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(54) **Electronic accordion**

Elektronisches Akkordeon

Accordéon électronique

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Description

Field of Industrial Utilization

[0001] The present invention relates to an electronic accordion that is furnished with a keyboard, a bellows, and a sound source, and with which a musical tone is generated in conformance with the operation of the keyboard and the bellows.

Prior Art

[0002] Electronic accordions are known with which the keyboard and the pressure in the bellows are detected and a musical tone is generated from a sound source that is configured by an electronic circuit in conformance with the operation of the keyboard and the operation of the bellows.

[0003] In Japanese Laid-Open Patent Application Publication (Kokai) Number 2002-366145 (Patent Reference 1), an electronic accordion is disclosed with which it is possible to simulate the musical tones that are produced by an acoustic accordion.

[0004] United States Patent No. 4,196,650 discloses a valve system controlling an opening of the bellows of an electronic accordion depending on the number of keys depressed. U.S. Patent No. 3,250,843 describes a pressure sensor for an electronic accordion, detecting air pressure using two closed pistons arranged to compress a variable resistance element whenever the pressure in the bellows changes.

Disclosure of the Invention

Problems of Prior Art To Be Addressed by the Invention

[0005] However, with the electronic accordions of the past, the aspect of the reactive force with which the bellows act in those cases where the bellows are operated is different than the aspect of this kind of reactive force of the bellows of an acoustic accordion and there have been the weaknesses that the performance is difficult or that there is a feeling of unease.

[0006] This is because of the fact that the structures for the intake of air into the bellows or the discharge of air from the bellows due to the operation of the keyboard and the operation of the bellows are different in the acoustic accordion and in the electronic accordion.

[0007] The acoustic accordion has sound holes for each key with which air enters and exits and sound hole covers and reeds that vibrate due to the discharge of air or the intake of air that are furnished at each of the sound holes. When a key is pressed down, the sound hole cover is opened, and when a key is released, the sound hole cover is closed. Accordingly, when a large number of keys are pressed down, many air holes link through to the outside, the resistance of the airflow is reduced, and it is possible to easily open and close the bellows.

[0008] When the reeds begin to vibrate, the amplitude gradually increases and the flow of the air that passes through the sound hole changes. In addition, a plurality of reeds for which the pitch is slightly different and reeds for different octaves are furnished at each sound hole and each reed is furnished with a shutter that cuts off the air. By means of the switching of these shutters, it can be made such that a plurality of reeds produce sounds for a single tone and it is possible to set the timbre. The setting of the timbre is carried out by the performer operating a register switch. Accordingly, since the numbers and the types of reeds that are used from among this plurality of reeds are different depending on the timbre, the flow of air changes.

[0009] In addition, these reeds are each furnished with a check valve (reed leather) such that vibration does not occur during the intake of air for a reed that vibrates during air discharge and does not occur during the discharge of air for a reed that vibrates during air intake. In those cases where these check valves are closed when the air pressure in the bellows is a pressure that is the same as atmospheric pressure and when the pressure in the bellows increases or decreases, open again, there is a phenomenon such as that in which the resistance of the air flow becomes higher for an instant.

[0010] In contrast to this, with the electronic accordions of the past, control is carried out in which the air valves with which the bellows has been furnished open and close in conformance with the operation of the keys of the keyboard.

[0011] The present invention has been done in order to remedy the weaknesses described above and has as its object the provision of an electronic accordion with which an operating feeling can be obtained that closely resembles the operation of the bellows of an acoustic accordion.

[0012] In order to achieve the object described above, the electronic accordion cited in Claim 1 is, for one that has been furnished with a keyboard section that has a plurality of operators that prescribe the pitch of a musical tone and the generation and termination of the musical tone, and a bellows that intakes or discharges air, and an air pressure sensor that detects the air pressure in the bellows, and a sound source that forms a musical tone having the pitch that is prescribed by an operator of the previously mentioned keyboard section in conformance with the air pressure that has been detected by the air pressure sensor, furnished with an air valve that adjusts the degree of opening of an air hole with which the air is taken into the previously mentioned bellows or the air in the bellows is discharged, and degree of opening setting means that adjusts the degree of opening of the previously mentioned air valve in conformance with the air pressure that has been detected by the previously mentioned air pressure sensor, and control means that controls the previously mentioned air valve in conformance with the degree of opening that has been set by the previously mentioned degree of opening setting means.

[0013] The electronic accordion cited in Claim 2 is, for the electronic accordion cited in Claim 1, one in which the previously mentioned degree of opening setting means is one that sets the degree of opening in conformance with the case in which the air pressure that has been detected by the previously mentioned air pressure sensor is greater than atmospheric pressure and the case in which the air pressure is less than atmospheric pressure.

[0014] The electronic accordion cited in Claim 3 is, for the electronic accordion cited in Claim 1 or Claim 2, one that is furnished with pressed key state detection means that detects the state in which an operator of the previously mentioned keyboard section is being operated, and in which the previously mentioned degree of opening setting means is one in which the degree of opening of the previously mentioned air valve is set in conformance with the pressed key state that has been detected by the previously mentioned pressed key state detection means and the air pressure that has been detected by the previously mentioned air pressure sensor.

[0015] The electronic accordion cited in Claim 4 is, for the electronic accordion cited in Claim 3, one in which the previously mentioned degree of opening setting means is one that closes the previously mentioned air pressure valve in those cases where the number of pressed keys that has been detected by the previously mentioned pressed key state detection means is zero and sets the degree of opening of the previously mentioned air valve to a minimum degree of opening greater than zero in those cases where the number of pressed keys is one or greater and, moreover, the air pressure that has been detected by the previously mentioned air pressure sensor has been detected to be equal to atmospheric pressure, and that sets the degree of opening greater than the previously mentioned minimum degree of opening in those cases where the number of pressed keys that has been detected by the previously mentioned pressed key state detection means is one or more and, moreover, the air pressure that has been detected by the previously mentioned air pressure sensor is a specified value.

[0016] The electronic accordion cited in Claim 5 is, for the electronic accordion cited in Claim 4, one in which the previously mentioned degree of opening setting means is one in which the degree of opening of the previously mentioned air valve is altered in those cases where the previously mentioned air pressure has exceeded a specified value.

[0017] The electronic accordion cited in Claim 6 is, for the electronic accordion cited in any of the Claims 3 through 5, one in which the accordion is furnished with speed setting means that sets the speed at which the degree of opening changes up to the degree of opening that has been set by the previously mentioned degree of opening setting means, and the previously mentioned control means is one that controls the previously mentioned air valve in conformance with the degree of open-

ing that has been set by the previously mentioned degree of opening setting means and the speed that has been set by the previously mentioned speed setting means.

[0018] The electronic accordion cited in Claim 7 is, for the electronic accordion cited in Claim 6, one in which the previously mentioned degree of opening setting means sets a first degree of opening in conformance with the pressed key state and the air pressure that has been detected by the previously mentioned air pressure sensor in those cases where the pressed key state has been detected to have changed by the previously mentioned pressed key state detection means, and sets a second degree of opening in those cases where the pressed key state is fixed and the air pressure that has been detected by the previously mentioned air pressure sensor has been detected to have changed, and the previously mentioned speed setting means sets a first speed that changes the degree of opening up to the first degree of opening that has been set by the previously mentioned degree of opening setting means, and, after the degree of opening of the air valve reaches the degree of opening that has been set by the previously mentioned degree of opening setting means, sets a second speed, and the previously mentioned control means controls the previously mentioned air valve at the first speed up to the first degree of opening during the time that the pressed key state that has been detected by the previously mentioned pressed key state detection means does not change, and, after the degree of opening of the air valve reaches the first degree of opening, controls the air valve at the second speed up to the second degree of opening.

[0019] The electronic accordion cited in Claim 8 is, for the electronic accordion cited in Claim 6 or 7, one in which the previously mentioned speed setting means is one that sets both the speed in those cases where the degree of opening is increased and the speed in those cases where the degree of opening is decreased.

[0020] The electronic accordion cited in Claim 9 is, for the electronic accordion cited in Claim 8, one in which the previously mentioned speed setting means sets the speed in conformance with the air pressure that has been detected by the previously mentioned air sensor in those cases where the degree of opening is increased and sets a fixed speed in those cases where the degree of opening is decreased.

[0021] The electronic accordion cited in Claim 10 is, for the electronic accordion cited in any of the Claims 6 through 9, one in which the previously mentioned speed setting means is one that sets the speed in conformance with the case in which the air pressure that has been detected by the previously mentioned air pressure sensor is greater than atmospheric pressure and the case in which the air pressure is less than atmospheric pressure.

Advantageous Result of the Invention

[0022] In accordance with the electronic accordion cited in Claim 1, since the accordion is furnished with an

air valve that adjusts the degree of opening of an air hole with which the air is taken into the bellows or the air in the bellows is discharged, and degree of opening setting means that adjusts the degree of opening of the air valve in conformance with the air pressure that has been detected by the air pressure sensor, and control means that controls the air valve in conformance with the degree of opening that has been set by the degree of opening setting means, there is the advantageous result that it is possible to obtain an operating feeling that closely resembles the operation of the bellows of an acoustic accordion. In an acoustic accordion, air is supplied to the sound hole from the bellows or air is supplied from outside and the reed vibrates. The greater the difference between the air pressure in the bellows and atmospheric pressure, the greater the amplitude of the reed vibration becomes and the easier the flow of the air becomes. Therefore, due to the fact that the degree of opening of the air valve is controlled in conformance with air pressure in the bellows, it is possible to produce an operating feeling that closely resembles that of the bellows of an acoustic accordion.

[0023] In accordance with the electronic accordion cited in Claim 2, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 1, the degree of opening setting means is one that sets the degree of opening in conformance with the case in which the air pressure that has been detected by the air pressure sensor is greater than atmospheric pressure and the case in which the pressure is less than atmospheric pressure. In an acoustic accordion, since the flow path of the air is different in those cases where the bellows is expanded and in those cases where the bellows is compressed, the load applied to the bellows is different in the case where the bellows is expanded and the case where the bellows is compressed, and there is the advantageous result that it is possible to simulate this condition.

[0024] In accordance with the electronic accordion cited in Claim 3, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 2, since the accordion is furnished with pressed key state detection means that detects the state in which an operator of the keyboard section is being operated, and the degree of opening setting means is one in which the degree of opening of the air valve is set in conformance with the pressed key state that has been detected by the pressed key state detection means and the air pressure that has been detected by the air pressure sensor, there is the advantageous result that it is even more possible to produce an operating feeling that closely resembles that of the bellows of an acoustic accordion.

[0025] In accordance with the electronic accordion cited in Claim 4, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 3, the degree of opening setting means is one that closes the air pressure valve in those cases where the number of pressed keys that has been detected by the pressed key state detection means is zero and sets the degree

of opening of the air valve to a minimum degree of opening greater than zero in those cases where the number of pressed keys is one or greater and, moreover, the air pressure that has been detected by the air pressure sensor has been detected to be equal to atmospheric pressure, and that sets the degree of opening greater than the minimum degree of opening in those cases where the number of pressed keys that has been detected by the pressed key state detection means is one or more and, moreover, the air pressure that has been detected by the air pressure sensor is a specified value.

[0026] In an acoustic accordion, in those cases where a key or a performance button is pressed down, when the air pressure in the bellows becomes equal to atmospheric pressure, the check valve with which the reed is furnished blocks the air flow path. However, since the check valve does not completely close the sound hole, there is the advantageous result that it is possible to simulate this condition.

[0027] In accordance with the electronic accordion cited in Claim 5, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 4, the degree of opening setting means is one in which the degree of opening of the air valve is altered in those cases where the value that is specified for the air pressure has been exceeded.

