United States Patent

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[73] Assignee by said David S. Sheridan, Argyle, N.Y.

[54] MEDICO-SURGICAL SUCTION SYSTEMS
4 Claims, 9 Drawing Figs.

[52] U.S. Cl. 128/276, 128/2
[51] Int. Cl. A61m 1/00
[50] Field of Search 128/2, 276–278, 348–350, 297–300; 32/33

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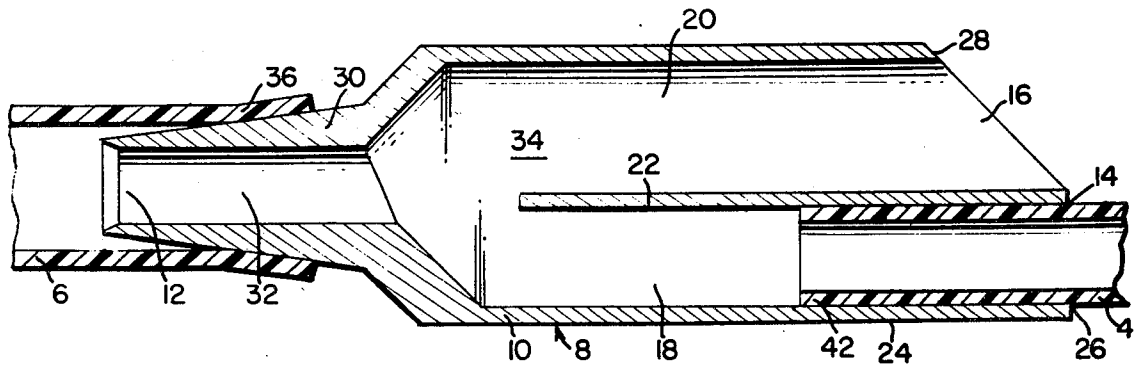
ABSTRACT: Medico-surgical suction systems capable not only of aspiration of body fluids from patients, but also precise collection of mucus samples, all under controlled vacuum conditions, include, as separate units, a fingertip-operated vacuum controller and liquid-sampling unit. The vacuum controller provides accurate regulation of suction during aspiration while isolating the operator's control finger from the suctioned fluid stream.



