

[54] **AUTOMATIC PLAYER FOR MUSICAL INSTRUMENTS**

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[51] Int. Cl. .... **G10f 1/02**

[58] Field of Search ..... **84/17-23, 123, 84/147, 160**

[56] **References Cited**

**UNITED STATES PATENTS**

1,073,792	9/1913	Buechner et al. ....	84/160
1,078,133	11/1913	Dorricott .....	84/160
1,324,453	12/1919	Klugh .....	84/123
1,648,840	11/1927	Clark .....	84/123
3,117,481	1/1964	Cushing .....	84/19

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[57] **ABSTRACT**

An automatic musical instrument, such as a player piano, having a tracker with openings over which a music roll, having apertures corresponding to music notes, is fed by operation of pneumatic or electric

motor means, and hammers and hammer jacks operable to sound the musical notes, is provided with an elongated box having a pair of opposed thickened walls and forming a vacuum chamber, evacuating means for the chamber, a plurality of cavities formed in the thickened walls, one for each note to be played, said cavities being closed by diaphragms, a small vent passage communicating each cavity with the interior of the vacuum chamber, a separate air passage, preferably within the thickened walls, communicating each cavity with a respective opening in the tracker, a weak spring in each of said cavities biasing its diaphragm outwardly but allowing movement of the diaphragm inwardly of the cavity when the vacuum chamber is evacuated, and a pair of electric contact members for each cavity mounted on one of said thickened walls and having one contact member engaging the diaphragm so as to make or break contact between the pairs of members when the diaphragm moves from a position inwardly of the cavity to a distended position outwardly of the cavity, a solenoid associated with each cavity and diaphragm and having a plunger arranged to lift a respective one of the hammer jacks, and electric circuit means connecting the pairs of contact members, the solenoids and a source of electric power in such manner that each of the pairs of contacts serves to energize and de-energize one of the solenoids.

**11 Claims, 10 Drawing Figures**

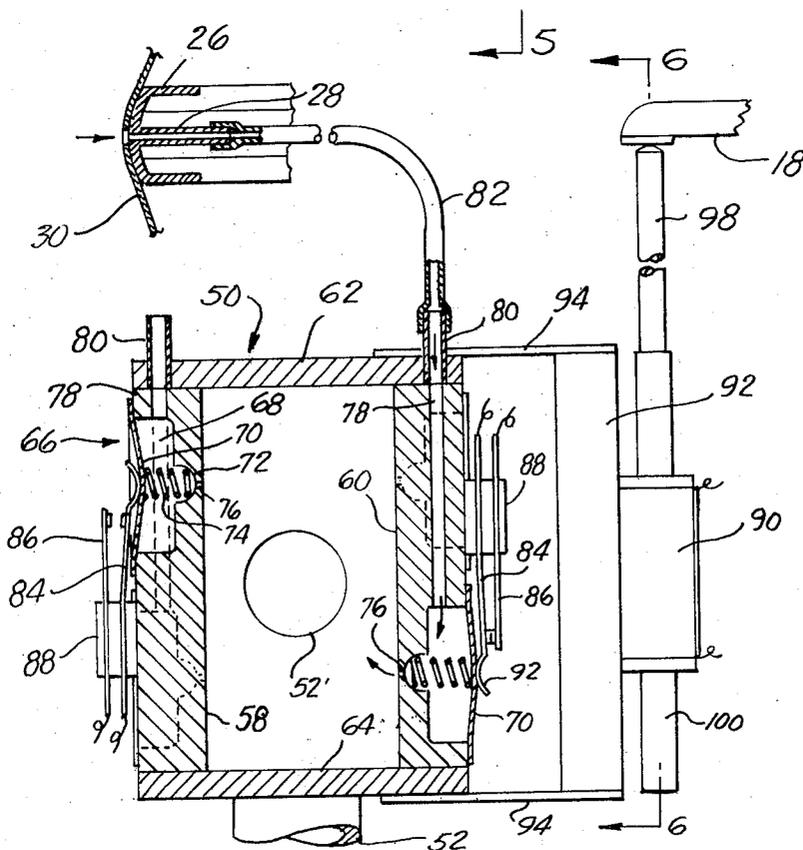


FIG. 1.

