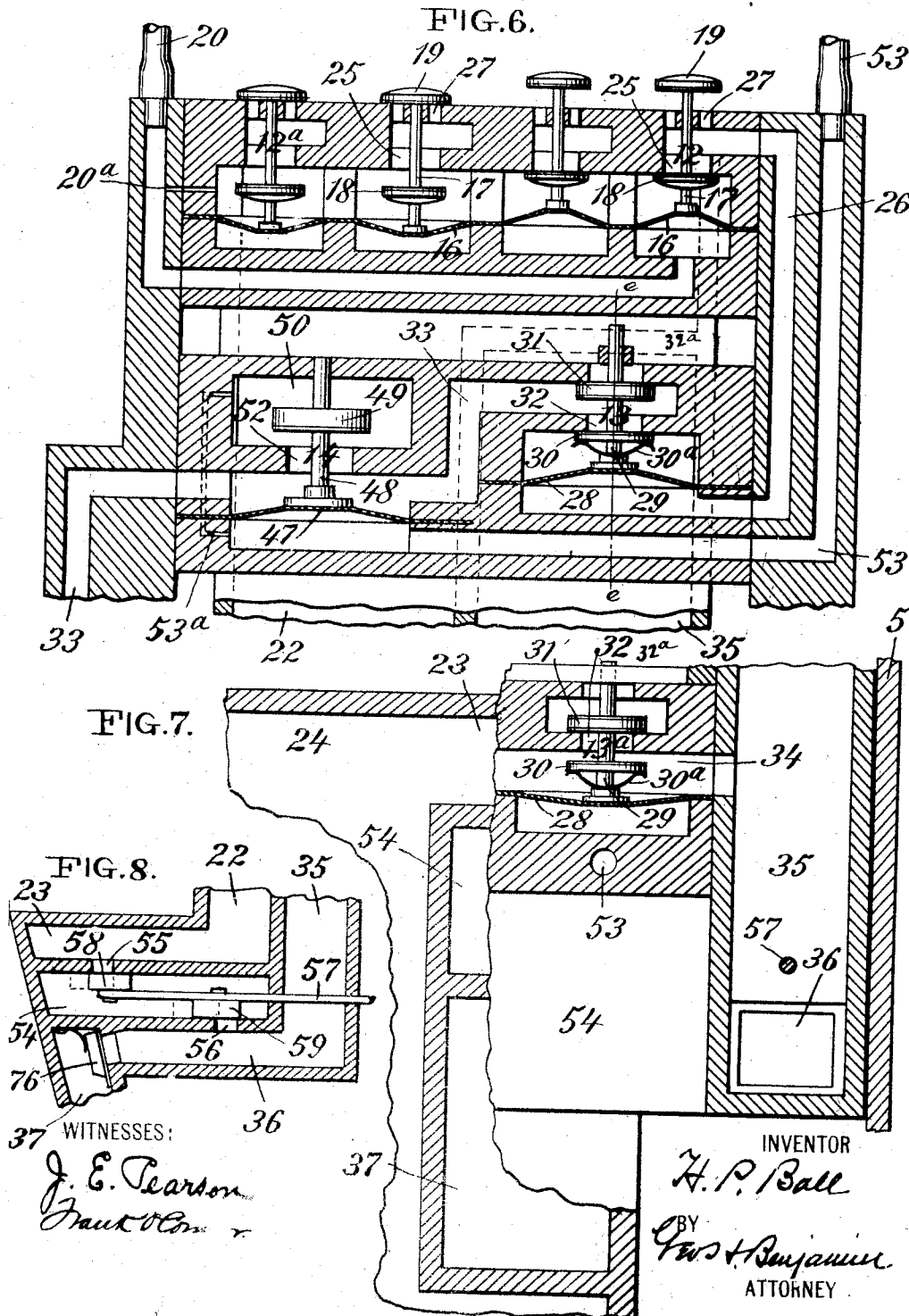
FIG. 2.



