An aseptic body fluid receiving system for use in locations where bodies are worked upon and where a source of vacuum is utilized to draw the fluid into a receiver, said system having means to protect the vacuum line from contamination, which means are compact and plainly visible and do not detract from integral asepsis. The term "body" herein may mean that of a living patient or that of a cadaver.

11 Claims, 8 Drawing Figures
ASEPTIC SUCTION SYSTEM FOR BODY FLUIDS AND VALVE THEREFOR

BRIEF SUMMARY OF THE INVENTION

Several types of body fluid receiving systems have been developed, including either a rigid or a flexible fluid receiver, some rigid receivers heretofore known being reusable and others being disposable. Usually the body fluid is withdrawn to the receiver by a vacuum system which must be prevented from contamination. Valve means have heretofore been used for that purpose and disposed within the receiver, but in a number of cases the stickiness of the received fluid has caused valve failure. Frequently, in a hospital or the like, a single vacuum system is utilized which extends from floor to ceiling, with connections provided in numerous rooms and consequently, contamination of such a system results in a highly costly expenditure and consumption of time in order to de-contaminate the system. Valves, as previously used, gave no visible warning that the vacuum system was about to be shut off from a particular body, and if very close inspection was not made, the vacuum could be closed off from the body for an undue length of time.

The instant invention provides a body fluid receiving or collecting system in which all part of the system, whether operating or not, are plainly visible from across a room, whereby even a casual or careless inspection by an attendant indicates whether flow of fluid from the body has stopped notwithstanding the presence of vacuum, or whether the fluid receiver should be removed and replaced with another.

More specifically, the invention embodies compact means for protecting the vacuum system and includes a housing disposed vertically and connected in the tubing leading to the main suction line, the housing having an inlet opening at the bottom thereof and an outlet opening at the top. The housing is transparent and performs a dual function, namely acting as a valve housing and also as a trap for debris or any other element in body fluid that may enter the housing and is entrapped within the housing prior to the closing shut of the valve. A deflector is spaced upwardly from the bottom of the housing and anchored to the side wall thereof. This deflector is such as to act upon incoming air and form it into a vortex of air passing through the housing. A lightweight floatable valve is freely disposed within the housing to spin rapidly bodily in a sloping position in the air vortex. At the top of the housing in line with the outlet is an inwardly extending enlarged valve seat, against which the valve may seat flatly, and this valve seat arrangement includes an annular flange to guide the valve and keep the same in the desired position of movement. The valve spins in a manner very closely approximating a precessional rotational movement. Both the valve and the deflector aid in entrapping fluid particles within the lower portion of the housing where they are plainly visible before sufficient fluid collects to cause a closing or seating of the valve over the outlet from the housing and accordingly cut off suction so the main suction line cannot become contaminated. The valve spins with sufficient rapidity to throw off particles striking the valve against the side wall of the housing by centrifugal force. Means are also provided to reduce the noise of the spinning valve below an annoying level.

Body fluid, drained or flowing from a body, as herein utilized, may include one or more of such substances as: blood, pus, excess fluids, exudates, clots, discharges, debris, effluvium, foams, etc. Such substances may be trapped within the aforesaid housing in a visual manner prior to the closing of the vacuum line. Should the fluid in the receiver be blood in a relatively pure state, such as from a punctured artery, it may be returned to the body of the patient, which is more receptive to its own blood than from a donor, except possibly in the relatively rare instances where exchange transfusion is indicated.

By way of example, and not by way of limitation, the present invention is shown and described as a system including a reusable canister and a disposable flexible plastic fluid receiver, although as stated above, a rigid receiver disposable or reusable, may also be utilized.

Other objects, features and advantages of the invention will be readily apparent from the following description of the preferred embodiments thereof, taken in conjunction with the accompanying drawing although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of an apparatus embodying principles of the instant invention shown in operative condition connected to the body of the patient in prone position;

FIG. 2 is a greatly enlarged fragmentary vertical sectional view through a portion of the apparatus taken substantially as indicated by the line II—II of FIG. 1;

FIG. 3 is a fragmentary vertical sectional view through the aforesaid housing showing the parts in inactive position;

FIG. 4 is a similar vertical section of the housing showing the valve in active position and indicating its movement in dotted lines;

FIG. 5 is a similar section through the housing showing the valve in closed position, sealing off the main vacuum line;

FIG. 6 is a fragmentary plan view of the housing;

FIG. 7 is a plan sectional view taken substantially as indicated by the lines VII—VII of FIG. 3; and FIG. 8 is an enlarged fragmentary sectional view taken substantially as indicated by the line VIII—VIII of FIG. 7.