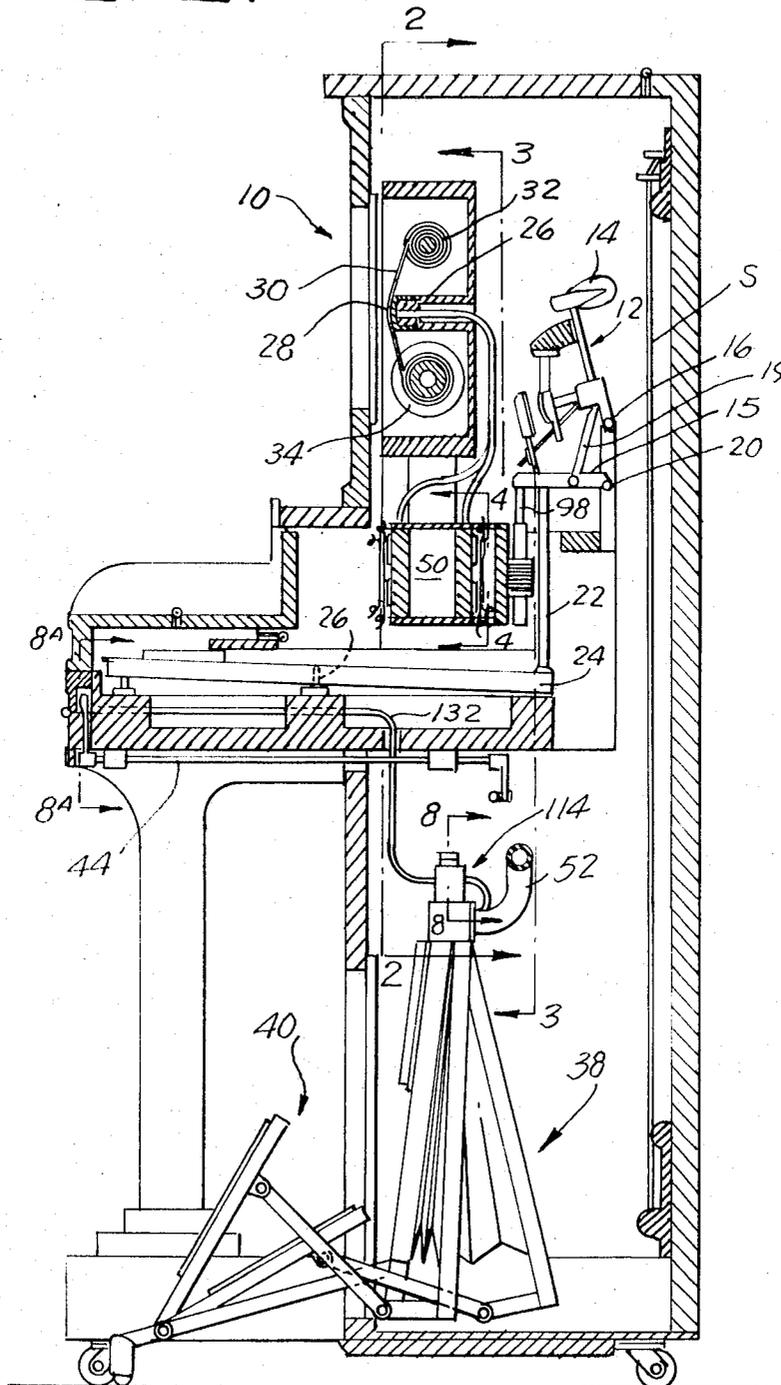


FIG. 2.

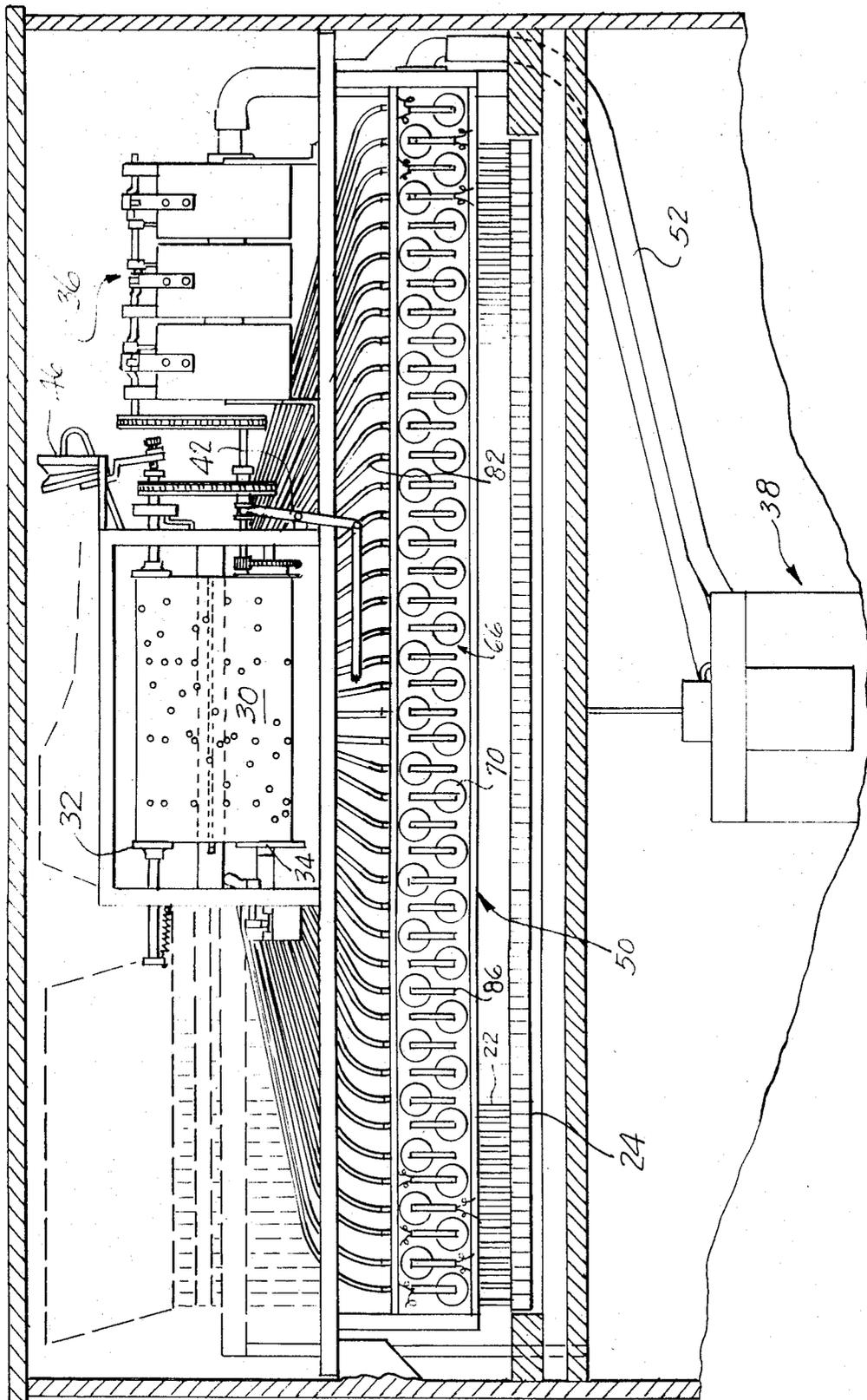


FIG. 3.

