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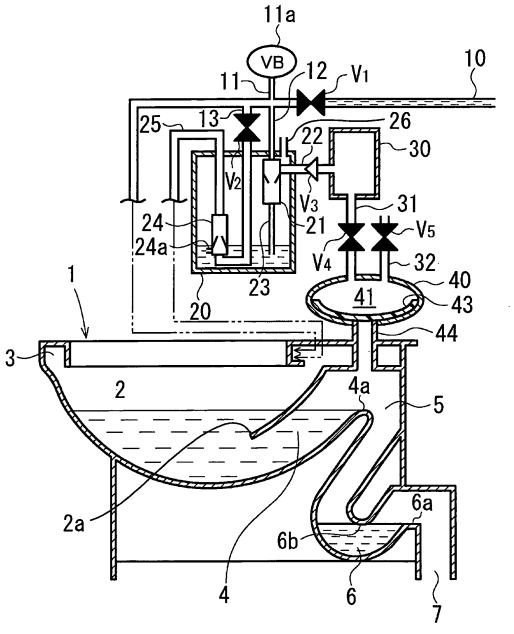
(54) TOILET BOWL FLUSHING DEVICE

(57) There is provided a toilet flushing apparatus for firmly discharging a filth by a small amount of flush water and by a short period of time and having still flush sound.

The toilet flushing apparatus includes first water supply means for supplying flush water to a toilet bowl 2 of a toilet main body 1, second water supply means for additionally supplying the flush water, a drain flow path 5 communicated with a downstream side of a water seal portion 4 of the toilet main body 1, air sucking means for sucking air from the drain flow path 5, and a control apparatus 50 for controlling the first, the second water supply means and the air sucking means. The first water supply means is constituted to be able to supply the flush water from a rear side of the toilet bowl 2 such that a swirl flow is formed at inside of the toilet bowl 2. The second water supply means includes a water tank 20 and transporting means for transporting the flush water at inside of the water tank 20 to the toilet bowl 2 by opening an opening/closing valve V_2. The control apparatus 50 produces a siphon operation by operating the air sucking means continuous to operating the first water supply means and opens the opening/closing valve V_2 after forming the swirl flow and before finishing the siphon operation.

Fig. 1



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Description

Technical Field

[0001] The present invention relates to a toilet flushing apparatus.

Background Art

[0002] In a background art, there has been proposed a toilet flushing apparatus including water supply means for supplying flush water to a toilet bowl of a toilet main body, a drain flow path communicated with a downstream side of a water seal portion of the toilet main body, air sucking means for sucking air from the drain flow path, and control means for controlling the water supply means and the air sucking means in flushing of the toilet main body (Patent References 1 and 2).

[0003] The toilet flushing apparatus described in Patent References 1 and 2 can bring the drain flow path into a full water state by flush water at an early stage by sucking air of the drain flow path, and therefore, siphon operation can be produced by a small amount of flush water.

[0004] Further, in an example of the toilet flushing apparatus described in Patent Reference 1, the water supply means includes a water supply pipe for delivering flush water to a rim of the toilet main body. Further, the air sucking means includes an ejector (referred to as 'aspirator' in Patent Reference 1) provided at a middle of the water supply pipe. Air sucked from the drain flow path by the ejector is discharged to the rim of the toilet main body along with the flush water delivered from the ejector.

[0005] On the other hand, in other example of the toilet flushing apparatus described in Patent Reference 2, the water supply means includes a water supply pipe for delivering flush water to a rim of the toilet main body. Further, the air sucking means includes a branch pipe branched from the water supply pipe for delivering flush water to a downward pipe path of the drain flow path and an ejector provided at a middle of the branch pipe. Air sucked from the drain flow path by the ejector is discharged to the downward pipe path of the drain flow path along with flush water delivered from the ejector.

[0006] Further, there has been proposed a toilet flushing apparatus including first water supply means for supplying flush water to a delivery port provided at a lower portion of a toilet bowl of a toilet main body, and second water supply means provided with a water tank contiguous to a water seal portion for delivering flush water stored at inside of the water tank from the delivery port before finishing siphon operation (Patent Reference 3).

[0007] The toilet flushing apparatus described in Patent Reference 3 can firmly discharge a filth because the filth (evacuation and/or paper) remaining at inside of the toilet bowl is forced to a drain flow path by water power of flush water delivered from the delivery port by the second water supply means.

[0008]

Patent Reference 1: JP-A-10-96255
Patent Reference 2: JP-A-2002-61262
Patent Reference 3: JP-A-11-264173

Disclosure of the Invention

Problems that the Invention is to Solve

[0009] However, according to the toilet flushing apparatus described in Patent References 1 and 2 mentioned above, an amount of flush water supplied to the toilet bowl is small, and therefore, the siphon operation is finished at the early stage and there is a case in which the filth cannot completely be discharged. Particularly, there is a case in which the filth floating at a vicinity of a surface of the toilet bowl is stuck to the surface of the toilet bowl to remain when flush water is discharged to the drain flow path and flush water at inside of the toilet bowl is reduced. Further, almost all of flush water at inside of the toilet bowl is discharged to the drain flow path in one motion by the strong siphon operation, and therefore, seal breaking sound produced by making air flow from a side of the toilet bowl to the drain flow path is large.

[0010] Further, according to the toilet flushing apparatus described in Patent Reference 3 mentioned above, a large amount of flush water needs to be supplied to the toilet bowl in order to produce the siphon operation, and therefore, time is required until producing the siphon operation.

[0011] The invention has been carried out in view of the actual situation of the background art and it is a problem thereof to be resolved to provide a toilet flushing apparatus discharging a filth in a short period of time and firmly by a small amount of flush water and having still flush sound. Means for Solving the Problem

[0012] A toilet flushing apparatus of the invention is characterized by a toilet flushing apparatus including first water supply means for supplying flush water to a toilet bowl of a toilet main body, second water supply means for additionally supplying flush water to the toilet bowl in addition to the flush water supplied from the first water supply means, a drain flow path continuous to a downstream side of a water seal portion of the toilet main body, air sucking means for sucking air from the drain flow path, and control means for controlling the first water supply means, the second water supply means and the air sucking means in flushing the toilet main body;

wherein the first water supply means is constituted to be able to supply the flush water from a rear side of the toilet bowl such that a swirl flow is formed at inside of the toilet bowl;

the second water supply means includes a water tank for storing the flush water, and transporting means for transporting the flush water at inside of the water tank to the toilet bowl by opening an opening/closing valve; and

wherein the control means makes the air sucking means operate to produce a siphon operation continuous to operating the first water supply means and makes the open-

ing/closing valve open after forming the swirl flow and before finishing the siphon operation.

[0013] According to the toilet flushing apparatus of the invention constituted in this way, air can be sucked from the drain flow path by the air sucking means controlled by the control means by an optimum timing. Further, by controlling to open and close the opening/closing valve by the control means, the flush water stored in the water tank can additionally be supplied to the toilet bowl by an optimum timing. Therefore, the siphon operation can be formed at an early stage and firmly.

[0014] By forming the swirl flow at inside of the toilet bowl, a filth is collected to a center of the toilet bowl, and therefore, the filth is also firmly discharged to the drain flow path along with the flush water discharged to the drain flow path by the siphon operation.

[0015] Further, the flush water stored at the water tank is additionally supplied to the toilet bowl before finishing the siphon operation, and therefore, a time period of continuing the siphon operation is prolonged without breaking seal of the water seal portion and a capability of discharging the filth is promoted. Further, the filth remaining at inside of the toilet bowl is forced to be discharged to the drain flow path by water power of the flush water additionally supplied to the toilet bowl. Further, a time period is required for discharging the flush water additionally supplied to the toilet bowl to the drain flow path, and therefore, the flush water at inside of the toilet bowl is not discharged to the drain flow path in one motion and large seal breaking sound can be prevented from being emitted.

[0016] Therefore, the toilet flushing apparatus of the invention can discharge the filth by a short period of time and firmly by a small amount of the flush water and make the flush sound still.

[0017] In the toilet flushing apparatus of the invention, the flush water may be taken out from a lower portion of the water tank to be transported to the toilet bowl. In this case, bubbles mixed in the flush water at inside of the water tank are separated and when the flush water is additionally supplied to the toilet bowl, bubbles are hardly contained in the flush water. Therefore, strange sound such as breaking sound produced by breaking air bubbles in being supplied to the toilet bowl can be prevented from being emitted.

