

[54] SUCTION-PUMP ASSEMBLY FOR
DRAWING BODY FLUIDS

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[22] Filed: Nov. 17, 1972

[21] Appl. No.: 307,459

[52] U.S. Cl. 128/278, 128/218 A

[51] Int. Cl. A61m 1/00, A61m 5/20

[58] Field of Search 128/DIG. 1, 214 R, 214 B,
128/214 F, 218, 230, 234, 260, 276-278

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[57] **ABSTRACT**

A disposable evacuator assembly for drawing fluids from a surgical site or body orifices. The assembly comprises a standard syringe in which a piston is slidable within a cylinder whose upper end is flanged. The lower end of the cylinder is provided with an outlet that is coupled through a uni-directional relief valve to a collector bottle which, in turn, is coupled by a drain pipe to the surgical site. The piston is actuated by a stem terminating in a flange. The assembly is operatively associated with a driver provided with a stationary fitting adapted to receive the cylinder flange and to latch the cylinder thereto, and a movable fitting adapted to receive the stem flange, the movable fitting being shifted back and forth relative to the stationary fitting to cause reciprocation of the piston within the cylinder to create a suction force drawing fluid into the collector bottle. To dispose of the assembly after use, the syringe is detached from the fittings.

4 Claims, 3 Drawing Figures

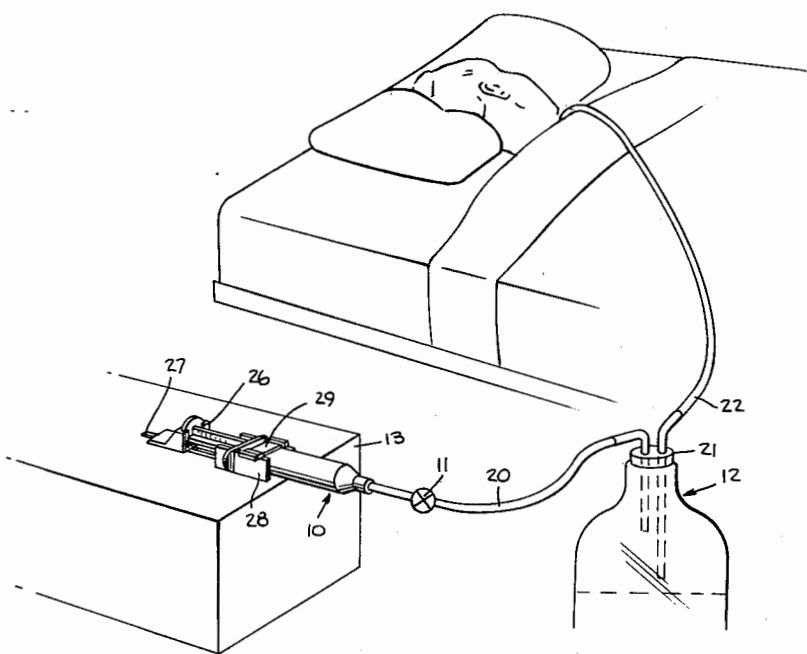


Fig. 1.