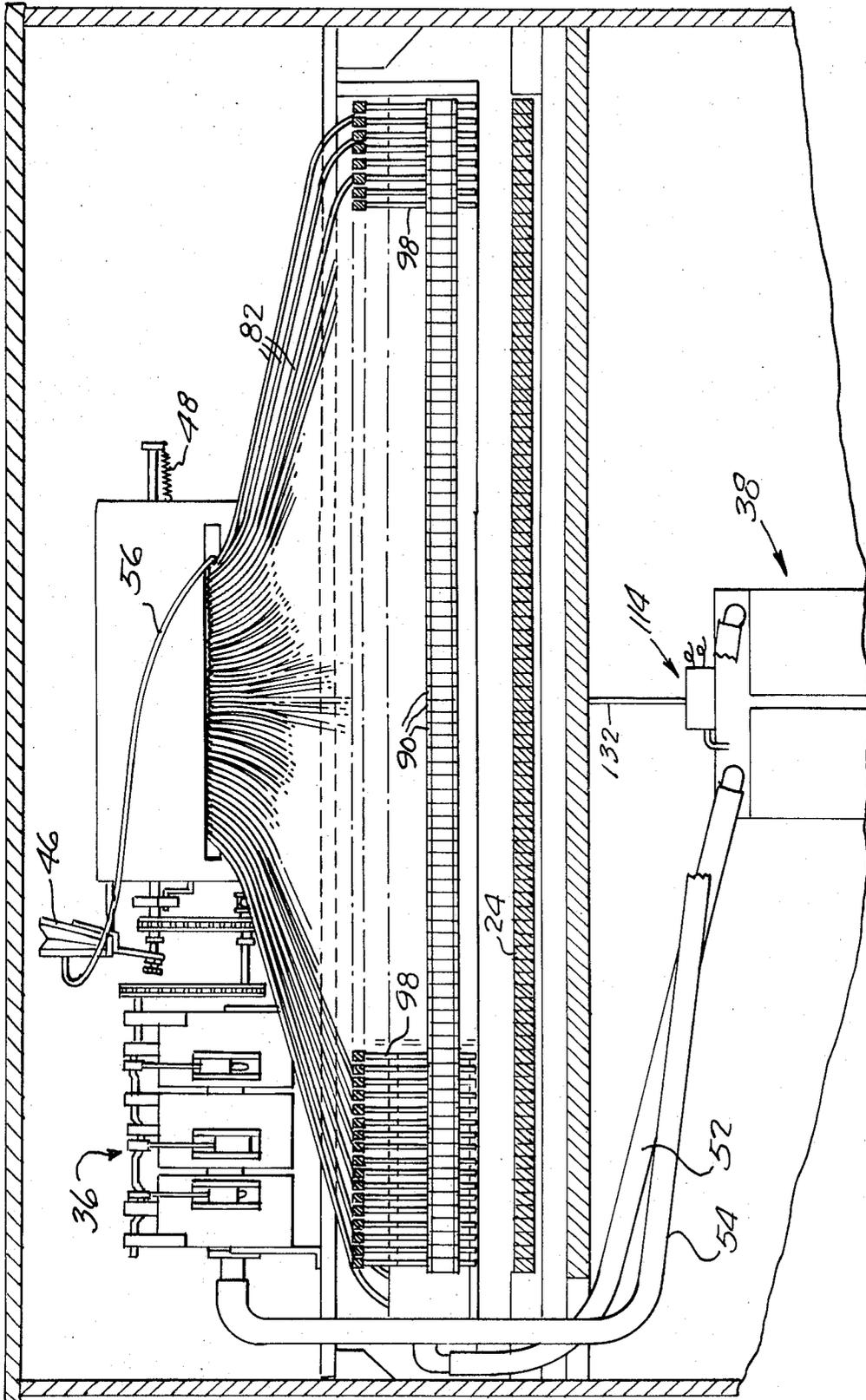


FIG. 4.