[0028] In an acoustic accordion, in those cases where the pressure in the bellows has increased due to a state in which the check valve is blocking the air flow path, the check valve is not opened until the air pressure becomes a specified pressure or greater and there is the advantageous result that it is possible to simulate this condition.

[0029] In accordance with the electronic accordion cited in Claim 6, in addition to the advantageous result that is exhibited by the electronic accordion cited in any of the Claims 3 through 5, since the accordion is furnished with speed setting means that sets the speed at which the degree of opening changes up to the degree of opening that has been set by the degree of opening setting means, and the control means is one that controls the air valve in conformance with the degree of opening that has been set by the degree of opening setting means and the speed that has been set by the speed setting means, there is the advantageous result that it is even more possible to produce an operating feeling that closely resembles that of the bellows of an acoustic accordion. In an acoustic accordion, as discussed above, reeds are furnished in the sound holes and these reeds vibrate and produce the musical tones. However, when the sound hole cover is opened, the amplitude of the vibrations of the reed gradually increases. Accordingly, the amount of air that is taken into the bellows or that is discharged from the bellows gradually becomes greater and it is possible to simulate this kind of condition by setting the opening and closing speed of the air valve.

[0030] In accordance with the electronic accordion cited in Claim 7, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 6,

since the degree of opening setting means sets a first degree of opening in conformance with the pressed key state and the air pressure that has been detected by the air pressure sensor in those cases where the pressed key state has been detected to have changed by the pressed key state detection means, and sets a second degree of opening in those cases where the pressed key state is fixed and the air pressure that has been detected by the air pressure sensor has been detected to have changed, and the speed setting means sets a first speed that changes the degree of opening up to the first degree of opening that has been set by the degree of opening setting means, and, after the degree of opening of the air valve reaches the degree of opening that has been set by the degree of opening setting means, sets a second speed, and the control means controls the air valve at the first speed up to the first degree of opening during the time that the pressed key state that has been detected by the pressed key state detection means does not change, and, after the degree of opening of the air valve reaches the first degree of opening, controls the air valve at the second speed up to the second degree of opening, there is the advantageous result that it is possible to simulate the opening and closing of the sound hole covers by the keys of the keyboard and the performance buttons in an acoustic accordion as the first degree of opening and in those cases where the air pressure changes in a state in which the first degree of opening is fixed, to make the simulation setting the second degree of opening in conformance with the air pressure, while in those cases where the first degree of opening has changed and in those cases where the second degree of opening has changed, it is possible to set the respective opening and closing speeds of the air valves.

[0031] In accordance with the electronic accordion cited in Claim 8, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 6 or 7, since the speed setting means is one that sets both the speed in those cases where the degree of opening is increased and the speed in those cases where the degree of opening is decreased, there is the advantageous result that it is possible to set speeds that are different in those cases where the degree of opening increases and where the degree of opening decreases.

[0032] In accordance with the electronic accordion cited in Claim 9, in addition to the advantageous result that is exhibited by the electronic accordion cited in Claim 8, the speed setting means sets the speed in conformance with the air pressure that has been detected by the air sensor in those cases where the degree of opening is increased and sets a fixed speed in those cases where the degree of opening is decreased. In an acoustic accordion, the vibration of the reeds starts when the keys or the performance buttons are pressed down. When the vibration starts, the amplitude gradually increases and in those cases where the air pressure in the bellows and atmospheric pressure differ greatly, the change in the amplitude is rapid. On the other hand, in those cases

where the key or performance button that is being pressed down is released, the flow path of the air is blocked without regard to the pressure of the bellows and it is possible to simulate this kind of condition.

[0033] In accordance with the electronic accordion cited in Claim 10, in addition to the advantageous result that is exhibited by the electronic accordion cited in any of the Claims 6 through 9, because, since the speed setting means is one that sets the speed in conformance with the case in which the air pressure that has been detected by the air pressure sensor is greater than atmospheric pressure and the case in which the pressure is less than atmospheric pressure, it is possible to set the speed at which the air valve opens and closes in those cases where the bellows is expanded as well as in those cases where the bellows is compressed, there is the advantageous result that it is even more possible to produce an operating feeling that closely resembles that of the bellows of an acoustic accordion.

Brief Description of the Drawings

[0034]

Fig. 1 is an external view drawing that shows the exterior of the electronic accordion in accordance with the present invention;

Fig. 2 is a drawing that shows the air valve, (a) is an oblique drawing that shows the exterior of the air valve, and (b) is a schematic drawing that shows the interior of the air valve;

Fig. 3 is a block diagram that shows the electrical configuration of the electronic accordion;

Fig. 4 is a flowchart that shows the main processing;

Fig. 5 is a flowchart that shows the processing with which the degree of opening is set;

Fig. 6 is a flowchart that shows processing that is a continuation of the processing shown in Fig. 5;

Fig. 7 is a flowchart that shows the timer interrupt processing;

Fig. 8 is a flowchart that shows processing that is a continuation of the processing shown in Fig. 7.

Preferred Embodiments of the Invention

[0035] An explanation will be given below of a preferred embodiment of the present invention while referring to the attached drawings. Fig. 1 shows the exterior of the electronic accordion 1, which is a preferred embodiment of the present invention. In the drawing, the keyboard 2 and the plurality of register switches 4 are furnished on the right hand operating section that is operated with the right hand and the keys 3, which comprise a plurality of white keys and black keys, are furnished on the keyboard 2. The plurality of register switches 4, with which the timbres of the musical tones that have been performed by the keys 3 are set, are furnished behind the keyboard 2. A sensor is furnished for each key 3 and

each register switch 4 and the state in which they are being operated is detected.

[0036] The accompaniment section 7, which has the plurality of performance buttons 8 furnished, and the plurality of register switches 9, with which the timbres of the musical tones that are performed using the accompaniment section 7, are furnished on the left hand operating section that is operated with the left hand. A sensor is also furnished for each performance button 8 and each register switch 9 and the state in which they are being operated is detected.

[0037] When the performance state of a key 3 of the keyboard 2 is detected, the performance information is sent to the sound source 24 (refer to Fig. 3) and a musical tone is generated or terminated by the sound source 24. The performance information is in a format that has been prescribed in accordance with the MIDI standard and, in those cases where a key 3 has been pressed down, a Note On message that comprises the status, which indicates the key that has been pressed down, the MIDI channel, the note number, which indicates the pitch of the key that has been pressed down, and a value that specifies the velocity value (hereinafter, referred to as the "Note On"), is formed. In addition, in those cases where a key has been released, a Note Off message that comprises the status, which indicates the key that has been released, the MIDI channel, the note number, which indicates the pitch of the key that has been released, and a value that specifies the velocity value (hereinafter, referred to as the "Note Off"), is formed.

[0038] In addition, in those cases where a register switch 4 has been operated, the performance information that indicates the timbre that is set to the register switch 4 that has been turned on is sent to the sound source 24. The performance information that directs the timbre is a program change in accordance with the MIDI standards and comprises the status that indicates the timbre that is directed, the MIDI channel, and the program number.

[0039] The bass or chords are assigned to the large number of performance buttons 8 of the accompaniment section 7 that are performed with the left hand and the timbres for these are selected and set by means of the register switches 9. In those cases where a performance button 8 that specifies a chord has been pressed down, the Notes On that correspond to the plurality of sounds that comprise the chord are sent to the sound source 24. For example, in the case where the performance button 8 that directs the chord of C major has been pressed down the three Notes On that have the note numbers for which the letter notations are C, E, and G are sent to the sound source.

[0040] A bellows 6 that is the same as that of an acoustic accordion is furnished between the right hand keyboard 2 and the left hand accompaniment section 7 and an air pressure sensor 5 is furnished that detects the pressure of the air inside the bellows 6. In those cases where the bellows 6 is compressed such that the volume

inside the bellows 6 becomes smaller, the air pressure inside the bellows 6 becomes greater than atmospheric pressure and the air in the bellows 6 is discharged via the air valve 14. In those cases where the bellows 6 is expanded such that the volume inside the bellows 6 becomes larger, the air pressure inside the bellows 6 becomes less than atmospheric pressure and the air from outside is taken into the bellows 6 via the air valve 14.

[0041] A release button that is not shown in the drawing is furnished on the left hand side and a valve to mechanically release the bellows 6 can be operated no matter what state the air valve 14 is in. Since in those cases where the air valve 14 is closed and a key 3 or a performance button 8 has not been pressed down, the opening and closing of the bellows 6 cannot be done, a valve that mechanically releases the bellows 6 has been furnished separately and a release button has been furnished that opens that valve. This is something that can be used in those cases where the bellows 6 is opened or closed in any position and is operated, in particular, in those cases where the performance has ended and the bellows 6 is then closed.

[0042] For the Note On, Note Off, and program change that are generated in those cases where a key 3 of the keyboard 2 has been operated, for example, the MIDI channel is set to 1, the MIDI channel of the chord that is generated in those cases where the accompaniment section 7 has been operated is set to 2, and the MIDI channel of the bass sound is set to 3.

[0043] In addition, the air pressure in the bellows 6 is detected by the air pressure sensor 5 and the MIDI standard control change that directs the volume is used. In this case, the control change is transmitted for all of the MIDI channels that are set to the keyboard 2 and the accompaniment section 7.

[0044] The electrical control circuit 12 and the battery 11 that supplies power to the electrical control circuit 12, the speaker 26, the air hole 19 with which the air in the bellows 6 is taken in or discharged, and the air valve 14 that controls the flow path of the air between the air hole 19 and the bellows 6 are furnished inside the right hand keyboard 2.

[0045] Fig. 2 shows the details of the air valve 14, Fig. 2(a) is an oblique view drawing that shows the exterior of the air valve 14, and Fig. 2(b) is a cross-section drawing that shows the interior of the air valve 14.

[0046] As is shown in Fig. 2(a), the bellows 6 and the air valve 14 are linked by the air pipe 13, the air valve 14 has the flow path 15 in its interior, and the air valve 14 is linked to the air hole 19. The air hole 19 is furnished with a filter (not shown in the drawing) that is formed from a net and felt and the like inside the net so as not to suck in dirt and dust.

[0047] As is shown in Fig. 2(b), inside the air valve 14, the throttle 16, which opens and closes the flow path 15 that is circular in cross-section, is disposed so that it is free to rotate with the diameter in the vertical direction of the circular flow path 15 as the axis. The throttle 16 is

formed from a disk that follows along the inner circumference of the circular flow path 15. Accordingly, in those cases where the periphery of the disk of the throttle 16 is set in a position that follows along the inner periphery of the flow path 15 (known as the degree of opening 0), the air valve 14 is in a closed state and the position at which the throttle 16 has been rotated 90 degrees from that position with the axis as the center (known as the degree of opening 100) is the state in which the valve has been opened fully. Incidentally, Fig. 2(b) shows a state in which the valve has been rotated roughly 45 degrees.

[0048] The shaft of the throttle 16 is connected to the shaft of the pulse motor 17 and it is possible to drive the throttle 16 to a specified angle by inputting a single pulse to the pulse motor 17 in the opening direction or the closing direction.

[0049] Fig. 3 is a block diagram that shows the electrical configuration of the electronic accordion 1. The electronic accordion 1 comprises the CPU 21, the ROM 22, the RAM 23, the pulse motor 17, the keys 3 and performance buttons 8, the register switches 4 and 9, the air sensor 5, the sound source 24, the amp 25, and the speaker 26. The CPU 21, the ROM 22, the RAM 23, the sound source 24, and the amp 25, are formed into the electrical control circuit 12.

