Sept. 19, 1939. J. T. STIFF 2,173,216

PNEUMATICALLY OPERATED ELECTRICAL MUSICAL INSTRUMENT

Filed Jan. 29, 1938 2 Sheets-Sheet 1

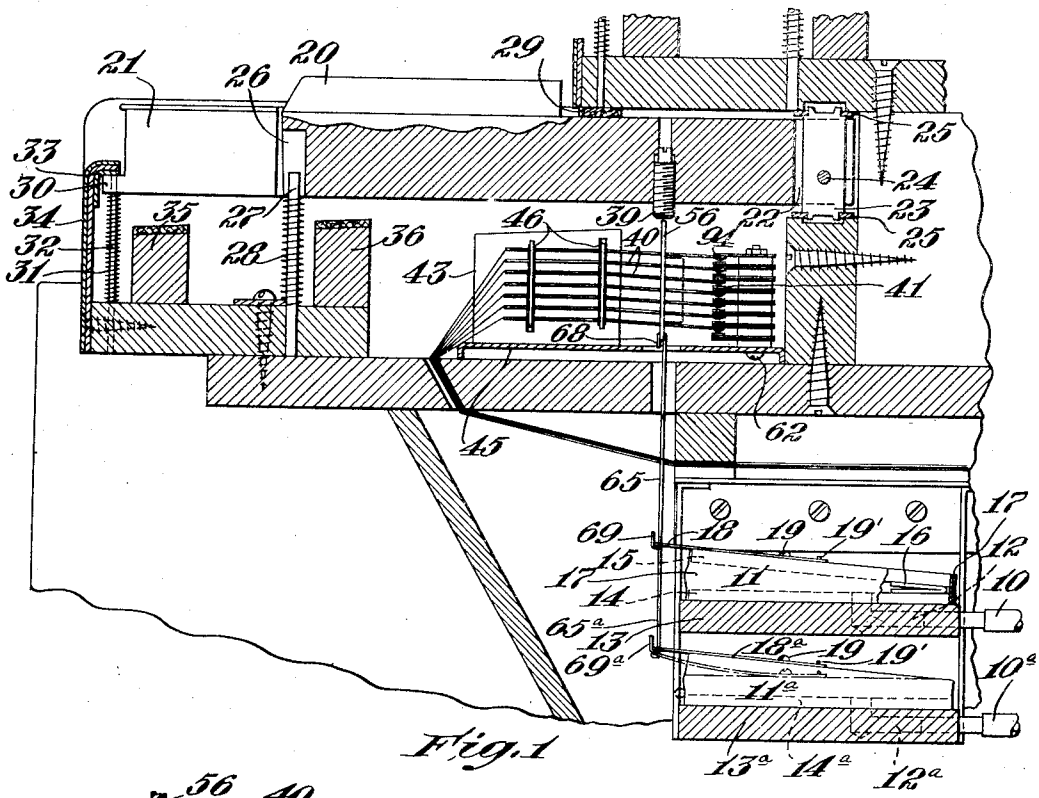


Fig. 1

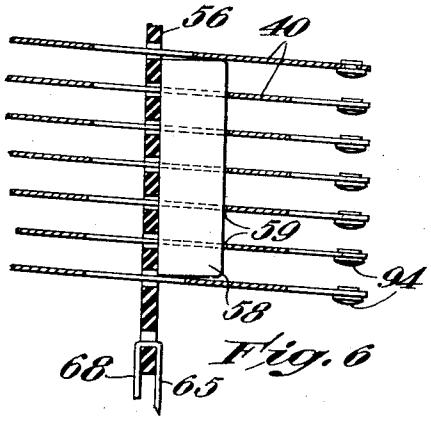


Fig. 6

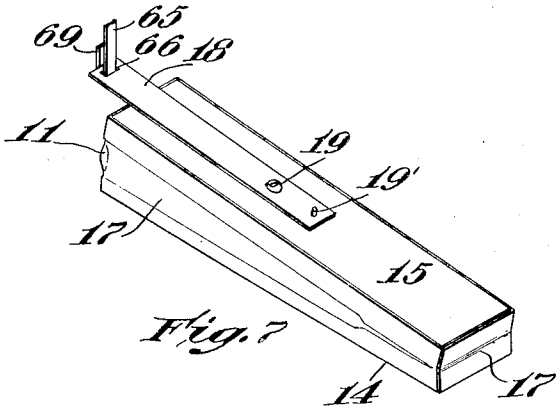


Fig. 7

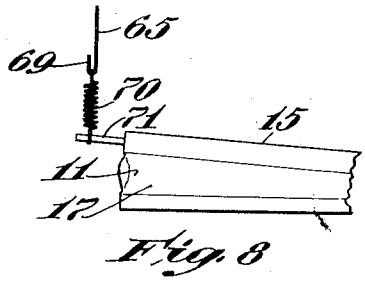


Fig. 8

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PNEUMATICALLY OPERATED ELECTRICAL MUSICAL INSTRUMENT

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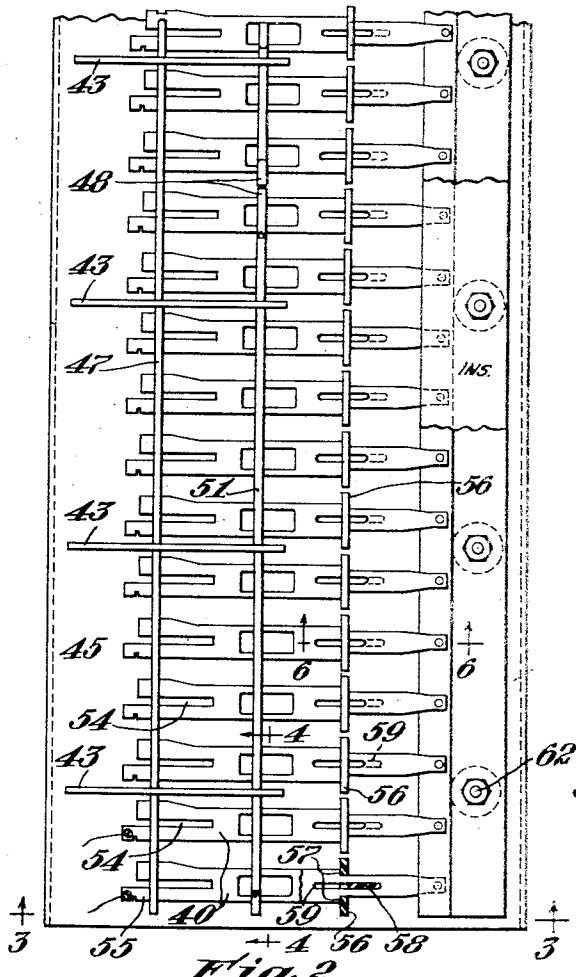


Fig. 2

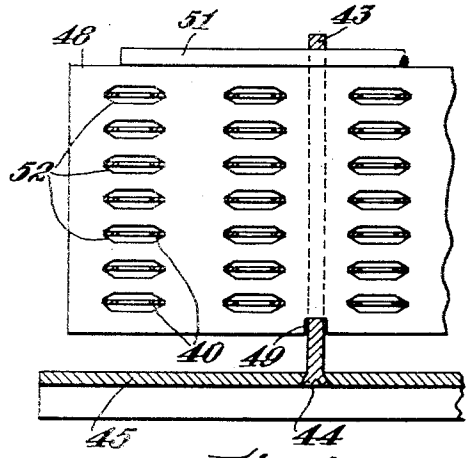


Fig. 4

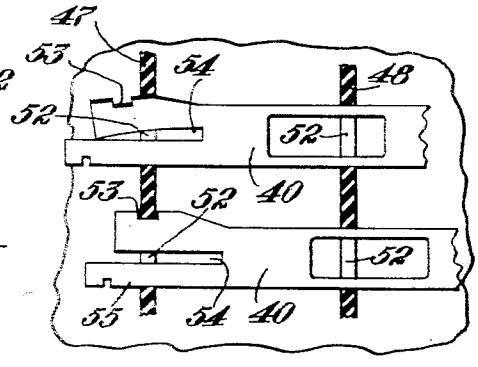


Fig. 5

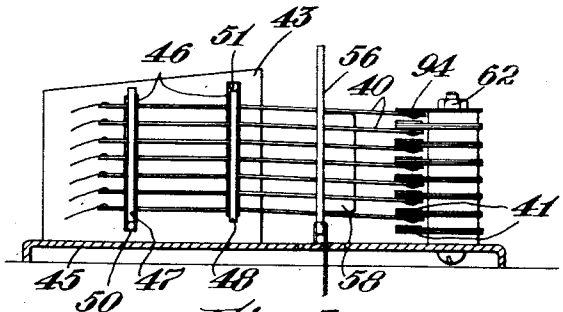


Fig. 3

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UNITED STATES PATENT OFFICE

2,173,216

PNEUMATICALLY OPERATED ELECTRICAL MUSICAL INSTRUMENT

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Application January 29, 1938, Serial No. 187,649

4 Claims. (Cl. 200—81)

This invention relates to pneumatically operated electrical musical instruments, and more particularly to a novel connecting means between each pneumatically operated bellows element and each corresponding contact switch, to eliminate the click which otherwise results when the switch is actuated to close the electrical circuit for producing the musical tone.

