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(54) **Electrically controlled control valve to control the air stream of a bellows of an electronic accordion**

(57) An electrically controlled control valve (14) to control the air stream of a bellows (6) of an electronic accordion (1); the electrically controlled control valve (14) has: a valve body (15), in which an air passage opening (17) is obtained; a plug (19), which is mounted so as to be mobile and coupled to the passage opening (17); an electric actuator (26), which is mechanically connected to the plug (19) to move the plug (19) between a complete opening position and a closing position of the passage opening (17); a fixing body (23) with an annular shape, which is suited to be rigidly fixed to the electronic accordion (1), is arranged around the valve body (15), and is separate from and independent of the valve body (15) itself; and a flexible connecting diaphragm (24) with an annular shape which connects the valve body (15) to the fixing body (23).

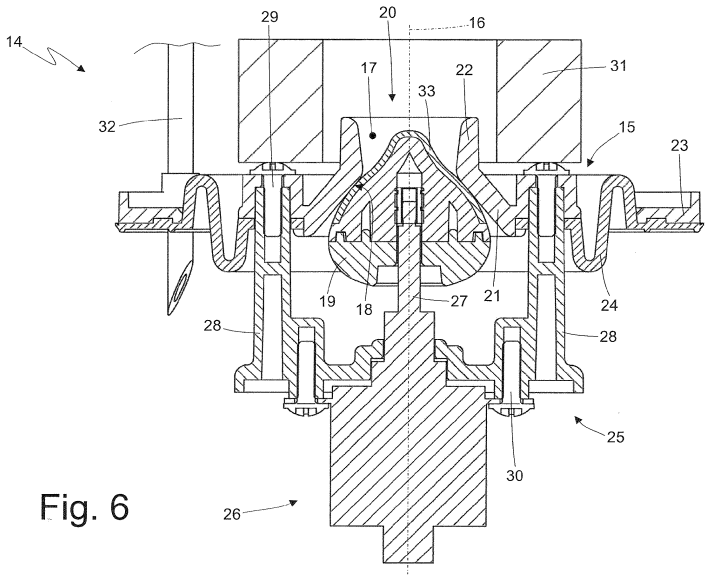


Fig. 6

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Description

TECHNICAL FIELD

[0001] The present invention relates to an electrically controlled control valve to control the air stream of a bellows of an electronic accordion.

PRIOR ART

[0002] An acoustic accordion is an instrument provided with a bellows for pumping air towards valves, which are operated by a plurality of respective keys divided on two keyboards (one for the right hand and one for the left hand). Each valve controlled by a respective key is suited to send the air pumped by the bellows to a plurality of respective reeds, which are all coupled to the same valve, belong to different feet, and vibrate substantially together to produce the note associated with the corresponding key. The acoustic accordion is further provided with a series of registers which are suited to modify the features of the sound produced by pressing the keys thus either allowing or preventing some reed feet to/from vibrating. In an acoustic accordion, each reed is normally defined by a foil arranged at a hole for passing the air from the respective valve, which hole may be closed by a specific window controlled by a corresponding register.

[0003] Electronic accordions are known on the market which are provided with a bellows coupled to a pressure sensor for generating a pressure signal proportional to the air pumped by the bellows, and are provided with two keyboards (one for the right hand and one for the left hand) coupled to a plurality of sensors for generating a series of keyboard signals reproducing the pressure of the keys; the pressure signal and the keyboard signals are supplied to a sound module, which is able to generate the corresponding accordion sound electronically. The known sound modules are based on the sampling and storing of the characteristic sounds produced by the single keys; when a key is pressed, the sound module reproduces the characteristic sound of the key until the key itself is released; with a different pressure of the air pumped by the bellows, the sound module reproduces the characteristic sounds of the pressed keys with a different sound volume.

[0004] In an acoustic accordion, the air pressure pumped by the bellows through the holes of each reed depends on the force exerted on the bellows by the user and on the number of open valves, which depends, in turn, on the activated registers and on the number of pressed keys. The force exerted on the bellows being equal, the air pressure, and thus the opposite resistance force exerted by the bellows on the user's arms, is thus a function of the activated registers and of the number of keys pressed by the user. As a consequence, the absence of activated registers and of pressed keys causes the closing of all the valves, thus blocking the movement of the bellows. For the purpose of recovering the bellows and compressing it to its rest position, this operation being needed, for example, to transport the instrument, the acoustic accordion is provided with a specific key for opening a specific hole which allows the residual air to exit from the bellows without crossing any of the reeds. Once the bellows has been completely compressed, the specific key may be released to prevent air from entering into the bellows again, which is thus blocked in the most suitable position for transport.

[0005] In the marketed electronic accordions, the pressure of the air pumped by the bellows depends only on the force that the user exerts on the bellows, because the compressed air is ejected through one or more fixed section openings. Furthermore, the marketed electronic accordions have a mechanical bellows releasing and blocking device similar to those of acoustic accordions, i.e. provided with a specific key which moves a partition that opens and closes the fixed section opening.

[0006] By comparing the dynamic behavior of an acoustic accordion with that of the bellows of a marketed electronic accordion, it is clearly apparent that in the electronic accordions the non-linear resistance of the bellows (which is typical of the acoustic accordions) is missing; such a shortcoming is generally unfavorably viewed by musicians, who are accustomed to the dynamic behavior of acoustic accordions. Moreover, the space needed to house the mechanical bellows releasing and blocking device considerably and unfavorably influences the arrangement of the internal electronic modules, which for its nature cannot mimic the typical arrangement of the mechanical members in acoustic accordions.

[0007] Patent IT1341587B and patent EP1752966B1 describe an electronic accordion in which the bellows is connected to the external environment by means of a connecting duct which is controlled by an electrically controlled control valve, the position of which is controlled as a function of the keyboard signals. Thereby, the section of the connecting duct (and thus the opposite resistance force exerted by the bellows on the user's arms) can be electronically varied as a function of the activated registers and of the number of keys pressed by the user.

