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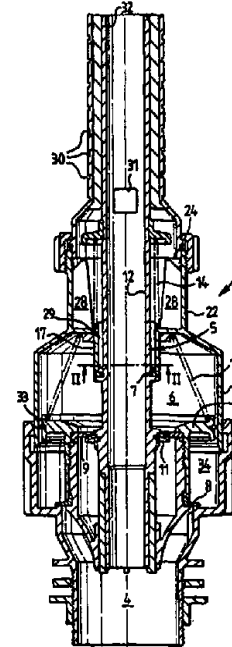
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(54) Title: DISCHARGE VALVE APPARATUS

(57) Abstract

The invention relates to discharge valve apparatus for immersion in and discharge of fluid, usually water, from a cistern (not shown) comprising a housing (2), a valve means or piston (3) in the housing (2) for co-operation with an outlet (4) from the housing (2) to prevent flow of fluid from the housing (2) and being movable to open the outlet (4) for flow of fluid therefrom, a pilot valve (5) which is operable to open a free flow between a chamber (6) of the housing (2) and the outlet (4) and means (7) to provide passage of ambient air to the chamber (6), the arrangement being such that with a passage of air being maintained, hydrostatic forces acting on the underside of the valve reduce in proportion to the fluid level fall so that as the fluid falls to a desired level the weight of the valve (3) exceeds the upwards forces whereby to allow the valve to descend and close the outlet (4).



DISCHARGE VALVE APPARATUS

The invention relates to a discharge valve apparatus and is primarily intended to provide a light action, easily operable, fast flowing valve for emptying or partly emptying cisterns and other types of liquid storage containers. It is particularly, although not exclusively, applicable to being used to reduce the amount of water used for flushing domestic lavatories or W.C.s.

For a great many years flushing lavatories, pans and bowls have been in existence, and the W.C. in one form or another, is common-place in most modern homes round the world. With the conventional low flush or close coupled W.C. cistern and pan, the means for achieving the flush consists either of a siphon (which at present for the U.K. is still the only acceptable device that meets the water byelaws), or a non-siphon type valve as used extensively on the Continent of Europe and elsewhere in the world.

These non-siphon or direct type valves generally have a valve plate or member which covers and seals the outlet to prevent water from escaping unintentionally. Both the siphon and the direct type flush valve have a threaded outlet pipe which extends downwards through the bottom of the cistern into which it is fixed by a bulkhead fitting. It is then connected to the lavatory pan either directly or by a short length of pipe.

With the sole means of flushing or cleaning the pan being the water discharge from the cistern, the effectiveness of the flush is mainly dependent on flow rate. Most siphons do not have a good flow rate and require a considerable amount of water to achieve a satisfactory flush; moreover they are sensitive to changes in water level setting and most do not perform satisfactorily below

a medium level setting. With some siphon installations, the flow rates are so low that in some cases more than one flush is necessary.

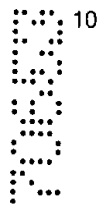
Non-siphon valves generally achieve greater flow rates. The kinetic energy of the water in the pan approximately doubles for a 50% increase in flow rates, so less water is required for an effective flush. Indeed, the performance of most U.K. lavatory pans could be considerably improved by replacing the siphon with a direct discharge valve. Some existing installations in the U.K. and elsewhere would accommodate even higher flow rates than are generally available with existing flush valves. For new installations, by designing the galleries and contours of the pan and cistern in conjunction with a high performance non-siphon flush valve, the quantity of water required for effective flushing could be substantially reduced.

When the valve is operated in a short flush mode, only 1.5 - 2.0 litres of water is generally required.

Known discharge valve apparatus is usually suitable for use on medium and high performance W.C. pans, but are not so efficient on low performance pans because water rises inside a hollow pilot valve stem thereby preventing air from entering above a valve thereof in a short flush mode. This then prevents a desired rapid re-seating of the piston so that a short flush cannot satisfactorily be obtained, with concomitant waste of water.

Accordingly it is an object of the invention to seek to provide a fluid outlet valve to enhance the performance of W.C.s, particularly low efficiency W.C.'s

According to an aspect of this invention there is provided discharge apparatus for discharge of a fluid in a cistern, comprising a housing, a valve in the housing for cooperation with an outlet from the housing to prevent flow of fluid from the housing and being movable to open the outlet for flow of fluid therefrom, a pilot valve which is operable to open a free flow between a chamber of the housing and the outlet, and an annular passage between the pilot valve and the housing which puts the chamber into communication with the ambient atmosphere when the pilot valve is open, the arrangement being such that with such a passage of air being maintained, hydrostatic forces acting on the underside of the valve reduce in proportion to the fluid level fall so that as the fluid falls to a desired level the weight of the valve exceeds the upward forces whereby to allow the valve to descend and close the outlet.



