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FLUSHING SYSTEM FOR WATER CLOSETS AND ACTUATING
MECHANISM THEREFOR

The present invention relates to water closets and in particular to a new and improved flushing system which permits essentially reducing the force required for initiating a flushing operation by using a siphon-based flushing system. The invention also relates to an actuating mechanism which is especially well suited for use in such a new and improved flushing system.

GB-A-2,205,595 discloses a flushing system for water closets which has a double siphon immersed in a flush cistern. This siphon has an almost sinuous conduit with four juxtaposed vertical conduit legs and U-bends successively interconnecting the conduit legs. The central bend is facing downwards and interconnects the lower ends of the two central conduit legs, while the two outer U-bends are facing upwards and connect the upper ends of the central conduit legs to the upper ends of the outer conduit legs. This approximately sinusoidally-bent conduit is arranged in a flush cistern and is completely immersed in the water when the flush cistern is filled therewith. The first vertical conduit leg acts as the suction pipe of the siphon, and the last vertical conduit leg acts as the outlet pipe of the siphon and is connected to a flushing ramp at the upper end of the water closet. From the upper end of the upwardly-facing first U-bend further extends a downwardly-directed U-bent venting tube which at the upper end of its other U-leg is connected to the upwardly-facing third U-bend a certain distance below the crest of this U-bend. This venting tube, shaped as a U-bend, acts as a water trap in the starting position of the flushing system when the cistern is filled. For initiating the flushing operation, the water in the water trap is removed by means of a air ball which is connected to the lower U-web of the U-bent venting tube and which,

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upon compression and, hence, increase of the air pressure in the system, displaces the water in the water trap and evacuates it into the outlet pipe of the siphon. In this manner, a communication is established between the upper
5 end of the first upwardly-facing U-bend and the third upwardly-facing U-bend, such that air entrapped in the first upwardly-facing U-bend can be evacuated through the venting tube, whereby the entire sinuous conduit loop is intended to be filled with water so as to initiate the
10 siphon function for evacuating the major part of the water in the flushing system into the outlet pipe by suction. When a maximum amount of water has been sucked from the flush cistern and air starts leaking into the double siphon, a certain amount of water will remain in the
15 double siphon and also in the U-bent venting tube. When the water level thereafter rises in the water cistern, the water remains in the double siphon even if the water levels in the first, the second and the third conduit leg are displaced vertically in relation to one another. The
20 system also includes a further U-bent conduit which is connected to the crest of the third U-bent conduit of the double siphon and extends up over the maximum water level in the flush cistern and opens on a level with the intended minimum water level in the flush cistern. When
25 the water level in the flush cistern has sunk to below the lower end of this U-bent conduit, air is sucked into the double siphon and the flushing operation is consequently interrupted.

Danish Patent Specification DK-B-57,606 describes a
30 flush cistern which also uses a type of double siphon. In this case, there is provided a flushing mechanism which has a water trap. In this water trap is immersed an actuator piston which, when lifted, will lower the water level in the water trap and, hence, also reduce the pressure of the water column. As a result, the liquid in the
35 water trap will no longer be able to withstand the pressure from the air entrapped in the double siphon and the



water-trap function will thus cease, so that the air in the first upwardly-facing U-bend of the double siphon is emitted into the atmosphere and the siphon function is initiated. The actuator mechanism is disposed in an upwardly-oriented compartment at the inlet end of this U-bend. This mechanism has however not proved completely satisfactory in operation, and difficulties have often been met with in establishing and maintaining the siphon function. This is probably due to the fact that air can enter the mechanism between the actuating piston and the wall of the water-trap leg where the piston is disposed. As a result, there is a risk of air leakage into the siphon, impairing or interrupting the siphon effect. Also the placement of the actuator mechanism above the inlet leg of the double siphon entails certain drawbacks, in that the leaving air must flow countercurrently to the incoming flush water from the flush cistern. This also makes it more difficult to completely remove the air in the first upwardly-facing U-bend of the double siphon. In fact, remaining air is most detrimental to the performance of the siphon.

The system shown and described in GB-A-2,205,595 is an improvement over prior-art siphon systems, but yet suffers from several drawbacks which have made the system not as successful as it ought to have been. One drawback resides in the poor function of the system, which depends, at least partially, on the difficulties of completely evacuating the entrapped air in the upwardly-facing first U-bend. Another drawback resides in the design of the actuator mechanism, i.e. the use of an air ball which is to be compressed to provide displacement and evacuation of water remaining in the venting tube, serving as a water trap. As in other known siphon-based flushing systems, this actuating technique requires substantial forces to initiate the flushing operation. First, it has proved difficult to completely displace and remove the water in the venting tube with the aid of the

air ball, and if the water is not completely removed, the remaining water will prevent or at least counteract the evacuation of the air lock or plug in the upwardly-facing first U-bend. Second, it is often difficult to make the user change his habits, i.e. which amount to starting the flushing operation by pressing a button, lifting a valve rod or pulling a flush-valve string.

An object of the present invention is to provide an improvement of the flushing systems and actuating mechanisms described in GB-A-2,205,595 and DK-B-57,606. This and other objects of the invention are achieved by means of a flushing system and an actuating mechanism having the features stated in claims 1 and 6, respectively. The subclaims define especially advantageous embodiments of the invention.

The invention sets out from a flushing system according to GB-A-2,205,595, i.e. a flushing system having a double siphon arranged in a flush cistern and being in the form of a substantially sinusoidally-bent conduit with four substantially vertical juxtaposed conduit legs and U-bends successively interconnecting the conduit legs, the central U-bend facing downwards and interconnecting the lower ends of the two central conduit legs, while the two outer U-bends are facing upwards and connect the upper ends of the central conduit legs to the upper ends of the outer conduit legs, the substantially sinusoidally-bent conduit being arranged in a flush cistern so as to be completely immersed in the water when the flushing system is filled therewith, the first vertical conduit leg being intended to act as the suction pipe of the siphon and the last vertical conduit leg being intended to act as the outlet pipe of the siphon and being connected to a flushing ramp at the upper end of the bowl of the water closet. To sum up, the invention resides in preventing the evacuation of the flush water by means of an air lock or plug which is entrapped in the double siphon and upon the evacuation of which the



flushing procedure is started. In the invention, the air lock is evacuated via a venting tube whose one end is connected to the double siphon at a point located in the U-bend containing the air lock a certain distance below the crest of the bend towards the outlet side of the U-bend. Therefore, the connecting point is located in the downstream direction of the flushing liquid, and the air can thus be removed in a more reliable manner. The venting tube extends up over the level of the crest of the double siphon and is connected at its other end to a piston chamber, in which a starter piston is arranged for vertical movement. The piston chamber and the starter piston act as part of an actuating mechanism. The connection of the venting tube with the piston chamber is located a certain distance over the bottom of the piston chamber so as to define a liquid sump at the lower end of the piston chamber. The piston chamber is filled with water when in the closed state, and when lifting the starter piston, the entrapped liquid will flow down into the liquid sump below the connection of the venting tube and the air lock is evacuated via the piston chamber. The actuating mechanism, especially well suited for this flushing system, has a locking device to prevent renewed initiation of the flushing operation before liquid has again been filled into the flush cistern to above a certain minimum level over the venting tube.

The invention will be described in more detail hereinbelow with reference to the accompanying drawings showing some preferred embodiments of the invention. These must however not be considered restrictive of the invention.

Figs 1-6 schematically illustrate the inventive principle and its function in the different phases of an evacuation procedure.

Fig. 7 is a vertical section of a specific embodiment of a flushing system and an actuating mechanism according to the invention.



- Fig. 8 shows the embodiment of Fig. 7 in the state corresponding to Fig. 3.
- Fig. 9 shows the embodiment of Fig. 7 in the state corresponding to Fig. 5.
- 5 Fig. 10 shows the embodiment of Fig. 7 from above.
- Fig. 11 is a section taken along line XI-XI in Fig. 7.
- Fig. 12 shows the embodiment of Fig. 7 from the left with respect to Fig. 7.
- Fig. 13 shows the embodiment of Fig. 7 from the right with respect to Fig. 7.
- 10 Fig. 14 shows the embodiment of Fig. 7 in a side view from the front with respect to Fig. 7.
- Fig. 15 is a section taken along line XV-XV in Fig. 14.
- Fig. 16 shows parts of another embodiment of a flushing system and an actuating mechanism according to the invention, this Figure corresponding the setting position in Fig. 7.
- 15 Fig. 17 is a view similar to Fig. 8, but shows said other embodiment of the invention.
- 20 Fig. 18 is a view similar to Fig. 9, but shows said other embodiment of the invention.

Figs 1-6 schematically show a flushing system and an actuating mechanism according to the present invention. In a flush cistern 10, an outlet device 11 is immersed.

25 The outlet device is designed as a double siphon in the form of an approximately sinusoidally-extending conduit having four juxtaposed conduit legs 12, 13, 14, 15 and U-bends 16, 17 and 18 successively interconnecting the conduit legs. The central U-bend 17 is facing downwards and interconnects the lower ends of the two central conduit legs 13, 14. The two outer U-bends 16, 18 are facing upwards and connect the upper ends of the two central conduit legs 13, 14 to the upper ends of the outer conduit legs 12, 15. The first vertical conduit leg 12 is

30 intended to act as the suction pipe of the siphon. The last vertical conduit leg 15 is intended to act as the outlet pipe of the siphon and is connected in customary

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manner to a flushing ramp (not shown) at the upper end of the bowl of a water closet.

The flushing system also has a venting tube 19 serving to evacuate air which, when the flush cistern 10 is filled with liquid, is entrapped in the first upwardly-facing U-bend 16 of the double siphon. One end of the venting tube 19 is connected to a point on the downstream side of this U-bend and extends up over the level of the crests of the upwardly-facing U-bends 16, 18 to be connected at its other end to an actuating mechanism 20. This mechanism includes a nonreturn valve 21 comprising a substantially vertical piston chamber 22, in which a starter piston 23 is provided for vertical movement. The upper end of the piston chamber 22 can be connected to the ambient air at a point above the maximum water level 24 in the flush cistern. The piston chamber further has a liquid sump 25 which is located below the opening of the venting tube 19 in the piston chamber 22. The liquid sump has a sufficient volume for holding liquid that remains in the starter-piston chamber 22 and the venting tube 19 when the flush cistern 10 is filled. At the upper end, the starter piston 23 and the starter-piston chamber 22 are so designed that air- and liquid-tight engagement is produced within a conically flared portion 26. Alternatively, a special seal can be used between an outwardly directed flange and an engagement surface, as will be described further on. This seal within the conically flared portion or a similar seal provides the desired nonreturn-valve function. The starter piston 23 and the piston chamber 22 are so designed that when the starter piston is lifted, air will be sucked into the starter-piston chamber 22 and, consequently, liquid present in the starter-piston chamber and the venting tube will flow down into the liquid sump 25. As a result, the air entrapped in the first U-bend 16 in the starting position (Fig. 1) can be evacuated via the venting tube 19 and the nonreturn valve 21.



Figs 1-6 show the sequence of the different phases of operation. Thus, Fig. 1 shows the flushing system in the starting position when the cistern 10 is filled with liquid and the starter piston 23 is in its lower position, in which the flared portion 26 sealingly engages the starter-piston chamber. In this position, air is entrapped in the U-bend 16 and the venting tube 19. An overpressure prevails, which appears from the differences between the liquid levels 31, 31' in the first three conduit legs 12, 13 and 14.

To initiate the flushing operation, the starter piston 23 is lifted so that air can pass from above into the starter-piston chamber 22 and so that the liquid entrapped therein flows down into the liquid sump 25 to expose the opening of the venting tube 19. As a result, the air entrapped in the U-bend 16 will be discharged by the liquid pressure through the starter-piston chamber. The resulting liquid surge makes the liquid fill the first U-bend 16 of the double siphon and thereafter the entire siphon as well, such that the siphon function is initiated and liquid is discharged from the flush cistern.

Fig. 3 shows the state when the first three conduit legs 12, 13, 14 are completely filled with liquid. Upon continued suction of liquid into the double siphon, this will be completely filled with liquid as is also the venting tube 19 and the starter-piston chamber 22 (Fig. 4). In this position, the starter piston 23 has been returned to its initial position with a sealing nonreturn-valve function within the flared portion 26.

Fig. 5 shows the next stage when flushing proceeds. During this stage, there is a negative pressure in the double siphon and, hence, also in the venting tube 19 and the starter-piston chamber 22. Suction of air into the double siphon via the starter-piston chamber is prevented by the above-mentioned nonreturn-valve function. Flushing proceeds until air is sucked into the double siphon through the inlet of the conduit leg 12. Fig. 6

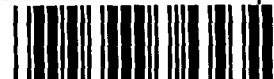


shows this position. If a smaller flushing liquid amount is desired than that corresponding to evacuation as far as the lower end of the first conduit leg, it is possible to provide holes on different levels along the first conduit leg, e.g. for achieving a 4-litre or a 6-litre flushing liquid amount. At any rate, the siphon effect is interrupted when air is sucked into the first conduit leg. When this takes place, a certain amount of liquid will remain in the second U-bend 17. When refilling the flush cistern with fresh flushing liquid, this liquid column will be displaced in order to eventually occupy the position shown in Fig. 1.

A major advantage of this system is that the flushing operation is easily started and requires but a slight force, in that the liquid column in the piston chamber 22 over the inlet 29 of the venting tube 19 substantially outbalances the overpressure represented by the difference in level between the liquid surfaces 31 and 31'. Moreover, the system is advantageous in so far as the starter ball used in GB-A-2,205,595 has been dispensed with and the flushing operation can be initiated by traditional measures, i.e. by either lifting a piston or by depressing a button so as to lift the piston. By the selected position of the inlet 29 of the venting tube 19, the drawbacks inherent in the prior-art device according to the GB-A-2,205,595 are also overcome, in that the air is removed at a point downstream of the crest of the U-bend. In this manner, improved or complete removal of the air is achieved, especially if the conduit legs are designed to promote laminar flow.