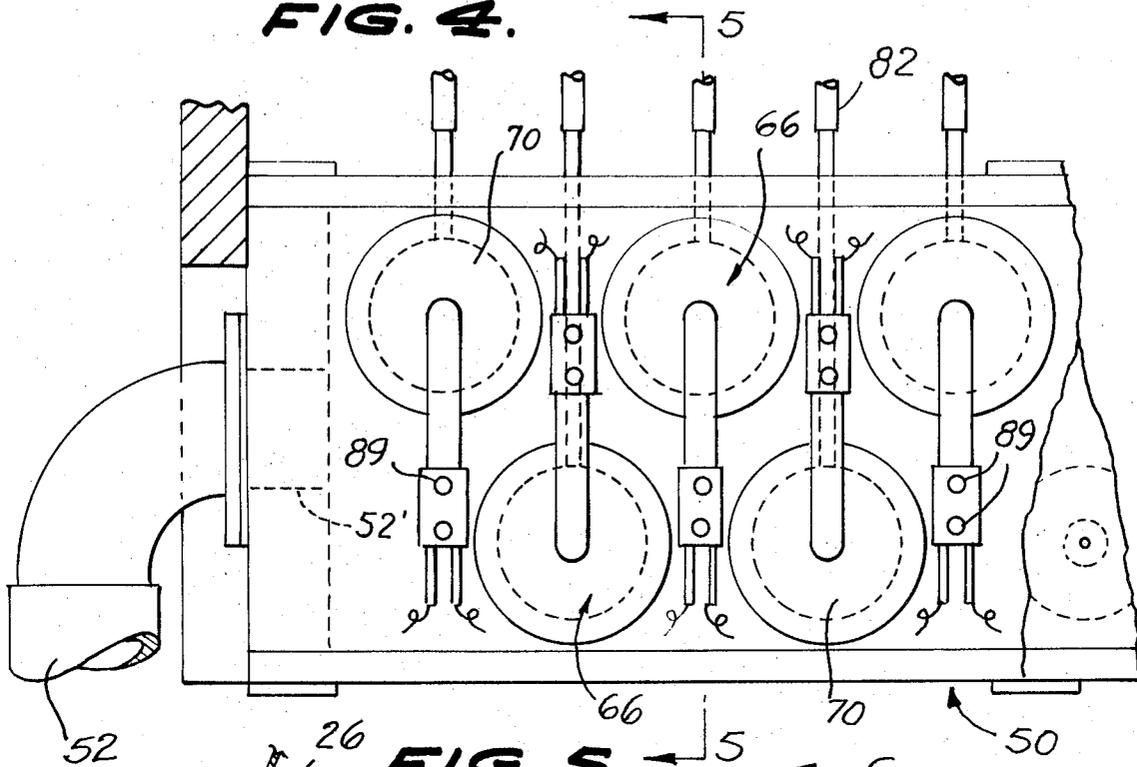
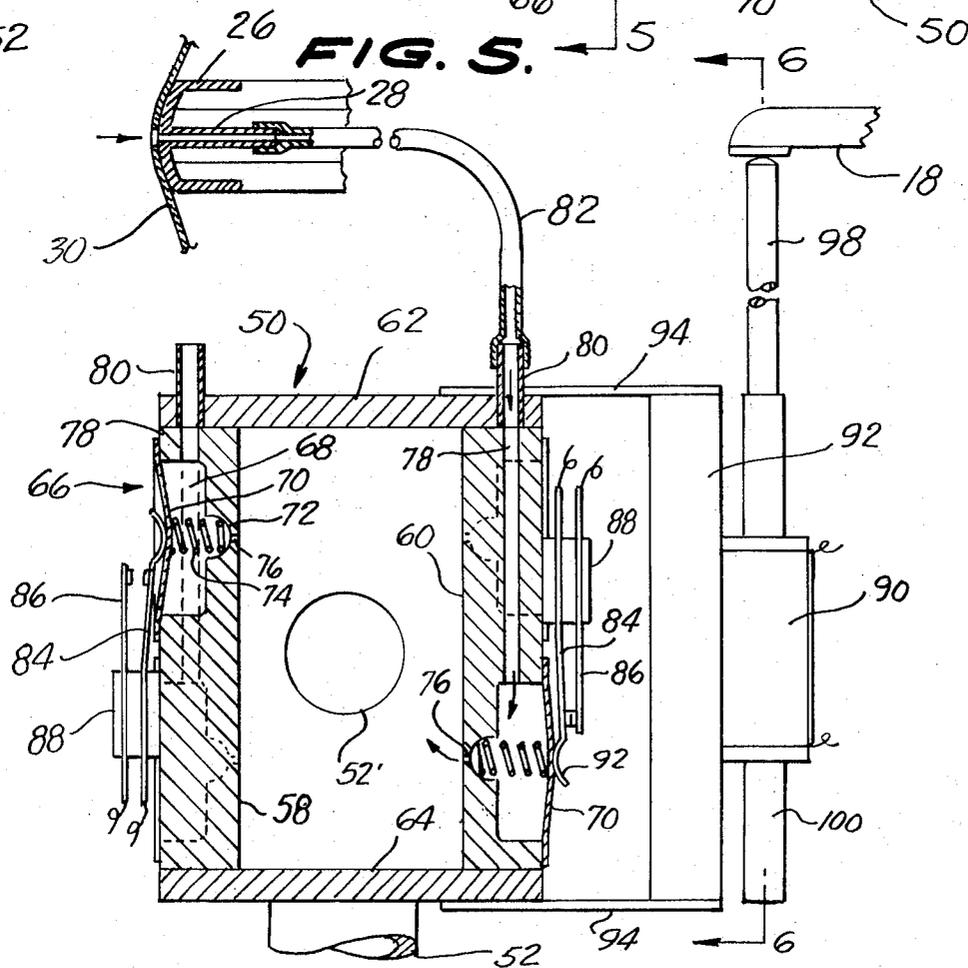
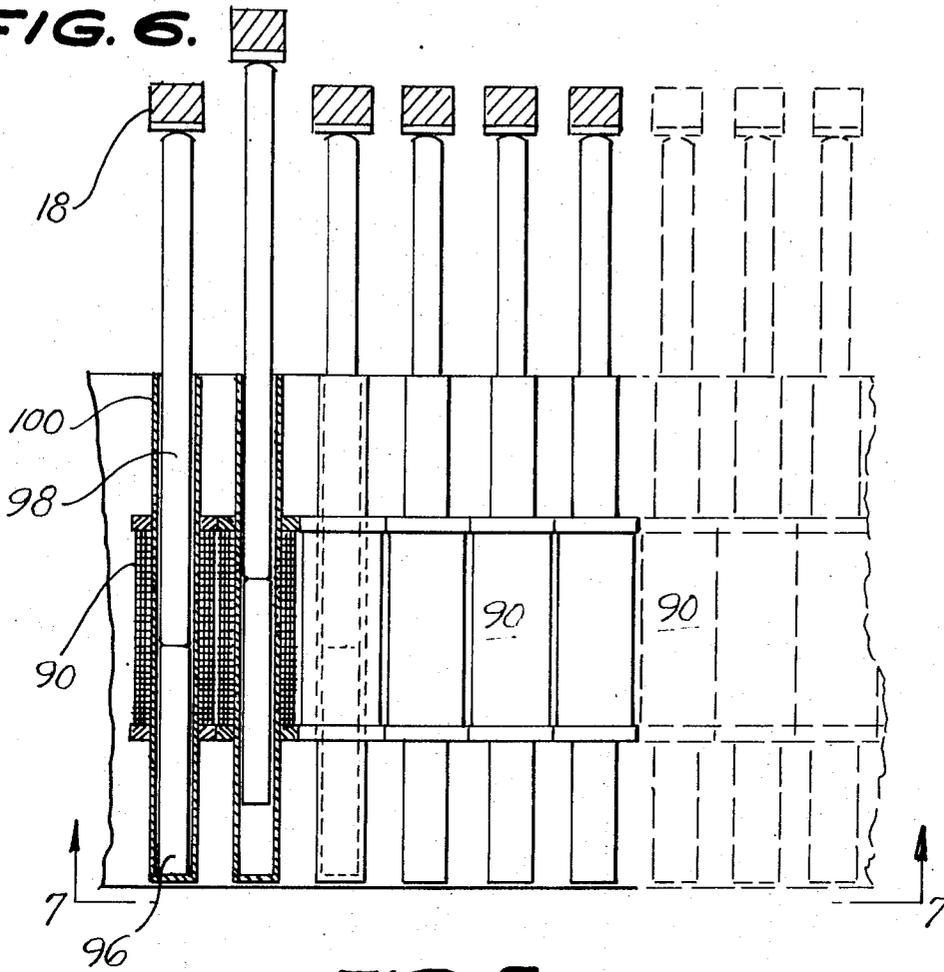