In the well known prior art of pneumatically operated or "player" pianos, a pneumatically operated striker is provided for each key of the piano. To actuate these strikers a perforated note sheet is drawn over an apertured tracker bar from the spool or music roll upon which the sheet is wound. This note sheet has a series of perforations corresponding in arrangement and spacing to the notes of the piece of music which is to be placed. The tracker bar has a series of apertures corresponding in number to the actions or keys to be operated, and pneumatic communication is provided between each aperture and the corresponding striker of the action or key. As the perforated note sheet is drawn over the tracker bar, the perforations in the note sheet uncover the apertures in the tracker bar in sequence, so that the proper actions are successively struck to render the musical composition for which the sheet is perforated. The tempo is governed by the speed with which the note sheet is drawn over the tracker bar, and means are provided whereby the operator may regulate such speed.

The prior art also discloses electrical musical instruments of various types which are operated manually, and specific reference is made to the instrument described in United States Patent No. 1,956,350, as a disclosure of one type of such instrument. In operating such instruments, the pianist or organist depresses the keys of the piano or organ manually in the usual manner, and as each key is depressed it causes a corresponding switch to complete a corresponding electrical circuit, which produces electrically the tone corresponding to the key depressed.

The primary object of this invention is to combine the generically old pneumatically operated means with the switches of the likewise old electrical music instrument, so that the electrical instrument may be pneumatically operated without undesirable mechanical noise resulting from the pneumatic operation of the switches.

A further object is to provide a connecting means between the switch elements and the pneumatically actuated bellows elements which reduces the force with which the switch is actuated to complete the electrical circuit, thereby eliminating the annoying audible click which otherwise results.

A further object is to provide a novel and efficient pneumatically operated electrical musical instrument.

Further objects will be apparent from the following description, reference being had to the accompanying drawings, in which:

Fig. 1 is a vertical cross-sectional view of the lower manual of the keyboard and associated parts;

Fig. 2 is a fragmentary plan view of a section of multiple contact switches, parts thereof being shown in fragmentary section;

Fig. 3 is a transverse sectional view taken on the line **3—3** of Fig. 2;

Fig. 4 is a fragmentary vertical sectional view taken on the line **4—4** of Fig. 2;

Fig. 5 is a fragmentary sectional view illustrating the method by which the switch contact members are mounted;

Fig. 6 is a fragmentary sectional view taken on the line **6—6** of Fig. 2;

Fig. 7 is a perspective view showing a pneumatically operated bellows and a portion of the connecting means which goes to the corresponding switch; and

Fig. 8 is a fragmentary side elevation of a bellows similar to that of Fig. 7 and a portion of a modified switch connecting means.

The drawings do not show the construction of the elements which produce the musical tone or tones; they merely show one embodiment of switch for completing the electrical circuits, which circuits in turn communicate with means for synthetically producing electrical waves of the desired frequency to produce a tone of the desired quality. For the construction of the electrical details of one electrical musical instrument which I have found to be satisfactory, reference may be had to United States Patent No. 1,956,350.

In Fig. 1 two keys of the lower manual of any suitable organ console are shown,—the black key **20** and the white key **21**. The number of keys customary in the manufacture of organs or pianos may be provided. Each key has a slot **22** at its rearward end to receive a support **23** to which it is pivoted by a rod **24**, which may extend the full length of the keyboard. The supports **23** fit in suitable slots formed in straps **25**, which are suitably secured to the framework of the keyboard. The forward faces of the black keys **20** are provided with recesses **26**, which receive pins

27 which serve as guides for compression coil springs 28. Upward movement of the black keys is limited by a strip of felt 29 or other suitable material.

Each of the white keys 21 is pivotally supported in the same manner and is provided at its forward end with a projecting flange 30. The key is normally held in its uppermost position by a compression coil spring 31 held in position by a pin 32, the upper end of which projects through an opening formed in the flange 30. Upward movement of the white keys is limited by a strip of felt 33 secured to the inwardly turned flange of the front finishing plate 34. The downward movement of the white keys is limited by a felt faced stop 35, and downward movement of the black keys is limited by a felt faced stop 36, each of said stops extending the length of the keyboard.

Each of the keys is provided with an adjustable set screw 39, which actuates the contact switches when the instrument is operated manually.