[0018] In the toilet flushing apparatus of the invention, the transporting means can be provided on a branch pipe branched from a water supply pipe of the first water supply means and a jet pump arranged at inside of the water tank can be adopted. The jet pump is provided with a structure similar to that of an ejector for sucking and transporting the flush water stored in the water tank by a water flow of the flush water flowing at inside of the jet pump. In this case, the flush water at inside of the water tank and the flush water flowing at inside of the jet pump are altogether supplied to the toilet bowl and therefore, an amount of supply water per unit time is increased. Therefore, the swirl flow at inside of the toilet bowl becomes strong, the siphon operation is continued for a long period of time, and therefore, the filth can further firmly be discharged.

[0019] In the toilet flushing apparatus of the invention, it is preferable that the air sucking means includes a negative pressure generating apparatus, and a sucking tank partitioned into a first chamber and a second chamber by an extractable/retractable movable wall, the first chamber is communicated with the negative pressure generating apparatus by a sucking pipe and communicated with an atmosphere by way of an atmosphere open valve, the second chamber is communicated with the drain flow path by a communicating path, and the control apparatus controls the negative pressure generating apparatus and the atmosphere open valve.

[0020] In this case, when inside of the first chamber is constituted by a negative pressure by the negative pressure generating apparatus, the movable wall is moved to a side of the first chamber, and a volume of the second chamber is increased by a constant amount. When an inner volume of the sucking tank is pertinently selected, a constant amount of air is sucked from the drain flow path, and therefore, the siphon operation can stably be generated without sucking the flush water including the filth at inside of the drain flow path to inside of the second chamber.

[0021] Further, the first chamber and the second chamber are partitioned by the movable wall, only the second chamber is communicated with the drain flow path, and therefore, the flush water including the filth, air including an odor or the like of the drain flow path can be prevented from entering a side of the negative pressure generating apparatus.

[0022] Further, by recovering inside of the first chamber to an atmospheric pressure by sucking air from the drain flow path to the second chamber, thereafter, communicating the first chamber to an atmosphere by opening the atmosphere open valve, the movable wall is firmly recovered to an original position and flushing at a next time can stably be carried out.

[0023] In the toilet flushing apparatus of the invention, it is preferable that the negative pressure generating apparatus includes an ejector for generating a negative pressure by passing the flush water, and a negative pressure tank storing a negative pressure produced by sucking air at inside thereof by the ejector and communicated with the first chamber by the sucking pipe.

[0024] In this case, the negative pressure stored at inside of the negative pressure tank is used, and therefore, the movable wall can be moved to the side of the first chamber by a short period of time and air of the drain flow path can be sucked to the second chamber by a short period of time. Therefore, the flush water flows powerfully from the toilet bowl, inside of the drain flow path is brought into a full state by the flush water at an early stage to produce the siphon operation and a discharge flow is formed at an early stage.

[0025] Further, by selecting an inner volume of the

negative pressure tank and a pipe diameter of the sucking pipe, a speed of sucking air from the drain flow path to the second chamber can be optimized. For example, when the inner volume of the negative pressure tank is made to be small, the negative pressure at inside of the negative pressure tank is rapidly weakened, and movement of the movable wall to the side of the first chamber is retarded, and therefore, the sucking speed becomes slow. On the other hand, when the inner volume of the negative pressure tank is increased, the negative pressure at inside of the negative pressure tank is not weakened so much, the movement of the movable wall to the side of the first chamber is accelerated, and therefore, the sucking speed is accelerated.

[0026] Further, in the toilet flushing apparatus of the invention, as the negative pressure generating apparatus, a pressure reducing pump or the like driven by electricity or the like can also be adopted. In this case, the movable wall can be moved to the side of the first chamber by operating the pressure reducing pump or the like. Therefore, when the pressure reducing pump is controlled to drive, a speed of moving the movable wall can be adjusted and a speed of sucking air from the drain flow path to the second chamber can easily be adjusted.

[0027] In the toilet flushing apparatus of the invention, it is preferable that the flush water delivered from the ejector is stored at the water tank.

[0028] In this case, the flush water supplied to the ejector is utilized as additionally supplied flush water, and therefore, the flush water is effectively utilized.

[0029] In the toilet flushing apparatus of the invention, it is preferable that the drain flow path is provided with a dwell portion dwelled with the flush water and reducing or nullifying a communication area and the air sucking means sucks air from between the water seal portion and the dwell portion.

[0030] In this case, the drain flow path is difficult to communicate with the downstream side or blocked by the dwell portion, and therefore, the air sucking means is difficult to suck air downstream of the dwell portion and does not suck air of the downstream side in the best case. In latter case, in other words, the sucking means can further efficiently suck air from the drain flow path made to constitute a closed space present between the water seal portion and the dwell portion. Therefore, the siphon operation can firmly be produced.

Brief Description of the Drawings

[0031]

[Fig. 1]
Fig. 1 is a schematic view showing an operational state when a western style toilet equipment including a toilet flushing apparatus of an embodiment is brought into a nonflushing state.

[Fig. 2]
Fig. 2 is a schematic view showing an operational state when the western style toilet equipment of Fig. 1 is in a toilet bowl flushing/negative pressure storing stroke.

[Fig. 3]
Fig. 3 is a schematic view showing an operational state when the western style toilet equipment of Fig. 1 is in an air sucking stroke.

[Fig. 4]
Fig. 4 is a schematic view showing an operational state when the western style toilet equipment of Fig. 1 is at an initial stage of a flush water adding stroke.

[Fig. 5]
Fig. 5 is a schematic view showing an operational state when the western style toilet equipment of Fig. 1 is at a final stage of the flush water adding stroke.

[Fig. 6]
Fig. 6 is a schematic view showing an operational state when the western style toilet equipment of Fig. 1 is in an atmosphere opening/water covering stroke.

[Fig. 7]
Fig. 7 is a timing chart for explaining an operation of the western style toilet equipment including the toilet flushing apparatus of Fig. 1 through Fig. 6.

[Fig. 8]
Fig. 8 is a schematic diagram showing a control apparatus of a toilet flushing apparatus of an embodiment.

[Fig. 9]
Fig. 9 is a schematic view of a western style toilet equipment including a toilet flushing apparatus of other embodiment.

Description of Reference Numerals and Signs

[0032]

1..toilet main body
2..toilet bowl
3..rim
4..water seal portion
5..drain flow path
6..dwell portion
7..drain port
10..water supply pipe
20..water tank
21..ejector
24..jet pump
30..negative pressure tank
40..sucking tank
41..first chamber
42..second chamber
43..partitioning film (movable wall)
44..communicating path

Best Mode for Carrying Out the Invention

[0033] An embodiment of the invention will be explained in details in reference to the drawings as follows.

[0034] As shown by Fig. 1 through Fig. 6, a rim 3 is provided at an inner periphery of an upper portion of a toilet bowl 2 of a toilet main body 1 made of porcelain. The toilet bowl 2 is communicated with a drain port 7 by way of a water seal portion 4, a drain flow path 5 and a dwell portion 6. The drain flow path 5 goes downward from a highest portion 4a of the water seal portion 4 to be communicated with the dwell portion 6. The drain port 7 is connected to a drain pipe.

[0035] The dwell portion 6 is constituted by a U-like flow path going around a lower side of a lowest portion 6b of a lower portion of a pipe wall of the drain flow path 5 to successively reach a highest portion 6a for overflow. The highest portion 6a of the dwell portion 6 is slightly higher than the lowest portion 6b.

[0036] A water supply pipe 10 constituting first water supply means is connected to the rim 3. The water supply pipe 10 includes a main valve V_1. The toilet main body 1 is constituted by a one turn water supply system of supplying flush water only to a right side or a left side of the rim 3 from a rear side of the toilet bowl 2. Therefore, when flush water is supplied from the water supply pipe 10 to the rim 3, a swirl flow of right turning or left turning is formed at inside of the toilet bowl 2.

[0037] Pipes 11, 12, 13 are branched from the water supply pipe 10 on a downstream side of the main valve V_1. A front end of the pipe 11 is provided with a vacuum breaker 11a.

[0038] The pipe 12 is introduced into a water tank 20 and a front end thereof is connected to a flow inlet of an ejector 21. A base end of a pipe 23 is connected to a flow outlet of the ejector 21 and a front end of the pipe 23 is opened to inside of the water tank 20. An air sucking port provided at a throat portion of the ejector 21 is connected with a base end of an air sucking pipe 22 including a check valve V_3. A front end of the pipe 22 is drawn to an outer side of the water tank 20 and connected to a negative pressure tank 30. An upper portion of the water tank 20 is provided with a communicating pipe 26 for communicating inside of the water tank 20 to the atmosphere.