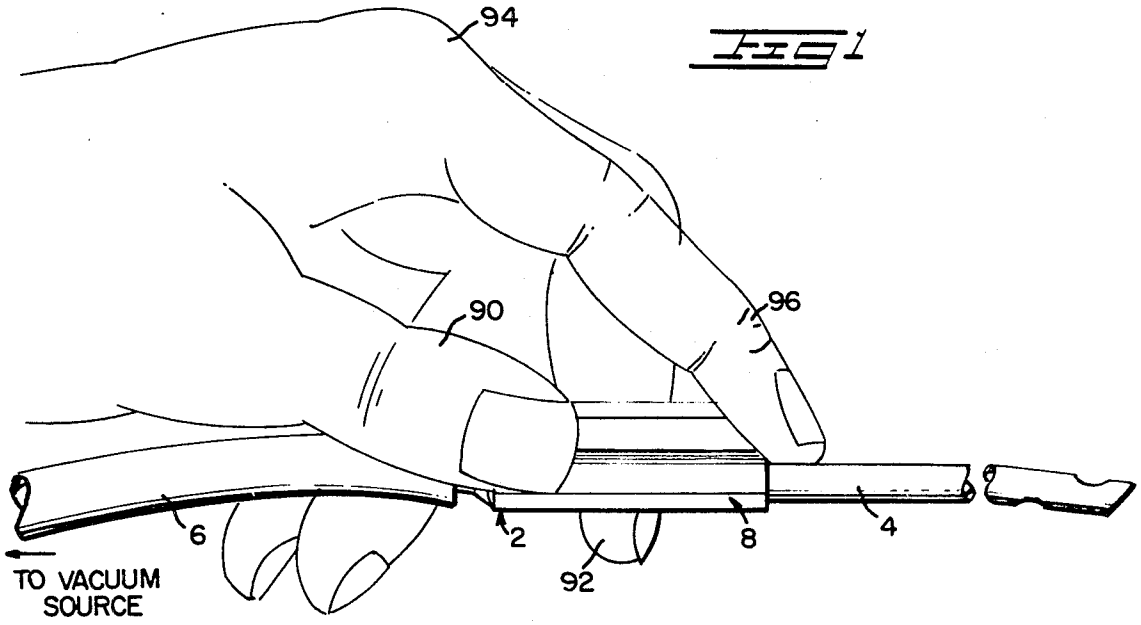


Fig 1

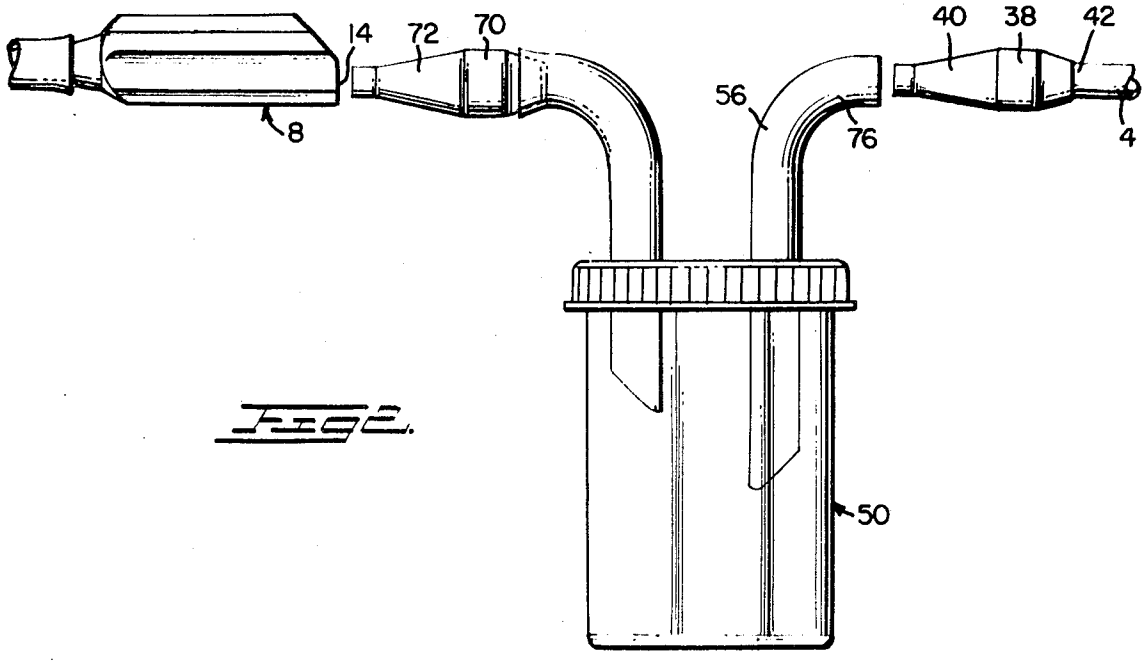


Fig 2.

Fig 3.

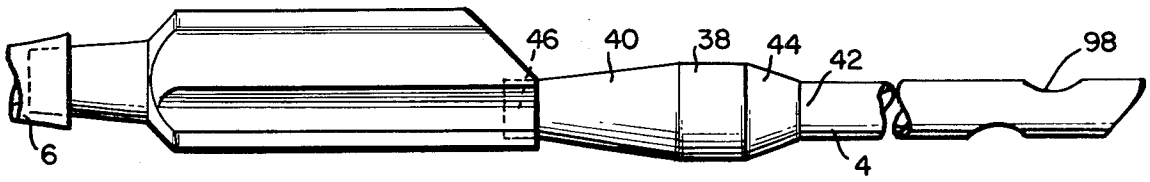


Fig 4.

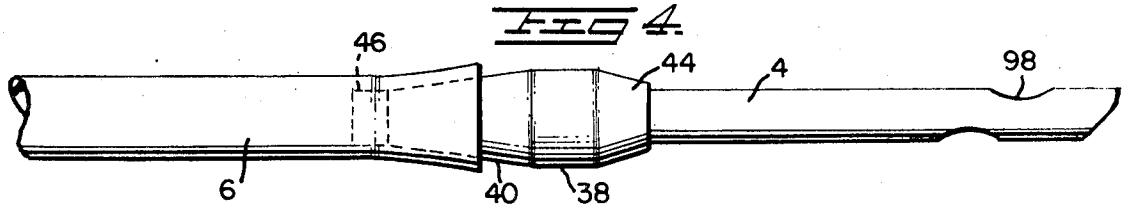


Fig 5.