Referring to Figs. 1 to 6, inclusive, a separate set of seven switches 40 is provided for each key. Each of the seven switches 40 of each set is adapted to engage separate contacts 41 upon depression of the set, and thus seven different circuits are thereby closed each time a key 20 is depressed. Seven circuits are illustrated for each key, because it has been found desirable to supplement the predominant tone with various proportions of harmonics to produce improved tone quality or color. It is to be specifically understood, however, that in use of the present invention only a single circuit and only one switch to close it may be utilized for each key,—the invention is equally adaptable to one or more switches and one or more circuits for each key.

The contact switches 40 are supported by a plurality of vertical plates 43 (Figs. 2, 3 and 4) which have lugs 44 (Fig. 4) peened to a horizontal supporting plate 45, the latter being suitably secured to the frame of the console (see Fig. 1). The vertical supporting plates 43 are each provided with a pair of elongate vertical slots 46 (Figs. 1 and 3) to receive a number of strips 47, 48 of insulating material (Figs. 2 to 5). These strips have notches 49 spaced along one edge thereof which are adapted to engage the plates 43, this engagement being maintained by wires 50, 51 (Figs. 2, 3 and 4) which hold the strips 47, 48 respectively, at the upper and lower ends of the slots 46.

As shown in Fig. 4, the strips 47, 48 are each provided with a plurality of rows of apertures 52, there being one vertical row for each key of the keyboard. The switch contact elements 40, as best shown in Figs. 2, 4 and 5, are carried in the supporting strips 47, 48. The switches 40 are so conformed that they may be slipped through the apertures 52 (Fig. 5), being held against retraction by the engagement of a notch 53 with the insulating strip 47. The end of the switch 40 adjacent the notch 53 has a longitudinal slot 54 (Figs. 2 and 5) formed therein, so that the end of the member may be bent as shown in Fig. 5, to allow the ends to spring outwardly and cause engagement of the notch 53 with the strip 47.

The switch 40 is preferably made of bronze and is thin enough so as to be longitudinally resilient. The end of the switch 40 has a notched extension portion 55 (Figs. 2 and 5) for facilitating the making of a soldered connection with a wire. Each of the vertical rows of switch members 40 is provided with an actuator member 56 suitably slotted to embrace the switch members, and held in position by a pair of shoulders 57 (Fig. 2) formed on each of the contact members and by a strip 58 (Figs. 2, 3 and 6) of insulating material, the lower end of which rests upon and is supported by the lowermost of the row of switches. The insulating strip 58 projects through slots 59 (Fig. 6), formed in the intermediate switches 40, and is held against removal by the upper most and lowermost of the switches 40, since the slot in said switch members is not as long as the slots 59 in the intermediate switch members.

Either a silver rivet 94 (Fig. 6) or a fine wire (not shown) of a palladium alloy, platinum, platinum iridium or the like, is secured to the end of each switch 40 for engagement with the contacts 41 (Figs. 1 and 3), each of which preferably has either a strip of silver or a fine wire (not shown) of a palladium alloy, platinum, platinum iridium or the like, secured thereto for contact with the rivet 94 (or the corresponding fine wire) on the switch 40. The contact members 41 are suitably insulated from each other and are secured to the supporting plate 45 (Figs. 1, 2 and 3) by bolts 62, which are suitably insulated from the contact members.

After having secured the strips 47, 48 in place, all of the switch members except the upper one are pushed into place until their notches 53 engage the strip 47, and then after inserting the insulating strip 58 the uppermost contact member may be pushed into place, thus locking the actuator member 56 in position.

Looking at Fig. 1, when the black key 20 is depressed by the organist, the set screw 39 moves downwardly as the key moves about the pivot 24. The bottom face of the set screw engages the top of the actuator 56 and moves it downwardly. Downward movement of the member 56 causes the free ends of the resilient switches 40 to be moved downwardly and the rivets 94 engage the contacts 41, closing the electrical circuits, which cause the musical tone corresponding to that key to be produced. When the key 20 is released, the spring 28 returns it to normal position, the set screw 39 is elevated with the key to normal position, and the resiliency in the switches 40 causes them to be sprung back to normal position opening the electrical circuits.

The drawings do not show the construction of perforated note sheet, tracker bar, means for drawing the note sheet over the tracker bar, nor means for creating variations in pressure responsive to registration of the note sheet perforations with apertures in tracker bar, since various suitable constructions thereof will be well known to persons skilled in the art. One end of the rubber tube 10 (Fig. 1) communicates with the source of pressure variations (not shown) and the other end communicates with the interior of the bellows 11 through the tubular passage 12 formed in the wooden base block 13 and the bottom wall 14 of the bellows 11.

