

[54] **SUCTION CATHETER**

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[51] Int. Cl.² **A61M 1/00**

[58] Field of Search **128/276-278, 128/350 V, 351; 32/33; 137/625.12, 625.13, 625.4 X, 625.46; 251/210, 301**

[56] **References Cited**

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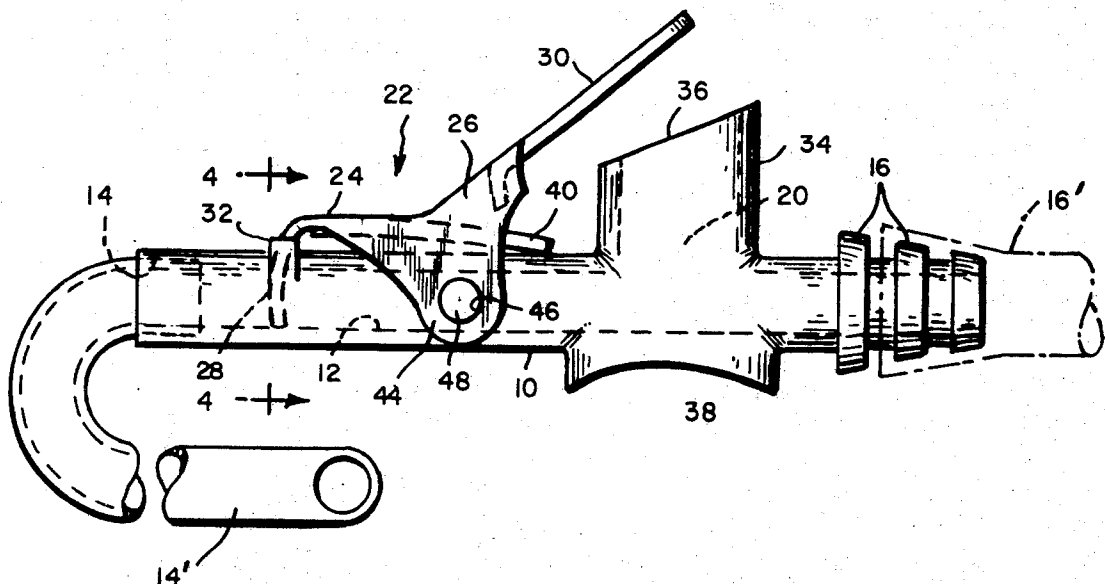
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Primary Examiner—Richard A. Gaudet
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[57] **ABSTRACT**

A suction catheter for surgical evacuation purposes which includes a catheter tube for insertion into a body cavity of a patient and a control valve having an interior passage connected at one end to the catheter tube and at its other end to a flexible suction tube which in turn is connected to a source of vacuum, openings in the valve body intermediate its ends in communication with the interior passage and a spring biased rocker member comprising a gate adapted by engagement within one of the openings to block the passage and thereby cut off the vacuum to the catheter tube and body cavity and a closure lever adapted when moved in engagement with the other opening to simultaneously withdraw the gate from the passage and establish a vacuum through the valve body and in the catheter tube and body cavity.