[0039] The check valve V_3 permits air to flow from the negative pressure tank 30 to the ejector 21 and hampers air from flowing in a direction opposed thereto. The check valve V_3 is provided at the outer side of the water tank 20.

[0040] A base end of a sucking pipe 31 including an operating valve V_4 is connected to the negative pressure tank 30, and a front end of the sucking pipe 31 is connected to an upper portion of a sucking tank 40. Inside of the sucking tank 40 is partitioned to a first chamber 41 on an upper side and a second chamber 42 on a lower side by a partitioning film 43 constituting a movable wall. The sucking pipe 31 is connected to the first chamber 41. Further, the first chamber 41 of the sucking tank 40 is connected with a base end of an atmosphere open pipe 32 including an atmosphere open valve V_5, and a front end of the atmosphere open pipe 32 is opened to the atmosphere. The second chamber 42 of the sucking tank 40 and an upper end portion of the drain flow path 5 are communicated by way of a communicating path 44.

[0041] A negative pressure generating apparatus is constituted by the pipe 12, the ejector 21, the air sucking pipe 22 including the check valve V_3, the negative pressure tank 30 and the sucking pipe 31 including the operating valve V_4. Further, sucking means is constituted by the negative pressure generating apparatus, the sucking tank 40, the atmosphere open pipe 32 including the atmosphere open valve V_5 and the communicating path 44.

[0042] The pipe 13 includes an opening/closing valve V_2, a front end of the pipe 13 is introduced to inside of the water tank 20 and is connected to a flow inlet on a lower end side of a jet pump 24. The jet pump 24 is provided with a structure similar to that of the ejector 21 for sucking and transporting flush water stored at inside of the water tank 20 from a water sucking port 24a provided at a throat portion by a water flow of flush water flowing at inside of the jet pump 24. The water sucking port 24a is open into the water tank 20 and located at a lower portion of the water tank 20.

[0043] A flow outlet of the jet pump 24 is connected with a base end of a pipe 25 for added flush water and a front end of the pipe 25 is drawn out from the water tank 20 to be connected to the rim 3.

[0044] The main valve V_1, the opening/closing valve V_2, the operating valve V_4 and the atmosphere open valve V_5 are opening/closing valves and as shown by Fig. 8, the toilet flushing apparatus is provided with a control apparatus 50 as controlling means for controlling timings of opening and closing the respective valves V_1, V_2, V_4 and V_5. The control apparatus 50 opens and closes the respective valves by electric signals.

[0045] Although not illustrated, the water tank 20, the negative pressure tank 30, the sucking tank 40, the control apparatus 50 and the like are contained at inside of a unit case provided at a rear portion of the toilet main body 1.

[0046] Next, operation of the toilet flushing apparatus will be explained.

[Nonflushing time (Fig. 1)]

[0047] In Fig. 7, at nonflush time before time point t_1, the main valve V_1, the opening/closing valve V_2, the operating valve V_4 and the atmosphere open valve V_5 are closed. Under the state, the partitioning film 41 at inside of the sucking tank 40 is brought into contact with a bottom face at inside of the sucking tank 40 by the atmospheric pressure and a self weight of the partitioning film 41.

[Toilet bowl cleaning/negative pressure storing stroke (Fig. 2)]

[0048] After evacuation, at time point t_1, the control apparatus 50 is operated by a user and the main valve V_1 is opened.

[0049] Then, flush water is supplied from the water

supply pipe 10 to the rim 3 and flows down while being swirled along an inner face of the toilet bowl 2 to form a swirl flow at inside of the toilet bowl 2. The filth is collected to a center of the toilet bowl 2 by the swirl flow and paper is disintegrated to be adapted to flush water and is dispersed in flush water.

[0050] Further, a portion of flush water flowing at inside of the water supply pipe 10 is stored at inside of the water tank 20 by passing the pipe 12, the ejector 21 and the pipe 23. By making flush water flow to inside of the ejector 21, the ejector 21 sucks air at inside of the negative pressure tank 30 into the water tank 20 by way of the pipe 22 and the check valve V_3. Thereby, a negative pressure is gradually accumulated at inside of the negative pressure tank 30.

[Sucking stroke (Fig. 3)]

[0051] At time point t_2 of Fig. 7, the operating valve V_4 is opened by the control apparatus 50. Thereby, the negative pressure at inside of the negative pressure tank 30 is transmitted to the first chamber 41 of the sucking tank 40 by way of the sucking pipe 31 and the operating valve V_4 and inside of the first chamber 41 is constituted by the negative pressure. Thereby, as shown by Fig. 3, the partitioning film 43 at inside of the sucking tank 40 is pulled up to be brought into contact with a ceiling face of the sucking tank 40. The operating valve V_4 is controlled to open and close by the control apparatus 50, and therefore, air can be sucked from the drain flow path 5 by an optimum timing.

[0052] The negative pressure accumulated at inside of the negative pressure tank 30 is used, and therefore, the partitioning film 43 is moved to a side of the first chamber 41 by a short period of time, and air at inside of the drain flow path 5 can be sucked to the second chamber 42 by a short period of time. At this occasion, a water level of inside of the toilet bowl 2 becomes sufficiently high by supplying water from the water supply pipe 10 and a water head difference between the water level and the highest portion 4a of the water seal portion 4 becomes sufficiently large. Therefore, flush water at inside of the toilet bowl 2 is discharged to the drain flow path 5 powerfully by an urge force superposed with the water head difference and the negative pressure at inside of the drain flow path 5, inside of the drain flow path 5 is brought into a full water state by flush water at an early stage to produce the strong siphon operation and a discharge flow is formed at an early stage by a small amount of flush water.

[0053] The filth collected to the center of the toilet bowl 2 by the swirl flow formed at inside of the toilet bowl 2 is firmly discharged to the drain flow path 5 along with flush water discharged to the drain flow path 5 by the siphon operation. Further, the water level of flush water at inside of the toilet bowl 2 is moved down while swirling flush water, the water level of flush water at inside of the toilet bowl 2 becomes proximate to height of the lowest portion 2a of the rear portion of the toilet bowl 2, and therefore, even the heavy filth is firmly discharged from the water seal portion 4 to the drain flow path 5 along with flush water.

[0054] The drain flow path 5 is blocked from the downstream side by the dwell portion 6 and the drain flow path 5 is made to constitute a closed space present between the water seal portion 4 and the dwell portion 6. Further, by the sucking tank 40 an inner volume of which is pertinently selected, a constant air amount is firmly sucked from the drain flow path 5 made to constitute the closed space, and therefore, the siphon operation can stably be produced by a small amount of flush water. Further, flush water including the filth at inside of the drain flow path 5 is not sucked to inside of the second chamber 42.

[0055] Inside of the sucking tank 40 is partitioned to the first chamber 41 and the second chamber 42 by the partitioning film 43, only the second chamber 42 is communicated with the drain flow path 5, and therefore, flush water including the filth, air including odor or the like of the drain flow path 5 are firmly prevented from going to the side of the negative pressure tank 30 or the ejector 21.

[Initial stage of flush water adding stroke (Fig. 4)]

[0056] At time point t_3 of Fig. 7, the water level of the toilet bowl 2 is moved down to a vicinity of the height of the lowest portion 2a of the rear portion of the toilet bowl 2, and at that moment, the opening/closing valve V_2 is opened by the control apparatus 50. Thereby, a portion of flush water at inside of the water supply pipe 10 is shunted and supplied to the rim 3 by way of the pipe 13, the jet pump 24 and the pipe 25. At this occasion, by a water flow of flush water flowing at inside of the jet pump 24, flush water stored at inside of the water tank 20 is sucked from the water sucking port 24a of the jet pump 24 and is supplied to the rim 3 by passing the pipe 25 along with flush water from the pipe 13. Thereby, water level at inside of the water tank 20 is moved down.

[0057] In this way, before the water level of inside of the toilet bowl 2 becomes lower than the lowest portion 2a of the rear portion of the toilet bowl 2, and air flows from the toilet bowl 2 to the drain flow path 5 to finish the siphon operation, in addition to flush water supplied from the water supply pipe 10 to the rim 3, flush water is additionally supplied to the toilet bowl 2 also from the pipe 25. Therefore, the seal of the water seal portion 4 is not broken, flush water at inside of the toilet bowl 2 continues swirling, also the siphon operation is continued, and therefore, the filth is further firmly discharged.

