

[54] **ENDOSCOPE**

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[52] U.S. Cl..... **128/6; 15/250.01; 244/129 W**

[51] Int. Cl.<sup>2</sup>..... **A61B 1/06**

[58] Field of Search..... 128/4-9; 32/69; 15/320-322, 405, 250.01; 244/129 W

[56]

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[57]

**ABSTRACT**

An endoscope comprising a single nozzle disposed near the view window provided at the distal end of said endoscope so as to wash the surface of said window and a separately provided feed line which is branched near the nozzle into a washing liquid tube and an air tube selectively used as occasion demands.

**6 Claims, 8 Drawing Figures**

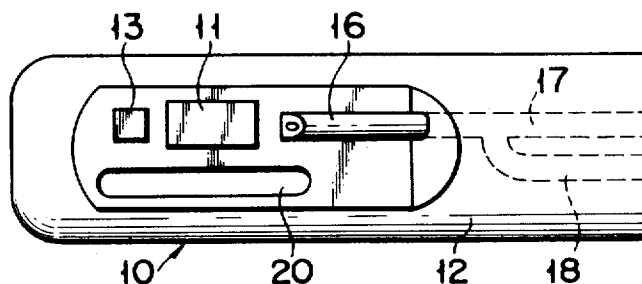


**FIG. 1**  
(PRIOR ART)

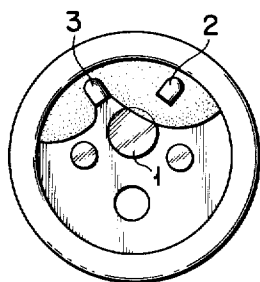


**FIG. 2**  
(PRIOR ART)

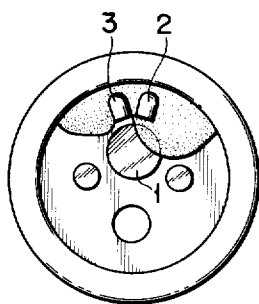


**FIG. 3**

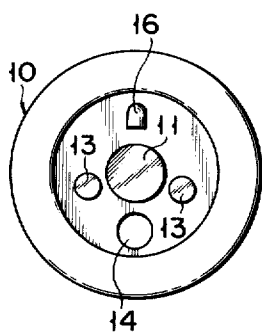


**FIG. 4**

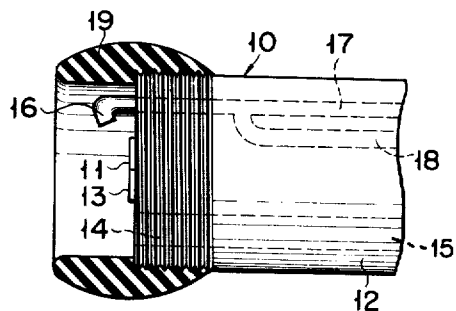


