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Yen(10) **Pub. No.: US 2006/0196542 A1**(43) **Pub. Date: Sep. 7, 2006**(54) **VACUUM BREAKER**

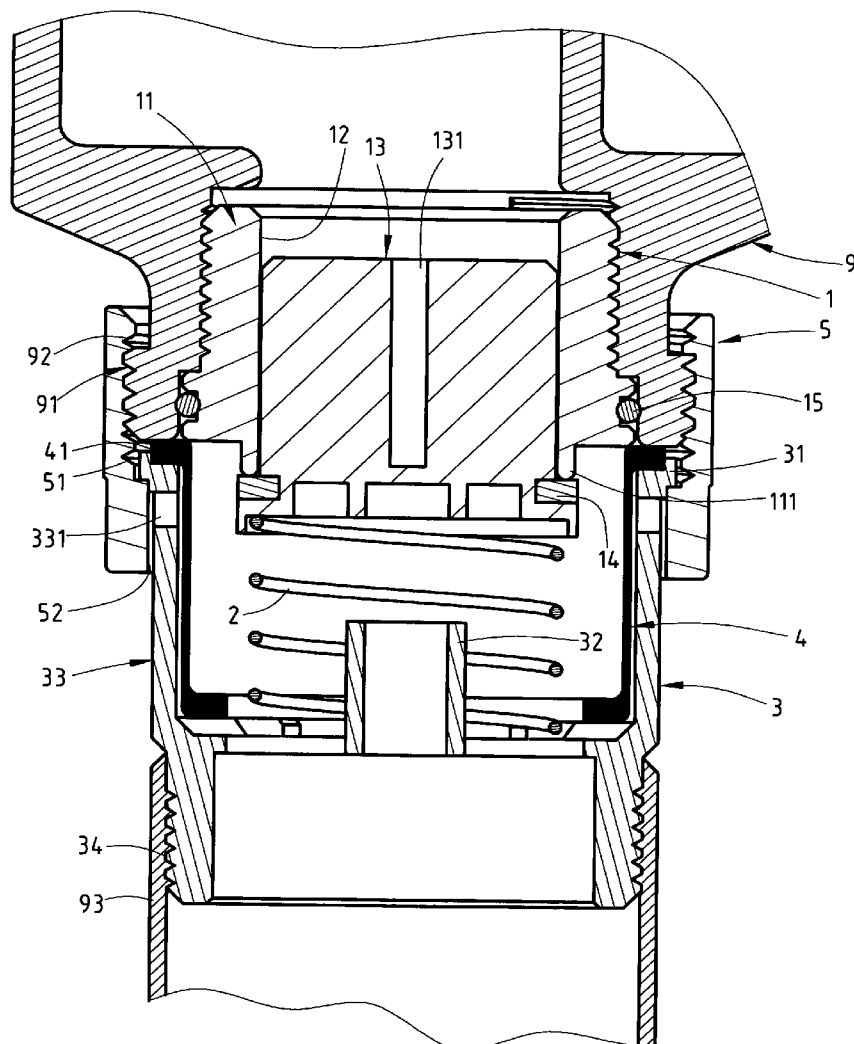
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ABSTRACT(75) Inventor: **Chih-Chen Yen**, Taipei City (TW)

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A vacuum breaker is adopted for use on a water discharge end of a flush valve in a water supply piping system. It includes a valve which has a valve seat with a hollow section to house a plug. The plug is movable up and down under water pressure and a spring on the bottom to actuate flushing or stop flushing. The vacuum breaker further includes a coupling duct and a bushing housed in the coupling duct that is made from a flexible material. The coupling duct has a plurality of apertures near the top end. The outer wall of the bushing and the inner wall of the coupling duct form a gap therebetween. During flushing, the wall of the bushing is expanded outwards under water pressure to close the apertures to stop water overflow through the apertures. When the flushing stops, external air can enter through the apertures and the gap between the coupling duct and the bushing to balance the internal and external pressure and eliminate vacuum, and prevent back siphonage from occurring.