Fig. 7 shows a preferred embodiment of a flushing system and an actuating mechanism according to the present invention. In the Figure, the different components are shown in the same positions as in Fig. 1. The flushing system is mounted on the bottom 27 of a flush cistern. The double siphon 11 has its four conduit legs 12, 13, 14, 15 arranged substantially vertically beside each





other. As appears from Fig. 11, the conduit legs have flattened cross-section to promote laminar flow. However, the cross-sectional shape need not be as flattened as shown in Fig. 11, but an oval or square cross-section can also be used. Moreover, the flow passage of the double siphon is preferably designed with a reduced flowthrough area from the conduit leg 12 to a location in the conduit leg 15 in order to improve the flow, to increase the flow velocity and to promote the laminar flow.

10 The last conduit leg or outlet pipe 15 is connected to an outlet sleeve 28, in turn connected to the conventional flushing ramp (not shown) of the water closet.

15 As appears from Fig. 7, the venting tube 19 is connected to the second conduit leg 13 at a point facing away from the first conduit leg and close to the upper end of second conduit leg 13, i.e. along the wall surface where the air flows when evacuating the entrapped air bubble. The reason for this placement is that the inlet 29 of the venting tube 19 should be disposed so far away in the downstream direction that the air is completely displaced by the water flowing into the conduit leg 12 upon the initiation of the flushing operation. The outlet end of the venting tube 19 is connected to the piston chamber 22 at a point which is preferably located slightly below the liquid levels 31 in the first conduit leg and the third conduit leg in the starting position of the flushing system (see Fig. 7).

20 In this preferred embodiment, the starter piston 23 has an outwardly-directed flange 32 which in the closed state of the nonreturn valve engages an edge 33 on the starter-piston chamber 22. If so required, the flange 32 may be provided with a seal, with which it engages the edge 33. In the illustrated embodiment, the piston 23 has two floating bodies 34 for a purpose which will be described in more detail hereinafter (Fig. 11). These floating bodies are disposed on the outside of the starter-piston chamber 22 and depend below the upper



edge 33 of the chamber. The upper face of the piston is provided with a lug 35, in which a locking latch 36 is pivotally mounted for pivotal movement between a locking position indicated by full lines and a release position indicated by dash-dot lines in Fig. 7. In the locking position, the locking surface 37 of the latch engages a stationary locking surface on a fork 38. To limit the outward pivotal movement of the locking latch, this preferably has a projection 39 stopping the outward pivotal movement by engaging the upper face of the piston 23.

In the embodiment of Fig. 7, the float 40 of the flushing system has been designed as a downwardly open bell which is guided in a float chamber 41 for vertical movement therein. The chamber 41 is fixedly connected to the double siphon 11 and the piston chamber 22. The float chamber 41 is intended to be filled with flushing liquid, which is achieved by the liquid, when filling the flush cistern, flowing over the top edge of the float chamber and down between this and the float 40. At the lower end of the float chamber, there is provided a nonreturn valve 42 in the form of a pivotable valve plate mounted for pivotal movement about a pivot pin 43 adjacent the upper edge of the float chamber. The nonreturn valve is inclined so as to be urged downwards, when in its normal position, by the force of gravity into abutment against the side of the float chamber and into sealing engagement with a valve seat 44. By this arrangement, the float chamber will be successively evacuated as the liquid level in the flush cistern is sinking. On the other hand, filling of the float chamber with flushing liquid is prevented until the flushing liquid can flow over the top edge of the float chamber. This arrangement enables quicker filling of the flush cistern and does not involve the customary gradual decrease of the supply of liquid during the final phase of the filling procedure.

The float 40 has an upright 45, at the top end of which a pivot pin 46 is provided. This pin is connected



to a control arm 47 for a conventional inlet valve 48. The valve 48 is closed in the position shown in Fig. 7 and open in the position shown in Fig. 9.

For starting the flushing operation, the actuating mechanism in the embodiment of Fig. 7 has a release means 49 which in this embodiment is a push-button mechanism having at its lower end a laterally projecting actuator 50 which is resiliently biased upwards by a spring unit 51. The spring unit 51 may be integrally formed with the components 49 and 50. The free end of the spring unit 51 is fixed in the body 53 of the mechanism in a suitable manner, e.g. by means of projecting pins 52. The body 53 is integrally formed with the fork 38 and thus forms a stationary element. In this stationary element is fixed a pivot pin 54. On the pivot pin 54, a sensor lever 55 is pivotally fixed with one end. The other end of the sensor lever is designed as a cam follower 56 which engages the upper face of the float 40, this face thus serving as a cam surface 57. Between the cam follower 56 and the pivot pin 54, the sensor lever 55 has a pivot pin 58, on which a release rocker arm 59 is pivotally mounted. In this embodiment, the rocker arm is designed as a double-armed lever and engages the actuator 50 with one end 60 and a cam surface 62 on the locking latch 36 with the other end 61.

A downward pressure on the release means 49 against the action of the spring 51 produces a pivotal movement of the release rocker arm 59 in the clockwise direction with respect to Fig. 7, such that the locking latch 36 is released from its locking engagement with the fork 38 and is swung to its position indicated by dash-dot lines. This means that the starter piston 23 is released and lifted by its floating bodies 34 to the position shown in Fig. 8, in which the upper face of the starter piston comes into engagement with the fork 38.

Fig. 8 only shows an instantaneous position to illustrate the function of the mechanism. In this instant-

neous position, the piston 23 has thus been lifted so that the liquid entrapped in the piston chamber and the venting tube can flow down into the liquid sump 25. As a result, the air entrapped in the first U-bend 36 and parts of the second conduit leg 13 will flow out and be evacuated through the venting tube 19 and the piston chamber 22 into the free air over the liquid surface 24 in the cistern 10. This initiates the siphon function, and the flushing liquid is discharged to the flushing ramp of the water closet in the manner described above. When the liquid level in the flush cistern is gradually sinking, the liquid level in the float chamber 41 will also sink, since the water can flow out through the non-return valve 42. In this manner, the sensor lever 55 will be pivoted clockwise with respect to Fig. 7. This also means that the vertical position of the pivot pin 58 is lowered correspondingly. The lowering of the position of the pivot pin 58 relative to the stationary pivot pin 54 entails that the release rocker arm 59 is also lowered. As a result, a gap will form between the end 60 of the rocker arm and the actuator 50. Because of this gap, renewed initiation of the flushing procedure cannot be started until the liquid level in the flushing system has been restored. The gap between the components 50 and 60 is maintained during the entire filling procedure by the float 40 remaining in its lower position (Fig. 9) until water flows into the float chamber 41 via the top edge of the float chamber, since the nonreturn valve 42 prevents water from flowing in before that. A float chamber 41 is however not necessary for maintaining this locking function against renewed initiation of the flushing operation. It is however essential that the mechanism be so designed that a restart of the flushing operation is not possible before the liquid level in the flushing system has been restored to a position above the crest of the venting tube 19.



Fig. 9 shows the positions of the components after the liquid level has sunk to such an extent that the floating bodies 34 are no longer capable of holding the starter piston 23 in a lifted position. As soon as the starter piston 23 has been returned to the position shown in Fig. 9, the nonreturn-valve function is achieved, i.e. a sealing engagement exists between the flange 32 and the top edge of the piston chamber 22. This function is also promoted by the engagement of the latch 36 with the fork 38. The floats 34 should be designed with a lifting power which is so adjusted that the sealing function of the nonreturn valve is achieved before the liquid level in the flushing system has sunk to below the upper crest of the venting tube 19. In fact, it is essential that liquid remains in the venting tube and the piston chamber in order that an air plug or lock should remain in the U-bend 16 when the flush cistern is again being filled with liquid.

Figs 7-15 show a preferred embodiment of an actuating mechanism for the flushing system according to the invention. However, the actuating mechanism can also be designed otherwise, a conceivable embodiment being illustrated in Figs 16-18. In this case, there is no counterpart to the locking latch 36, but the release rocker arm 59 lifts the piston 23 by directly engaging and lifting a laterally-directed hook 63 on the piston 23. As soon as the piston, via the hook 63, has been lifted to cancel the sealing engagement between the flange 32 and the top edge 33 of the starter-piston chamber 22, the floating bodies 34 will take over the lifting power and lift the piston to the position shown in Fig. 17. In this case too, a restart of the flushing operation is prevented by the pivot pin 58 being lowered during the evacuation to a lower level by pivotal movement of the sensor lever 55 about the stationary pivot pin 54. In other respects, this embodiment functions in the same way as the embodiment in Figs 7-15.



The actuating mechanism need not necessarily have a single-armed sensor lever 55. This lever may also be double-armed, in which case a reversal of the direction of movement can be carried out in a suitable manner, such that pressures or tractions in the release means will start the flushing operation. In the light of the above principles, a person skilled in the art may easily provide such as modification of the system.

The double siphon of the flushing system may suitably be formed from plastics material and be made in two halves forming a parting plane against each other, as shown in Figs 11-13. As previously mentioned, the different conduit legs 12-15 need not have exactly the flattened shape as shown at 11, but the conduits preferably are of such a flattened shape or of oval shape to provide or promote a laminar flow. In fact, a laminar flow promotes the achievement of an efficient evacuation of all the air entrapped in the system at the start of the flushing operation. The use of an actuating mechanism with no floating bodies 34 also falls within the scope of the invention. In such a case, the starter piston can be lifted directly, as indicated in Figs 1-6. The actuating mechanism described above is especially well suited for the flushing system according to Figs 7-18, but can of course also be used for other flushing systems where it is desirable to prevent a restart of the flushing operation until a certain minimum level of the liquid in the flush cistern has been exceeded during the filling procedure.

To permit varying the amount of flushing liquid in each flushing operation, the first conduit leg 12 may have air-suction holes 64 on different vertical levels, e.g. one level for discharging 4 litres of flushing liquid and another level for discharging 6 litres of flushing liquid. When installing the device, the fitter then plugs the air suction hole or holes 64 not to be used.



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tern, said piston chamber having a liquid sump (25) located below the opening of the venting tube in the piston chamber (22) and having a sufficient volume for holding liquid that remains in the starter-piston chamber (22) and the venting tube (19) when the flush cistern (10) is filled, the starter piston (23) and the starter-piston chamber (22) being so designed that when the starter piston is lifted, liquid present in the starter-piston chamber (22) and the venting tube (19) will flow down into the liquid sump (25) and the air entrapped in the first U-bend will thus be evacuated via the venting tube (19).

2. A flushing system as claimed in claim 1, characterised in that the conduit legs (12-15) of the double siphon have a flattened cross-sectional shape, preferably an elongate, rectangular cross-sectional shape, for creating a laminar flow of liquid through the conduit legs.

3. A flushing system as claimed in claim 1 or 2, characterised in that the conduit legs (12-15) of the double siphon have a generally decreasing cross-sectional area, counting from the first conduit leg (12) to a location in the last conduit leg (15).

4. A flushing system as claimed in any one of claims 1-3, characterised in that the venting tube (19) is connected to the second conduit leg (13) substantially on a level with the connection thereof with the first upwardly-facing U-bend (16).

5. A flushing system as claimed in any one of claims 1-4, characterised in that the actuating mechanism has a locking device (54-62) for preventing the initiation of a new flushing operation before the flush cistern (10) has again been filled with liquid to above a predetermined minimum level above the crest of the venting tube (19).

6. An actuating mechanism for a flushing system having an outlet device (11) arranged in a flush cistern





(10) and an inlet device (48) which has a float device (40) for controlling the supply of liquid into the flush cistern (10) by an inlet valve (48) included in the inlet device (48), the float (40) of said float device being
5 operatively connected to the inlet valve (48) via a link system (47) for opening and closing the inlet valve (48) depending on the liquid level in the flush cistern, the outlet device (11) of the actuating mechanism comprising a release means (49) for opening the outlet valve (11) of
10 the outlet device, characterised in that the actuating mechanism has a locking device (54-62) for preventing the initiation of a new flushing operation before the flush cistern (10) has again been filled with liquid to above a predetermined minimum level.

15 7. An actuating starter mechanism as claimed in claim 6, characterised in that the locking device (54-62) for refilling has a sensor lever (55) which is pivotally mounted on a stationary pivot pin (54) and has a cam follower (56), by which the sensor lever
20 (54) is in operative engagement with a cam surface (57) on the float (40) for sensing the movements thereof in the vertical direction and for pivoting the sensor lever (55) depending on the liquid level in the flush cistern, that the sensor lever (55) has a release rocker arm (59)
25 which is pivotally mounted on the sensor lever (55) for pivoting about a rocker-arm shaft (58) spaced from the pivot pin (54) of the sensor lever, that the release means (49) has an actuator means (50) which is adapted, when a flushing operation is initiated, to be engaged
30 with the release rocker arm (59) for pivoting this arm and opening the outlet valve (11), and that the rocker-arm shaft (58), the pivot pin (54) of the sensor lever (55) and the actuator means (50) of the release means are so arranged in relation to one another as to prevent
35 every engagement between the actuator means (50) of the release means and the rocker arm (59) when the liquid





level in the flush cistern (10) sensed by the float (40) is below said predetermined level.

8. An actuating mechanism as claimed in claim 7, characterised in that the outlet valve (11) is connected to an opening float (23, 24) arranged in the flush cistern (10) and having a locking latch (36) which is pivotally mounted on the opening float (23, 24) and engages, when the outlet valve (11) is closed, a stationary abutment (38), and which is arranged in the path of movement of the release rocker arm (59) in order, when the actuating mechanism is released, to be disengaged from said abutment (38).

9. An actuating mechanism as claimed in claim 7 or 8, characterised in that the sensor lever (55) is a single-armed lever (55) whose one end is pivotally mounted on the stationary pivot pin (54) and whose other end has the cam follower (56) by means of which the sensor lever engages the float (40), and that the release rocker arm (59) is a double-armed rocker arm (59) whose rocker-arm shaft (58) is arranged on the sensor arm (55) between the two ends thereof.

10. An actuating mechanism as claimed in claim 7, 8 or 9, characterised in that the release means (49) has a return means (51) which is adapted to load the release means (49) in such a direction that the actuator means (50) of the release means is removed from the release rocker arm (59).



