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July 19, 1966 F. J. WALLACE 3,261,356

SUCTION AND ILLUMINATION DEVICE

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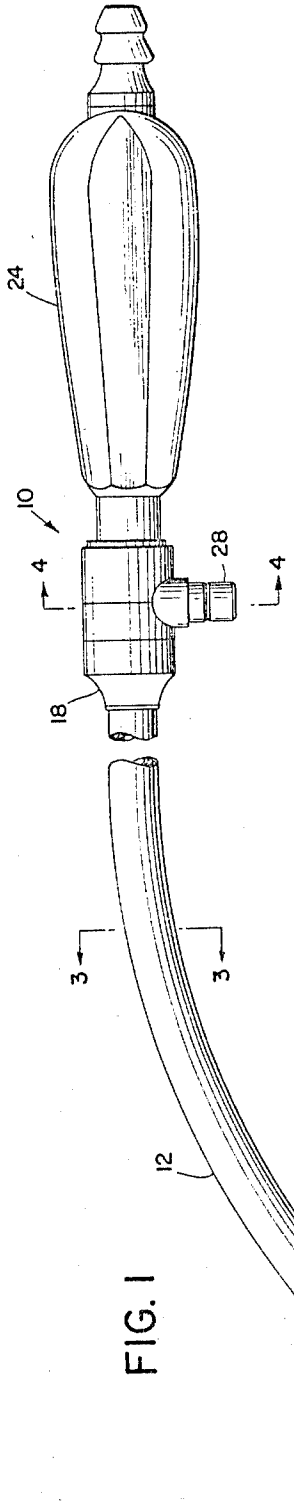

FIG. 1

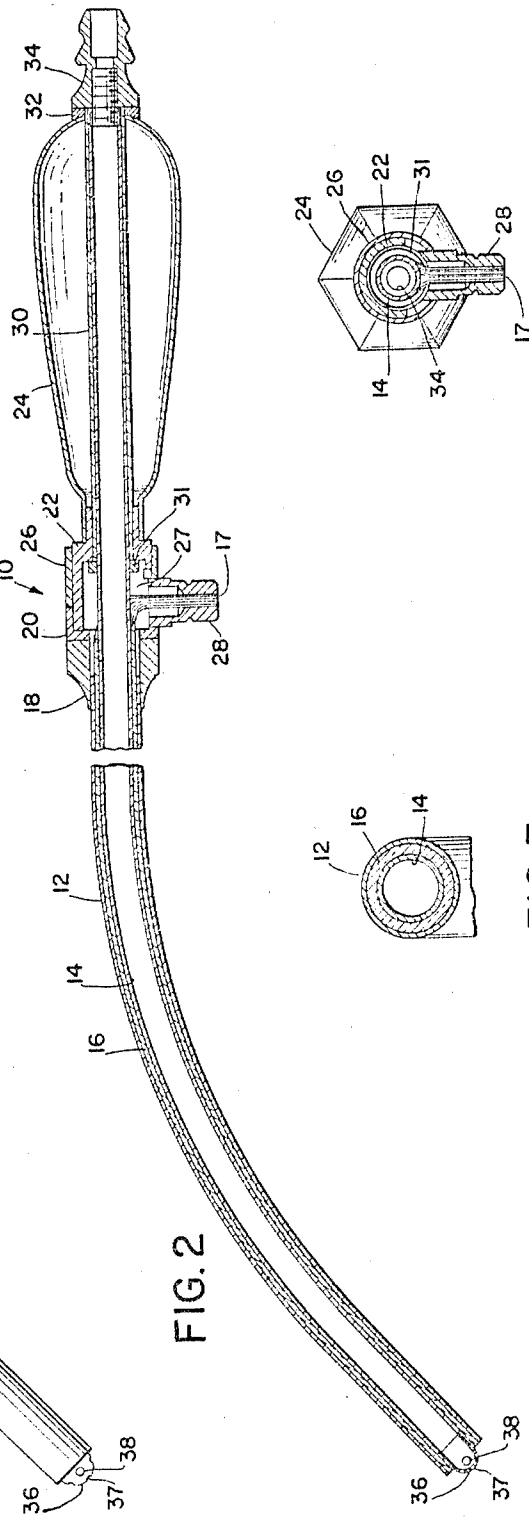

FIG. 2

FIG. 4

FIG. 3

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SUCTION AND ILLUMINATION DEVICE

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3 Claims. (Cl. 128—276)

This invention relates to a surgical instrument and more particularly to an instrument which is especially well suited for the removal of body fluids such as blood from a surgical wound and for simultaneously illuminating an area of the wound so that the same can be visualized by the surgeon.

