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(54) Flush control apparatus

(57) The present invention relates to an apparatus to be used for flushing a toilet bowl. The invention simplifies current apparatuses and allows stepless adjustment of the flush water amount, for instance by means of the opening period of an electrically controlled inlet valve (12), without opening the cover of the water tank (1). The supply water pressure, the float member (2) and the force of gravity are utilised to control the movement of the piston member (4) in the chamber (5) communicating with the mains, this movement, in turn, controlling the movement of the outlet valve (15), thus regulating the flush water amount. The level of the water surface (3) in the water tank (1) is monitored by means of any device or method. An electric sensor (11), for instance, can be used for this purpose.

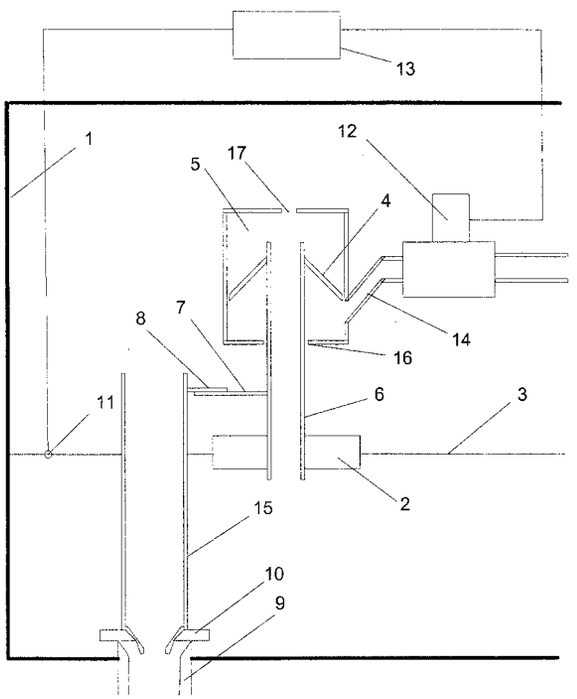

Fig. 1

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Description

[0001] This invention relates to an apparatus used for flushing a toilet bowl or the like. The apparatus controls the amount of water used for flushing which enters the water tank through a valve from the water mains and is discharged through the discharge pipe.

[0002] The operation of current systems involves the control of the water level in the tank by means of two separate apparatuses. The inlet valve is opened each time the water level sinks below a determined level and allows additional water to enter the tank from the water mains, until the predetermined water level is reached, whereby the valve is closed. The water level is monitored and the inlet valve is opened and closed mechanically by means of a float. To control the water level and consequently the amount of flush water used, the cover of the water tank must be removed and the operation of the float controlled.

[0003] The discharge valve is mechanically opened in that the user acts to release either one or both of the superposed pair of floats controlling the discharge function. This method allows regulation of the flush water in a larger or smaller amount and reduction of unnecessary water consumption. Yet there are only two options of water amounts to be used. As the water level has sunk in the tank to the level adjusted by the float, the end of the discharge pipe is closed and the tank starts filling again.

[0004] The object of the present invention is to provide an apparatus for use in the flushing of a toilet bowl or the like, which provides stepless and easy adjustment of the amount of flush water, without opening the cover of the WC water tank, even with different water amounts each time the bowl is flushed, if desired. This enables the amount of water used for flushing to be crucially decreased on the long term. This has been achieved in accordance with the invention in the manner described in the accompanying independent claim 1.

[0005] The valve apparatuses used in the conventional solutions mentioned above comprise a relatively large number of components. In this invention, the control apparatus provided in the toilet water tank has been significantly simplified. Besides a device used for turning on and off supply water, for instance a solenoid valve, the apparatus comprises a substantially smaller number of movable parts than commonly known solutions. This reduces the need for service of the interior of the water tank appreciably.

[0006] In addition, operation controlled by a solenoid valve, for instance, can be remote-controlled from some other location. Owing to this concept, it is possible to ensure that a public toilet, for instance, has always been flushed before it is used next.