[0050] The CPU 21 is a central processing unit and executes each of the various programs that are stored in the ROM 22. The ROM 22 stores the control programs and the fixed data that are referred to when those programs are executed. In the fixed data are set such things as the timbre parameters that are set by the timbres that have been assigned to each of the register switches 4 and 9 and the like and, for each timbre, how many reeds produce sounds for one note and the like is set.

[0051] In addition, a timer is built into the CPU 21 and is configured such that when a time that has been set is clocked, an interrupt is generated by the CPU 21.

[0052] The RAM 23 possesses areas that store each of the required areas, flags, and the like that are each of the various register groups store when the CPU 21 executes the control programs and is a memory that can be accessed and be overwritten randomly.

[0053] The sound source 24 generates or terminates a musical tone in conformance with the performance information such as the Note On or the Note Off and the like that are sent from the CPU 21. The sound source has a plurality of sound production channels and can generate a plurality of musical tones at the same time. The musical tone signal that is generated by the sound source 24 is amplified by the amp 25 and emitted as sound from the speaker 26.

[0054] Fig. 4 is a flowchart that shows the main processing that is executed by the CPU 21. This processing is carried out repeatedly from when the power to the electronic accordion 1 is turned on until the power is turned off. When the power is turned on, first, the initial settings are carried out (S1). In the initial setting, a flag

is set to "pressure." For the degree of opening of the air valve 14, the key degree of opening and the pressure degree of opening are set in those cases where a key 3 or a performance button 8 has been operated and the pressure degree of opening is set in those cases where the pressure in the bellows 6 has changed. The degree of opening of the air valve 14 is first controlled so as to arrive at the key degree of opening and after the key degree of opening has been arrived at, is controlled so as to arrive at the pressure degree of opening. In those cases where the control is carried out so as to arrive at the key degree of opening, the flag is set to "key" and in those cases where the control is carried out so as to arrive at the pressure degree of opening, the flag is set to "pressure."

[0055] In addition, in the initial settings, the current degree of opening and the opening number are set to 0. The opening number here simulates the number of sound holes that are opened by the operation of the keys 3 or the performance buttons 8 and if one key 3 of the keyboard 2 is pressed down and the timbre that has been selected by the register switch 4 is one that uses one reed, the opening number is increased by 1. If the timbre that has been selected is one that uses two reeds, the opening number is increased by 2. In addition, if a performance button 8 that specifies a chord in the accompaniment section 7 is pressed down and the timbre that is selected by the register switch 9 is one that uses one reed, in those cases where the chord that has been directed is composed of three notes, the opening number is increased by 3 and if the timbre is one that uses two reeds, the opening number is increased by 6.

[0056] Next, whether or not any of the keys 3 of the keyboard 2 or any of the performance buttons 8 of the accompaniment section 7 has been pressed down is detected (S2), and then the air pressure in the bellows 6 is detected using the air pressure sensor 5 (S3). Next, a determination is made as to whether or not a Note On is to be generated. In those cases where the fact that the air pressure in the bellows 6 is not equal to atmospheric pressure and any of the keys 3 or the performance buttons 8 has been pressed down has been detected (S4: yes), a Note On is generated and transmitted to the sound source 24 (S5). When the sound source receives the Note On, the production of a musical tone having a specified pitch is started at a prescribed level.

[0057] When in those cases where a determination has been made in the processing of S4 that a Note On is not generated (S4: no) and, in addition, the processing of S5 has finished, a determination is made as to whether or not a Note Off is to be generated (S6). In those cases where the air pressure in the bellows 6 has become equal to atmospheric pressure, a Note Off that directs the termination of the production of the musical tones for all of the musical tones that are being produced by the sound source 24 is generated and, in those cases where any of the keys 3 or the performance buttons 8 that had been pressed down has been released, a Note Off is generated

for the musical tone having the pitch that corresponds to the key 3 or the performance button 8 that has been released (S6: yes). The Note Off that has been generated is transmitted to the sound source 24 (S7). When the sound source 24 receives the Note Off, the generation of the musical tone having the pitch that has been specified is terminated.

[0058] In those cases where in the processing of S6, a determination has been made that a Note Off is not generated (S6: no) and, in addition, the processing of S7 has ended, a determination is made as to whether or not a control change is to be generated (S8). In those cases where the air pressure in the bellows 6 that has been detected by the air pressure sensor 5 changes and a musical tone is being generated by the sound source 24, a control change is generated (S8: yes) and transmitted to the sound source 24 (S9). When the sound source 24 receives the control change, the volume of the musical tone that is being generated is changed to the volume that is directed by the control change.

[0059] In those cases where in the processing of S8 a determination has been made that a control change is not generated (S8: no) and, in addition, the processing of S9 has ended, whether or not a register switch 4 or 9 has been operated is detected (S10) and a determination is made as to whether or not a program change is to be generated (S11).

[0060] In those cases where a register switch has been operated and a new timbre has been specified (S11: yes), a program change for the MIDI channel that corresponds to the register switch 4 or 9 that has been operated that has a program number that corresponds to the timbre that has been specified is transmitted to the sound source 24 (S12).

[0061] In those cases where in the processing of S11, a determination has been made that a program change is not generated (S11: no) and, in addition, the processing of S12 has ended, the air valve control processing is carried out (S13) and the routine returns to the processing of S2. An explanation will be given regarding the air valve control processing of S13 while referring to the flowcharts described in Fig. 5 through Fig. 8.

[0062] Fig. 5 through Fig. 8 are flowcharts that show the air valve control processing, which is processing in which the degree of opening of the air valve 14 and the speed up to that degree of opening is set in conformance with the operation of the keys 3, the performance buttons 8, and the bellows 6. Fig. 5 shows the processing in which the degree of opening is set in conformance with the operation of a key 3 or a performance button 8 and Fig. 6 shows the processing in which the degree of opening is set in conformance with the operation of the bellows 6. Fig. 7 and Fig. 8 show the processing in which the speed for the opening and closing of the air valve 14 from the current degree of opening to the degree of opening that has been newly set is controlled by a timer interrupt.

[0063] First, an explanation will be given regarding the processing for setting the degree of opening while refer-

ring to Fig. 5 and Fig. 6. First, a determination is made as to whether or not a Note On has been generated (S21). This Note On is the case in which a Note On has been generated by the processing of S4 in the flowchart of Fig. 4. In those cases where a Note On has been generated (S21: yes), the opening number is increased by the amount α (S22). As discussed before, how many reeds are used to form the musical tone that is generated by the Note On differs depending on the timbre that is selected by the register switch 4 or 9. If the timbre is one in which one musical tone is formed using one reed, α is 1, and if the timbre is one in which one note is formed using two reeds, α is 2.

[0064] On the other hand, in those cases where in the determination processing of S21, a determination has been made that a Note On is not generated (S21: no), a determination is made as to whether or not a Note Off has been generated (S23). This Note Off is the case in which a Note Off has been generated by the processing of S6 in the flowchart of Fig. 4. In those cases where a Note Off has been generated (S23: yes), the opening number is decreased the amount of α . With regard to the value of α , this is as discussed before.

[0065] In the processing of S22 and S24, following the setting of the opening number, the degree of opening is made the value in which the opening number is multiplied by the opening percentage (S25). The opening percentage is the degree of opening that corresponds to the air pressure for each opening number and is stored in a table and the like that corresponds to the air pressure.

[0066] Next, a determination is made as to whether or not the degree of opening that has been obtained in this manner is greater than 100 (S26) and in those cases where the degree of opening is greater than 100 (S26: yes), the degree of opening is made 100 (S27). In those cases where the degree of opening is not greater than 100 (S26: no) or following the processing of S27, the key degree of opening is set in conformance with the value of the degree of opening referring to the step table and the pressure degree of opening is set to the key degree of opening (S28).

[0067] The step table is one with which the degree of rotation of the throttle 16 of the air valve 14 is set in conformance with the degree of opening. The degree of rotation of the throttle 16 is proportional to the number of pulses that are supplied to the pulse motor 17, but since the degree of rotation of the throttle 16 is not proportional to the facility of the flow of the air (the airflow for the case in which the air pressure is fixed), this is a table with which the number of pulses that are supplied to the pulse motor 17 are converted in conformance with the degree of opening so as to make the degree of opening and the facility of the flow of the air roughly proportional.

[0068] Next, the pressure degree of opening is set to the key degree of opening (S28). For the key degree of opening and the pressure degree of opening, the key degree of opening that is set primarily by the keys 3 or the performance buttons 8 and the pressure degree of

opening that is set primarily by the change in the air pressure inside the bellows 6 are each set for the purpose of simulating the reactive force that is the action of the bellows of an acoustic accordion. It is set up such that the modes for the case in which the control of the degree of opening is in accordance with the key degree of opening and the case in which the control of the degree of opening is in accordance with the pressure degree of opening are different.

[0069] Following the processing of S28, a determination is made as to whether or not the current degree of opening, which is the degree of opening as of the present time, is equal to the key degree of opening (S29). In those cases where the current degree of opening is not equal to the key degree of opening (S29: no), the flag is set to "key" (S30), permission is given to the timer interrupt (S31) and the degree of opening setting processing ends. In those cases where in the determination processing of S29, a determination has been made that the current degree of opening is equal to the key degree of opening (S29: yes), the degree of opening setting processing ends.

[0070] In those cases where in the determination processing of S23, a Note Off is not generated (S23: no), the setting processing for the degree of opening that corresponds to the change in the air pressure shown in Fig. 6 is carried out. First, a determination is made as to whether or not the air pressure in the bellows 6 that has been detected by the air pressure sensor 5 has changed. In those cases where the air pressure has not changed (S41: no), the degree of opening setting processing ends. In those cases where the air pressure has changed (S41: yes), a determination is made as to whether or not the air pressure is equal to atmospheric pressure (the air pressure is taken to be equal to 0) (S42). In those cases where the air pressure is 0 (S42: yes), a determination is made as to whether or not the opening number at the present time is 0 (S43). The opening number is, as discussed previously, set to a value greater than 0 if any of the keys 3 or the performance buttons 8 has been pressed down. Accordingly, in those cases where none of the keys 3 or the performance buttons 8 has been pressed down, the opening number is 0. In those cases where the opening number is 0 (S43: yes), the degree of opening is set to 0 making it so that the air valve 14 is to be completely closed (S44). On the other hand, in those cases where the opening number is not 0, the degree of opening is set to the minimum value that is not 0, which has been specified in advance. This is because in an acoustic accordion, in those cases where a key or a performance button is pressed down, the check valve closes the airflow path of the reed but, differing from the closing off of the sound hole by the sound hole cover, the check valve does not completely close the sound hole and some air enters and exits. Setting the degree of opening to the minimum value is something that simulates this kind of condition. In those cases where the degree of opening has been set in S44 or S45, the routine advances

to the processing of S51.

[0071] On the other hand, in those cases where in the determination processing of S42, a determination has been made that the air pressure is not 0 (S42: no), a determination is made as to whether or not the degree of opening is set to the minimum value (S46). In those cases where the degree of opening is set to the minimum value (S46: yes), a determination is made as to whether or not the air pressure is greater than a threshold value (S47). In those cases where the air pressure is not greater than a threshold value (S47: no), the degree of opening setting processing ends and in those cases where the air pressure is greater than a threshold value (S47: yes), the degree of opening is made a value in which the opening number has been multiplied by the opening percentage (S48). The threshold value is equivalent to the pressure value in an acoustic accordion for opening the check valve and making the air flow in to the reed and in those cases where the threshold value has been exceeded, the setting is such that the air valve 14 is opened.