**FIG. 5**

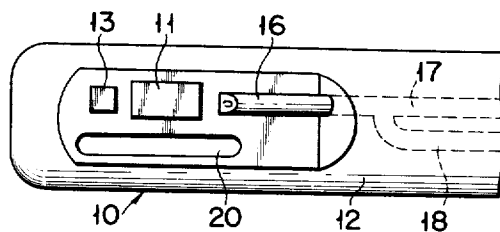


**FIG. 6**

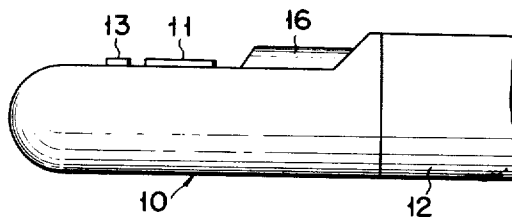


FIG. 7

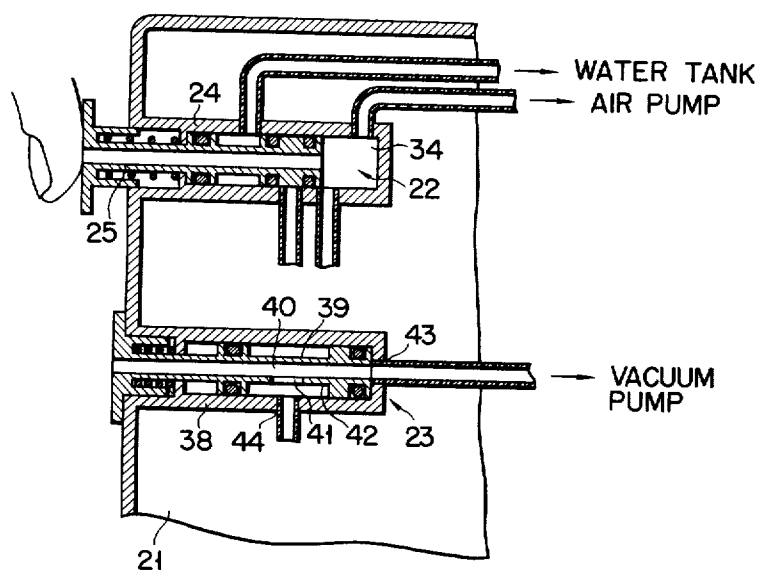
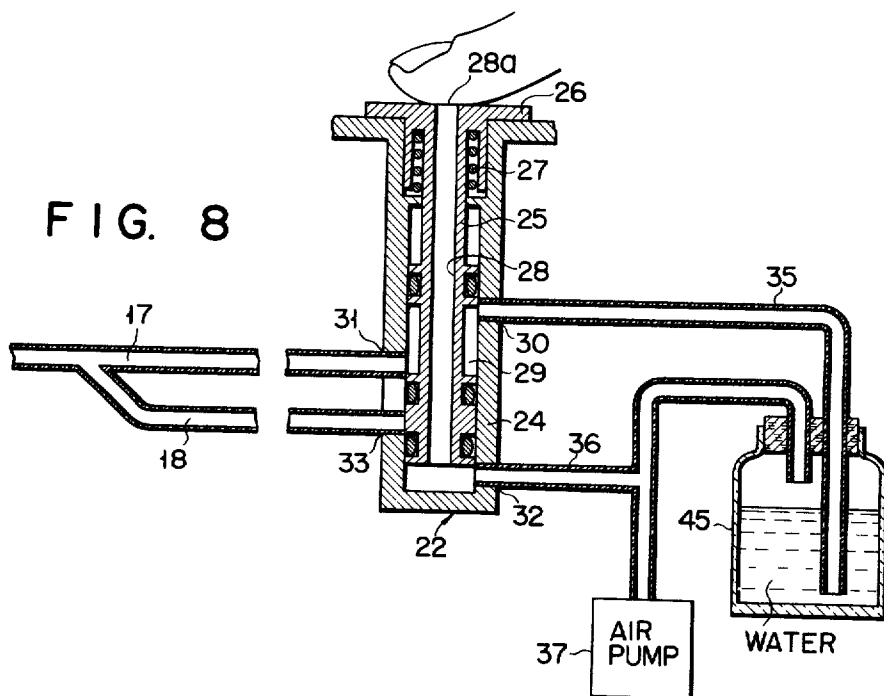


FIG. 8



## ENDOSCOPE

## BACKGROUND OF THE INVENTION

This invention relates to an endoscope designed to have washing liquid or air selectively delivered to the surface of a view window to wash and clean said surface.

Generally, an endoscope has its distal end inserted into the abdominal cavity of a patient externally to observe the condition of the affected part thereof through a view window. When, therefore, the surface of the view window is soiled with body liquid or blood, good view is obstructed. Customary means for eliminating such event is to fit a nozzle near the observation window and eject a washing liquid through said nozzle to wash away filth deposited on the surface of said window.