[0058] Flush water additionally supplied to the toilet bowl 2 is combined with flush water at inside of the water tank 20 and flush water flowing to inside of the jet pump 24 and an amount of supply water per unit time to the toilet bowl 2 becomes large. Therefore, the swirl flow at inside of the toilet bowl 2 becomes strong, the siphon operation is continued for a long period of time, and therefore, the filth can further firmly be discharged. Further,

by water power of flush water additionally supplied to the toilet bowl 2, the filth remaining at inside of the toilet bowl 2 is forced to be discharged to the drain flow path 5. Further, flush water additionally supplied to the toilet bowl 2, flush water supplied to the ejector 21 in the toilet bowl cleaning/negative pressure storing stroke and sucking stroke which is stored at inside of the water tank 20 is used, and therefore, flush water is effectively utilized.

[0059] The opening/closing valve V_2 is controlled to open and close by the control apparatus 50, and therefore, flush water stored in the water tank 20 can additionally be supplied to the toilet bowl 2 by an optimum timing. Therefore, the siphon operation is firmly formed and the filth is firmly discharged.

[0060] A time period is acquired for discharging flush water additionally supplied to the toilet bowl 2 to the drain flow path 5, and therefore, flush water at inside of the toilet bowl 2 is not discharged to the drain flow path 5 in one motion and large seal breaking sound can be prevented from being emitted.

[0061] Flush water is taken out from the lower portion of the water tank 20 to be additionally supplied to the toilet bowl 2, and therefore, bubbles are separated from flash water at inside of the water tank 20, additionally supplied flush water does not totally include or hardly includes bubbles. As a result thereof, when additionally supplied flush water flows to the toilet bowl 2, strange sound of break sound and the like produced by breaking bubbles is not emitted.

[Final stage of flush water adding stroke (Fig. 5)]

[0062] As shown by Fig. 5, at time point t_4 elapsed from time point t_3 for some period of time of Fig. 7, the opening/closing valve V_2 is closed by the control apparatus 50. Thereby, there is not a supply of flush water from the pipe 25 to the rim 3, and air flows from the toilet bowl 2 to the drain flow path 5 to thereby finish the siphon operation.

[0063] Time point t_4 of Fig. 7 of closing the opening/closing valve V_2 is immediately before the water level at inside of the water tank 20 becomes lower than the water sucking port 24a provided at the throat portion of the jet pump 24. Therefore, air at inside of the water tank 20 is prevented from being sucked from the water sucking port 24a, air at inside of the water tank 20 is prevented from being sucked by the jet pump 24 to emit strange sound, and flush water entrapped with air is prevented from flowing out from the rim 3 by passing the pipe 25 to emit strange sound.

[Atmosphere opening/water covering stroke (Fig. 6)]

[0064] At time point t_5 of Fig. 7, the operating valve V_4 is closed and the atmosphere open valve V_5 is opened by the control apparatus 50. Thereby, the first chamber 41 at inside of the sucking tank 40 is recovered to the atmospheric pressure, the partitioning film 43 is pushed down to the lower side to be brought into contact with the bottom face at inside of the sucking tank 40 to be recovered to the state of Fig. 1. Thereafter, at time point t_6 of Fig. 7, the atmosphere open valve V_5 is closed by the control apparatus 50.

[0065] After sucking air from the drain flow path 5 to the second chamber 42, by recovering the first chamber 41 to the atmospheric pressure by opening the atmosphere open valve V_5, the partitioning film 43 is firmly recovered to original position and flushing at next time can stably be carried out.

[0066] When flush water is stored at inside of the toilet bowl 2 after an elapse of some period of time after finishing the siphon operation, at time point t_7 of Fig. 7, the main valve V_1 is closed. Thereby, the state at nonflush time is recovered and the flushing is finished.

[0067] Therefore, the toilet flushing apparatus of the embodiment can discharge the filth by a short period of time and firmly by a small amount of flush water and can make flush sound still.

[0068] The embodiment is an example of the invention and the invention is not limited to the embodiment.

[0069] For example, the lowest portion 6b of the dwell portion 6 may be slightly higher than the highest portion 6a. In this case, although the height of the water level becomes lower than the lowest portion 6b even when flush water is stored at inside of the dwell portion 6, when the negative pressure is applied to the drain flow path 5 and a large amount of flush water flows to inside of the dwell portion 6, the water level at inside of the dwell portion 6 is moved up more than the lowest portion 6b, inside of the drain flow path 5 and the side of the drain port 7 are blocked, and therefore, the drain flow path 5 between the water seal portion 4 and the dwell portion 6 constitutes a closed space and air can efficiently be sucked.

[0070] Further, although according to the embodiment, the base end of the pipe 32 including the atmosphere open valve V_5 is connected to the upper portion of the sucking tank 40, the base end of the pipe 32 including the atmosphere open valve V_5 may be connected at a portion of the sucking pipe 31 between the operating valve V_4 and the sucking tank 40.

[0071] Further, a valve may be provided on an upstream side of the ejector 21 of the pipe 12, and the opening/closing valve V_2 may be opened by closing the valve in the flush water adding stroke. In this case, an amount of flush water flowing at inside of the pipe 13 becomes large, and therefore, flush water at inside of the water tank 20 is further strongly sucked to be discharged by the jet pump 24 and water power of the flush water flowing in the pipe 25 becomes strong.

[0072] Further, the control means may open and close the respective valves V_1, V_2, V_4 and V_5 mechanically. In a case of opening and closing respective valves mechanically, for example, a hydraulic turbine may be provided at the water supply pipe 10, rotation of the hydraulic turbine may be transmitted to a shaft including a plurality of cams by way of a gear train and the respective valves of cam drive type may be opened and closed by rotation of

the respective cams.

[0073] Further, as shown by Fig. 9, a pressure reducing pump 35 of an electrical drive type constituting a load generating apparatus may be connected to the base end of the sucking pipe 31 and the front end of the sucking pipe 31 may be connected to the upper portion of the sucking tank 40. In this case, the partitioning film 43 of the sucking tank 40 can be pulled up by operating the pressure reducing pump 35 by controlling the pressure reducing pump 35 by the control means. Therefore, a speed of pulling up the partitioning film 43 can arbitrarily be adjusted and a speed of sucking air from the drain flow path 5 can easily be adjusted.

[0074] Further, time point t_4 of Fig. 7 of closing the opening/closing valve V_2 may be after the water level at inside of the water tank 20 becomes lower than that of the water sucking port 24a of the jet pump 24. In this case, almost all of flush water stored at inside of the water tank 20 can be utilized, and therefore, the water tank 20 can be downsized.

Industrial Applicability

[0075] The invention can be utilized for a water flush type toilet.

Claims

1. A toilet flushing apparatus **characterized by** a toilet flushing apparatus including first water supply means for supplying flush water to a toilet bowl of a toilet main body, second water supply means for additionally supplying flush water to the toilet bowl in addition to the flush water supplied from the first water supply means, a drain flow path continuous to a downstream side of a water seal portion of the toilet main body, air sucking means for sucking air from the drain flow path, and control means for controlling the first water supply means, the second water supply means and the air sucking means in flushing the toilet main body;
   wherein the first water supply means is constituted to be able to supply the flush water from a rear side of the toilet bowl such that a swirl flow is formed at inside of the toilet bowl;
   the second water supply means includes a water tank for storing the flush water, and transporting means for transporting the flush water at inside of the water tank to the toilet bowl by opening an opening/closing valve; and
   wherein the control means makes the air sucking means operate to produce a siphon operation continuous to operating the first water supply means and makes the opening/closing valve open after forming the swirl flow and before finishing the siphon operation.

2. The toilet flushing apparatus according to Claim 1, wherein the air sucking means includes a negative pressure generating apparatus, and a sucking tank partitioned into a first chamber and a second chamber by an extractable/retractable movable wall;
   the first chamber is communicated with the negative pressure generating apparatus by a sucking pipe and communicated with an atmosphere by way of an atmosphere open valve;
   wherein the second chamber is communicated with the drain flow path by a communicating path; and
   wherein the control apparatus controls the negative pressure generating apparatus and the atmosphere open valve.

3. The toilet flushing apparatus according to Claim 2, wherein the negative pressure generating apparatus includes an ejector for generating a negative pressure by passing the flush water, and a negative pressure tank storing a negative pressure produced by sucking air at inside thereof by the ejector and communicated with the first chamber by the sucking pipe.