In the specification the term "comprising" shall be understood to have a broad meaning similar to the term "including" and will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps. This definition also applies to variations on the term "comprising" such as "comprise" and "comprises".



This provides a relatively simple construction and assembly.

The annular passage may be exteriorly of a stem of the pilot valve. This provides for a compact construction, particularly where the intermediate annular passage may terminate at a seal of the pilot valve in one operating position.

The annular passage may be defined by a boss which is concentric with the stem. This provides for ease of movement of the pilot valve, particularly where there may be guide means for the stem associated with the annular passage.

The guide means may comprise a plurality of ribs or splines extending longitudinally of the passage. This construction provides a positive guiding



action.

The splines may be carried by the boss, and for preference of construction may be formed integrally with the boss.

There may be means to limit the stroke of the pilot valve. This provides for ease of operation, the means preferably comprising a plurality of webs adapted to operate with a collar of the pilot valve stem.

There may be five webs equiangularly spaced round the pilot valve stem. This provides for positive limitation of the stroke of the pilot valve.

There may be an overflow pipe secured to the housing by a coupling nut and seal arrangement.

The overflow pipe may have means to provide a desired length thereof. This provides for a varying overflow capacity, particularly where the means may comprise a plurality of notches or zones of weakness spaced apart over the length of the overflow pipe, and which may allow that pipe to be cut to a desired length. This provides for ease of adjustment of the length of the overflow pipe.

Discharge valve apparatus is hereinafter described, by way of example, with reference to the accompanying drawings.

Fig. 1A to 1D show respectively and schematically four operational steps for discharge of fluid in a cistern by apparatus according to the invention, the four Figs. showing different operational stages during a short flush operation

to discharge water from a cistern in which the discharge valve apparatus is installed; and

Fig. 2 is a transverse cross-section on the line II-II of Fig. 1A.

Referring to the drawings there is shown discharge valve apparatus for immersion in and discharge of fluid, usually water, from a cistern (not shown) comprising a housing 2, a valve means or piston 3 in the housing 2 for cooperation with an outlet 4 from the housing 2 to prevent flow of fluid from the housing 2 and being movable to open the outlet 4 for flow of fluid therefrom, a pilot valve 5 which is operable to open a free flow between a chamber 6 of the housing 2 and the outlet 4 and means 7 to provide to provide passage of ambient air to the chamber 6, the arrangement being such that with a passage of air being maintained, hydrostatic forces acting on the underside of the valve reduce in proportion to the fluid level fall so that as the fluid falls to a desired level the weight of the valve 3 exceeds the upward forces whereby to allow the valve to descend and close the outlet 4.

The valve 3 is shown in its normal (unflushed) state, there being annular seals 8, 9 which seal the outlet 4 against flow of water, the weight of water keeping the seals water-tight, the seal 8 bearing on a rib 10 of the housing and the seal 9 on an annular rib or shoulder 11 projecting from a hollow stem or centre column 12 of the pilot valve 5. There is a means in the form of a spring 13 urging the valve 3 to the Fig. 1A position, and a means in the form of a compression spring 14 urging the pilot valve 5 to the Fig. 1A position, the compression spring 14 bearing between an annular upper (as viewed) shoulder seal 15 of the stem and an annular land 16 at the top of the housing 2 and which forms a roof of the housing, the land 16 extending downwardly,

inwardly of the housing to provide a cylindrical boss 17 which bears on an annular seal 18 on an intermediate shoulder 19 of the stem 12. The spring 13 bears between the underside of the land 16 and the top of the valve 3, there being respective shoulders 20, 21 to keep it in place.

The boss 17 is spaced from the stem to provide a passage which in turn provides means for allowing air to pass from the ambient atmosphere through space 21, defined by an upper extension 22 of the housing 2, to the chamber 6 in use. The upper extension 22 of the housing 2 provides a seating for an overflow tube 23 which is mounted on top of the extension via a seal 24 and by a releasable coupling nut 25 which is screwed into a thread at the top of the extension and tightens down by a flange 26 which bears on a rib or flange 27 of the overflow tube 23.

