July 5, 1949. E. R. WORKMAN 2,475,168

MUSICAL INSTRUMENT

Filed Jan. 28, 1943 3 Sheets-Sheet 1

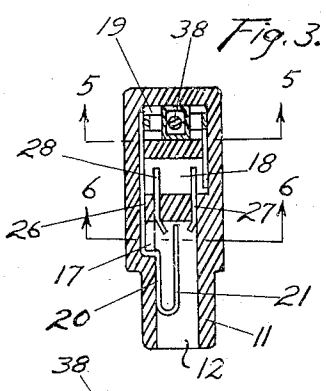


Fig. 3.

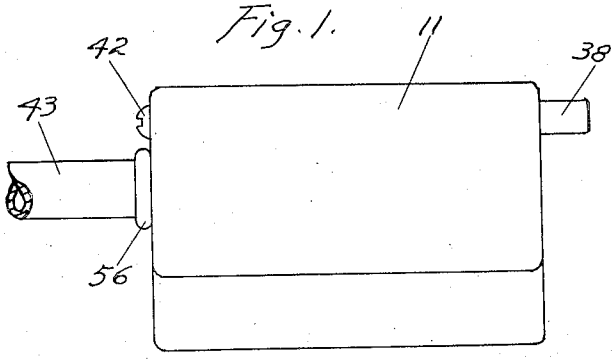


Fig. 1.

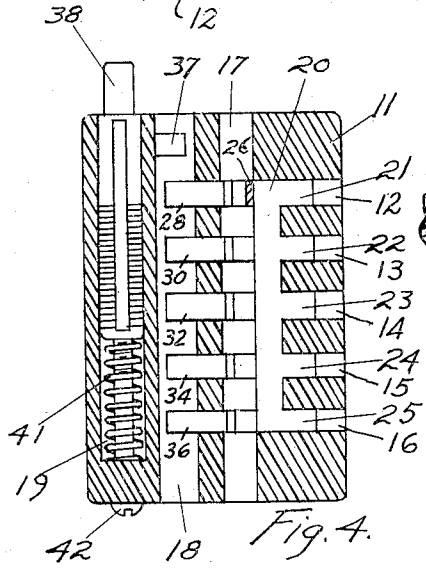


Fig. 4.

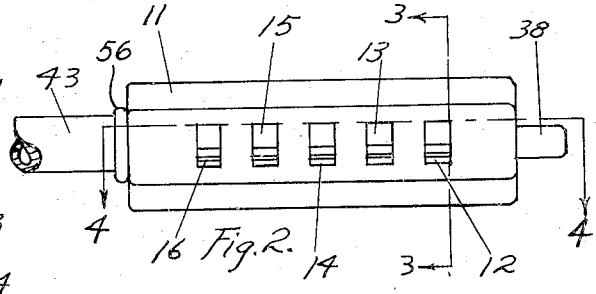


Fig. 2.

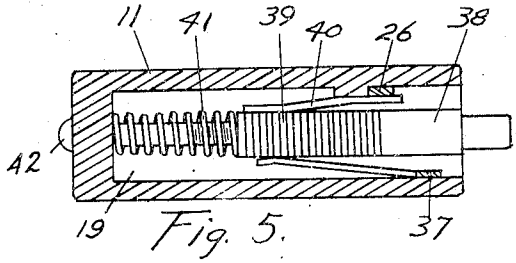


Fig. 5.

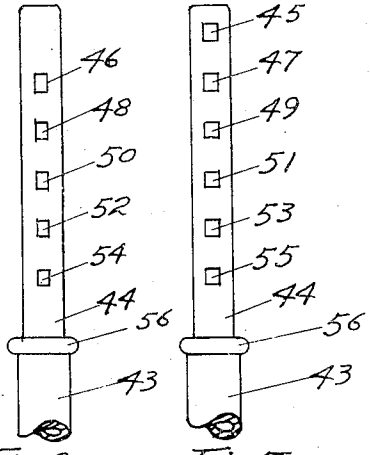


Fig. 8.

Fig. 7.