14 Claims, 4 Drawing Figures



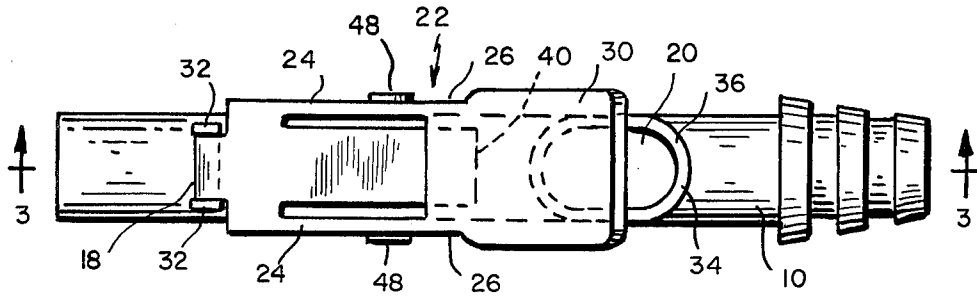


FIG. 1

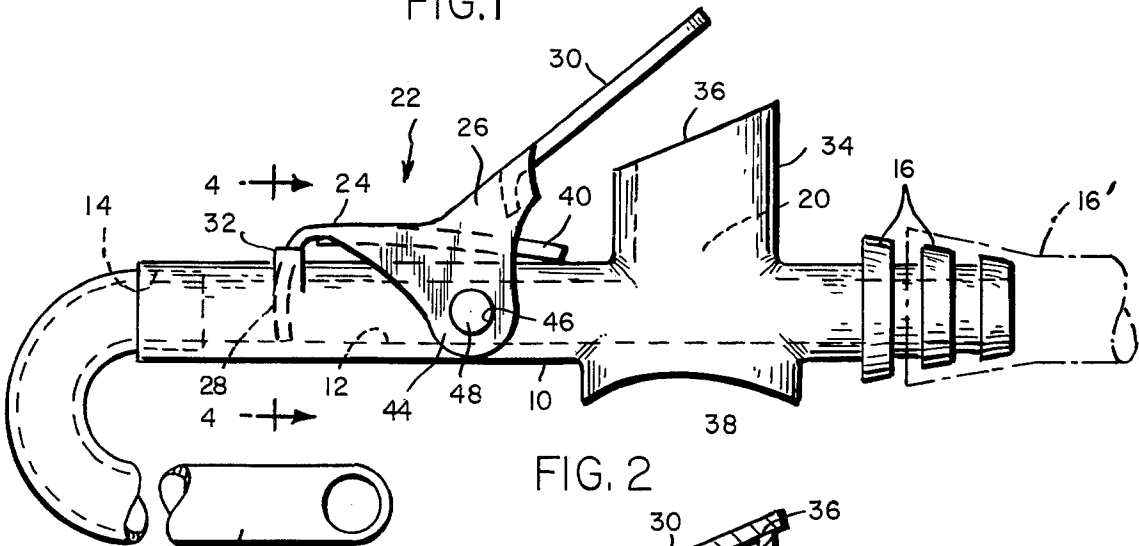


FIG. 2

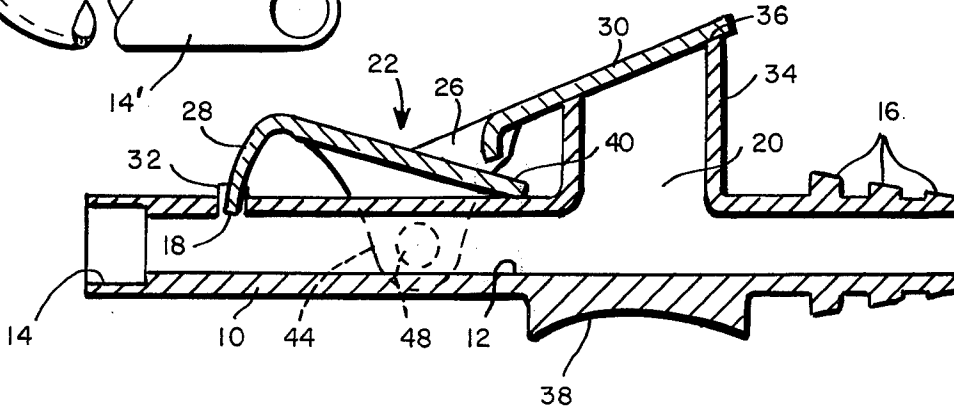


FIG. 3

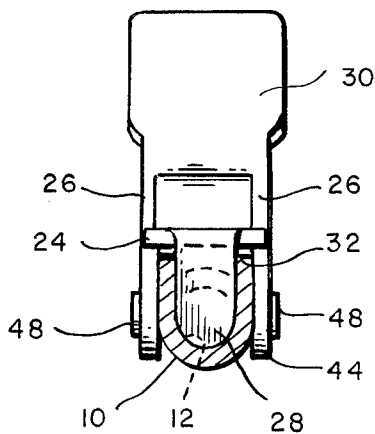


FIG. 4

SUCTION CATHETER

BACKGROUND OF INVENTION

This invention relates to suction catheters, aspirators and evacuators, particularly to suction catheters used for aspirating mucous, blood or other matter from the nose, mouth, pharynx, trachea, bronchi, lungs and other body cavities, e.g. urethra, bladder, kidneys, stomach, etc., of medical patients.