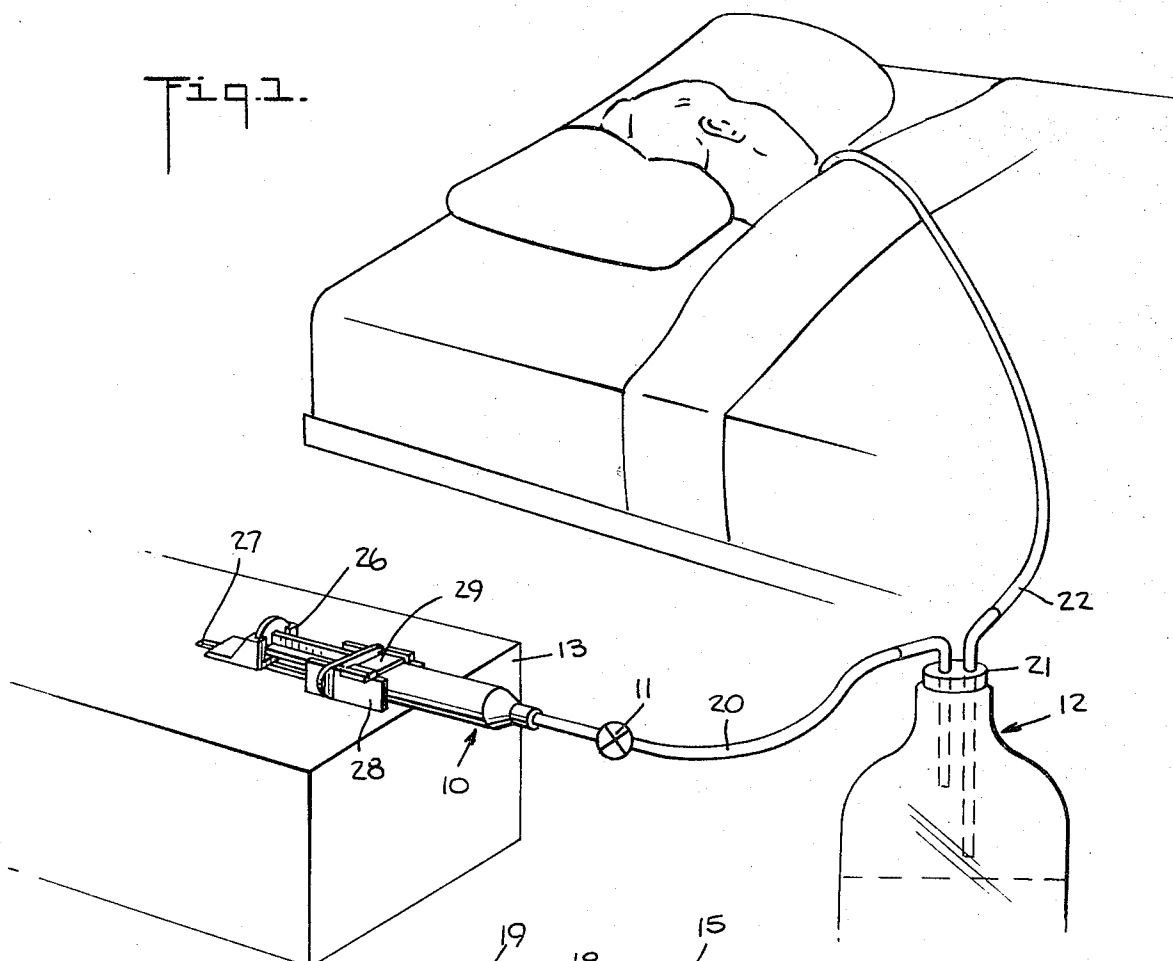
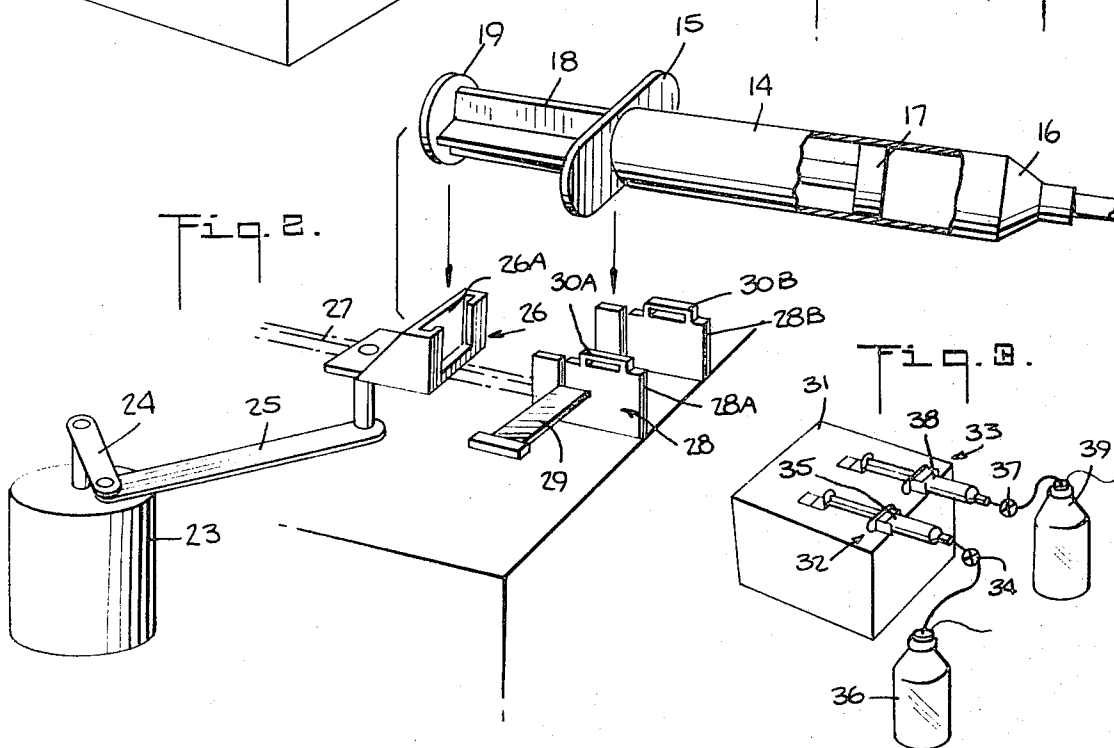