[0072] The calculation of S48 is identical to the processing of S25 in the flowchart that is described in Fig. 5. Next, a determination is made as to whether or not the degree of opening that has been obtained in this manner is greater than 100 (S49) and in those cases where the degree of opening is greater than 100 (S49: yes), the degree of opening is made 100 (S50). In those cases where the degree of opening is not greater than 100 (S49: no), or following the processing of S50, the step table is referred to and the pressure degree of opening is set in conformance with the value of the degree of opening (S51). Next, a determination is made as to whether or not the current degree of opening, which is the degree of opening at the present time is equal to the pressure degree of opening (S52). In those cases where the current degree of opening is not equal to the pressure degree of opening (S52: no), permission is given to the timer interrupt (S53) and the degree of opening setting processing ends. In those cases where in the determination processing of S52, it has been determined that the current degree of opening is equal to the pressure degree of opening (S52: yes), the degree of opening setting processing ends.

[0073] Next, an explanation will be given regarding the timer interrupt processing while referring to Fig. 7 and Fig. 8. First, a determination is made as to whether or not the flag is set to "key" (S61). In those cases where the flag is set to "key" (S61: yes), a determination is made as to whether the current degree of opening is smaller than the key degree of opening and, moreover, is not smaller than the pressure degree of opening (S62). In those cases where the current degree of opening is not smaller than the key degree of opening or is smaller than the pressure degree of opening (S62: no), a determination is made as to whether the current degree of opening is larger than the key degree of opening and, moreover, is not larger than the pressure degree of opening (S63). In those cases where the current degree of opening is

smaller than the key degree of opening and, moreover, is not smaller than the pressure degree of opening (S62: yes) or in those cases where the current degree of opening is larger than the key degree of opening and, moreover, is not larger than the pressure degree of opening (S63: yes), the flag is set to "pressure" (S64) and the routine advances to the processing of the flowchart that is described in Fig. 8.

[0074] In those cases where in the determination processing of S63, the current degree of opening is not larger than the key degree of opening or in those cases where the current degree of opening is larger than the pressure degree of opening (S63: no), a determination is made as to whether or not the current degree of opening is larger than the key degree of opening (S65). In those cases where the current degree of opening is larger than the key degree of opening (S65: yes), the pulse motor 17 is set one pulse in the direction of closing of the air valve 14 and the current degree of opening is decreased by 1 (S66).

[0075] In those cases where in the determination processing of S65, a determination has been made that the current degree of opening is not larger than the key degree of opening (S65: no), then, next, a determination is made as to whether or not the current degree of opening is smaller than the key degree of opening (S67). In those cases where the current degree of opening is smaller than the key degree of opening (S67: yes), the pulse motor 17 is set one pulse in the direction of opening of the air valve 14 and the current degree of opening is increased by 1 (S68).

[0076] Following the processing of S66 and the processing of S68, the timer is set to a fixed value and the interrupt processing ends (S69). On the other hand, in those cases where in the determination processing of S67, a determination has been made that the current degree of opening is not smaller than the key degree of opening (S67: no), the flag is set to "pressure" and, the timer interrupt processing is prohibited (S70), and the interrupt processing ends.

[0077] Accordingly, in those cases where the air valve 14 is opened and closed by the key degree of opening, the speed at which the air valve opens and closes is the identical fixed magnitude both in the case of opening and in the case of closing.

[0078] In those cases where in the determination processing of S61, a determination has been made that the flag is not set to "key" (S61: no) and in those cases where the flag has been set to "pressure" in S64, the routine advances to the processing of the flowchart that is described in Fig. 8.

[0079] First, a determination is made as to whether or not the current degree of opening is larger than the pressure degree of opening (S71). In those cases where the current degree of opening is larger than the pressure degree of opening (S71: yes), the pulse motor 17 is set one pulse in the direction of closing of the air valve 14, the current degree of opening is decreased by 1, and the

width, which is time that is set to the timer, is set to a value that corresponds to the air pressure for the case in which the air valve 14 is controlled in the direction of closing (S72). In those cases where the current degree of opening is not larger than the pressure degree of opening (S71: no), a determination is made as to whether or not the current degree of opening is smaller than the pressure degree of opening (S73). In those cases where the current degree of opening is smaller than the pressure degree of opening (S73: yes), the pulse motor 17 is set one pulse in the direction of opening of the air valve 14, the current degree of opening is increased by 1, and the width, which is the time that is set to the timer, is set to a value that corresponds to the air pressure for the case in which the air valve 14 is controlled in the direction of opening (S74).

[0080] In those cases where the processing of S72 and S74 has ended, the value of the width that has been set is set to the timer and the processing ends.

[0081] Accordingly, for the cases in which the opening and closing of the air valve 14 are controlled by the air pressure, the speed becomes different for the case in which the control of the air valve 14 is in the direction of opening and for the case in which the control of the air valve 14 is in the direction of closing and, together with this, the speeds are also different depending on the magnitude of the air pressure.

[0082] As has been explained above, since in accordance with the preferred embodiment described above, the degree of opening is set not only by the opening number due to the operation of the keys 3 and the performance buttons 8, but also in accordance with the air pressure in the bellows 6, it is possible for the action to be made to closely resemble the behavior of the bellows of an acoustic accordion. In addition, since a new degree of opening is set and the speed is set at which the air valve 14 moves from the current degree of opening to the degree of opening that has been newly set in accordance with the operation of the keys 3, the performance buttons 8, and the bellows 6, it is possible for the operation to more closely resemble the behavior of the bellows of an acoustic accordion.

[0083] Incidentally, the degree of opening setting means that is cited in Claim 1 is equivalent to the processing of S25 of the flowchart described in Fig. 5 and of S48 of the flowchart described in Fig. 6, and the control means is equivalent to the processing of S66 and S68 of the flowchart described in Fig. 7 and of S72 and S74 of the flowchart described in Fig. 8. In addition, the pressed key state detection means that is cited in Claim 3 is equivalent to the processing of S2 of the flowchart described in Fig. 4. Also, the speed setting means that is cited in Claim 6 is equivalent to the processing of S66, S68, and S69 of the flowchart described in Fig. 7 and of S72, S74, and S75 of the flowchart described in Fig. 8.

[0084] An explanation was given above of the present invention based on a preferred embodiment, however, the present invention is one that is in no way limited to

the preferred embodiments described above and the fact that various modifications and changes are possible that do not deviate from and are within the scope of the essentials of the present invention can be easily surmised.

[0085] For example, in the preferred embodiment described above, it has been set up such that the degree of opening and the speed are determined in accordance with the operation of the key 3 or the performance button 8 that have been pressed down, and the bellows 6 but it may also be set up such that the performer has parameters that can be set as desired and the degree of opening and the speed are set in accordance with those parameters. For example, in S25 of the flowchart described in Fig. 5, the degree of opening has been made a value in which the opening number has been multiplied by the opening percentage but it has been set up such that the degree of opening can be derived by means of the product of the opening percentage and the opening number and a coefficient that is set by the performer and in those cases where the coefficient that is set by the performer is greater than 1, the degree of opening is set larger and in those cases where the coefficient that is set by the performer is less than 1, the degree of opening is set smaller. When it is done in this manner, by means of a performer whose strength is weak setting the coefficient larger and a performer whose strength is strong setting the coefficient smaller and the like, it would be possible to set operating properties of the bellows 6 that are optimized to the performer.

[0086] In addition, since in an acoustic accordion, the form of the reed and the like is different depending on the pitch, it may be set up such that the degree of opening and the opening and closing speed differ in conformance with the pitch that is prescribed by the key 3 of the keyboard or the performance button 8. Since the length of a reed having a pitch that is low is long, the amplitude of vibration of the tip of the reed is great and, together with this, the size of the opening becomes large. In addition, because the length of a reed having a low pitch is long, the vibration is begun at a low air pressure but because the length of a reed having a high pitch is short, if the air pressure is not high to some extent, the vibration will not start.

[0087] In addition, since in an acoustic accordion, the forms and materials of the reeds are different depending on the timbre, it may be set up such that the degree of opening and the opening and closing speed differ in conformance with the timbre that is prescribed by the register switches 4 and 9. The forms and materials of the reeds also are different depending on the manufacturer and the model and the aspects of the vibrations are different. With regard to the materials, usually, aluminium is employed and extra-hard aluminium alloys and the like are used in high-quality units. Since together with generating a pure sound, the aspect of the vibrations is different from ordinary aluminium, the simulation of that condition may also be done.

Description of the Keys

[0088]

- | | | |
|----|-------|--|
| 5 | 1: | electronic instrument (electronic accordion) |
| | 2: | keyboard (keyboard section) |
| | 3: | key (keyboard section operator) |
| | 4, 9: | register switch |
| | 5: | air pressure sensor |
| 10 | 6: | bellows |
| | 7: | accompaniment section (keyboard section) |
| | 8: | performance button (keyboard section operator) |
| | 14: | air valve |
| | 21: | CPU |
| 15 | 23: | RAM |
| | 24: | sound source |

Claims

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1. An electronic accordion (1) furnished with a keyboard section (2) that has a plurality of operators (3) that prescribe the pitch of a musical tone and the generation and termination of the musical tone, and a bellows (6) that intakes or discharges air, and an air pressure sensor (5) that detects the air pressure in the bellows (6), and a sound source that forms a musical tone having the pitch that is prescribed by an operator (3) of the previously mentioned keyboard section (2) in conformance with the air pressure that has been detected by the air pressure sensor (5), wherein the accordion (1) is furnished with an air valve (14) that adjusts the degree of opening of an air hole with which the air is taken into the previously mentioned bellows (6) or the air in the bellows (6) is discharged, and **characterised in** comprising a degree of opening setting means (16) that adjusts the degree of opening of the previously mentioned air valve (4) in conformance with the air pressure that has been detected by the previously mentioned air pressure sensor (5), and control means (21) that controls the previously mentioned air valve (14) in conformance with the degree of opening that has been set by the previously mentioned degree of opening setting means (16).
 2. The electronic accordion (1) cited in Claim 1 **characterized in that** the previously mentioned degree of opening setting means (16) is one that sets the degree of opening in conformance with the case in which the air pressure that has been detected by the previously mentioned air pressure sensor (5) is greater than atmospheric pressure and the case in which the air pressure is less than atmospheric pressure.
 3. The electronic accordion (1) cited in Claim 1 or Claim 2 **characterized in that** the accordion (1) is fur-

nished with pressed key state detection means that detects the state in which an operator (3) of the previously mentioned keyboard section (2) is being operated, and the previously mentioned degree of opening setting means (16) is one in which the degree of opening of the previously mentioned air valve (14) is set in conformance with the pressed key state that has been detected by the previously mentioned pressed key state detection means and the air pressure that has been detected by the previously mentioned air pressure sensor (5).

4. The electronic accordion (1) cited in Claim 3 **characterized in that** the previously mentioned degree of opening setting means (16) is one that closes the previously mentioned air pressure valve (14) in those cases where the number of pressed keys (3) that has been detected by the previously mentioned pressed key state detection means is zero and sets the degree of opening of the previously mentioned air valve (14) to a minimum degree of opening greater than zero in those cases where the number of pressed keys (3) is one or greater and, moreover, the air pressure that has been detected by the previously mentioned air pressure sensor (5) has been detected to be equal to atmospheric pressure, and that sets the degree of opening greater than the previously mentioned minimum degree of opening in those cases where the number of pressed keys (3) that has been detected by the previously mentioned pressed key state detection means is one or more and, moreover, the air pressure that has been detected by the previously mentioned air pressure sensor (5) is a specified value.

5. The electronic accordion (1) cited in Claim 4 **characterized in that** the previously mentioned degree of opening setting means (16) is one in which the degree of opening of the previously mentioned air valve (14) is altered in those cases where the previously mentioned air pressure has exceeded a specified value.