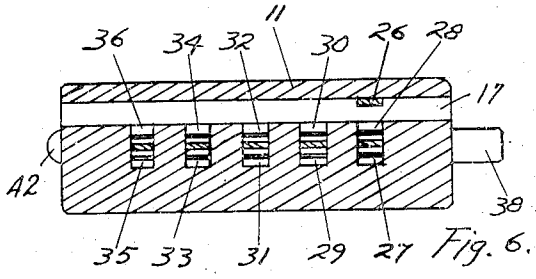


Fig. 6.

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MUSICAL INSTRUMENT

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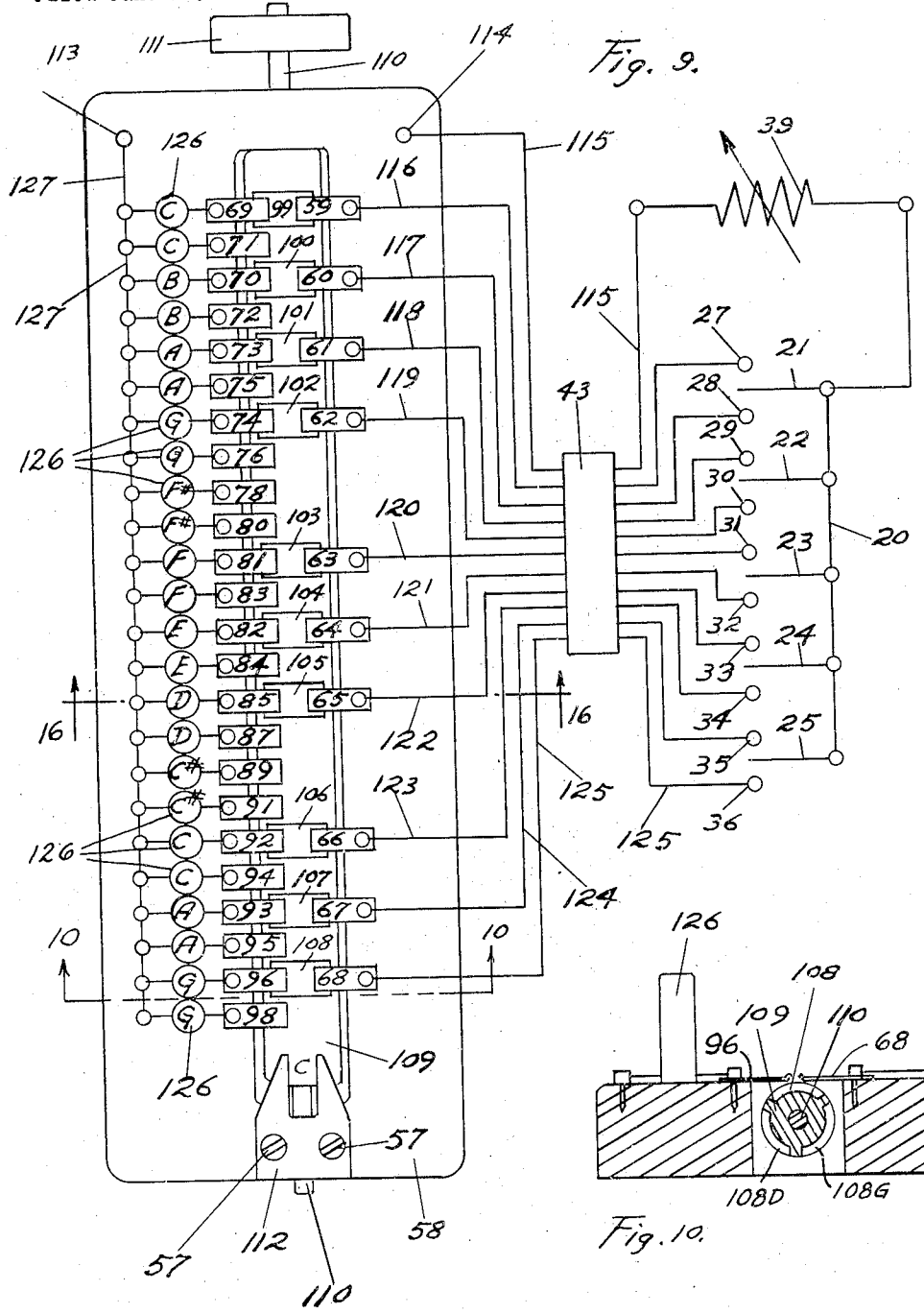


Fig. 9.

