July 14, 1964 W. R. KISKER 3,141,056

VACUUM SWITCH

Filed Nov. 20, 1961 2 Sheets-Sheet 1

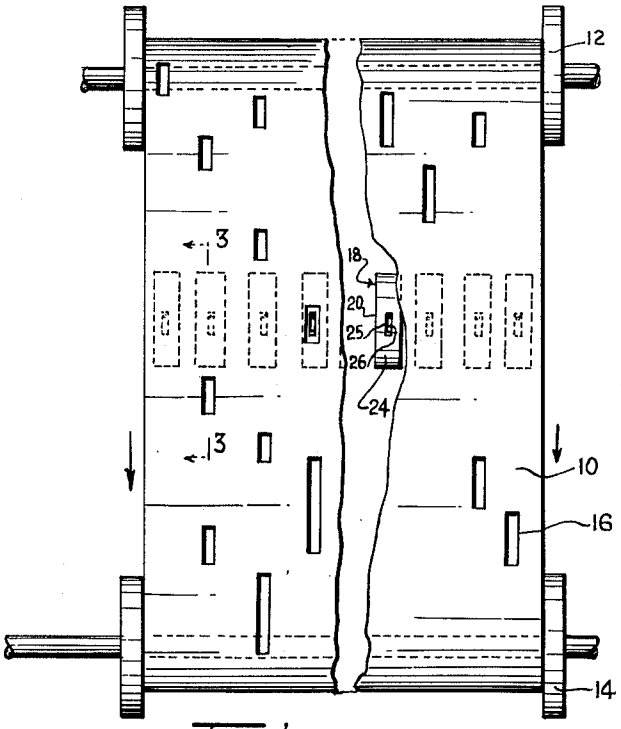


Fig. 1.

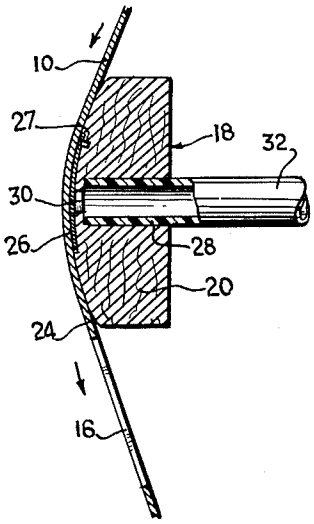


Fig. 3.