Suction catheters, which consist in essence of a catheter tube connected to a source of vacuum, have long been used to clear mucous, blood clots and other fluids, secretions and materials from the airways and lungs of patients, in order to prevent interference with respiration. Such secretions and mucous are generally caused by the anesthetic administered to surgical patients, by other drugs that have been administered, by infection, or by irritation of the mucosa due to intubation or suctioning. In order to prevent such irritation by the catheter, it has been standard practice to cut off the vacuum by pinching off the catheter and/or by venting the vacuum through a "T" or "Y" tube while the catheter is being inserted into or removed from the patient, and at other times when it is not desired to apply suction to the area.

The use of these standard procedures has been fraught with difficulties. Previous catheters have been difficult to use, requiring the doctor or nurse to use one hand to control or prevent suction, and thus leaving only one hand free to guide the application of the catheter.

In order to minimize the trauma caused by insertion and removal of the catheter, it is most often preferable to leave the catheter in the patient. Catheters with the aforesaid T or Y tubes have been used for this purpose, with one branch of the T tube connected to the source of vacuum, one branch connected to the catheter tube, and one branch vented to the atmosphere. In practice, the doctor or nurse leaves the vent branch open to the atmosphere, and covers it with a finger or thumb only when the application of suction is desired. One difficulty with this system is that even though the source of suction is vented to the atmosphere through one branch of the T tube, a significant amount of suction is still applied through the other branch, and thus through the catheter tube to the patient. Attempts have been made to minimize or avoid this problem, e.g., by providing a much larger vent hole as compared to the branch which leads to the catheter tube, but they have not been totally successful, and fully vented commercially available T tubes still allow from ½ to 4 inches of water vacuum to be applied through the catheter. This amount of suction can seriously impede respiration and thus slow down the recovery process. In some patients having minimal breathing capacity, that level of suction applied over a time may actually be enough to asphyxiate the patient.

Another problem experienced with previous systems is the sudden surge of suction which occurs when the finger is placed over the vent hole or when the pinch is released from the suction tube. Such sudden surges tend to cause the end of the catheter to grab and attach itself to the mucosa or other tissues, rather than removing the fluid. This grabbing effect further traumatizes the tissue, causing hematomas, tissue damage, increased secretion of mucous, and contamination of the aspirated fluid with cellular debris, which may make

clinical tests difficult. Repeated aspirations increase the traumatic effect of these sudden surges in suction.

Another difficulty experienced with the standard T tubes is splashback of the aspirated liquid through the vent hole onto the finger of the doctor or nurse operating the catheter. Such splashback contaminates both the finger and the aspirated liquid. Contamination of the doctor's finger increases the chance of infection and can be very serious, e.g., where the catheter is being used in the operating room. Contamination of the aspirated liquid can significantly interfere with clinical tests to be performed on that liquid.

These and other problems with previous catheter systems have been discussed extensively, e.g. in U.S. Pat. Nos. 3,319,628, 3,375,828, 3,517,669, 3,595,234, 3,625,221 and 3,713,433, which also postulate methods and means for minimizing them. Among the suggested solutions have been various types of control valves for shutting off the suction apertures in catheters, but the proposed valves have not solved all of the problems, especially those connected with the sudden surge of suction. In addition they are inconvenient to use, complicated and expensive to manufacture, difficult to keep in sanitary condition and not entirely reliable, and have not gained general professional acceptance.

It is therefore an object of the present invention to provide a suction catheter which obviates the need for clamping or pinching when being inserted into a body cavity. It is a further object to provide a suction catheter which prevents the application of any suction at the end of the catheter until and during the precise time the suction is desired. It is a further object to provide an indwelling catheter which does not cause hypoxia when not being used for aspiration. It is a further object to provide a catheter which does not give a sudden surge of suction when the vacuum is applied. It is a further object to provide a suction catheter which prevents the possibility of contamination of the person operating through the vent port, and at the same time prevents the possibility of contamination of the liquid being aspirated. It is still a further object to provide a catheter having all of these advantages, which is extremely easy to operate, and is so simple and inexpensive to manufacture that the entire catheter can be disposable after its use, thus obviating the necessity of cleaning and sanitizing the catheter structure.

These and other objects and advantages will be apparent upon consideration of this disclosure, or upon practicing the invention disclosed herein.

