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(72) Inventors:
• **Moura De Oliveira, Antonio Manuel**
3800-25 Aveiro (PT)
• **Lopes Dias De Figueiredo, Noé**
3800-716 Aveiro (PT)
• **Pacheco Teixeira, Pedro Miguel**
Lote 33 - R/c D
8600-775 Lagos (PT)

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(71) Applicant: **Oliveira & Irmão S.A.**
3800 Aveiro (PT)

(74) Representative: **Jorio, Paolo et al**
Studio Torta S.r.l.
Via Viotti, 9
10121 Torino (IT)

(54) **Flush tank drain valve assembly with a system for regulating the amount of water drained**

(57) In a flush tank drain valve assembly (1) with a regulating system for adjusting the amount of water drained, a supporting structure (2), extending along an axis (A) and including a vessel (6), houses a valve body (3) which slides along the axis (A) and has a shutter (26) cooperating with a fluidtight seat (10); the vessel (6) houses at least one float (41) cooperating selectively with the valve body (3); the valve assembly (1) has a regulating system (75) for adjusting the water level inside the vessel (6) and hence the level (H1) activating the float (41); and the regulating system (75) is defined by a window (14) formed through a lateral wall (11) of the vessel (6), and by a gate (16) closing the window (14) and movable to adjust the opening of the window (14).

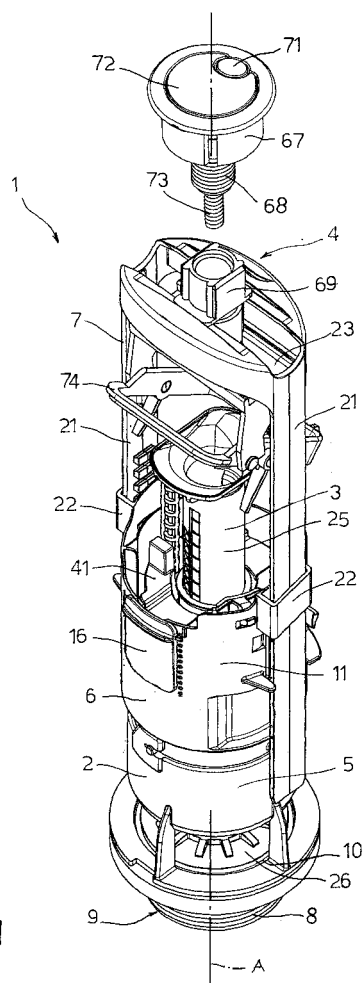


Fig.1

Description

[0001] The present invention relates to a flush tank drain valve assembly with a system for regulating the amount of water drained, and in particular to a dual-flush drain valve assembly (i.e. for draining all or only part of the water from the tank) which may, however, also be used in different flush modes.

[0002] Generally speaking, a dual-flush drain valve assembly comprises a supporting structure fixed to the bottom wall of the tank and having a drain hole defined by a fluidtight seat; and a valve body (normally a tubular member which also acts as an overflow pipe) housed in sliding manner inside the supporting structure and having a shutter at the bottom which cooperates with the fluidtight seat to close the drain hole. The valve body is raised by means of actuating members controlled by the user to drain all or part of the water from the tank. To achieve the two (full- or partial-) flush modes, the closing speed of the shutter is known to be varied by engaging the valve body with one or more floats and/or additional weights.

[0003] Known valve assemblies are not without drawbacks, not only in terms of reliable operation, easy, low-cost manufacture, efficiency, and practical operation, but above all as regards the accuracy with which the amount of water drained in different operating modes, particularly partial-flush mode, is regulated.

[0004] It is an object of the present invention to provide a flush tank drain valve assembly designed to eliminate the drawbacks of the known art. In particular, it is an object of the invention to provide a valve assembly which is extremely straightforward, highly efficient, and permits easy, precise adjustment of the amount of water drained in different operating modes, particularly partial-flush mode.