This application is a continuation-in-part of my application Serial No. 305,304 filed August 29, 1963, and assigned to the assignee of the present application.

It is often necessary during the course of a surgical procedure, for body fluids, such as blood, to be removed from the area of the surgical wound in order that the same may be visualized by the surgeon. The arrangements hitherto provided for the removal of such fluids from and for the illumination of surgical wounds have left much to be desired. This is true not only when conventional hot light sources are utilized but also when there is utilized the more recently available cold sources of intense illumination made possible by the use of fiber optics.

This may be better appreciated when it is understood that it is often necessary to maintain a surgical suction device in place in the wound in order to permit the surgeon to visualize the point at which the bleeding has occurred. Particularly when such a suction device is in place, it is extremely difficult and often impossible to prevent the suction device from interfering with the desired illumination.

It is, therefore, a principal object of the present invention to provide a suction and illumination device which is especially well suited for use in carrying out surgical procedures and which provides for simultaneous evacuation of fluids from and illumination of a surgical wound.

Another object of this invention is to provide such a device which is capable of providing highly intense illumination and yet which is extremely sturdy in construction and may be sterilized by boiling, autoclaving or chemicals, without deleterious results.

Further objects as well as advantages in the present invention will be apparent from the following description and the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a light carrying surgical suction and illumination device constructed in accordance with the present invention;

FIGURE 2 is a longitudinal cross-sectional view thereof;

FIGURE 3 is a transverse cross-sectional view taken generally along line 3—3 of FIGURE 1 on an enlarged scale; and

FIGURE 4 is a transverse cross-sectional view taken generally through the line 4—4 of FIGURE 1.

The objects of this invention may be accomplished by joining two tubular members in concentric relation with an annular bundle of light-conducting fibers between them. At their distal ends, the two tubes and the light-conducting fibers terminate substantially in alignment with one another. The outer tube terminates adjacent to a handle through which the inner tube extends, thus providing a central passageway extending through the entire length of the instrument which is adapted at its proximal end for connection to a suitable source of suction. A perforated guard is connected to the distal end of the inner tube to prevent mucosa from being sucked into the lumen of the instrument and thereby blocking the same.

The distal end of the light-conducting fiber bundle is formed into an annular configuration, while at its proximal end, the fibers are gathered together to form a rod the end of which receives light from an external source. Light is preferably supplied by juxtaposing to the end of the rod, one end of a flexible light-conducting bundle, the other remote end of which receives light from a suitable high intensity light source. Such an arrangement provides intense illumination at the distal end of the suction and illumination device, thus permitting simultaneous removal of blood and other fluids from a surgical wound and intense illumination of the cleared area. An important advantage of the present invention is that a surgeon may now more readily and more clearly visualize desired areas in a wound even when there is substantial bleeding.

The arrangement of the light-conducting fiber bundle to form an annulus at its distal end has been found to provide best results. With such a configuration, light is transmitted through the bundle to provide high intensity, cold illumination in an annular pattern at the distal end, permitting ready observation of internal areas free of shadows which might otherwise be cast by the instrument. However, if desired, the distal end of the bundle may have a different shape, for example, the fiber bundle may be rod-shaped at its distal end as well as its proximal end. Preferably, the ends of the fiber bundle are optically polished to provide better light dissemination and a protective lens may be placed over the polished ends of the bundle.

High intensity illumination is possible using the present invention. Intensities up to 2000 foot candles or more at a working distance of one-half inch and up to 400 foot candles or more at four inches may be obtained by connecting the device to a variable high intensity light source by means of a flexible light-conducting fiber optics bundle.

