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ELECTRONIC MUSICAL INSTRUMENT

Filed Aug. 19, 1964

2 Sheets-Sheet 1

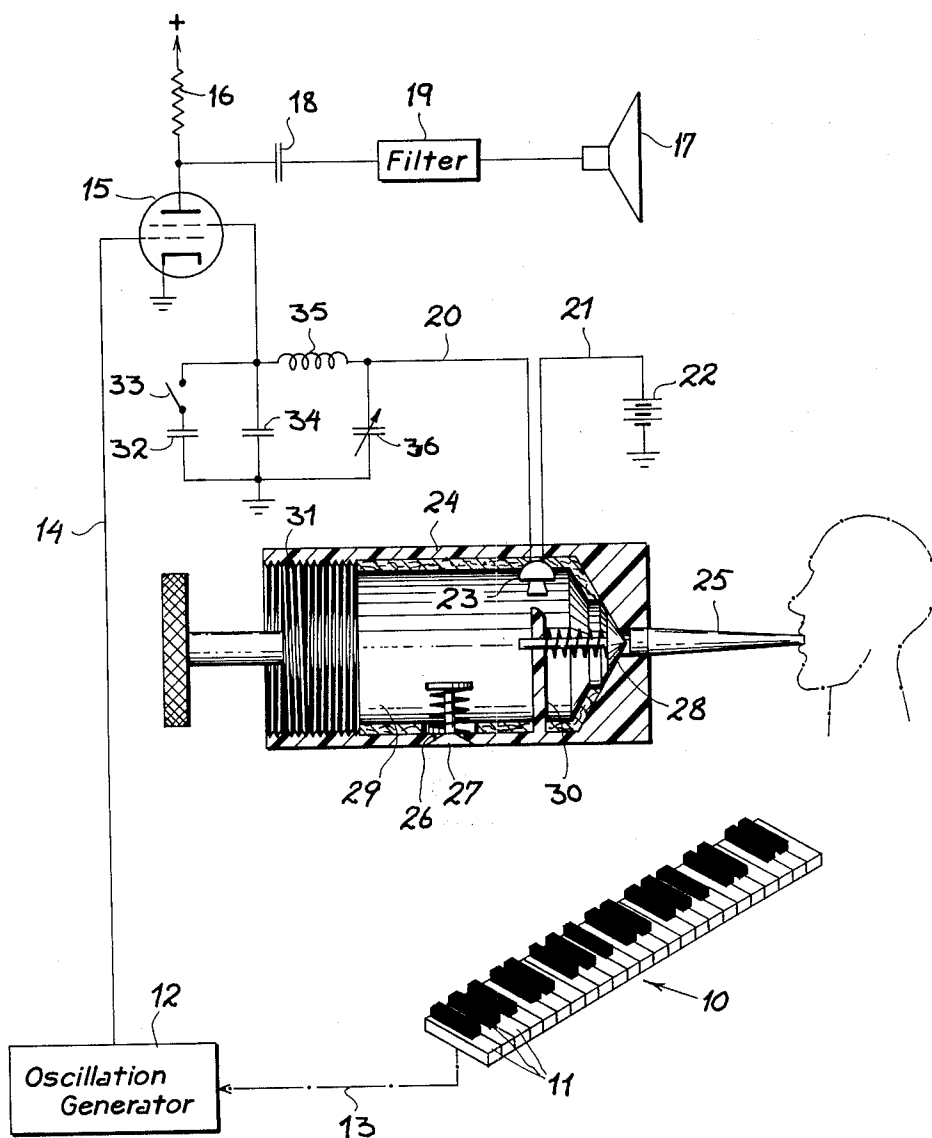


Fig.1

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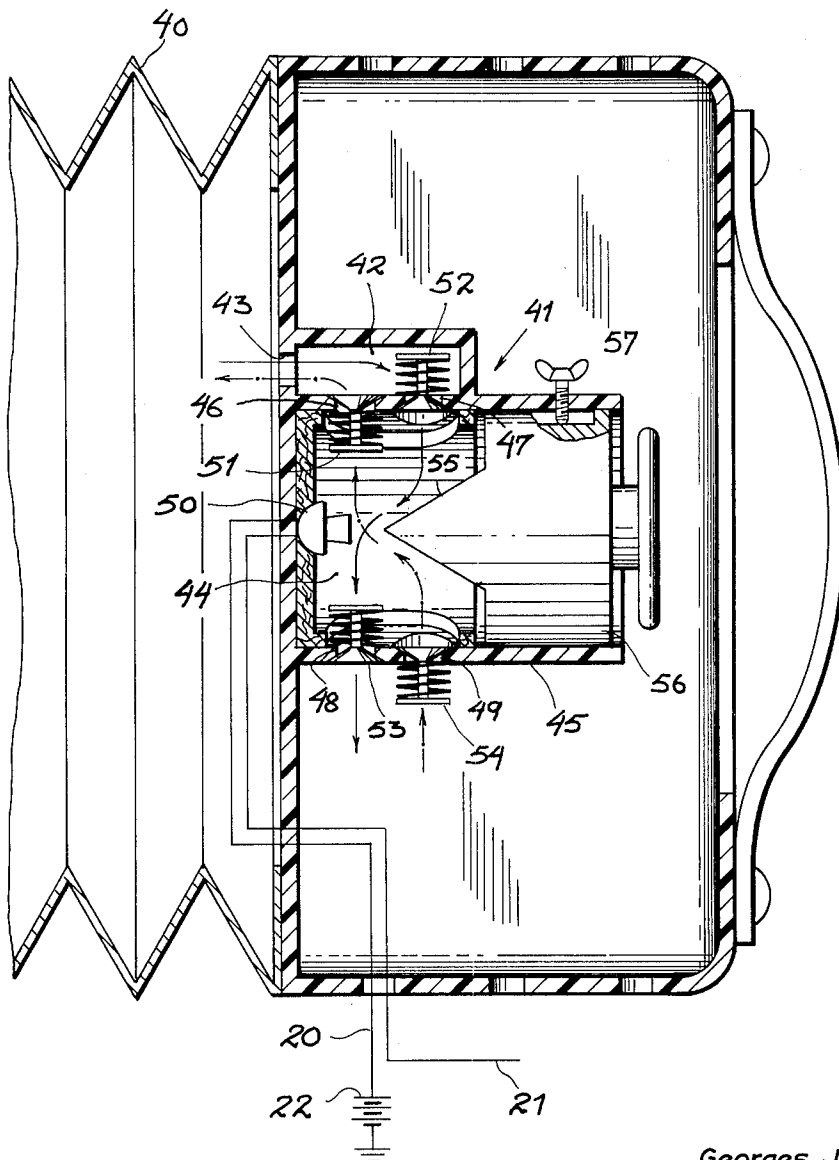


Fig. 2

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ELECTRONIC MUSICAL INSTRUMENT

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7 Claims. (Cl. 84-1.13)

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In my copending application Ser. No. 390,694, filed on even date herewith as a continuation-in-part of my application Ser. No. 123,818, filed July 13, 1961, I have disclosed an electronic musical instrument in which the desired simulation of the performance of a wind instrument is accomplished with the aid of a body-actuated source of air flow, such as a mouthpiece or bellows operable by hand or foot, in combination with flow-blocking means oscillatable at subaudible frequencies to control an amplitude-modulating network in the output circuit of an associated tone generator. My present invention is directed to a different solution in which the amplitude-modulating network is controlled by an electroacoustic transducer responsive to frequencies in the sonic range.

Attempts to utilize such transducers for the purpose set forth have heretofore been unsuccessful because of sonic interferences from the instrument itself, in particular acoustic feedback from the output of the tone generator. This feedback, because of the finite transit time required by the sound waves traveling from the loudspeaker of the tone generator to the transducer, continues to stimulate the latter for some time after cessation of the original control force, e.g. that of a vibrating air column excited by the aforementioned mouthpiece or bellows. It is, therefore, a more specific object of the instant invention to provide means for preventing such undesirable acoustic feedback.