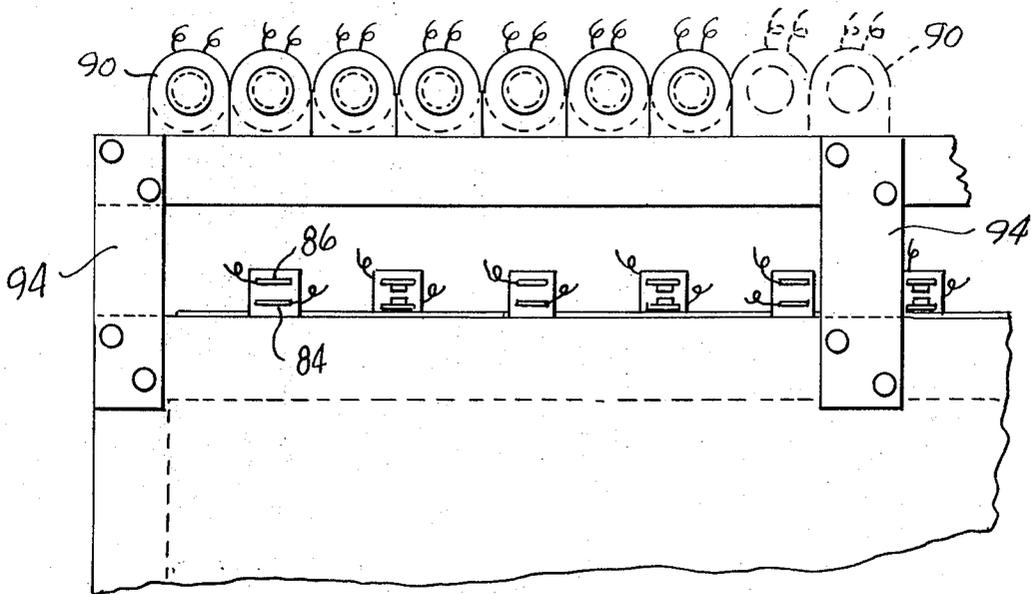
FIG. 5.

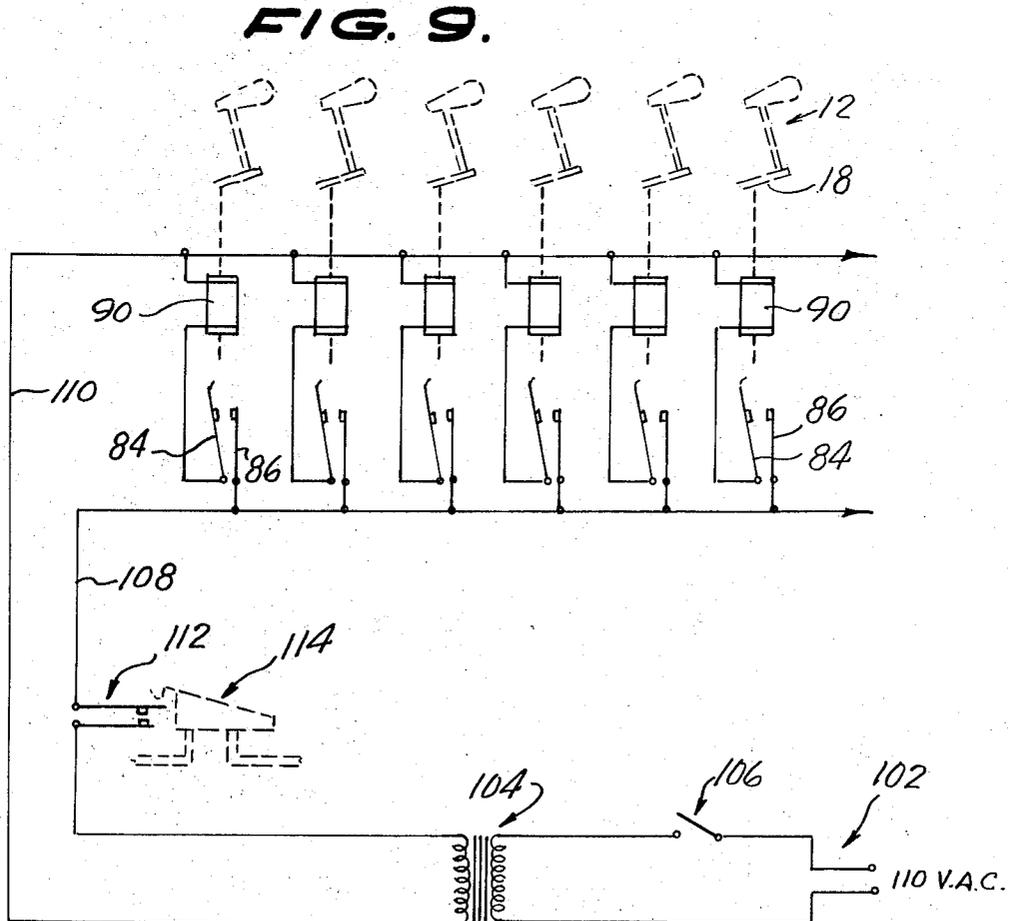
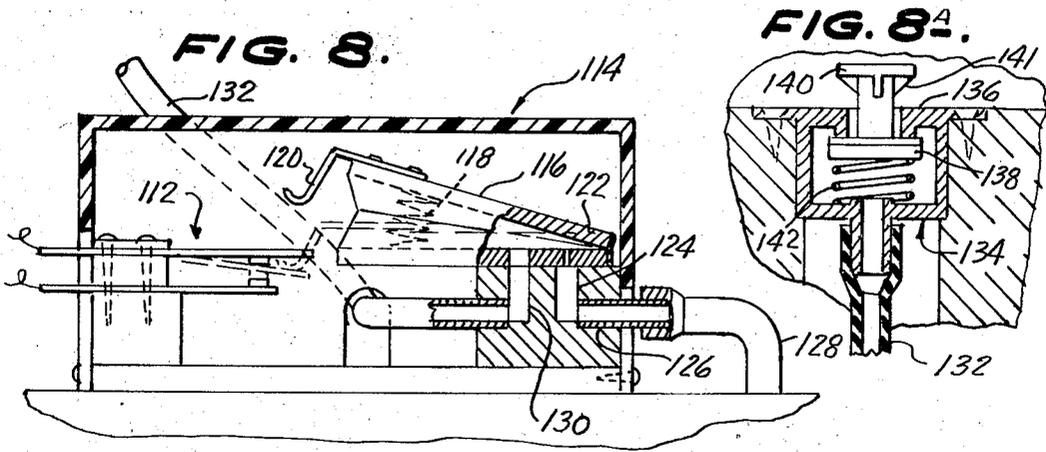


**FIG. 6.**



**FIG. 7.**





## AUTOMATIC PLAYER FOR MUSICAL INSTRUMENTS

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to new and useful improvements in automatic musical instruments, and more particularly to a combination pneumatic and electrical apparatus usable in an automatic player piano either as new, or repair equipment therefor.

The improvement relates to those musical instruments which are commonly known as "automatic" musical instruments in which the sound producing devices are controlled by a music sheet, card, or tablet which is usually perforated to represent the notes of a musical composition.

The improvement is especially intended for use in a pianoforte, although as to some features it is applicable to other musical instruments.