6. The electronic accordion (1) cited in any of the Claims 3 through 5 **characterized in that** the accordion (1) is furnished with speed setting means that sets the speed at which the degree of opening changes up to the degree of opening that has been set by the previously mentioned degree of opening setting means (16), and the previously mentioned control means (21) is one that controls the previously mentioned air valve (14) in conformance with the degree of opening that has been set by the previously mentioned degree of opening setting means (16) and the speed that has been set by the previously mentioned speed setting means.

7. The electronic accordion (1) cited in Claim 6 **char-**

acterized in that the previously mentioned degree of opening setting means (16) sets a first degree of opening in conformance with the pressed key state and the air pressure that has been detected by the previously mentioned air pressure sensor (5) in those cases where the pressed key state has been detected to have changed by the previously mentioned pressed key state detection means, and sets a second degree of opening in those cases where the pressed key state is fixed and the air pressure that has been detected by the previously mentioned air pressure sensor (5) has been detected to have changed, and the previously mentioned speed setting means sets a first speed that changes the degree of opening up to the first degree of opening that has been set by the previously mentioned degree of opening setting means (16), and, after the degree of opening of the air valve (14) reaches the degree of opening that has been set by the previously mentioned degree of opening setting means (16), sets a second speed, and the previously mentioned control means (21) controls the previously mentioned air valve (14) at the first speed up to the first degree of opening during the time that the pressed key state that has been detected by the previously mentioned pressed key state detection means does not change, and, after the degree of opening of the air valve (14) reaches the first degree of opening, controls the air valve (14) at the second speed up to the second degree of opening.

8. The electronic accordion (1) cited in Claim 6 or 7 **characterized in that** the previously mentioned speed setting means is one that sets both the speed in those cases where the degree of opening is increased and the speed in those cases where the degree of opening is decreased.

9. The electronic accordion (1) cited in Claim 8 **characterized in that** the previously mentioned speed setting means sets the speed in conformance with the air pressure that has been detected by the previously mentioned air sensor in those cases where the degree of opening is increased and sets a fixed speed in those cases where the degree of opening is decreased.

10. The electronic accordion (1) cited in any of the Claims 6 through 9 **characterized in that** the previously mentioned speed setting means is one that sets the speed in conformance with the case in which the air pressure that has been detected by the previously mentioned air pressure sensor (5) is greater than atmospheric pressure and the case in which the air pressure is less than atmospheric pressure.

Patentansprüche

1. Elektronisches Akkordeon (1), aufweisend: einen Tastatur-Abschnitt (2), der eine Mehrzahl von Bedienelementen (3) aufweist, die die Höhe eines musikalischen Tons und das Erzeugen und Beenden des musikalischen Tons bestimmen, und einen Balg (6), der Luft einzieht oder ausstößt, und einen Luftdrucksensor (5), der den Luftdruck in dem Balg (6) detektiert, und eine Schallquelle, die einen musikalischen Ton erzeugt, der eine Höhe hat, die von einem Bedienelement (3) des vorgenannten Tastatur-Abschnitts (2) in Übereinstimmung mit dem von dem Luftdrucksensor (5) detektierten Luftdruck bestimmt wird, wobei das Akkordeon (1) ein Luftventil (14) aufweist, das den Öffnungsgrad eines Luftlochs anpasst, mit welchem die Luft in den vorgenannten Balg (6) eingezogen oder die Luft in dem Balg (6) ausgestoßen wird, und **dadurch gekennzeichnet ist, dass** es aufweist: ein Öffnungsgrad-Einstellungs-Mittel (16), welches den Öffnungsgrad des vorgenannten Luftventils (14) in Übereinstimmung mit dem Luftdruck, der von dem zuvor genannten Luftdrucksensor (5) detektiert wurde, anpasst, und ein Steuermittel (21), welches das vorgenannte Luftventil (14) in Übereinstimmung mit dem Öffnungsgrad steuert, der von dem vorgenannten Öffnungsgrad-Einstellungs-Mittel (16) eingestellt wurde.
2. Elektronisches Akkordeon (1) gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das vorgenannte Öffnungsgrad-Einstellungs-Mittel (16) eines ist, das den Öffnungsgrad entsprechend dem Fall, in dem der von dem vorgenannten Luftdruck-Sensor (5) detektierte Luftdruck größer als der atmosphärische Druck ist, und dem Fall, in dem der Luftdruck geringer als der atmosphärische Druck ist, einstellt.
3. Elektronisches Akkordeon (1) gemäß Anspruch 1 oder Anspruch 2, **dadurch gekennzeichnet, dass** das Akkordeon (1) ein Mittel zum Detektieren eines gedrückten Tastenzustands aufweist, welches den Zustand detektiert, in dem ein Bedienelement (3) des vorgenannten Tastatur-Abschnitts (2) betätigt wird, und das vorgenannte Öffnungsgrad-Einstellungs-Mittel (16) eines ist, bei dem der Öffnungsgrad des vorgenannten Luftventils (14) in Übereinstimmung mit dem gedrückten Tastenzustand, der von dem vorgenannten Mittel zum Detektieren eines gedrückten Tastenzustands detektiert wurde, und dem Luftdruck, der von dem vorgenannten Luftdruck-Sensor (5) detektiert wurde, eingestellt wird.
4. Elektronisches Akkordeon (1) gemäß Anspruch 3, **dadurch gekennzeichnet, dass** das vorgenannte Öffnungsgrad-Einstellungs-Mittel (16) eines ist, das in den Fällen, in denen die Anzahl von gedrückten Tasten (3), die von dem vorgenannten Mittel zum
- Detektieren eines gedrückten Tastenzustands detektiert wurde, gleich Null ist, das vorgenannte Luftdruckventil (14) schließt, und in den Fällen, in denen die Anzahl von gedrückten Tasten (3) eins oder mehr beträgt und ferner der Luftdruck, der von dem vorgenannten Luftdrucksensor (5) detektiert wurde, als gleich dem atmosphärischen Druck detektiert wurde, den Öffnungsgrad des vorgenannten Luftventils (14) auf einen minimalen Öffnungsgrad größer Null einstellt, und das in den Fällen, in denen die Anzahl von gedrückten Tasten (3), die von dem vorgenannten Mittel zum Detektieren eines gedrückten Tastenzustands detektiert wurde, eins oder mehr beträgt und ferner der Luftdruck, der von dem vorgenannten Luftdrucksensor (5) detektiert wurde, ein bestimmter Wert ist, den Öffnungsgrad auf größer als den vorgenannten minimalen Öffnungsgrad einstellt.
5. Elektronisches Akkordeon (1) gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das vorgenannte Öffnungsgrad-Einstellungs-Mittel (16) eines ist, bei dem der Öffnungsgrad des vorgenannten Luftventils (14) in den Fällen, in denen der vorgenannte Luftdruck einen bestimmten Wert überschritten hat, verändert wird.
6. Elektronisches Akkordeon (1) gemäß einem der Ansprüche 3 bis 5, **dadurch gekennzeichnet, dass** das Akkordeon (1) ein Geschwindigkeits-Einstellungs-Mittel aufweist, das die Geschwindigkeit einstellt, mit welcher der Öffnungsgrad zu dem Öffnungsgrad wechselt, der von dem vorgenannten Öffnungsgrad-Einstellungs-Mittel (16) eingestellt wurde, und dass das vorgenannte Steuermittel (21) eines ist, welches das vorgenannte Luftventil (14) in Übereinstimmung mit dem Öffnungsgrad, der von dem vorgenannten Öffnungsgrad-Einstellungs-Mittel (16) eingestellt wurde, und der Geschwindigkeit, die von dem vorgenannten Geschwindigkeits-Einstellungs-Mittel eingestellt wurde, steuert.
7. Elektronisches Akkordeon (1) gemäß Anspruch 6, **dadurch gekennzeichnet, dass** das vorgenannte Öffnungsgrad-Einstellungs-Mittel (16) in den Fällen, in denen der gedrückte Tastenzustand von dem vorgenannten Mittel zum Detektieren eines gedrückten Tastenzustands als verändert detektiert wurde, einen ersten Öffnungsgrad in Übereinstimmung mit dem gedrückten Tastenzustand und dem Luftdruck einstellt, der von dem vorgenannten Luftdrucksensor (5) detektiert wurde, und in den Fällen, in denen der gedrückte Tastenzustand unveränderlich ist und der Luftdruck, der von dem vorgenannten Luftdrucksensor (5) detektiert wurde, als verändert detektiert wurde, einen zweiten Öffnungsgrad einstellt, und dass das vorgenannte Geschwindigkeits-Einstellungs-Mittel eine erste Geschwindigkeit einstellt, die den Öffnungsgrad bis zu dem ersten Öffnungsgrad

verändert, der von dem vorgenannten Öffnungsgrad-Einstellungs-Mittel (16) eingestellt wurde, und, nachdem der Öffnungsgrad des Luftventils (14) den Öffnungsgrad erreicht, der von dem vorgenannten Öffnungsgrad-Einstellungs-Mittel (16) eingestellt wurde, eine zweite Geschwindigkeit einstellt, und dass das vorgenannte Steuermittel (21) das vorgenannte Luftventil (14) während der Zeit, in welcher der gedrückte Tastenzustand, der von dem vorgenannten Mittel zum Detektieren eines gedrückten Tastenzustands detektiert wurde, sich nicht ändert, bis zu dem ersten Öffnungsgrad mit der ersten Geschwindigkeit steuert, und nachdem der Öffnungsgrad des Luftventils (14) den ersten Öffnungsgrad erreicht, das Luftventil (14) bis zu dem zweiten Öffnungsgrad mit der zweiten Geschwindigkeit steuert.

8. Elektronisches Akkordeon (1) gemäß Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** das vorgenannte Geschwindigkeits-Einstellungs-Mittel eines ist, das die Geschwindigkeit in den Fällen einstellt, in denen der Öffnungsgrad vergrößert wird, sowie die Geschwindigkeit in den Fällen einstellt, in denen der Öffnungsgrad verkleinert wird.
9. Elektronisches Akkordeon (1) gemäß Anspruch 8, **dadurch gekennzeichnet, dass** das vorgenannte Geschwindigkeits-Einstellungs-Mittel die Geschwindigkeit in den Fällen, in denen der Öffnungsgrad vergrößert wird, in Übereinstimmung mit dem Luftdruck einstellt, der von dem vorgenannten Luftdrucksensor detektiert wurde, und in den Fällen, in denen der Öffnungsgrad verkleinert wird, eine feste Geschwindigkeit einstellt.
10. Elektronisches Akkordeon (1) gemäß einem der Ansprüche 6 bis 9, **dadurch gekennzeichnet, dass** das vorgenannte Geschwindigkeits-Einstellungs-Mittel eines ist, das die Geschwindigkeit in Übereinstimmung mit dem Fall, in dem der von dem vorgenannten Luftdrucksensor (5) detektierte Luftdruck größer als der atmosphärische Druck ist, und dem Fall, in welchem der Luftdruck geringer als der atmosphärische Druck ist, einstellt.

Revendications

1. Accordéon électronique (1) pourvu d'une section de clavier (2) qui comporte une pluralité d'actionneurs (3) qui prescrivent la tonie d'une tonalité musicale et la génération et la fin de la tonalité musicale, et un soufflet (6) qui admet ou décharge de l'air, et un capteur de pression d'air (5) qui détecte la pression d'air dans le soufflet (6), et une source sonore qui forme une tonalité musicale ayant la tonie qui est prescrite par un actionneur (3) de la section de clavier (2) mentionnée précédemment conformément à la pression

d'air qui a été détectée par le capteur de pression d'air (5), dans lequel l'accordéon (1) est pourvu d'une soupape d'air (14) qui ajuste le degré d'ouverture d'un orifice d'air par lequel l'air est admis dans le soufflet (6) mentionné précédemment ou l'air dans le soufflet (6) est déchargé, et

caractérisé en ce qu'il comprend des moyens de réglage de degré d'ouverture (16) qui ajustent le degré d'ouverture de la soupape d'air (14) mentionnée précédemment conformément à la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment, et des moyens de commande (21) qui commandent la soupape d'air (14) mentionnée précédemment conformément au degré d'ouverture qui a été fixé par les moyens de réglage de degré d'ouverture (16) mentionnés précédemment.