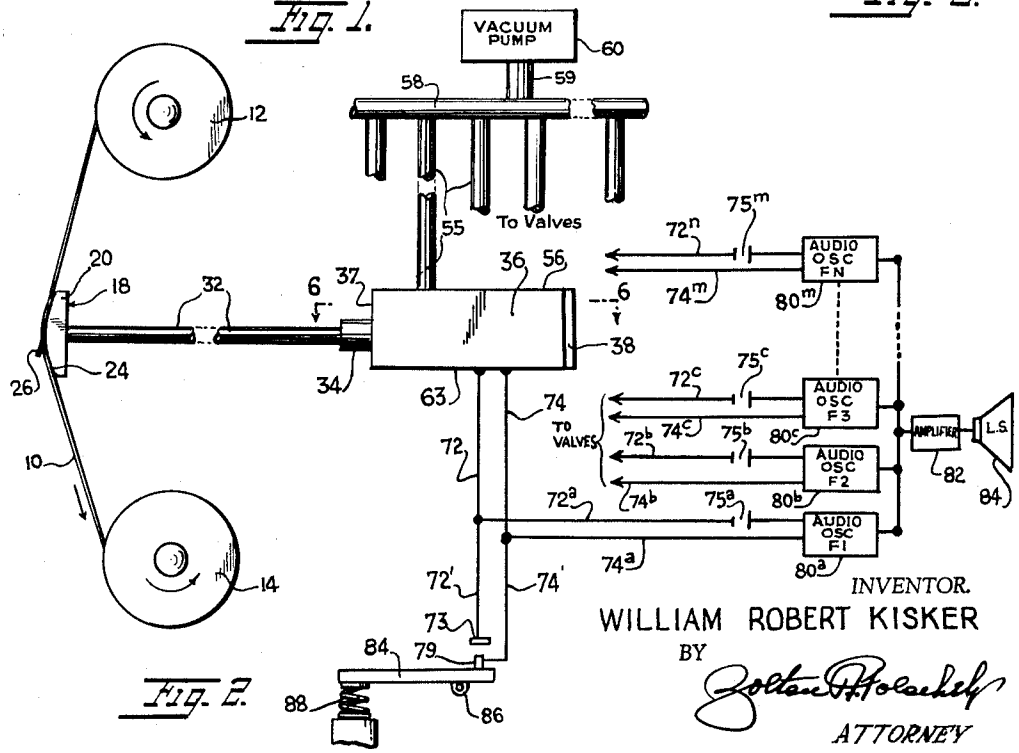


Fig. 2.

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VACUUM SWITCH

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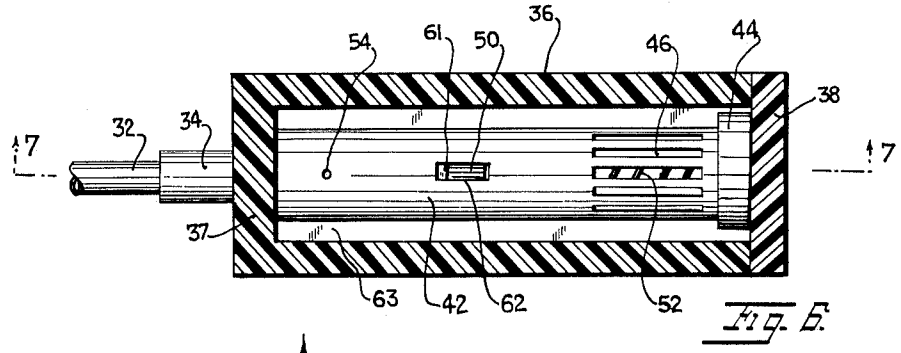


Fig. 6.

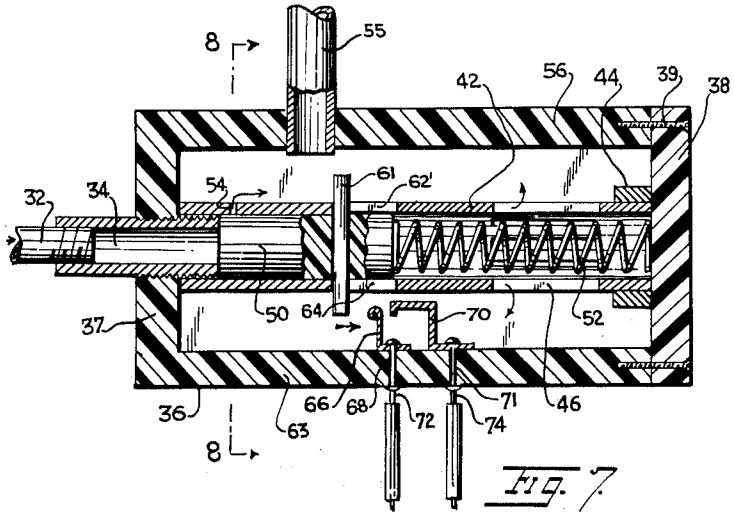


Fig. 7.

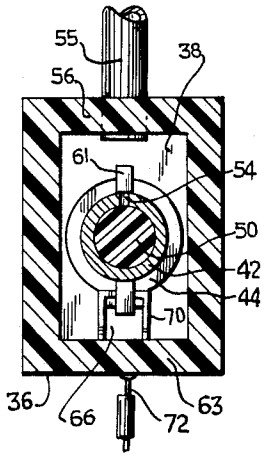


Fig. 8.

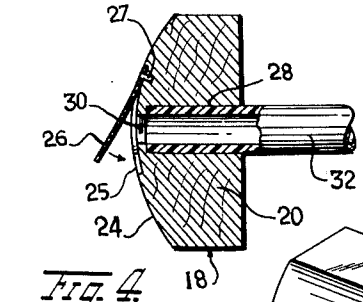


Fig. 4.

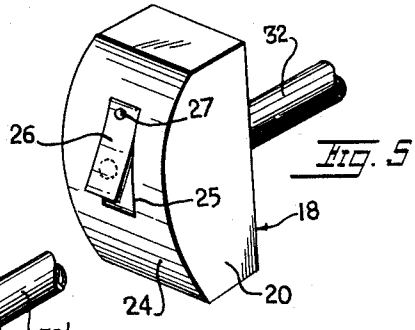


Fig. 5.