Fig. 10.

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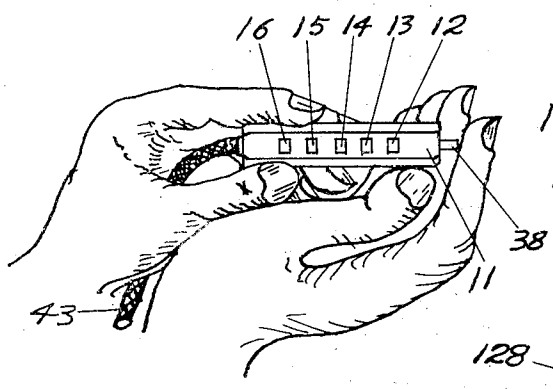


Fig. 16.

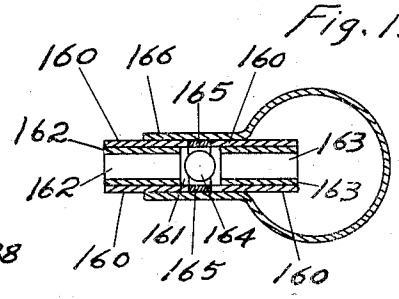


Fig. 15.

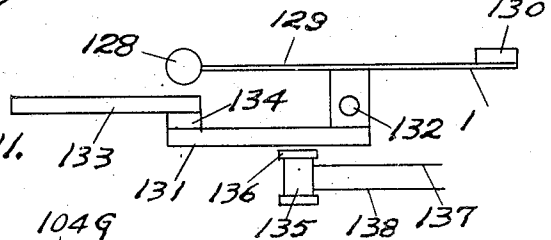


Fig. 11.

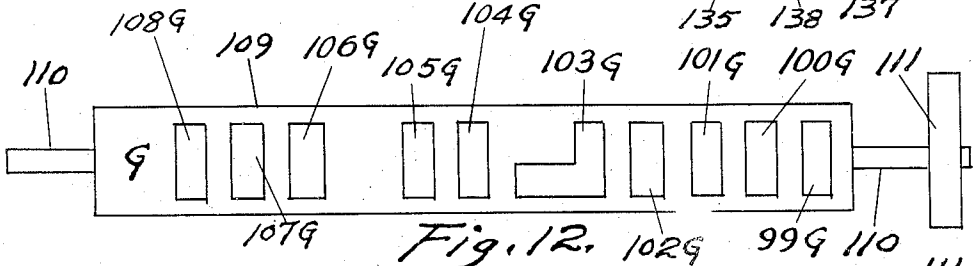


Fig. 12.

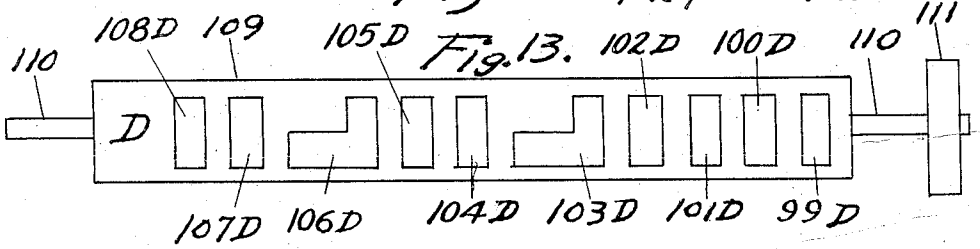


Fig. 13.