[0005] According to the present invention, there is provided a flush tank drain valve assembly with a system for regulating the amount of water drained, comprising a supporting structure extending along an axis and including a vessel; a valve body slidable along the axis and having a shutter cooperating with a fluidtight seat; and at least one float housed movably inside the vessel and cooperating selectively with the valve body; the valve assembly being characterized by comprising a regulating system for adjusting the water level in the vessel and hence the level activating the float.

[0006] The valve assembly according to the invention is extremely cheap and easy to produce, is of straightforward, reliable operation, and permits fast, easy, precise adjustment of the amount of water drained.

[0007] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of a valve assembly in accordance with the invention;

Figure 2 shows a partial exploded side view of the

Figure 1 valve assembly;

Figure 3 shows a view in perspective of a detail of the Figure 1 valve assembly;

Figure 4 shows a side view of a further detail of the Figure 1 valve assembly;

Figure 5 shows a view in perspective of a further detail of the Figure 1 valve assembly;

Figure 6 shows, schematically, operation of the Figure 1 valve assembly.

[0008] Number 1 in Figures 1 and 2 indicates as a whole a valve assembly, in particular a dual-flush valve assembly, for a known flush tank (not shown), and having a system for regulating the amount of water drained. Valve assembly 1 comprises a supporting structure 2; a valve body 3 extending and slidable along an axis A; and a control assembly 4.

[0009] Structure 2 comprises a base body 5; a vessel 6 connected integrally to base body 5; and a frame 7 height-adjustable with respect to base body 5 to support control assembly 4.

[0010] Base body 5 is fixed to a bottom wall of the tank by a threaded sleeve 8 having a drain hole 9 bounded by a fluidtight seat 10. Vessel 6 is bounded by a substantially cylindrical lateral wall 11, is open at the top, and is closed at the bottom by a bottom wall 12 having a central hole 13 through which valve body 3 is fitted.

[0011] As shown in detail in Figure 3, wall 11 has a window 14 extending downwards from a top edge 15 of vessel 6. Window 14 is closed by a movable gate 16, which slides parallel to axis A to adjust the opening of window 14 and therefore the amount of water inside vessel 6. More specifically, gate 16 is located on the outside of wall 11, and has two flexible opposite wings 17, which project laterally from gate 16 to engage respective lateral edges 18 of window 14 and attach gate 16 to wall 11. Gate 16 also has two lateral pins 19 which engage one of a number of seats 20 formed on wall 11.

[0012] Frame 7 is substantially known and not described in detail for the sake of simplicity. Very briefly, frame 7 comprises two height-adjustable uprights 21 inserted inside respective seats 22 on structure 2; and a top crosspiece 23 supporting control assembly 4.

[0013] Valve body 3 comprises a tubular member 25 (which also acts as an overflow pipe) housed inside vessel 6 to slide along axis A, and having a shutter 26 at the bottom, which cooperates with fluidtight seat 10 to close drain hole 9. Tubular member 25 is adjustable in length, being defined by two tubes 27, 28 connected telescopically in known manner.

[0014] With reference also to Figure 4, valve body 3 has a first catch 31 defined by a tooth 32 projecting radially from an outer lateral surface 33 of valve body 3; and a second catch 34 defined by a pair of appendixes 35, which project radially from surface 33 in the opposite direction to tooth 32, and are aligned with each other and located on opposite sides of valve body 3. Tooth 32 and appendixes 35 are carried by valve body 3 at different

heights along axis A. More specifically, tooth 32 is located higher than appendixes 35 along axis A.

[0015] Valve assembly 1 also comprises a top float 41 and a bottom float 42, which are housed inside vessel 6 and cooperate with valve body 3. Floats 41, 42 are located at different heights along axis A, and in particular at respective axially opposite ends of vessel 6, and are movable independently of each other with respect to valve body 3, alongside variations in the water level inside vessel 6, to selectively and independently engage valve body 3 at different heights along axis A.

[0016] Top float 41 comprises a double-walled, substantially annular float body 45 surrounding valve body 3; a rod 46 extends vertically downwards from float body 45, and is inserted in sliding manner inside a guide 47 formed inside vessel 6; and float 41 slides along axis A with respect to structure 2, and is connected by a rod 48 to a lever 49 hinged inside vessel 6.

