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(54) **Flush tank drain valve assembly**

(57) In a flush tank drain valve assembly (1), in particular a dual-flush drain valve assembly, 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 a top float (41) and a bottom float (42), which are located at different heights along the axis (A), and cooperate with the valve body (3); the floats (41, 42) are movable independently of each other with respect to the valve body (3) alongside variations in the water level inside the vessel (6), so as to selectively and independently engage the valve body (3) at different heights along the axis (A).

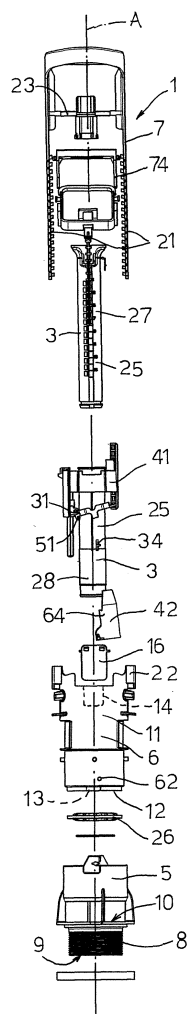


Fig. 2

Description

[0001] The present invention relates to a flush tank drain valve assembly, in particular a dual-flush drain valve assembly (i.e. for draining all or only part of the water from the tank).

[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, particularly in terms of reliable operation; easy, low-cost manufacture; efficiency and practical operation; and 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 and, at the same time, highly efficient. It is a further object of the invention to provide a valve assembly designed to permit easy adjustment of the amount of water drained in different operating modes.

[0005] According to the present invention, there is provided a flush tank drain valve assembly 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 a top float and a bottom float, located at different heights along the axis and cooperating with the valve body; the valve assembly being characterized in that the floats are movable independently of each other with respect to the valve body alongside variations in the water level inside the vessel, so as to selectively and independently engage the valve body at different heights along the axis.

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

[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). 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 also 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.

Claims

1. A flush tank drain valve assembly (1) 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 a top float (41) and a bottom float (42), located at different heights along the axis (A) and cooperating with the valve body (3); the valve assembly being **characterized in that** the floats (41, 42) are movable independently of each other with respect to the valve body (3) alongside variations in the water level inside the vessel (6), so as to selectively and independently engage the valve body (3) at different heights along the axis (A).
2. A valve assembly as claimed in Claim 1, **characterized in that** the floats (41, 42) have respective releasable latch means (51, 64) for engaging the valve body (3), and which selectively and independently engage respective catches (31, 34) on the valve body (3) alongside variations in the water level.
3. A valve assembly as claimed in Claim 2, **characterized in that** said releasable latch means (51, 64) are moved by the respective floats (41, 42) to selectively engage or release the valve body (3) axially when the water in the vessel (6) is above or below respective predetermined levels (H1, H2).
4. A valve assembly as claimed in Claim 2 or 3, **characterized in that** the catches (31, 34) on the valve body (3) are located at different heights along the axis (A).
5. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the floats (41, 42) are designed to selectively assume respective engaged positions, in which the floats (41, 42) engage the valve body (3) and prevent downward movement of the valve body (3) along the axis (A), and respective release positions, in which the floats (41, 42) do not engage the valve body (3); the engaged positions of the top float (41) and the bottom float (42) being defined respectively by a first and a second water level (H1, H2) in the vessel (6), the second level (H2) being lower than the first level (H1).
6. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the floats (41, 42) are located at respective axially opposite ends of the vessel (6).
7. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the bottom float (42) is hinged to the supporting structure (2).
8. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the top float (41) slides with respect to the supporting structure (2), and is connected to a lever (49) hinged to the supporting structure (2).
9. A valve assembly as claimed in one of the foregoing Claims, **characterized by** comprising a first and a second control button (71, 72), which act on a control lever (74) connected to the valve body (3) to raise the valve body (3) along the axis (A); the buttons (71, 72) travelling respective different lengths along the axis (A) to raise the valve body (3) to respective different heights and drain off respective amounts of water.
10. A valve assembly as claimed in Claim 9, **characterized in that** the first button (71) travels a first predetermined length to raise the valve body (3) into a partial-flush position, in which the valve body (3) is only engaged by the top float (41), and the bottom float (42) does not engage the valve body (3).
11. A valve assembly as claimed in Claim 9 or 10, **characterized in that** the second button (72) travels a second predetermined length, greater than the first length, to raise the valve body (3) into a full-flush position, in which the valve body (3) is engaged by the bottom float (42).
12. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the vessel (6) is bounded by a lateral wall (11) having a window (14); the window (14) being closed by a movable gate (16) height-adjustable to adjust the amount of water inside the vessel (6).
13. A valve assembly as claimed in one of the foregoing Claims, **characterized in that** the top 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.