#### 2. Description of the Prior Art

In nearly all previous vacuum-type player pianos each hammer jack is moved by a separate bellows device, or pneumatic so that the system includes 88 pneumatics, and each pneumatic is associated with one or two valves so that often a total of 176 valves are involved. This complex structure makes it very hard to pump and maintain a sufficient vacuum because of leakage of air in the many pneumatics and because of cracks in the large wind chest which leaks air at its joints and seams. Since most actions require a double set of valve assemblies known as the primary and secondary valve to control each pneumatic, it is very frequent that particles of paper and lint are trapped in the valves so that they fail to seal, causing a severe drop in the vacuum and thereby increasing the difficulty of pumping the vacuum and involving more rapid strokes on the part of the operator.

### SUMMARY OF THE INVENTION

The present invention seeks to overcome the above-described deficiencies of conventional automatic player pianos by providing a vacuum chamber in which are arranged a plurality of pouches, one for each note to be played, each pouch constituting a flexible wall, or diaphragm, a small vent passage communicating with the interior of the vacuum chamber, a separate air passage connected to one of the openings in the piano tracker and a spring within the pouch biasing the diaphragm outwardly, but allowing movement of the flexible wall, or diaphragm, inwardly when the vacuum chamber is evacuated. With each pouch there is associated a pair of electric contact members, one member of each pair engaging the flexible wall in such manner as to make or break contact between the pair of members when the flexible wall moves from an inner to an outer distended position. A solenoid is also associated with each pouch, each solenoid having a plunger arranged to lift the respective one of the hammer jacks of the piano, and the said pair of contacts is connected in an electrical circuit to operate the solenoid when the pouch is distended. With the described apparatus there is provided a vacuum switch in the electrical circuit which is operated by a slow acting bellows to ensure that all of the solenoids are disconnected from the electric power source until such time as an adequate vacuum exists in the vacuum chamber, and a push button

valve is provided on the keyboard of the instrument to quickly open the vacuum switch whenever the music roll is to be reversed, or the music is otherwise to be stopped.

It will be apparent from the above that the primary object of the present invention is to overcome the above briefly described deficiencies of conventional player pianos by providing a system in which it is easy to pump the vacuum and in which the loss of vacuum through leakage is avoided.

It is an important object of the present invention to provide an automatic player piano system, having the above-described characteristics, which eliminates many of the parts of conventional systems and, thereby, avoids trouble requiring repair or maintenance, and which reduces the cost of fabrication, or repair of the instrument.

It is still another object of the present invention to provide an improved automatic player piano, having the above-described characteristics, which is easy to operate and which, because of the simplicity of its structure and parts, and the reduced number of parts, is more certain of positive continual and accurate operation.

### BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention, itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, wherein like reference characters indicate like parts throughout the several Figures, and in which:

FIG. 1 is a vertical sectional view centrally of an automatic player piano constructed in accordance with the present invention;

FIG. 2 is a fragmentary sectional view taken along the line 2—2 of FIG. 1, and looking in the direction of the arrows;

FIG. 3 is a fragmentary sectional view taken along the line 3—3 of FIG. 1, and looking in the direction of the arrows;

FIG. 4 is a fragmentary sectional view to an enlarged scale taken along the line 4—4 of FIG. 1, and looking in the direction of the arrows;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4, and looking in the direction of the arrows;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 5, and looking in the direction of the arrows;

FIG. 7 is a fragmentary bottom view taken along the line 7—7 of FIG. 6;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 1;

FIG. 8a is a sectional view taken along the line 8a—8a of FIG. 1; and

FIG. 9 is an electric circuit diagram showing the connections of the electrical elements of the apparatus.

### BRIEF DESCRIPTION OF THE CONVENTIONAL PORTION OF THE APPARATUS

Referring now to the drawings, the conventional portion of the apparatus may be briefly described as follows:

A conventional player piano, except as modified in certain portions to be described later, is shown in FIG. 1 under the general designation 10 as comprising a set of 88 strings, only one of which appears in FIG. 1, a hammer mechanism generally designated 12 and which includes a hammer 14 for each string pivoted at 16, a hammer jack 18 pivoted at 20. Each jack has a pivotal lever 19 which engages the hammer 14 to move it. The jack seats near its rear end on a pin 22 which is raised by the fulcrumed key 24. Each key is fulcrumed near its center on a pin 26 so that the instrument may be manually played by operating the keys to strike the appropriate notes of a composition in the usual manner.

The piano is provided with a conventional tracker board 26 having an aperture 28 for each of the notes to be played. A music sheet 30 passes over the tracker board and is provided with perforations representing the notes of a musical composition. The music sheet is unwound from a music roll 32 onto a second roll 34 while the music is being played. To operate these rolls, conventional apparatus is illustrated as including three wind motors connected by belts, pulleys and gears to the shafts upon which rolls 32 and 34 turn, as best seen in FIG. 2, this operating mechanism being given the general designation 36. The wind motors 36 are actuated by the bellows mechanism 38 shown near the bottom of FIG. 1, which is pumped by the foot treadles 40. A reversing lever 42 for the player rolls is shown in FIG. 2 which lever is operated by links extending to the keyboard at the front of the piano, one element of such link system being shown at 44 in FIG. 1. A regulator for the vacuum in the tracker board and for aligning the music roll and sheet is shown at 46 in FIG. 2 as being connected to one end of the music roll shaft, the other end of the shaft being spring-biased in one direction by spring 48, FIG. 3.