DETAILED DESCRIPTION

The apparatus illustrated by way of example is of the general type as that shown in our U.S. Pat. No. 3,719,197 issued Mar. 6, 1973, and includes a rigid transparent plastic canister 1, closed at the bottom. The canister is open at the top and when in use is sealed at the top by means of a cover 2, also preferably made of plastic. Depending from the cover 2 is a flexible, transparent plastic receiver or bag 3 which collects the fluid. In the illustrated instance, the receiver 3 is secured to the inside of the cover 2 by welding, adhesively, or in any other satisfactory manner, although such securing is by way of example and is not critical.

With reference now to FIGS. 1 and 2 particularly, it will be seen that the body of the patient 4, in prone position upon a hospital bed 5, diagrammatically illustrated, is connected at the point where fluid drainage is necessary by a tubular line 6 to a fitting 7 in the canister cover 2. Fluid from the patient's body passes
through the tube 6 and fitting 7. The end of the fitting extending inside the cover is cut away as indicated at 8 substantially halfway around in order to decrease foaming of the fluid and guide the same away from a direct path to a tubular vacuum fitting 9 having a portion 10 inside the cover 2 extending to a lower level than the fitting 7 so that fluid may be stopped by cutting off the vacuum before there is a possibility of its siphoning back into the body of the patient. As seen in FIG. 1, the apparatus is mounted upon a conventional hospital stand, generally indicated by numeral 11.

Secured in the wall of the canister 1, preferably near the top thereof, is a tee 12, a leg 13 of which projects through an opening in the canister wall just sufficiently to open into the interior of the canister outside the bag 3. A housing 14 having a female fitting 15 at the top thereof is connected to one arm 16 of the tee 12, as best seen in FIGS. 3-5. At the bottom thereof, the housing is provided with a male fitting 17 in open communication with the interior of the housing. One end of an elbow 18 is attached over the fitting 17, and a tube 19 has one end connected to the vacuum line fitting 9 in the canister cover, and the other end connected to the opposite end of the elbow 18. A tube 20 connects the other arm of the tee 12 to a conventional vacuum source 21 which may be in the wall of a hospital room or leading to any other source of vacuum. Thus, it can be seen that the interior of the bag 3 is connected by way of the tube 19, tee 12, and line 20 to a source of vacuum, while the interior of the canister outside the liner is connected through the leg 13 of the tee and tube 20 to the same source of vacuum. Consequently, the vacuum within the liner and within the canister outside the liner are countervailed so that the liner will remain in expanded position and adequate vacuum will also be applied to the body of the patient. Such countervailing of vacuum is, of course, not necessary if a rigid receiver is utilized in lieu of the canister and bag 3. The difference in fittings at the top and bottom of the housing 14 prevent the housing from being mounted upside down.

At the outset, in the manufacture of the housing, the housing may be cast or molded in two parts with a substantially central line of separation 22, as there indicated in FIG. 5. After the parts are disposed within the housing or molded to the halves, the housing halves may be secured together in any suitable manner, but preferably by ultrasonic welding or the equivalent, and after being so joined, the joint is virtually invisible.

Spaced upwardly a short distance from the bottom of the housing 14 is a fixed deflector plate 23 firmly bonded to the inside wall of the housing. Beneath the deflector plate is a shallow chamber 24, at the center of which traveling air will enter through the fitting 17. This deflector plate 23 is provided with an annular recess or groove 25 surrounding a smoothly topped central table 26. The outer edge of the groove 25 is chamfered as indicated at 27 in FIG. 8. Around the chamfered edge 27 is a series of upwardly inclined deflector blades 28, each formed from a non-radial cut 29 in the outer margin of the plate and the deflector blade 28 in bent upwardly at the line of cut along an imaginary line 30 to form a blade sloping both upwardly and circumferentially of the deflector plate. All of the blades extend in the same direction, thereby causing air that enters through the fitting 17 into the chamber 24 and passing upwardly by the plate to form a vortex of whirl.

ing air above the deflector plate. In the center of the smooth topped table 26 is an upstanding spike 31 for a purpose that will later appear. Inside the top of the housing and integral therewith is a short depending cylinder made deliberately larger in diameter than the opening from the fitting 15 with which the depending cylinder 32 is concentric. At the lower end of the cylinder there is an inside chamber 33 which forms an annular knife-edge valve seat 34 at the lower end of the cylinder. Above the valve seat 34 is an annular guide flange 35 surrounding the cylinder and this guide flange has an upward chamfer 36 thereon to form a valve riding track.

Disposed between the deflector plate 23 and the valve seat 34 is a freely floating valve generally indicated by numeral 37. This valve 37 is of thin, lightweight plastic material and so shaped as to provide running surfaces that are smooth as possible and disposed so as to contact only smooth surfaces rather than edges in order to reduce friction and lessen noise made by the valve spinning rapidly. The valve is preferably made of one piece and is imperforate throughout. The valve has a large circular central portion 38 circumscribed by a depending groove formation formed by a smooth bend 39 at the outer circumference of the central portion 38, a downward smooth curvature 40 forming an upwardly open groove, the outer wall of which is topped by an outwardly flaring flange 41.