There are in the space 21 means to limit the stroke of the pilot valve in the form of a plurality of webs 28, in the embodiment five, which are integral with the extension 22 and land 16 and have an upper surface which in the Fig. 1A position is engaged by the shoulder seal or collar 15 of the pilot valve stem.

There is in the annular space 7 defined between the boss 17 and the pilot valve stem 13 guide means for that stem, the guide means being in the form of ribs or splines 29 (in the embodiment four ribs), which are integrally formed with and project from the boss 17 and whilst providing clearance for reciprocation of the pilot valve stem 12, nevertheless guide it so that it does not cant during movement.

The overflow pipe 23 is notched as shown by a series of spaced annular

notches 30 or at least areas of decreased wall thickness and hence areas of weakness so the overflow height can be set by cutting the pipe 23 at a desired notch or area of weakness to provide a desired length of tube. Any water overflowing into the tube 23 escapes through aperture 31 (one of which is shown) in the valve stem 12 and hence through the outlet 4. The upper (as viewed) part 32 of the pilot valve stem is at least flush with the top of the overflow pipe 23 so that the operating mechanism is always accessible.

In use, in the Fig. 1A condition, with the valve 3 seated and the cistern filled, the valve is kept in the seated condition mainly by net downward hydrostatic forces acting on the upper annular area between the pilot stem 12 and the land 16 of the upper housing, the valve 6 being sealed in the housing by a centring ring 33. Other downward forces are due to water pressure on the seal 8, the weight of the valve 6 and a small amount of initial compression from the spring 13. The only upward force on the valve 6 in the seated condition (Fig. 1A) is due to the water pressure acting on the underneath of the valve in the annular space 34. The pilot valve stem 12 does not act as a contributor to these forces, as it is maintained in the closed position by the compression spring 14 acting on the land 16.

In order to operate the apparatus 1 to provide a reduced or short flush mode whereby the water level falls to a level 'L' - 'L' (Fig. 1D) the pilot valve stem 12 is depressed for a few seconds, usually 2 - 3 seconds to provide a depression of about 8.00 mm as shown in Fig. 1B. This action separates the end of the boss 17 and the seal 18 enabling air to be drawn from the ambient atmosphere through the overflow space 35 past the water 28 in the upper part of the housing 22 and down the outside of the pilot valve stem 12 into the chamber 6 above the valve 3. The valve 3 is raised by the hydrostatic

pressure, against its own weight and the pressure of the spring 13 (Fig. 1C) until that hydrostatic pressure is balanced by the head of water at the level 'L' - 'L', the valve then being raised fully in the embodiment by 30mm. Water flows out through the outlet 4, but there is no water to obstruct continuous flow of air into the housing above the valve. When the water reaches the level 'L' - 'L', the weight of the piston and the force of the spring return the valve 3 rapidly to the Fig. 1A condition, so ensuring a short flush operation. The pilot valve stem 12 is returned by the spring 14, the pilot valve 5 being closed by seating of the boss 17 on the seal 18. The stroke of the pilot valve stem 12 is limited by the upper extent of the ribs 28 as shown in Figs. 1B and 1C.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Discharge apparatus for discharge of a fluid in a cistern, comprising a housing, a valve in the housing for cooperation with an outlet from the housing to prevent flow of fluid from the housing and being movable to open the outlet for flow of fluid
- 5 therefrom, a pilot valve which is operable to open a free flow between a chamber of the housing and the outlet, and an annular passage between the pilot valve and the housing which puts the chamber into communication with the ambient atmosphere when the pilot valve is open, the arrangement being such that with such a passage of air being maintained, hydrostatic forces acting on the underside of the valve reduce
- 10 in proportion to the fluid level fall so that as the fluid falls to a desired level the weight of the valve exceeds the upward forces whereby to allow the valve to descend and close the outlet.
2. Apparatus according to Claim 1, the annular passage being exteriorly of a
- 15 stem of the pilot valve.
3. Apparatus according to Claim 1 or Claim 2, the intermediate annular passage terminating at a seal of the pilot valve in an operating position.
- 20 4. Apparatus according to Claim 3, the annular passage being defined by a boss which is concentric with the stem.
5. Apparatus according to Claim 4, wherein there is a guide means for the stem associated with the annular passage.
- 25 6. Apparatus according to Claim 5, the guide means comprising a plurality of splines extending longitudinally of the passage.
7. Apparatus according to Claim 6, the splines being carried by the boss.
- 30 8. Apparatus according to Claim 7, the splines being formed integrally with the boss.