The known endoscope provided with such nozzle is a forward view type shown in FIG. 1. This prior art endoscope has first and second nozzles 2, 3 projectively provided at a prescribed interval near a view window 1 positioned at the center of the end face of the distal end. This arrangement is designed to spray washing liquid on the surface of the view window from the first nozzle 2 to wash away filth settled on said surface and thereafter eject air on the washed surface of the view window 1 to remove the liquid still attached to said surface.

With the prior art endoscope having two water and air nozzles 2, 3 projectively provided at a prescribed interval, a considerable portion of the washing liquid sprayed over the relatively broad area of the end face of the distal end still adheres to the periphery of the additional water nozzle 2 and the neighboring portion of the said end face, as illustrated by the dotted region of FIG. 1, even when air is ejected on said end face. The remaining washing liquid partly covers the view window, undesirably narrowing the field of view through the view window.

It may be contemplated, as shown in FIG. 2, to provide the two water and air nozzles 2, 3 close to each other on the upper part of the view window 1. However, some of the sprayed water is still left on the periphery of the water nozzle 2 due to the surface tension of the water as in the case of FIG. 1, similarly restricting the field of view through the view window, as indicated by the dotted region of FIG. 2.

## SUMMARY OF THE INVENTION

It is accordingly the object of this invention to provide an endoscope designed to have washing liquid or air selectively ejected on the surface of the view window fully to clean it of deposited filth and, after ejection of air, prevent any sprayed washing liquid from still sticking to the surface of the view window to restrict the field of view therethrough.

To eliminate drawbacks accompanying the prior art endoscope, it may be contemplated to provide a single nozzle for selectively ejecting washing liquid or air in the neighborhood of the view window, connect said nozzle to a single feed line or tube which is used concurrently for supply of both washing liquid and air, and deliver first washing liquid and then air to the single nozzle through the single feed line. With an endoscope based on this concept, the remaining water indeed only sticks to the periphery of the single nozzle, more reducing the settled amount of sprayed washing liquid than

has been possible in the past and in consequence substantially preventing the remaining water from covering the view window to narrow a field of view there-through. But the above-mentioned process using a single feed line is still unsatisfactory and fails to be put to practical application for the reason that since the common feed line supplies both washing liquid and air, some of the washing liquid conducted through a long course extending from a control unit to the distal end of an endoscope is likely to adhere to the inner walls of the feed tube, and the settled washing liquid is ejected from the nozzle together with the air supplied thereafter through said feed line, and in this case said remaining washing liquid is discharged from the nozzle in an atomized state due to inclusion of air. As the result, the view window is all clouded with the fine particles of the washing liquid to blur the field of view. This new defect renders the above-mentioned prior art process also unavailable for practical application.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are front views of the different types of prior art endoscope;

FIGS. 3 and 4 jointly denote a forward view type endoscope according to an embodiment of this invention; FIG. 3 is a front view of the distal end of said endoscope, and FIG. 4 is a side view thereof;

FIGS. 5 and 6 jointly illustrate a side view type endoscope according to another embodiment of the invention: FIG. 5 is a plan view of said endoscope and FIG. 6 is a side view thereof;

FIG. 7 is a fractional sectional view of a control unit used in the endoscope of this invention; and

FIG. 8 presents the relative connected positions of an operation valve and other members provided in the control unit of FIG. 7.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The forward view type endoscope of FIGS. 3 and 4 (whose entire outline is the same as that already known in this particular field and is omitted from illustration) has a distal end 10, whose end face is provided with a circular view window 11 at the center thereof. This view window 11 is formed of transparent glass, enabling that portion of the abdominal cavity which is located straight ahead of the distal end to be observed from a control unit (not shown) through a flexible tube 12 by means of the known optical system. A pair of illumination windows 13 are provided on both sides of the view window 11. A foreground subject being examined through the view window 11 is illuminated by a proper source of light through the illumination windows 13. A suction port 14 disposed below the view window 11 may be connected to a proper vacuum pump through a narrow tube 15 (indicated in broken lines in FIG. 4). This narrow tube 15 may be used as a forceps-guiding channel already known in this particular field. In this case, it is possible to provide a forceps-raising mechanism near the suction port 14 so as to enable the forceps to be extended ahead of the distal end from the suction port 14 at a prescribed angle. Further, a suitable cap (not shown) may be provided for the suction port 14 to close it when it is not used. A spray nozzle 16 is projectively disposed above the view window 11 at a symmetrical point with the suction port 14, with the nozzle opening directed to the view window 11.