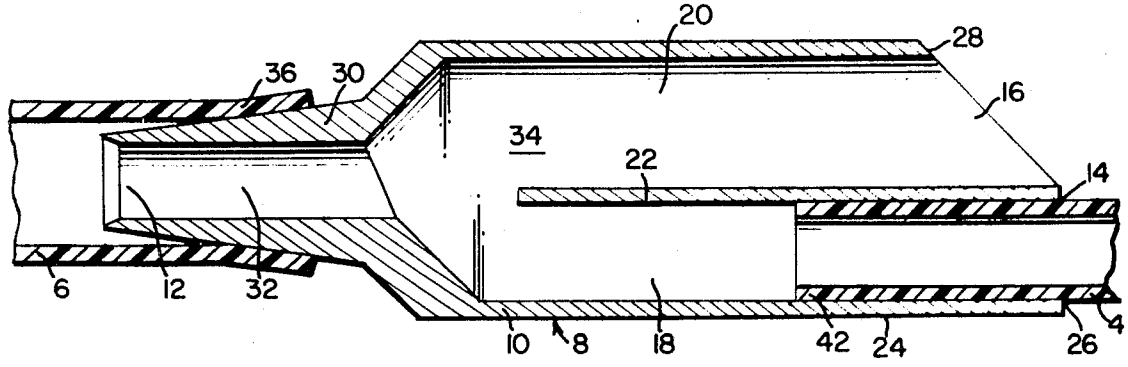
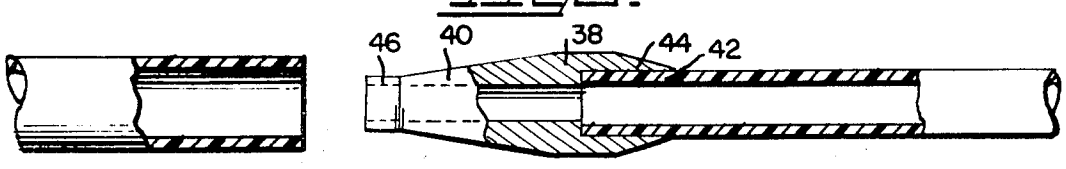


Fig 6.



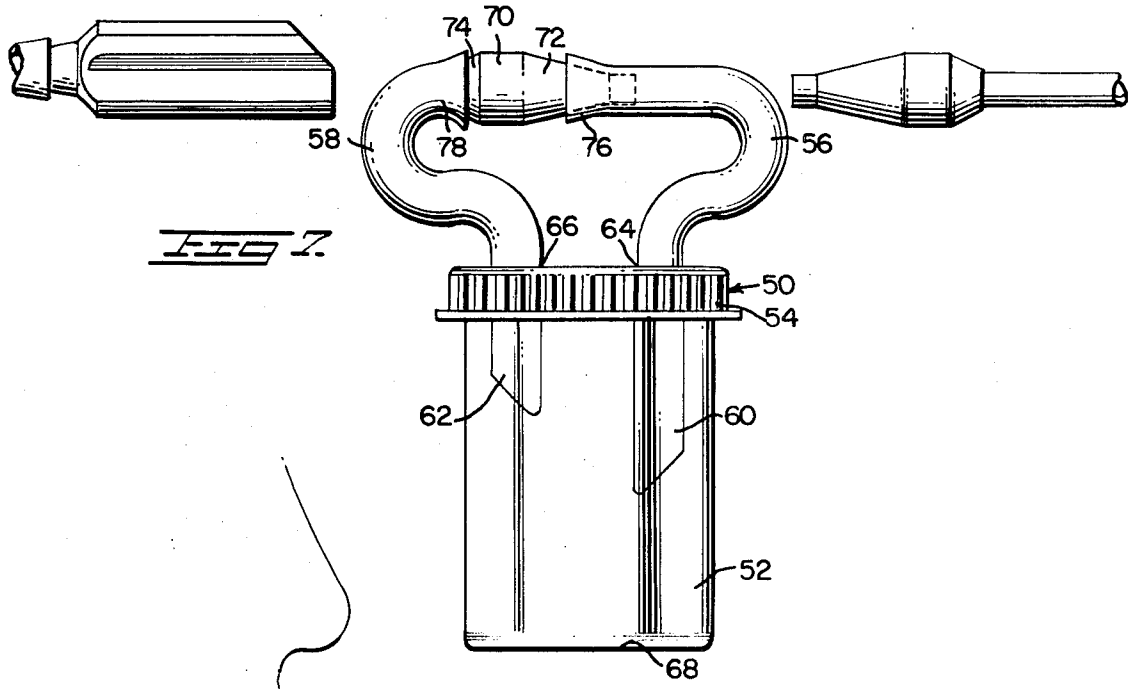


Fig 7.