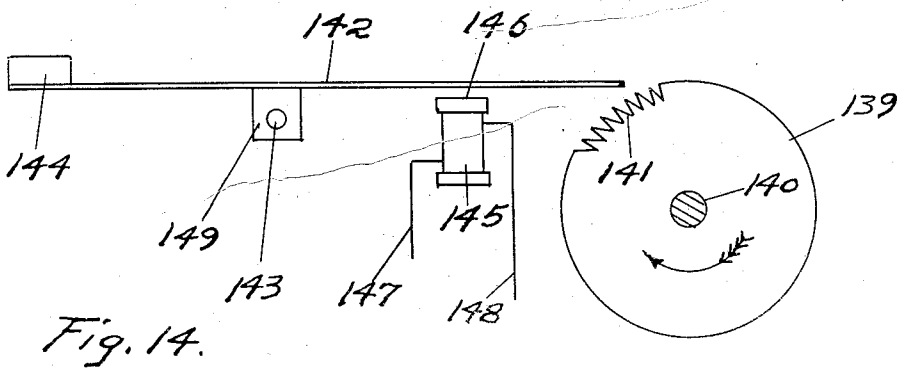


Fig. 14.

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Patented July 5, 1949 2,475,168

UNITED STATES PATENT OFFICE

2,475,168

MUSICAL INSTRUMENT

Ernest Robert Workman, Chicago, Ill.

Application January 28, 1943, Serial No. 474,051

14 Claims. (Cl. 84—1.01)

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The present invention relates to switch devices for controlling electric circuits for playing selections on suitably equipped musical instruments in which it is necessary to close and open various combinations of circuits in rapid succession and in timed relation. Said switch devices are also adapted to produce sounds which are confined to a predetermined musical key and to vary the strength of the current in the closed circuits for shading the volume of the tones produced.

The primary object of the invention is to provide a switch which can be operated by the hands in conjunction with the organs of the respiratory tract in a manner similar to that involved in executing musical selections on the well-known harmonica.

Another object of the invention is to provide a switch device having mechanism whereby closed circuits may be interrupted in rapid succession to produce quavering or vibrato effects in the sound.

A further object of this invention is to provide a switch device with auxiliary control means whereby the sounds produced can be confined to those of a predetermined musical key, but to render this control adjustable for quickly changing from tones of one musical key to those of another musical key.

It is also an object of the invention to attain all of the foregoing results by such arrangement as will eliminate discordant tones when a selection is being rendered by an instrument controlled in accordance with the invention.

Now, in order to acquaint those skilled in the art with the manner of constructing and operating the invention, I shall describe a specific embodiment designed for use in playing electric sounders:

In the accompanying drawings:

Figure 1 is a top plan view of a switch device for controlling a plurality of circuits in numerous combinations and in momentary succession;

Figure 2 is a front elevational view of the switch device shown in Figure 1;

Figure 3 is a typical cross-sectional view of the said switch, taken as indicated at line 3—3 on Figure 2;

Figure 4 is a sectional view of the switch, taken at line 4—4 on Figure 2;

Figure 5 is a sectional view at the line 5—5 on Figure 3;

Figure 6 is a sectional view at the line 6—6 on Figure 3;

Figure 7 is a plan bottom view of a plug se-

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cured to one end of a flexible tube which forms a cover for wires providing electrical connections between the switch shown in Figure 1, and an auxiliary control mechanism;

Figure 8 is a top plan view of the plug shown in Figure 7;

Figure 9 is a combination top plan view of an auxiliary control mechanism and a wiring diagram for the switch device shown in Figure 1, with connections to said auxiliary control;

Figure 10 is a sectional view of the auxiliary control at the line 10—10 on Figure 9;

Figure 11 is a diagrammatic representation of a sound producing mechanism adapted for use with the switch device shown in Figure 1, and its auxiliary control;

Figure 12 is a view of a sector of the drum employed in the auxiliary control and adapted to confine the tones to a different musical key than that for which the control is adjusted, as shown in Figure 9;

Figure 13 is a view of a sector of the drum adapted to confiine musical tones to a key different from those secured by active use of the sectors shown in either Figure 9 or Figure 12;

Figure 14 is a diagrammatic representation similar to Figure 11, but illustrating another sound producing mechanism; and

Figure 15 is a sectional view taken similarly to Figure 3, but showing a modified form of switch contact.

Figure 16 is a view illustrating the manner of playing the device.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and rearrangements of the parts may be made without departing from the spirit and scope of the invention, and that the same is not limited to the particular form herein shown and described, except in so far as indicated by the appended claims.

Referring now to the several figures of the drawings in detail, I have illustrated the switch as adapted for execution of musical selections on electric sounders by operation of the device in a manner similar to that involved in playing the well-known harmonica.