Since the apparatus thus far briefly described is conventional, no further description is deemed necessary. The remaining portions of the automatic player piano in which improvements according to the invention have been made are described below.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

An hermetically sealed vacuum chamber extending approximately the width of the keyboard is generally designated 50 and is supported within the instrument under the tracker board in any suitable manner. Vacuum chamber 50 is connected by a duct 52 to the bellows mechanism 38, there being a second duct 54, best seen in FIG. 3, which connects the bellows mechanism 38 to the wind motors 36. The pressure and alignment regulator 46 is connected by a duct 56 to the tracker board. For sounding each note an individual pneumatic-electrical apparatus is provided associated with the vacuum chamber 50. The pneumatic portion of this apparatus comprises a flexible pouch for each note arranged to close and open an electric switch connecting a solenoid in a circuit to lift a respective hammer jack. Desirably, each pouch is formed in a wall of the vacuum chamber 50 and for this purpose the vacuum chamber can be formed as an elongated box having a front and rear walls 58 and 60, FIG. 5, which are relatively thickened with respect to the upper and lower walls 62,64. Each pouch, generally designated 66, comprises a cylindrical cavity 68 opening to the outer surface of its respective wall, its opening being covered by

a circular, flexible, resilient diaphragm 70 which is glued, or otherwise adhered along its peripheral margin to the wall surface surrounding the opening cavity 68. The bottom of each cavity 68 is formed with a smaller cavity 72 which may be of semispherical shape and seats a weak spring 74 whose outer end engages the inner surface of the diaphragm 70. The cavity 68 communicates with the interior of the vacuum chamber 50 through a small bleed hole 76. A larger cross-section air passage 78 is preferably formed in the thickened wall and this air passage is connected by a nipple 80 and a hose 82 to an aperture 28 in the tracker board 26. The flexible pouches, as thus described, are preferably arranged in two lines on each of the front and rear walls of the vacuum box 50 with the pouches of one line staggered in relation to those of the other line, as best seen in FIG. 4. It will be noted that when the vacuum chamber is evacuated through duct 52 connected to opening 52' in one end of the vacuum box, the diaphragms 70 of all of the pouches are moved inwardly of their cavities 68 against the pressure of the springs 74 as illustrated in the pouch 66 at the left side of FIG. 5. However, when air is admitted through a note aperture in the music sheet 30 to passage 28, duct 82, nipple 80 and air passage 78 to one of the pouches 66, as illustrated at the right side of FIG. 5, the diaphragm is distended outwardly to move out of the cavity 68 aided by the pressure of the spring 74. Since the diaphragm is arranged to operate an electric switch, as will be shortly explained, this action gives a quick, assured and positive reaction to the passage of an opening in the music sheet 30 corresponding to a note to be played.

Associated with each flexible pouch 66 is a pair of contact members 84,86 in the form of strips of spring metal spacedly supported in an insulation block 88 which is adhered, or otherwise secured as by screws 89 to the front or rear face of the vacuum box wall 58 or 60. The innermost spring member 84 is bent, or curved at its end 92 to engage the diaphragm 70 of the associated pouch so that when the diaphragm is in its normal inner position the pair of contacts are open, as illustrated at the left side of FIG. 3. When, however, a note passes over the tracker to admit air to the pouch 66 the diaphragm will be distended and will force the inner spring outwardly to close the contacts between the members 84 and 86 and thereby energize an associated solenoid 90.

One solenoid is provided for each note to be played, and they are arranged in a bank preferably mounted on a board 92 which is secured by upper and lower straps 94 to the upper and lower walls 62,64 of the vacuum box 50. Each solenoid includes a magnetic plunger 96, FIG. 6, which supports a pin 98 for vertical guided movement in sleeve 100. The pins 98 seat under the rear ends of the hammer jacks 18 so that when a solenoid is energized, and the plunger 96 is lifted, the hammer jack 18 will be tilted around its fulcrum 20 and thereby operate its hammer to strike a string.

The electrical circuit is diagrammed in FIG. 9 from which it will be noted that a power source 102 is connected across the primary of a voltage reducing transformer 104 through an on off switch 106. Each of the solenoids 90 through its associated pair of contact members 84,86 is connected across the secondary of the transformer 104 by power lines 108,110. A vacuum switch 112 is inserted in one of the power lines for

operation by a slow acting bellows device 114 now to be described.

The vacuum switch operating device 114, as best illustrated in FIGS. 1 and 8, comprises a bellows 116 biased to open position by an internal spring 118 and having a switch actuating member 120 extending forwardly and downwardly from its upper surface. When the bellows 116 is closed the actuator member 120 moves downwardly, as shown in broken lines in FIG. 8, to close the switch 112. The bellows is closed slowly upon evacuation thereof through the small bleed aperture 122 which communicates with the treadle operated bellows 38 through passages 124, 126 and 128. The bellows may be quickly expanded to open the switch 112 by air admitted to the interior through the passage 130 and hose 132 which is connected to a valve 134, FIG. 8a, which is seated in a suitable recess at the front of the base of the keyboard of the piano. The valve 134 has an opening 136 which is normally closed by a valve 138 having a push button secured thereto and passing through the valve opening. The push button 140 has spaced foot portions 141 thereon which prevent closure of the valve opening 136 when the push button is depressed by the operator. The valve 138 is normally in its illustrated closed position by the biasing coil spring 142.

#### OPERATION OF THE IMPROVED INSTRUMENT

Operation of the device as described is as follows: The operator having placed the supply roll in position and having threaded its triangular lead portion over the tracker 26 and onto the take-up roll 34, uses his feet to pump the treadle device 40 which operates the bellows 38 to start pumping a vacuum in vacuum chamber 50. At this time, and until the music sheet 30 is sufficiently wound on the take-up roll 34 to cover all of the openings 28 in the tracker board 26, there is sufficient air in the vacuum chamber 50 so that all of the contact members 84,86 are in their "make" condition, but due to the slow action of the bellows 116 in vacuum device 114, the vacuum switch 112 is still open and no notes are played. When the music sheet 30 is sufficiently wound on the take-up roll to close all of the apertures 28 in the tracker board, a complete vacuum is pumped in the chamber 50 and all of the diaphragms 70 of pouches 66 are drawn inwardly to open all of the pairs of contact members 84,86. By this time, the bellows 116 has closed, closing the vacuum switch 112 and this readies the electric circuit for operation of the solenoids 90. Thereafter, as the operator continues to pump the treadle 40, the vacuum is maintained in chamber 50 and as the various notes of the composition represented by apertures in the music sheet 30 pass over their respective openings 28 in the tracker board, air is admitted to the respective pouch 66 causing its diaphragm 70 to quickly move to its distended position aided by the spring within the pouch. This closes the associated pair of contact members 84,86 energizing the respective solenoid 90 and lifts the plunger 96 and its rod 98 to tilt the associated hammer 18 and strike a string.

When it is desired to discontinue playing, the operator stops pedaling the treadles 40 and pushes the button 140 to open the valve 134 at the keyboard and admit air quickly to the bellows 116. This quickly opens the vacuum switch 112 and de-energizes the circuits to all of the solenoids so that no more notes can be played.