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**FLUSHING SYSTEM FOR WATER CLOSETS AND
ACTUATING MECHANISM THEREFOR**

ABSTRACT

In a flushing system and an actuating mechanism for
5 water closets having a double siphon (11) for the flush-
ing operation, the discharge of flushing liquid is pre-
vented by an air lock which is entrapped in a U-bend in
the double siphon and upon the removal of which the
flushing operation is initiated. The air lock is evacu-
10 ated via a venting tube (19) whose one end is connected
to the double siphon (11) at a location which in the
direction of flow is situated after and below the crest
of the U-bend (16). The venting tube (19) extends up over
the crest of the double siphon and is connected to a pis-
15 ton chamber (22). A starter piston (23) is vertically
movable in the piston chamber. This and the starter pis-
ton acts as part of an actuating mechanism. The connec-
tion of the venting tube (19) with the piston chamber
(22) is located a certain distance above its bottom. In
20 the closed position, the piston chamber (22) is filled
with liquid, and when the starter piston is lifted, the
entrapped liquid flows down into the liquid pump (25) and
the air lock is evacuated via the piston chamber. The
actuating mechanism which is especially well suited for
25 this flushing system has a locking device (54-62) to pre-
vent renewed initiation of the flushing operation before
the flush cistern has again been filled with liquid to
above a certain minimum level over the venting tube (19).

30
Figure 7

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FIG. 1

1/6

FIG. 2

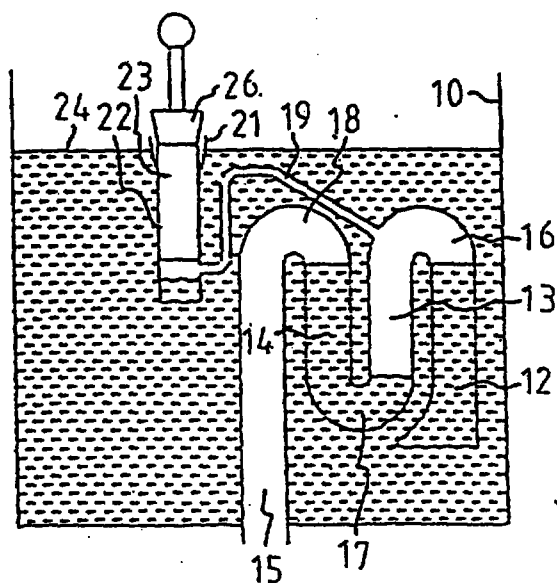
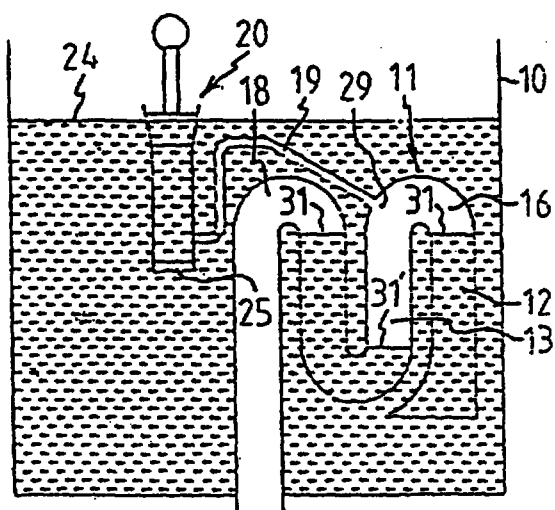