In the several figures, 11 is a switch body composed of insulating material, with five transverse openings 12, 13, 14, 15, and 16, in its front wall, as shown by Figure 2, and three lengthwise openings, 17, 18 and 19, extending through it, as shown by Figure 4. Embedded in this body 11 is a metallic bar 20, which carries five projections,

21, 22, 23, 24 and 25, which substantially fit the respective transverse openings, but with just enough clearance so that their free ends may be sprung up or down, with slight effort, so as to form electric contacts or temporary junctions with ten metallic brushes or terminals, 27 to 36. These terminals are also embedded in the body 11, and the free ends of the said projections are normally positioned midway between the bent ends of the terminals or brushes, as shown in Figure 3, so that the projections offer obstruction to air passing either way between the opening or passage 17, and the respective openings in which the projections are positioned. A sixth projection, 26, from the bar 20, extends across both openings 17 and 18, at one side of each, and reaches into opening 19, as shown in Figure 3, where it forms, through another brush 40, an electric junction between one end of a resistance element 39 and the bar 20.

Slidably mounted in opening 19 is a block 33 of insulating material, in which is embedded the resistance element 39, and to which is attached the brush 40, and a spring 41 serves to hold the block so that its reduced end normally projects from the frame, as shown in Figure 1, while a bolt 42, threaded into the block, limits its outward movement. A second brush 37, is also embedded in the body 11, and forms an electric junction with the resistance element 39, as shown in Figure 5.

The arrangement of the brushes and resistance element 39, which they contact, are such that when the block is pressed into its opening against the spring, more resistance is introduced into a circuit passing through them, and this reduces the current in the circuit; furthermore, their arrangement is such that when the block is pressed farther in, the brush 40 will pass beyond the projection 26, and completely interrupt the circuit. The spring will quickly return the block to its normal position when the pressure is released, so that successive repetitions of interruptions or variations in the strength of the current can be produced by operation of the block 38.

A flexible tube 43 provides a conduit for eleven insulated wires which form electric connections between eleven contacts 45 to 55, which are embedded, five in one face and six in the opposite face of a hollow plug 44 mounted at the end of the tube. These wires are connected respectively to ten brushes 59 to 68, and one terminal of a supply source 114; said brushes and terminal are mounted on the auxiliary control frames 58 and their connecting wires are shown diagrammatically in Figure 9. The contacts of this plug are arranged so that they form electric junctions with the ten brushes or terminals 27 to 36 and the brush 37, which extend into the opening 18 of the switch when the plug is inserted into this opening with its flange 56 engaging the outer face of the body 11, as shown in Figure 1. Upon comparison of Figures 7 and 8 with Figures 4 and 6, it will be evident that when the plug 44 is inserted in the opening 18 of the switch body 11, the brushes or contact elements 46, 48, 50, 52 and 54 will engage respectively the contacts 28, 30, 32, 34, and 36 which appear in Figure 4. On the underside of the plug 44 which is illustrated in Figure 7, the contacts 45, 47, 49, 51, 53 and 55 will engage respectively the terminals 37, 27, 29, 31, 33 and 35, the last five of which may be identified in Figure 6.

The frame 58 of the auxiliary control is composed of insulating material, and a drum 109 is

journaled in the frame by a shaft 110, which is rigid with the drum but slidable and rotatable within the frame so that the drum and its mountings can be rotated or moved endwise by turning or pressing a control knob 111. Embedded in this drum are three sets of segments, one segment of each set being shown in Figure 10 as 108, 108G and 108D extending through sectors of about 120 degrees each. One set of these segments 99 to 108 is visible when the drum is turned to the position shown in Figure 9; in this position the segments form electrical junctions between the brushes 59 to 68, and certain of the brushes 69 to 98, but if the drum were moved endwise, then these segments would form electrical junctions between double the number of brushes 69 to 98.

Mounted on this frame 58 of the auxiliary control are two sets of electric sounders 126, arranged to produce the musical tones indicated by their respective letters, and one set of these sounders will produce tones one musical octave above the other set. Each of these sounders has one of its terminals connected to a common wire 127, to provide electrical connection with the terminal 113 of the electric current supply source, and the opposite terminal of each of these sounders is connected to its respective brush, thus completing the circuit so that the current will pass between the terminal 113 of the current supply source to its other terminal 114 when the plug 44 is inserted into its opening in the switch device, and one or more of the projections 21 to 25 moved to make electrical contact with some of the brushes 27 to 36.