The valve is a little less in diameter than the inside diameter of the housing 14.

When the system is idle or, in other words, before suction is established, the valve will be in the position shown in FIG. 4. The only purpose of the spike 31 on the deflector 23 being to prevent the valve lying flat upon the deflector, which might interfere with its ultimate proper spinning position. When suction is established at the source 21 and consequently through the line 20, FIG. 1, air will pass through the fitting 17, and housing 14, as above explained. This air passing by the vanes or blades 28 will result in a vortex of air inside the housing. This vortex elevates the valve 37 from the position seen in FIG. 3 to the position seen in FIG. 4, a slantwise position. Due to the vortex, the valve will not spin in a horizontal plane but will take the oblique position shown in FIG. 4. The beginning of the air vortex is indicated by the arrows 42 of FIG. 8.

During operation of the system, the vortex of air in the housing 14 will move the valve 37 into the sloping position seen in FIG. 4. The valve will be guided to this position by virtue of the chamfer 27 on the deflector plate and the chamfer 36 on the guide flange 35 on the cylinder elements 32. At the outset, the flange 41 of the valve will contact the chamfer 36 and then the valve will be moved into the position whereby the curvature 30 forming the upwardly open groove contacting or tracking on the inside wall of the housing 14 at the point A, FIG. 4, while the curvature or smooth bend 39 of the valve will track on the chamfer 36 as indicated by B. The lower portion of the valve, namely the same curvature 40, will also contact and spin upon the central table 26 of the deflector plate as indicated at C. These tracking points A, B and C, all consist of smoothly molded portions of the valve and housing and consequently, friction is reduced to a minimum and noise of the spinning valve thereby lessened. The valve will continuously spin during operation of the system at a speed sufficiently to throw off any particles of fluid
that may contact it against the inside housing wall. It will also be noted that the valve spins in a manner closely approximating a precessional rotational movement.

During the continuous spinning of the valve, it will obviously create some noise and additional steps may be taken to keep that noise from reaching an annoying sound level. One such step may be the placing of a ring of soft rubber-like material, such as latex or a chemical foam within the groove formed by the bend 40 in the valve as indicated at 43. Such low density material will absorb much of the vibration thereby effecting quieter running. Another and quite effective step in silencing the noise of the valve well below an annoying sound level, is to place a pinch of a flour-like substance, such as cornstarch flour or tapioca in flour form, within the housing prior to the start of operation. Either or both, the low density ring 43 and the pinch of flour-like substance, may be utilized as deemed necessary, the latter functioning as a dry lubricant.

Of course, the valve is designed to operate continuously under normal air flow caused by the amount of vacuum and pressure differentials common to hospital requirements and will close with the introduction of relatively small amounts of liquid into the housing 14. In normal operation, the valve will be sucked against the valve seat 34 upon the entrance of fluid equivalent to 3 or 4 cubic centimeters of water entering the housing. The relatively large diameter of the valve seat is by choice in order to increase the surface area acted upon at low pressures and increase the sealing properties of the valve which will, when closed, be disposed flatly against the valve seat as shown in FIG. 5 and shut off all vacuum to the system.

When fluid within the receiving bag 3 approaches the lower end of the tubular portion 10 of the vacuum fitting 9 on the canister cover, some particles of fluid might be sucked up through the tube 10 and into the housing 14. Some of this fluid would be entrapped in the chamber 24 by virtue of its striking against the imperforate central portion of the deflector 23. Should fluid particles pass by the deflector 23 and reach the valve, they will be thrown outwardly against the inside wall of the housing 14, aided by the vortex of whirling air. Should such fluid reduce the inside diameter of the housing so that it approaches the diameter of the valve, the valve will flatten and be sucked upwardly to seat positively against the seat 34 and close off vacuum to the system and stoppage of air flow therethrough. It will be noted that due to the transparency of the housing and the structure therein, any fluid particles reaching the interior of the housing will be perfectly visible from a distance across the room, clearly indicating that some fluid has passed beyond the receiving bag, and vacuum should be intentionally stopped and a new receiving bag substituted for the one already in use. Such indication of fluid, notwithstanding the fact that the amount of fluid within the bag is plainly visible because of the transparency of the bag and the canister, would indicate to a very casual inspection that a new bag was required. That visibility, of course, lessens the probability of the patient being devoid of proper suction for fluid for an undesirable length of time. Should inspection of the system by unnecessarily delayed so that the amount of fluid in the bag 3 reaches a level closing off the flow of air through the tubular portion 10 of the vacuum fitting 9, the float disk will lay flat on top of the fluid entering the housing and be buoyed upwardly until it reaches a position where the vacuum is effective to suck the valve against the valve seat. The likelihood of such occurring is reduced to a minimum by virtue of the clear visibility of fluid within the housing, assuming that even most casual inspection of the system is neglected. In any event, contamination of the vacuum system in the hospital is eliminated.