SUMMARY OF INVENTION

The catheter of the present invention comprises a flexible catheter tube and a control valve having a hollow body containing an elongate interior passage, one end of the valve body being adapted to be connected to a source of suction, e.g. by means of a flexible suction tube. The hollow body contains axially spaced openings intermediate its ends, which are in communication with the interior of the passage. A control member, preferably a rocker member, is mounted (preferably pivotally) on the valve body, and comprises a gate portion (gate) arranged to enter one of the openings and block off or close the passage, and a closure portion (a closure lever in the case of a rocker member) arranged to be moved into engagement with the other opening, preferably by pivotal movement of the control

member, to close the other opening and simultaneously withdraw the gate from the passage. Means are provided for yieldably biasing the control member in a direction to normally hold the gate in the closed position and to hold the closure portion out of engagement with said other opening. The opening for receiving the gate is preferably located at the end of the valve which is connected to the catheter tube, and thus to the area to be evacuated, and the other opening connects or vents the passage to the atmosphere and normally has a larger cross sectional area than that of the passage. In the preferred embodiment where the control member is a pivotally mounted rocker member, a finger cradle is provided diametrically opposite the vent opening to the atmosphere to facilitate pressing the closure lever into engagement with that opening and a valve seat is provided around the vent opening having a flat sloping rim with which the closure lever is adapted to be engaged. The rocker member is pivotally mounted on the valve body between the openings and has angularly disposed limbs at the ends of which are respectively the gate and closure lever. The means for biasing the rocker valve to said closed position comprise a cantilever applied leaf spring fixed to, and preferably integral with, the limb mounting the gate, with its distal end yieldingly engaged with the valve body. Preferably the entire structure is comprised of a non-metallic, moldable plastic material which is resistant to corrosive action and bacterial refuge.

The invention will now be described in greater detail with reference to the accompanying drawings, wherein:

FIG. 1 is a top view of the valve part of the catheter;

FIG. 2 is an elevation;

FIG. 3 is a vertical section taken longitudinally of the device on line 3—3 of FIG. 1, and

FIG. 4 is a transverse section taken on the line 4—4 of FIG. 2.

Referring to the drawing, the valve comprises a body 10 containing an interior longitudinally extending passage 12. The ends of the valve body are adapted to be connected to conventional flexible catheter tube 14', and thus to the part to be evacuated, and to a suction tube 16' which in turn is connected to a source of suction (not shown). One end of the valve contains an enlarged recess 14 for snugly receiving the end of the catheter tube 14', and the other end has series of annular ribs 16 of decreasing diameter for receiving an end of the flexible suction tube 16'.

The valve body contains intermediate the ends axially spaced openings 18 and 20, with opening 18 being arranged to permit a gate 28 to be moved into the axial passage to block the passage and thereby shut off the suction to catheter tube 14', and the opening 20 providing for connecting and venting the interior passage to the atmosphere.

A rocker member 22 is mounted on the valve body and has angularly disposed limbs 24—24 and 26—26 at the distal ends of which are respectively a gate 28 and a closure lever 30. The gate 28 is supported by the rocker for movement through the opening 18 to a position to block the passage 12 and thereby shut off suction to catheter tube 14', and for guiding it and holding it in registration with the opening 18 when withdrawn there are provided on the valve body at opposite ends of the opening 18 transversely spaced projections 32—32.

There is a tubular valve seat 34 on the valve body around the opening 20 which has a sloping rim 36, the slope being designed to provide for natural pinching of the closure lever into engagement with the valve seat and to provide a more gradual closing and opening of the vent 20. To enhance closing and holding the closure in its closed position there is a finger saddle 38 at the under side of the valve body diametrically opposite the valve seat. As shown in FIGS. 1 and 3, the closure lever 30 comprise a flat portion or "feather," which engages the sloping rim 36 of the valve seat.

The rocker member 22 is yieldably held in the closed position by a leaf spring member 40 connected at one end to the limb 24—24 which by yieldable engagement with the valve body biases the rocker towards its closed position. As illustrated, the rocker valve has spaced parallel knees 44—44 containing aligned openings 46—46 which are rotatably received by diametrically disposed gudgeons 48—48 on the valve body. The leaf spring 40 is cantilever supported at the end fastened to the limb 24—24 and extends rearwardly therefrom across the pivot axis so that its distal end which is stressed against the top of the valve body when the closure lever is held engaged with the seat 34 rotates the rocker in a counter clockwise direction when the closure lever is released as shown in FIG. 2.