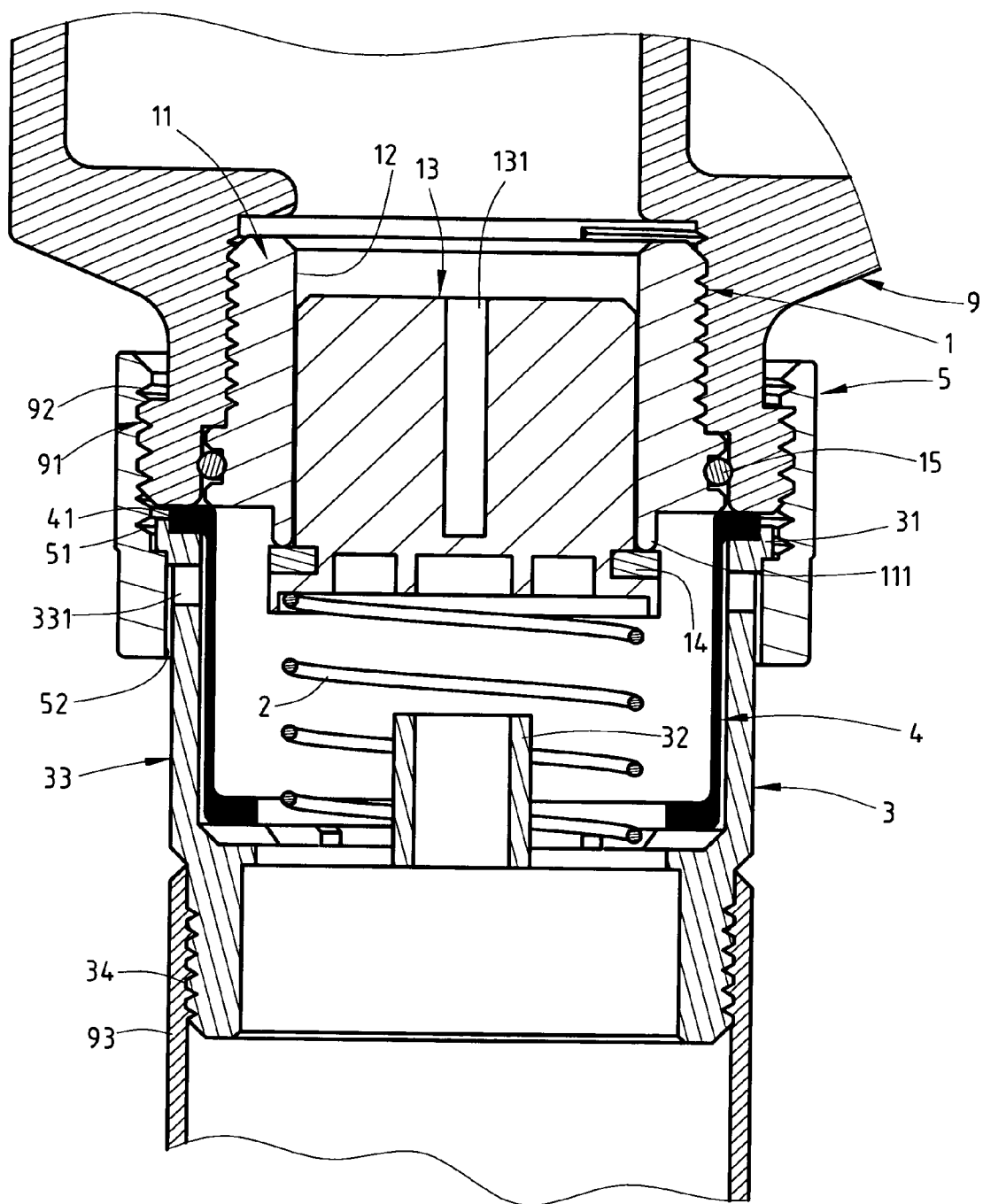


FIG. 1

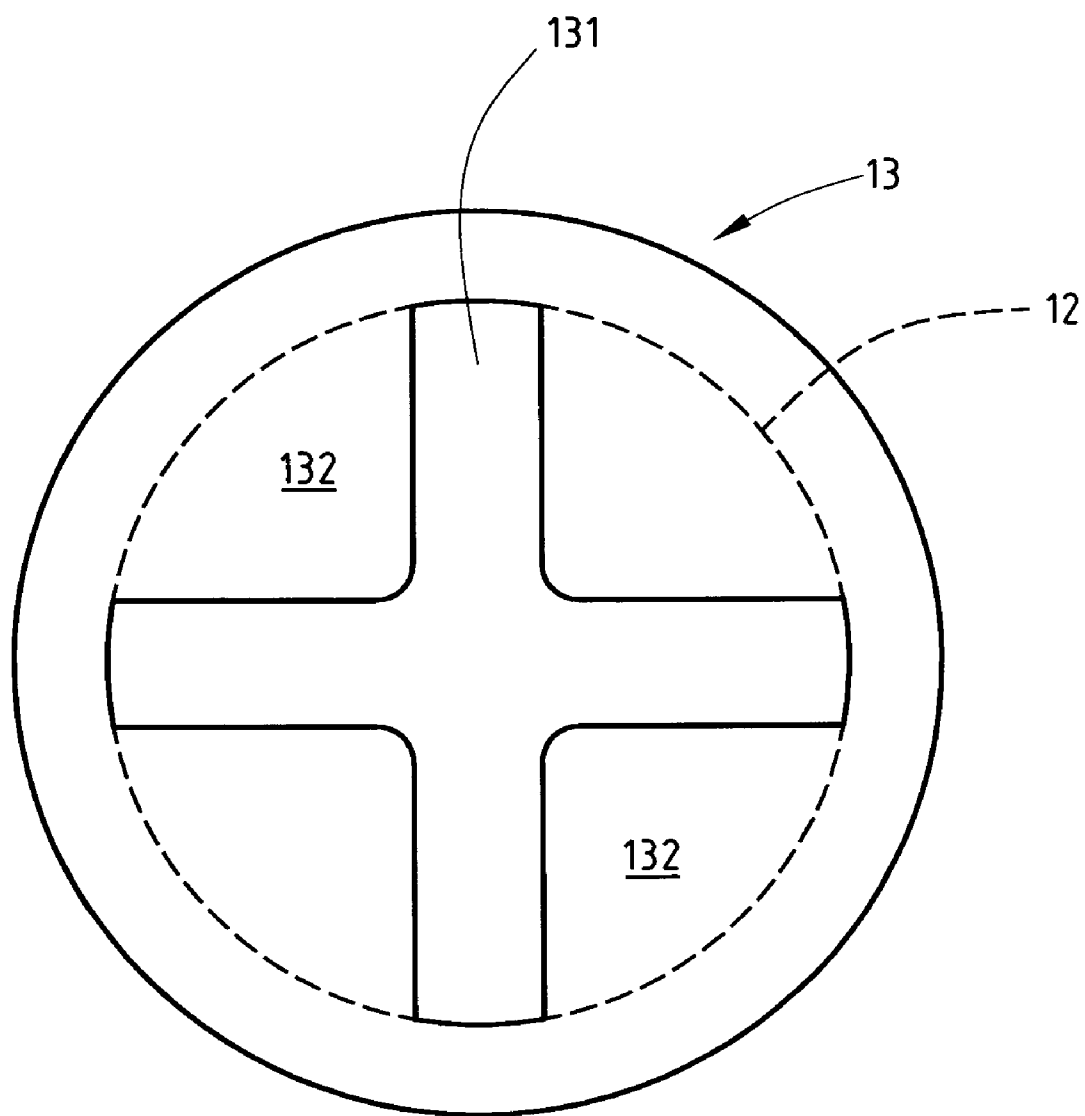


FIG. 2

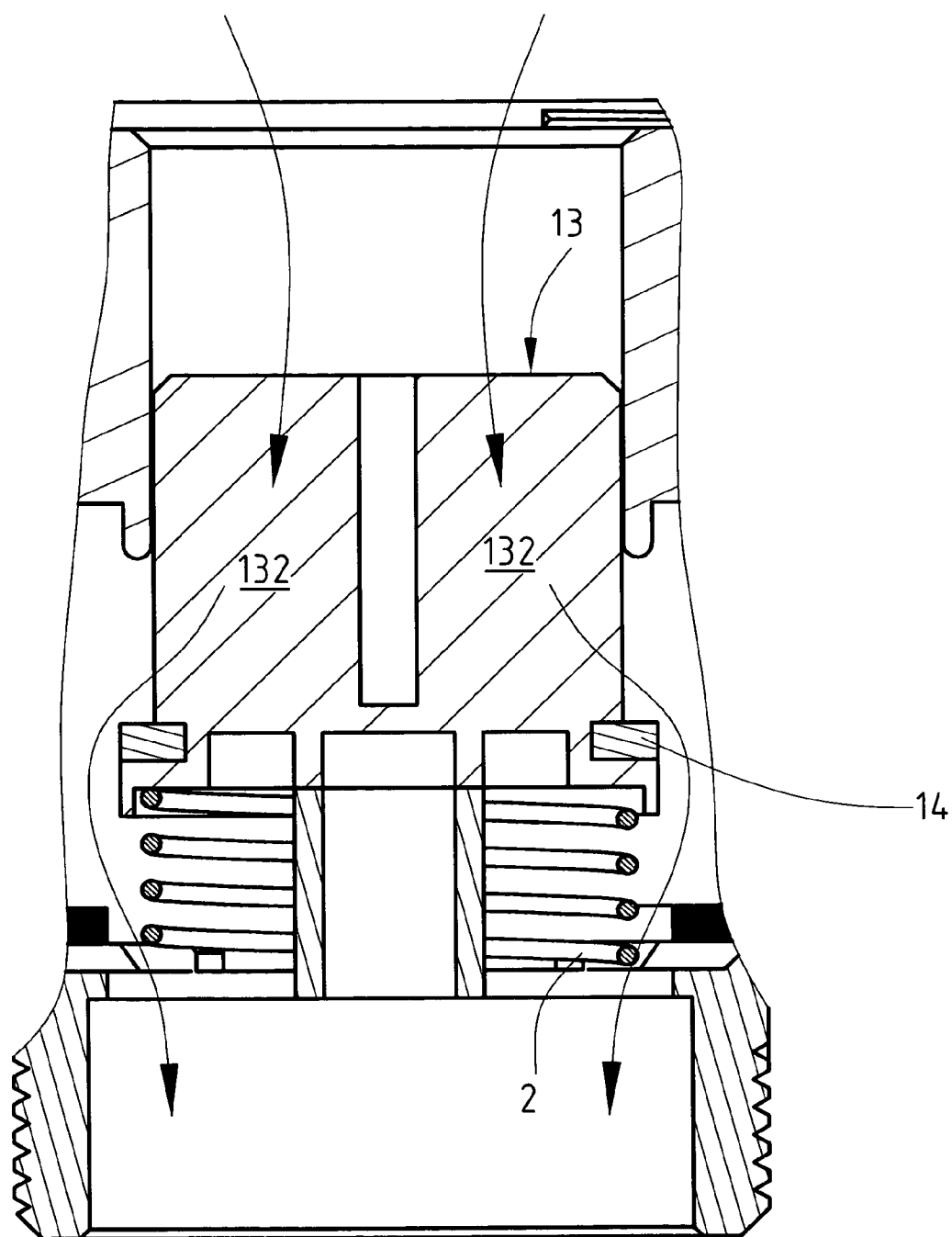


FIG. 3

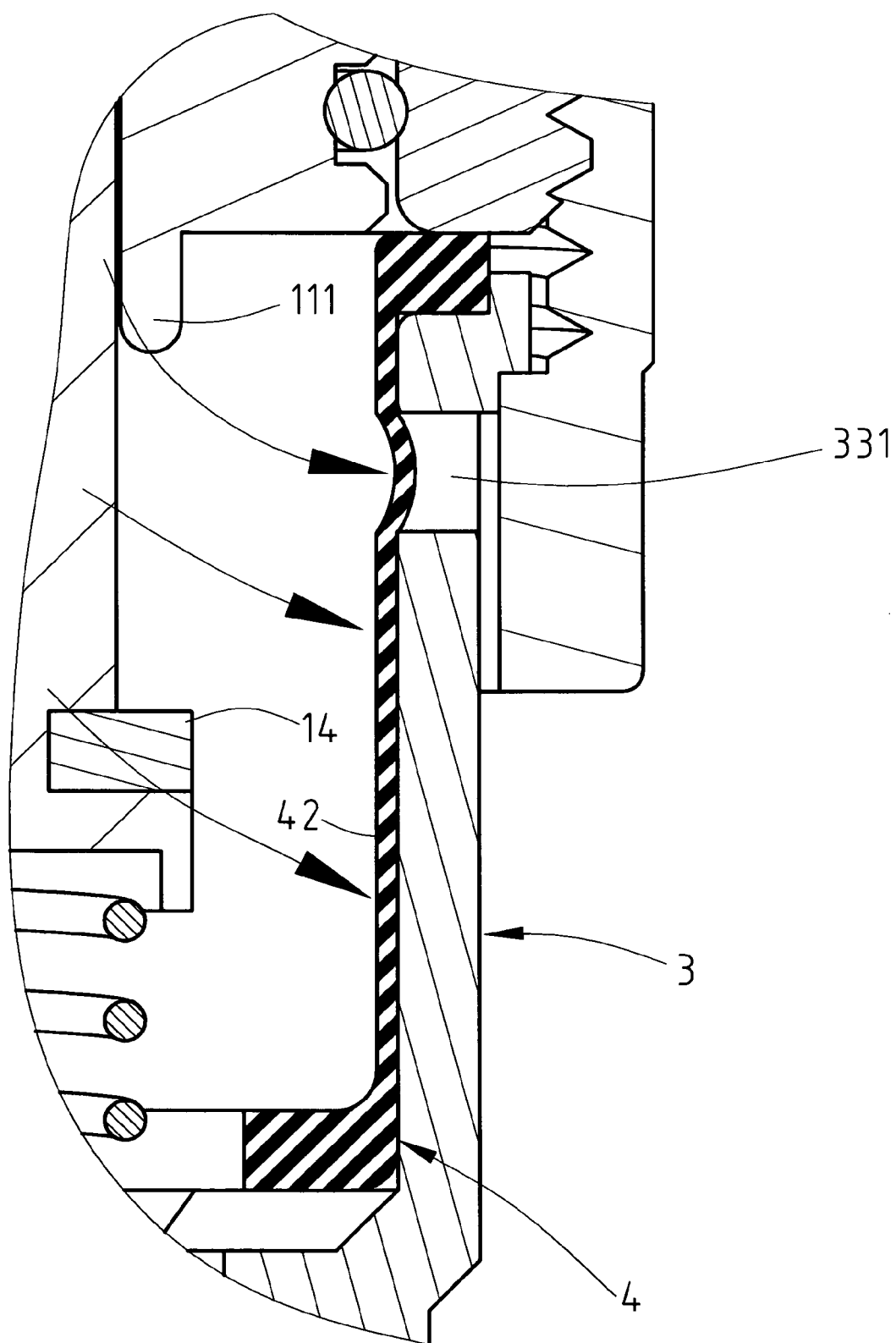


FIG. 4

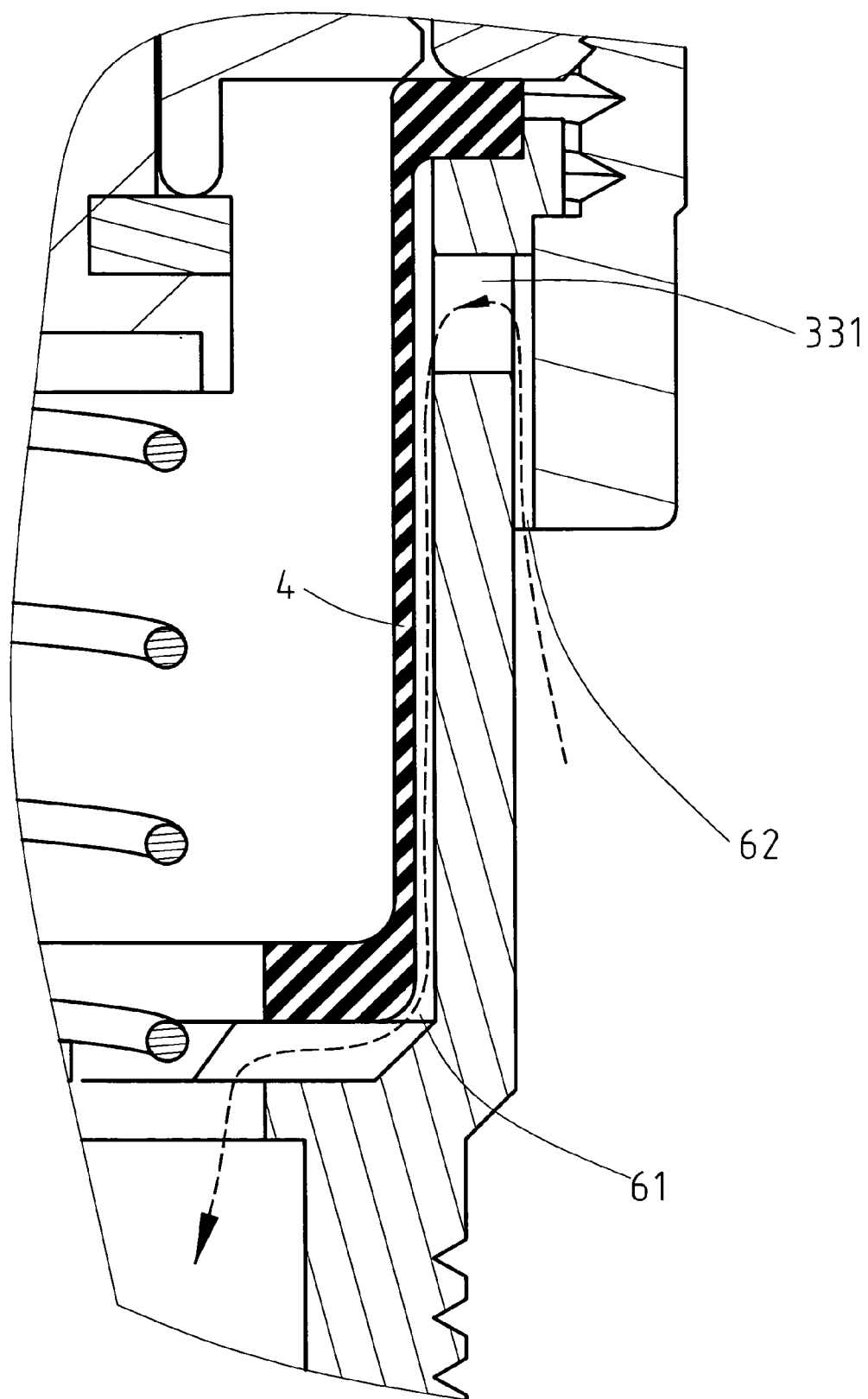


FIG. 5

VACUUM BREAKER

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to a vacuum breaker installed on a water discharge water end of a flush valve of toilet devices to eliminate vacuum in the flush valve through a plug which may return automatically and a flexible and deformable bushing and prevent sewage from counter flowing and contaminating clean water.

[0003] 2. Description of the Prior Art

[0004] Vacuum breaker is installed in a discharge tube of a flush valve to prevent back siphonage from occurring to the toilet or urinal that would result in counter flow to contaminate clean water. Conventional vacuum breakers such as those disclosed in U.S. Pat. Nos. 3,334,646 and 5,564,460 mainly have a flexible bushing with a discharge end temporarily open under the pressure of flushing water and closed after the flushing finishes. Moreover, the bushing wall will be expanded outwards during flushing to close air outlets of the water discharge tube to prevent water from overflowing through the air outlets. The air outlets and the flexible bushing function jointly to prevent the back siphonage in the water supply piping system. The conventional structure set forth above eliminates the vacuum mainly through material characteristics of the bushing which opens and closes automatically under varying water pressure. However, when fatigues or damage occurs to the material after used for a period of time, response and control become not accurate, and sewage could counter flow through the not closely sealed bushing and contaminate drinking water.