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Patented Feb. 14, 1911.

4 SHEETS—SHEET 4.



UNITED STATES PATENT OFFICE.

HENRY PRICE BALL, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO SAMUEL INSULL OF CHICAGO, ILLINOIS.

MECHANICAL MUSICAL INSTRUMENT.

984,256.

Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed February 20, 1903. Serial No. 144,259.

To all whom it may concern:

Be it known that I, HENRY PRICE BALL, a citizen of the United States, residing at New York city, county and State of New York, have invented certain new and useful Improvements in Mechanical Musical Instruments, of which the following is a specification.

My invention relates to mechanical musical instruments of the type employing perforated music rolls and adapted when used in connection with a piano, organ or other similar instrument, to produce upon said instrument the musical tones constituting a musical composition, and which are effected by a series of perforations in such music rolls.

Instruments of the above-mentioned type, so far as I am aware, have heretofore been so constructed that the personal acts of the operator are necessary to alter, change or modify the normal value, at any given moment, of the notes produced through the action of the instrument. For instance, by varying the rapidity of movement of the exhaust bellows, and thence the effective air pressure in the instrument, or by altering the position of a lever, thereby controlling by a valve the effective air pressure. Such means for altering the normal value of the notes have, in practice, been found unsatisfactory, owing to the fact that the operator cannot through such means control the value of individual notes which are immediately preceded or followed by other notes or any particular note, such as the theme or melody note, in a chord.

My invention has for its object to control the value of the individual notes produced, whether produced simultaneously with other notes or not, by controlling the effective air pressure through either automatic or manual means, or both. My invention, therefore, consists in the mechanism employed for controlling the effective air pressure exerted to produce the individual notes.

The general object of my invention is to perfect and increase the variety of musical results obtainable through the use of mechanical musical instruments such, for example, as accentuating the theme or melody notes or tones over and above the balance of the tones, or in other words, to subdue the accompaniments and accent the air.

The accompanying drawings will serve to

illustrate such a device as may be employed to carry my invention into effect. I wish it understood, however, that I do not limit myself to the particular mechanism shown, as it will be obvious that many other different forms of mechanism may be employed which will act in substantially the same manner to produce the same result.

In the device which I have shown in the drawings, the pneumatic mechanism employed is adapted to be operated by the pressure of the atmosphere, made effective through exhaust apparatus. I may, however, arrange the mechanism so that it will be operated by air under pressure.

Figure 1 is a vertical section of a mechanical musical instrument taken on the line *a-a* of Fig. 3. Fig. 2 shows two vertical sections taken respectively through the top and bottom of the instrument on the line *b-b* of Fig. 3, and also showing a modification of the arrangement of the pneumatics. Fig. 3 is a view showing the upper portion of the instrument in front elevation and the middle portion containing the pneumatics in four sections on the line *c-c* of Fig. 4. Fig. 4 is a plan view, and three horizontal sections taken on the line *d-d* of Fig. 3. Fig. 5 is a plan view of a portion of the music strip and the tip of the tracker-board. Fig. 6 is an enlarged view of the primary, secondary, and high pressure pneumatics, with intercommunicating ports and channels corresponding to Fig. 1. Fig. 7 is a section through the secondary pneumatic on the line *e-e* of Fig. 6. Fig. 8 is a detail sectional view showing the valves in the equalizing wind chest in a different position from that shown in Fig. 2.

In this specification I will describe the device and its operation so far as relates to the production of two notes of the same key; *i. e.*, a note having its normal value and a note accentuated or otherwise increased above the normal value. It will be understood that in the device the co-acting pneumatic mechanisms, with the exception of the bellows, is repeated for each note to be produced.