Fig. 2.



SUCTION-PUMP ASSEMBLY FOR DRAWING BODY FLUIDS

BACKGROUND OF THE INVENTION

This invention relates generally to surgical evacuators for withdrawing fluids from the human body, and more particularly to a motor-driven suction-pump assembly for drawing such fluids, the assembly being separable from the driver and being disposable.

In post-operative surgical procedures, drains are used whenever an abnormal collection of fluid is encountered. This fluid may be in the form of contaminated or infected material, blood, bile or lymph, exudate or transudate. Ordinary wounds are normally drained for a post-operative period running as long as forty-eight hours. Effective drainage is of medical importance, for swelling and tension are minimized thereby, post-operative pain is reduced, and the edges of wounds are maintained flat and quiescent. Drainage is also important in dealing with infections.

It is known to use motor-driven suction pumps for evacuating fluids in post-operative surgical procedures. Such pumps are adapted to function in conjunction with a fluid collector coupled to a drain pipe leading to the wound. In order to maintain sterile conditions, it is the present practice to discard the collector and the associated tubing after a single use rather than resterilize the system.

But existing drainage pump systems present a problem in regard to the sterility of the motor-driven suction pump, for the cost of such pumps is relatively high and one cannot afford to discard the pump after a single use. On the other hand, since the pump is operatively associated with the fluid collector and tends to contaminate in the course of operation, the re-sterilization of the suction pump involves time-consuming and costly procedures and in some instances requires dismantling and reassembly of the pump structure. Consequently the pump is rarely sterilized.

SUMMARY OF INVENTION

In view of the foregoing, the primary object of this invention is to provide a motor-driven pump assembly adapted to function as a surgical evacuator, the assembly being separable from the powered driver therefor and being disposable.

More specifically, it is an object of this invention to provide a surgical evacuator assembly which is reliable and efficient in operation, the assembly including a standard pistontype syringe functioning as a suction pump, the syringe being detachably coupled to a driver adapted to reciprocate the piston to produce a suction force drawing fluid from the wound into a collector bottle.

Among the significant features and advantages of the invention are the following:

A. The standard syringe, being a mass-produced device, is commercially available in large quantities at very low unit cost; hence the total cost of the assembly is such as to make its disposability feasible.

B. Because the evacuator assembly, which includes the pump, is separable from the driver and no fluid derived from the site being evacuated reaches or makes contact with the driver, there is no need to resterilize the driver after use.

C. Because the syringe is easily and quickly attached to and detached from the driver, the installation and disposal of the assembly may be carried out without difficulty.

D. Because the driver need be nothing more than a conventional electrical motor whose shaft is operatively coupled to a motion converter to produce a reciprocal action, the driver itself may be of compact and low-cost design.