[0017] Lever 49 has one end 50 hinged to vessel 6 and having a tooth-like latch 51 extending radially with respect to axis A; and a free end 52 attached to rod 48.

[0018] As shown in detail in Figure 5, float body 45 has a radial through slot 54 bounded by two opposite sides 55, which are connected by a strap 56 and define respective arms of an elastic gripper 57 having two grips 58 and two projections 59 at respective opposite ends. Rod 48 has a succession of notches 60, and grips 58 are designed to engage any one of notches 60 to secure rod 48 in a selected position to float 41. Grips 58 are releasable to change the position of grips 58 on rod 48 and therefore the distance between float 41 and lever 49; for which purpose, projections 59 are operated manually to part grips 58.

[0019] Bottom float 42 is located inside vessel 6, close to bottom wall 12, and is hinged to structure 2 by two pins 61 inserted inside respective aligned holes 62 formed in wall 11. Float 42 rotates about an axis of rotation defined by pins 61 and substantially perpendicular to axis A, and comprises a double-walled, sector-shaped float body 63 located radially outwards and substantially coaxial with respect to valve body 3. Pins 61 are located at the bottom end of float body 63; and float 42 has a second latch 64 defined by two teeth projecting from respective sides 65 of float body 63 to engage appendixes 35.

[0020] Floats 41, 42 are designed to selectively assume respective engaged positions, in which floats 41, 42 engage valve body 3 and prevent valve body 3 from moving down along axis A, and respective release positions, in which floats 41, 42 do not engage valve body 3. The engaged positions of top float 41 and bottom float 42 are defined respectively by a first and a second water level H1, H2 in vessel 6, the second level H2 being lower than the first level H1.

[0021] Control assembly 4 (Figure 1) is substantially known and therefore not described in detail for the sake of simplicity, and comprises a cup-shaped casing 67 fixed by a threaded rod 68 to a sleeve 69 on crosspiece 23; and a first and second control button 71, 72, which, by

means of a slide 73 housed in sliding manner inside sleeve 69, act on a control lever 74 connected to valve body 3 to raise valve body 3 along axis A.

[0022] Buttons 71, 72 slide parallel to and by different lengths along axis A to raise valve body 3 to respective different heights and discharge respective amounts of water. More specifically, button 71 travels a first predetermined length L1 to raise valve body 3 into a partial-flush position, in which valve body 3 is only engaged by top float 41 and not by bottom float 42; and button 72 travels a second predetermined length L2, greater than first length L1, to raise valve body 3 to a full-flush position, in which valve body 3 is engaged by bottom float 42.

[0023] Operation of valve assembly 1 is shown schematically in Figure 6.

[0024] When the tank is full (Figure 6A), the water in the tank and therefore in vessel 6 is at an initial level H; valve body 3 is in a closed position, in which shutter 26 closes drain hole 9; floats 41, 42 are buoyed by the water in the tank in respective engaged positions; latches 51, 64 are located above respective catches 31, 34; and valve body 3 is free to slide upwards along axis A.

[0025] To perform a partial flush, the user presses button 71, which travels length L1 to raise valve body 3 into the partial-flush position (Figure 6B), in which valve body 3 is only engaged by top float 41 (catch 31 being located above latch 51), and bottom float 42 does not engage valve body 3 (catch 34 being located below latch 64). The water flows out of the tank through drain hole 9; and the downward movement by force of gravity of valve body 3 is prevented by float 41 engaging valve body 3, i.e. by latch 51 engaging catch 31.

[0026] When the water drops below level H1 - the level activating float 41 - float 41, no longer sustained by the buoyancy of the water, moves by force of gravity into the release position, thus allowing valve body 3 to slide down by force of gravity to close drain hole 9.