9. Apparatus according to any preceding claim, comprising means to limit the stroke of the pilot valve.

10. Apparatus according to Claim 9, the means comprising a plurality of webs
5 adapted to cooperate with a collar of the pilot valve stem.

11. Apparatus according to Claim 10, there being five webs equiangularly spaced around the pilot valve stem.

10 12. Apparatus according to any preceding claim, including an overflow pipe secured to the housing by a coupling nut and seal arrangement.

13. Apparatus according to Claim 12, the overflow pipe having means to provide a desired length thereof.

15 14. Apparatus according to Claim 13, the means comprising a plurality of notches or zones of weakness spaced apart over the length of the overflow pipe, and which allow that pipe to be cut to a desired length.

20 15. Discharge apparatus for discharge of a fluid in a cistern substantially as herein described in the detailed description of the invention with reference to Figures 1 and 2.

DATED THIS THIRD DAY OF SEPTEMBER 2001.

25 Derwent Macdee Limited

BY

PIZZEYS PATENT AND TRADE MARK ATTORNEYS



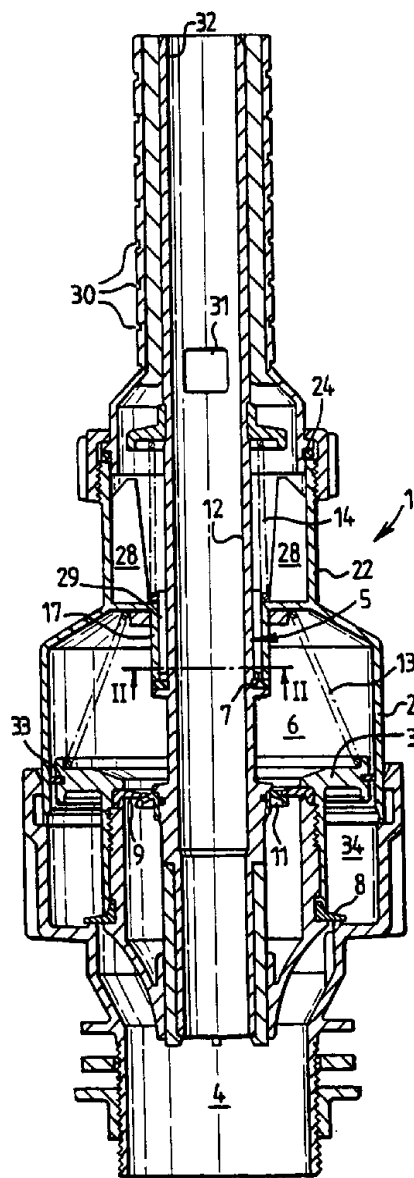


FIG.1A

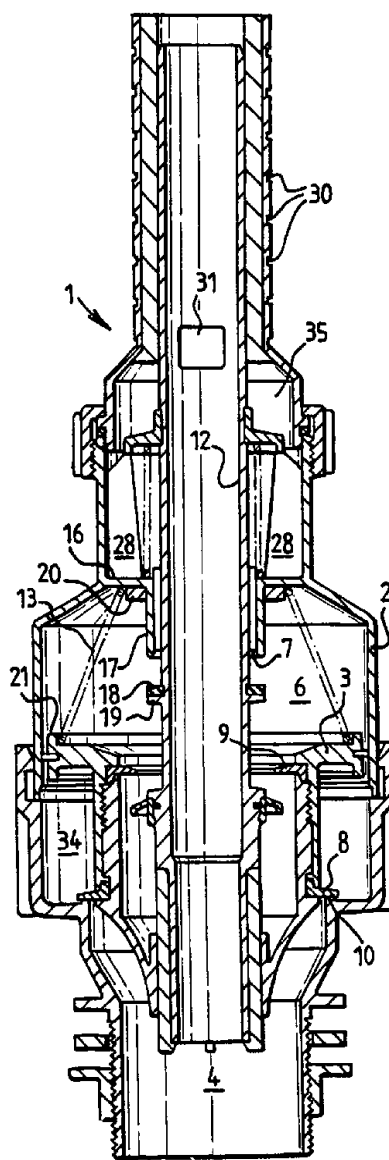


FIG.1B