Referring to the drawings, 5 indicates the inclosing case of the instrument, which may be given any suitable shape. Located in the upper part of the instrument and in the usual position is a tracker board 6. This tracker board is provided with two series of

parallel tracker ducts 7, 8, with the ducts of the series 7 located to the rear of and intermediate of the series of ducts 8. For the purposes of description, the series of ducts 7 I will term the "note tracker ducts" and the series of ducts 8 the "modifying tracker ducts". I make this distinction in order to have it clearly understood that all the normal musical notes due to the action of the instrument are produced through the instrumentality of the tracker ducts 7 and that the tracker ducts 8 are not primarily note tracker ducts but co-act with the tracker ducts 7 to accentuate notes produced through the instrumentality of the tracker ducts 7.

It will be understood that the "note tracker-ducts" 7 may be used independently of the "modifying tracker-ducts" 8.

Arranged to move over the tracker board is a perforated music strip 9, Figs. 3 and 5. This strip is provided with two series of perforations arranged in alternate parallel zones longitudinally of the music strip; the perforations 10 or 10^a constituting one series and the perforations 11 the other series. The perforations 10, 10^a, I will term for the purposes of description the "note perforations" and the perforations 11 the "modifying perforations". The note perforations 10, 10^a, are arranged to register with "note tracker" ducts 7 and the modifying perforations 11 with the "modifying tracker" ducts 8.

It will be observed that the perforations 10, 11, bear the same relation to each other, so far as regards position, as the tracker ducts 7, 8, and that consequently when the music strip 9 moves over the tracker board in the direction of the arrow, indicated in Fig. 5, the beginning of perforations 10 and 11 will simultaneously be brought into relation with the tracker ducts 7, 8, and will act to produce an accented note; whereas, when the perforation 10^a moves over the tracker board there will be produced a note of normal value.

I will now describe the pneumatic mechanism which is thrown into action by the movement of the music strip over the tracker board and which serves to produce a note of normal value, or accentuated above normal in accordance with the perforations in the music strip.

Located below the tracker board are the pneumatics. There are four pneumatics for each note to be sounded, and these I term for purposes of description the "primary pneumatics" 12, the low pressure "secondary pneumatics" 13, the "high pressure pneumatics" 14, the "power pneumatics" 15. In the drawings, Figs. 1, 2, 3, four of each type of pneumatics are shown and in the drawings, Fig. 6, four primary, one secondary and one high pressure pneumatic are illustrated. The primary pneumatics 12 are

shown as located in air passages between the atmosphere and the secondary pneumatics 13. Corresponding primary pneumatics might also be located in the air passages between the atmosphere and the high pressure pneumatics 14, but such are not shown. I wish it understood, however, that they may be so used.

Each primary pneumatic 12 consists of a flexible dished diaphragm 16 secured at its edges in a suitable chamber and having mounted upon it a stem 17, carrying the valves 18, 19. The space below each diaphragm is connected through air passages 20 with the tracker ducts 7 in the tracker board 6, and the spaces above the diaphragm 16 are connected through air passages 21, 22, 23 (see Fig. 3) with the high pressure wind chest 24, Fig. 1.

The valves 18 control ports 25, leading from the chambers above the diaphragms 16 to the air passage 26, which communicates with the space below the diaphragms of the secondary pneumatics 13. The valve disks 19 control ports 27, leading from the passage 26 to the external air. The spaces above the diaphragms 16 are also connected through bleed holes 20^a, with the air passages 20, which bleed holes permit the air under the diaphragms 16 to be exhausted through the passages 20 into the spaces above the diaphragm and from thence through the high pressure wind chest 24, when the tracker-ducts 7 are closed to the atmosphere, thus equalizing a pressure above and below the diaphragm 16.

Each secondary pneumatic 13 consists of a flexible diaphragm 28, secured at its edges in a suitable chamber and having mounted upon it a stem 29, carrying the valves 30, 31. The valve 30 is yieldingly supported on the valve stem 29 by means of a spring 30^a, and controls port 32. The valve 31 controls the port 32^a. The spaces above the diaphragms 28 are connected through air-passages 34, 35, 36, Fig. 7, with a low pressure wind chest 37, Fig. 2. 33 is an air-passage leading from the secondary pneumatic 13, to the power pneumatic 15.