The nozzle 16 is connected to a washing liquid path or tube 17. Further, a separate air path or air tube 18 has its forward end connected to that part of the washing liquid tube 17 which is located near the end face of the distal end, thus communicating with the nozzle 16. These two feed lines 17, 18 of washing liquid and air extend to the control unit (not shown) through a flexible tube. This control unit delivers washing liquid to the first feed line 17 and air to the second feed line 18 at different points of time. A protective cylindrical rubber member 19 projectively surrounds the tip of the distal end of the endoscope.

Where the view window 11 is soiled with body liquid or blood when the distal end 10 is inserted into the abdominal cavity of a patient or during observation, an endoscope according to the embodiment of this invention has washing liquid supplied to the nozzle 16 through the first feed line 17. The washing liquid is ejected from the nozzle 16 on the surface of the view window 11 to wash away filth deposited thereon. After washing, air is delivered to the nozzle 16 through the second feed line 18 to blow off the washing liquid still adhering to the surface of the view window 11 to clean said surface, thereby attaining the full observation of the abdominal cavity.

With the endoscope of this invention, the washing liquid sticking to the surface of the view window 11 is almost fully removed by the air ejected from the nozzle 16 in the same direction as that in which the washing liquid was previously sprayed. Thus the washing liquid only remains around and close to the nozzle 16, substantially preventing part or the whole of the view window 11 from being covered with the line particles of washing liquid to narrow the field of view through said window 11, as has been the case with the prior art endoscope. Moreover, up to a point near the nozzle 16, the washing liquid feed line 17 and the air feed line 18 are independently provided and a common feed line stretched between the nozzle 16 and the junction of both feed lines 17, 18 is very short. Accordingly, only extremely minute amounts of washing liquid particles adhere to the inner walls of said common feed line, preventing the remaining liquid from being finely atomized by the air ejected.

There will now be described by reference to FIGS. 5 and 6 the operation of the side view type endoscope of this invention. Most of the respective elements of the side view type endoscope have the same functions as those of the aforesaid forward view type and the same parts of FIGS. 5 and 6 as those of FIGS. 3 and 4 are denoted by the same numerals, description thereof being omitted.

A rectangular view window 11 is formed at the center of the flat upper surface of the distal end 10 connected to the tip of the flexible tube 12. An illumination window 13 is provided ahead of said view window 11, and a spray nozzle 16 is located behind said window 11. This spray nozzle 16 is connected with the opening thereof directed to the window 11 to a common feed line, at the rear end of which the washing liquid feed line 17 and air feed line 18 are joined. A forceps opening 20 extending lengthwise of the distal end is formed aside of the view window 11. The side view type endoscope arranged as described above displays exactly the same effect as the aforesaid forward view type, as easily understood by those skilled in the art.