14. A valve assembly as claimed in the foregoing Claim,
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). 5
15. A valve assembly as claimed in the foregoing Claims,
characterized in that the top 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). 10

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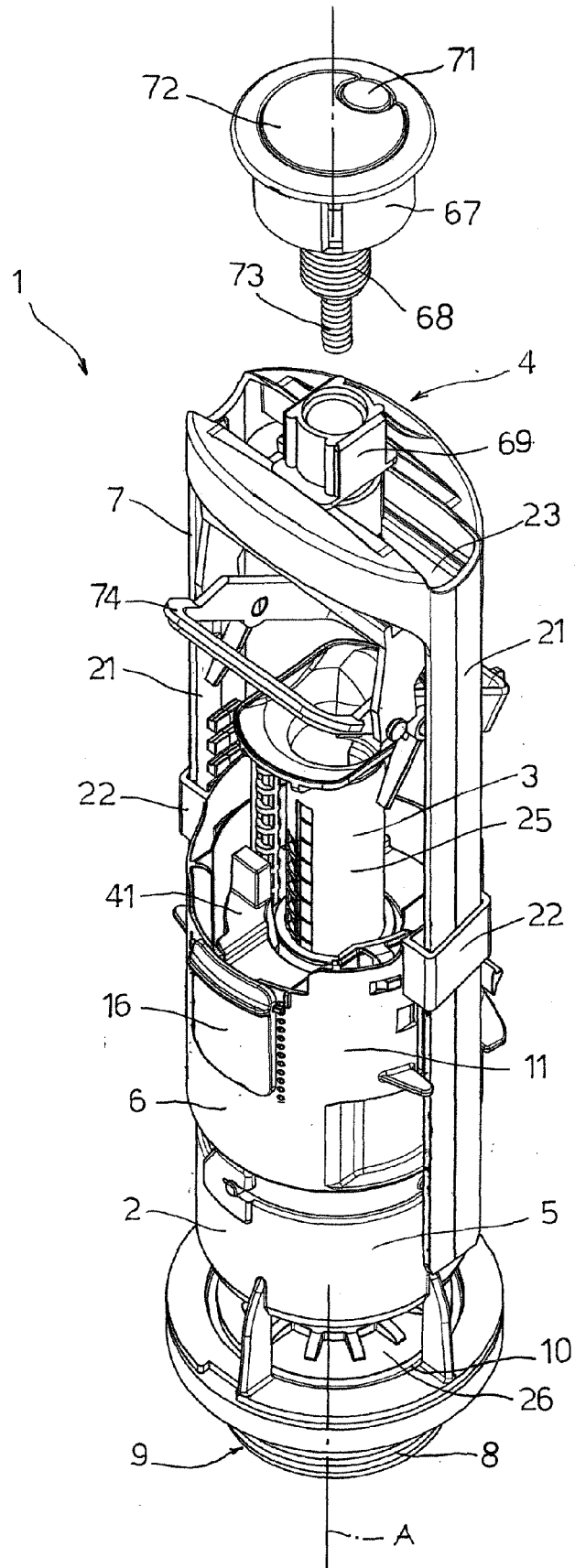