In the illustrated structure the angular disposition of the gate and enclosure are such that as the gate is gradually withdrawn the closure is simultaneously gradually closed and vice versa as the closure is gradually opened the gate is gradually closed so as to avoid any abrupt change in flow either when initiating the suction operation or in terminating such action. The gate 28 is located close enough to the end which is connected to the suction tube 14' so as to terminate the flow without lag and hence with relatively precise control. The atmospheric opening 20 is made substantially larger in cross sectional area than the cross sectional area of the interior passage 12 to substantially nullify any vacuum within that passage beyond that opening.

The entire device comprising the valve body and the rocker member are preferably comprised of a moldable plastic which is durable, resistant to acid and alkaline fluids and not easily contaminated. Preferably the valve body is made of a relatively rigid plastic material, preferably thermoplastics, such as rigid polymers or copolymers of styrene, acrylonitrile-butadienestyrene (ABS), acrylics, acetals, fluoroplastics, nylons, polyolefins, polyvinyl compounds such as rigid polyvinyl chloride, and rigid thermosetting compounds, such as epoxies, phenolics, and polyesters and other materials well known in the art. ABS-based plastics are presently preferred. Preferably the rocker member is integral with the spring member, and is made of a relatively flexible thermoplastic material, which has good "memory" and resilience, and can be deformed many times without adverse effect. Many such materials are well known in the art, such as polyolefins, polyvinyl compounds, and nylons, with polyolefins being preferred, most preferably polypropylene.

All components of the catheter are easily manufactured by techniques such as injection molding, which are standard in the art. In contrast with the more complex, previously known structures, assemblage merely involves snapping the two knees of the integral rocker member and spring over the protrusions 48 on the valve body, and insertion of the catheter tube into re-

cess 14. The preferred method of connecting the catheter tube with the valve body is indicated in the drawings, and in practice with that embodiment the inner surface of the catheter tube would be flush with the shoulder at the end of recess 14, or possibly of slightly smaller diameter than the shoulder. That arrangement minimizes the possibility of plugging by build up of materials on the shoulder. Of course other methods of connecting the catheter tube, as well as other ways of connecting the source of vacuum, will be readily apparent to those skilled in the art.

It can be easily appreciated that the catheter described solves essentially all of the problems experienced with prior catheters discussed above. The positive shut off of the source of vacuum to the catheter tube provided by gate 28, in combination with the large vent opening 36, ensures that no suction is applied through the catheter tube until the gate is lifted and the vent closed. Thus the doctor or nurse can leave it in its normally biased closed position and use both hands in inserting the catheter tube, and the catheter tube can be left in the patient ready for instant usage, without any suction being applied through the catheter tube to cause hypoxia or breathing difficulties.

Because of the simultaneous action obtained by operation of the rocker member, by which the blocking gate is gradually opened at the same time the vent hole is gradually closed, there is no substantial sudden surge of suction through the catheter tube which would cause it to grab and traumatize the mucosa or other tissue.

The risks of contamination of either the doctor or nurse operating the catheter or the liquid being aspirated are substantially eliminated by the present invention. Should a splashback occur while the catheter is in use, the liquid contacts only the undersurface of closing lever 30. That undersurface is sterile, as in practice the entire catheter is supplied in a sterilized, disposable package for a single use. The ease of manufacture of this invention makes the valved catheter inexpensive enough so that it can be used once, for whatever length of time desired, and thrown away when removed from the patient. This avoids the need for cleaning and re-sterilizing which are necessary with previous devices.

The embodiments disclosed herein are exemplary only, and many modifications of the basic teachings will be apparent to the skilled in the art. The scope and spirit of the invention are therefore not limited by embodiments disclosed, but are indicated in the following claims.

I claim:

1. A catheter for aspiration from a body cavity of a patient comprising a catheter tube and valve having a tubular valve body containing an elongate passage and provided at its ends with means for connecting it to said catheter tube and suction tube respectively, said body containing axially spaced openings in communication with said elongate passage and closure means mounted on the body having angularly disposed closure elements so arranged that when one is engaged with one of the openings the other is retracted from another of the openings and vice versa, and wherein one closure element comprises gate means which enters the opening with which it is associated to block the passage, and the other closure element provides means for covering the opening with which it is associated and for retracting the gate means from its opening to unblock said elongate passage and wherein the closure means is yieldably

held with the gate means situated within the opening with which it is associated to block the passage.