4. The toilet flushing apparatus according to Claim 3, wherein the flush water delivered from the ejector is stored at the water tank.

5. The toilet flushing apparatus according to any one of Claims 1 through 4, wherein the drain flow path is provided with a dwell portion dwelled with the flush water and reducing or nullifying a communication area and the air sucking means sucks air from between the water seal portion and the dwell portion.

Fig. 1

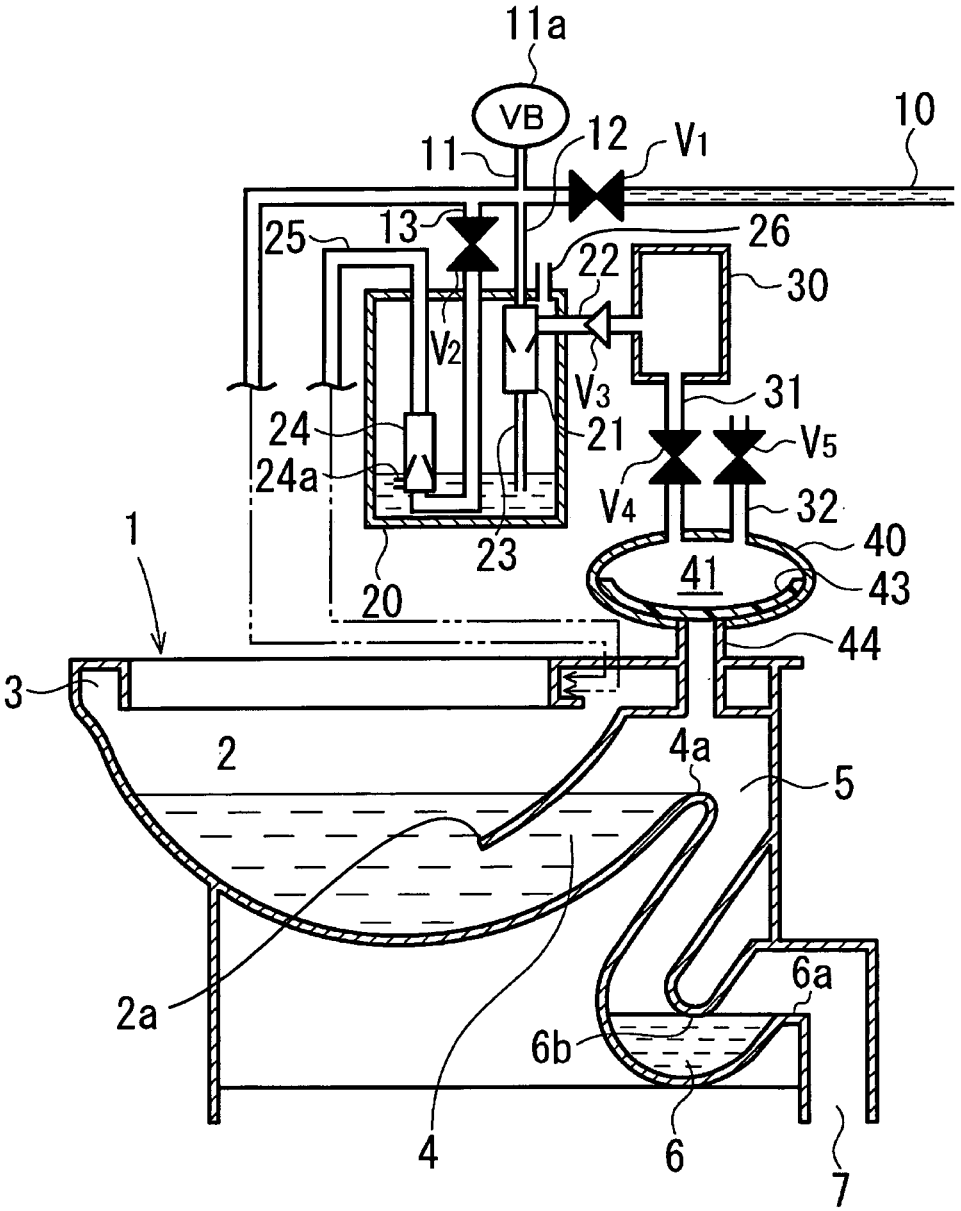
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Fig. 2

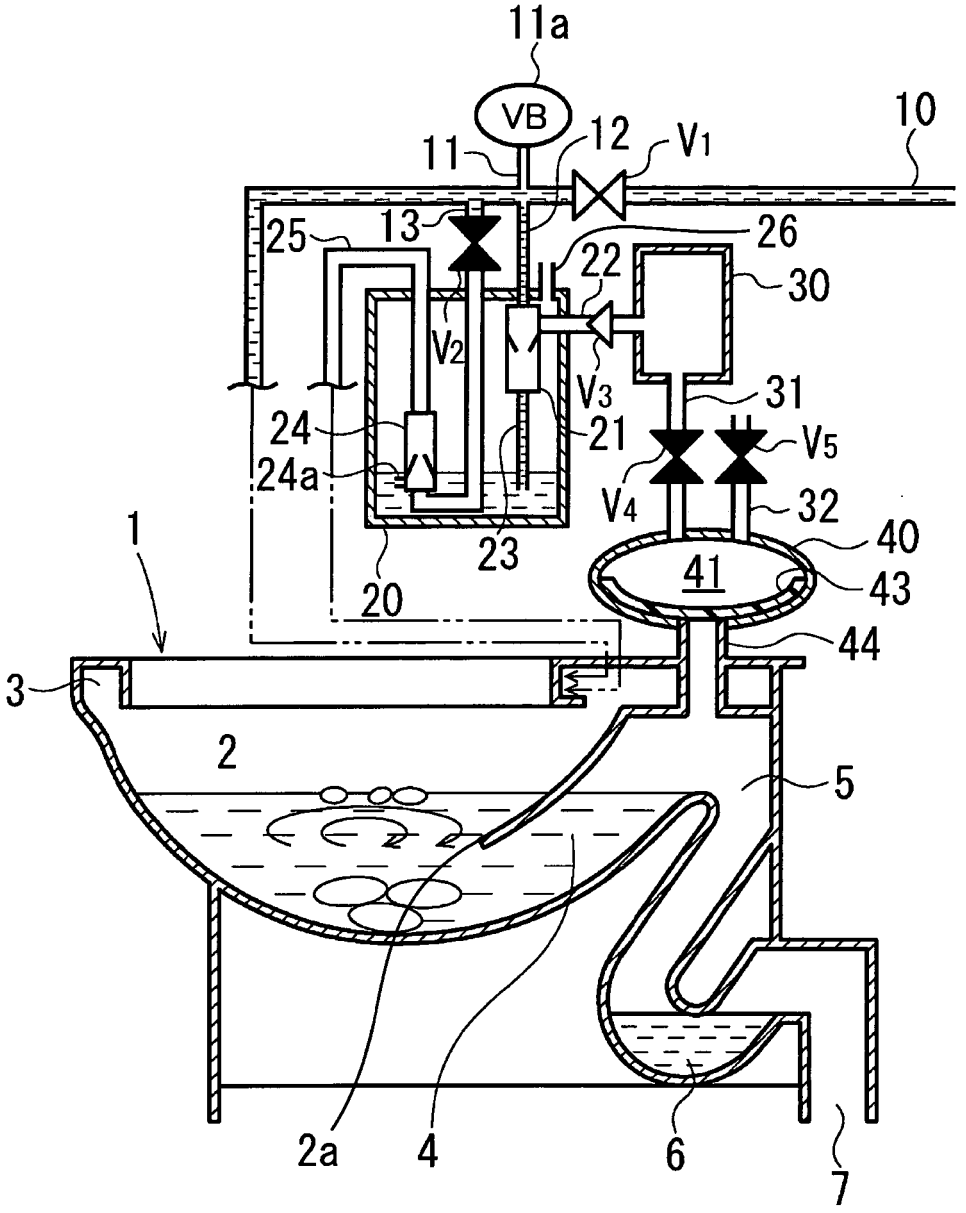
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Fig. 3