In order to provide aseptic disposal of the receiving bag 3 and its contents, if the vacuum is intentionally turned off for substitution of a new bag 3 before any contaminated fluid has reached the housing 14, the elbow 18 and tube 19 may be disconnected from the fitting 17 and the elbow tightly pressed over the fitting 7 in the canister cover after the removal of the patient tube 6, as indicated in dotted lines FIG. 1, thereby providing a handle for carrying the canister cover, the receiving bag and the contents thereof. Should there be any trace of fluid within the housing 14, then the entire housing may be removed from the tee 12 and the female fitting on the top thereof pressed over the fitting 7 and the housing along with its contents disposed along with the bag 3 and the fluid therein in the same aseptic manner.

It is also noteworthy that the present system is highly useful in connection with autopsy proceedings, since body fluid may then be acquired from various parts of the body of a cadaver, in separate receiving bags, for later intensive study of the contents of each bag in an endeavor to ascertain the actual cause of death.

We claim:
1. A body fluid receiving system for use in locations where bodies are worked upon, said system including a fluid receiver with means for connecting the interior of the receiver to the body being worked upon and also to a vacuum system, wherein the improvement comprises
   a transparent housing in the vacuum line mounted so air passes through said housing from one end to the other drawn by the vacuum system, and
   entrapment means in said housing to entrap fluid particles in a manner visible from a distance to denote to an observer that some body fluid has passed beyond the receiver,
   said entrapment means including a deflector plate spaced inwardly from the inlet end of the housing and shaped to cause the air passing through to assume a vortex.

2. The system of claim 1, including a floating valve disc spun rapidly by the air vortex.

3. The system of claim 1 including a circumferential series of blades on said deflector plate sloping in a manner to cause said vortex.

4. The system of claim 3, wherein said valve disc spins bodily in a manner approximating a precessional rotational movement.

5. A body fluid receiving system for use in locations where bodies are worked upon, said system including a fluid receiver with means for connecting the interior of the receiver to the body being worked upon and also to a vacuum system, wherein the improvement comprises
   a transparent housing in the vacuum line mounted so air passes through said housing from one end to the other drawn by the vacuum system, and
   entrapment means in said housing to entrap fluid particles in a manner visible from a distance to denote
to an observer that some body fluid has passed beyond the receiver,
said entrapment means including a spinning valve disc capable of throwing off fluid particles by centrifugal force against the inner wall of said housing.
6. The system of claim 5, wherein said valve disc has a circumferential groove therein, and a soft substance is inserted in said groove to absorb vibration and reduce the noise of the spinning valve disc.
7. The system of claim 5, including a pinch of a substance in flour form capable of acting as a dry lubricant to reduce the noise of the spinning valve disc.
8. A body fluid receiving system for use in locations where bodies are worked upon, said system including a fluid receiver with means for connecting the interior of the receiver to the body being worked upon and also to a vacuum system, wherein the improvement comprises a transparent housing in the vacuum line, an inlet fitting at one end of said housing, and an outlet fitting at the other end of said housing, both said fittings communicating with the interior of said housing and connected in the vacuum line to make the housing a component part thereof, and means in said housing to entrap fluid particles in a manner visible from a distance to denote to an observer that some body fluid has passed beyond the receiver,
said entrapment means including means to cause air passing through said housing to assume a vortex, and a valve disc spun rapidly to the vortex of air.
9. The system of claim 8 including a valve seat adjacent the outlet from said housing against which said valve disc will seat when drawn thereagainst by suction after some fluid has entered the housing.
10. The system of claim 9 including guide means between said valve seat and the outlet from said housing to guide the valve disc into and maintain it in position to spin bodily in a manner approximating a precessional rotational movement.
11. The system of claim 10, including a cylinder around the outlet of the housing and extending inwardly from the end of the housing, said valve seat being at the inner end of said cylinder, a smooth topped table on the means causing incoming air to assume a vortex, said guide means comprising a flange on said cylinder having a smooth chamfered circumference, said valve having a circumferential groove therein defined by an inner curvate top edge and a curvate portion defining said groove, whereby during its spinning motion the inside curvate edge at the groove in said valve disc tracks on the chamfer of said guide means, and the curvate groove portion tracks on the inside wall of said housing and said table, all smooth surfaces of contact.
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