These objects are realized, in conformity with my present invention, by the provision of a substantially soundproof enclosure forming a passage for an air flow generated by a body-actuated source, an electroacoustic transducer being disposed in that passage and being connected to a detector for converting sonic frequencies, picked up by the transducer, into a control voltage which in turn is applied to an amplitude-modulating device in the output of the associated tone generator. Feedback is prevented by the presence of one or more check valves in the outlet of the passage containing the transducer, these check valves closing immediately upon cessation of the air flow.

Advantageously, in accordance with another feature of my invention, the passage within the soundproof enclosure is provided with one or more discontinuities designed to deflect the air stream toward the transducer and, at the same time, to generate transverse vibrations in the moving air column so that the transducer, e.g., a capacitive or crystal-type microphone, is most effectively actuated. In the case of a reversible air flow, e.g. as produced by an accordion, two oppositely biased check valves may be provided.

The invention will be described in greater detail with reference to the accompanying drawing in which:

FIG. 1 is a partly diagrammatical view of a mouth-operated modulating system according to the invention; and

FIG. 2 is a cross-sectional view of an accordion embodying the invention in modified form.

In FIG. 1 I have shown a keyboard 10 whose keys 11 individually control, in a manner known per se, an oscillation generator 12 via a set of conductors symbolized by a connection 13. An output lead 14 of generator 12 terminates at the control grid of an amplifier tube 15, here shown as a tetrode, whose plate is connected to high positive voltage via a resistor 16 and is further coupled to a loudspeaker 17 by way of a blocking condenser 18 and a filter 19.

The screen grid of tetrode 15 is connected via leads 20, 21 to positive voltage at a battery 22 by way of a microphone 23 in a substantially windproof enclosure 24 having suitably padded walls. This enclosure forms a passage for a flow of air entering via a mouthpiece 25 into which the user may blow, the air exiting by way of an outlet port 26 provided with a spring-biased check valve 27 which is normally closed. Another check valve 28, similarly spring-loaded blocks the inlet to the chamber 29 within enclosure 24 when no air pressure is applied to the mouthpiece 25.