Each power pneumatic 15 consists, as is usual, of a vertically arranged bellows having one side fixed and the other side movable. Each power pneumatic 15 is provided with an arm 40, which coöperates with a horizontal rod 41, and bell-crank 42, pivoted at 43. To the lower side of the horizontal arm of the bell-crank lever is secured a flat cushion 44, which is located over a key 45 of a piano or other musical instrument 46. The keys and instrument are indicated in dotted lines Figs. 1 and 2.

The parts as described serve to produce a note of normal value, as follows: When a perforation 10 passes over a tracker-duct 7, air is allowed to enter under the diaphragm

16 of a primary pneumatic which primary pneumatic, at such time, occupies the position shown at 12^a at the left of Fig. 6, and at such time the air in the space above the diaphragm 16 is exhausted under the action of the high pressure wind chest 24. The pressure of the atmosphere under the diaphragm 16 causes the diaphragm 16 to be moved upward or "explode" to the position shown at 12 on the right of Fig. 6, thereby lifting the valves 18, 19, closing port 25, and opening port 27. The opening of the port 27 allows air at the pressure of the atmosphere to enter under the diaphragm 28 of a secondary pneumatic 13, which at such time occupies the position indicated at 13^a Fig. 7. The air above the diaphragm 28 at such time is exhausted under the action of the low pressure wind chest 37. The pressure of the atmosphere under the diaphragm 28 causes such diaphragm, and with it the valves 30, 31, as shown at 13, Fig. 6, to move upward thereby closing ports 32, 32^a. When, however, the valve occupies the position shown at 13, Fig. 6, both ports are closed by their valves, but if the pressure above the disk 30 is such as to overcome the spring 30^a, the disk 30 yields for the passage of air from the power pneumatic through the passages 33, 34 and 35 to the low tension wind chest 37. This action permits the low pressure wind chest 37 to exhaust the air through the port 38 and passage 33 from in front of the bellows of the power pneumatic 15, thereby permitting the pressure of the atmosphere on the outside of the bellows to collapse the bellows moving a rod 41 and through it a bell crank lever 42, thereby causing the cushion 44 on the horizontal end of the bell crank to strike a key of the piano and produce a note. It will be observed that the blow imparted by the bell crank will be dependent upon the degree of exhaustion of air from in front of the bellows 15 through low pressure wind chest 37, and, assuming that such degree of exhaustion is uniform under normal conditions, it is evident that the blows imparted by each of the bell cranks to the keys will be uniform.

I will now describe how a note may be accented: Each high pressure pneumatic 14 consists of a flexible diaphragm 47, secured at its edges in a suitable chamber and having mounted upon it a stem 48 carrying a valve 49, which moves within a chamber 50, and controls a port 52. The interior of these chambers is connected through passages 51, 23, 22, Fig. 3, with the high pressure wind chest 24. The space below the diaphragm 47 is connected through the passage 53 with a modifying tracker-duct 8, and the space above the diaphragm forms part of the air passage 33. Each chamber 50 is connected with the space below its diaphragm 47, by a bleed hole 53^a, which

bleed hole permits the air under the diaphragm 47 and in the passage 53, to be drawn under the action of the high pressure wind chest 24, through the chamber 50, when the tracker ducts 8 are closed to the atmosphere, thus equalizing the pressure above and below the diaphragm 47, or in other words, rendering the diaphragm 47 and valve 49 inactive at such time. Assuming now that a music strip having perforations 10, 11, is moved over tracker board having ducts 7, 8, all as arranged in Fig. 5, the operation would be as follows: Air at the pressure of atmosphere would be admitted to the air passages 20, 53. The operation of the high pressure pneumatic 12 and low pressure pneumatic 13 will at such time be as previously described, and at the same time the pressure of the atmosphere admitted through duct 53 will act upon the under side of the diaphragm 47 of the high pressure pneumatic 14, the air in the chamber 50 above the diaphragm being at such time exhausted through the high pressure wind chest 24. The diaphragm 47 will therefore be lifted and will raise valve 49 and open port 52, thereby subjecting the inside of the bellows 15 to the exhaust from the high pressure wind chest 24, acting through the chamber 50 and air passages 51, 22, 23.