There will now be described by reference to FIGS. 7 and 8 the mechanisms for the supply of washing liquid and air as well as for suction included in a control unit of the endoscope because of its application to the distal end of FIGS. 3 and 4 and that of FIGS. 5 and 6. Referring to FIG. 7, the control unit 21 has first and second manually operative valves 22, 23. The first valve 22 comprises a cylinder 24 and a piston 25 slidable there-through and is intended selectively to supply washing liquid or air to the nozzle 16. The outward extending end of the piston 25 is provided with a push button 26 (FIG. 8). When the push button 26 is depressed by the finger, the piston 25 slides inward through the cylinder 24. A coil spring 27 is interposed between the cylinder 24 and piston 25 to urge the piston 25 upward. Further, the piston 25 is bored with a lateral through hole 28 extending along the central axis thereof which is open at one end to the upper surface of the push button 26 and at the opposite end to the underside of the piston 25. An annular groove 29 is formed at the intermediate part of the peripheral wall of the piston 25. Where the piston 25 is in a position depressed by the finger as shown in FIG. 8 (hereinafter referred to for convenience as "a washing liquid-feeding position"), then a washing liquid inlet port 30 and washing liquid outlet port 31 bored in those parts of the wall of the cylinder 24 which face the annular groove 29 communicate with each other through said annular groove 29. Further, an air inlet port 32 and air outlet port 33 are provided in the lower peripheral wall of the cylinder 24. Where the piston 25 is in a position free from depression by the finger as indicated in FIG. 7 (hereinafter referred to for convenience as "an air feeding position"), then the air inlet port 32 and air outlet port 33 communicate with each other through a hollow space 34 defined by the bottom face of the piston 25 with the inner bottom surface of the cylinder 24. The washing liquid outlet port 31 is connected to the rear end of the washing liquid feed line 17, and the air outlet port 33 is connected to the rear end of the air feed line 18. A washing liquid pipe 35 extends from the washing liquid inlet port 30 with a washing liquid vessel 45. The air inlet port 32 is connected to the first branch line of an air feed pipe 36. The second branch line extends into the washing liquid vessel 45. The main line of the air feed pipe 36 is connected to an air pump 37, causing air delivered therefrom to be conducted to the air inlet port 32 and washing liquid vessel 45.

Where it is desired to spray washing liquid from the nozzle 16, it is advised to bring the first manually operative valve 22 to a washing liquid-feeding position shown in FIG. 8. Where it is desired to eject air, it is advised to close the opening 28a of the penetrating hole 28 with the finger as shown in FIG. 7, and set said first valve 22 at an air feeding position indicated in FIG. 7.

The second manually operative valve 23 of FIG. 7 also includes a cylinder 38 and piston 39 and, when depressed by the finger, is designed to suck in filth or fine particles of washing liquid through a suction port (indicated by numeral 14 in FIG. 3). The piston 39 is bored with a penetrating hole 40 extending lengthwise thereof. An annular groove 42 is formed at the intermediate part of the peripheral wall of the piston 39 so as to communicate with the penetrating hole 40 through an opening 41. Further, a first port 43 connected to a vacuum pump is formed at the bottom of the cylinder 38, and a second port 44 communicating with a suction

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port is provided in the side wall of said cylinder 38. When the piston 39 is depressed by the finger, the first and second ports 43, 44 are communicated with each other, as shown in FIG. 7, through the penetrating hole 40, opening 41 and annular groove 42. Where it is desired to carry out suction of filth or fine particles of washing liquid through the suction port 14, the piston 39 is depressed by the finger to cause the suction port 14 to communicate with the vacuum pump. Where the second valve 23 is not used, it is advised not to depress it by the finger.

What is claimed is:

1. An endoscope comprising a distal end; a view window formed at the distal end; a nozzle disposed at the distal end with the opening of said nozzle directed to the view window; and two separately provided feed lines one for washing liquid and the other for air, respectively connected to the nozzle through a common passage communicating with each said feed line adjacent the nozzle.

2. An endoscope according to claim 1 wherein the

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distal end has a flat end face, to which the view window and nozzle are fitted.

3. An endoscope according to claim 2 wherein the nozzle is located on one side of the view window and a suction port is disposed on the opposite side of said view window in a symmetrical relationship with the nozzle.

4. An endoscope according to claim 1 wherein the distal end has a flat side wall, to which the view window and nozzle are fitted.

5. An endoscope according to claim 1 which further comprises a control unit operatively connected to the distal end, said control unit being provided with supply means for selectively supplying washing liquid to the washing liquid feed line and air to the air feed line.

6. An endoscope according to claim 5 wherein said supply means comprises a piston and cylinder, and washing liquid and air are selectively delivered to the nozzle by the corresponding operation of the piston.

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