Chamber 29 is partly subdivided by a partition 30 which represents a discontinuity in the path of the air stream and which is disposed next to the microphone 23 so that the air flow is deflected toward the latter in its passage through the chamber. The volume of chamber 29 can be adjusted with the aid of a plug 31 threadably inserted into its end opposite mouth piece 25.

The microphone 23 with its operating battery 22 is shunted by network of manually adjustable impedance including a first condenser 32 in series with a switch 33 and a second condenser 34 in parallel therewith; an inductance 35 and a further condenser 36, which may be adjustable as shown, supplement to condensers 32 and 34 to constitute an adjustable filter in the output of microphone 23. This network permits selective variation of the passband constant of the input circuit of amplifier 15 to modify the response characteristic of the oscillation generator 12 as modulated by an air stream applied to the mouthpiece 25. Such modification of the response characteristic is also obtained by a displacement of plug 31.

In operation, a skilled musician will be able to produce a variety of artistic expressions in modulating the output of tone generator 12, as selected with the aid of keyboard 10, under the control of his own breath as he blows more lightly or more strongly into the mouthpiece 25. The voltage of battery 22 or of other biasing source associated with tube 15 may, of course, be so chosen that the acoustic output of loudspeaker 16 is zero or at a selected minimum intensity when the mouthpiece 25 is not blown into.

In FIG. 2 I have shown at 40 the bellows of an otherwise conventional accordion provided with an attachment 41 which forms a passage 42 communicating with the interior of the bellows via an orifice 43. A chamber 44 within a soundproof enclosure 45 is connected by way of two ports 46, 47 with the passage 42 and by way of two ports 48, 49 with the surrounding atmosphere. A microphone 50 is mounted into the chamber 44 and connected between leads 20 and 21 in the manner and for the purpose illustrated in FIG. 1 with reference to microphone 23.

The ports 46-49 are occupied by check valves 51, 52, 53 and 54 normally closing the chamber against the outer atmosphere in the interior of bellows 40. When the bellows 40 is compressed, the resulting pressure differential between its interior and the outer atmosphere opens the valves 52 and 53 to let a flow of air pass through the chamber 44 in the direction indicated by solid arrows; when the bellows is expanded, the reversal of the pressure differential opens the check valves 51 and 54 so that air flows through the chamber in the direction shown by dot-dashed arrows. A wedge-shaped projection 55 on a plug 56 forms a discontinuity designed to direct either air flow toward the microphone 50; the plug 56 is axially shiftable in the cylindrical chamber 45 to vary the distance between projection 55 and microphone 50, a set screw 57 serving to immobilize the plug 56 in a selected position.

As will be apparent, the microphone 50 picks up sonic frequencies from the onrushing air stream upon both compression and expansion of the bellows 40, in much the same manner as does the microphone of FIG. 1 when air is blown into the mouth piece 25.

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It will be apparent that the mouth piece 25 and the bellows 40 are representative of a variety of body-actuated means for generating a variable air flow and that such means may be used with either the system of FIG. 1 or that of FIG. 2; other modifications readily apparent to persons skilled in the art are also intended to be embraced within the spirit and scope in my invention as defined in the appended claims.

I claim:

1. In a musical instrument having an electronic tone generator and a multiplicity of individually operable tone selectors connected to said generator for energizing the latter to produce a variety of audible frequencies, the combination therewith of a body-actuated source of air flow, a substantially soundproof enclosure forming a passage for said air flow, electroacoustic transducer means in said passage for picking up sonic frequencies associated with said air flow, detector means connected to said transducer means for converting said sonic frequencies into a control voltage, amplitude-modulating means for the output of said generator responsive to said control voltage and connected to said detector means, and check-valve means in the outlet of said passage for preventing acoustic feedback from said generator to said detector means upon cessation of said air flow.

2. The combination defined in claim 1 wherein said source comprises a mouthpiece.

3. The combination defined in claim 1 wherein said source comprises a manually operable bellows.

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4. The combination defined in claim 1 wherein said amplitude-modulating means includes impedance means adjustable independently of said source.

5. In a musical instrument having an electronic tone generator and a multiplicity of individually operable tone selectors connected to said generator for energizing the latter to produce a variety of audible frequencies, the combination therewith of a body-actuated source of air flow, a substantially soundproof enclosure forming a discontinuous passage for said air flow, electroacoustic transducer means located in said enclosure at a discontinuity of said passage for picking up sonic frequencies associated with said air flow, detector means connected to said transducer means for converting said sonic frequencies into a control voltage, amplitude-modulating means for the output of said generator responsive to said control voltage and connected to said detector means, and check-valve means in the outlet of said passage for preventing acoustic feedback from said generator to said detector means upon cessation of said air flow.

6. The combination defined in claim 5 wherein said check-valve means includes a pair of oppositely biased check valves permitting flow reversal in said passage.

7. The combination defined in claim 6 wherein said discontinuity is constituted by a wedge-shaped formation disposed to intercept said air flow in both directions and to deflect it toward said transducer means.

No references cited.

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