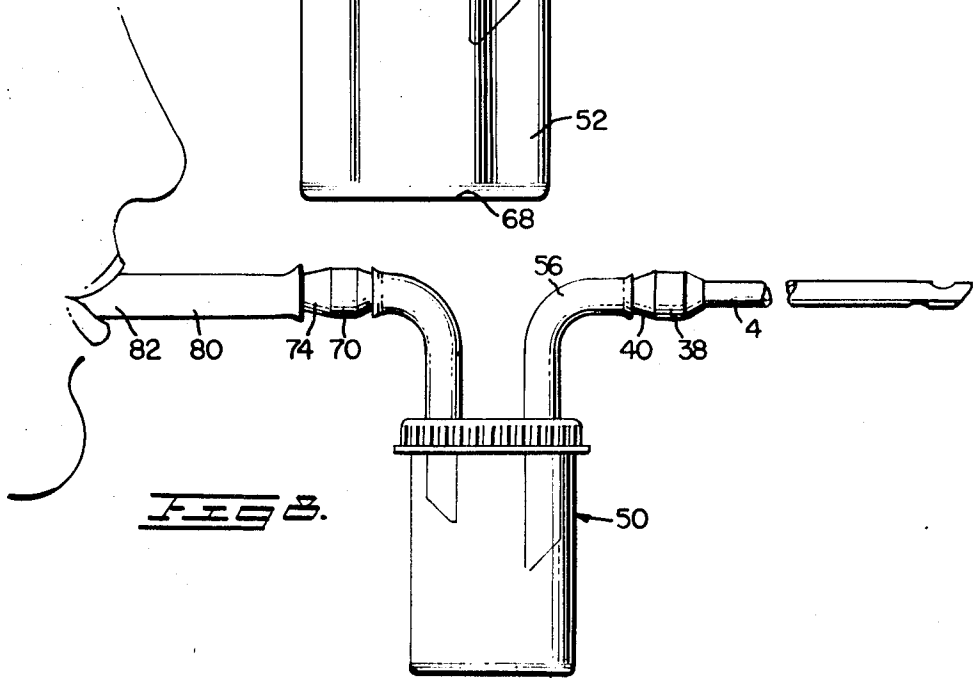


Fig 8.

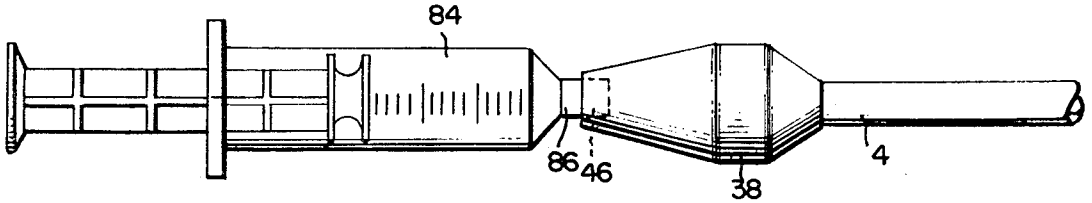


Fig 9.

MEDICO-SURGICAL SUCTION SYSTEMS

BACKGROUND OF THE INVENTION

Medicosurgical suction devices in a variety of forms are used in a number of different ways in medical and surgical procedures. Such devices may be, for example, suction catheters which are used for the aspiration of mucus from the nose, mouth, pharynx, trachea or bronchi of patients. Alternatively, medicosurgical suction tubes may be used for connection to sump drain tubes or other pieces of equipment or structures where application of a vacuum as a part of a clinical or surgical operation is required.

The control of suction, either in extent of time or degree of vacuum may be required in connection with the use of medicosurgical suction systems. In many types of patient treatments, it is frequently necessary for the person administering the treatment to have some means associated with a suction tube to permit vacuum to be instantaneously controlled from an on to an off position and vice versa. A convenient way of accomplishing this has been to provide a small aperture somewhere in the suction tube structure and control of suction has been accomplished by the person administering the treatment placing a thumb or finger over this aperture. As can be understood, closing the aperture with the thumb or finger induces the vacuum whereas uncovering the aperture breaks the vacuum by admitting atmospheric air to the system. The control aperture in some devices has been constructed in a suction catheter near the proximal end (see U.S. Pat. No. 3,375,828).

The direct contact of a thumb or finger of a person administering treatment to a patient using the medicosurgical suction tube as a means for control of the suction has been recognized by the medical profession and surgical equipment manufacturers as a potential source of contamination. Accordingly, it would serve to aid maintenance of sterile conditions if some means were provided by which the convenience of control of suction in devices of this type could still be accomplished by simple manipulation of a thumb or finger but at the same time the thumb or finger would be isolated from the direct flow or stream of suctioned air or liquid flowing in the system. However, in providing such an improvement, there is the requirement of assuring that the means provided to isolate the control finger from the suctioned fluid stream does not interfere with absolute and immediate response of the system to the movement of the thumb or finger of the operator. There could be disastrous results if the control means failed to permit the vacuum to be broken as soon as required.

In addition to use of suction systems for aspiration of body fluids for disposal, they may also be employed for obtaining samples of mucus or other body fluids for laboratory evaluation. In the past, such sampling has often involved use of sampling devices difficult to assemble and/or inefficient in use because of need for special handling, separate sterilization or the like. Such sampling procedure, therefore, would be improved if there were available sampling units that were presterilized, disposable after one use and quickly insertable into the medicosurgical suction system.

OBJECTS

A principal object of this present invention is the provision of new medicosurgical suction systems. Further objects include the provision of:

1. Vacuum controllers for medicosurgical suction tubes, e.g., suction catheters or the like, in which control of the suction can be obtained by manipulation of a thumb or finger of the person administering treatment to a patient but in which the thumb or finger effecting the control is isolated from the suctioned fluid stream.

2. Improved vacuum controllers for medicosurgical suction tubes which can be made and sold at relatively low cost for use with disposable suction catheters or the like intended for only a single patient.