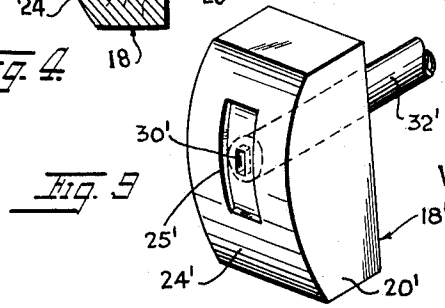


Fig. 9.

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3,141,056

VACUUM SWITCH

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3 Claims. (Cl. 84—1.03)

This invention relates to a vacuum switch device and particularly concerns a vacuum switch device for use in an electronic music generation apparatus or the like.

It is one object of the present invention to provide a vacuum switching device adapted for use with a perforated music roll or the like to operate electronic music generation means or other electrical circuitry.

It is another object to provide a vacuum switching device in a music generation system or the like, which device is operable in parallel with manually operated keys in the system.

According to the invention there is provided a switching device including a casing having a piston movable against spring tension in a vacuum maintained in the casing. The piston is movable axially by admission of air under atmospheric pressure via a valve. The valve is disposed to track a moving perforated sheet. When a perforation is encountered, air enters the valve via the perforation in the sheet to move the piston. When the piston is retracted it closes electrical contacts in the casing. The contacts are connected in an external circuit for actuation of an audio signal generator.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawings, and to the appended claims in which the various novel features of the invention are more particularly set forth.

In the accompanying drawings forming a material part of this disclosure:

FIG. 1 is a front elevational view of a music roll and an assembly of switching devices according to the invention, parts being broken away.

FIG. 2 is a side elevational view on a reduced scale of the music roll, part of the assembly of switching devices, and parts of associated electrical circuitry shown schematically.

FIG. 3 is a sectional view on an enlarged scale through an air valve employed in the system.

FIG. 4 is a sectional view on an enlarged scale similar to FIG. 3, showing the valve in open condition.

FIG. 5 is a perspective view of the air valve on an enlarged scale.

FIG. 6 is a sectional view on an enlarged scale taken on line 6—6 of FIG. 2.

FIG. 7 is a sectional view taken on line 7—7 of FIG. 6.

FIG. 8 is a sectional view taken on line 8—8 of FIG. 7.

FIG. 9 is a similar view to FIG. 5, showing another valve arrangement.

In the drawings is shown a sheet 10 of extended length supported on an upper supply roller 12 and a lower take-up roller 14. The sheet is moved continuously in the direction of its length from roller 12 to roller 14. The sheet 10 has rectangular perforations 16 arranged in spaced columns along the length of the sheet. The perforations have different lengths for a purpose to be described. The sheet is entrained over a plurality of spaced valves 18 arranged in a horizontal row, so that the perforations in each column move over a different valve.

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The valve structure is shown to best advantage in FIGS. 1–5. Each valve has a head 20 formed of a wood, metal or plastic block having a curved, convex front face 24. In the front face is a rectangular recess 25. A leaf spring 26 is secured by a rivet 27 at its top end in the recess. The lower end of the spring normally projects outwardly and downwardly. The sheet 10 is tensioned over the valves so that all springs 26 are fully compressed and held in the recesses of the valve heads, as clearly shown in FIG. 3. When a perforation 16 is encountered, the free end of the spring, which is narrower than the perforation and shorter than the shortest of the perforations, extends outwardly through the perforation to open a passage for air into the valve. Each valve has a transverse bore 28 extending from front to rear of the valve head. The bore has a narrow end 30 open at the front of the valve head behind the spring in the rear of recess 25. In the wider rear end of the bore 28 is fitted a tube 32. This tube is normally closed to the outside air. When the valve opens air can enter the tube through the end 30 of bore 28.

In FIG. 9, the valve 18' is shown without a leaf spring 26. In other respects, this form of the invention is similar to the previous form and the corresponding parts may be recognized by similar reference numerals with a prime added.