[0008] However, in the electronic accordion described in patents IT1341587B and EP1752966B1, it has been observed that the electrically controlled control valve may be excessively noisy, i.e. in use it may produce a noise which could be perceived by the musician playing the instrument; the noise produced by the electrically controlled control valve is an interference because it is unnatural (i.e. absent in an acoustic accordion). In order to attenuate the noise generated in use by the electrically controlled control valve, acoustic screens have been suggested which acoustically isolate the electrically controlled control valve by using soundproofing screens arranged around the electrically controlled control valve itself; however, the use of acoustic screens has found to be unsatisfactory because it can attenuate but not eliminate the perception of noise produced by the electrically controlled control valve outside the instrument.

DESCRIPTION OF THE INVENTION

[0009] It is the object of the present invention to provide an electrically controlled control valve to control the air stream of a bellows of an electronic accordion, which electrically controlled control valve is easy and cost-effective to be implemented while being free from the above-described drawbacks, thus allowing to eliminate the perception of noise generated by the electrically controlled control valve outside the instrument.

[0010] According to the present invention, an electrically controlled control valve is provided to control the air stream in a bellows of an electronic accordion, as claimed in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will now be described with reference to the accompanying drawings, which illustrate a non-limitative embodiment thereof, in which:

- figure 1 diagrammatically shows an electronic accordion;
- figure 2 shows a block chart of a control and sound playing unit of the electronic accordion in figure 1;
- figure 3 diagrammatically shows a perspective view of a pneumatic circuit of the electronic accordion in figure 1 provided with an electrically controlled control valve which is arranged at an air passage of a bellows and is made in accordance with the present invention;
- figure 4 is a perspective top view of the electrically controlled control valve in figure 3;
- figure 5 is a perspective bottom view of the electrically controlled control valve in figure 3; and
- figure 6 is a longitudinal section view of the electrically controlled control valve in figure 3.

PREFERRED EMBODIMENTS OF THE INVENTION

[0012] In figure 1, reference numeral 1 indicates an electronic accordion as a whole, which is completely externally similar to an acoustic accordion and has a pair of keyboards 2 consisting of respective pluralities of keys 3 used to play, and two selectors 4 consisting of respective pluralities of registers 5 used to modify the features of the sound. The electronic accordion 1 is provided with a bellows 6, which is structurally identical to the bellows of an acoustic accordion and pumps air towards an electromechanical pressure sensor 7 (of substantially known type) suited to generate a pressure signal proportional to an air pressure pumped from bellows 6 in real time. The air pumped by bellows 6 is exchanged with the external environment through an air passage opening 8 arranged on the exterior of the accordion and covered by a permeable grid. It is apparent that air is aspirated into bellows 6 from the external environment during the step of expanding the bellows 6 itself, while air is ejected from bellows 6 towards the external environment during the step of compressing the bellows 6 itself.

[0013] Each key 3 is connected to a respective sensor 9, which is suited to generate a respective keyboard signal indicating the position of the key 3 itself. Each register 5 is connected to a respective sensor 10, which is suited to generate a respective keyboard signal indicating the position of the register 5 itself.

[0014] As shown in figure 2, sensor 7, sensors 9 and sensors 10 are connected to a control unit 11, which is housed inside the electronic accordion 1 and uses a MIDI interface to send the pressure, keyboard and register signals in real time to a sound module 12 suited to electronically generate the typical sounds of an accordion.

[0015] In use, a user selects the position of registers 5 in the selectors 4, presses and releases the keys 3 of keyboards 2, and operates the bellows 6; as a result of these actions, the control unit 11 receives the time evolution of the corresponding pressure, keyboard and register signals in real time from sensors 7, 9 and 10. From the control unit 11, the pressure, keyboard and register signals are sent to the sound module 12 which then generates the sound of the electronic accordion 1. The amplitude, i.e. the volume, with which the sound of the electronic accordion 1 is generated is not constant and depends (according to an empirically obtained biunivocal function) on the pressure signal, which is proportional to the pressure value of the air pumped by bellows 6.

[0016] In an acoustic accordion, each key 3 of keyboard 2 is suited to open a valve which sends the air pumped by bellows 6 towards a plurality of reeds, which are all coupled to the same valve, and thus to the same key 3, belong to different feet, and vibrate substantially together to produce the note coupled to the key 3 itself; moreover, each register 5 is suited to open a plurality of windows at the holes of respective reeds. Thus, in an acoustic accordion, the air pumped by bellows 6 crosses an actual section equivalent to the sum of the sections of the open windows at the holes of the reeds concerned by the open valves; such a section is obviously variable in time as a function of the number of pressed keys 3 and of the activated registers 5, and may vary from a minimum value which is substantially null (corresponding to no pressed keys 3 and/or no activated registers 5) and a maximum value (theoretically corresponding to all open valves, i.e. all keys 3 pressed and all registers 5 activated). In particular, the absence of activated registers 5 and pressed keys 3 determines a substantially null air passage section, and thus causes the blocking of the movement of bellows 6.

[0017] As diagrammatically shown in figure 3, in the electronic accordion 1, bellows 6 is connected to the air passage opening 8 by means of a connecting duct 13, which allows the air transit between bellows 6 and the air passage opening 8; the connecting duct 13 is controlled by an electronically controlled control valve 14, which is suited to vary an air passage section provided by the connecting duct 13 itself.

[0018] In use, the electronic control unit controls the electrically controlled control valve 14 to vary the air passage section of the connecting duct 13 as a function of the keyboard and register signals generated by sensors 9 and 10 (corresponding to the status of keys 3 and registers 5, respectively). In particular, the control unit 11 is suited to translate the combination of pressed keys 3 and activated registers 5 into a corresponding value of the air passage section in the connecting duct 13 according to a biunivocal mapping, which is obtained from the architecture of an acoustic accordion and is stored in a memory (not shown in detail). The air passage section value of the connecting duct 13 increases as the number of pressed keys 3 and the number of activated registers 5 increase.

[0019] The air passage section of the connecting duct 13 controlled by the action of the electrically controlled control valve 14 reproduces the actual air passage section which could be obtained in an acoustic accordion under the same operating conditions. As in an acoustic accordion, the dynamic variation of the air passage section of the connecting duct 13 obviously causes a corresponding variation of the pressure signal independent from the force that the user of the electronic instrument 1 exerts on bellows 6.

