Jan. 11, 1955 O. M. MOE 2,699,124

ONE-WAY CHECK VALVE

Filed Aug. 20, 1952

Fig. 1

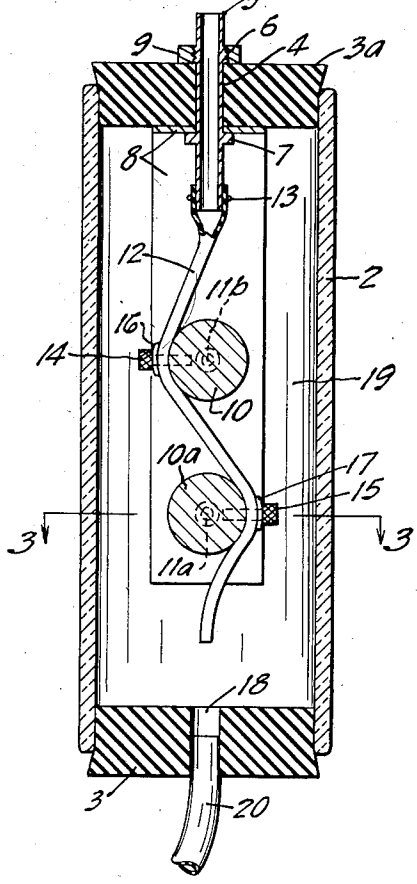


Fig. 2

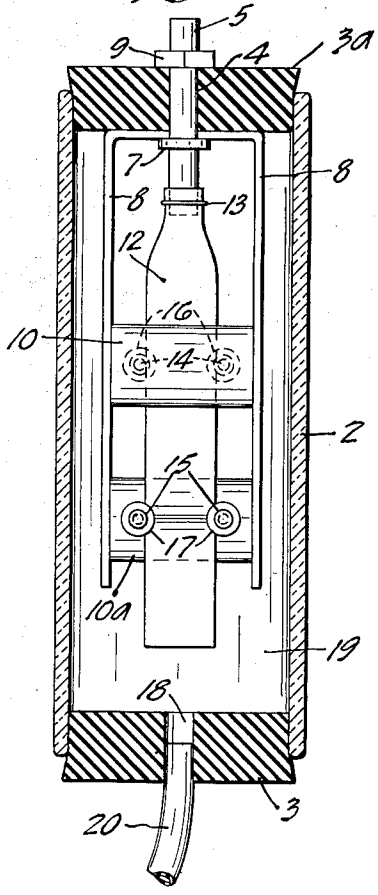
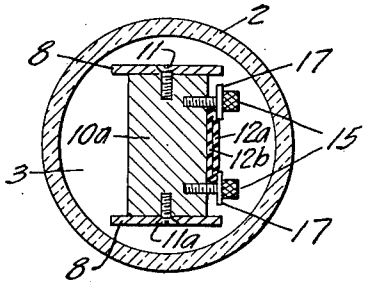


Fig. 3



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United States Patent Office 2,699,124 Patented Jan. 11, 1955

2,699,124

ONE-WAY CHECK VALVE

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Application August 20, 1952, Serial No. 305,369

4 Claims. (Cl. 103—228)

This invention relates to a one way safety check valve, and provides a valve of novel construction which will, under the application of a very slight amount of pressure, close to prevent the back-flow of fluid therethrough. The valve has particular utility in connection with surgical operations where certain portions of a surgical patient's body are post-operatively drained of fluids which may accumulate in the area of the body on which the operation was performed. More specifically, the valve has particular utility for use in conjunction with a suction pump apparatus for post-operative drainage of the chest cavity of a person who has been subjected to chest surgery.