The push button 140 is also operated in the same manner to de-energize the solenoids through the vacuum switch 112 when it is desired to reverse the direction of rotation of the rolls 32 and 34 to rewind the sheet music onto roll 32. In this manner the notes are not played during the rewinding operation.

It will be apparent from the above description that the described improvements provide a simplified apparatus involving fewer parts than the more complex conventional pianos, and one which is more positive and assured of action in striking the notes of a composition, as well as easier to maintain in playing condition over longer periods of time. While the invention has been described as embodied in a player piano, it is apparent that it may be easily adapted to other stringed instruments. It is further apparent that the improved mechanism may be initially constructed in fabricating a new player piano, or may be installed in an old player piano to replace non-functioning, or poorly functioning elements of the conventional piano.

Although a certain specific embodiment of the invention has been shown and described, it is obvious that many modifications thereof are possible. The invention, therefore, is not intended to be restricted to the exact showing of the drawings and description thereof, but is considered to include reasonable and obvious equivalents.

What is claimed is:

1. In an automatic musical instrument, such as a player piano, of the type having a tracker with openings over which a music roll having apertures corresponding to music notes is fed by operation of pneumatic or electric motor means, and hammer and hammer jacks operable to strike strings for sounding the musical notes, the improved combination comprising a vacuum chamber, means for evacuating said chamber, a plurality of pouches, one for each note to be played, associated with said vacuum chamber, each pouch having a flexible wall, a small vent passage communicating with the interior of said vacuum chamber, a separate air passage connected to one of the openings in said tracker and a spring within the pouch biasing said flexible wall outwardly but allowing movement of the flexible wall inwardly when said vacuum chamber is evacuated, a pair of electric contact members operatively mounted on each of said pouches in such manner as to make or break contact between the pair of members when the flexible wall moves from an inner to an outer distended position, a solenoid associated with each pouch, each solenoid having a plunger arranged to lift a respective one of said hammer jacks, an electric power source, and circuit means connecting said pairs of contact members, said source and said solenoids so that each of said pairs of contacts serves to energize and de-energize one of said solenoids

2. The combination as claimed in claim 1, wherein said vacuum chamber is an elongated box having a pair of opposed and thickened walls, said pouches each comprising a cavity in one of said thickened walls opening to the outer surface of the wall, said small vent passage connecting each cavity to the interior of said box, said separate air passages each being disposed within one of said opposed walls and communicating with its respective cavity, duct means connecting said air passages to respective ones of the openings in said tracker, said flexible wall of each pouch being a diaphragm secured at its periphery to the outer surface of one of said

thickened walls so as to cover the opening of the cavity, said spring being disposed in each said cavity and biasing the diaphragm outwardly, and said pairs of electric contact members being mounted on said thickened walls with one contact member of each pair engaging one of said diaphragms.

3. The combination as claimed in claim 2, wherein said thickened walls of the box forming the vacuum chamber are front and rear walls respectively, said cavities of the pouches being disposed in staggered arrangement in each of said front and rear walls.

4. The combination as claimed in claim 2, wherein each of said cavities is cylindrical and said diaphragms are each circular discs, each of said cavities having a smaller cavity recessed in its inner face, said smaller cavities each communicating with said small vent passages leading to the interior of the vacuum box, and said smaller cavities seating said weak springs which extend between the smaller cavities to the interior surfaces of their respective diaphragms.

5. The combination as claimed in claim 3, wherein said pairs of contact members comprise spring strips mounted in spaced parallel arrangement in an insulating support secured to the outer surfaces of said front and rear walls of the vacuum box, one spring strip of each pair having a curved end portion engaging the outer surface of an adjacent diaphragm and so arranged that outward movement of the diaphragm will bend the said one strip outwardly to close the contacts of the contact members.

6. The combination as claimed in claim 3, wherein a mounting board is secured by straps to said vacuum box, the mounting board being parallel to and spaced from the rear wall of the vacuum box, and said solenoids are secured to the rear face of said mounting board.

7. The combination as claimed in claim 1, wherein said circuit means connecting said pair of contact members, said source and said solenoids includes a transformer connected across said source, said solenoids being connected in parallel across the secondary of said transformer through their associated pair of contact members, and there being a vacuum switch in series with all of the solenoids and connected between the solenoids and the secondary of the transformer, said vacuum switch being closed by movement of a slow acting bellows communicating with said means for evacuating said vacuum chamber so that the solenoids are prevented from being energized until a sufficient vacuum exists in said vacuum chamber to open the

contacts of all of said pairs of contact members.

8. The combination as claimed in claim 7, wherein said slow acting bellows communicates with said vacuum chamber through a passage of very small size.

9. The combination as claimed in claim 8, wherein said slow acting bellows is further provided with a large passage extending to the keyboard of the instrument, and manual valve means is provided at said keyboard for opening said large passage to quickly expand the slow acting bellows so as to open the vacuum switch.

10. Apparatus for use in a pneumatic automatic player for a musical instrument comprising the combination of a vacuum chamber, a plurality of pouches, one for each note to be played, associated with said vacuum chamber, each pouch having a flexible wall, a small vent passage communicating with the interior of said vacuum chamber, a separate air passage for connection to a music sheet tracker and a spring within the pouch biasing said flexible wall outwardly but allowing movement of the flexible wall inwardly when said vacuum chamber is evacuated, a pair of electric contact members operatively mounted on each of said pouches in such manner as to make or break contact between the pair of members when the flexible wall moves from an inner to an outer distended position, a solenoid associated with each pouch, each solenoid having a plunger for actuating a string note striker, an electric power source, and circuit means connecting said pairs of contact members, said source and said solenoids so that each of said pairs of contacts serves to energize and de-energize one of said solenoids.

11. The combination as claimed in claim 10, wherein said vacuum chamber is an elongated box having a pair of opposed and thickened walls, said pouches each comprising a cavity in one of said thickened walls opening to the outer surface of the wall, said small vent passage connecting each cavity to the interior of said box, said separate air passages each being disposed within one of said opposed walls and communicating with its respective cavity, duct means connecting said air passages to respective ones of the openings in said tracker, said flexible wall of each pouch being a diaphragm secured at its periphery to the outer surface of one of said thickened walls so as to cover the opening of the cavity, said spring being disposed in each said cavity and biasing the diaphragm outwardly, and said pairs of electric contact members being mounted on said thickened walls with one contact member of each pair engaging one of said diaphragms.

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