Attached by screws 57 to this auxiliary control frame 58 is an index plate having a slot or window, with the letter C showing through the slot therein in Figure 9. This letter is mounted on the drum 109 and rotates with it. The display of the letter C at the slot indicates that all of the sounds that can be produced when the drum is in this position are limited to tones composing the musical scale of C. If the drum were moved endwise, so as to sound both sets of sounders simultaneously, the letter C would still show through the slot in the indicator, and all of the sounds which could be produced with the drum in this position would still be in the musical key of C, but the tones produced by one set of sounders would be a musical octave above those produced by the sounders in the other set, and this would provide full concert tones.

By mounting on another sector of the drum segments, 99G to 108G shaped as shown in Figure 12, and turning the drum through 120 degrees, the tone of F-sharp would be played instead of F. The tones which could be sounded with the drum turned to this position would be those comprising the key of G, and this letter G would appear through the slot in the index plate instead of the letter C. Likewise, by utilizing segments 99D to 108D on another sector of the drum of the shape shown in Figure 13, the tone C would be changed to C-sharp, and the tones would be limited to those which comprise the musical key of D; and this letter D will appear through the slot in the index plate. Similarly, by suitable designing, as providing more sets of segments on the drum 109 all of the musical keys could be had with a single switch.

By blowing with the mouth into any of the openings 12 to 16 in front of the switch device 11, the flexible projection in this opening will be forced into contact with the bent end of its

registering upper brush or terminal, and this will close a circuit which will produce a musical tone; and by drawing with the mouth on this same hole the flexible contact will be engaged with the lower terminal and a different tone will be produced. If two or more holes are blown into simultaneously, two or more tones will be produced, and if suction is applied to two or more holes, two or more different tones will be produced simultaneously. If, while blowing into or drawing upon these holes and producing tones, the block **38** is pressed into the frame so as to alter the strength of the current producing the sound, the tone of this sound will be affected accordingly. If the block in worked in and out of the switch device in rapid succession, a quavering or tremolo sound will be produced, and if the block is forced in far enough to break the circuit in rapid interruptions, a vibrato sound will be produced; and as the artist acquires experience and skill, he will find that many other musical effects may be produced with the device.

The circuits of the switch device and its auxiliary control are so arranged that all circuits closed by blowing produce harmonious sounds, and all those closed by suction produce harmonious sounds; in other words, circuits which produce discordant sounds are separated from those which produce concordant sounds, and since it is impossible to blow the draw through the openings of the switch simultaneously, the possibility of producing discords in rendering a musical selection is eliminated.

In rendering a selection, if the air is carried by blowing or drawing in single holes with the tongue working on and off the adjacent holes in timed rhythm in the tempo of the selection being rendered, a harmonious chord effect will be produced. The two lower tones A and G have been added to the octave shown in Figure 9, to provide chord tones for the lower tones of the octave. From the above it will be seen that successive combinations of sounds can be produced which have different starting and ending periods from the initial or melody tone of that particular combination, thus providing an accompaniment for the melody.

The best way to render a musical selection with the device is to hold it between the left thumb and forefinger, with the tube **43** extending down under the left arm to the auxiliary control, and with the right-hand fingers extending over the end to work the block **38** in and out of the switch body **11** to produce the desired effect while blowing or drawing through single holes **12, 13, 14, 15** and **16** in the front of the switch. By positioning the lips so as to form an enclosure around the front entrance to the holes **13, 14, 15** and **16**, as shown by the dotted line in Figure 17, and positioning the tongue within this enclosure so as to close the front entrance to holes **14, 15** and **16**, as shown by the shaded portion of the enclosure, pressure or vacuum may be created within the hole **13**, which will cause the movable contact to form electrical connections with contact **29** or contacts **30** to close the corresponding circuit. The position of the lips may be moved endwise so as to uncover hole **16**, cover hole **13**, and bring the contacts of hole **12** under the control of the pressure or vacuum, and the range of this movement in either direction would be limited only by the number of holes provided in the switch. Since all of the contacts effected by pressure are in circuits that operate sounders that produce sounds that harmonize with each other and all of the contacts effected by vacuum are in circuits that have sounders that produce also harmonizing sounds, it follows that if the tongue is moved so as to momentarily allow pressure or vacuum to effect the contacts and sounders in holes covered by it, chord effects will be produced in timed rhythm according to the movement of the tongue.