It will be observed by reference to Figs. 3 and 5 that the perforations 10, 11, are adapted to register with the tracker ducts 7, 8, at the same moment, consequently a primary pneumatic 12, secondary pneumatic 13, a high pressure pneumatic 14, and a power pneumatic 15, will be actuated at approximately the same moment, and such power pneumatic will be subjected to an exhaust action represented by the difference between the pressure of the atmosphere and the exhaust from the high pressure wind chest, or in other words, the power pneumatic will at such time be subjected to the exhaust from the high pressure wind chest, instead of that from the low pressure wind chest, thus the note struck upon the piano will be accented over notes operated by the low pressure exhaust. At such time the valve 30 of the secondary pneumatic 13 will close the port 32, as the pressure to which it is subjected on its upper side by the exhaust from the high pressure wind chest 34, will be less than that to which it is subjected on its lower side from the low pressure wind chest 37.

The mechanism so far as described had related wholly to the automatic means employed for sounding a normal note and an accented note. I will now describe means which may be manually operated to modify a note.

Referring to Figs. 2 and 8: There is shown as located between the air passages 23, 36, a wind chest 54, and which I term the equal-

izing wind chest, in that it is employed to limit the volume of high pressure exhausted air which is thrown at any time into the low pressure wind chest, and aids in maintaining a constant difference between the high and low pressure wind chests. This wind chest 54 is connected with the high pressure wind chest, through a port 55, and with the low pressure wind chest, through a port 56.

Arranged to be reciprocated in the wind chest 54, is a rod 57, and mounted upon this rod are valves 58, 59. The valve 58 controls the port 55, and the valve 59 the port 56. In order to reciprocate the rod 57, I make use of the vertical rod 60, the upper and lower ends of which are provided with crank arms 61, 62; the crank 62 is connected to the rod 57, and the crank 61 to a horizontal rod 63, pivotally connected to hand-lever 64, pivoted at 65, to the front of the instrument.

By moving the hand-lever 64 in the arc of a circle, the rod 57 will be reciprocated and the valves 58, 59, caused to move over the ports 55, 56, opening and closing them in any degree required, and thus permitting the pressure in the respective wind chests to be varied; as for instance, increasing the exhaust in the low pressure wind chest 37 and decreasing the exhaust in the high pressure wind chest 24. Of course, it will be understood, that by varying the pressure in the wind chests 23, 36, the force exerted by a power pneumatic 15 upon a key 45 will be altered in proportion to the variation in exhaust pressure.

For example, if it is desired to play an accompaniment very softly and the melody simultaneously therewith, but louder, the lever 64 is adjusted to shift the valve 59, to the position shown in full lines either Figs. 2 or 8, to close the port 56. This throws all of the power pneumatics 15, which respond to the accompaniment perforations 10^a, on the low pressure wind chest 37, causing them when actuated to collapse with little force and impart a correspondingly light touch to the key operating levers. The melody notes which respond to the perforations 10, 11, however, are thrown onto the high pressure wind chest 24 and are in consequence produced with an intensity proportional to the pressure produced by the performer in exhausting the high pressure wind chest 24, and this being under his control through the foot pedals 70, may be varied as desired.