2. Accordéon électronique (1) selon la revendication 1, **caractérisé en ce que** les moyens de réglage de degré d'ouverture (16) mentionnés précédemment sont des moyens qui fixent le degré d'ouverture conformément au cas dans lequel la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment est supérieure à la pression atmosphérique et au cas dans lequel la pression d'air est inférieure à la pression atmosphérique.
3. Accordéon électronique (1) selon la revendication 1 ou la revendication 2, **caractérisé en ce que** l'accordéon (1) est pourvu de moyens de détection d'état de touche enfoncée qui détectent l'état dans lequel un actionneur (3) de la section de clavier (2) mentionnée précédemment est actionné, et les moyens de réglage de degré d'ouverture (16) mentionnés précédemment sont des moyens dans lesquels le degré d'ouverture de la soupape d'air (14) mentionnée précédemment est fixé conformément à l'état de touche enfoncée qui a été détecté par les moyens de détection d'état de touche enfoncée mentionnés précédemment et à la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment.
4. Accordéon électronique (1) selon la revendication 3, **caractérisé en ce que** les moyens de réglage de degré d'ouverture (16) mentionnés précédemment sont des moyens qui ferment la soupape de pression d'air (14) mentionnée précédemment dans les cas où le nombre de touches enfoncées (3) qui a été détecté par les moyens de détection d'état de touche enfoncée mentionnés précédemment est nul et qui fixent le degré d'ouverture de la soupape d'air (14) mentionnée précédemment à un degré d'ouverture minimum supérieur à zéro dans les cas où le nombre de touches enfoncées (3) est égal à un ou plus et où, de plus, la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment.

ment a été détectée comme étant égale à la pression atmosphérique, et qui fixent le degré d'ouverture pour qu'il soit supérieur au degré d'ouverture minimum mentionné précédemment dans les cas où le nombre de touches enfoncées (3) qui a été détecté par les moyens de détection d'état de touche enfoncée mentionnés précédemment est égal à un ou plus et où, de plus, la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment a une valeur spécifiée.

5. Accordéon électronique (1) selon la revendication 4, **caractérisé en ce que** les moyens de réglage de degré d'ouverture (16) mentionnés précédemment sont des moyens dans lesquels le degré d'ouverture de la soupape d'air (14) mentionnée précédemment est modifié dans les cas où la pression d'air mentionnée précédemment a dépassé une valeur spécifiée.

6. Accordéon électronique (1) selon l'une quelconque des revendications 3 à 5, **caractérisé en ce que** l'accordéon (1) est pourvu de moyens de réglage de vitesse qui fixent la vitesse à laquelle le degré d'ouverture change jusqu'au degré d'ouverture qui a été fixé par les moyens de réglage de degré d'ouverture (16) mentionnés précédemment, et les moyens de commande (21) mentionnés précédemment sont des moyens qui commandent la soupape d'air (14) mentionnée précédemment conformément au degré d'ouverture qui a été fixé par les moyens de réglage de degré d'ouverture (16) mentionnés précédemment et à la vitesse qui a été fixée par les moyens de réglage de vitesse mentionnés précédemment.

7. Accordéon électronique (1) selon la revendication 6, **caractérisé en ce que** les moyens de réglage de degré d'ouverture (16) mentionnés précédemment fixent un premier degré d'ouverture conformément à l'état de touche enfoncée et à la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment dans les cas où l'état de touche enfoncée a été détecté comme ayant changé par les moyens de détection d'état de touche enfoncée mentionnés précédemment, et fixent un deuxième degré d'ouverture dans les cas où l'état de touche enfoncée est fixe et où la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment a été détectée comme ayant changé, et les moyens de réglage de vitesse mentionnés précédemment fixent une première vitesse de changement du degré d'ouverture jusqu'au premier degré d'ouverture qui a été fixé par les moyens de réglage de degré d'ouverture (16) mentionnés précédemment, et, après que le degré d'ouverture de la soupape d'air (14) a atteint le degré d'ouverture qui a été fixé par les moyens de réglage de degré

d'ouverture (16) mentionnés précédemment, fixent une deuxième vitesse, et les moyens de commande (21) mentionnés précédemment commandent la soupape d'air (14) mentionnée précédemment à la première vitesse jusqu'au premier degré d'ouverture pendant le temps où l'état de touche enfoncée qui a été détecté par les moyens de détection d'état de touche enfoncée mentionnés précédemment ne change pas, et, après que le degré d'ouverture de la soupape d'air (14) a atteint le premier degré d'ouverture, commandent la soupape d'air (14) à la deuxième vitesse jusqu'au deuxième degré d'ouverture.

8. Accordéon électronique (1) selon la revendication 6 ou 7, **caractérisé en ce que** les moyens de réglage de vitesse mentionnés précédemment sont des moyens qui fixent à la fois la vitesse dans les cas où le degré d'ouverture est augmenté et la vitesse dans les cas où le degré d'ouverture est diminué.

9. Accordéon électronique (1) selon la revendication 8, **caractérisé en ce que** les moyens de réglage de vitesse mentionnés précédemment fixent la vitesse conformément à la pression d'air qui a été détectée par le capteur d'air mentionné précédemment dans les cas où le degré d'ouverture est augmenté et fixent une vitesse fixe dans les cas où le degré d'ouverture est diminué.

10. Accordéon électronique (1) selon l'une quelconque des revendications 6 à 9, **caractérisé en ce que** les moyens de réglage de vitesse mentionnés précédemment sont des moyens qui fixent la vitesse conformément au cas dans lequel la pression d'air qui a été détectée par le capteur de pression d'air (5) mentionné précédemment est supérieure à la pression atmosphérique et au cas dans lequel la pression d'air est inférieure à la pression atmosphérique.