2. A catheter for aspiration from a body cavity of a patient comprising a flexible catheter tube and a valve having a valve body containing an elongate passage and provided at its opposite ends with means for connecting it to said catheter tube and to a suction tube respectively, said valve body having intermediate its ends axially spaced openings in communication with the elongate passage, a rocker mounted on the valve body having angularly disposed parts arranged to be rocked about an axis intermediate said openings alternately to dispose one part in overlying relation to one of the openings, and the other in overlying relation to the other of the openings, a gate carried by one part arranged to enter the opening associated with one part to block the passage, a closure carried by the other part arranged to cover the opening associated with said other part, said closure providing means for rocking said parts to cause the closure to cover its associated opening and to withdraw the gate from its associated opening and means for biasing the parts to cause the gate to block the passage.

3. A catheter for aspiration from a body cavity of a patient comprising a catheter tube and a valve having a valve body containing an elongate passage and provided at its opposite ends with means for connecting it to said catheter tube and to a suction tube respectively, said valve body containing axially spaced openings in communication with said elongate passage, a rocker having angularly disposed arms, means mounting the rocker on the valve body for rocking movement to bring one or the other of the arms into operative relation to an opening, a gate on one arm movable into one of the openings to block the passage, a closure on the other arm movable into covering engagement with the other of the openings, said closure providing means for rocking the rocker to move the closure to cover said other opening, said other opening comprising a vent port connecting the passage to the atmosphere downstream of the one opening and means yieldably holding the rocker in a position such that the gate is in the blocking position.

4. A catheter for aspiration from a body cavity of a patient comprising a catheter tube and having a tubular valve body containing an elongate interior passage, the ends of said valve body being adapted to be connected respectively to the part to be evacuated and to a flexible suction tube, said valve body containing intermediate its ends axially spaced openings in communication with the interior of the passage, a rocker member pivotally mounted on the valve body comprising a gate arranged to enter one of the openings into the passage to close the passage, and a closure lever arranged to be moved into engagement with the other opening by pivotal movement of the rocker valve to close said other opening and simultaneously to withdraw the gate from said passage, and means yieldably biasing the rocker valve in a direction to hold the gate in said closing position.

5. A device according to claim 4 wherein the one opening enters the valve passage at the end adapted to be connected to the part to be evacuated and the other opening enters the valve passage intermediate the one opening and the end of the valve body which is adapted to be connected to the flexible suction tube.

6. A device according to claim 4 wherein said other opening has a larger cross sectional area than that of the valve passage.

7. A device according to claim 4 wherein there is a finger cradle on the valve body diametrically opposite said other opening to facilitate pinching the closure lever into firm engagement with said other opening.

8. A device according to claim 4 wherein there is a tubular valve seat around said other opening provided with a flat sloping rim and the closure lever is provided with a flat feather for engagement with the ring of said seat.

9. A device according to claim 8 wherein the rim of the valve seat slopes at an angle of approximately 30° to the axis of the valve body.

10. A device according to claim 4 wherein there are guides on the valve body at the opposite ends of the one opening for guiding and confining the gate in alignment with said one opening when in a withdrawn position.

11. A device according to claim 4 wherein the tubular valve body has on it intermediate said openings dia-

metrically disposed gudgeons on which the rocker valve is pivotally mounted for rocking about an axis at right angles to the axis of the valve body.

12. A device according to claim 11 wherein the rocker valve has spaced parallel knees containing aligned openings for rotatably receiving the gudgeons.

13. A device according to claim 11 wherein a cantilever supported spring element is fixed at one end to the rocker valve at one side of the pivot axis and in the closed position of the rocker valve yieldably bears on the valve body at the opposite side of the pivot axis.

14. A device according to claim 11 wherein a cantilever supported spring element is fixed at one end of the rocker valve at one side of the pivot axis and extends therefrom to the other side of the pivot axis and wherein the distal end of the spring element slidably engages the top of the valve body and is displaced upwardly relative to the pivot axis by engagement with the top of the valve body.

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