Fig. 1

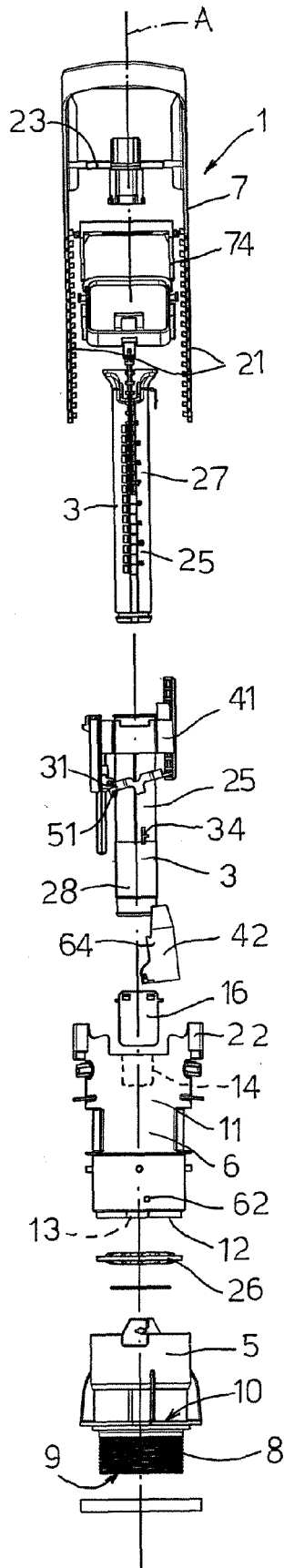


Fig. 2

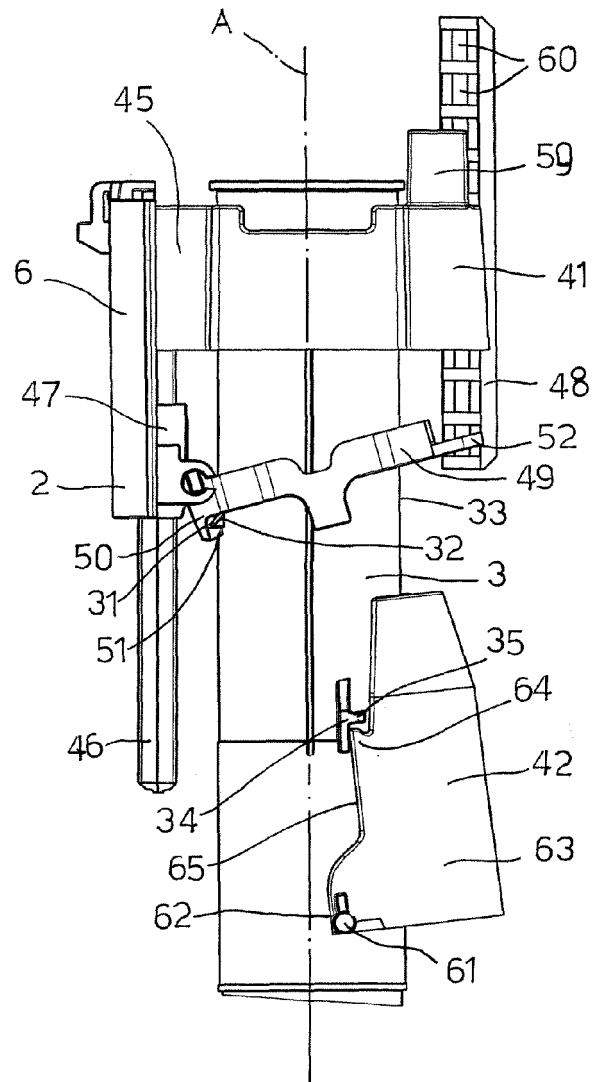