Tube 32 is connected to the casing 36 forming part of the vacuum switching device 40. Tube 32 terminates at a fitting 34 threaded in the front end wall 37 of casing 36, as shown in FIG. 7. The casing has an opposite rear end wall 38 held by screws 39. Between the end walls is secured a hollow cylinder 42. The cylinder is threaded on the fitting 34 at one end and is engaged in a cylindrical seat 44 on wall 38 at the other end. The cylinder has circumferentially spaced openings 46 near its rear end. In the cylinder is a cylindrical piston 50 engaged by a coil spring 52 which normally urges the piston axially forward to the fitting 34. The cylinder has a small lateral hole 54 normally closed by piston 50. The interior of the cylinder beyond the rear end of the piston communicates with the interior of the casing via openings 46. A pipe 55 is connected from the top wall 56 of the casing to a manifold 58. A vacuum pump 60 is connected to the manifold via a connecting pipe 59. A plurality of pipes 55 are provided as shown in FIG. 2, each of which terminates at a different casing 36 (not shown).

A pin 61 extends through the piston and slots 62, 64 formed in diametrically opposed positions in the cylinder. The pin extends diametrically outward of the cylinder. A spring contact member 66 is secured to the bottom wall 63 of the casing by a rivet 68. This contact has an upwardly extending finger which can be contacted by pin 61 and bent rearwardly when the piston 50 is retracted. A rigid contact member 70 is secured by rivet 71 to bottom wall 63 rearwardly of contact 66. Wires 72, 74 are connected to the contact members 66.

Wire 72 is connected via wire 72^a to one terminal of a battery or other power supply 75^a. Other similar wires 72^b, 72^c . . . 72^n are connected to other similar power supplies 75^b, 75^c . . . 75^n. Wire 74 is connected to wire 74^a. Wire 74^a and other similar wires 74^b, 74^c . . . 74^n are connected to different casings 36 and terminate at individual, separate audio oscillators or audio signal generators 80^a, 80^b, 80^c . . . 80^n. The several oscillators generate different audio frequencies F1, F2, F3 . . . FN.

The audio oscillators are connected to an amplifier 82 which drives one or more loud-speakers 84.

In parallel with wires 72 and 74 are respective wires 72' and 74'. Wire 72' terminates at a fixed contact 73. Wire 74' terminates on a contact 79 mounted at the end of a key 84 pivoted on a pin 86 against tension in spring 88. Contacts 73 and 79 are normally separated. Contact members 66 and 70 in the casing 36 are also normally separated so that the input circuit to oscillator 80a is normally open.

In operation of the device, the springs 26 of the several valves are held closed and retracted by the tensioned sheet 10 as the sheet moves across the valves. A vacuum is maintained in each of casings 36. If any one or more valve springs 26 encounters one or more perforations 16, air will enter the bore end 30 and tube 32 to retract the piston 50 axially. As the piston retracts it closes contacts 66, 70 which closes the input circuit of the oscillator associated with the closed contacts. A single tone or a mixture of tones are generated by the actuated oscillator or oscillators. A tone is generated only as long as the outside air pressure is applied to the piston 50. This pressure will be applied only while the free end of spring 26 projects outwardly of recess 25 into opening 16. The length of the opening 16 determines the length of time that the valve 18 is open, since the sheet 10 moves continuously and preferably at a constant or substantially constant speed. When valve 18 closes upon retraction of the spring 26 into recess 25, the outside air is closed off from the casing 16. Air trapped in the tube 32 escapes through the hole 54. Spring 52 returns the piston 50 to the forward position at fitting 34 closing hole 54. The vacuum is maintained in the casing by pump 60, so that only the pressure of the spring 52 need be overcome by the air pressure applied through open valve 18.

The arrangement is such that the keys 84, of which only one is shown in FIG. 2, can be played independently of the vacuum switching system to generate musical tones. The invention thus adapts an electronic music generating apparatus such as an electronic organ to automatic playing of music rolls.

The vacuum switching device can be connected to any other suitable type of electrical circuitry responsive to closing and opening of the contacts 66, 70. Instead of perforated music rolls, the sheet 10 could be perforated to record data representing intelligence of other subject matter than music.