It is customary in chest surgery, before the surgical incision has been closed, to affix a drainage tube or tubes within the chest cavity so that any fluids which may post-operatively accumulate within the patient's chest may be pumped out. Such pumping is frequently continued for from three to six days following the surgical operation. The negative pressure applied on the pump is very slight (from five to twenty-seven centimeters of water), but is sufficient to withdraw through the drainage tubes fluids which might otherwise dangerously accumulate in the patient's chest. Pumps used for such purposes are now well-known to the surgical profession, but, prior to the present invention, there have been certain difficulties and dangers involved in their use. Among such dangers there was the likelihood that the pump might, for one reason or another, have stopped functioning at some time during the period it was being used on a patient, whereupon the negative pressure applied upon the chest cavity would have been destroyed, and, instead, the "vacuum" within the chest cavity of the patient would draw back into that cavity, through the drainage tube, air and possibly impure or contamined fluids or mucous matter, with great danger of post-operative infection, blood clots, etc. There was also the likelihood that air which might re-enter the chest cavity would cause the collapse of the patient's lung, in certain types of operation.

It is an object of the present invention to provide a check valve whereby, if the pump should cease to operate, the drainage tube will be automatically and quickly closed to prevent any back-flow of any fluid into the chest of the patient. As will be understood from the fact that the pump applies only from five to twenty-seven centimeters of negative pressure, the valve of the present invention is extremely sensitive in that it will close when such negative pressure is no longer applied.

It should be understood that although the description of this invention has been related principally to chest surgery, the valve also has great utility in connection with surgical operations on various other parts of the human body, and, also, has utility in other fields where a particularly sensitive check valve is desired.

Referring now to the drawings:

Figure 1 is a side elevational view of the valve of this invention, in cross section.

Figure 2 is a front elevational view of the valve.

Figure 3 is a cross sectional view, along line 3—3 of Figure 1.

The valve of the present invention comprises, first, hollow cylinder **2**, preferably made of transparent, heat resistant glass. The ends of said cylinder **2** are provided with corks **3** and **3***a*, which may conveniently be made of rubber. Said corks fit snugly within cylinder **2** to provide an air tight closure thereof. Cork **3***a* is provided with vertical bore **4**, through which extends tubular fitting

member **5**. The upper central portion of member **5** is provided with threads **6** and the lower central portion of member **5** is provided with shoulder **7**. Said member **5** is of a diameter which will fit snugly within bore **4**, so that an air tight connection will be obtained. Strap **8** is interposed between shoulder **7** and the bottom of cork **3***a*. Said strap **8** is made in U shape and is mounted on member **5** with its arms depending vertically, parallel to the side walls of cylinder **2**. Said strap **8** may conveniently be made from stainless steel. Nut **9** is threaded on portion **6** of member **5**, and, as said nut is tightened, shoulder **7** will be drawn up to hold strap **8** in fixed position, as shown. Bar **10***a* is mounted by screws **11** and **11***a* in horizontal position between the depending arms of strap **8**. Bar **10** is likewise mounted by screw **11***b* and a fourth screw, not shown. As illustrated, said bars are circular in cross section, and that is preferred. However, such bars could also be rectilinear in cross section. Flexible tube **12** is slipped over the lower end portion of member **5** and is held thereon by tie member **13**. Flexible tube **12** may be conveniently made from latex rubber. I have found that ordinary "penrose tubing" such as is sold in surgical supply houses is satisfactory and desirable for use as tube **12** in my valve, although other types of tubing, as hereinafter described, may also be used. Said tube extends downwardly and in the particular embodiment shown, lies over and against peripheral portions of bars **10** and **10***a*, in the manner shown particularly in Figure 1; that is, tube **12** lies against the "left" hand side of bar **10**, and against the "right" hand side of bar **10***a*, in Figure 1.

The opposite side walls **12***a* and **12***b* of tube **12** are held flush against each other by knurled screws **14** and **15** which are threaded into bars **10** and **10***a*: see Figure 3. When my valve is being prepared for use, screws **14** and **15** are tightened sufficiently so that the side walls of tube **12** will be flush against each other in the absence of any negative pressure in area **19**, hereinafter identified. Screws **14** and **15** are fitted with washers **16** and **17** which conform to the curvature of bars **10** and **10***a* and thus serve to pinch together the longitudinal edge portions of tube **12** to bring the side walls **12***a* and **12***b* thereof into contact. The lower end of tube **12** is allowed to remain depending freely within cylinder **2**.