Fig. 4

Fig.3

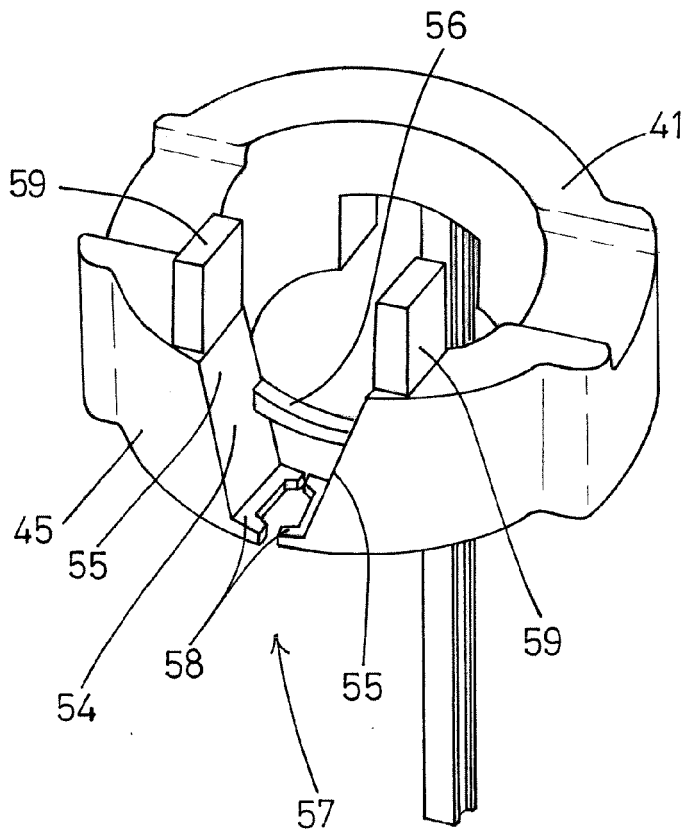
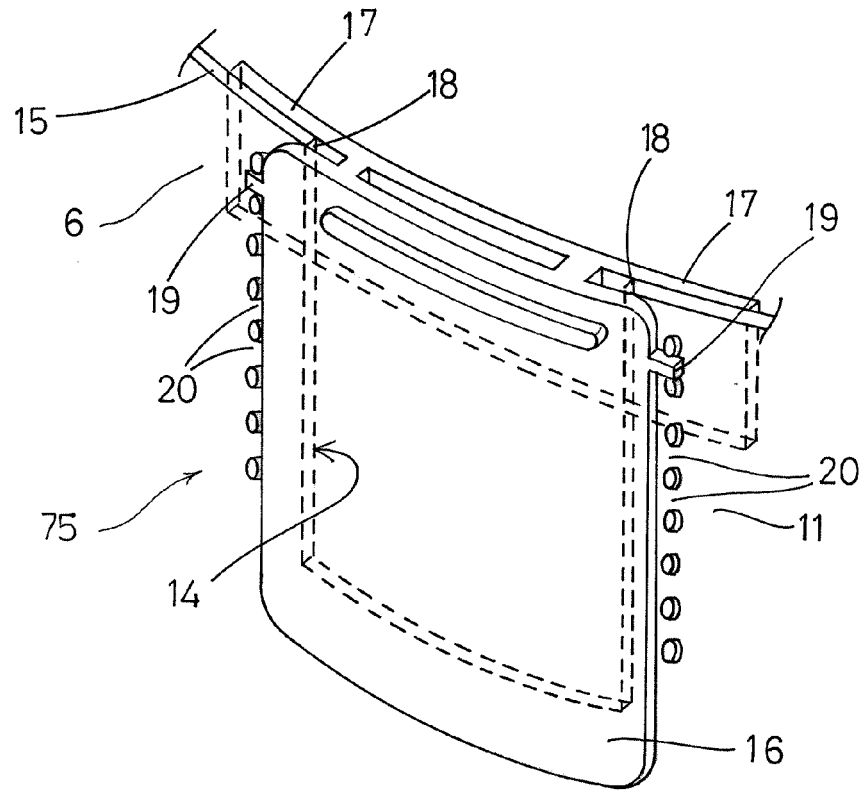