Notes produced by the perforations 10, accompanied by accenting perforations 11, are sounded with increased intensity, as above described, but it will be observed that by a full opening of both ports 55 and 56 as indicated by dotted lines in Fig. 2, all notes, that is, both the accented and unaccented, will be sounded with maximum intensity. Of course it is to be borne in mind that, when high tension is applied to chamber 36, the check valve 76 prevents the low tension

bellows 73 from having communication with the chamber 36, since at this time the tension in this chamber is much greater than that in the rear of the valve 76. A forward or right hand movement of the rod 57 from the position shown in Fig. 8 opens the port 55 without opening the port 56, and the tension in the intermediate chamber 54 is made equal to that in the high tension chamber 23, so that a backward movement of the arm 57 will close the port 55 and open the port 56, so that high tension, commensurate alone to the cubic contents of chamber 54, may act effectively upon chamber 36. This may be accomplished without reopening the port 55, so that in effect momentary high tension is applied to the passages 36, 35, etc., until the tension in the intermediate chamber 54 has been reduced by the operation of pneumatics. In this operation, the check valve 76 prevents the interference of the large low pressure bellows 73 with the momentary change in tension by the manipulation of the valve 59 to open port 56. In a word, the intermediate chamber 54 may be described as acting in this operation as a vacuum pocket, causing a sort of a jerk upon the air in what are normally low pressure passages.

It now only remains for me to describe how the high and low pressure exhausts are obtained.

Mounted on the back of the high and low pressure wind chests is the bellows 66, normally maintained in a collapsed condition by means of the springs 67. This bellows, there may be two, is provided on its movable face with the outwardly opening valve 68, and is connected to the high pressure wind chest through the outwardly opening valve 69. This (or these) bellows are adapted to be actuated by means of the foot treadles 70, in the usual manner. Mounted on the front of the high pressure wind chest is a high pressure bellows 71, Fig. 1, containing spring 72, and a low pressure bellows 73, Fig. 2, containing spring 74. The springs of the respective bellows, as is usual, are of different strengths.

75 indicates a valve in the low pressure bellows 73, which is closed to the high pressure wind chest 24 when the bellows is collapsed. The low pressure bellows is connected to the wind chest 37 and thence through the air passage 36 to the upper part of the instrument. Situated between these passages is a valve 76, which serves to prevent the exhaust in the high pressure wind chest from acting upon the exhaust in the low pressure bellows as will be readily understood.

The valve 76 serves to prevent the high pressure exhaust from acting upon the exhaust in the low pressure chest, bellows, etc., in the following manner: When the valves

58 and 59 of the equalizing wind chest 54 are adjusted to the position indicated by dotted lines in Fig. 2, the volume of high pressure exhaust which is thus thrown in is effective within the passages 35 and 36, but not within the chest 37 as communication between these passages and the low pressure chest 37 is closed by the valve 76. This valve therefore, serves to maintain the pressure in the low pressure chest 37, while at the same time permitting the high pressure exhaust volume of chest 24, to be thrown in at will to accent or modify one or more notes. The valve 76, acts in a similar manner, when the valves 58 and 59 of the equalizing chest 54 are adjusted as indicated in dotted lines in Fig. 2 to throw the high pressure wind chest 24, into communication with the secondary pneumatics 13. Such high pressure exhaust becomes effective throughout the passages 35 and 36 but not within the low pressure wind chest 37, by reason of the action of valve 76, in closing the communicating passage.

It will be seen that in shifting the valves 58, 59, from the position shown in full lines in Fig. 8, to that shown in dotted lines, the port 55, between the equalizing chest and the high pressure chest, continues closed, but the port 56, to the low pressure chest is opened. As the equalizing chest is comparatively small, the amount of exhaust volume represented by its capacity which may be thus suddenly thrown into the low pressure chest 36, at the will of the operator, is therefore limited and the resulting action produces only a momentary effect, such for example, as might be required in accenting a single note or chord. On the other hand, by a light pumping action on the pedals, the low pressure equalizing bellows may be caused to open the valve 75, and equalize the pressure in the high and low pressure wind chests, thereby sounding all notes very softly whether accented or not, as the high pressure chest has, at that time, a low degree of exhaustion. It will therefore be seen that a complete range of expression is obtained without being limited in any manner whatever, and it is entirely within the control of the operator to produce just the effects which he desires.