SUMMARY OF THE INVENTION

[0005] The primary object of the present invention is to provide a vacuum breaker which has a rigid mechanism to actuate opening and closing of flushing to overcome the disadvantages occurred to the conventional vacuum breakers that cannot flush normally due to material fatigue.

[0006] Another object of the invention is to provide a vacuum breaker to eliminate the vacuum in the piping to prevent back siphonage from occurring.

[0007] In order to achieve the foregoing objects, the vacuum breaker according to the invention is installed on a water discharge end of a flush valve. It includes a valve, a spring, a coupling duct, a bushing and a nut. The valve has a valve seat screwed on the water discharge end of the flush valve, and has a hollow section housing a plug which is movable up and down. The plug is coupled with a retaining ring on the bottom and seals the bottom end of the valve seat when flushing stops. The coupling duct and the bushing are coupled on the water discharge end of the flush valve below the valve through the nut. The coupling duct has a first flange on the top end and a plurality of apertures on the wall below the first flange. There is a gap between the outer wall of the coupling duct and the inner wall of a distal end of the nut, and between the inner wall of the coupling duct and the outer wall of the bushing. The bushing is made of a flexible material and formed in a barrel with two open ends. It can be deformed as desired under water pressure. The spring has one end pressing the bottom of the plug and other end coupled on a strut in the coupling duct.

[0008] By means of the construction set forth above, during flushing, the retaining ring on the lower side of the plug is moved downwards under water pressure to compress the spring. When the flush valve stops flushing, the elastic force of the spring pushes the plug upwards and the retaining ring seals the bottom end of the valve seat to prevent sewage in the toilet devices from counter flowing to the clean water. Moreover, during flushing, water passes through the bushing and forms a pressure on the wall of the bushing, and presses the flexible wall partly outwards to contact the inner wall of the coupling duct and seal the apertures of the coupling duct. Hence water does not over flow through the apertures. In addition, when flushing is stopped, water pressure on the wall of the bushing is absent, and outward deformation of the bushing does not take place, hence the apertures remain open, and external air can flow into the vacuum breaker through the apertures and the gap between the inner wall of the coupling duct and the outer wall of the bushing to balance the internal and external pressure of the vacuum breaker and eliminate the vacuum, and the back siphonage that might otherwise occur.

[0009] The foregoing, as well as additional objects, features and advantages of the invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] **FIG. 1** is a sectional view of an embodiment of the invention in a non-flushing condition;

[0011] **FIG. 2** is a top view of an embodiment of the plug of the invention;

[0012] **FIG. 3** is a schematic view of an embodiment of the invention in a flushing condition;

[0013] **FIG. 4** is a schematic view of an embodiment of the invention in an operating condition to eliminate vacuum; and

[0014] **FIG. 5** is a schematic view of an embodiment of the invention in an operating condition to prevent counter flow.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] Refer to **FIGS. 1 and 2** for an embodiment of the vacuum breaker of the invention. It is installed on a water discharge end **91** of a flush valve **9**. It includes a valve **1**, a spring **2**, a coupling duct **3**, a bushing **4** and a nut **5**. The valve **1** has a valve seat **11** screwing in the water discharge end **91** of the flush valve **9**. The bottom of the valve seat is coupled with an O-ring **15**. The valve seat **11** has a hollow section **12** to house a plug **13** which is movable up and down. The plug **13** has a bottom coupled with a retaining ring **14** which seals a bottom end **111** of the valve seat **11** when flushing is stopped. The plug **13**, referring to **FIG. 2**, has a cross rib **131** on a upper side forming a plurality of water inlets **132** corresponding to the hollow section **12** of the valve seat **11** so that water flushing from the flush valve **9** passes through the plug and is divided into several water streams to become a more stable water flow. The spring **2** has one end pressing the bottom of the plug **13** and other end coupled on a center strut **32** located in the coupling duct **3**. When the retaining ring **14** is moved downwards under