[0027] To perform a full flush, the user presses button 72 (which travels a longer length L2 than length L1) to raise valve body 3 into the full-flush position (Figure 6C), in which catches 31, 34 are both located above respective latches 51, 64. As the water is being drained from the tank, downward movement of valve body 3 is prevented by float 42 engaging valve body 3, i.e. by latch 64 engaging catch 34. Even when the water drops below level H1, so that float 41 releases valve body 3, valve body 3 is still secured axially to float 42, so that drain hole 9 remains open. Only when the water drops below level H2 - the level activating float 42 - does float 42 assume the release position to allow valve body 3 to close drain hole 9.

[0028] Latches 51, 64 of floats 41, 42 therefore selectively and independently engage respective catches 31, 34 alongside variations in the water level.

[0029] Valve assembly 1 comprises a system 75 for adjusting the amount of water drained off, and which comprises window 14 and gate 16. The amount of water drained off in partial-flush mode is adjusted by simply

sliding gate 16 parallel to axis A, and inserting pins 19 inside a selected seat 20 to adjust the distance between edge 15 of vessel 6 and gate 16, and hence the opening of window 14.

[0030] The position of float 41 with respect to structure 2 can also be adjusted using gripper 57. Pressing projections 59 towards each other parts grips 58, so that float 41 can be slid along axis A to insert the grips inside a selected notch 60. When projections 59 are released, float 41 remains secured in the desired position with respect to lever 49.

[0031] Clearly, changes may be made to the valve assembly as described and illustrated herein without, however, departing from the scope of the accompanying Claims.

[0032] In particular, regulating system 75 may be used not only in dual-flush but also in single-flush valve assemblies.

Claims

1. A flush tank drain valve assembly (1) with a system for regulating the amount of water drained, comprising a supporting structure (2) extending along an axis (A) and including a vessel (6); a valve body (3) slidable along the axis (A) and having a shutter (26) cooperating with a fluidtight seat (10); and at least one float (41) housed movably inside the vessel (6) and cooperating selectively with the valve body (3); the valve assembly being **characterized by** comprising a regulating system (75) for adjusting the water level in the vessel (6) and hence the level (H1) activating the float (41).
2. A valve assembly as claimed in Claim 1, **characterized in that** the regulating system (75) comprises a window (14) formed through a lateral wall (11) of the vessel (6); and a gate (16) closing the window (14) and movable to adjust the opening of the window (14).
3. A valve assembly as claimed in Claim 2, **characterized in that** the window (14) extends downwards from a top edge (15) of the vessel (6).
4. A valve assembly as claimed in Claim 2 or 3, **characterized in that** the gate (16) slides parallel to the axis (A) to adjust the opening of the window (14) and hence the amount of water inside the vessel (6).
5. A valve assembly as claimed in one of Claims 2 to 4, **characterized in that** the gate (16) is located on the outside of the wall (11) and rests on the wall (11).
6. A valve assembly as claimed in one of Claims 2 to 5, **characterized in that** the gate (16) has flexible wings (17) projecting from the gate (16) to attach the

gate (16) to the wall (11).

7. A valve assembly as claimed in one of Claims 2 to 6, **characterized in that** the gate (16) has two pins (19), each of which engages a seat selected from a number of seats (20) formed on the wall (11).
8. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the float (41) slides with respect to the supporting structure (2).
9. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the float (41) is connected by a rod (48) to a lever (49) hinged to the supporting structure (2), and has grips (58) for engaging the rod (48) in a position selected from a number of predetermined positions.
10. A valve assembly as claimed in Claim 9, **characterized in that** the grips (58) are releasable to change the position of the grips (58) on the rod (48) and therefore the distance between the top float (41) and the lever (49).
11. A valve assembly as claimed in Claim 9 or 10, **characterized in that** the float (41) has an elastic gripper (57) having, at respective opposite ends, the grips (58) and projections (59) operated manually to part the grips (58).