3. Such vacuum controllers which are positive in operation ensuring immediate response to movement of a thumb or finger of an operator in use of the suction system involving the vacuum controller.

4. a liquid-sampling unit for a medicosurgical suction system that is constructed for immediate insertion into the suction tube line from a presterilized, sealed, self-contained condition.

5. Such a liquid-sampling unit of a disposable type designed for single use with a single patient.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description, while indicating preferred embodiments of the invention, is given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description. It should also be understood the foregoing abstract of the disclosure is for the purpose of providing a nonlegal brief statement to serve as a searching-scanning tool for scientists, engineers, and researchers and is not intended to limit the scope of the invention as disclosed herein nor is it intended it should be used in interpreting or in any way limiting the scope or fair meaning of the appended claims.

SUMMARY OF THE INVENTION

The foregoing objects are accomplished according to the invention by constructing a medicosurgical system to include a suction catheter, a connector tube separate from said catheter adapted to join said system to a vacuum source and a vacuum controller connecting said catheter to said connector tube, said controller comprising a longitudinally extending body, a single opening at one end and a pair of openings at the opposite end of said body, a first bore extending axially a substantial distance within said body from one of the openings of said pair, a second bore parallel to and separate from said first bore extending axially within said body from the other opening of said pair, a third bore extending axially within said body from said single opening, said first, second and third bores being interconnected with one another by a cavity positioned in said body substantially closer to said single opening than to said pair of openings.

Advantageously, in the new suction systems, the connector tube is joined to the single opening of the controller and the suction catheter is joined to one of the openings of the pair of openings at the other end of the controller. Also, the end of the body of the controller which forms the pair of openings presents a face which is square to one of the openings of said pair and is angled with respect to the second opening of said pair of openings.

The new suction systems also include a liquid-sampling unit which comprises a container, a removable cap for the container, a pair of flexible tubes each having an end extending through said cap with a fluidtight junction between the cap and the side of the tube and a tube connector having two opposed tapered male connector portions, the free end of one of said flexible tubes being fitted in a fluidtight manner over one of said male connectors and the free end of the second of said flexible tubes being similarly fitted over the other of said male connectors, and a sterile atmosphere chambered within the internal volume defined by said container cap, tubes and connector.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the medicosurgical suction systems of the invention may be had by reference to the accompanying drawings in which:

FIG. 1 is a fragmentary side elevational view of a medicosurgical suction system in accordance with the invention comprising a suction catheter, a connector tube and a vacuum controller;

FIG. 2 is a fragmentary side elevational view of a liquid-sampling unit for the new medicosurgical suction systems;

FIG. 3 is a fragmentary enlarged side elevational view of the portion of the medicosurgical suction system shown in FIG. 1;

FIG. 4 is a fragmentary enlarged side elevational view of the suction system portion of FIG. 3 with the vacuum controller removed from the system;

FIG. 5 is a fragmentary enlarged side sectional view of another embodiment of the vacuum controller portion of the new suction systems;

FIG. 6 is an enlarged fragmentary side sectional view showing the embodiment of FIG. 3 in the course of changeover to the embodiment shown in FIG. 4;

FIG. 7 is a fragmentary side elevational view of a suction system of the invention being prepared for insertion of a liquid-sampling unit into the system;

FIG. 8 is a side elevational view of a pediatric modification of the new suction systems; and

FIG. 9 is a fragmentary top plan view of a modification of the suction system which employs a plunger syringe as the pressure or suction source for the system.

DETAILED DESCRIPTION

Referring in detail to the drawings, a medicosurgical suction system 2 of the invention comprises a suction catheter 4, a connector tube 6 separate from the catheter adapted to join to a vacuum source (not shown) and a vacuum controller 8.

The vacuum controller 8 comprises a longitudinally extending body 10, a single opening 12 at one end and a pair of openings 14 and 16 at the opposite end. There is a first bore 18 extending axially a substantial distance within the body 10 from the opening 14 and a second bore 20 parallel to but separated by the wall 22 from the bore 18. The bore 20 is larger in cross section than the bore 18 and extends axially within the body 10 from the opening 16. The inlet end 24 of the body 10 has a face 26 which is square to the bore 18 and defines the opening 14. It further has a face 28 which defines the opening 16 and is angled with respect to this opening and the bore 20.

The controller body 10 has a tapered male connector 30 in which a bore 32 extends from the opening 12 to a cavity 34 which is positioned in the body 10 substantially closer to the single opening 12 than to the pair of openings 14 and 16. The cavity 34 forms an interconnection between the two parallel bores 18 and 20 and the opposed single bore 32.

The vacuum controller 8 is operatively joined to the connector tube 6 by having the end 36 of the connector tube pushed over the male connector portion 30 of the controller 8. A fluidtight connection is readily accomplished in this fashion due to the inherent resiliency in rubber or plastic material of which the connector tube 6 is formed. Formation of such tubes by plastic extrusion or other means of fabrication are well known in the rubber or plastic art and need not be described in detail here.