FIG. 3

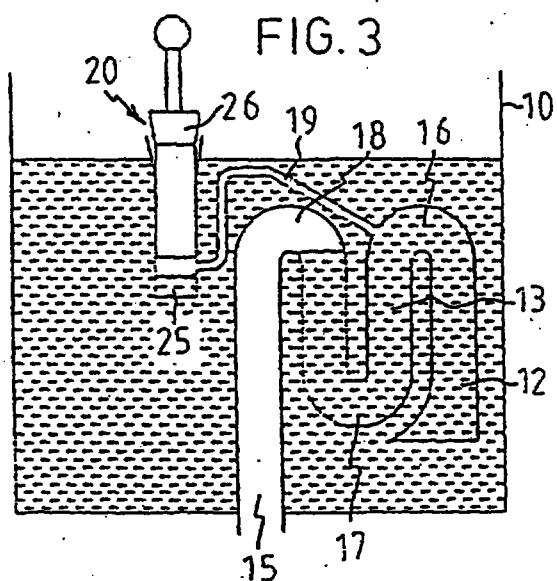


FIG. 4

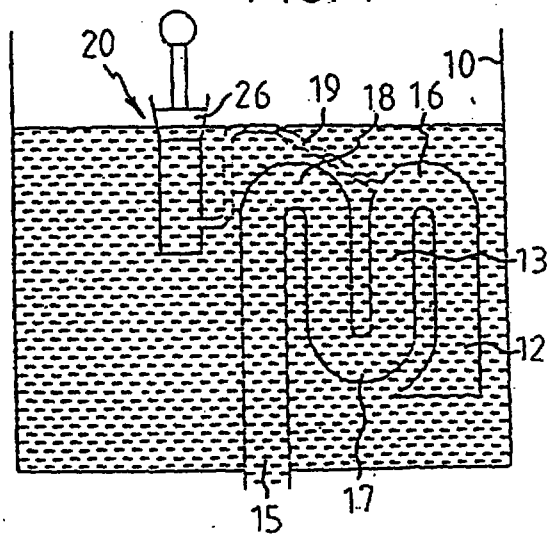


FIG. 5

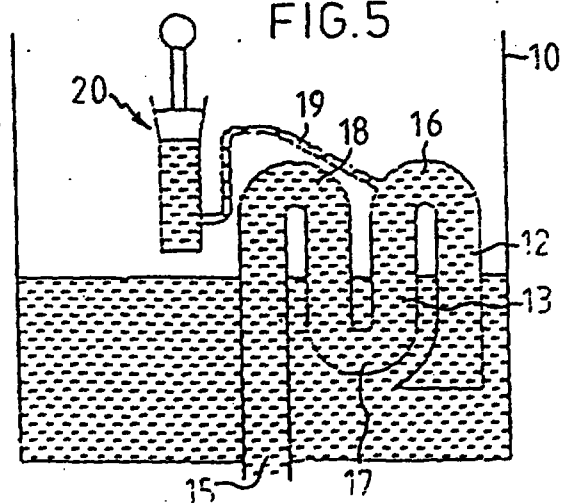


FIG. 6

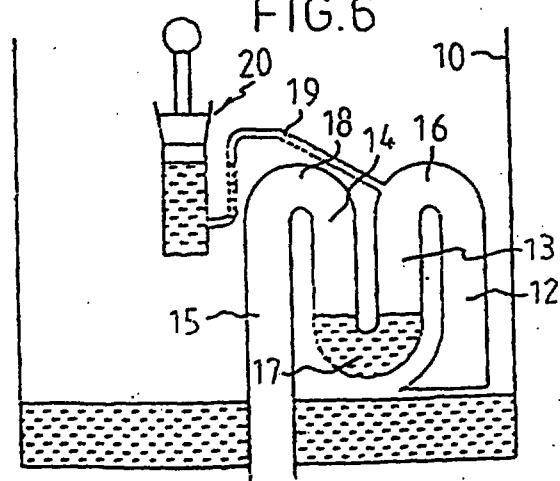




FIG. 7

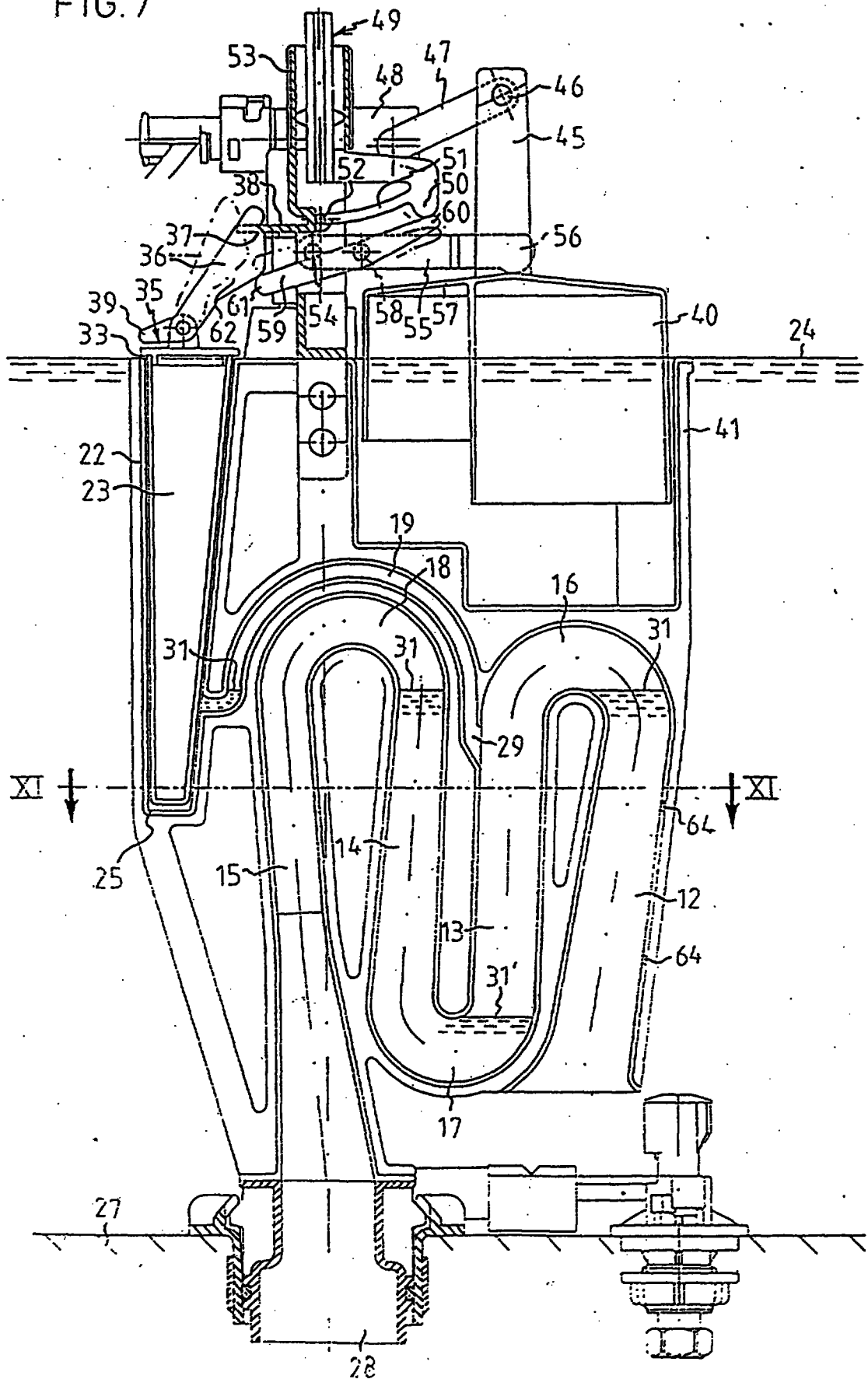




FIG. 8

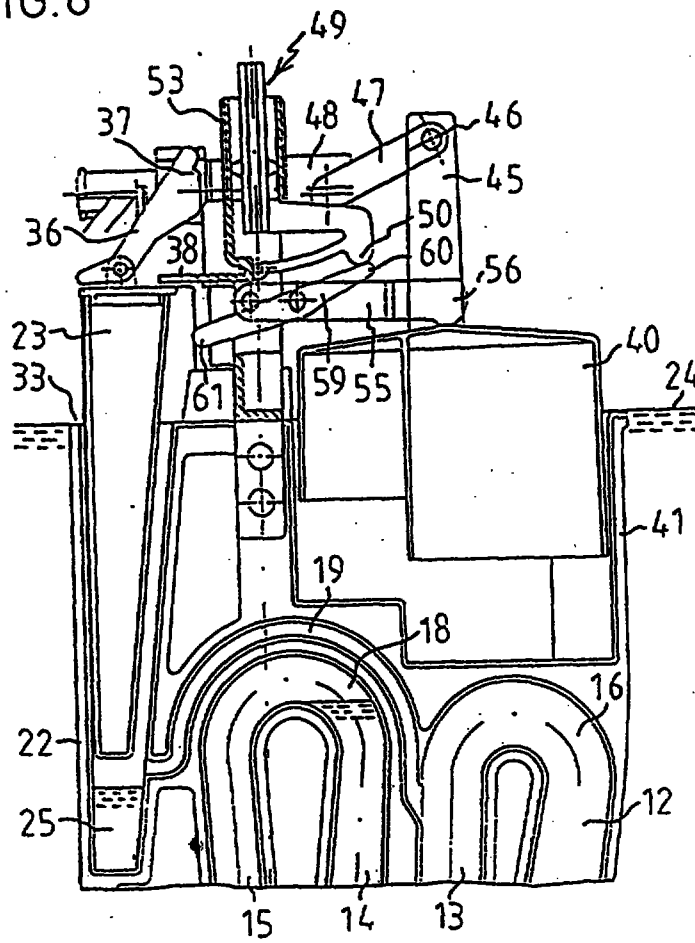


FIG. 9

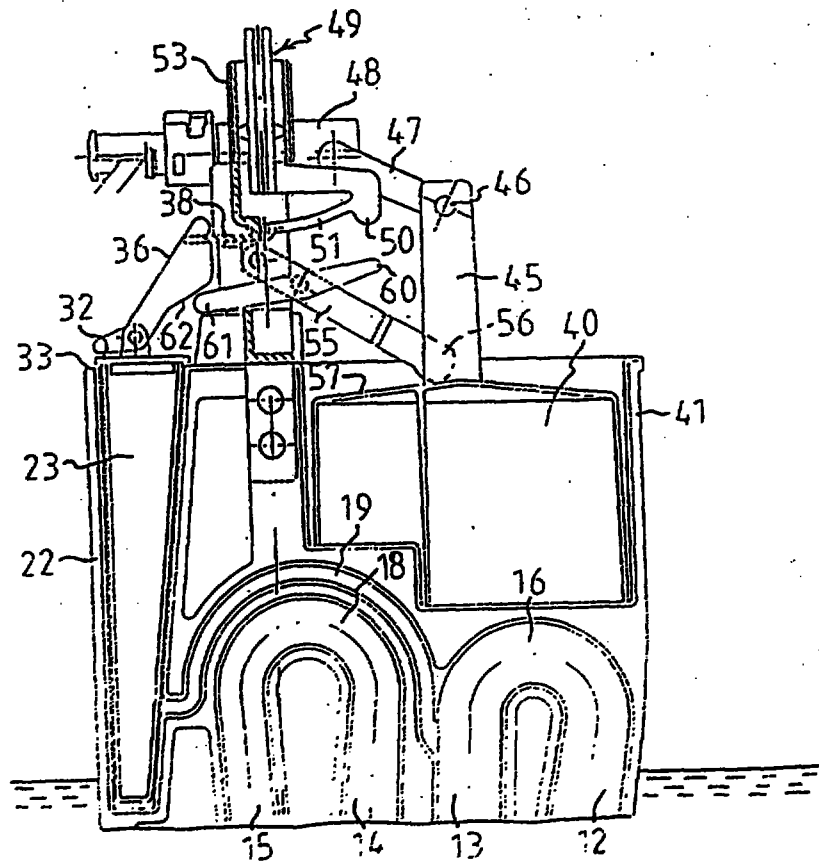




FIG.10

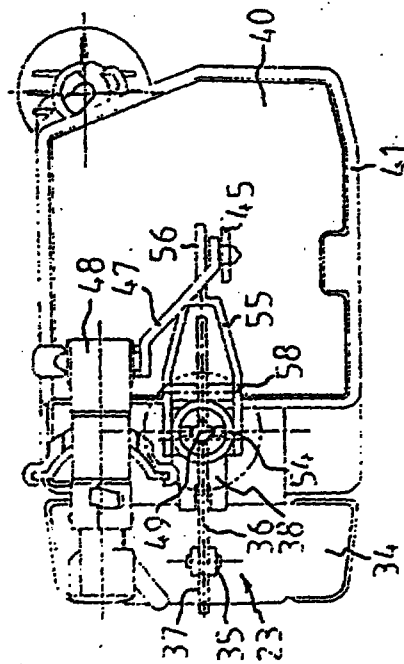


FIG.12

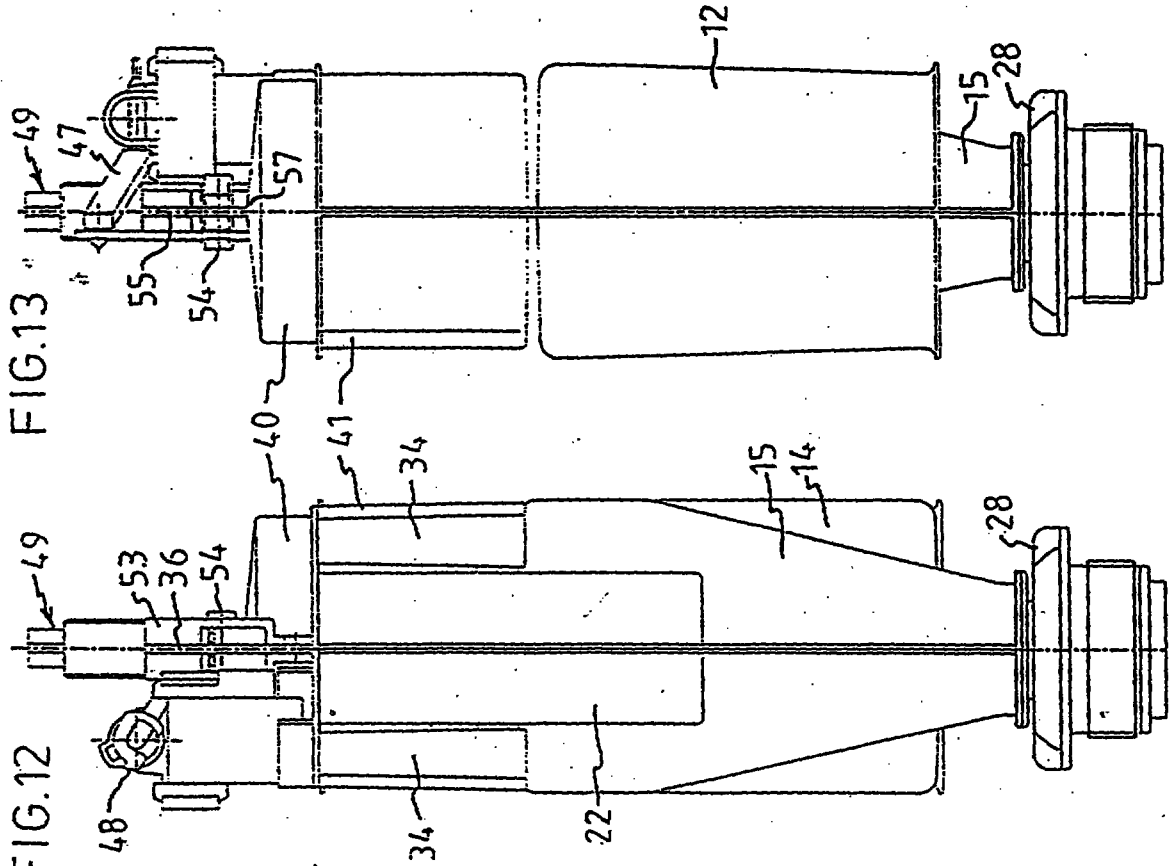


FIG.13

FIG.11

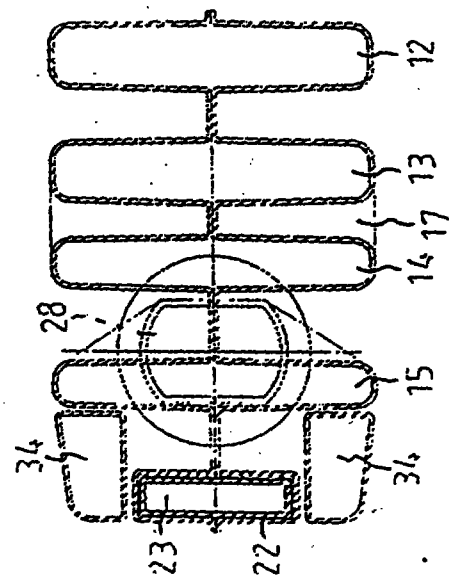




FIG.14

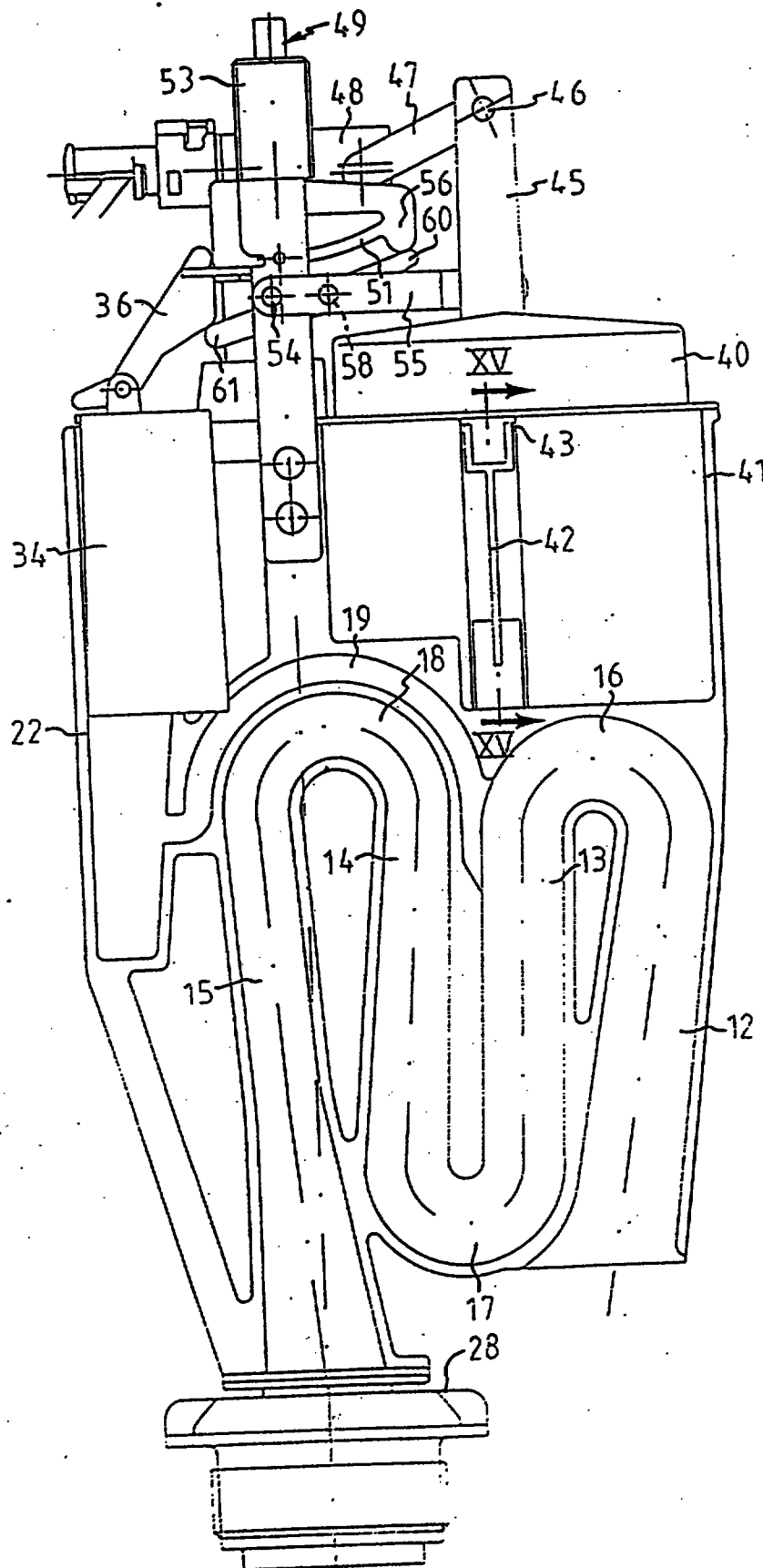


FIG.15

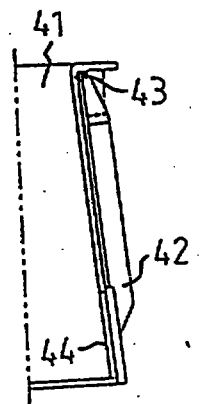




FIG.16

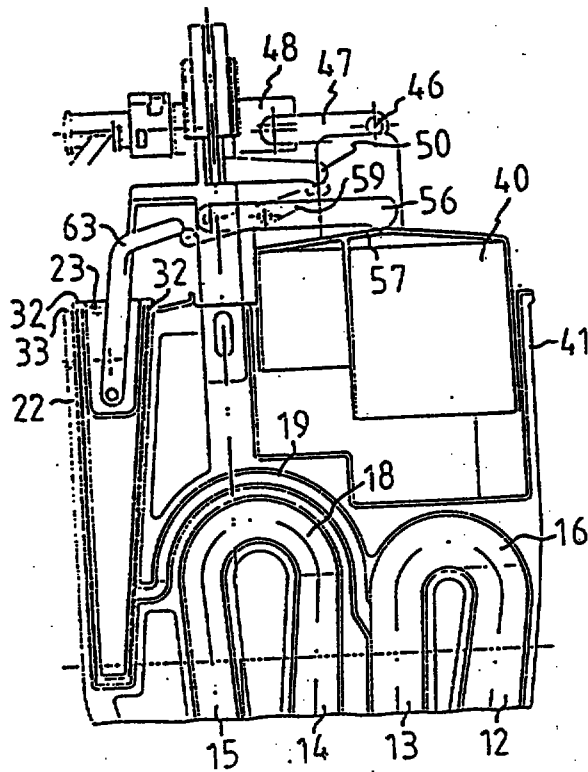


FIG.17

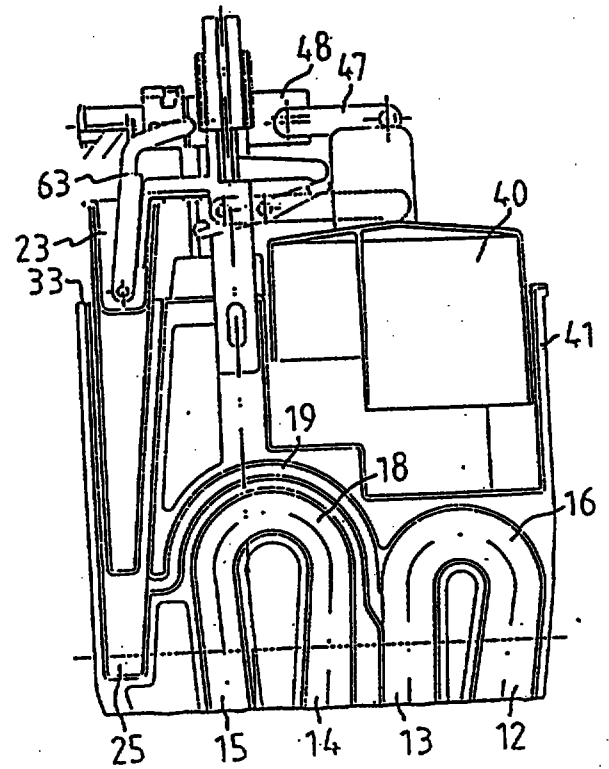
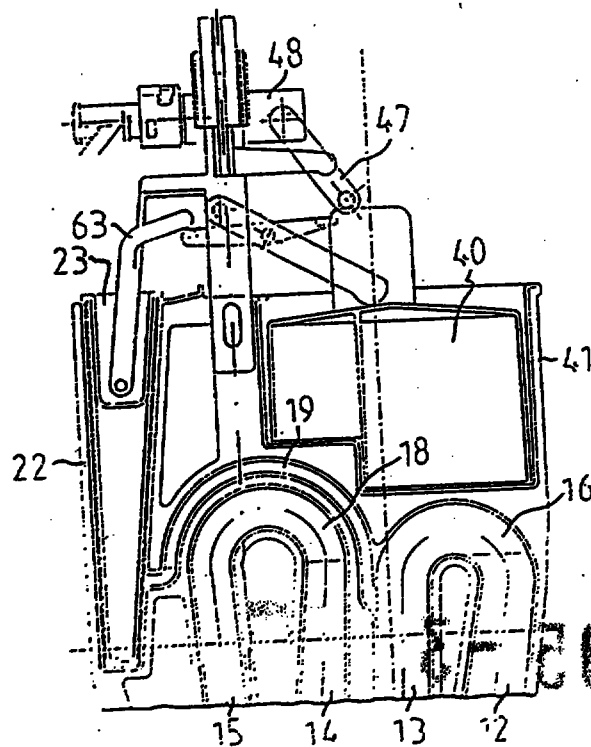


FIG.18



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☒ Claim(s) : paged ... to paged ...
☒ Drawing(s) : paged ... to paged ...
☒ Abstract : paged ... to paged ...