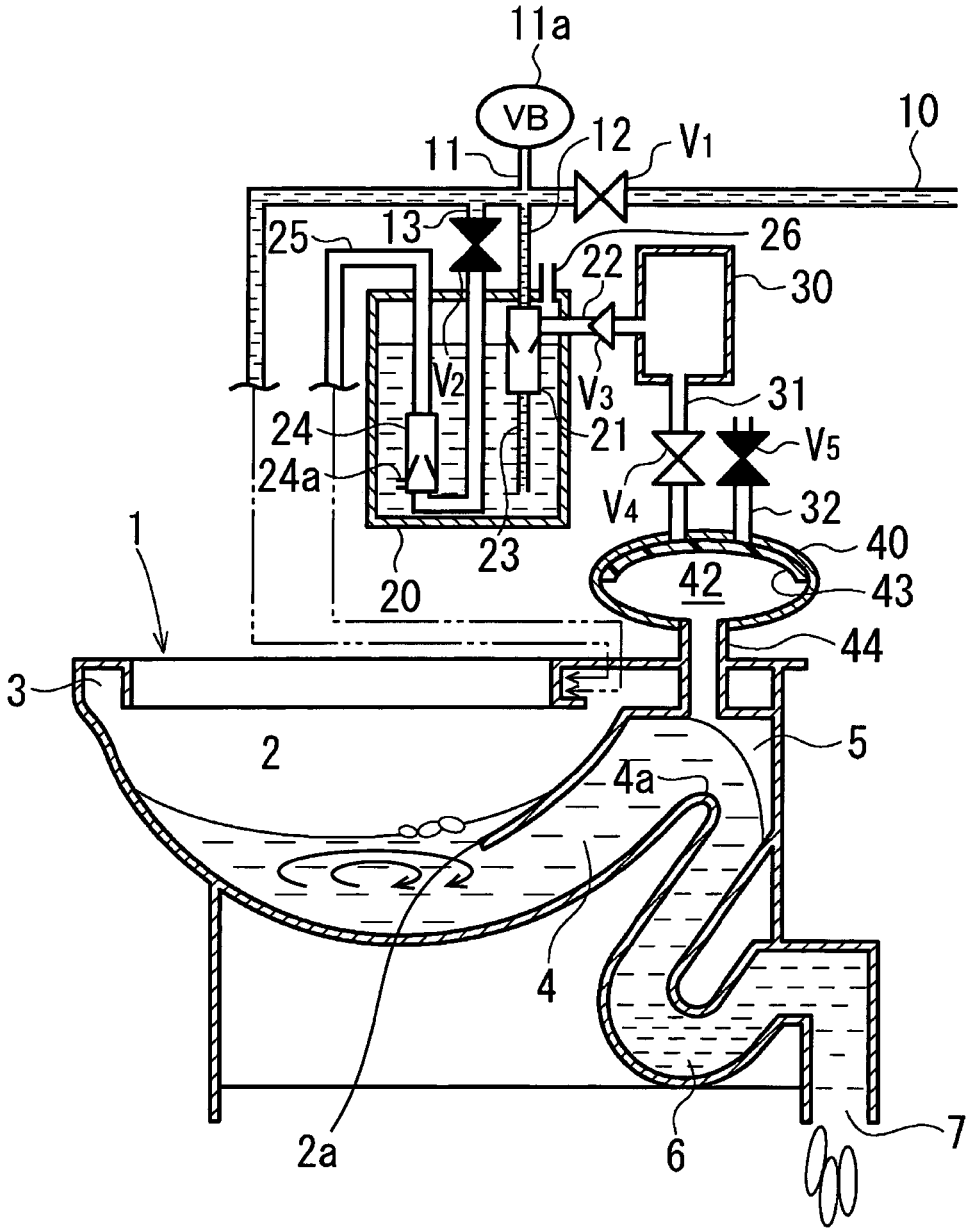
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Fig. 4

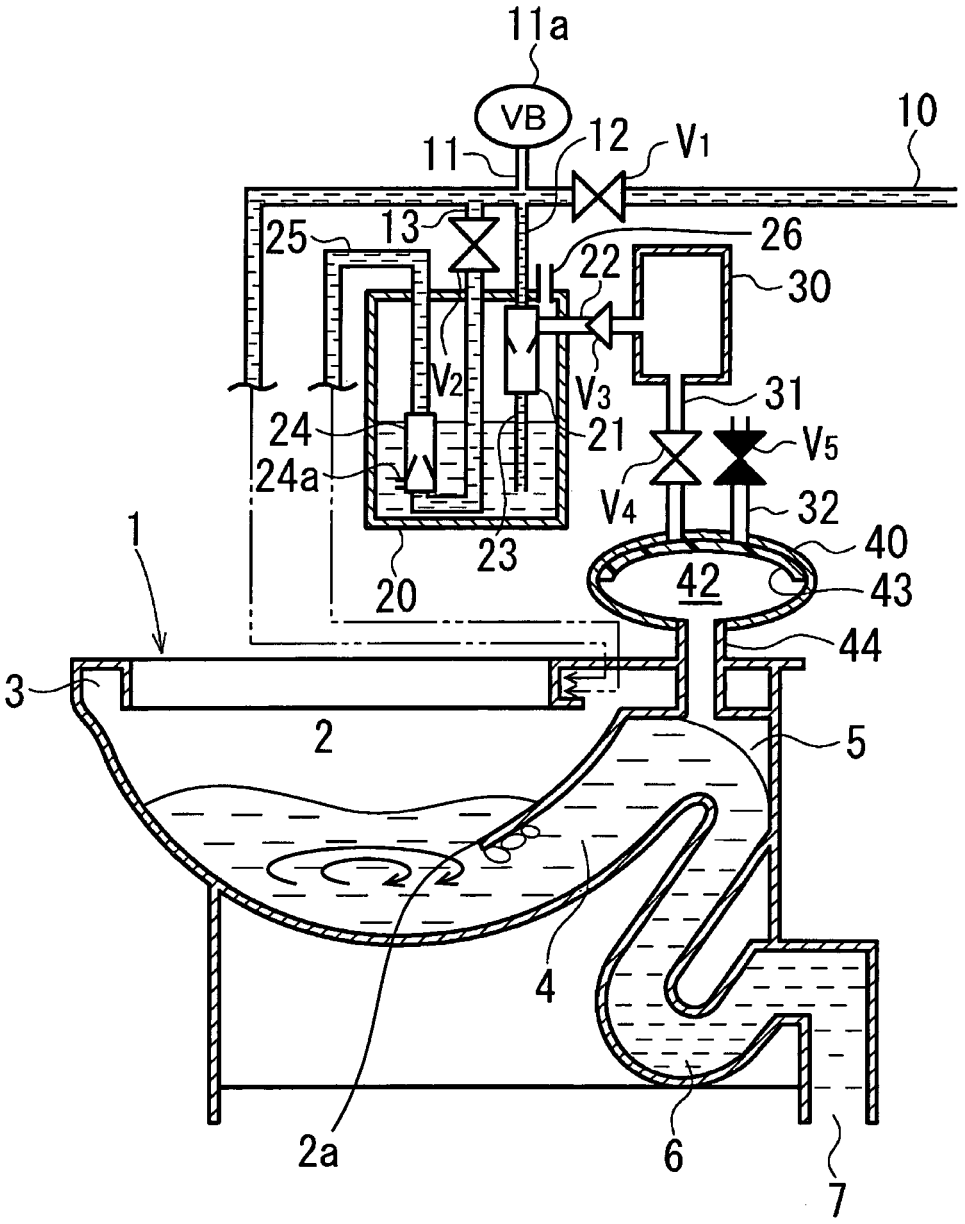
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Fig. 5