The vacuum controller 8 may be fabricated from various materials and in various ways. Advantageously, it may be made by injection molding from rigid plastic such as polystyrene, nylon, hard rubber or the like. Alternatively, it can be formed of metal such as by casting or by punching, drilling, or similar metalworking techniques. Fabrication by plastic molding is advantageous since this enables these units to be made in large quantity at low cost so that they may be used as "single patient, disposable" items.

Junction between the suction catheter 4 and the vacuum controller 8 can be accomplished in a variety of ways. Since aspiration of mucus from a patient following surgery or another medical or clinical treatment may be required to be performed many times a day on the same patient, it is advantageous to have a quickly detachable connection between the vacuum controller 8 and the suction catheter 4 so that the suction catheters can be disposed of after each aspiration while the vacuum controller 8 and connecting tube 6 remains the same for a single patient. This can be accomplished by providing the suction catheter 4 with a connector 38 comprising at one end a tapered male connector 40, the catheter proximal end 42 being inserted in the opposite end 44 of the connector and permanently joined to the connector 38 by being cemented in the end 44 or otherwise attached such as by heat welding, induction welding or the like. As seen in FIG. 3, the tip 46 of the male-tapered end 40 of the connector 38 is of such size that it can be press fit into the opening 14 of the controller 8. Alternatively, as shown in FIG. 4, the connector 38 may be taken out of the vacuum controller 8 and pushed into the connecting tube 6, e.g., in a procedure in which a continuous vacuum is to be applied to the suction catheter 4 instead of controlled application of vacuum using the controller 8.

An alternative method of connecting the suction catheter 4 to the controller 8 is shown in FIG. 5. Here, the proximal end 42 of the suction catheter 4 is formed with an outside diameter substantially the same as the inside diameter of the bore 18. The proximal end 42 of the catheter is then solvent welded into the bore 18 or otherwise permanently joined to the vacuum controller 8 such as by induction welding, heat welding or the like. In this form of construction, the vacuum controller 8 would be discarded along with the suction catheter 4, i.e., the controller 8 and suction catheter 4 together would constitute a single disposable unit.

A liquid-sampling unit 50 for the medicosurgical suction systems of the invention comprises a container 52, a removable cap 54 and a pair of flexible tubes 56 and 58. The end 60 of tube 56 and the end 62 of the tube 58 both extend through the cap 54 with a fluidtight junction between the cap and the side of the tube. Such a fluidtight junction can readily be obtained with extruded vinyl plastic or rubber tubes used in forming medicosurgical devices by making the holes 64 and 66 in the cap 54 slightly smaller in diameter than the outside diameter of the tubes 56 and 58. The tubes have sufficient resiliency to permit the ends 60 and 62 to be forced through the holes 64 and 66 and when this is done, a fluidtight connection between the sidewalls of the tubes 56 and 58 and the cap 54 is obtained. If desired, additional sealing material, such as an elastomeric cement or the like, can be applied around the edges of he holes 64 and 66.

The end 60 of the tube 56 is positioned closer to the bottom 68 of the container 52 than the end 62 of the tube 58. The tube 56 is connected to the suction catheter (see FIGS. 2 and 8) so that liquid being sampled will be guided to the bottom of the container 52 avoiding entrainment in air or other gas which will pass through the tube 58 via the end 62.

The liquid-sampling unit 50 can be produced in a ready to use form with a sterile atmosphere chambered within the internal volume of the unit by using the arrangement shown in fIG. 7. This is accomplished by providing a tube connector 70 having a pair of opposed tapered male connectors 72 and 74. Such a connector is advantageously molded of plastic material although it may be formed in other ways such as metal casting, machining of metal or plastic or the like.

The free end 76 of tube 56 is fitted in a fluidtight manner over the tapered end 72 of the connector 70 and the free end 78 of the other flexible tube 58 is similarly fitted over the tapered end 74 of the connector. This arrangement produces a sealed liquid-sampling unit. The internal volume of the unit including the atmosphere can then be sterilized in known manner such as by gamma ray radiation, exposure to ethylene oxide vapors or in any other suitable manner.

The sterilized liquid-sampling unit as shown in FIG. 7 can be incorporated in the new suction systems as illustrated in FIG. 2. This is accomplished by removing the tube 56 from the end 72 of the connector 70 and inserting the end 72 into the mating opening 14 of the vacuum controller 8. The free end 76 of the tube 56 is then forced over the tapered end 40 of the connector 38 fixed to the proximal end 42 of the suction catheter 4. The location of the vacuum controller 8 downstream of the liquid sampler unit 50 in such an arrangement serves to prevent any contamination of the sample being taken.

For delicate control of suction in operation of the liquid-sampling unit **50**, e.g., with infants, instead of connecting the tube **58** to a mechanical source of vacuum, an extension tube **80** (see FIG. **8**) is fitted over the end **74** of the connector **70**. The free end **82** of the tube **80** is then held in the physician's mouth and he provides the required suction to aspirate the sample from the infant patient.