Briefly stated, these objects and features are attainable in a surgical evacuator assembly comprising a standard syringe in which a piston is slidable within a cylinder whose upper end is flanged and whose lower end is provided with an outlet that is coupled by a tube through a uni-directional relief valve to a collector bottle, which, in turn, is coupled by a drain pipe to the surgical site. The piston is actuated by an axial stem terminating in a flange.

The assembly is operatively associated with a powered driver having a stationary fitting adapted to receive the cylinder flange and to latch the cylinder thereto, and a movable fitting adapted to receive the stem flange, the movable fitting being reciprocated relative to the stationary fitting to cause reciprocation of the piston within the cylinder. To dispose of the assembly after use, the syringe is detached from the fittings.

The forward stroke of the piston ejects air from the cylinder chamber, the ejected air being discharged into the atmosphere through the uni-directional relief valve. The return stroke of the piston draws air into the chamber, which air is derived from the collector bottle to produce a negative pressure or vacuum force causing fluid to be drawn from the surgical site into the bottle.

By reversing the setting of the valve the assembly is adapted to function as an infusion pump to force a therapeutic liquid contained in the bottle into the patient.

OUTLINE OF DRAWING

For a better understanding of the invention as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 is a perspective view of a driver and disposable evacuator assembly in accordance with the invention;

FIG. 2 illustrates the manner in which the syringe of the assembly is coupled to the driver, and

FIG. 3 shows a dual driver system operating in conjunction with an evacuator assembly and an infusion assembly.

DESCRIPTION OF INVENTION

Referring now to the drawings, there is shown a disposable evacuator assembly in accordance with the invention, the main components of the assembly being a standard syringe, generally designated by numeral 10, a uni-directional relief valve 11 and a collector bottle 12. The assembly is operatively associated with a powered driver, generally designated by numeral 13.

The syringe 10 is constituted by a cylinder 14, made of glass or suitable transparent plastic material, the upper end of the cylinder being provided with a winged flange 15, ordinarily intended to be grasped by the fin-

gers of the user. The lower end of the cylinder is provided with a tapered outlet 16, normally intended to be coupled to a hypodermic needle or catheter.

Slidable within cylinder 14 is a piston 17, which is attached to one end of an axial stem 18, the other end of the stem terminating in a disc-shaped flange 19. In normal use, an operator, by means of the cylinder flange 15, holds the cylinder in one hand, and by means of the stem flange 19, pulls piston 17 up the cylinder to draw liquid into the cylinder chamber. Thereafter, by pushing piston 17 down the cylinder, the liquid contained therein is ejected from the chamber. But in the present invention, the syringe, as will now be explained, functions in conjunction with the driver and the relief valve as an air suction pump.

Cylinder outlet 16 is coupled by a pipe 20 to a collector bottle 12, the end portion of the pipe passing through the bottle stopper 21. Interposed in pipe 20 is the uni-directional relief valve 11, which is arranged to exhaust air into the atmosphere when piston 17 is pushed down the cylinder (forward stroke) to eject air from the cylinder chamber, and to conduct air from bottle 12 into the cylinder chamber when the piston is pulled up the cylinder (return stroke).

Bottle 12 is coupled to the surgical site by means of a drain pipe 22. Hence when air from bottle 12 is drawn into the cylinder chamber during the return stroke, a suction force is created to draw fluid from the surgical site into the bottle.

The syringe is operated by means of powered driver 13 which is provided with an electrically energized motor 23 (or equivalent means) whose armature shaft 24 is likened by a crank 25 to a movable fitting 26 which is slidable along a linear slot 27 toward and away from a stationary fitting 28 mounted on the top wall of the driver casing.

Stationary fitting 28 is provided with a pair of parallel vertical plates 28A and 28B, which are sufficiently spaced apart to snugly accommodate cylinder 14 of the syringe, the plates having slots therein adapted to receive the winged flange 15 and thereby prevent axial displacement of the cylinder. To securely latch the cylinder in the stationary fitting, a latching strip 29 is provided which slides into loops 30A and 30B mounted on the top edge of the plates 28A and 28B.