A separate bellows element and corresponding rubber tube is provided for each key of the instrument, so that as the perforation in the note sheet corresponding to a key registers with the corresponding aperture in the tracker bar, negative pressure will be created in the rubber tube which communicates with the interior of the corresponding bellows element, and the bellows element corresponding to that note or key will be contracted or collapsed by said negative pressure.

Each bellows element comprises a bottom wall

or side 14 secured to the block 13, and a movable top wall or side 15 hinged to the bottom wall by a strong sheet of tightly stretched rubberized fabric 16. This hinge member 16 tends to force the top wall away from the bottom wall, and thus tends to keep the bellows in its expanded position, as shown in Figs. 7 and 8. Any hinge may be used for this purpose, and it may be supplemented by a compression coil spring to return the top wall to expanded position. A strip of flexible material 17, such as very thin rubber coated fabric, is secured between the edges of the walls 14 and 15 to provide the air-tight chamber of the bellows.

A longitudinally resilient spring member 18 (Figs. 1 and 7) is secured to the top wall 15 of the bellows by a screw 19 and pin 19', and its free end extends outwardly from the end of the bellows. This free end is provided with a slot 66 (Fig. 7). The spring member is preferably made of steel and is quite thin, so that it is highly resilient.

A rigid connecting member 65, made of wire or other rigid material, connects the free end of the spring member 18 to the lower end of the actuating member 56, which is secured to the switches 40. This connecting member is secured to the actuating member 56 by an integral downturned hook member 68, which extends through a slot in the member 56 (Fig. 6), and said connecting member is secured to the spring member 18 by an integral upturned hook member 69, which extends through the slot 66 (Fig. 7).

A separate bellows, rubber tube and connecting element are provided for each key. For example, the bellows 11a (Fig. 1), tube 10a, spring member 18a and connecting member 65a are associated with the white key 21.

Any suitable resilient means may be associated with the connecting members 65, 65a, etc., so long as said means are adapted to reduce the force transmitted from the upper or movable wall of the bellows to the switches 40. For example, in Fig. 8 the lower end of the connecting member is secured to one end of a tension coil spring 70, and the other end of the spring is secured to a rigid bar 71, which is secured to the upper wall 15 of the bellows. However, I prefer the flat spring means 18, because its resiliency can be more readily and more accurately adjusted to reduce the force transmitted by the connecting member 65 to exactly the correct amount. This adjustment may be made by permanently bending the free end of the member 18 either upwardly or downwardly.

When the instrument is operated pneumatically, as negative pressure is created in the appropriate tube 10a, the bellows is completely collapsed, as shown in dot-dash position of the lower bellows 11a of Fig. 1. As the bellows is collapsed, the spring member 18 flexes away from the upper wall 15 of the bellows, and transmits a reduced or softer force to the connecting member so that the switches 40 are flexed slowly or softly and the rivets 94 engage the contacts 41 with reduced force, thereby eliminating the audible click which otherwise results. When the negative pressure is released in the tube 10a the upper wall of the bellows returns to normal expanded position, and the switches 40 return to normal open position by their own resiliency.

By providing the open hook 69 on the lower end of the connecting member 65, movement of the bellows and of the resilient member 18 is eliminated when the instrument is played manually, since the member 65 merely slides a short distance downwardly through the slot 66, when the actuating member 56 is depressed by the member 39. The provision of this open hook 69 also eliminates noise when the instrument is played manually since there is no audible contact between this hook and the resilient member 18 (or 70) upon downward movement of the connecting member 65.

I claim:

1. In a pneumatically operated musical instrument, means for connecting the movable wall of a bellows and a switch, comprising a longitudinal element and a resilient element, said elements being slidably interconnected whereby upon movement of the bellows wall away from the switch the switch is actuated, and upon movement of the switch toward the bellows wall said wall is not actuated.

2. In a pneumatically operated musical instrument, means for connecting the movable wall of a bellows and a switch, comprising a longitudinally resilient member attached to said movable bellows wall and having a free end extending beyond one side of said wall, and a longitudinal member having one end connected to said free end of the resilient member and the other end connected to said switch.

3. In a pneumatically operated musical instrument, means for connecting the movable wall of a bellows and a switch, comprising a longitudinally resilient member attached to said movable bellows wall and having a free end extending beyond one side of said wall, a transverse passage extending through said resilient member adjacent the free end thereof, a longitudinal member having one end connected to said switch and the other end passing through said transverse passage and slidably connected to the free end of said longitudinally resilient member.

4. In a pneumatically operated musical instrument, means for connecting the movable wall of a bellows and a switch, comprising a coil spring having one end connected to said movable wall, and a longitudinal member having one end slidably connected to the other end of said spring and the other end connected to said switch.

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