As an alternative to the use of a physician's mouth suction for delicate control of vacuum in pediatric use of a liquid-sampling unit of the invention, delicate suction may be obtained through the use of a plunger syringe (see FIG. **9**). Thus, the syringe **84** having a standard tapered male connector **86** may be inserted into the tip **46** of the connector **38** fixed to a suction catheter **4**. This arrangement permits a sample to be collected directly into the syringe **84** through the suction catheter **4** or alternatively permits liquid which would be initially placed in the syringe **84** to be injected into a patient through the catheter **4**. If it were desired to hold the liquid sample obtained when a syringe is used for the vacuum source in a sampling unit of the type **50**, an alternative arrangement to that shown in FIG. **9** can be used. Thus, an assembly such as shown in FIG. **8** would be employed but the syringe **84** would be substituted for the extension tube **80**. In this manner, delicate suction from the syringe **84** could be applied to the patient through the container **50** and the catheter **4** to withdraw a liquid sample from the patient into the container.

DESCRIPTION OF USE

The vacuum controllers for the new medicosurgical suction systems of the invention possess a number of features valuable not only in actual use of the suction systems but also in their packaging and handling. Some of these may be appreciated by reference to FIGS. **1** and **5**. The slim, elongated form of the vacuum controller **8** permits the controller to be easily grasped between the thumb **90** and middle finger **92** o the operator's hand **94**. When so held, the sloped face **28** of the opening **16** is easily covered by the operator's index finger **96**. Since the control opening **16** of the controller **8** points in the direction of the suction catheter **4**, and in turn the direction of the patient, the operator's hand **94** may assume a relaxed position with the controller **8** easily balanced between the thumb and finger **92** permitting the index finger **96** to be quickly moved to open or close the control opening **16** so as to apply or remove suction as required by the procedure being performed upon the patient.

Using the separable suction catheter form of system as shown in FIG. **1**, the suction catheter may be installed in the patient in the manner required without being burdened with other portions of the suction system. When this has been accomplished, the controller **8** and the attached connecting tube **6**, in turn joined to a vacuum source (not shown), may be operatively united with the suction catheter by inserting the tip **46** of the connector **38** on the catheter **4** into the controller opening **14**. So long as the opening **16** in the controller is uncovered, no suction will be applied to the catheter although it is continually applied to the connecting tube **6** since air from the ambient atmosphere will be drawn through opening **16** and bore **20** to relieve the vacuum being applied through the connecting tube **6**. Complete absence of any vacuum on the catheter through bore **18** under such circumstances is insured by having the cross-sectional area of the bore **20** larger than the cross-sectional area of the bore **18**.

Covering the opening **16** with the index finger **96**, or if more convenient to the operator, the thumb or any other finger, results in substantially instantaneous application of vacuum to the suction catheter **4** by way of the bore **18**.

At the completion of any particular aspiration of mucus or other fluid from the patient's body, the suction catheter **4** may be withdrawn, disconnected from the controller **8** and discarded. The next required aspiration of mucus or the like is then accomplished by repeating the procedure as described above using a new disposable suction catheter **4**. A single vacuum controller **8** may be used continually on one patient and then discarded. However, if extreme contamination problems are associated with an individual case, it is not unreasonable to discard the vacuum controller and connecting line since these can be furnished inexpensively due to their simple but effective structure. Of course, in the form of suction system shown in FIG. **5**, in which the vacuum controller **8** is permanently cemented or otherwise attached to the suction catheter **4**, the controller will necessarily need to be discarded when the catheter is thrown away.

The structure of the vacuum controller **8** isolates the control finger **96** of the operator from the fluid stream passing through the system comprising the catheter **4**, bores **18** and **32** and the connector tube **6**. The wall **22** separating the bore **18** from the bore **20** prevents any direct contact of the finger **96** with aspirated fluid passing through the system. When the opening **16** is closed by the finger, a closed chamber is produced in the bore **20** and fluid will flow directly from bore **18** to bore **32** without entering the bore **20**. When the opening **16** is uncovered, flow of air from the atmosphere into the system through bore **20** will clear the junction chamber **34** of any fluid aspirated from the patient and thus serve to maintain isolation of the opening **16** from the aspirated fluid stream.

With reference to advantages of the structure of the controller **8** relative to packaging, the slim elongated construction permits the controller to be enclosed in a simple envelope-type package since it will not cause any great protrusion of the envelope sides, and there are no sharp edges or the like likely to puncture or snag the envelope. An attached form of controller is shown in FIG. **5** or the separable controller as illustrated in FIG. **1** can be packaged in this manner. Inclusion of a connecting tube, vacuum controller and suction catheter in a single envelope is advantageous since this permits all of these units to be packaged and stored in a sterilized condition ready for use. Cellophane, polyolefin film, vinyl plastic film or the like can be used for the packaging envelope and sterilization can be accomplished by gamma radiation, ethylene oxide exposure or other suitable means. If desired, the liquid-sampling unit can also be included in such an envelope package. Alternatively, the sampling unit can be marketed and stored in a separate package but even in the absence of a package, internal atmosphere of the sampling unit will remain in sterile condition when the unit is maintained in the closed form as shown in FIG. **7**.