Movable fitting 26 is provided with a rectangular socket adapted to receive stem flange 19. Thus when cylinder 14 is seated within stationary fitting 28 and is latched thereto, and stem flange 19 is received within movable fitting 26, the reciprocal motion of the movable fitting causes reciprocation of piston 17 to produce a suction force during each return stroke of the piston.

The amount of suction generated may be controlled by varying the length of the stroke or the rate of reciprocation. In practice a variable speed motor may be used in order to adjust the rate of evacuation to the needs of the patient.

In the course of operation, the collector bottle fills with body fluid, and the syringe, because it draws air from the bottle, becomes contaminated. However, contaminants contained in the syringe are isolated from the driver. When the bottle is filled, the entire assembly may be discarded, after first detaching the syringe from the driver fittings.

It will be appreciated that the syringe behaves as a positive displacement pump when the operative direc-

tion of valve 11 is reversed, so that now in the forward stroke of the piston, air is ejected from the cylinder and discharged into the bottle, while during the return stroke air is drawn from the atmosphere into the cylinder. This is useful when one desires to infuse a liquid into the patient.

In some instances it may be necessary to carry out fluid evacuation and fluid infusion concurrently. This may be accomplished as shown in FIG. 3 by means of a dual-driver 31 having a pair of stationary and movable fittings operating in conjunction with two disposable assemblies, generally designated by numerals 32 and 33.

Assembly 32 is provided with a valve 34 which is set with respect to syringe 35 to produce a suction force drawing liquid into a collector bottle 36 from a surgical site. The second assembly is provided with a valve 37 which is set with respect to syringe 38 to produce a positive displacement force, pushing air into a liquid supply bottle 39 and causing liquid from the bottle to flow through a pipe feeding liquid to the patient. The nature of this liquid will of course depend on the liquid indicated by the patient's condition.

Thus with the arrangement shown in FIG. 3 the parallel pump systems are essentially identical, save for the setting of the valves, one system functioning to draw liquid from a surgical site and the other to infuse a therapeutic liquid into the patient.

While there has been shown and described a preferred embodiment of the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention.

We claim:

1. A disposable pump assembly for evacuating fluid from the body of a patient or for infusing fluid into said body, said assembly and the driver therefor comprising:

- A. a bottle for containing a fluid to be infused into the body or for receiving fluid evacuated from the body, said bottle being provided with first and second inlets, said first inlet communicating with an air space in said bottle, said second inlet functioning with respect to infused or evacuated fluid,
- B. a pipe connected to said second inlet for coupling said bottle to said body for infusion or evacuation;

- C. a disposable, standard syringe functioning as an air pump and constituted by a cylinder having an outlet and a movable piston therein, said piston being actuated by an axial stem connected thereto,

- D. a powered driver having a stationary fitting and a movable fitting which reciprocates with respect to said stationary fitting, said fittings including means effecting a detachable coupling to said cylinder and to said stem whereby said syringe may readily be coupled to said fittings or withdrawn therefrom, and

- E. pipe means having a reversible uni-directional valve interposed therein coupling the outlet of the syringe to said first inlet, said assembly being operative in the evacuating mode when said valve functions in a predetermined direction and being operative in the infusion mode after the valve setting is reversed when said valve functions in the reverse direction.

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2. An assmebly as set forth in claim 1, wherein said valve is set for operation in the evacuation mode, whereby in the forward stroke of said piston air ejected from the cylinder is discharged by said valve to the atmosphere and in the return stroke air is drawn into said cylinder from said bottle to produce a suction force withdrawing fluid from the body.

3. An assembly as set forth in claim 1, wherein said valve is set for operation in the infusion mode whereby

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in the forward stroke of said piston, air is forced into said bottle to force fluid therefrom through said feed pipe and in the return stroke air is drawn into said cylinder from the atmosphere.

4. An assembly as set forth in claim 1, wherein said power driver is constituted by a motor whose armature shaft operates a crank coupled to said movable fitting.

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