In the alternative sounder illustrated in Figure 11, **128** is a ball hammer carried by a spring arm **129**, which has its opposite end in contact with a rigid block **130**. The arm **128** is connected to an armature **131**, which is pivoted at **132**. A sound bar **133** is also fixedly mounted, and the armature **131** carries a deadening pad or damper **134**. An insulated coil **135** energizes a magnet **136** when an electric current is admitted to it through its terminal leads **137** and **138**.

The sound bar, pivot, magnet and block are fixed in relation to each other, with the armature, pad and spring normally in the positions shown in this Figure 11, but when the current is admitted to the coil, the armature is quickly drawn toward it so that the hammer strikes the bar and produces the sound, and as soon as the current is interrupted, the armature is quickly returned to its normal position by the spring, and the damper pad **134** comes in contact with the bar, checking its vibration and preventing further sound.

A further alternative sounder is shown in Figure 14, wherein a disc **139** is rotatable on a shaft **140**, in the direction of the arrow, to bring teeth **141**, which are spaced around the perimeter of the disc, into contact with an armature sound bar **142**, which is pivoted at **143**, and held in normal position by a block **144**. A coil **145** energizes a magnet **146**, when an electric current is admitted to it through its terminals **147** and **148**.

The tone of the sound produced by a sounder of the class shown in Figure 14 is determined by the speed of the disc and the number of teeth it carries; for instance, if the speed of the disc shown were 1760 R. P. M., and the number of teeth it carried gave fifteen vibrations on each revolution, we would get the tone of A, at 440 vibrations per second, and if the number of teeth were increased, a higher pitch would be produced, while, if a lesser number of teeth were carried, we would get a lower pitch. Thus, if the shaft **140** carries a number of discs having different numbers of teeth, a full range of sounds will be produced by their respective armature bars.

In this Figure 14, the shaft **140**, the pivot **143**, the block **144** and the magnet are mounted in fixed relation to each other so as to hold the sound bar normally in the position shown, but on admission of the electric current to the coil, the bar will be drawn in contact with the moving teeth to produce a sound, but when the current is interrupted, the bar will be quickly returned to its normal position by the spring reaction of the bar against the block **144**.

By substituting an instrument equipped with a range of sounders of either of the alternative types for one of the octaves of tones shown in Figure 9, we would be able to execute musical selections with the switch shown in Figure 1, on two or more instruments simultaneously.

While the range of musical tones in the described embodiment has been confined to an octave with a few added tones to demonstrate chord and key effects, it must be understood that the invention is intended to extend to the fullest range of musical tones, and is applicable to many other musical instruments. With large instru-

ments actuated by steam or air, the valves of such instruments may be controlled by electrical relays of any suitable type, under control of the switch device of this invention.

In the modified construction shown in Figure 15, the body or frame block 160 is formed of insulating material with several transverse openings corresponding to the openings 12, 13, 14, 15 and 16 of the switch device already described. In this modified structure, one of these openings is shown at 161 as a bore extending from edge to edge of the body 160. A metallic tube 162 is fixed in one end of this bore in alignment with a second metallic tube 163 fixed in the other end. A ball 164 of steel or other magnetic metal is positioned movably in the bore 161 in the space between the inner ends of the tubes 162 and 163, and this ball is normally seated upon a suitably recessed iron bar 165 set into the body 160 and exposed at the lower side of the bore 161. Either the ball 164 or the bar 165 is permanently magnetized so that the ball is normally drawn onto its seat on the bar 165; but suction applied to the outer end of the tube 162 will draw the ball into contact with said tube 162, and by blowing into the tube 162 the ball can be shifted into contact with the tube 163. These two tubes correspond to the terminals 27 and 28 shown in Figure 3, and will be provided with electrical connecting wires (not shown), such wires forming a cable like that enclosed in the tube 43 and leading to an auxiliary control device, such as that shown in Figure 9. Such a cable will be accommodated in the rounded cover member shown at 166. Thus, the device of Figure 15 may be substituted for that of Figure 3 as the switch device of the invention, with the iron bar 165 connected into the circuit by means not shown in Figure 15, but corresponding substantially to the parts 26, 40, 39 and 37 of Figures 3 and 5.