Fig. 1

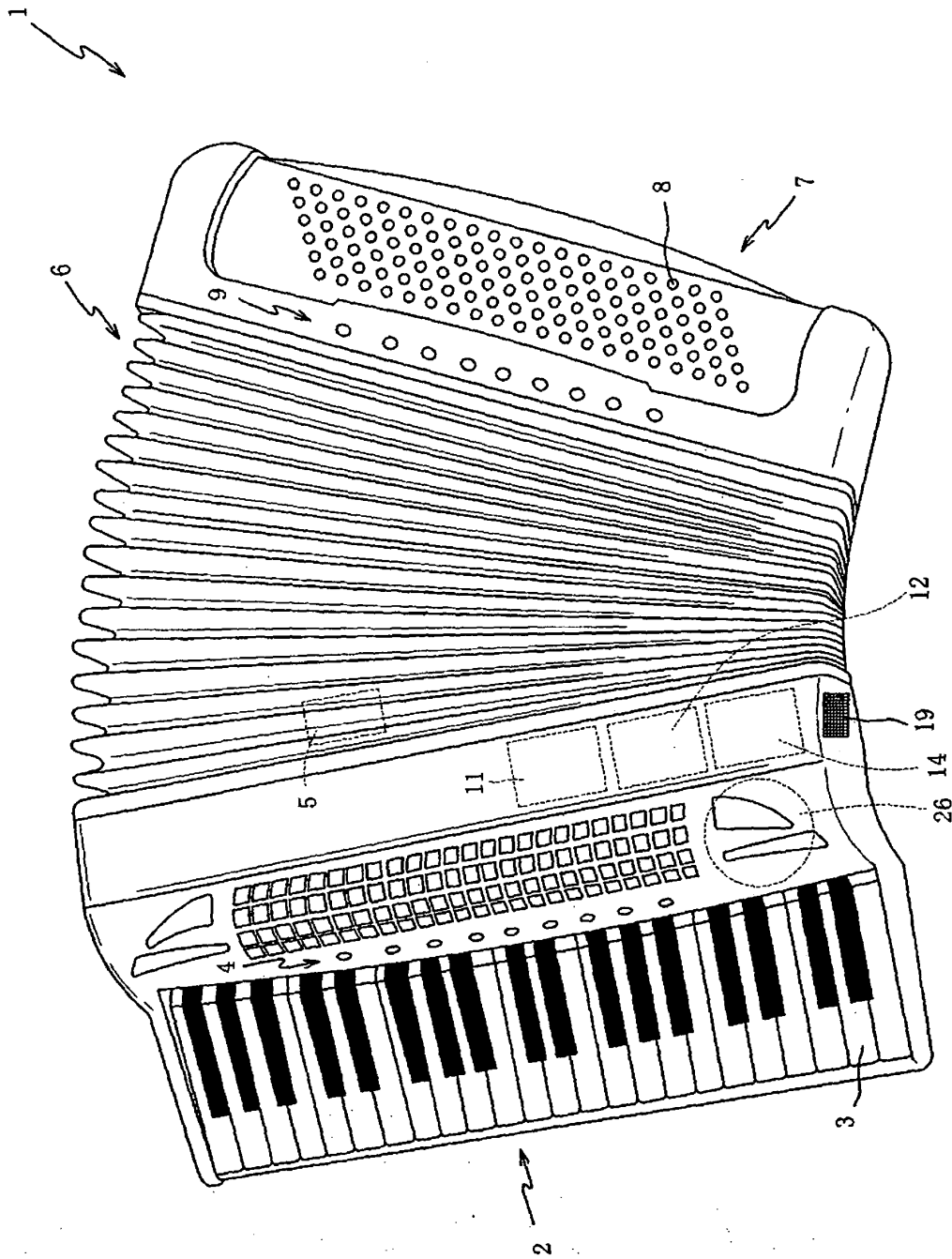


Fig. 2

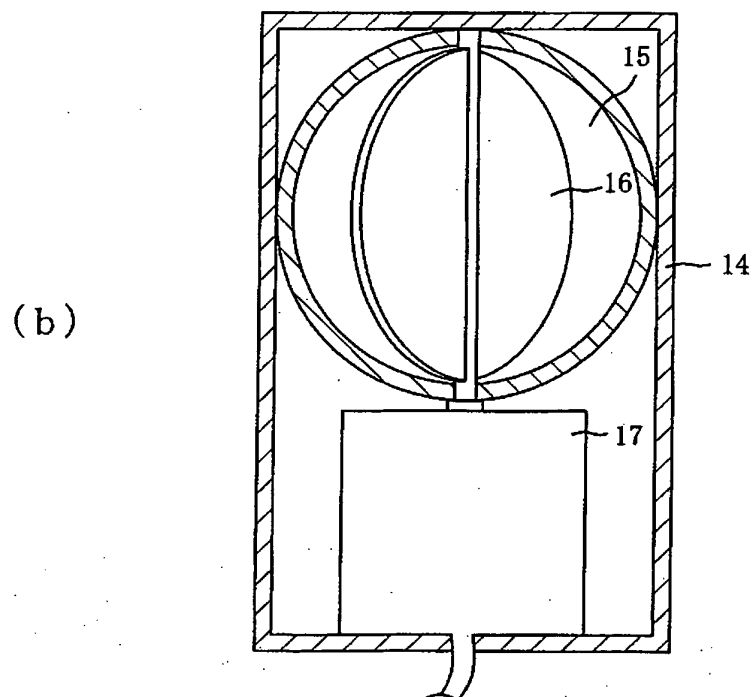
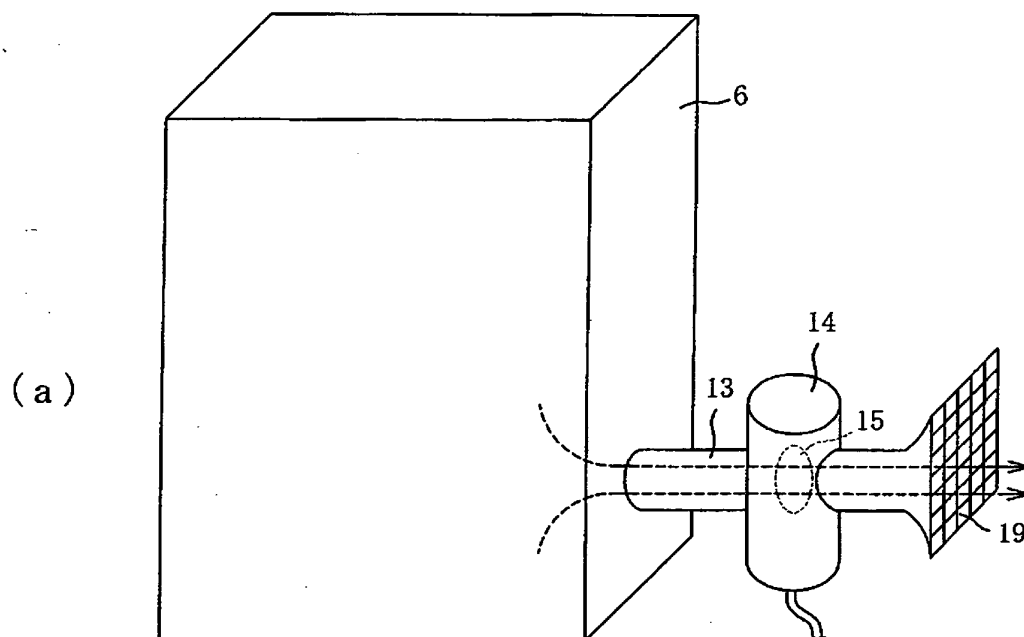