Fig.5

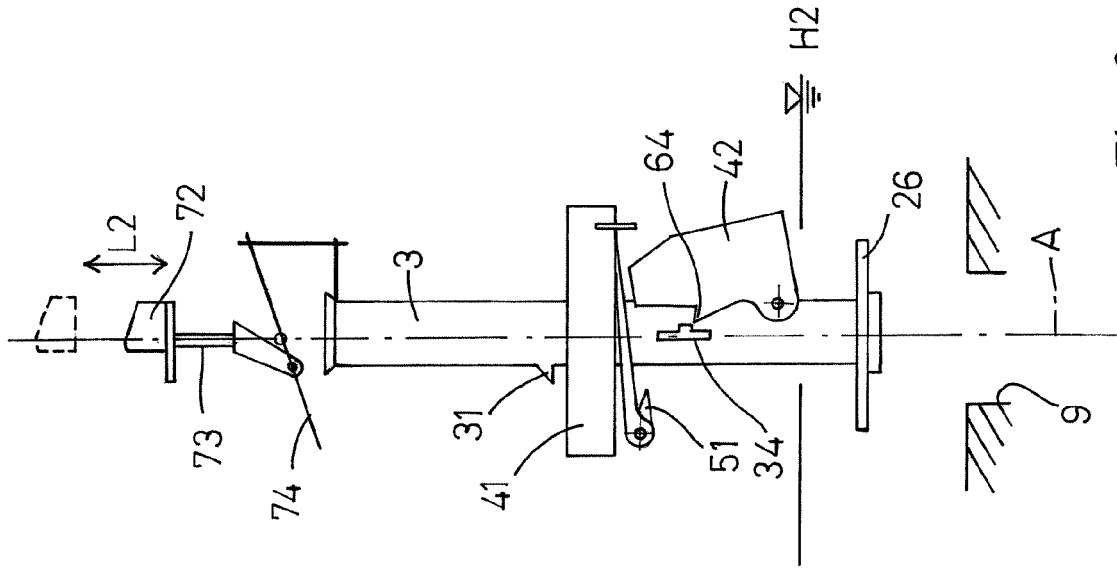


Fig. 6A

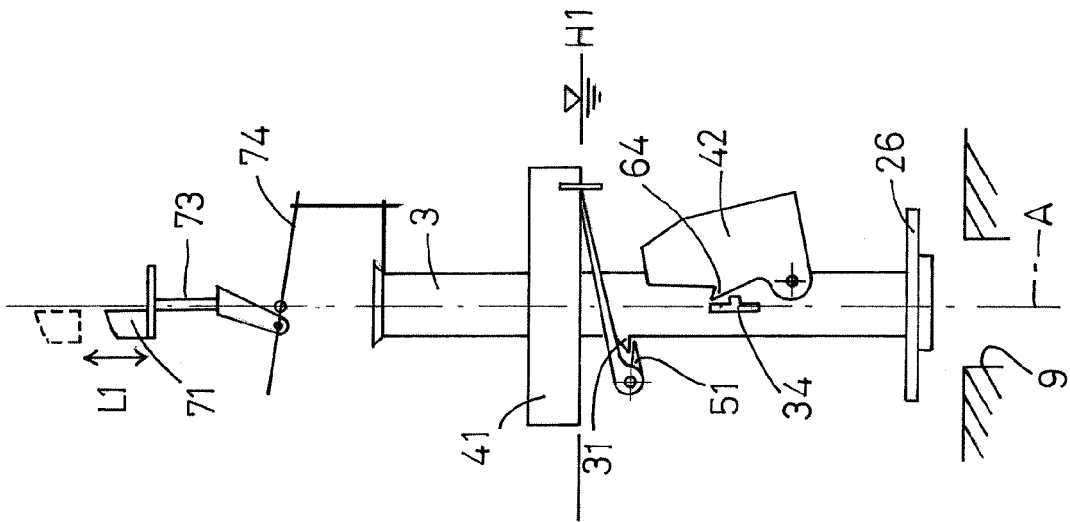


Fig. 6B

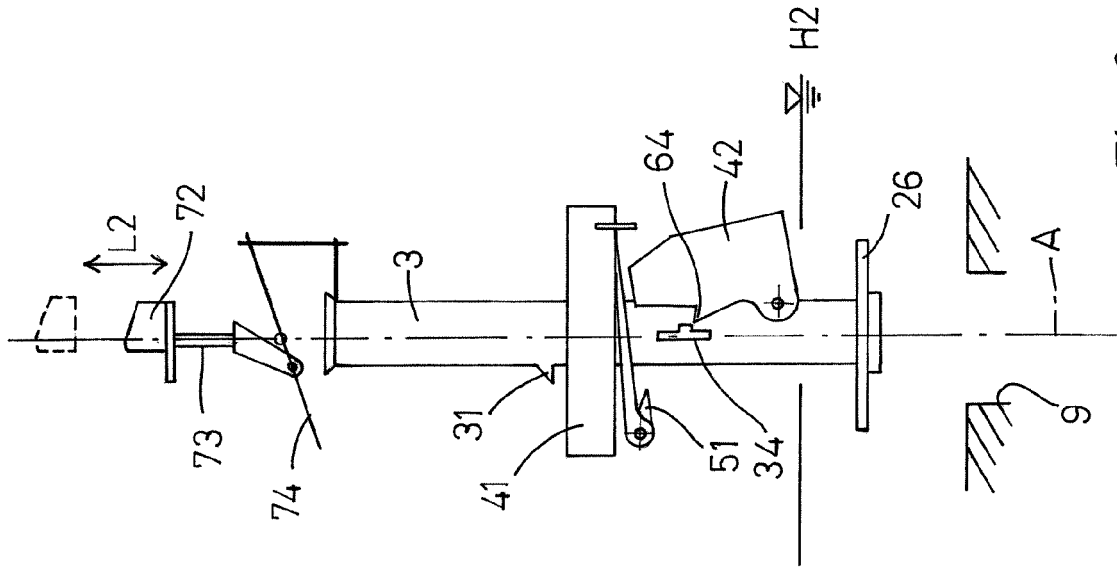


Fig. 6C