[0007] The apparatus for flushing a toilet bowl of the invention is characterised by electric control of the amount of water used for flushing and of stepless adjustment of the flush water amount as a function of the flushing period, using one single control valve. The control valve may be any electrically controlled valve, for instance a solenoid valve, and the stepless adjustment of the flush water amount is performed electrically from the outside of the water tank, using any commonly known electric control unit used in valve control. The electric control equipment allows the toilet bowl to be flushed by remote control and the amount of water in the tank to be identified by an electric sensor, for instance.

[0008] The invention is described below with reference to the accompanying drawings, in which

figure 1 shows a full water tank ready for flushing,

figure 2 shows the water tank during flushing,

figure 3 shows the water tank while it is being filled and

figure 4 shows a second embodiment of the invention, in which a chamber has been disposed around the discharge valve.

[0009] Figure 1 shows the apparatus of the invention, which consists of a water tank 1, an inlet valve 12, a discharge valve 15 and an actuator means. The actuator means consists of a chamber 5, which may be e.g. circular, rectangular or square in cross-section. However, it is preferably cylindrical. The chamber 5 communicates with the water mains over an inlet pipe 14. The inlet pipe 14 is preferably oriented obliquely downwards, but it may also be horizontal.

[0010] A substantially vertical shaft 6 preferably passes through the bottom of the chamber. The shaft is preferably a hollow cylinder, through which water can flow. On the other hand, it may also be a solid body, and then water can flow to the chamber and be discharged from there through an opening in the top of the chamber 5, e.g. in its cover. The chamber contains a piston member 4, which is fastened to the shaft and ascends and descends under the action of the amount of water and the dynamic pressure of supply water. The piston member 4 consists e.g. of a plate-like part, which encloses the shaft 6 as a collar, and is preferably oriented obliquely downwards. If desired, the piston member 4 may also be horizontal relative to the shaft, or shaped in any other suitable way. The piston member 4 extends from the shaft to the vicinity of the wall of the chamber 5 so as to leave a gap between the edge of the plate-like part of the piston member and the inner surface of the chamber, allowing for free movement of the piston part within the chamber.

[0011] A float member 2 has been fastened to the shaft 6 in order to keep the shaft and the associated piston member 4 floating on the water surface. The float member 2 may be fastened for instance to the bottom part of the shaft 6, as shown in figures 1-3, however,

other kinds of solutions are also conceivable. Below the bottom of the chamber 5, the shaft 6 comprises a counter-part 7, which may be for instance a transverse pin fastened to the shaft or the end of an upwardly continuing vertical groove. The counter-part 7 bears against a counter-part 8 provided at the upper part of the body of the hollow, preferably cylindrical discharge valve 15. The counter-part 8 may be e.g. a transverse pin fastened to the body of the discharge valve, or the end of a downwardly continuing vertical groove. If a pin is used for both the counter-parts 7 and 8, the pins must have the correct shape to make sure that they match. One of them may be round and the other plate-like, for instance. At the lower end of the discharge valve 15, a gasket 10 is provided between the water discharge pipe 9 and the discharge valve. The end of the discharge pipe 9 is opened when the discharge valve is lifted. A water gauge or control based on the opening period of the inlet and outlet valves can be used to control the amount of water in the water tank 1. However, this control is preferably carried out by means of an electric sensor 11.

[0012] In the situation illustrated in figure 1, the water tank 1 is filled with water and ready for flushing. The float member 2, such as a float, is floating on the water surface 3 and the piston member 4 is in central position in the chamber 5, with the lower edge of the collar-like piston member 4 located above the mouth of the water inlet pipe 14. The counter-part 7 in the shaft 6 is pressed against the counter-part 8 of the discharge valve. The counter-part 8 transmits the vertical movement of the float member 2, the shaft 6 and the piston member 4 to the outlet valve 15. The outlet pipe 9 is tightly pressed against the gasket 10 of the discharge valve. The water surface 3 is on the level of the electric sensor 11, and then the inlet valve 12, preferably a solenoid valve, is in closed position.