[0020] According to a further embodiment (not shown), the connecting duct 13 consists of a number of channels, which pneumatically connect bellows 6 to the air passage opening 8; at least part of the channels are controlled by respective electrically controlled control valves 14; in this embodiment, the various channels have mutually different sections so as to improve the control possibility and to further approach the behavior of an acoustic accordion. Similarly, the air passage opening 8 can also consist of a single circular section through hole, a single crescent-shaped hole, or of a set of through holes having an increasing section.

[0021] If the user does not press any key 3, the control unit 11 controls the complete closing of the electrically controlled control valve 14 with the effect of blocking the movement of bellows 6. In order to recover the bellows 6 and compress it to its rest position, the electronic accordion 1 has a release key (not shown) on the outside, which is suited to electronically control the release of the movement of bellow 6, i.e. to take the electrically controlled control valve 14 to a partial or complete opening position. In particular, the pressing of the release key sends a signal to the control unit 11, which controls the opening of the electrically controlled control valve 14, thus causing the release of the movement of bellows 6; as soon as the release key is released, the control unit 11 returns the electrically controlled control valve 14 to the previous closing state.

[0022] As shown in figures 4, 5 and 6, the electrically controlled control valve 14 comprises a valve body 15 with a circular shape which runs around a longitudinal symmetry axis 16. An air passage opening 17, through which the air flows along the connecting duct 13 so as to enter or exit from bellows 6, is obtained in the middle of the valve body 15, coaxial to the valve body 15. An intermediate annular portion of the surface of the passage opening 17 defines a valve seat 18, against which a plug 19 leans to seal the passage opening 17 and thus prevent the air stream through the passage opening 17 itself. In particular, plug 19 is mounted so as to be mobile between a complete opening position in which plug 19 is at the maximum distance from the valve seat 18 and a closing position (shown in figure 6) in which plug 19 leans against the valve seat 18 and seals the passage opening 17.

[0023] According to a preferred embodiment, the valve body 15 comprises a tubular element 20 in which the passage opening 17 is defined. The tubular element 20 has a sandglass shape and thus the passage opening 17 has an inner portion 21 which is arranged on the side of plug 19, supports the valve seat 18, and has a converging taper, and an outer portion 22 which is connected to the inner portion 21, is arranged on the opposite side of plug 19 and has a diverging taper (i.e. opposite to the inner portion 21). It is worth noting that the converging taper of the inner portion 21 is much more accentuated than the diverging taper of the outer portion 22 (which is substantially nearly cylindrical).

[0024] According to a preferred embodiment, plug 19 has the shape of an ogive having a pointed end which faces the passage opening 17 and which, in the closing position (shown in figure 6), gets into the passage opening 17 beyond the valve seat 18. Therefore, in the closing position, the valve seat 18 leans against an intermediate portion of the outer surface of plug 19 spaced apart from the pointed end of plug 19. In the axial section thereof, plug 19 preferably has the shape of a heart. Such a shape and such an arrangement of plug 19 allow to reduce the aerodynamic noises produced by the contact of the air with the plug 19 itself.

[0025] The electrically controlled control valve 14 comprises a fixing body 23 with annular shape which is suited to be rigidly fixed to the electronic accordion 1 (for this purpose it is provided with through holes, visible in figures 4 and 5, through which screws are arranged), is arranged around the valve body 15, and is separated and independent from the valve body 15 itself. In other words, the fixing body 23 has a void in the middle (the fixing body 23 having an annular shape) in which the valve body 15 is arranged (at a given distance) without touching the fixing body 23 itself in any manner. A flexible connecting diaphragm 24 with an annular shape is included, which mechanically connects the valve body 15 to the fixing body 23 so as to allow the valve body 15 to axially and radially move (vibrate) with respect to the fixing body 23. In other words, the connecting diaphragm 24 has an outer end which is fixed to the fixing body 23 and an inner end which is fixed to the valve body 15; thereby, the valve body 15 is hanging on the fixing body 23 to move (vibrate) freely with respect to the fixing body 23 itself.

[0026] According to a preferred (but not binding) em-

bodiment shown in figures 4, 5 and 6, the connecting diaphragm 24 has, in its axial section, the shape of an overturned "S", i.e. a "sinusoid" shape, or double "U" shape; alternatively, the connecting diaphragm 24 could have an axial section in the shape of a "U".

[0027] The electrically controlled control valve 14 comprises a supporting body 25 which is fixed to the valve body 15 and supports an electric actuator 26 which is arranged coaxially to the passage opening 17 and is mechanically connected to plug 19 in order to move plug 19 between the complete opening position and the closing position; in particular, the electric actuator 26 is provided with a shaft 27 which is axially slidingly mounted and has an end rigidly restrained to plug 19. According to a possible embodiment, the electric actuator 26 comprises a rotary stepper electric motor, which controls a worm screw coupled to a corresponding nut screw obtained on the shaft 27; alternatively, the electric actuator 26 is a linear stepper motor which directly controls shaft 27.

[0028] The support body 25 comprises two columns 28 (but obviously there could be more), which are axially arranged on opposite sides of the passage opening 17 and connect the support body 25 to the valve body 15. Each column 28 of the support body 25 is preferably fixed to the valve body 15 by means of a corresponding screw 29; similarly, the electric actuator 26 is also fixed to the support body 25 by means of a pair of screws 30. According to a preferred embodiment, the flexible diaphragm 24 has two through holes, each of which is crossed by a corresponding column 28 of the support body 25; thereby, the flexible diaphragm 24 is also kept integral with the valve body 15 by means of the columns 28.

[0029] The function of the connecting diaphragm 24 is to mechanically uncouple the valve body 15 from the fixing body 23 so as to avoid the transmission of vibrations generated by the electric actuator 26, from the valve body 15 (which supports the electric actuator 26) to the fixing body 23; indeed, such variations, if transmitted to the fixing body 23 and thus to the whole structure of the electronic accordion 1 to which the fixing body 23 is rigidly connected, could generate a noise of relatively high intensity because they could be amplified by the electronic accordion 1, which behaves as a harmonic resonance box. In other words, the connecting diaphragm 24 forms a mechanical filter which blocks the transmission of vibrations generated by the electric actuator 26, from the valve body 15 (which supports the electric actuator 26) to the fixing body 23.