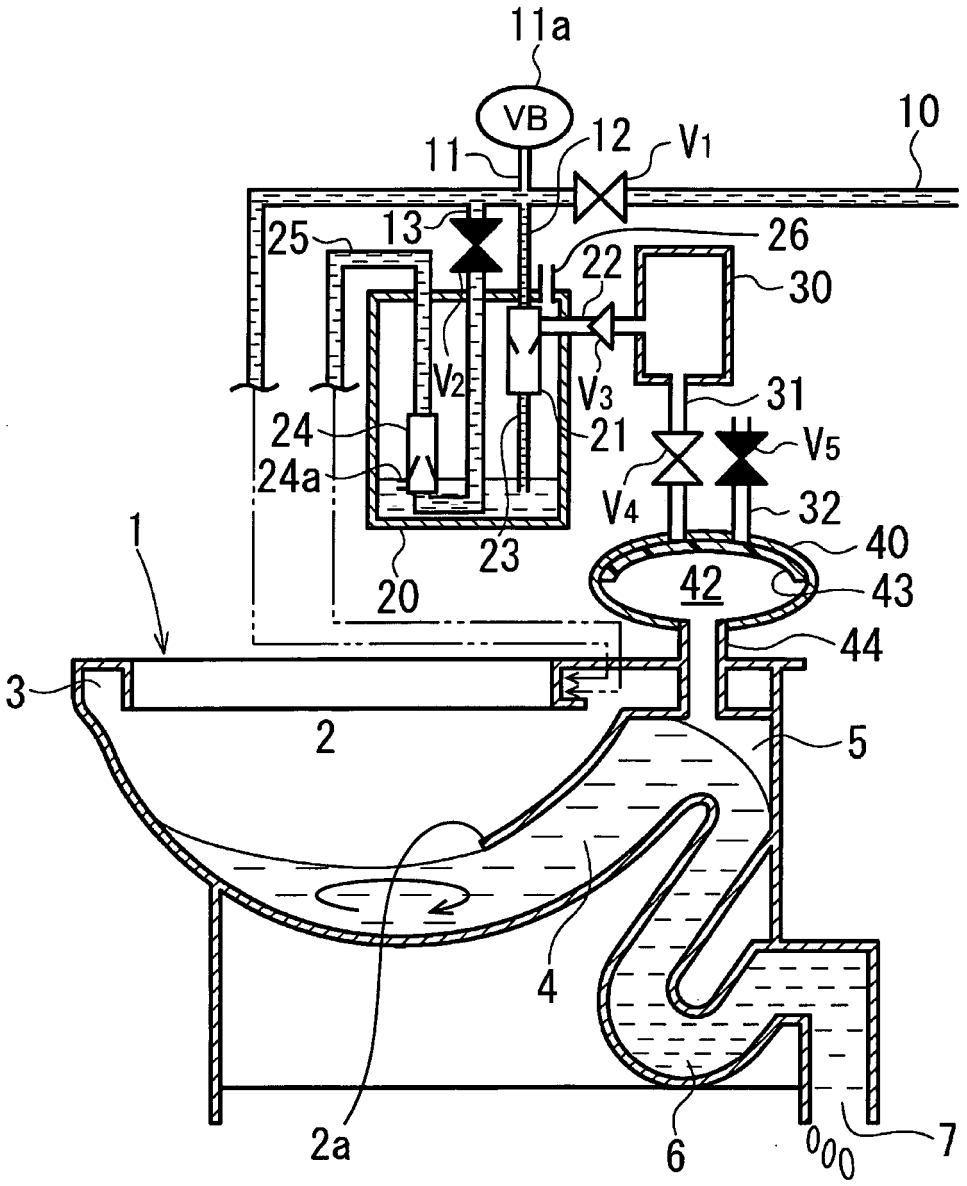
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Fig. 6

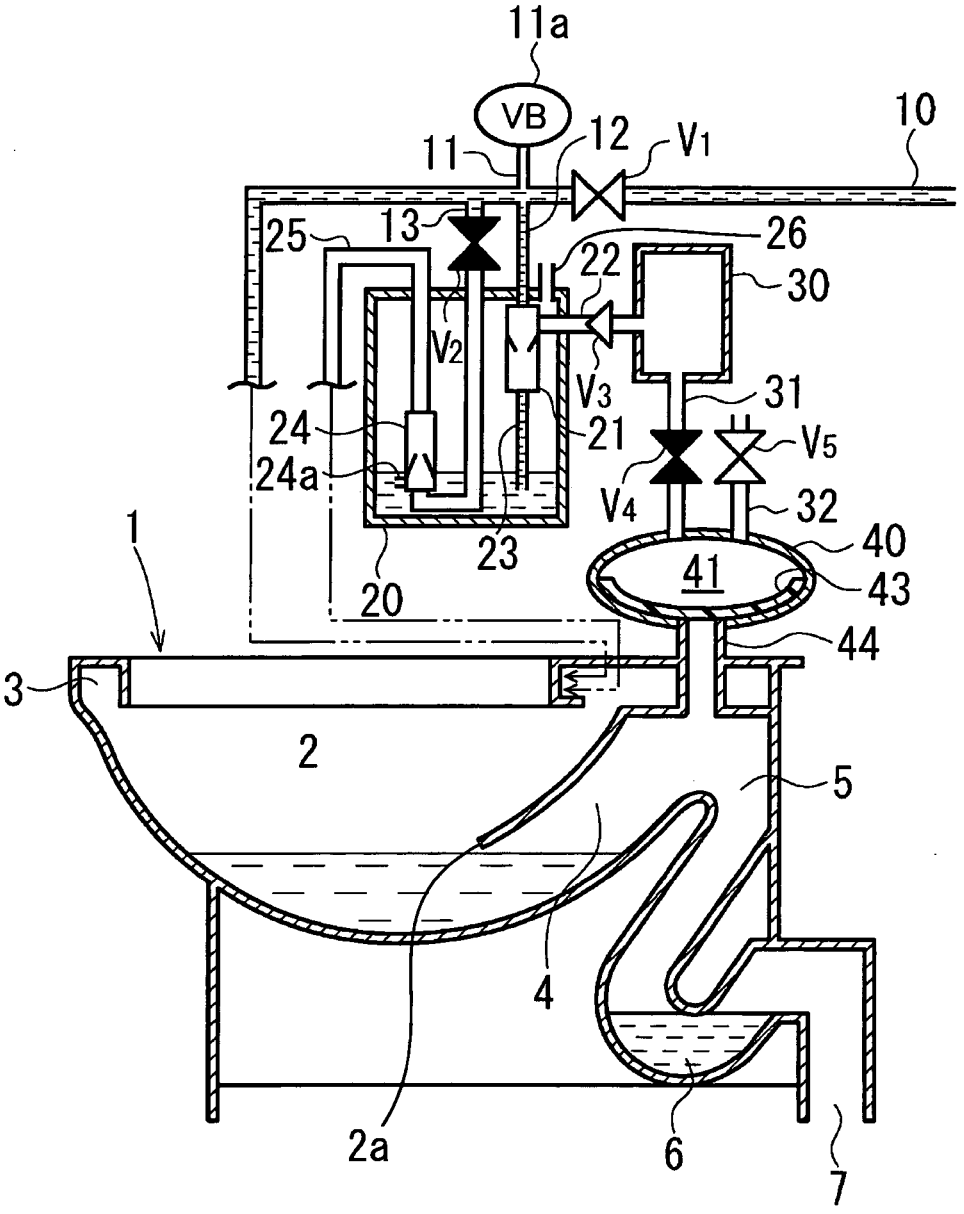
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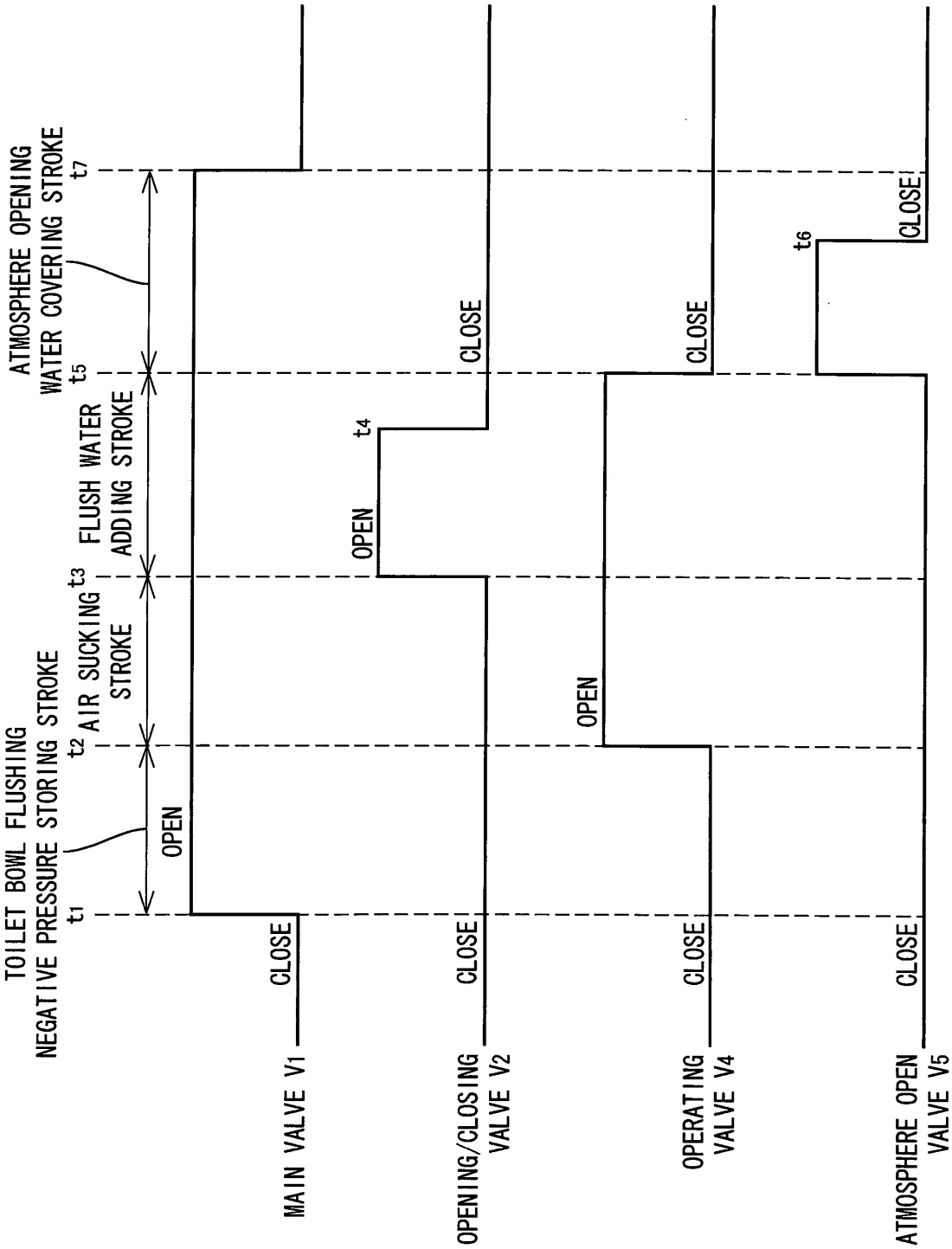
Fig. 7