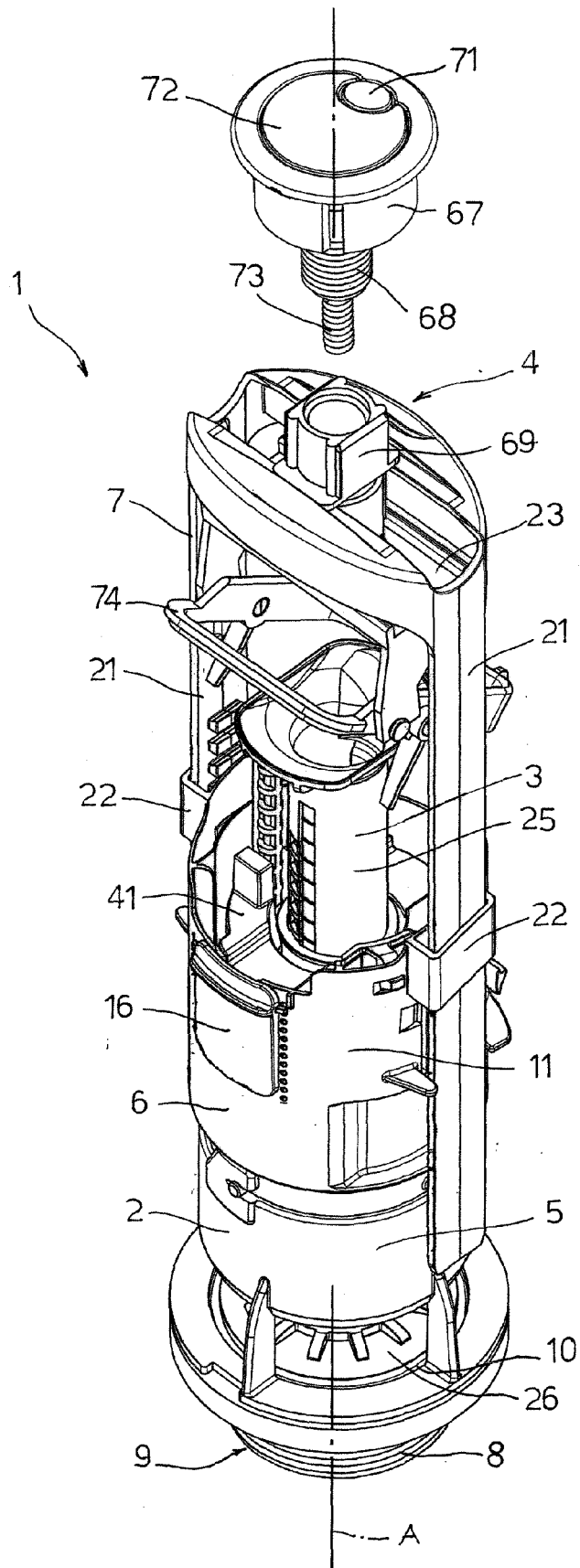


Fig. 1

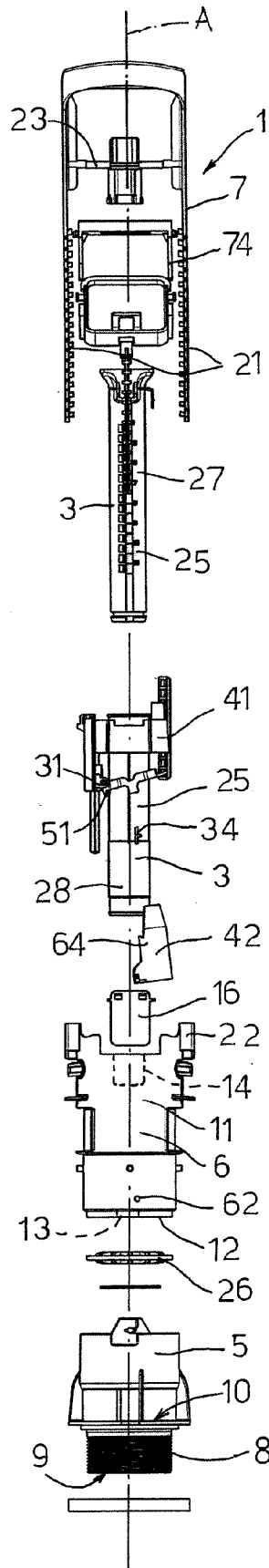