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FLUSHING SYSTEM FOR WATER CLOSETS AND ACTUATING
MECHANISM THEREFOR

The present invention relates to water closets and in particular to a new and improved flushing system which permits essentially reducing the force required for initiating a flushing operation by using a siphon-based flushing system. The invention also relates to an actuating mechanism which is especially well suited for use in such a new and improved flushing system.

GB-A-2,205,595 discloses a flushing system for water closets which has a double siphon immersed in a flush cistern. This siphon has an almost sinuous conduit with four juxtaposed vertical conduit legs and U-bends successively interconnecting the conduit legs. The central bend is facing downwards and interconnects the lower ends of the two central conduit legs, while the two outer U-bends are facing upwards and connect the upper ends of the central conduit legs to the upper ends of the outer conduit legs. This approximately sinusoidally-bent conduit is arranged in a flush cistern and is completely immersed in the water when the flush cistern is filled therewith. The first vertical conduit leg acts as the suction pipe of the siphon, and the last vertical conduit leg acts as the outlet pipe of the siphon and is connected to a flushing ramp at the upper end of the water closet. From the upper end of the upwardly-facing first U-bend further extends a downwardly-directed U-bent venting tube which at the upper end of its other U-leg is connected to the upwardly-facing third U-bend a certain distance below the crest of this U-bend. This venting tube, shaped as a U-bend, acts as a water trap in the starting position of the flushing system when the cistern is filled. For initiating the flushing operation, the water in the water trap is removed by means of an air ball which is connected to the lower U-web of the U-bent venting tube and which,

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upon compression and, hence, increase of the air pressure in the system, displaces the water in the water trap and evacuates it into the outlet pipe of the siphon. In this manner, a communication is established between the upper
5 end of the first upwardly-facing U-bend and the third upwardly-facing U-bend, such that air entrapped in the first upwardly-facing U-bend can be evacuated through the venting tube, whereby the entire sinuous conduit loop is intended to be filled with water so as to initiate the
10 siphon function for evacuating the major part of the water in the flushing system into the outlet pipe by suction. When a maximum amount of water has been sucked from the flush cistern and air starts leaking into the double siphon, a certain amount of water will remain in the
15 double siphon and also in the U-bent venting tube. When the water level thereafter rises in the water cistern, the water remains in the double siphon even if the water levels in the first, the second and the third conduit leg are displaced vertically in relation to one another. The
20 system also includes a further U-bent conduit which is connected to the crest of the third U-bent conduit of the double siphon and extends up over the maximum water level in the flush cistern and opens on a level with the intended minimum water level in the flush cistern. When
25 the water level in the flush cistern has sunk to below the lower end of this U-bent conduit, air is sucked into the double siphon and the flushing operation is consequently interrupted.

Danish Patent Specification DK-B-57,606 describes a
30 flush cistern which also uses a type of double siphon. In this case, there is provided a flushing mechanism which has a water trap. In this water trap is immersed an actuator piston which, when lifted, will lower the water level in the water trap and, hence, also reduce the pres-
35 sure of the water column. As a result, the liquid in the water trap will no longer be able to withstand the pressure from the air entrapped in the double siphon and the

water-trap function will thus cease, so that the air in the first upwardly-facing U-bend of the double siphon is emitted into the atmosphere and the siphon function is initiated. The actuator mechanism is disposed in an
5 upwardly-oriented compartment at the inlet end of this U-bend. This mechanism has however not proved completely satisfactory in operation, and difficulties have often been met with in establishing and maintaining the siphon function. This is probably due to the fact that air can
10 enter the mechanism between the actuating piston and the wall of the water-trap leg where the piston is disposed. As a result, there is a risk of air leakage into the siphon, impairing or interrupting the siphon effect. Also the placement of the actuator mechanism above the inlet
15 leg of the double siphon entails certain drawbacks, in that the leaving air must flow countercurrently to the incoming flush water from the flush cistern. This also makes it more difficult to completely remove the air in the first upwardly-facing U-bend of the double siphon.
20 In fact, remaining air is most detrimental to the performance of the siphon.

The system shown and described in GB-A-2,205,595 is an improvement over prior-art siphon systems, but yet suffers from several drawbacks which have made the sys-
25 tem not as successful as it ought to have been. One drawback resides in the poor function of the system, which depends, at least partially, on the difficulties of completely evacuating the entrapped air in the upwardly-facing first U-bend. Another drawback resides in the
30 design of the actuator mechanism, i.e. the use of an air ball which is to be compressed to provide displacement and evacuation of water remaining in the venting tube, serving as a water trap. As in other known siphon-based flushing systems, this actuating technique requires
35 substantial forces to initiate the flushing operation. First, it has proved difficult to completely displace and remove the water in the venting tube with the aid of the

air ball, and if the water is not completely removed, the remaining water will prevent or at least counteract the evacuation of the air lock or plug in the upwardly-facing first U-bend. Second, it is often difficult to make the
5 user change his habits, i.e. which amount to starting the flushing operation by pressing a button, lifting a valve rod or pulling a flush-valve string.

An object of the present invention is to provide an improvement of the flushing systems and actuating mechanisms described in GB-A-2,205,595 and DK-B-57,606. This
10 and other objects of the invention are achieved by means of a flushing system and an actuating mechanism having the features stated in claims 1 and 6, respectively. The subclaims define especially advantageous embodiments of
15 the invention.

The invention sets out from a flushing system according to GB-A-2,205,595, i.e. a flushing system having a double siphon arranged in a flush cistern and being in the form of a substantially sinusoidally-bent conduit
20 with four substantially vertical juxtaposed conduit legs and U-bends successively interconnecting the conduit legs, the central U-bend facing downwards and interconnecting the lower ends of the two central conduit legs, while the two outer U-bends are facing upwards and connect the upper ends of the central conduit legs to the
25 upper ends of the outer conduit legs, the substantially sinusoidally-bent conduit being arranged in a flush cistern so as to be completely immersed in the water when the flushing system is filled therewith, the first
30 vertical conduit leg being intended to act as the suction pipe of the siphon and the last vertical conduit leg being intended to act as the outlet pipe of the siphon and being connected to a flushing ramp at the upper end of the bowl of the water closet. To sum up, the invention
35 resides in preventing the evacuation of the flush water by means of an air lock or plug which is entrapped in the double siphon and upon the evacuation of which the

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flushing procedure is started. In the invention, the air lock is evacuated via a venting tube whose one end is connected to the double siphon at a point located in the U-bend containing the air lock a certain distance below the crest of the bend towards the outlet side of the U-bend. Therefore, the connecting point is located in the downstream direction of the flushing liquid, and the air can thus be removed in a more reliable manner. The venting tube extends up over the level of the crest of the double siphon and is connected at its other end to a piston chamber, in which a starter piston is arranged for vertical movement. The piston chamber and the starter piston act as part of an actuating mechanism. The connection of the venting tube with the piston chamber is located a certain distance over the bottom of the piston chamber so as to define a liquid sump at the lower end of the piston chamber. The piston chamber is filled with water when in the closed state, and when lifting the starter piston, the entrapped liquid will flow down into the liquid sump below the connection of the venting tube and the air lock is evacuated via the piston chamber. The actuating mechanism, especially well suited for this flushing system, has a locking device to prevent renewed initiation of the flushing operation before liquid has again been filled into the flush cistern to above a certain minimum level over the venting tube.

The invention will be described in more detail hereinbelow with reference to the accompanying drawings showing some preferred embodiments of the invention. These must however not be considered restrictive of the invention.

Figs 1-6 schematically illustrate the inventive principle and its function in the different phases of an evacuation procedure.

Fig. 7 is a vertical section of a specific embodiment of a flushing system and an actuating mechanism according to the invention.

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- Fig. 8 shows the embodiment of Fig. 7 in the state corresponding to Fig. 3.
- Fig. 9 shows the embodiment of Fig. 7 in the state corresponding to Fig. 5.
- 5 Fig. 10 shows the embodiment of Fig. 7 from above.
- Fig. 11 is a section taken along line XI-XI in Fig. 7.
- Fig. 12 shows the embodiment of Fig. 7 from the left with respect to Fig. 7.
- Fig. 13 shows the embodiment of Fig. 7 from the right with respect to Fig. 7.
- 10 Fig. 14 shows the embodiment of Fig. 7 in a side view from the front with respect to Fig. 7.
- Fig. 15 is a section taken along line XV-XV in Fig. 14.
- Fig. 16 shows parts of another embodiment of a flushing system and an actuating mechanism according to the invention, this Figure corresponding the setting position in Fig. 7.
- 15 Fig. 17 is a view similar to Fig. 8, but shows said other embodiment of the invention.
- 20 Fig. 18 is a view similar to Fig. 9, but shows said other embodiment of the invention.

Figs 1-6 schematically show a flushing system and an actuating mechanism according to the present invention. In a flush cistern 10, an outlet device 11 is immersed.

25 The outlet device is designed as a double siphon in the form of an approximately sinusoidally-extending conduit having four juxtaposed conduit legs 12, 13, 14, 15 and U-bends 16, 17 and 18 successively interconnecting the conduit legs. The central U-bend 17 is facing downwards and interconnects the lower ends of the two central conduit legs 13, 14. The two outer U-bends 16, 18 are facing upwards and connect the upper ends of the two central conduit legs 13, 14 to the upper ends of the outer conduit legs 12, 15. The first vertical conduit leg 12 is

30 intended to act as the suction pipe of the siphon. The last vertical conduit leg 15 is intended to act as the outlet pipe of the siphon and is connected in customary

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manner to a flushing ramp (not shown) at the upper end of the bowl of a water closet.

The flushing system also has a venting tube 19 serving to evacuate air which, when the flush cistern 10 is filled with liquid, is entrapped in the first upwardly-facing U-bend 16 of the double siphon. One end of the venting tube 19 is connected to a point on the downstream side of this U-bend and extends up over the level of the crests of the upwardly-facing U-bends 16, 18 to be connected at its other end to an actuating mechanism 20. This mechanism includes a nonreturn valve 21 comprising a substantially vertical piston chamber 22, in which a starter piston 23 is provided for vertical movement. The upper end of the piston chamber 22 can be connected to the ambient air at a point above the maximum water level 24 in the flush cistern. The piston chamber further has a liquid sump 25 which is located below the opening of the venting tube 19 in the piston chamber 22. The liquid sump has a sufficient volume for holding liquid that remains in the starter-piston chamber 22 and the venting tube 19 when the flush cistern 10 is filled. At the upper end, the starter piston 23 and the starter-piston chamber 22 are so designed that air- and liquid-tight engagement is produced within a conically flared portion 26. Alternatively, a special seal can be used between an outwardly directed flange and an engagement surface, as will be described further on. This seal within the conically flared portion or a similar seal provides the desired nonreturn-valve function. The starter piston 23 and the piston chamber 22 are so designed that when the starter piston is lifted, air will be sucked into the starter-piston chamber 22 and, consequently, liquid present in the starter-piston chamber and the venting tube will flow down into the liquid sump 25. As a result, the air entrapped in the first U-bend 16 in the starting position (Fig. 1) can be evacuated via the venting tube 19 and the nonreturn valve 21.

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Figs 1-6 show the sequence of the different phases of operation. Thus, Fig. 1 shows the flushing system in the starting position when the cistern 10 is filled with liquid and the starter piston 23 is in its lower position, in which the flared portion 26 sealingly engages the starter-piston chamber. In this position, air is entrapped in the U-bend 16 and the venting tube 19. An overpressure prevails, which appears from the differences between the liquid levels 31, 31' in the first three conduit legs 12, 13 and 14.

To initiate the flushing operation, the starter piston 23 is lifted so that air can pass from above into the starter-piston chamber 22 and so that the liquid entrapped therein flows down into the liquid sump 25 to expose the opening of the venting tube 19. As a result, the air entrapped in the U-bend 16 will be discharged by the liquid pressure through the starter-piston chamber. The resulting liquid surge makes the liquid fill the first U-bend 16 of the double siphon and thereafter the entire siphon as well, such that the siphon function is initiated and liquid is discharged from the flush cistern.

Fig. 3 shows the state when the first three conduit legs 12, 13, 14 are completely filled with liquid. Upon continued suction of liquid into the double siphon, this will be completely filled with liquid as is also the venting tube 19 and the starter-piston chamber 22 (Fig. 4). In this position, the starter piston 23 has been returned to its initial position with a sealing nonreturn-valve function within the flared portion 26.

Fig. 5 shows the next stage when flushing proceeds. During this stage, there is a negative pressure in the double siphon and, hence, also in the venting tube 19 and the starter-piston chamber 22. Suction of air into the double siphon via the starter-piston chamber is prevented by the above-mentioned nonreturn-valve function. Flushing proceeds until air is sucked into the double siphon through the inlet of the conduit leg 12. Fig. 6

shows this position. If a smaller flushing liquid amount is desired than that corresponding to evacuation as far as the lower end of the first conduit leg, it is possible to provide holes on different levels along the first conduit leg, e.g. for achieving a 4-litre or a 6-litre flushing liquid amount. At any rate, the siphon effect is interrupted when air is sucked into the first conduit leg. When this takes place, a certain amount of liquid will remain in the second U-bend 17. When refilling the flush cistern with fresh flushing liquid, this liquid column will be displaced in order to eventually occupy the position shown in Fig. 1.

A major advantage of this system is that the flushing operation is easily started and requires but a slight force, in that the liquid column in the piston chamber 22 over the inlet 29 of the venting tube 19 substantially outbalances the overpressure represented by the difference in level between the liquid surfaces 31 and 31'. Moreover, the system is advantageous in so far as the starter ball used in GB-A-2,205,595 has been dispensed with and the flushing operation can be initiated by traditional measures, i.e. by either lifting a piston or by depressing a button so as to lift the piston. By the selected position of the inlet 29 of the venting tube 19, the drawbacks inherent in the prior-art device according to the GB-A-2,205,595 are also overcome, in that the air is removed at a point downstream of the crest of the U-bend. In this manner, improved or complete removal of the air is achieved, especially if the conduit legs are designed to promote laminar flow.