[0013] Figure 2 illustrates the situation while the water tank 1 is being emptied. When e.g. the flush button of the control unit 13 is pressed, the inlet valve 12 is opened over a pre-set period. Then the dynamic pressure of the supply water from the inlet pipe 14 lifts the piston member 4 into upper position. The counter-part 7 of the shaft is pressed against the counter-part 8 of the discharge valve, while lifting the discharge valve 15 into open position, whereby the water tank 1 is emptied at a rate of about 3 1/s through the outlet pipe 9.

[0014] Figure 3 illustrates the situation while the water tank is being filled. At the end of the set time, the inlet valve 12 is closed, and then the water below the collar-like piston member 4 is allowed to flow out of the chamber space 5 through the gap 16 between the bottom of the chamber space and the shaft 6 of the piston member. The piston member 4 is pressed under the force of gravity into lower position, the lower edge of the collar-like piston part 4 being below the mouth of the water inlet pipe 14, and at the same time, the counter-part 7 is pressed down, releasing the discharge valve 15, which descends and thus seals the end of the outlet pipe 9. After this, the inlet valve 12 is opened again. Supply water flows from the inlet pipe 14 onto the upper surface of the plate-like piston member 4, and the dynamic water pressure maintains the piston member 4 in lower position. Water fills the chamber 5 and flows from the chamber into the water tank 1, preferably through the hollow shaft 6 of the piston member. When a solid shaft 16 is used, the water flow from the chamber 5 to the water tank 1 can be arranged for instance by making the hole 17 large enough in the cover or upper part of the chamber. The inlet valve 12 remains open until the water surface reaches the electric sensor 11, and at that moment, a signal emitted from the sensor to the control unit 13 closes the inlet valve 12. As the water inlet pressure stops, the piston member 4 is allowed to rise back to its central position under the action of the float member 2 provided at the lower end of the shaft 6, and the counter-part 7 in the shaft 6 of the piston member gets into contact with the counter-part 8 of the discharge valve again. The buoyancy of the float member 2 used is dimensioned so as to enable the dynamic pressure of the supply water to keep the piston member 4 in lower position even at the final filling stage.

[0015] Should there be a malfunction in the inlet valve 12 or in the sensor 11 for measuring the water level, the inlet valve 12 remaining in open position, the water surface 3 still does not rise to a level where the floor floods with water. In case that the piston member 4 is in lower position and the dynamic pressure of supply water maintains it in this position, water entering the chamber 5 is allowed to leave through the hollow shaft 6 or the opening 17 in the chamber, and further through the hollow discharge valve 15 to the outlet pipe 9. If the piston member 4 is in central position, it will rise into upper position under the dynamic pressure of supply water, automatically opening the discharge valve 15, through which water may be discharged from the water tank 1 at a higher rate than the rate at which water is supplied from the water mains. If again, there is momentary under-pressure in the mains when the inlet valve 12 opens, the hole 17 in the chamber 5 will act as suction protection, preventing the water in the water tank to be sucked back.

[0016] Figure 4 shows a second embodiment of the invention, in which the chamber 5 is placed around the discharge valve 15. The partial figures A, B and C illustrate the situations of the tank being filled, of the tank ready for flushing and of the tank being flushed, respectively. When the tank 1 is ready for flushing, the piston member 4 is in its central position in the chamber 5, while being kept floating by a float member, for instance a float (not illustrated in the figure) fastened to the lower part of the shaft 6, so that the lower edge of the collar-like piston member is above the mouth of the water inlet pipe 14, as shown in partial figure B. The upper end 7 of the shaft, corresponding to the counter-part 7 in the preceding figures 1-3, is pressed against the counter-part 8 of the discharge valve. The outlet pipe 9 is closed

and the inlet valve is in closed position.

[0017] During flushing, the dynamic pressure of supply water from the inlet pipe 14 raises the piston member 4 into upper position (partial figure C). The counter-part 8 transmits the vertical movement of the shaft 6 and the piston member 4 to the outlet valve 15, which is opened.