Fig. 2

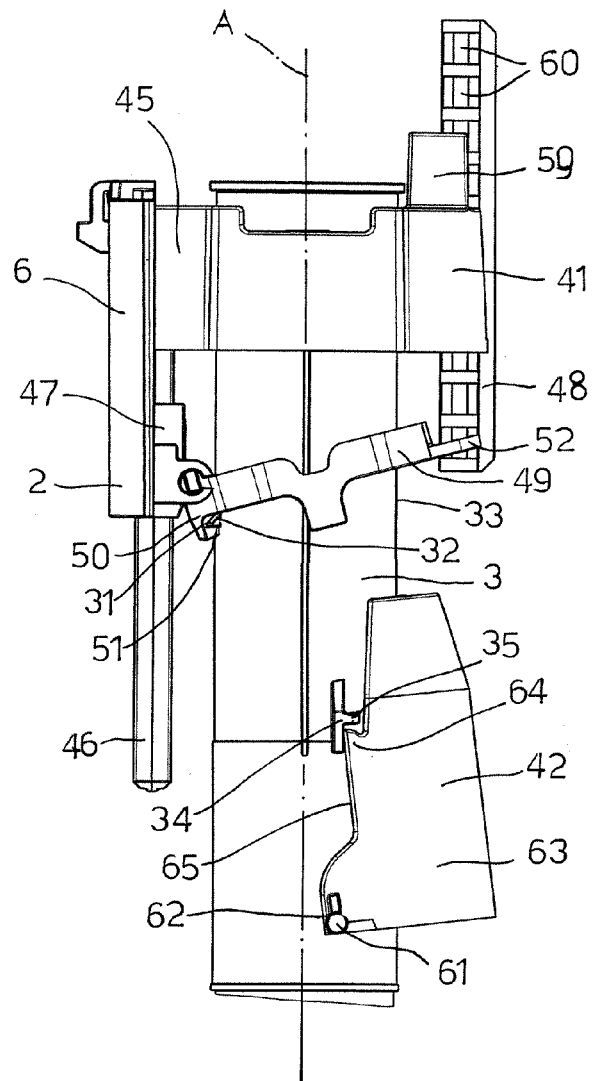


Fig. 4

Fig.3