TOILET BOWL FLUSHING
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AIR SUCKING STROKE
FLUSH WATER ADDING STROKE
ATMOSPHERE OPENING WATER COVERING STROKE
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t2
t3
t4
t5
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t7
OPEN
CLOSE
MAIN VALVE V1
OPENING/CLOSING VALVE V2
OPERATING VALVE V4
ATMOSPHERE OPEN VALVE V5

Fig. 8

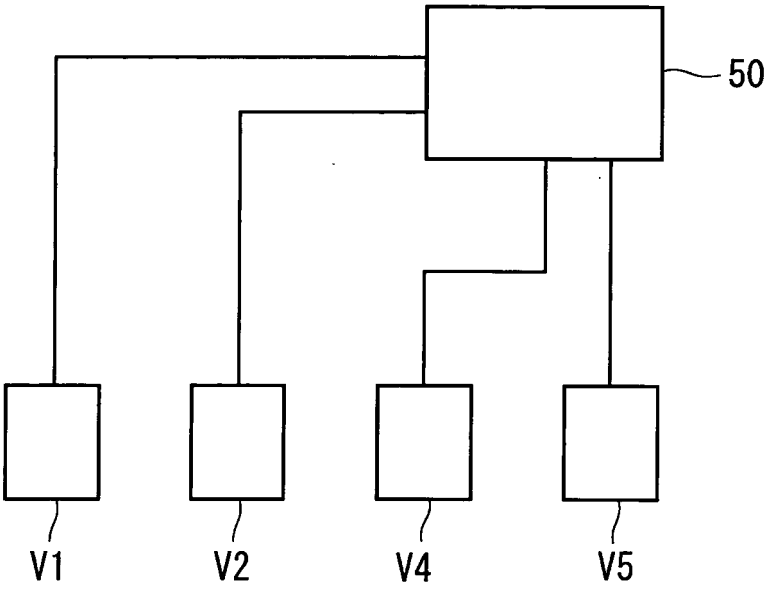
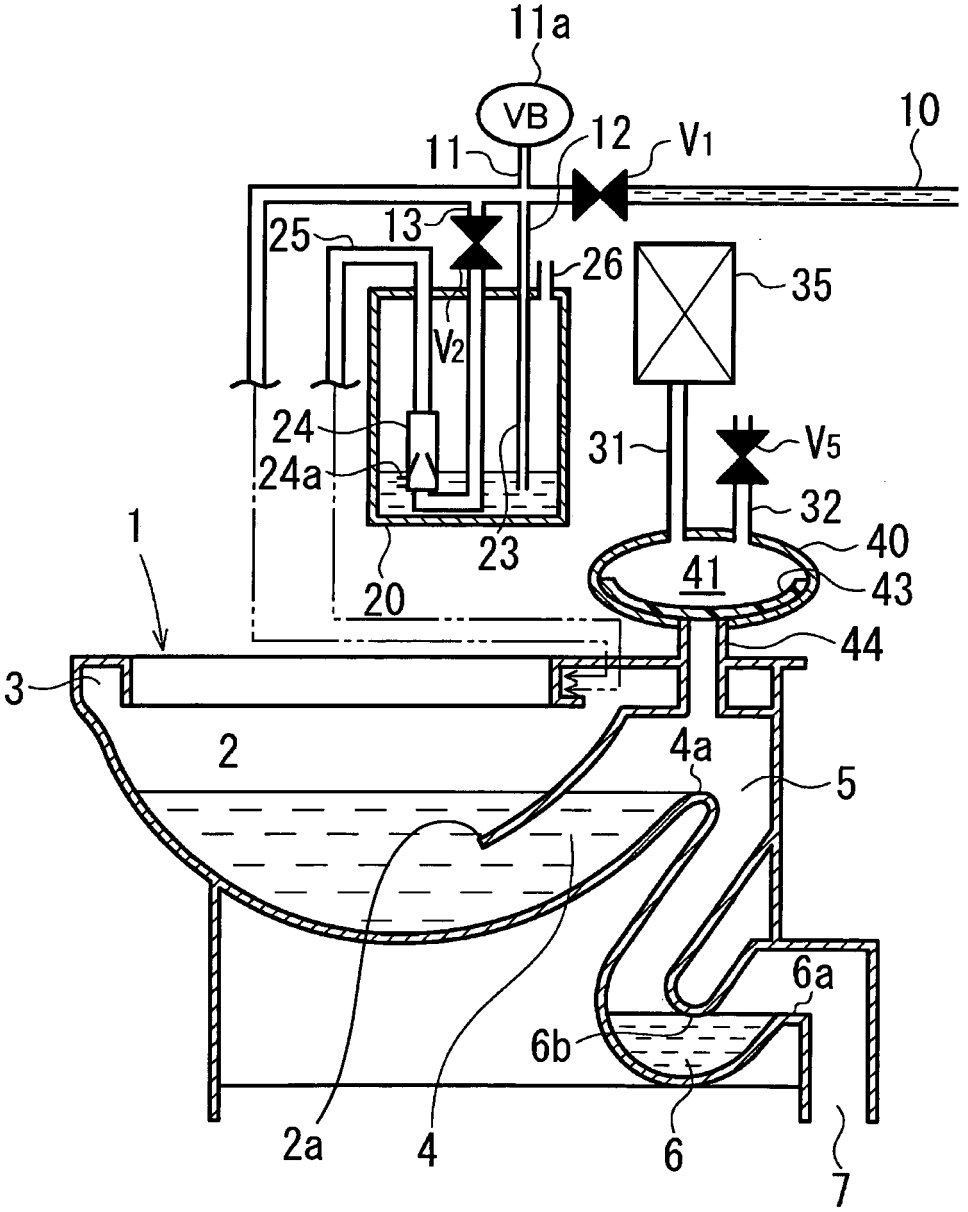


Fig. 9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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/052843

A. CLASSIFICATION OF SUBJECT MATTER
E03D11/02(2006.01)i, *E03D3/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E03D11/02, E03D3/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-54388 A (Toto Ltd.), 28 February, 1995 (28.02.95), Par. Nos. [0024] to [0064]; all drawings (Family: none)	1-5
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 69425/1992(Laid-open No. 27969/1994) (Toto Ltd.), 15 April, 1994 (15.04.94), Par. Nos. [0009] to [0022]; all drawings (Family: none)	1-5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 March, 2007 (27.03.07)	10 April, 2007 (10.04.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/052843

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-97704 A (Toto Ltd.), 05 April, 2002 (05.04.02), Par. Nos. [0051] to [0054]; Figs. 8, 9 & US 2003/0088910 A1 & WO 2001/073229 A1 & AU 4280801 A & CN 1432094 A	1-5

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Patent documents cited in the description

- JP 10096255 A **[0008]**
- JP 2002061262 A **[0008]**
- JP 11264173 A **[0008]**