pressure of the flushing water, the spring is compressed. When flushing stops, the spring releases a returning elastic force to push the plug 13 upwards and move the retaining ring 14 to seal the bottom end of the valve seat 11. The coupling duct 3 has a first flange 31 on the top end with a diameter greater than the body thereof. The flange can be coupled on the bottom end of internal screw threads 51 of the nut 5. The nut 5 is screwed with external screw threads 92 formed on the water discharge end 91 on a lower side of water discharge end 91. The duct wall 33 below the first flange 31 has a plurality of apertures 331. The duct wall 33 and an inner wall 52 at a distal end of the nut 5 form a gap. The coupling duct 3 has a coupling end 34 on a lower side that has external screw threads to be coupled with a water discharge tube 93. The bushing 4 is made from a flexible material and formed in a barrel with two open ends. It can be deformed slightly when subject to water pressure. The bushing 4 has a second flange 41 on the top end which is sandwiched between the bottom of the water discharge end 91 and the first flange 31 of the coupling duct 3 when they are installed by screwing the nut 5. Thus the bushing 4 is housed in the coupling duct 3. The outer wall of the bushing 4 and the inner wall of the coupling duct 3 forms a gap 61 as shown in FIG. 5.

[0016] Refer to FIGS. 3, 4 and 5 for the vacuum breaker of the invention is operating conditions. In the non-flushing condition, the wall of the bushing 4 does not receive water pressure and does not deform outwards, hence the apertures 331 are not sealed. External air can enter through the apertures 331 and the gap 61 into the vacuum breaker as shown in FIG. 5. Therefore the internal and external pressures of the vacuum breaker are balanced, and vacuum does not exist. As a result, back siphonage can be avoided. When the flush valve 9 is flushed manually or under automatic control, water (shown by arrows in the drawings) enters through the water inlets 132 of the plug 13, and water pressure pushes the retaining ring 14 and moves the plug 13 downwards and compresses the spring 2. When the water passes through the bushing 4, it pushes the wall 42 of the flexible bushing to expand a portion thereof outwards to be in contact with the inner wall of the coupling duct 3 to close the apertures 331 of the coupling duct 3. Therefore water does not flow out through the apertures 331, as shown in FIG. 4. On the other hand, when water discharge decreases gradually, water pressure reduces, the returning elastic force of the spring 3 increases and pushes the plug 13 upwards, and finally the retaining ring 14 seals the bottom end of the valve seat 11 to stop flushing. And the sewage at the other end of the toilet devices does not counter flow through the valve 1 to the clean water.

[0017] While the preferred embodiment of the invention has been set forth for the purpose of disclosure, modifications of the disclosed embodiment of the invention as well as other embodiment thereof may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments which do not depart from the spirit and scope of the invention.

I claim:

1. A vacuum breaker adopted for use in a water discharge end of a flush valve in

a water supply piping system, comprising:

a valve having a valve seat screwed on the water discharge end, the valve seat having a hollow section to house a plug which is movable up and down, the plug being coupled with a retaining ring on the bottom thereof;

a coupling duct located below the valve having a first flange on the top end, a plurality of apertures formed on the wall abutting a lower side of the first flange, and a coupling end on a distal end opposing the first flange;

a spring having one end pressing the bottom of the plug and other end coupled on a center strut located in the coupling duct;

a bushing housed in the coupling duct being made from a flexible material and formed in a barrel which has two open ends, and having a second flange on a top end; and

a nut having internal screw threads to screw the coupling duct and the rest elements in the water discharge end of the flush valve.

2. The vacuum breaker of claim 1, wherein the retaining ring seals the bottom end of the valve seat when flushing stops.

3. The vacuum breaker of claim 1, wherein the plug has a cross rib on a upper side to form a plurality of water inlets corresponding to the hollow section of the valve seat to divide water flow.

4. The vacuum breaker of claim 1, wherein the bushing has an outer wall in contact with an inner wall of the coupling duct when flushing stops.

5. The vacuum breaker of claim 1, wherein the coupling duct has an outer wall which forms a gap with an inner wall of a distal end of the nut.

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