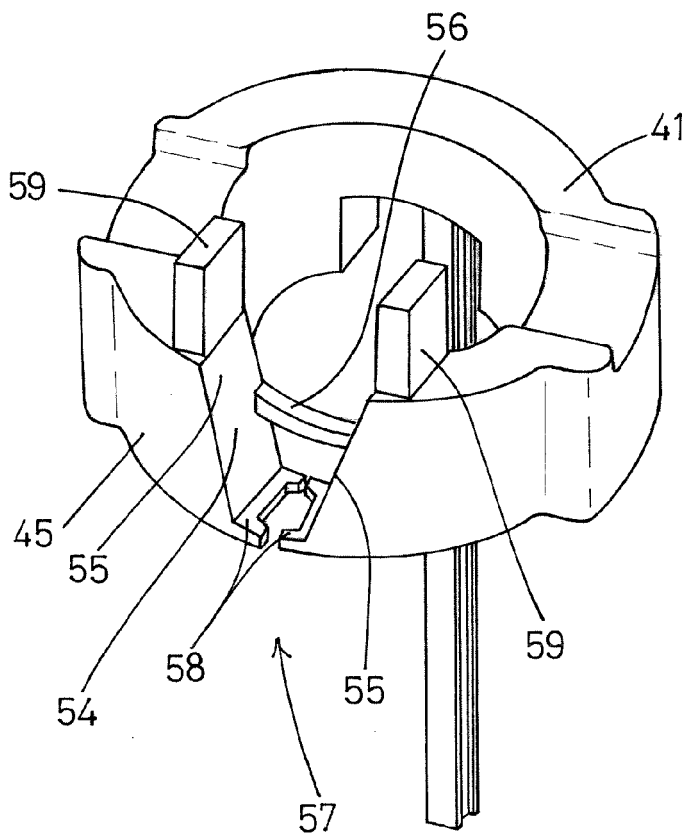
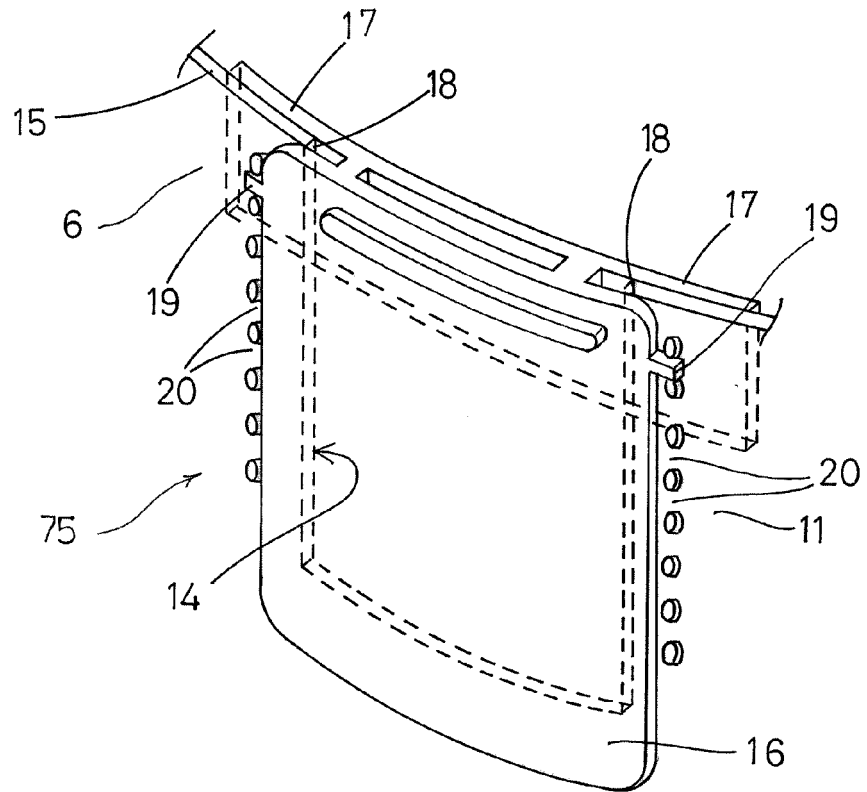