[0018] At the end of the set period, the inlet valve is closed, and then the water below the collar-like piston member 4 is allowed to flow out of the chamber space 5 through the gap (16) between the chamber space bottom and the shaft 6 of the piston member (partial figure A). The piston member 4 is pressed under the force of gravity into lower position, the lower edge of the collar-like piston member 4 being below the mouth of the water inlet pipe 14, while the upper end 7 of the shaft is pressed down and releases the discharge valve 15, which descends, thus closing the end of the outlet pipe 9. After this, the inlet vale is opens again. Supply water flows from the inlet pipe 14 to the upper surface of the plate-like piston member 4 and the dynamic water pressure keeps the piston member 4 in lower position. Water fills the chamber 5 and flows from the chamber to the water tank 1 over the edge of the chamber. When the water supply pressure stops, the piston member 4 is allowed to rise back to its central position under the action of the float member fastened to the shaft 6, and the upper end 7 of the shaft of the piston member gets into contact with the counter-part 8 of the discharge valve again.

[0019] The figures and the related disclosure are intended to illustrate the present invention. The details of the flush apparatus may vary within the scope of the inventive idea of the accompanying claims.

Claims

1. An apparatus to be used for flushing a toilet bowl or the like, comprising a water tank (1), an inlet valve (12), a discharge valve (15) and an actuator means, **characterised in that** the actuator means consists of a chamber (5), which communicates with the water mains over an inlet pipe (14), of a substantially vertical shaft (6) passing through the chamber bottom, and fastened within the chamber are a piston member (4), as well as a float member (2) to keep the shaft and the piston member floating on the water surface, and of a counter-part (7) fastened to the shaft (6) and bearing against the counter-part (8) of the discharge valve (15), and of a device (11) for identifying the amount of water in the water tank and for controlling the inlet valve, the flush water amount used when the toilet bowl is flushed being controlled by means of an electrically controlled inlet valve (12), which lets in water from the water mains through an inlet pipe (14) to the chamber (5), where the water raises the piston member (4) and its shaft (6) from central position to upper position, and then the discharge valve (15) is opened by means of the counter-parts (7, 8), remaining open until the inlet valve (12) is closed by the control unit (13) at the end of the set period, and the piston member (4) is pressed down into lower position under the force of gravity, after which the inlet valve (12) is reopened and the water tank (1) is refilled, after which the control unit closes the inlet valve (12), the piston member (4) rising into central position and the counter-part (7) rising into contact with the counter-part (8) under the action of the float member (2).

2. An apparatus as defined in claim 1, **characterised in that** the piston member (4) is a substantially plate-like member, which encloses the shaft (6) like a collar and extends from the shaft to the vicinity of the wall of the chamber (5).

3. An apparatus as defined in claim 1, **characterised in that** the inlet valve (12) is any electrically controlled valve, preferably a solenoid valve, and that the stepless control of the flush water amount is performed electrically by means of an electric control unit (13) apt for valve control.

4. An apparatus as defined in claim 3, **characterised in that** the electric control unit (13) is operated by remote control.

5. An apparatus as defined in any of claims 1-4, **characterised in that** the end of the water inlet pipe (14) is disposed between the lower position and the central position of the piston member (4) such that the dynamic water pressure keeps the piston (4) pressed down in lower position while the water tank (1) is filled and raises the piston (4) into upper position while the water tank (1) is emptied.

6. An apparatus as defined in any of claims 1-5, **characterised in that** the chamber (5) is preferably cylindrical.

7. An apparatus as defined in any of claims 1-6, **characterised in that** the shaft (6) in the chamber (5) is preferably hollow and allows supply water to flow through to the water tank.

8. An apparatus as defined in claim 1, **characterised in that** the upper part of the chamber (5) comprises an air intake (17), which acts as suction protection in preventing the water contained in the water tank from being sucked back.