I claim as my invention:

1. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, opposing terminal means of circuits for controlling different musical tones positioned in at least two of the openings and magnetic means responsive to selective action of the breath for controlling the circuits in determined combinations.

2. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, opposing terminal means of circuits for controlling different musical tones positioned in at least two of the openings and magnetic means responsive to selective action of the breath for controlling the circuits in determined combinations, the circuits and terminal means being arranged to limit the combinations to harmonizing tones.

3. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, opposing terminal means of circuits for controlling different musical tones, positioned in at least two of the openings and magnetic means, responsive to selective action of the breath, for controlling the circuits, the circuits and the terminal means being arranged to limit the controlled tones to a musical key.

4. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, opposing terminal means of circuits for controlling different musical tones, positioned in at least two of the openings and magnetic means, responsive to selective action of the breath, for controlling the circuits, the circuits and terminal means being arranged to limit the controlled tones to a musical key and transposing switch means for changing the tones from one musical key to a different musical key.

5. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, opposing terminal means of circuits for controlling different musical tones, positioned in at least two of the openings and magnetic means, responsive to the combined selective action of the breath and the tongue for controlling combinations of tones with musical chord effects.

6. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, like pole terminal means of circuits for controlling different musical tones, positioned in at least two of the openings and opposing common terminal means for the circuits, with projections extending adjacent the like pole terminal means in the openings, the projections being yieldable, in response to selective action of the breath, for operating the circuits in determined combinations.

7. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein and opposing pole terminal means of circuits for controlling different musical tones, positioned in at least two of the openings, a set of the pole terminal means being arranged for movement in response to selective action of the breath for operating the circuits in determined combinations.

8. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein and opposing pole terminal means of circuits for controlling different musical tones, positioned in at least two of the openings, a set of the pole terminal means being arranged for movement in response to selective action of the breath for operating the circuits in combinations, the circuits and terminal means being arranged to limit a combination to harmonizing tones.

9. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein and opposing pole terminal means of circuits for controlling different musical tones, positioned in at least two of the openings, a set of the pole terminal means being arranged for movement in response to selective action of the breath for operating the circuits in determined combinations and resistance means for varying the strength of the current in the circuits.

10. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein and opposing pole terminal means of circuits for controlling different musical tones, positioned in at least two of the openings, a set of the pole terminal means being arranged for movement in response to selective action of the breath for operating the circuits in determined combinations and finger operative means for introducing repetitions of minute interruptions in the closed circuits.

11. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein and opposing pole terminal means of circuits for controlling different musical tones, positioned in at least two of the openings, a set of the pole terminal means being arranged for movement in response to the combined selective action of the tongue and the breath for controlling combinations of tones with musical chord effects.

12. An electrical switch for controlling musical

tones which includes: a mouthpiece with an opening therein, like pole terminal means of a pair of circuits for controlling different musical tones, positioned within the opening and a common opposing terminal means for the circuits, positioned between the like pole terminal means, the common terminal means being operative in response to selective action of the breath for controlling either of the circuits.

13. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein, opposing terminal means of circuits for controlling different musical tones, positioned in at least two of the openings and means responsive to selective pressure of the breath for controlling combinations of tones which are in harmony with each other and also responsive to selective suction of the breath for controlling combinations of different tones which are also in harmony with each other.

14. An electrical switch for controlling musical tones which includes: a mouthpiece with openings therein and like pole terminal means of a pair of circuits for controlling different musical tones, positioned in at least two of the openings and a common opposing terminal for each pair of terminals, responsive to selective pressure of the breath to control harmonizing combinations of tones and also responsive to selective suction of the breath to control combinations of different harmonizing tones.

ERNEST ROBERT WORKMAN.

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