[0030] The electrically controlled control valve 14 comprises a ring 31 made of a spongy material (thus soundproofing) which is arranged around the passage opening 17 on the opposite side with respect to plug 19. According to a preferred embodiment, a central hole of the ring 31 made of a spongy material is arranged at a given distance from the tubular element 20, i.e. the tubular element 20 is inserted into the central hole of the ring 31 made of a spongy material with a given clearance. The function of the ring 31 made of a spongy material is to attenuate the aerodynamic swish which is generated by the air when it crosses the passage opening 17.

[0031] According to a preferred (but not binding) embodiment, the electrically controlled control valve 14 comprises a small tube 32 of the pressure sensor 7, which is arranged through the fixing body 23. In essence, an inner end of the small tube 32 is arranged inside bellows 6 (or inside the connecting duct 13 which forms the extension of bellows 6), while an outer end of the small tube 32 is arranged outside bellows 6 and is coupled to the pressure sensor 7; thus, the small tube 32 acts as an extension to "take" the inner pressure of bellows 6 up to the pressure sensor 7 which is arranged outside bellows 6 (arranging the pressure sensor 7 outside bellows 6 greatly simplifies the assembly of the pressure sensor 7, because bellows 6 is an elastic body, the shape and size of which being greatly, continuously modified).

[0032] According to a preferred (but not binding) embodiment, the outer surface of plug 19 which comes into contact with the valve seat 18 is externally coated with a layer 33 of elastic material (e.g. rubber or the like) which serves the function of both damping the impact of plug 19 against the valve seat 18 when plug 19 reaches the closing position, and increasing the sealing between the plug 19 and the valve seat 18.

[0033] In the preferred embodiment shown in the accompanying figures, plug 19 has an axially directed linear motion (i.e. plug 19 moves along the longitudinal axis of the passage opening 17). According to a different, equivalent embodiment, plug 19 could have a radially directed linear motion (i.e. plug 19 would move perpendicularly to the longitudinal axis of the passage opening 17). According to a further, equivalent embodiment, plug 19 could have a rotary motion (i.e. plug 19 would rotate around a rotation axis parallel or perpendicular to the longitudinal axis of the passage opening 17).

[0034] The above-described electrically controlled control valve 14 has many advantages.

[0035] Firstly, the above-described electrically controlled control valve 14 allows to eliminate the perception of the noise generated by the electrically controlled control valve 14 outside the electronic accordion 14. Such a result is not achieved by acoustically isolating the electrically controlled control valve 14, instead by eliminating (as much as possible) the noise source. In other words, the above-described electrically controlled control valve 14 is quieter *per se* and thus the noise of very low intensity which is generated by the electrically controlled control valve 14 cannot be perceived in any manner outside the electronic accordion 1.

[0036] Furthermore, the above-described electrically controlled control valve 14 is easy and cost-effective to be implemented because the existing adaptations are very simple *per se.*

[0037] Finally, the electrically controlled control valve 14 is particularly small in size, compact, and light in weight and so can be easily housed inside the electronic

accordion 1.

Claims

1. An electrically controlled control valve (14) to control the air stream of a bellows (6) of an electronic accordion (1); the electrically controlled control valve (14) comprises:

   a valve body (15), in which an air passage opening (17) is obtained, a part of the surface of the passage opening (17) defining a valve seat (18);
   a plug (19), which is mounted so as to be mobile between a complete opening position, in which the plug (19) is arranged at the maximum distance from the valve seat (18), and a closing position, in which the plug (19) leans against the valve seat (18); and
   an electric actuator (26), which is mechanically connected to the plug (19), so as to move the plug (19) between the complete opening position and the closing position;
   the electrically controlled control valve (14) is **characterized in that** it comprises:

      a fixing body (23) with an annular shape, which is suited to be rigidly fixed to the electronic accordion (1), is arranged around the valve body (15), and is separate from and independent of the valve body (15) itself; and
      a flexible connecting diaphragm (24) with an annular shape presenting an outer end, which is fixed to the fixing body (23), and an inner end, which is fixed to the valve body (15), so as to allow the valve body to axially and radially move with respect to the fixing body (23).

2. An electrically controlled control valve (14) according to claim 1, wherein the connecting diaphragm (24) presents, in its axial section, the shape of an overturned "S", namely the shape of a "sinusoid".

3. An electrically controlled control valve (14) according to claim 1 or 2, wherein the plug (19) presents the shape of an ogive having a pointed end that faces the passage opening (17) and, in the closing position, gets into the passage opening (17) beyond the valve seat (18).

4. An electrically controlled control valve (14) according to claim 3, wherein the plug (19) presents, in its axial section, the shape of a heart.

5. An electrically controlled control valve (14) according to claim 3 or 4, wherein, in the closing position, an intermediate portion of the outer surface of the plug (19), which is arranged at a distance from the pointed end of the plug (19), leans against the valve seat (18).

6. An electrically controlled control valve (14) according to any of the claims from 1 to 5, wherein the electric actuator (26)is arranged coaxial to the passage opening (17).

7. An electrically controlled control valve (14) according to claim 6 and comprising a support body (25), which is mounted on the valve body (15) and supports the electric actuator (26).

8. An electrically controlled control valve (14) according to claim 7, wherein the support body (25) comprises two columns (28), which are axially arranged on opposite sides of the passage opening (17) and connect the support body (25) to the valve body (15).

9. An electrically controlled control valve (14) according to claim 8, wherein each column (28) of the support body (25) is fixed to the valve body (15) by means of a corresponding screw.

10. An electrically controlled control valve (14) according to claim 9, wherein the flexible diaphragm (24) presents two trough holes, each of which is suited to house a corresponding column (28) of the support body (25) that extends therethrough.

11. An electrically controlled control valve (14) according to any of the claims from 1 to 10 and comprising a ring (31) made of a spongy material, which is arranged around the passage opening (17) on the opposite side with respect to the plug (19).

12. An electrically controlled control valve (14) according to claim 11, wherein the valve body comprises a tubular element (20), inside which the passage opening (17) is defined; the ring (31) made of a spongy material being inserted around the tubular element (20) by applying pressure.

13. An electrically controlled control valve (14) according to any of the claims from 1 to 12, wherein the passage opening (17) presents:

   an inner portion (21), which is arranged on the side of the plug (19), supports the valve seat (18), and presents a converging taper; and
   an outer portion (22), which is connected to the inner portion (21), is arranged on the opposite side with respect to the plug (19), and presents a diverging taper.