Cork **3** is provided with bore **18** through which the fluid drawn through tube **12** will drain into a larger drainage jar, not shown.

In use of my device in conjunction with a surgical pump, the pump is affixed so as to apply negative pressure on the drainage jar, above mentioned. Tube **20** is then run from said drainage jar to bore **18** in cork **3**, so that the pump will create a negative pressure within area **19** in cylinder **2**. The drainage tube or tubes affixed to the surgical patient's chest are then run from said patient's chest and affixed to the upper end of member **5**. Thus, as the pump operates, the negative pressure will serve to draw the fluid from the surgical patient's chest, through the drainage tubes, through my valve and into the drainage jar. As long as there is negative pressure within area **19**, tube **12** will remain open and allow the passage of fluid through tube **12**. However, should such negative pressure within area **19** be destroyed, tube **12** will collapse and close to prevent the leakage of air or other fluid or liquid back upwardly into the patient's chest cavity.

In the particular embodiment of valve shown in the accompanying drawing, the principal "closing" action occurs in the portion of tube **12** lying between bars **10** and **10***a*, and also at the portion of tube **12** lying against the periphery of said bars. The tube may not close completely at its upper and lower ends.

When the negative pressure in area **19** is destroyed, after the valve has been in use, a quantity of fluid matter will frequently be trapped in tube **12**, between bars **10** and **10***a*. This provides a means for checking to make certain that the valve is not leaking, for if the tube is not completely closed at the points where it lies against bars **10** and **10***a*, air bubbles may be observed progressing upwardly through tube **12**.

What I claim is:

1. A check valve for use in an apparatus for pumping

fluid, said apparatus including a suction pump, said valve comprising a sealed chamber and a flexible tube disposed within said sealed chamber; a flow line extending from said fluid to said sealed chamber; said flexible tube being in connection with said flow line to receive a discharge of fluid therefrom, means being provided within said sealed chamber for festooning of said flexible tube, said suction pump being in operating connection with said sealed chamber to maintain negative pressure therein and to draw quantities of said fluid through said flow line and through said flexible tube, said flexible tube being of a construction to provide for its assuming a collapsed cross-section in the absence of negative pressure in said sealed chamber.

2. A check valve for use in an apparatus for pumping fluid, said apparatus including a suction pump, said valve comprising a flexible tube, a sealed chamber, a plurality of bar members, means for suspending said bar members horizontally within said sealed chamber, a flow line extending from said fluid to said sealed chamber, said flexible tube being connected to said flow line, disposed within said sealed chamber and draped over a peripheral portion of each of said bar members, said suction pump being in operating connection with said sealed chamber to maintain negative pressure therein and to draw quantities of said fluid through said flow line and through said flexible tube, said flexible tube being of a construction to provide

for its assuming a collapsed cross-section in the absence of negative pressure in said sealed chamber.

3. The check valve of claim 1 in which means is provided for pinching together opposed side walls of said flexible tube.

4. A check valve for use in an apparatus for pumping fluid, said apparatus including a suction pump, said valve comprising a sealed chamber provided with an intake port and an outlet port, a flexible tube, at least one bar member suspended within said sealed chamber, a flow line extending from said fluid to said inlet port, said flexible tube being disposed within said sealed chamber and connected to said inlet port to receive a flow of fluid therefrom, a portion of the length of said flexible tube being supported by at least one bar member, said suction pump being in operating connection with said outlet port to maintain negative pressure in said sealed chamber and to draw quantities of said fluid through said flow line, through said flexible tube and out said outlet port, said flexible tube being of a construction to provide for its assuming a collapsed cross-section in the absence of negative pressure in said sealed chamber.

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