While I have illustrated and described the preferred embodiment of my invention, it is to be understood that I do not limit myself to the precise construction herein disclosed and that various changes and modifications may be made within the scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new, and desire to secure by United States Letters Patent is:

1. A switching system, comprising a closed casing, means connected to said casing for maintaining a vacuum therein, said casing having an opening in one wall thereof, a perforated, hollow cylindrical member in said casing axially aligned with said opening, said member having a radial hole, a piston movably mounted in said member, spring means in said member bearing on said piston and urging said piston to close said hole, a tube connected to said opening, a valve connected to said tube and communicating with the atmosphere for admitting air to the tube and retraction of the piston when the valve is open, a pair of normally open switch contacts disposed in said casing, an electric apparatus in circuit with said switch contacts adapted to be operated when the switch contacts are closed, an actuating element carried by said piston disposed to close the switch contacts when the piston is retracted, said valve including a head having a passage therethrough communicating with said tube, a flexible valve element carried by said head in normally open position, and a sheet supported between supply and takeup rollers and movable past said head and directly against said valve element under tension so that said flexible valve element is retracted to close said passage, said sheet having spaced perforations arranged in a column extending lengthwise of the sheet in alignment with said valve element, whereby said valve element automatically enters said perforations and open said passage for closing said switch contacts, a key, and another pair of switch contacts connected in parallel with the first-named contacts of said electrical apparatus, said other contacts being disposed for actuation by said key, whereby said apparatus is selectively actuated by operating said key and by opening and closing said valve, said apparatus comprising an audio signal generator having an input connected in circuit with the first-named and said other contacts, an amplifier connected to said generator, and a loud-speaker connected to the amplifier, whereby movements of said key and said valve element result in production of sounds of predetermined frequency by the loud-speaker.

2. A switching system, comprising a closed casing, means connected to said casing for maintaining a vacuum therein, said casing having an opening in one wall thereof, a perforated, hollow cylindrical member in said casing axially aligned with said opening said member having a radial hole, a piston movably mounted in said member, spring means in said member bearing on said piston and urging said piston to close said hole, a tube connected to said opening, a valve connected to said tube and communicating with the atmosphere for admitting air to the tube and retraction of the piston when the valve is open, a pair of normally open switch contacts disposed in said casing, an electric apparatus in circuit with said switch contacts adapted to be operated when the switch contacts are closed, an actuating element carried by said piston disposed to close the switch contacts when the piston is retracted, said valve including a head having a passage therethrough communicating with said tube, a flexible valve element carried by said head in normally open position, and a sheet supported between supply and takeup rollers and movable past said head and directly against said valve element under tension so that said flexible valve element is retracted to close said passage, said sheet having spaced perforations arranged in a column extending lengthwise of the sheet in alignment with said valve element, whereby said valve element automatically enters said perforations and open said passage for closing said switch contacts, said apparatus comprising an audio signal generator having an input connected in circuit with said contacts, whereby movements of said valve element result in production of audio signals of predetermined frequency by said generator.

3. A switching system, comprising a closed casing, means connected to said casing for maintaining a vacuum therein, said casing having an opening in one wall thereof, a perforated, hollow cylindrical member in said casing axially aligned with said opening said member having a radial hole, a piston movably mounted in said member, spring means in said member bearing on said piston and urging said piston to close said hole, a tube connected to said opening, a valve connected to said tube and communicating with the atmosphere for admitting air to the tube and retraction of the piston when the valve is open, a pair of normally open switch contacts disposed in said casing, an electric apparatus in circuit with said switch contacts adapted to be operated when the switch contacts are closed, an actuating element carried by said piston disposed to close the switch contacts when the piston is retracted, said valve including a head having a passage therethrough communicating with said tube, a flexible valve element carried by said head in normally open position, and a sheet supported between supply and takeup rollers and movable past said head and directly against said valve element under tension so that said flexible valve element is retracted to close said passage, said sheet having spaced perforations arranged in a column extend-

ing lengthwise of the sheet in alignment with said valve element, whereby said valve element automatically enters said perforations and open said passage for closing said switch contacts, said apparatus comprising an audio signal generator having an input connected in circuit with said contacts, whereby movements of said valve element result in production of audio signals of predetermined frequency by said generator, an amplifier connected to said generator and a loud-speaker connected to said amplifier for reproducing said audio signals audibly.

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