9. An apparatus as defined in claim 1, **characterised in that** the chamber (5) is disposed around the discharge valve (15) and the upper end of the shaft (6) acts as the counter-part (7).

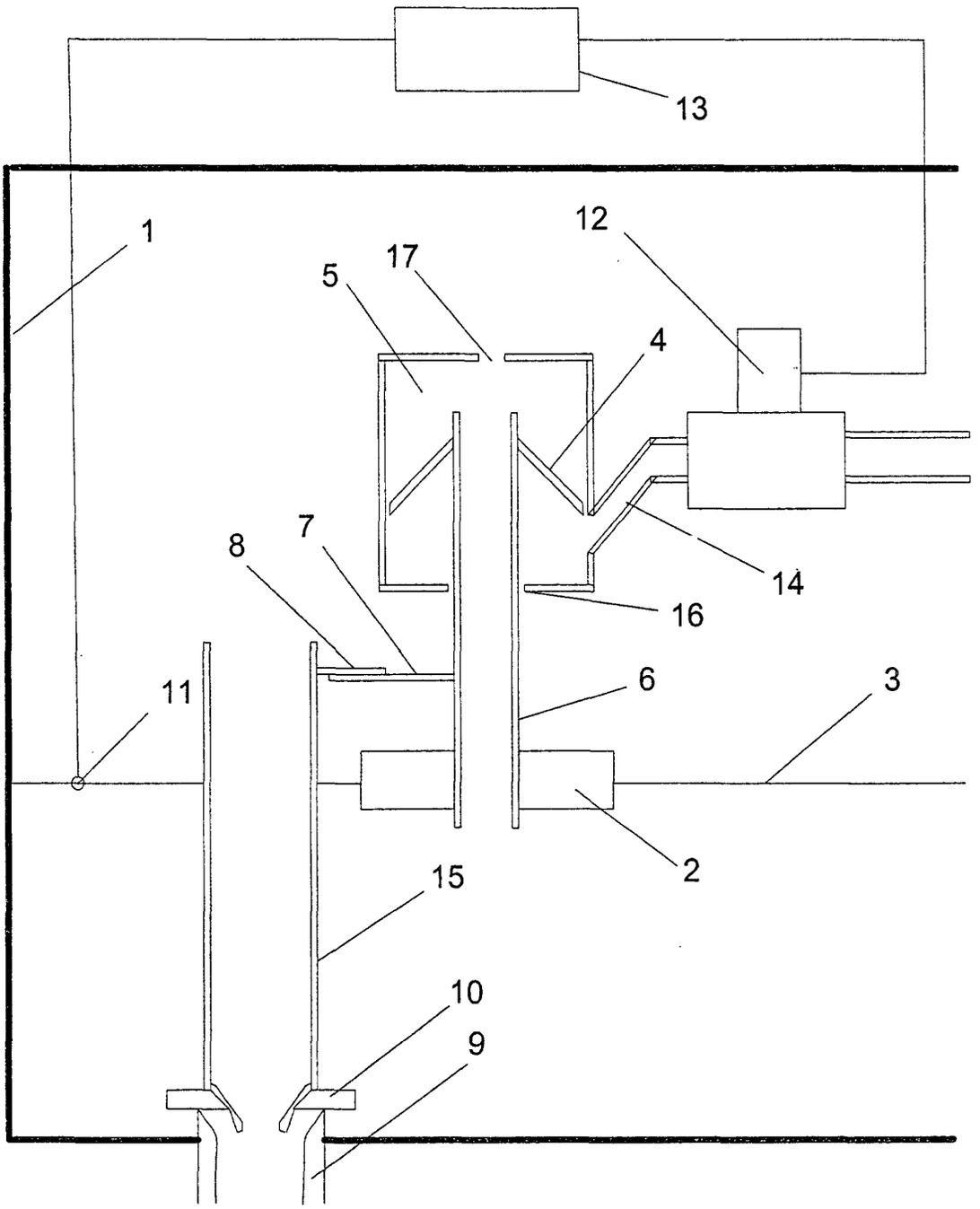