Fig. 7 shows a preferred embodiment of a flushing system and an actuating mechanism according to the present invention. In the Figure, the different components are shown in the same positions as in Fig. 1. The flushing system is mounted on the bottom 27 of a flush cistern. The double siphon 11 has its four conduit legs 12, 13, 14, 15 arranged substantially vertically beside each

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other. As appears from Fig. 11, the conduit legs have flattened cross-section to promote laminar flow. However, the cross-sectional shape need not be as flattened as shown in Fig. 11, but an oval or square cross-section can also be used. Moreover, the flow passage of the double siphon is preferably designed with a reduced flowthrough area from the conduit leg 12 to a location in the conduit leg 15 in order to improve the flow, to increase the flow velocity and to promote the laminar flow.

10 The last conduit leg or outlet pipe 15 is connected to an outlet sleeve 28, in turn connected to the conventional flushing ramp (not shown) of the water closet.

15 As appears from Fig. 7, the venting tube 19 is connected to the second conduit leg 13 at a point facing away from the first conduit leg and close to the upper end of second conduit leg 13, i.e. along the wall surface where the air flows when evacuating the entrapped air bubble. The reason for this placement is that the inlet 29 of the venting tube 19 should be disposed so far away
20 in the downstream direction that the air is completely displaced by the water flowing into the conduit leg 12 upon the initiation of the flushing operation. The outlet end of the venting tube 19 is connected to the piston chamber 22 at a point which is preferably located slightly below the liquid levels 31 in the first conduit leg
25 and the third conduit leg in the starting position of the flushing system (see Fig. 7).

30 In this preferred embodiment, the starter piston 23 has an outwardly-directed flange 32 which in the closed state of the nonreturn valve engages an edge 33 on the starter-piston chamber 22. If so required, the flange 32 may be provided with a seal, with which it engages the edge 33. In the illustrated embodiment, the piston 23 has two floating bodies 34 for a purpose which will be
35 described in more detail hereinafter (Fig. 11). These floating bodies are disposed on the outside of the starter-piston chamber 22 and depend below the upper

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edge 33 of the chamber. The upper face of the piston is provided with a lug 35, in which a locking latch 36 is pivotally mounted for pivotal movement between a locking position indicated by full lines and a release position indicated by dash-dot lines in Fig. 7. In the locking position, the locking surface 37 of the latch engages a stationary locking surface on a fork 38. To limit the outward pivotal movement of the locking latch, this preferably has a projection 39 stopping the outward pivotal movement by engaging the upper face of the piston 23.

In the embodiment of Fig. 7, the float 40 of the flushing system has been designed as a downwardly open bell which is guided in a float chamber 41 for vertical movement therein. The chamber 41 is fixedly connected to the double siphon 11 and the piston chamber 22. The float chamber 41 is intended to be filled with flushing liquid, which is achieved by the liquid, when filling the flush cistern, flowing over the top edge of the float chamber and down between this and the float 40. At the lower end of the float chamber, there is provided a nonreturn valve 42 in the form of a pivotable valve plate mounted for pivotal movement about a pivot pin 43 adjacent the upper edge of the float chamber. The nonreturn valve is inclined so as to be urged downwards, when in its normal position, by the force of gravity into abutment against the side of the float chamber and into sealing engagement with a valve seat 44. By this arrangement, the float chamber will be successively evacuated as the liquid level in the flush cistern is sinking. On the other hand, filling of the float chamber with flushing liquid is prevented until the flushing liquid can flow over the top edge of the float chamber. This arrangement enables quicker filling of the flush cistern and does not involve the customary gradual decrease of the supply of liquid during the final phase of the filling procedure.

The float 40 has an upright 45, at the top end of which a pivot pin 46 is provided. This pin is connected

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to a control arm 47 for a conventional inlet valve 48. The valve 48 is closed in the position shown in Fig. 7 and open in the position shown in Fig. 9.

For starting the flushing operation, the actuating
5 mechanism in the embodiment of Fig. 7 has a release means 49 which in this embodiment is a push-button mechanism having at its lower end a laterally projecting actuator 50 which is resiliently biased upwards by a spring unit 51. The spring unit 51 may be integrally formed with the
10 components 49 and 50. The free end of the spring unit 51 is fixed in the body 53 of the mechanism in a suitable manner, e.g. by means of projecting pins 52. The body 53 is integrally formed with the fork 38 and thus forms a stationary element. In this stationary element is fixed
15 a pivot pin 54. On the pivot pin 54, a sensor lever 55 is pivotally fixed with one end. The other end of the sensor lever is designed as a cam follower 56 which engages the upper face of the float 40, this face thus serving as a cam surface 57. Between the cam follower 56 and the pivot
20 pin 54, the sensor lever 55 has a pivot pin 58, on which a release rocker arm 59 is pivotally mounted. In this embodiment, the rocker arm is designed as a double-armed lever and engages the actuator 50 with one end 60 and a cam surface 62 on the locking latch 36 with the other end
25 61.

A downward pressure on the release means 49 against the action of the spring 51 produces a pivotal movement of the release rocker arm 59 in the clockwise direction with respect to Fig. 7, such that the locking latch 36 is
30 released from its locking engagement with the fork 38 and is swung to its position indicated by dash-dot lines. This means that the starter piston 23 is released and lifted by its floating bodies 34 to the position shown in Fig. 8, in which the upper face of the starter piston
35 comes into engagement with the fork 38.

Fig. 8 only shows an instantaneous position to illustrate the function of the mechanism. In this instant-

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neous position, the piston 23 has thus been lifted so that the liquid entrapped in the piston chamber and the venting tube can flow down into the liquid sump 25. As a result, the air entrapped in the first U-bend 36 and parts of the second conduit leg 13 will flow out and be evacuated through the venting tube 19 and the piston chamber 22 into the free air over the liquid surface 24 in the cistern 10. This initiates the siphon function, and the flushing liquid is discharged to the flushing ramp of the water closet in the manner described above. When the liquid level in the flush cistern is gradually sinking, the liquid level in the float chamber 41 will also sink, since the water can flow out through the non-return valve 42. In this manner, the sensor lever 55 will be pivoted clockwise with respect to Fig. 7. This also means that the vertical position of the pivot pin 58 is lowered correspondingly. The lowering of the position of the pivot pin 58 relative to the stationary pivot pin 54 entails that the release rocker arm 59 is also lowered. As a result, a gap will form between the end 60 of the rocker arm and the actuator 50. Because of this gap, renewed initiation of the flushing procedure cannot be started until the liquid level in the flushing system has been restored. The gap between the components 50 and 60 is maintained during the entire filling procedure by the float 40 remaining in its lower position (Fig. 9) until water flows into the float chamber 41 via the top edge of the float chamber, since the nonreturn valve 42 prevents water from flowing in before that. A float chamber 41 is however not necessary for maintaining this locking function against renewed initiation of the flushing operation. It is however essential that the mechanism be so designed that a restart of the flushing operation is not possible before the liquid level in the flushing system has been restored to a position above the crest of the venting tube 19.

Fig. 9 shows the positions of the components after the liquid level has sunk to such an extent that the floating bodies 34 are no longer capable of holding the starter piston 23 in a lifted position. As soon as the starter piston 23 has been returned to the position shown in Fig. 9, the nonreturn-valve function is achieved, i.e. a sealing engagement exists between the flange 32 and the top edge of the piston chamber 22. This function is also promoted by the engagement of the latch 36 with the fork 38. The floats 34 should be designed with a lifting power which is so adjusted that the sealing function of the nonreturn valve is achieved before the liquid level in the flushing system has sunk to below the upper crest of the venting tube 19. In fact, it is essential that liquid remains in the venting tube and the piston chamber in order that an air plug or lock should remain in the U-bend 16 when the flush cistern is again being filled with liquid.

Figs 7-15 show a preferred embodiment of an actuating mechanism for the flushing system according to the invention. However, the actuating mechanism can also be designed otherwise, a conceivable embodiment being illustrated in Figs 16-18. In this case, there is no counterpart to the locking latch 36, but the release rocker arm 59 lifts the piston 23 by directly engaging and lifting a laterally-directed hook 63 on the piston 23. As soon as the piston, via the hook 63, has been lifted to cancel the sealing engagement between the flange 32 and the top edge 33 of the starter-piston chamber 22, the floating bodies 34 will take over the lifting power and lift the piston to the position shown in Fig. 17. In this case too, a restart of the flushing operation is prevented by the pivot pin 58 being lowered during the evacuation to a lower level by pivotal movement of the sensor lever 55 about the stationary pivot pin 54. In other respects, this embodiment functions in the same way as the embodiment in Figs 7-15.

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The actuating mechanism need not necessarily have a single-armed sensor lever 55. This lever may also be double-armed, in which case a reversal of the direction of movement can be carried out in a suitable manner, such that pressures or tractions in the release means will start the flushing operation. In the light of the above principles, a person skilled in the art may easily provide such as modification of the system.

The double siphon of the flushing system may suitably be formed from plastics material and be made in two halves forming a parting plane against each other, as shown in Figs 11-13. As previously mentioned, the different conduit legs 12-15 need not have exactly the flattened shape as shown at 11, but the conduits preferably are of such a flattened shape or of oval shape to provide or promote a laminar flow. In fact, a laminar flow promotes the achievement of an efficient evacuation of all the air entrapped in the system at the start of the flushing operation. The use of an actuating mechanism with no floating bodies 34 also falls within the scope of the invention. In such a case, the starter piston can be lifted directly, as indicated in Figs 1-6. The actuating mechanism described above is especially well suited for the flushing system according to Figs 7-18, but can of course also be used for other flushing systems where it is desirable to prevent a restart of the flushing operation until a certain minimum level of the liquid in the flush cistern has been exceeded during the filling procedure.

To permit varying the amount of flushing liquid in each flushing operation, the first conduit leg 12 may have air-suction holes 64 on different vertical levels, e.g. one level for discharging 4 litres of flushing liquid and another level for discharging 6 litres of flushing liquid. When installing the device, the fitter then plugs the air suction hole or holes 64 not to be used.

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CLAIMS



1. A flushing system for water closets, which has an
5 outlet device (11) arranged in a flush cistern (10) and
designed as a double siphon in the form of a substantial-
ly sinusoidal conduit having four juxtaposed, substan-
tially vertical conduit legs (12-15) and U-bends (16-18)
successively interconnecting said legs, the central U-
10 bend (17) facing downwards and interconnecting the lower
ends of the two central conduit legs (13, 14), while the
two outer U-bends (16, 18) are facing upwards and connect
the upper ends of the central conduit legs (13, 14) to
the upper ends of the outer conduit legs (12, 15), this
15 substantially sinusoidally-bent double siphon being
arranged in the flush cistern to be completely immersed
in the flushing liquid when the flush cistern is filled
therewith, the first vertical conduit leg (12) being
intended to act as the suction pipe of the siphon and the
20 last vertical conduit leg (15) being intended to act as
the outlet pipe of the siphon and being connected to a
flushing ramp at the upper end of the bowl of the water
closet, and the flushing system having a venting tube
(19) for evacuating air which, when the flush cistern
25 (10) is filled with liquid, is entrapped in the first
upwardly-facing U-bend (16) of the double siphon,
c h a r a c t e r i s e d in that the venting tube (19)
is connected at one end to the second conduit leg a cer-
tain distance below the crest of the first upwardly-fac-
30 ing U-bend (16) and extends to a level above the crests
of the first and third upwardly-facing U-bends (16, 18)
and is connected at its other end to a substantially ver-
tical piston chamber (22) which is included in an actu-
ating mechanism (20) and in which a starter piston (23) is
35 vertically movable, the upper end of the piston chamber
being connectible to the ambient air at a location above
the intended maximum water level (24) in the flush cis-

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tern, said piston chamber having a liquid sump (25) located below the opening of the venting tube in the piston chamber (22) and having a sufficient volume for holding liquid that remains in the starter-piston chamber (22) and the venting tube (19) when the flush cistern (10) is filled, the starter piston (23) and the starter-piston chamber (22) being so designed that when the starter piston is lifted, liquid present in the starter-piston chamber (22) and the venting tube (19) will flow down into the liquid sump (25) and the air entrapped in the first U-bend will thus be evacuated via the venting tube (19).

2. A flushing system as claimed in claim 1, characterised in that the conduit legs (12-15) of the double siphon have a flattened cross-sectional shape, preferably an elongate, rectangular cross-sectional shape, for creating a laminar flow of liquid through the conduit legs.

3. A flushing system as claimed in claim 1 or 2, characterised in that the conduit legs (12-15) of the double siphon have a generally decreasing cross-sectional area, counting from the first conduit leg (12) to a location in the last conduit leg (15).

4. A flushing system as claimed in any one of claims 1-3, characterised in that the venting tube (19) is connected to the second conduit leg (13) substantially on a level with the connection thereof with the first upwardly-facing U-bend (16).

5. A flushing system as claimed in any one of claims 1-4, characterised in that the actuating mechanism has a locking device (54-62) for preventing the initiation of a new flushing operation before the flush cistern (10) has again been filled with liquid to above a predetermined minimum level above the crest of the venting tube (19).

6. An actuating mechanism for a flushing system having an outlet device (11) arranged in a flush cistern

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(10) and an inlet device (48) which has a float device (40) for controlling the supply of liquid into the flush cistern (10) by an inlet valve (48) included in the inlet device (48), the float (40) of said float device being
5 operatively connected to the inlet valve (48) via a link system (47) for opening and closing the inlet valve (48) depending on the liquid level in the flush cistern, the outlet device (11) of the actuating mechanism comprising a release means (49) for opening the outlet valve (11) of
10 the outlet device, characterised in that the actuating mechanism has a locking device (54-62) for preventing the initiation of a new flushing operation before the flush cistern (10) has again been filled with liquid to above a predetermined minimum level.