Fig. 3

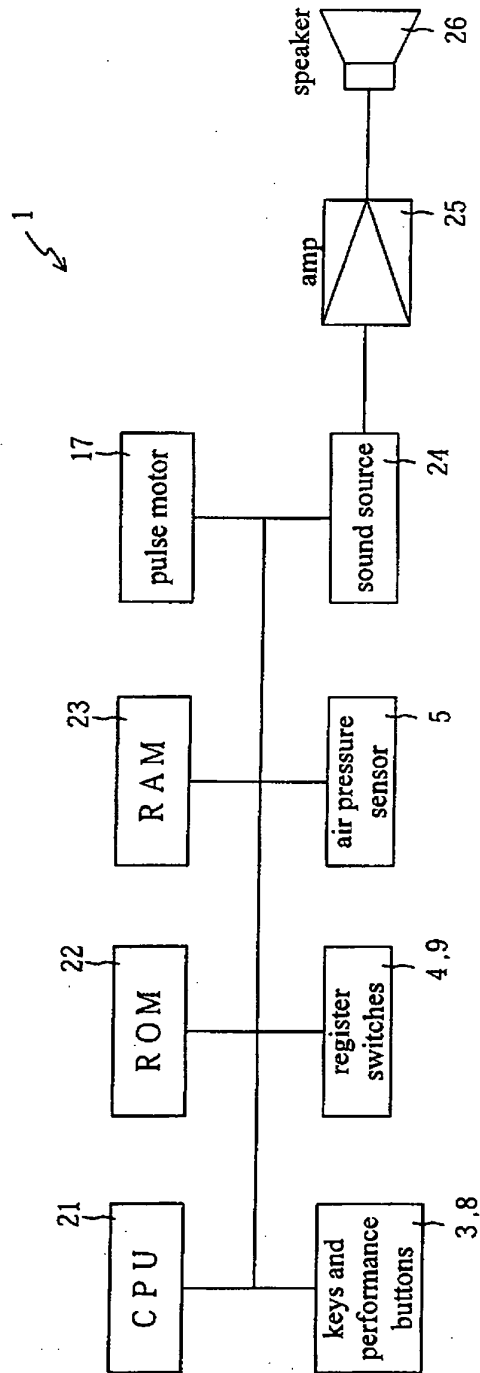


Fig. 4

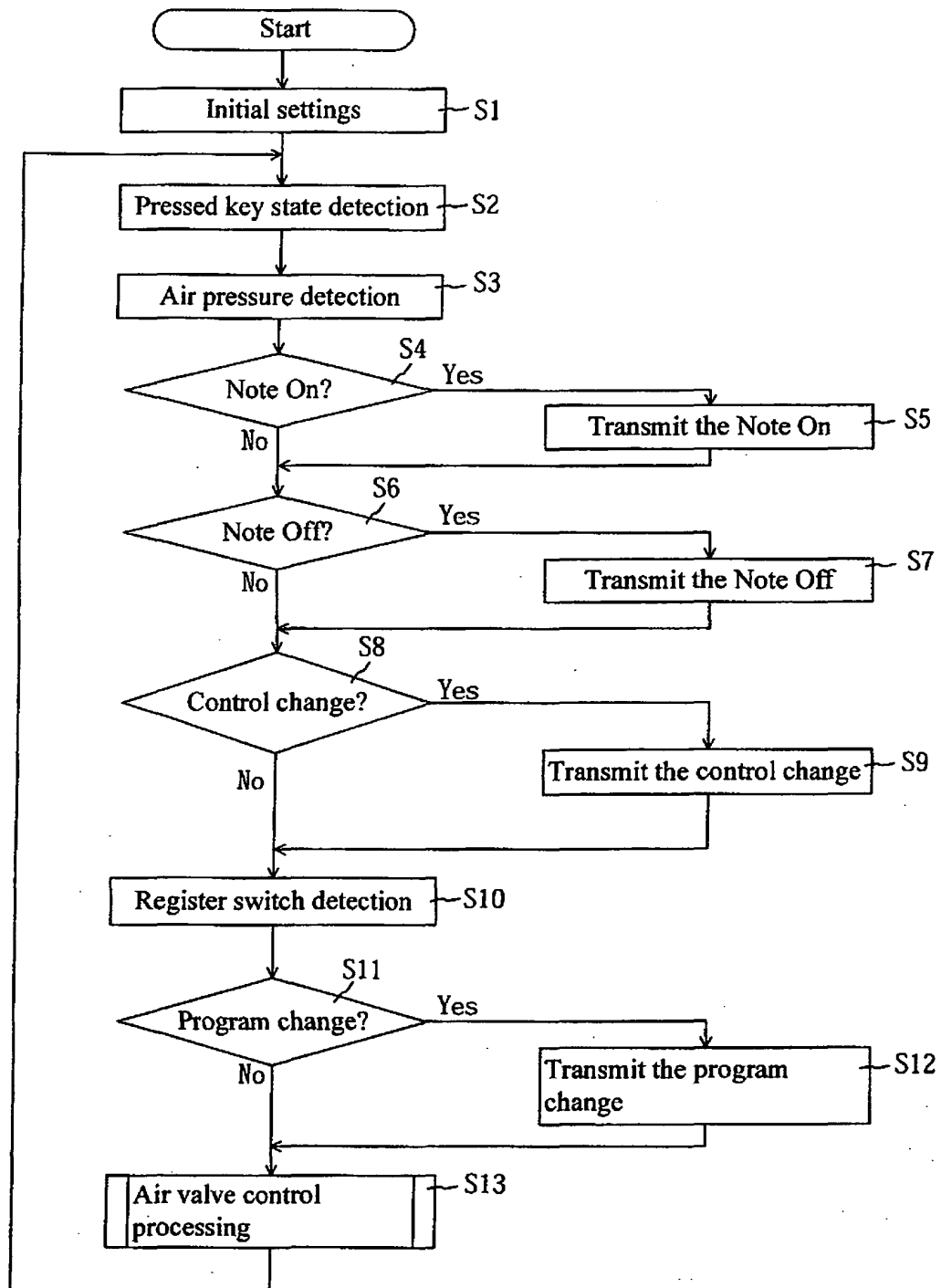


Fig. 5

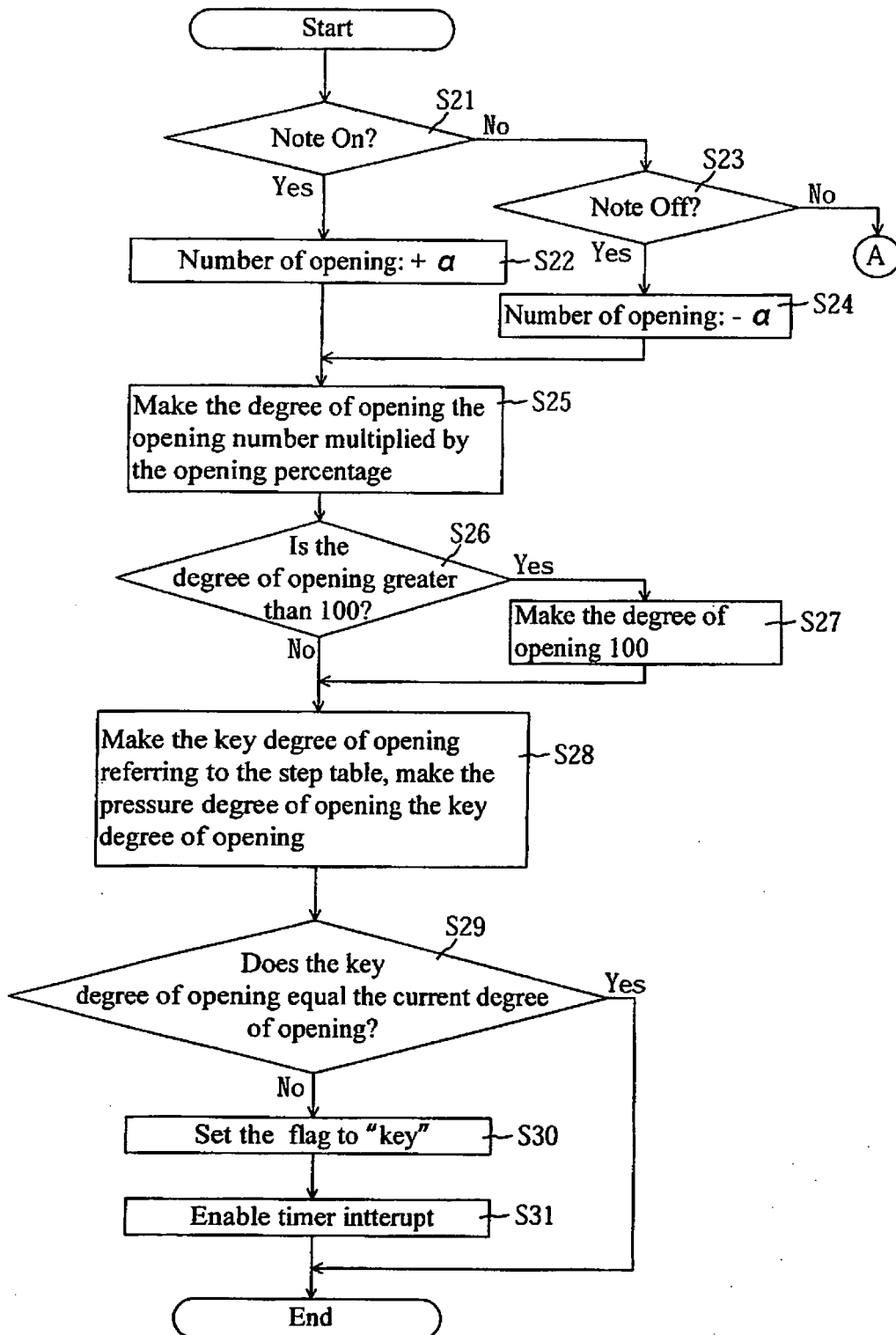


Fig. 6

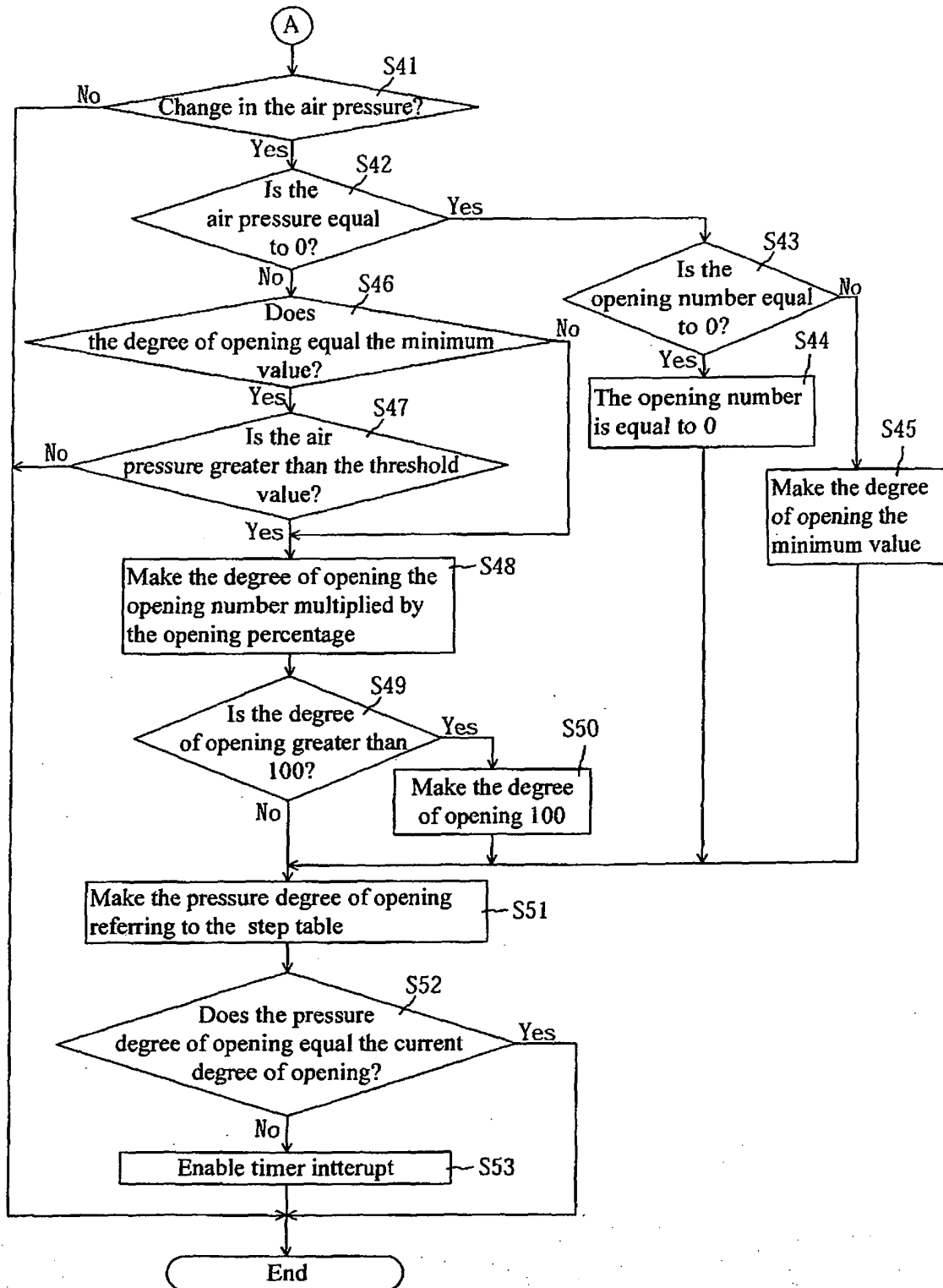


Fig. 7

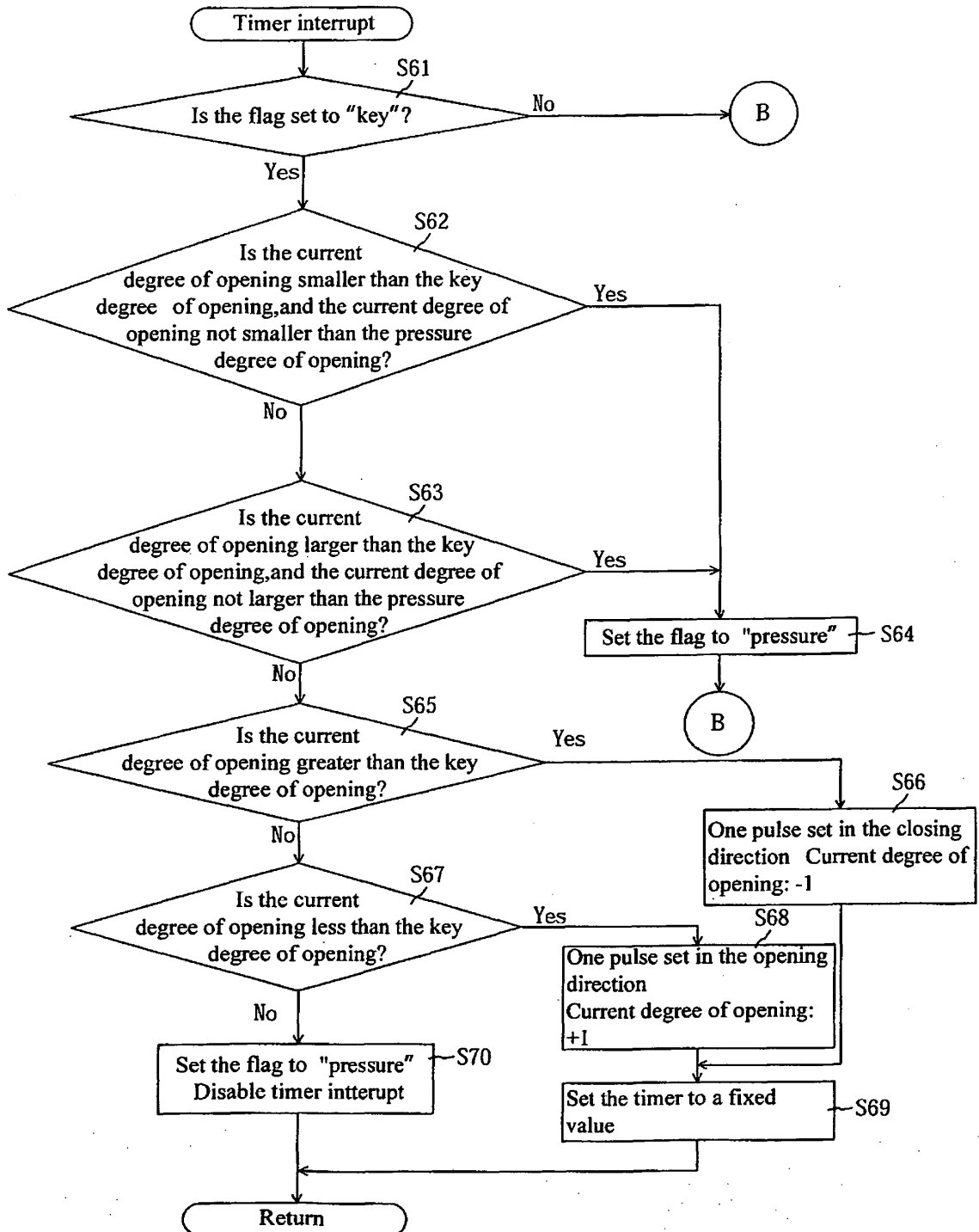
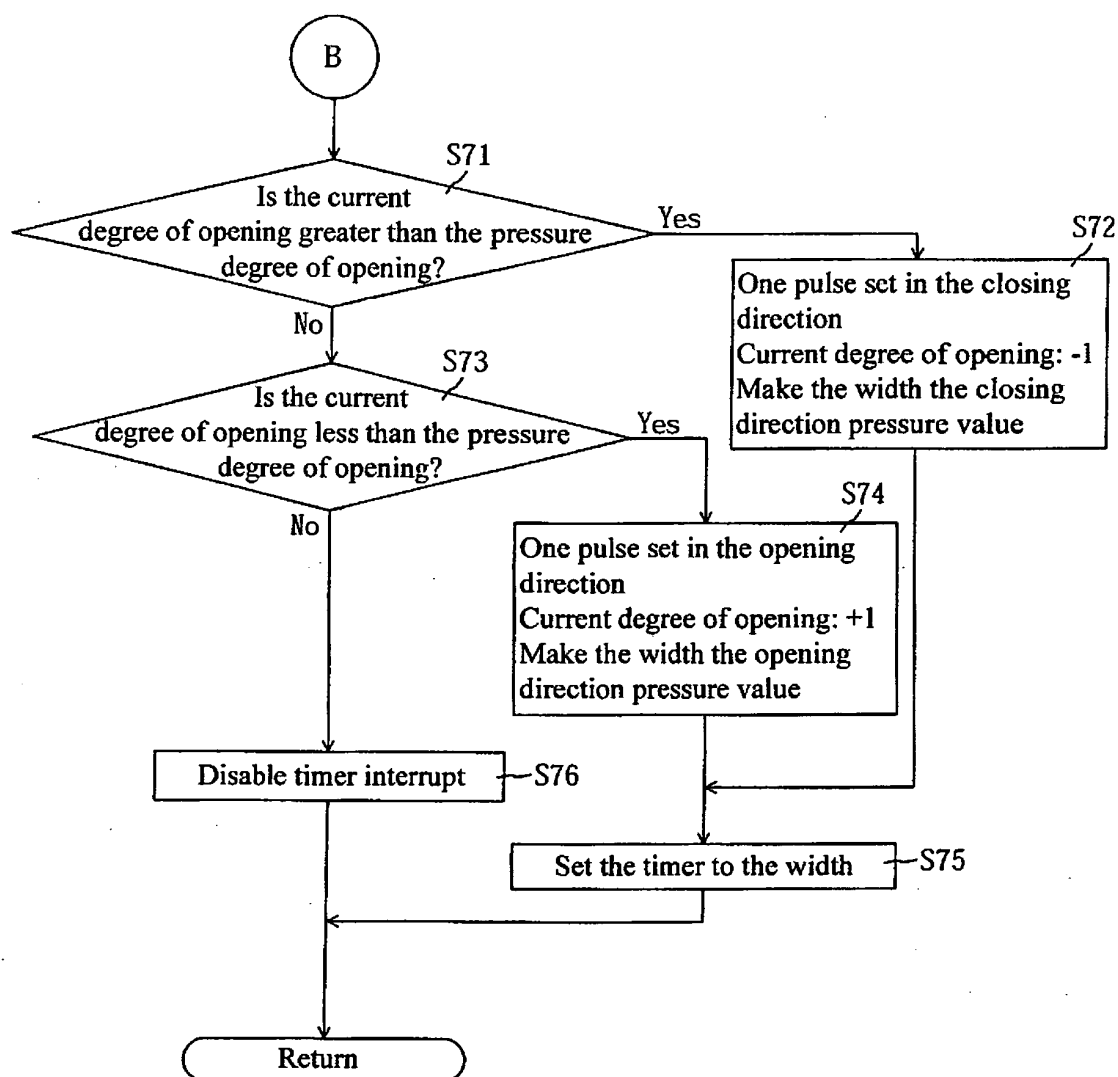


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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