14. An electrically controlled control valve (14) according to any of the claims from 1 to 13 and comprising a

small tube (32) of a pressure sensor, which is arranged so as to extend through the fixing body (23).

15. An electrically controlled control valve (14) according to any of the claims from 1 to 14, wherein the outer surface of the plug (19) that comes into contact with the valve seat (18) is externally coated with a layer (33) of elastic material.

16. An electronic accordion (1) comprising:

at least one keyboard (2), which is coupled to a plurality of sensors (9) so as to generate a series of keyboard signals reproducing the pressing of the keys (3);
a bellows (6), which is coupled to a pressure sensor (7) so as to generate a pressure signal that is proportional to the pressure of the air pumped by the bellows (6);
at least one air passage opening (8) for the passage of air with respect to the outer environment, which is connected to the bellows (6) by means of at least one connecting duct (13);
a sound module (12), which is able to electronically generate the sound as a function of the pressure signal and of the keyboard signals;
an electrically controlled control valve (14), which is coupled to the connecting duct (13), is suited to control an air passage section (15) of the connecting duct (13) itself, and is manufactured according to any of the claims from 1 to 15; and
a control unit (11) to control the position of the electrically controlled control valve (14) as a function of the keyboard signals.

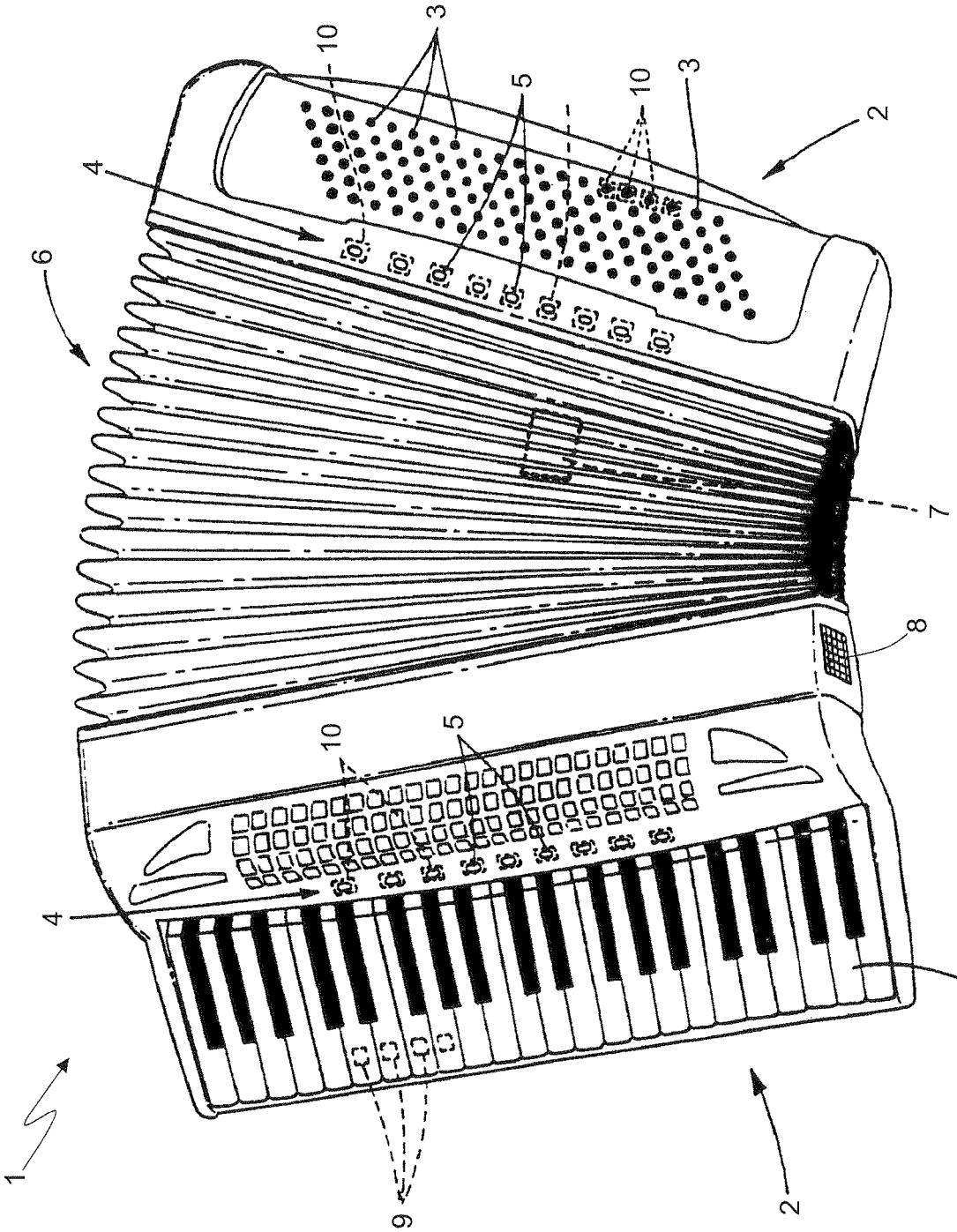


Fig. 1

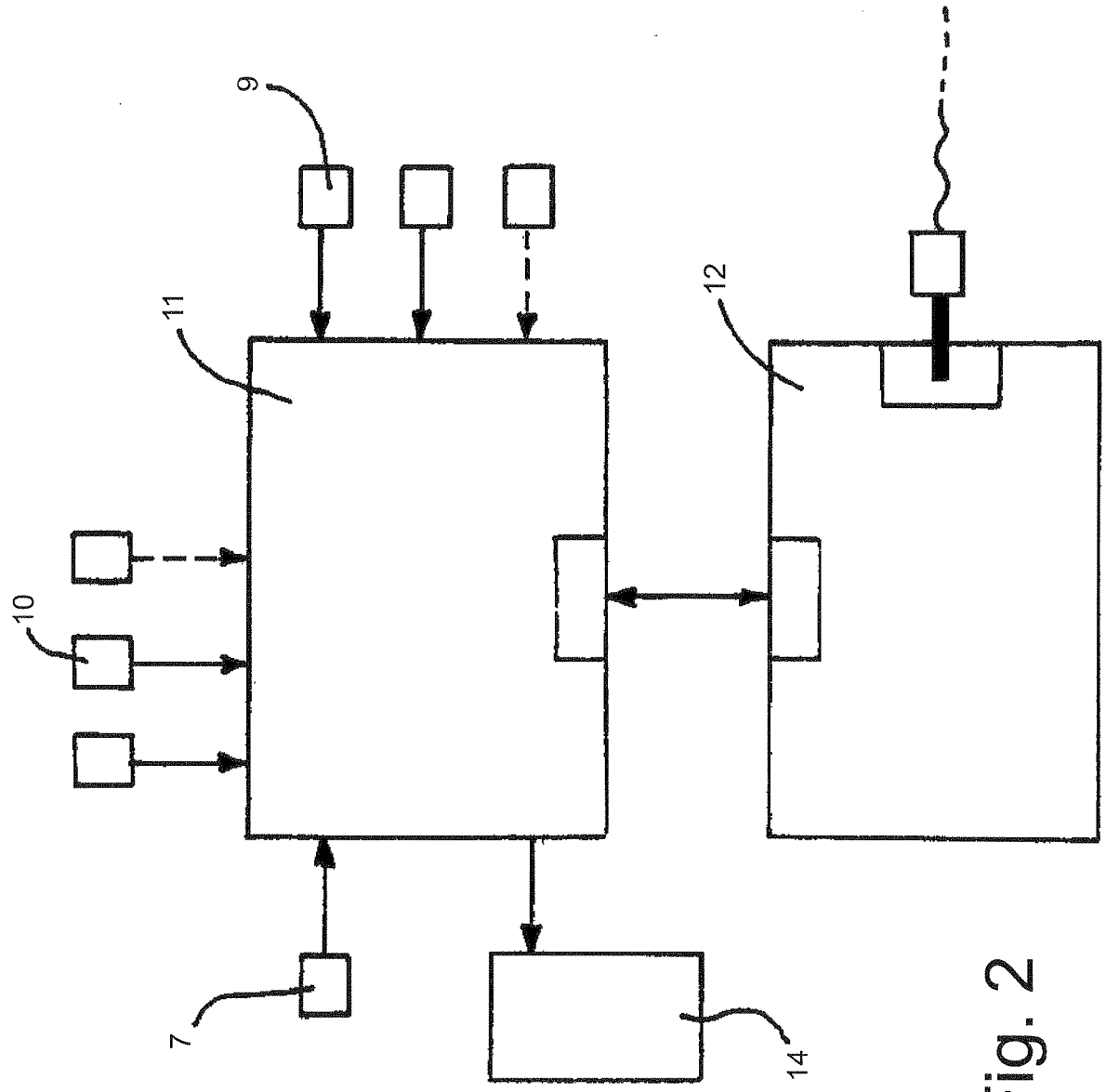
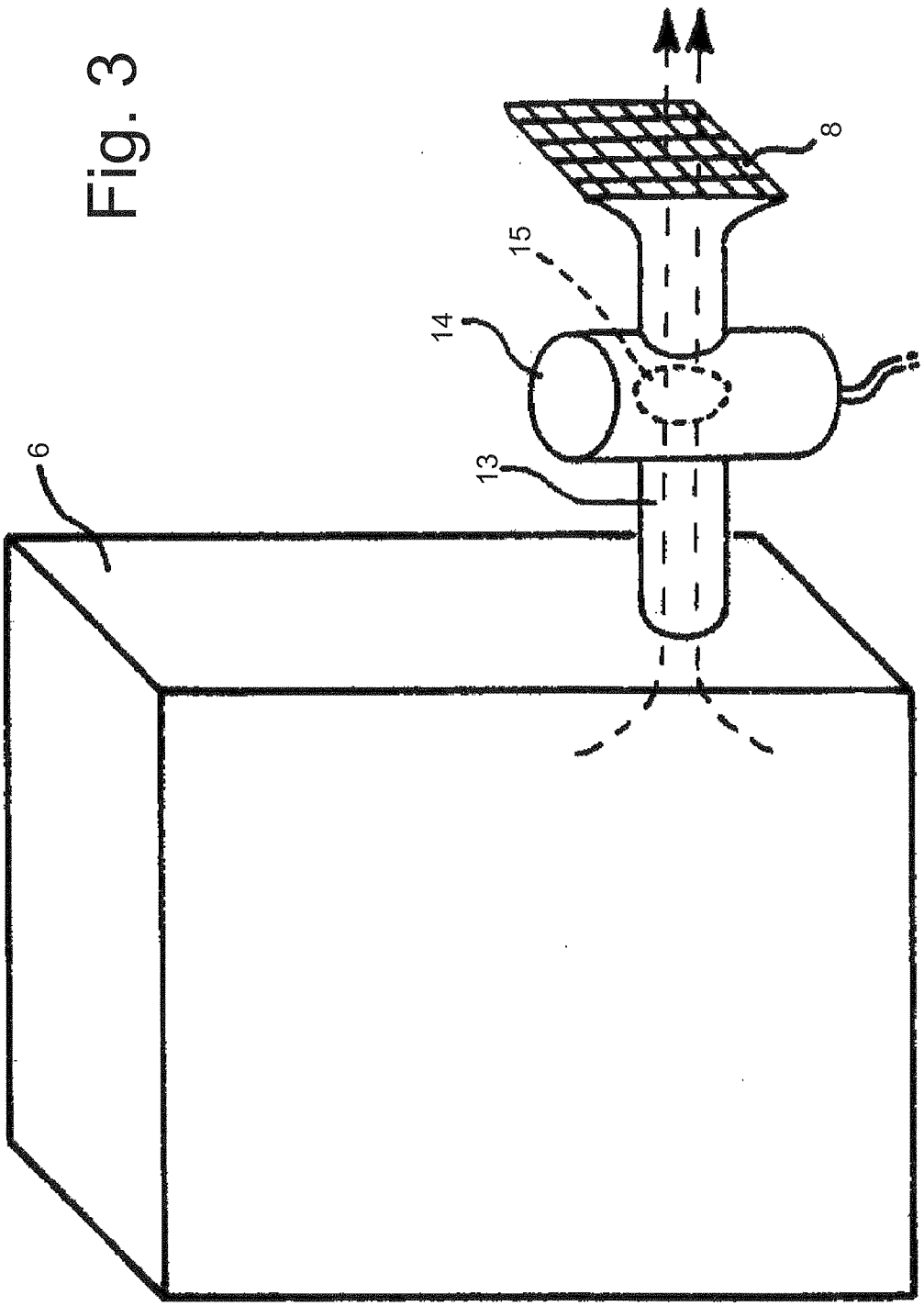