15 7. An actuating starter mechanism as claimed in claim 6, characterised in that the locking device (54-62) for refilling has a sensor lever (55) which is pivotally mounted on a stationary pivot pin (54) and has a cam follower (56), by which the sensor lever
20 (54) is in operative engagement with a cam surface (57) on the float (40) for sensing the movements thereof in the vertical direction and for pivoting the sensor lever (55) depending on the liquid level in the flush cistern, that the sensor lever (55) has a release rocker arm (59)
25 which is pivotally mounted on the sensor lever (55) for pivoting about a rocker-arm shaft (58) spaced from the pivot pin (54) of the sensor lever, that the release means (49) has an actuator means (50) which is adapted, when a flushing operation is initiated, to be engaged
30 with the release rocker arm (59) for pivoting this arm and opening the outlet valve (11), and that the rocker-arm shaft (58), the pivot pin (54) of the sensor lever (55) and the actuator means (50) of the release means are so arranged in relation to one another as to prevent
35 every engagement between the actuator means (50) of the release means and the rocker arm (59) when the liquid

level in the flush cistern (10) sensed by the float (40) is below said predetermined level.

8. An actuating mechanism as claimed in claim 7, characterised in that the outlet valve (11) is connected to an opening float (23, 24) arranged in the flush cistern (10) and having a locking latch (36) which is pivotally mounted on the opening float (23, 24) and engages, when the outlet valve (11) is closed, a stationary abutment (38), and which is arranged in the path of movement of the release rocker arm (59) in order, when the actuating mechanism is released, to be disengaged from said abutment (38).

9. An actuating mechanism as claimed in claim 7 or 8, characterised in that the sensor lever (55) is a single-armed lever (55) whose one end is pivotally mounted on the stationary pivot pin (54) and whose other end has the cam follower (56) by means of which the sensor lever engages the float (40), and that the release rocker arm (59) is a double-armed rocker arm (59) whose rocker-arm shaft (58) is arranged on the sensor arm (55) between the two ends thereof.

10. An actuating mechanism as claimed in claim 7, 8 or 9, characterised in that the release means (49) has a return means (51) which is adapted to load the release means (49) in such a direction that the actuator means (50) of the release means is removed from the release rocker arm (59).



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FLUSHING SYSTEM FOR WATER CLOSETS AND ACTUATING
MECHANISM THEREFOR

ABSTRACT

In a flushing system for water closets having a
5 double siphon (11) the flushing liquid discharge is prevented by an air lock entrapped in a U-bend (16) in the siphon. The flushing is initiated when evacuating the air lock via a venting tube (19) connected to the siphon (11) down-stream of and below the U-bend crest. The venting
10 tube (19) extends up over the crest of the double siphon and is connected to a piston chamber (22) in which a starter piston (23) is vertically movable. This chamber and this piston act as parts of an actuating mechanism. The venting tube (19) is connected to the piston chamber
15 (22) at a location a certain distance above bottom of the piston chamber. In the closed position, the piston chamber (22) is filled with liquid. When lifting the starter piston, the entrapped liquid flows down into a liquid sump (25) and the air lock is evacuated via the piston
20 chamber.

25

Fig. 7 elected for publication

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FIG.1

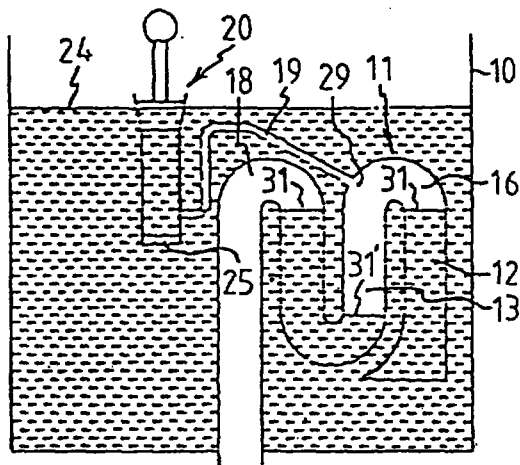


FIG.2

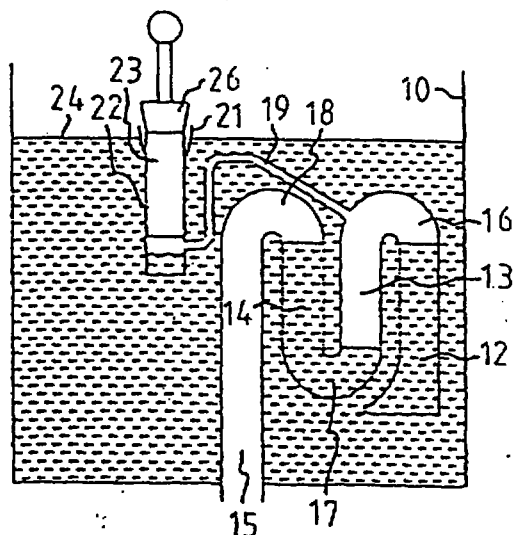


FIG.3

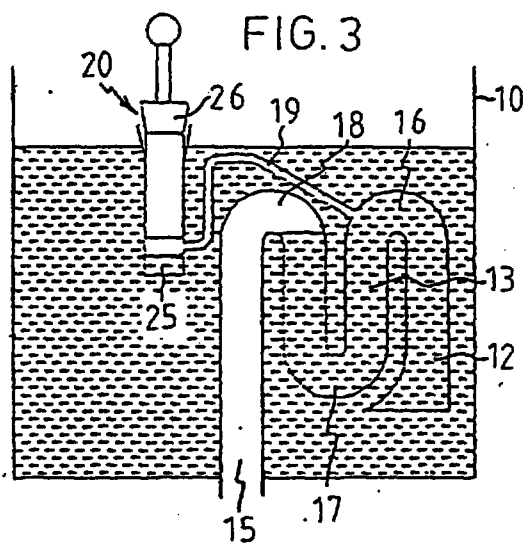


FIG.4

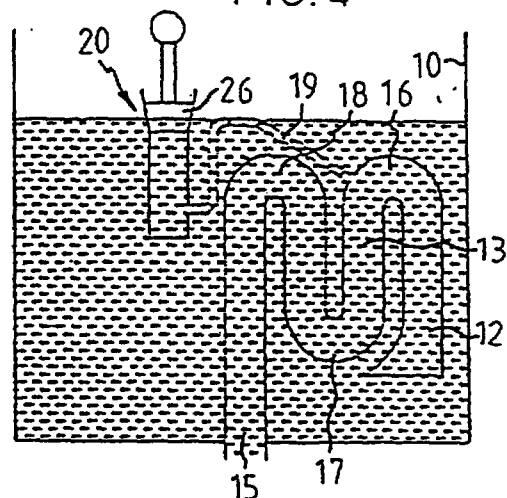


FIG.5

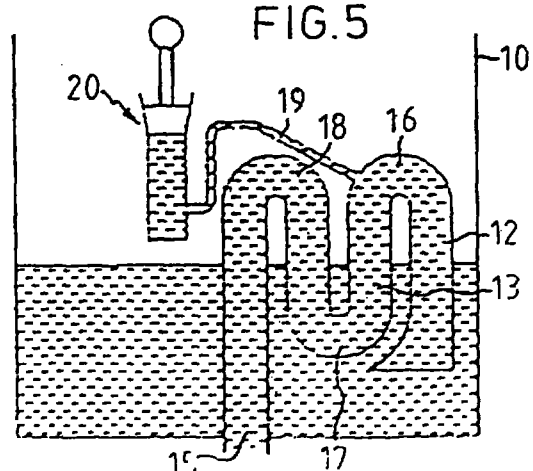
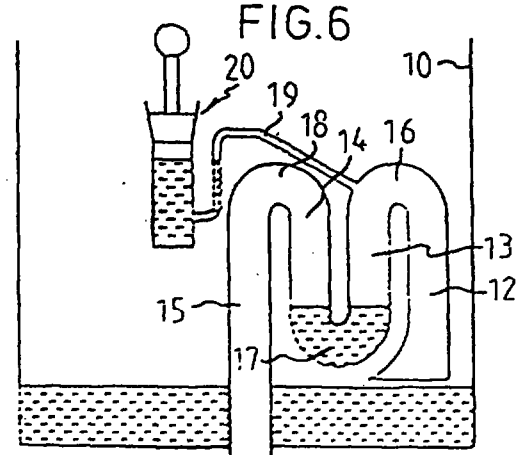


FIG.6

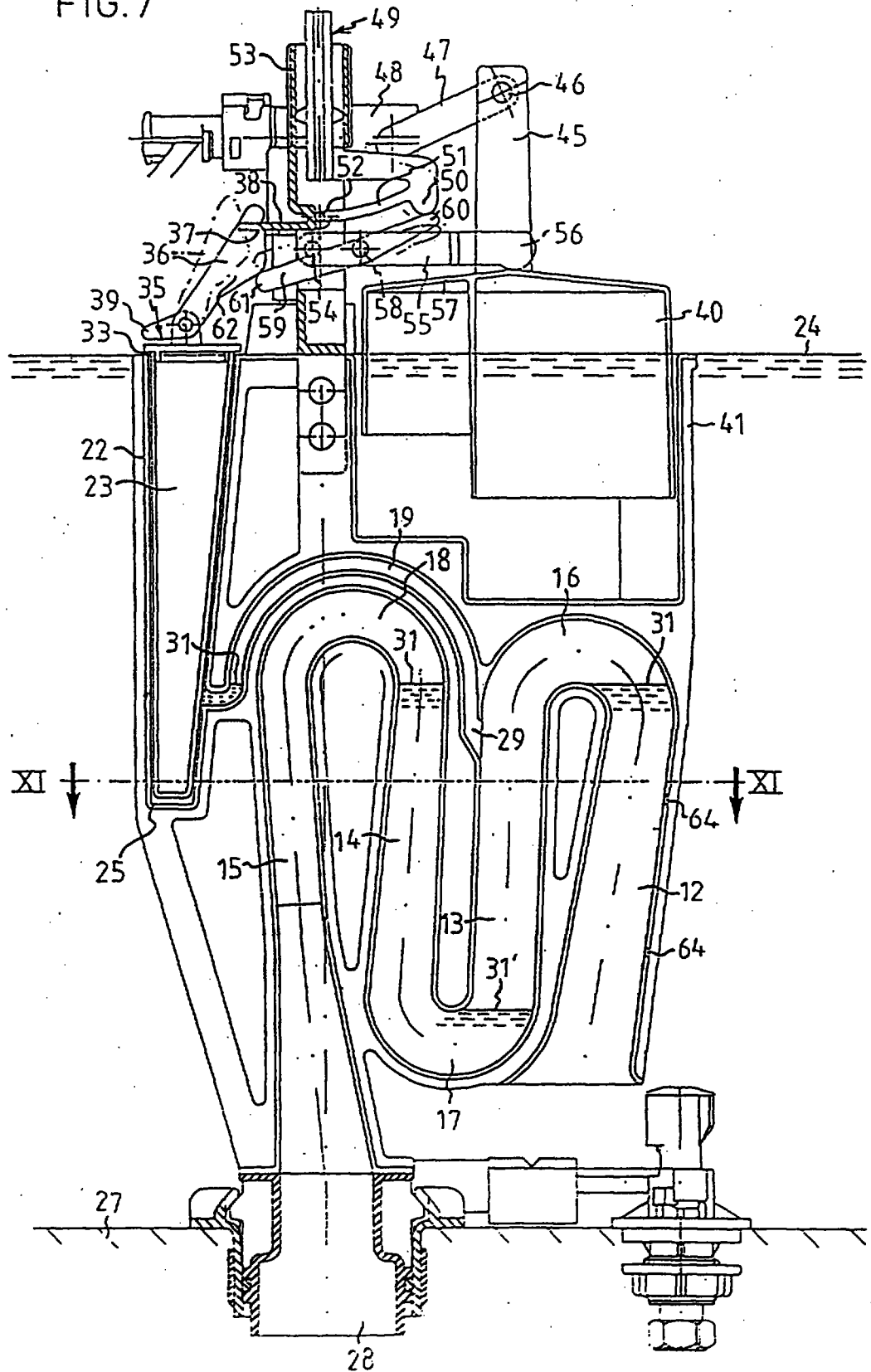


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FIG. 7



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FIG.8

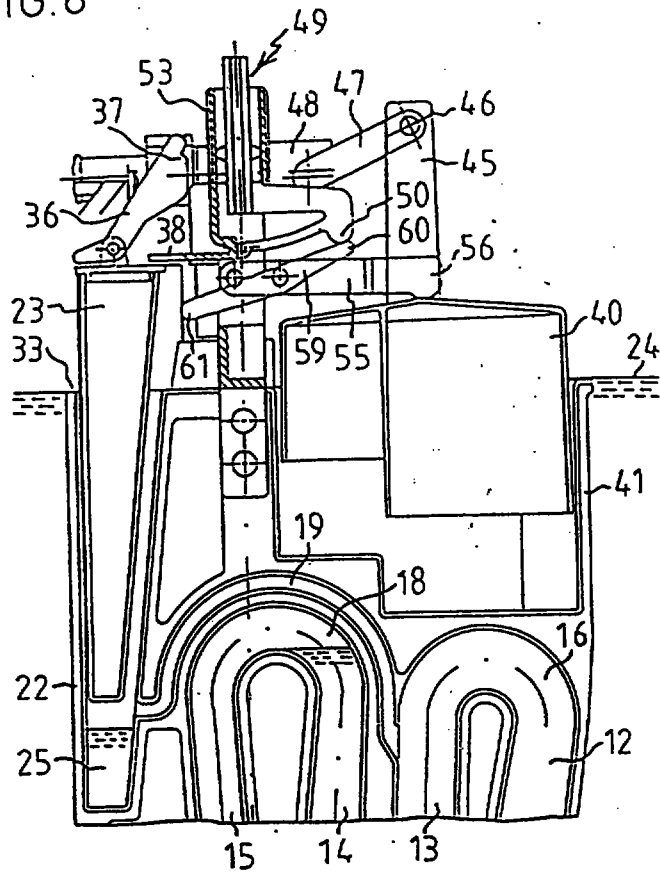
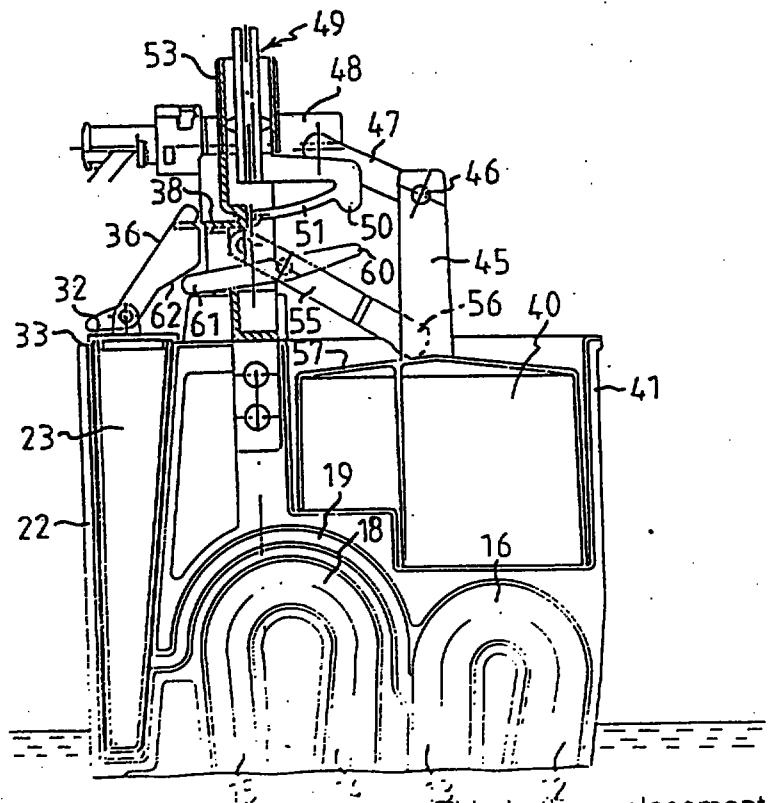