Fig.5

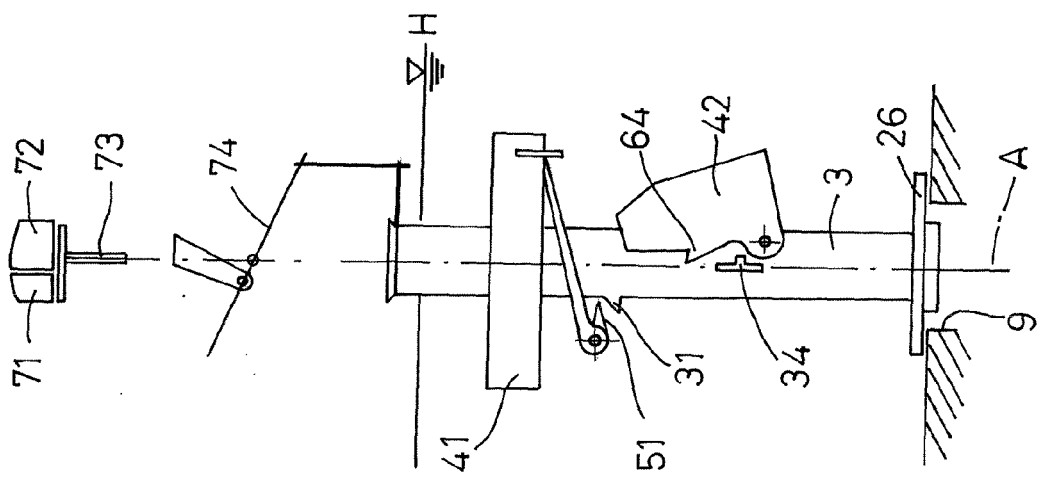


Fig. 6A

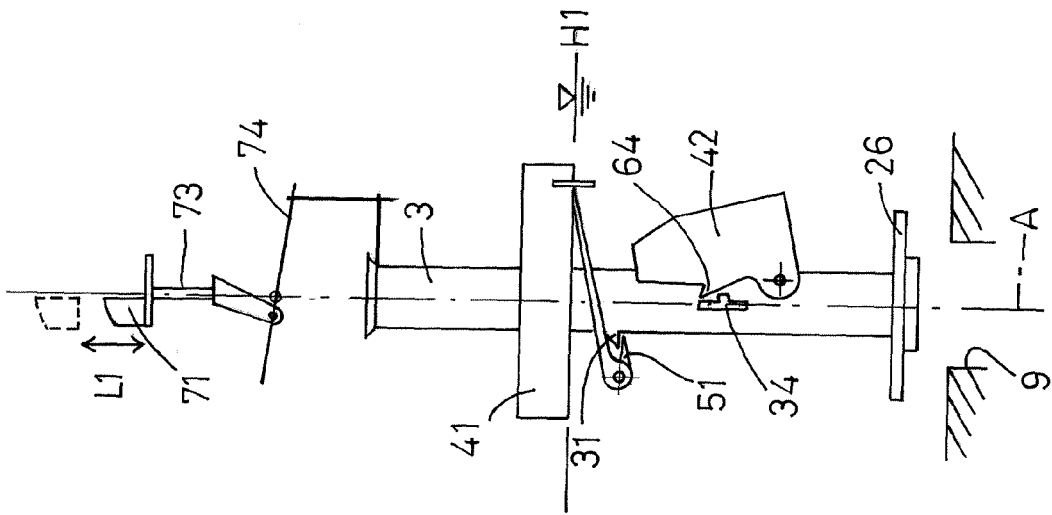


Fig. 6B

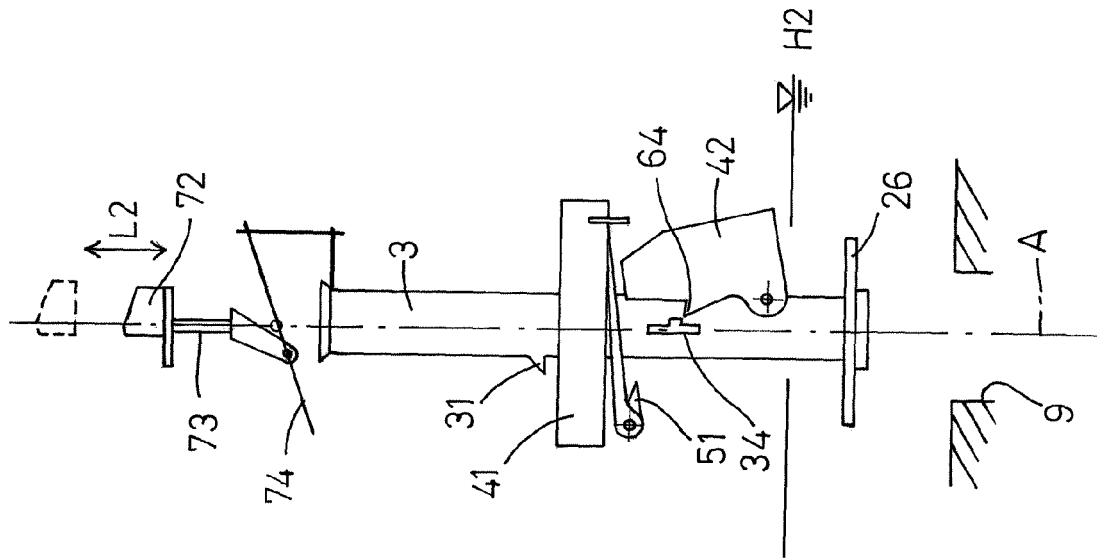


Fig. 6C