Fig. 1

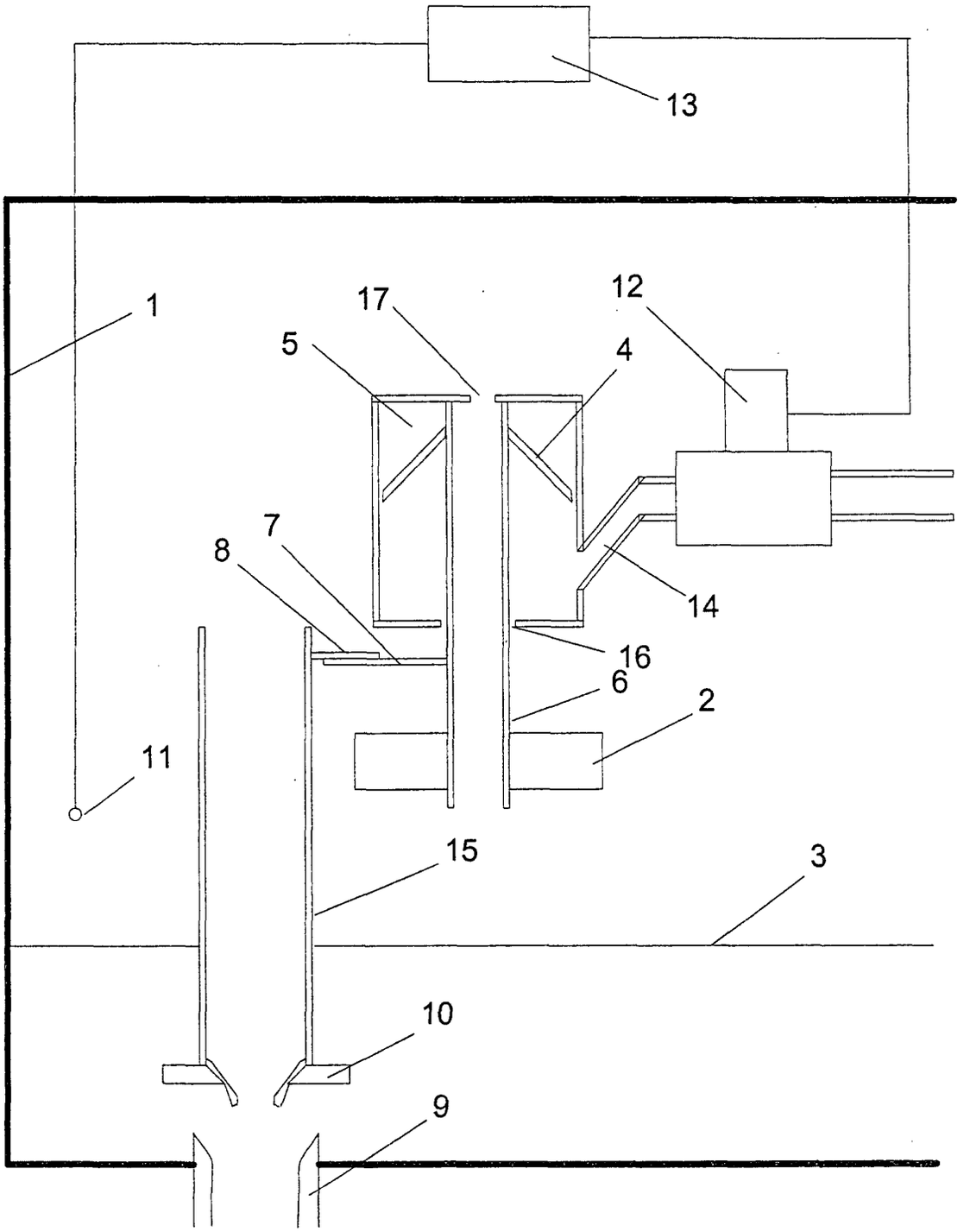

Fig. 2

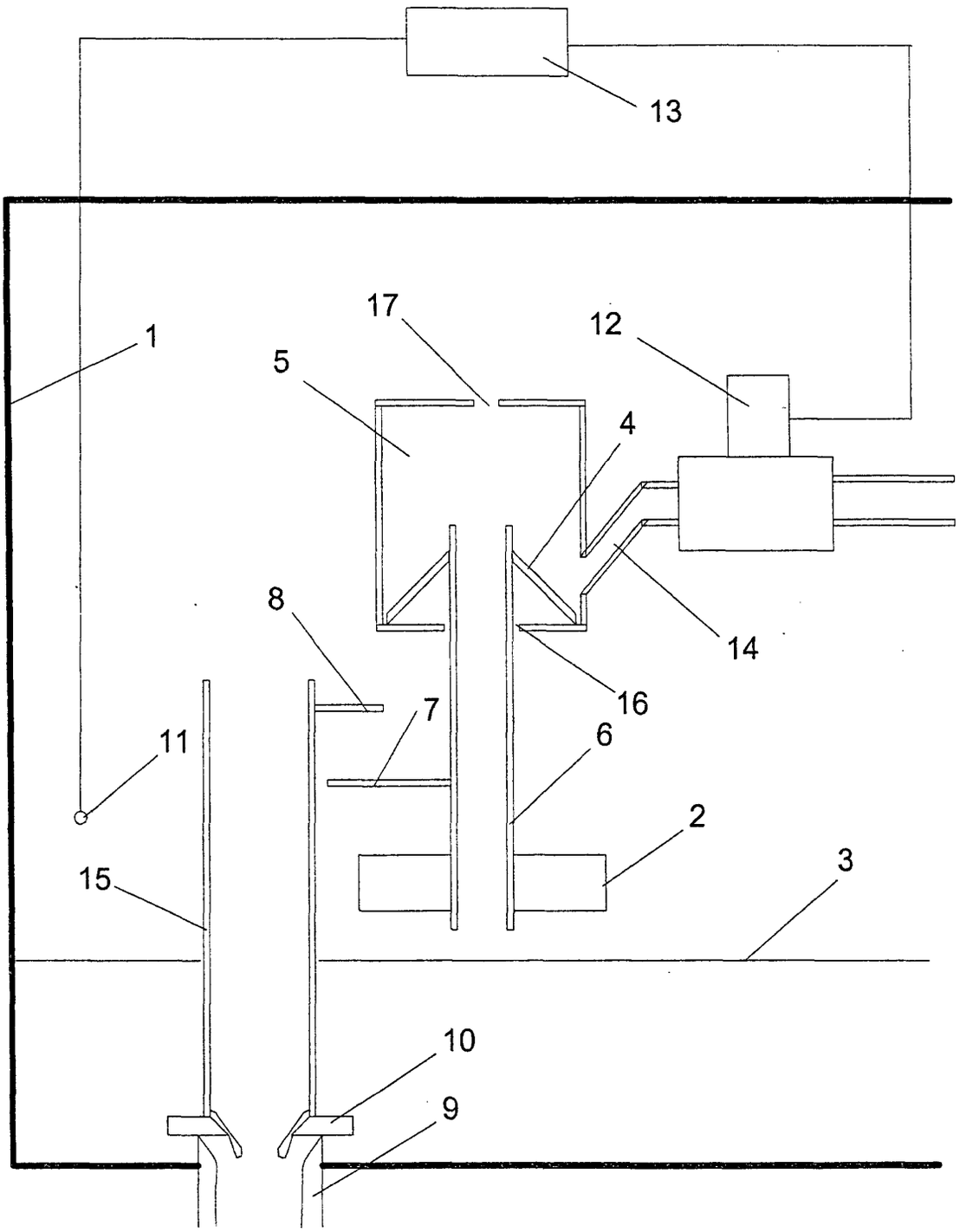

Fig. 3

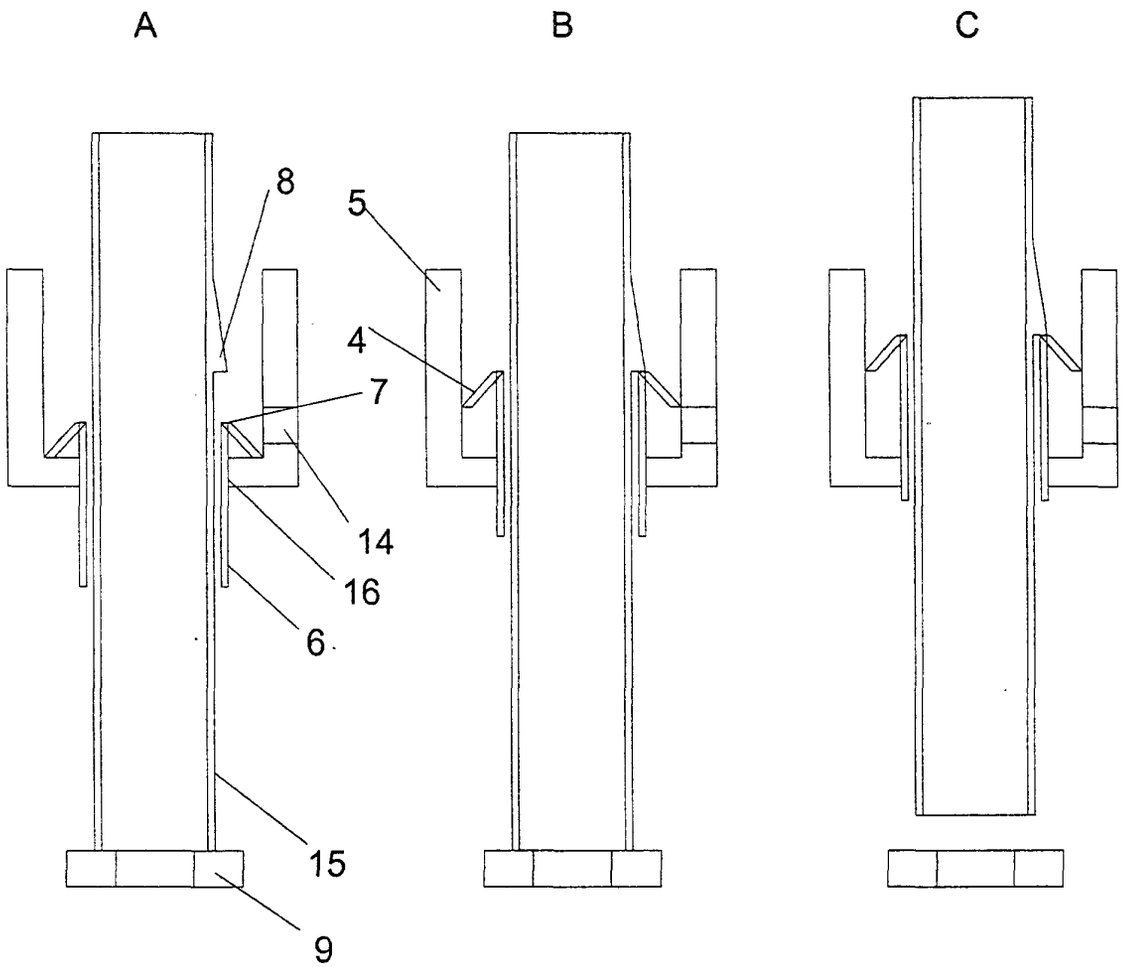

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 01 66 0102

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 937 455 A (DONATI WILLIAM R) 17 August 1999 (1999-08-17) * column 3, line 58 - line 65; figure 10 *	1	E03D5/10 E03D1/36 E03D1/30

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	13 September 2001	Ellis, D

CATEGORY OF CITED DOCUMENTS

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13-09-2001

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