FIG.9



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FIG.10

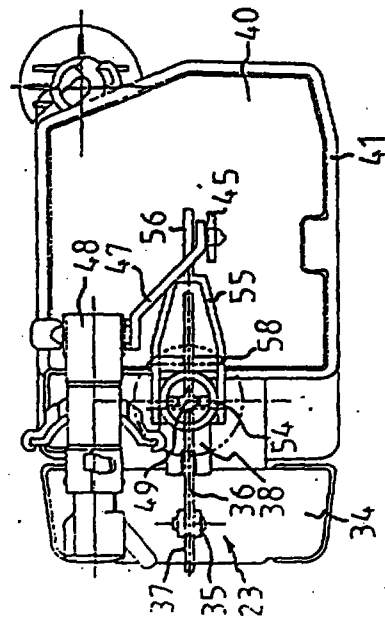


FIG.11

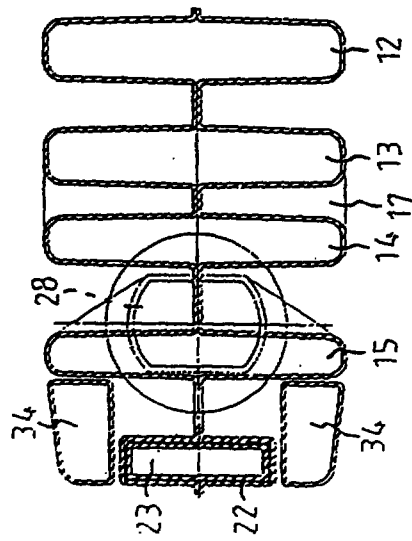
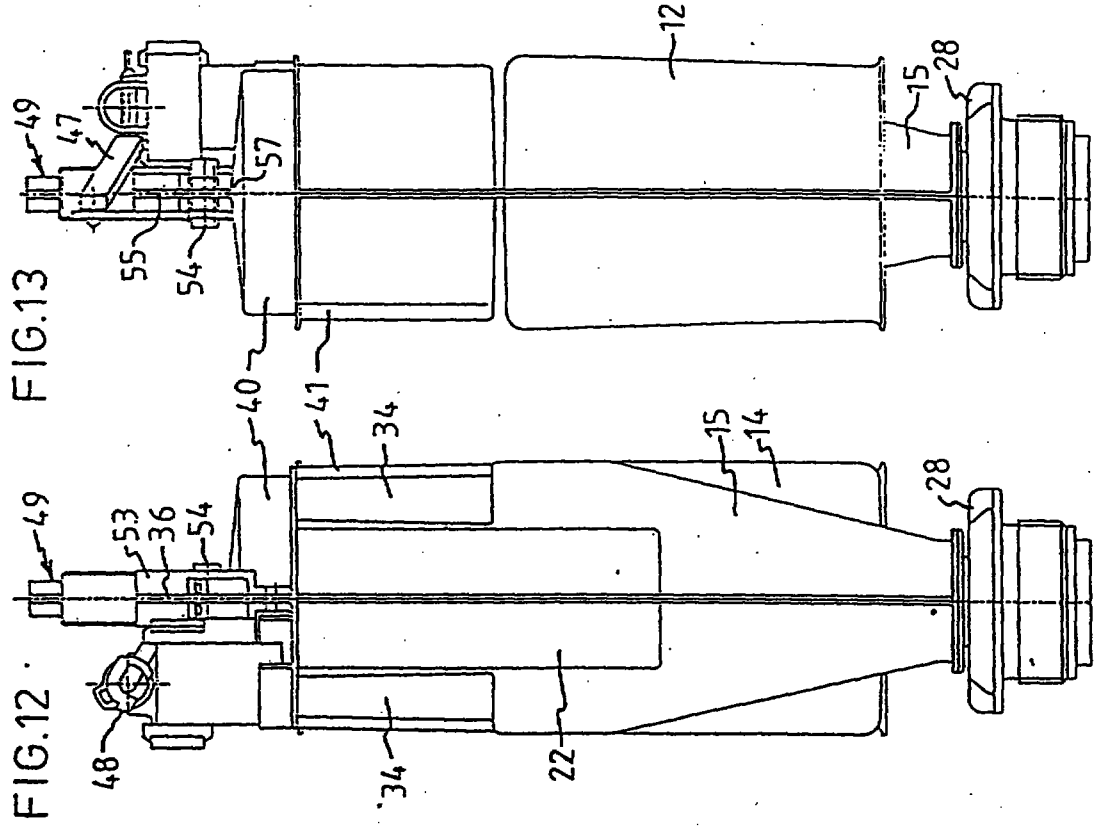


FIG.12

FIG.13



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FIG.14

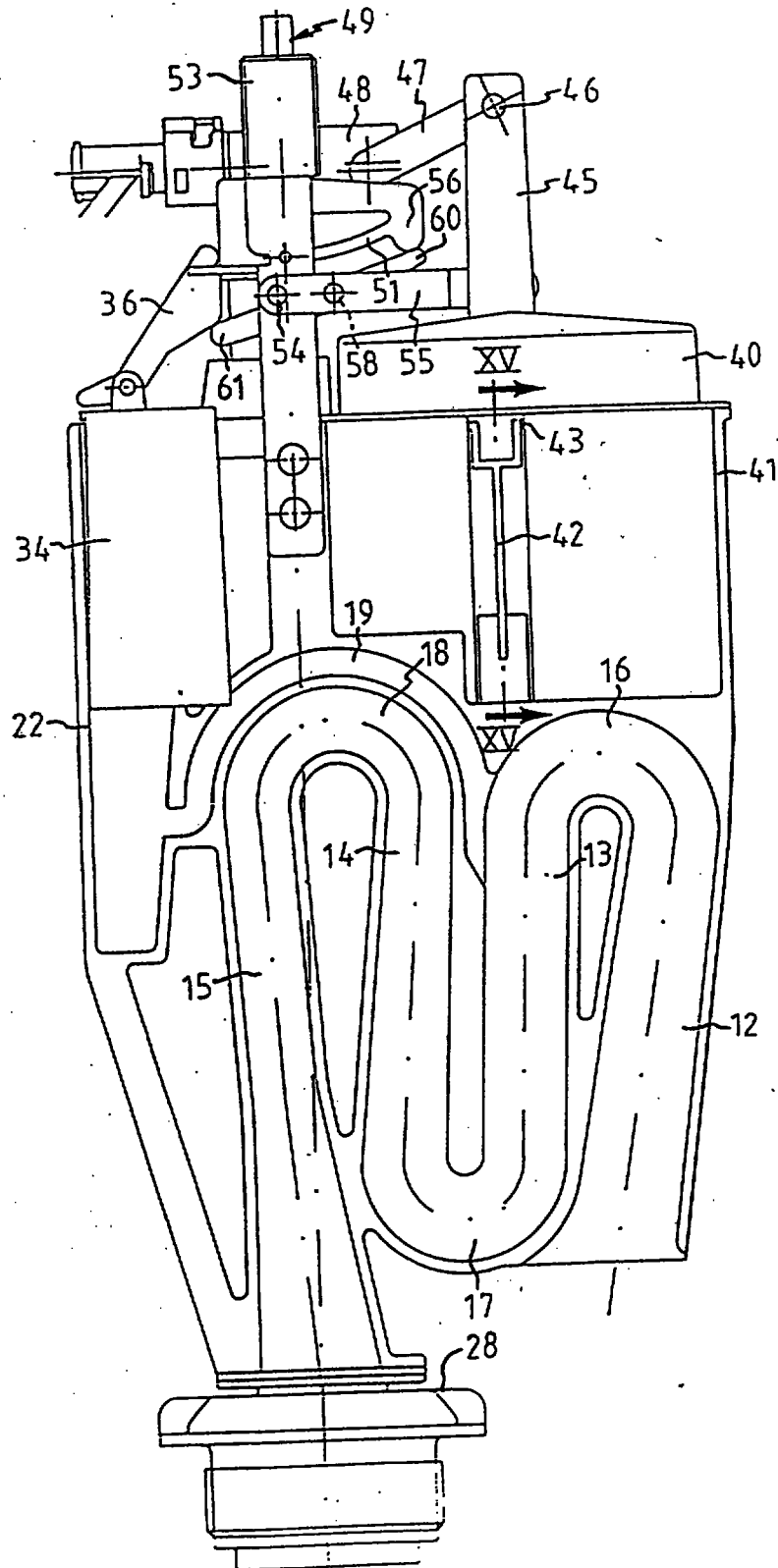
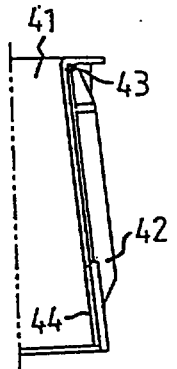


FIG.15



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FIG.16

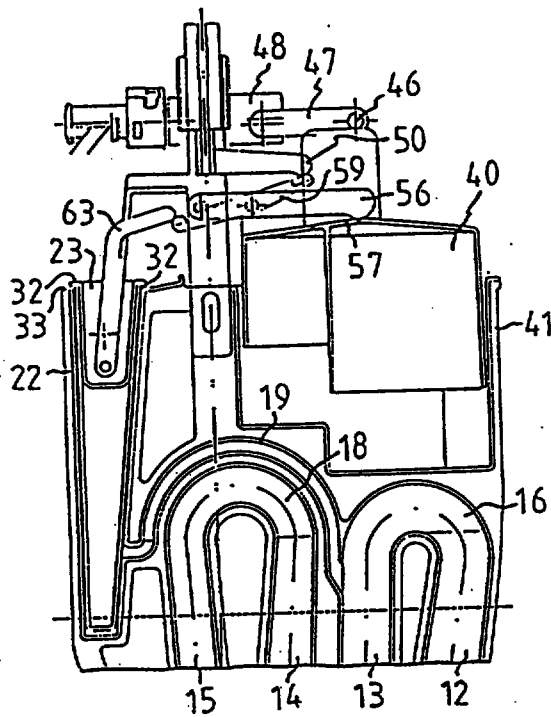


FIG.17

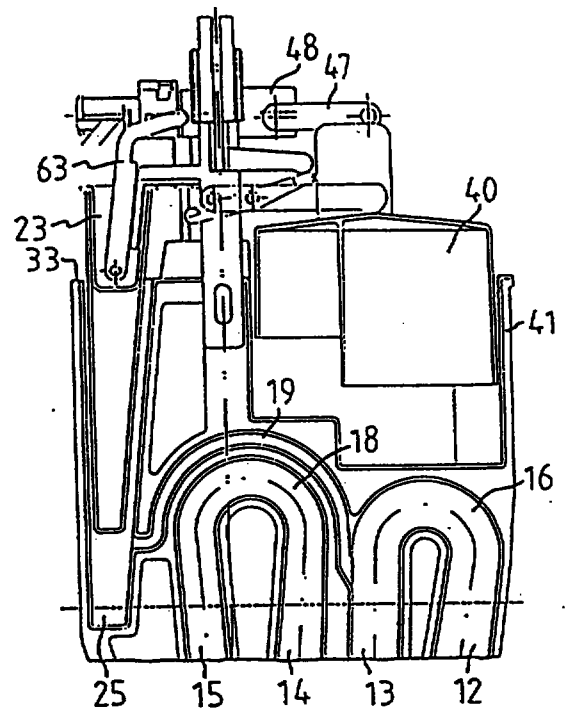
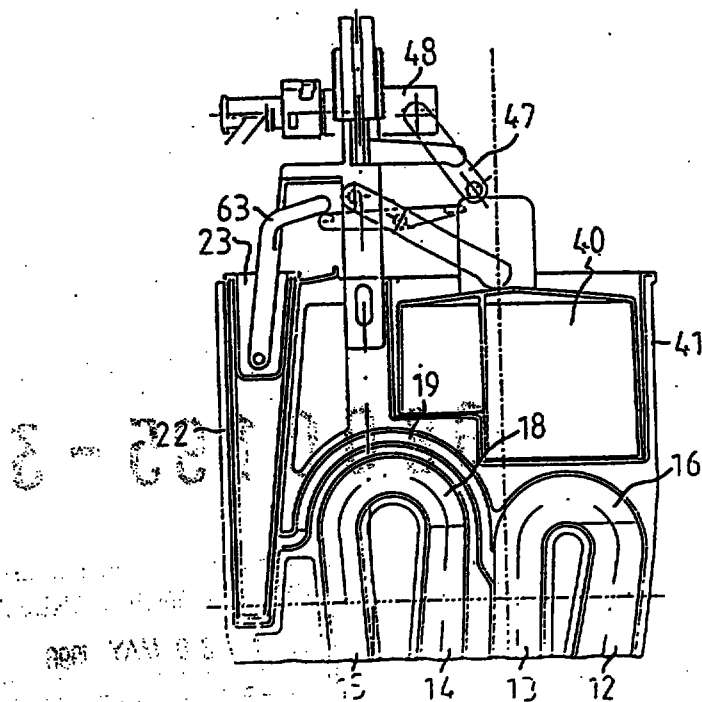


FIG.18



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