Fig. 2

Fig. 3



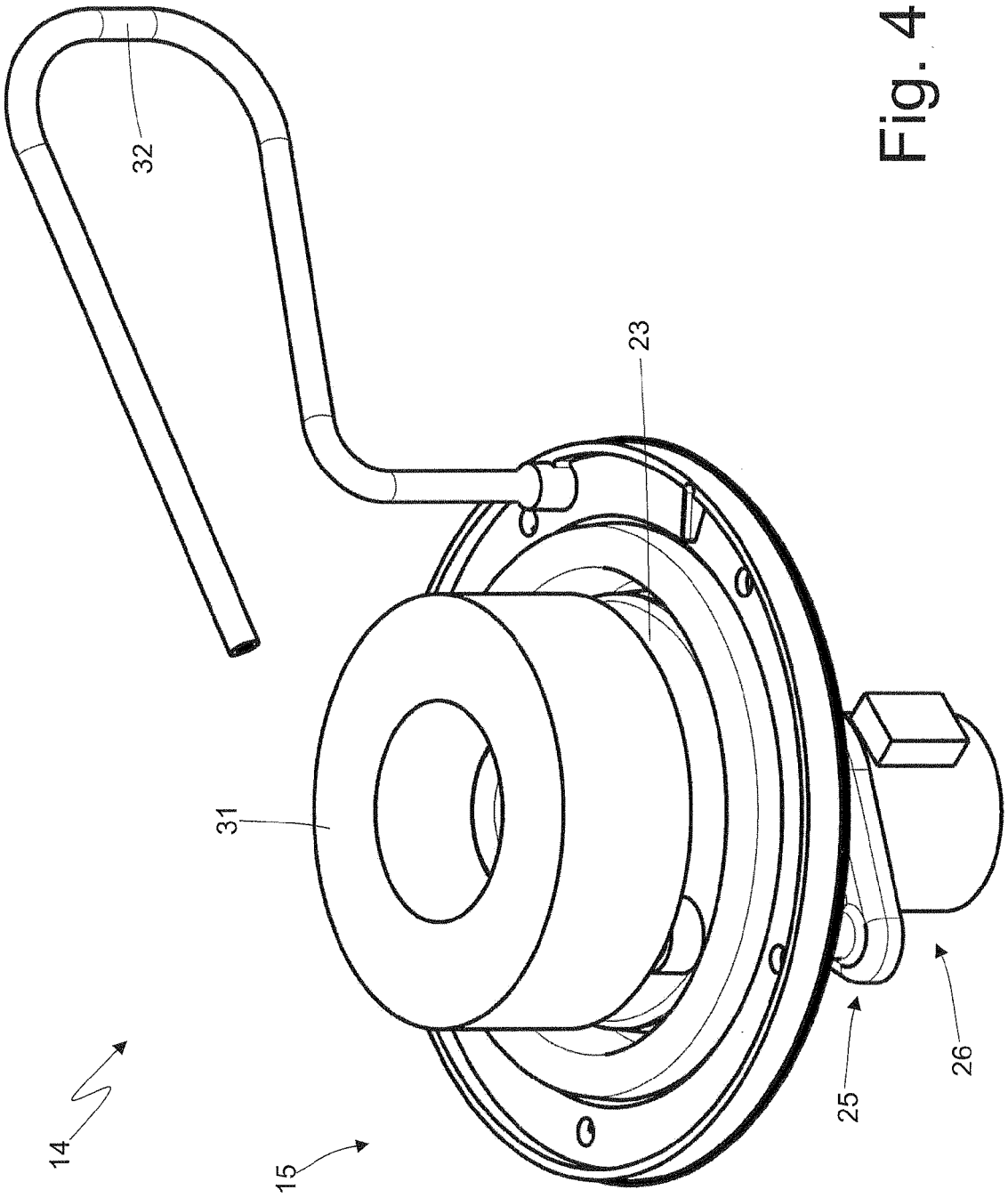


Fig. 4

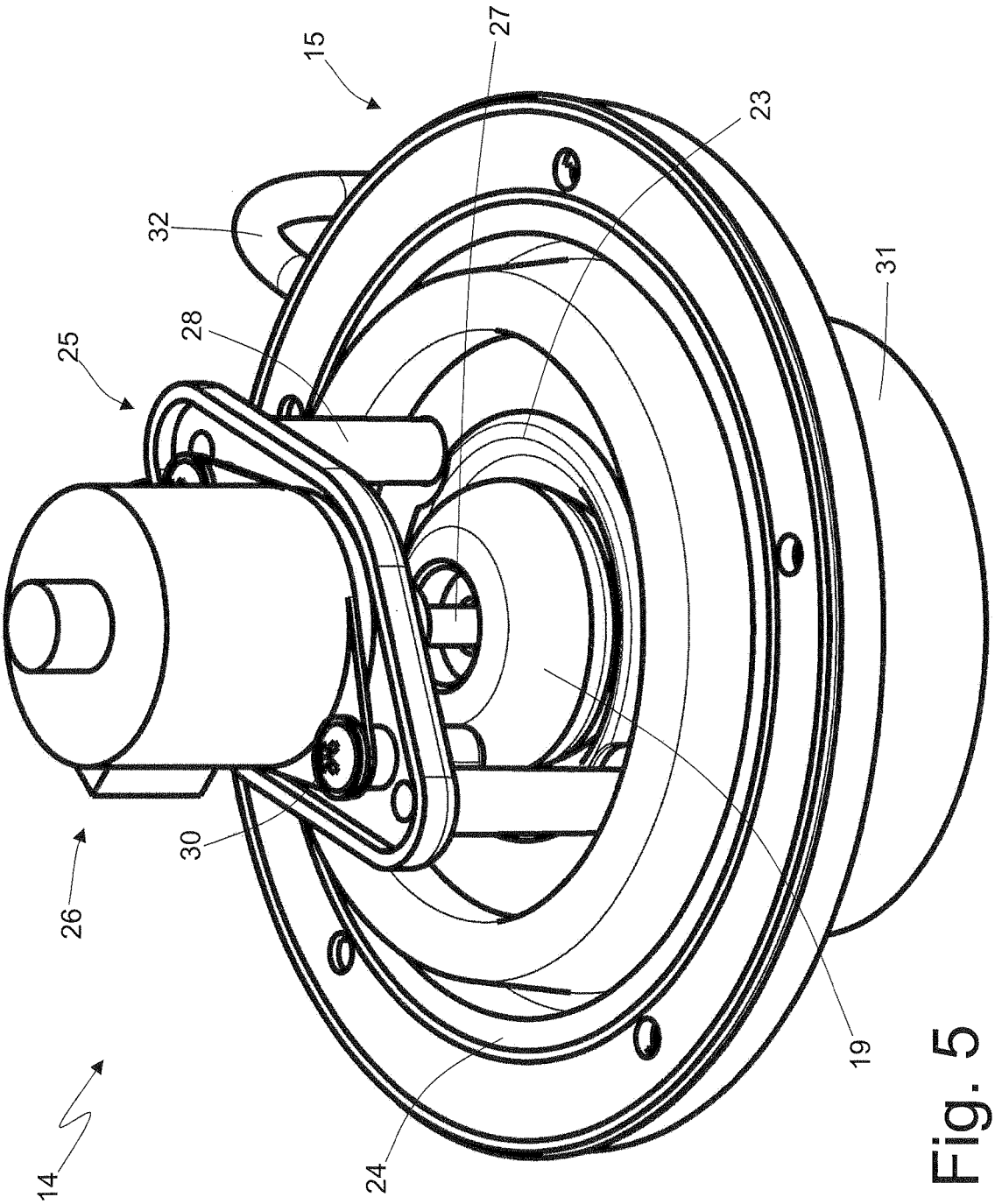


Fig. 5

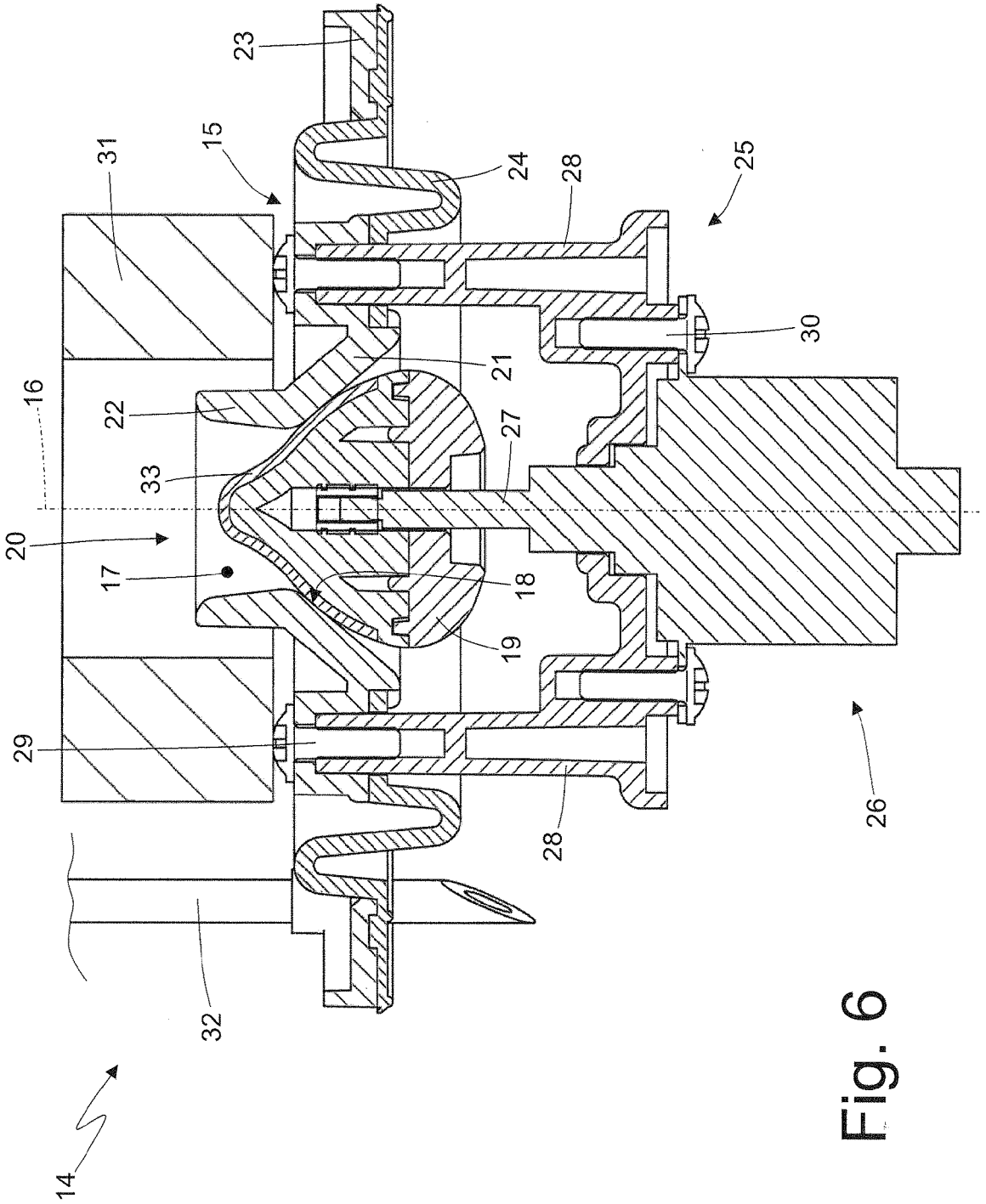


Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 8984

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 752 966 A2 (ROLAND CORP [JP]) 14 February 2007 (2007-02-14) * paragraph [0021]; claim 1; figures 1-9 * -----	1-16	INV. G10H1/32
A	EP 1 258 861 A2 (ROLAND EUROP SPA [IT]) 20 November 2002 (2002-11-20) * paragraph [0001] - paragraph [0005]; figure 1 * -----	1-16	

TECHNICAL FIELDS SEARCHED (IPC)

G10H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 June 2014	Righetti, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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