In Fig. 2 I have shown a slight modification of the ports and air passages between the pneumatics. Such modification consists in rearranging the passage 38, so that it extends in the plane of and includes the valves 31 and 49 of both pneumatics 13 and 14, and is merely intended to show that such modification can be made. The result is the same although the method of operation of the parts is slightly different.

I wish it understood that I do not limit myself to the mechanism shown for creating the high and low pressure exhaust, or other

detail arrangement of parts as many other means may be employed.

Having thus described my invention, I claim:

1. A mechanical musical instrument comprising a tracker-board having two series of tracker-ducts corresponding in number, means for producing notes of the normal value including as a part thereof a low pressure exhaust, connected to one series of ducts, means for accentuating notes produced including as a part thereof a high pressure exhaust, connected to the other series of ducts, and an intermediate means between the two exhausts for varying the value of said exhausts.

2. A mechanical musical instrument comprising a tracker-board having two series of ducts arranged in staggered relation and corresponding in number, a series of primary pneumatics, a series of secondary pneumatics, said pneumatics each having two valves, one fixed and the other spring-supported relative to the pneumatic, a series of power pneumatics, exhaust apparatus, and ports and passages between the respective parts.

3. A mechanical musical instrument of the class described comprising sound producing devices, a source of high exhaust energy and a source of low exhaust energy, passages connecting said sound producing devices and sources of energy, and means controlling the application of said energy to said devices, comprising a pneumatic for controlling communication between one of said passages and said source of high exhaust energy and a pneumatic having a valve adapted to yieldingly close communication between said passage and said source of low exhaust energy.

4. A mechanical musical instrument having its tone producing devices subject to two sources of energy, and having a spring seated valve for controlling one of said sources of energy, a pneumatic for actuating said valve, said valve being capable of operation independently of said pneumatic.

5. In a mechanical musical instrument, and in combination with the key-striking mechanism and controlling pneumatics, a high pressure wind chest, a low pressure wind chest, an intermediate wind chest, independent of said high and low pressure chests together with valve mechanism for controlling the introduction of air into the intermediate wind chest and from the intermediate chest to the high pressure chest.

6. A mechanical musical instrument comprising tone producing devices, a high exhaust chamber, a low exhaust chamber, and a transfer channel; means whereby said channel can be placed in communication with said high exhaust chamber thereby causing said channel to be highly exhausted,

means whereby said highly exhausted channel can be shut off from said high exhaust chamber, and means whereby said highly exhausted channel can be placed in communication with said low exhaust chamber whereby the exhaust in said low exhaust chamber is increased by transfer of exhaust from said high exhaust chamber.

7. In a mechanical musical instrument, and in combination with the tone producing devices and controlling pneumatics; a source of high exhaust energy, a transfer compartment, and a manually operated valve for establishing communication between said source of high exhaust energy and said transfer compartment, a source of low exhaust energy, a low exhaust compartment, and an automatic valve between said source of low exhaust and said low exhaust compartment; and means under control of the operator for shutting off said transfer compartment from said source of high exhaust energy and for establishing communication between said transfer compartment and said low exhaust compartment, said automatic valve serving to shut off communication with said source of low exhaust energy, whereby the exhaust is increased in said low exhaust compartment by high exhaust in said transfer compartment.

8. A mechanical musical instrument comprising tone producing devices, a source of energy, means connected to said source of energy for producing a high pressure exhaust, selective means coacting with said means for producing theme notes, means connected to said source of energy for producing a low pressure exhaust, selective means coacting with said last named means for producing accompaniment notes, an independent equalizing chamber and means for varying the respective value of said exhausts.

9. In a mechanical musical instrument and in combination with the key striking mechanism and controlling pneumatics, a high pressure exhaust chest, a low pressure exhaust chest having two compartments, a communicating chamber between said chests, hand controlled valves in said chamber for placing said high pressure chest into communication with one of the compartments of said low pressure chest independent of the other compartment.

In testimony whereof, I affix my signature, in the presence of two witnesses.

HENRY PRICE BALL.

Witnesses:

LOUIS WINTNER,
NICOLAI AALL.