As shown in FIG. **4**, the vacuum controller **8** may be removed from the suction system where conditions require application of a continuous vacuum through the catheter **4**. Should such conditions change requiring again the application of a controlled intermittent suction, the vacuum controller can be reinserted in the system as shown in FIG. **3**.

When the taking of a sample of liquid from the patient is required, such as for laboratory examination, this is accomplished by inserting the sampling unit **50** into the system as illustrated in FIG. **2**. The sterile condition arrangement of the sample unit **50** (see FIG. **7**) is opened so that the connector **70** remains on the flexible tube **58** and the tapered end **72** of the connector is pushed into the opening **14** of the controller **8**. Also, the suction catheter, which has been disconnected from the controller **8**, is inserted in the free end **76** of the flexible tube **56**. Controlled application of suction is then accomplished in a manner described above, using the controller **8** to withdraw from the patient through the suction catheter **4** a desired volume of body liquid into the container **52**. When this has been accomplished, the sampling unit **50** is disconnected from the suction system by reversing the procedure of connection to end up with sampling unit in a form as shown in FIG. **7** with the sampled liquid within the container **52** and the unit again sealed by joining of the tubes **56** and **58** through the connector **70**. The entire unit can then be forwarded to the clinical laboratory or other required location. The container **52** can be formed with a snap-on-type cap **54** or screw-type cap permitting the unit containing the liquid sample to be readily uncapped, the sample withdrawn and required tests applied to

it. Advantageously, the container **52** can be formed such as by injection molding, blow molding or the like of plastic such as polystyrene, vinyl plastic, polyolefin plastic, glass or other suitable material. Crystal clear or transparent material is advantageous in forming the container since this enables the physician to determine the volume of sample immediately during its taking, the container can be provided with volumetric markings or other indicia to aid in such procedure. However, if required, the container **52** can be formed of opaque material, e.g., molded plastic, paper, vulcanized fiber or the like.

To provide a full range of suction systems as may be required by present or future medical or clinical practice, the new systems can be packaged and marketed in various catheter sizes, e.g., French size 3½ to 18 and various sizes and lengths of connector tubes. Greater flexibility in meeting requirements of special hospitals or the like, can be attained by providing connecting tube of a maximum length, e.g., 6 to 10 feet, in each sterile package since the operator may readily cut off unnecessary length with a knife or scissors at the location of use. The suction catheters which would be supplied as components of the new suction systems may include distal end eyes **98** or other suitable openings, X-ray opaque markings, indicia indicating distance from the distal end or other embellishments well known in the art of construction of medicosurgical tube devices.

The embodiments of the invention in which an exclusive property or right is claimed are defined as follows:

1. A medicosurgical suction system vacuum controller comprising a longitudinally extending body, a tapered male connector member extending axially from one end of said body, a first opening at the end of said connector member, a second opening and a third opening, in the end of said body opposite to said connector member, a first bore extending axially a substantial distance within said body from said second opening, the end of said body defining said second opening being substantially perpendicular to the axis of said first bore, a second bore parallel to and separate from said first bore extending axially within said body from said third opening, the end of said body defining said third opening being at an acute angle to the axis of said second bore, and a third bore extending axially within said connector member from said first opening, said first, second and third bores being interconnected with one another within said body by a cavity positioned in the body substantially closer to said first opening than to said second and third openings.

2. A vacuum controller as claimed in claim **1** wherein said second opening is fixed to the proximal end of a catheter for fluid flow from the catheter into said first bore.

3. A mediocosurgical suction system which comprises a suction catheter, a connector tube separate from said catheter adapted to join said system to a vacuum source and a vacuum controller connecting said catheter to said connector tube, said controller comprising a longitudinally extending body, a tapered male connector member extending axially from one end of said body, a first opening at the end of said connector member, a second opening and a third opening in the end of said body opposite to said connector member, a first bore extending axially a substantial distance within said body from said second opening, the end of said body defining said second opening being substantially perpendicular to the axis of said first bore, a second bore parallel to and separate from said first bore extending axially within said body from said third opening, the end of said body defining said third opening being at an acute angle to the axis of said second bore, and a third bore extending axially within said connector member from said first opening, said first, second and third bores being interconnected with one another within said body by a cavity positioned in the body substantially closer to said first opening than to said second and third openings.

4. A suction system as claimed in claim **3** wherein said connector tube is joined to said first opening and said catheter is joined to said second opening.