Turning now to the drawings in detail, the suction and ilumination device **10** is comprised of an outer tube **12** and an inner tube **14** having very large number of extremely fine glass-coated glass fibers **16** disposed in an annular configuration between them. The fibers **16** may be prepared using the method described in the application of Lawrence E. Curtiss, Serial No. 76,868, filed December 19, 1960, in accordance with which continuous strands of glass-coated glass fibers are wound on a Mylar (polyethylene terephthalate) sheet which is disposed around a drum. As each successive layer of fibers is laid on the drum, a layer of thermosetting resin is placed upon them. The resin is allowed to dry but is not cured; thus it remains tacky but does not become hard and stiff. The sheet is then cut parallel to the axis of the cylinder, and a flat sheet of Mylar having well oriented fibers is obtained.

Second, the inner tube **14** is brought into contact with the flat sheet, and the flat sheet is rolled onto the inner tube in an integral number of revolutions sufficient to produce the thickness of the annular bundle that is desired. Because the resin that was applied is tacky, the sheet sticks readily to the tube, and successive convolutions stick to each other.

Third, the inner tube **14** and fibers **16** are inserted into the outer tube **12**, which is shorter than both the inner tube and the fibers used. The distal ends of the fibers are coextensive with the distal ends of both inner and outer tubes. The proximal ends of the fibers **16** are formed into a rod **17** by pulling the fibers together at an angle to the axis of the tubes. If necessary a solvent is used to soften the resin. The tubes **12** and **14** with the fibers **16** between them may now be bent to the desired curvature. This is readily carried out without damaging the fibers which are free to move relative to each other and the tubes while the assembly is bent. A terminal

fitting such as jack 28 is mounted on the fiber rod 17 and epoxy resin is added to the rod 17 as well as to the annular distal end of the assembly. The entire assembly is baked to cure the resin throughout the length of the fibers, thus producing a hard, rigid assembly in which the fibers function to conduct light and also rigidify and strengthen the assembly.

The outer tube 12 is connected at its proximal end to an annular retaining member 18 which is in turn connected to an annular mounting member 20 having a somewhat larger inner diameter. Seated within the mounting member 20, is the distal end portion of a handle assembly 24 formed by an annular extension 22. The handle extension 22 is encircled by a ring 26 the outer surface of which is preferably flush with that of the mounting member 20. Mounting member 20, handle extension 22 and ring 26 are shaped to form a laterally presented opening, communicating with the generally annular space 27 formed between them and the jack 28 closes the opening. The space 27 accommodates the intermediate portion of the fibers 16 extending between the annular array and the rod 17.

The proximal end portion of the inner tube 14 extending in the handle 24 carries sleeve 30 terminating at its distal end in a shoulder 31 forming a stop for the handle extension 22. The proximal end portion of inner tube 14 extends beyond the handle and is threaded to receive a nipple 34 to facilitate connection of the interior of tube 14 to a source of suction. The nipple 34 bears against an annular space 32 engaging the handle and thus serves to lock the handle extension against the stop 31.

The distal end portion of the inner tube 14 is internally threaded to receive a smoothly rounded tip 36 open at its end 37 and having a plurality of laterally presented openings 38. The openings permit the entry of fluid into the through passage formed by tube 14 while mucosa and the like are prevented from being sucked into the lumen of the instrument and thus block the same.

In operation, the suction and illumination device 10 is connected to a source of light by means of the jack 28 and to a source of suction by means of the nipple 34. The instrument may be hand held by the surgeon and the tip immersed in the fluid which is to be evacuated from a surgical wound. Shadow-free illumination is provided, enabling the surgeon to visualize the point at which there is bleeding. The curvature of the instrument keeps the handle and the surgeon's hand from interfering with visualization of the area.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possbile within the scope of the invention claimed.

I claim:

1. A suction and illumination device for removing fluids from a surgical wound while simultaneously illuminating the wound, comprising an outer tube, an inner tube disposed within said outer tube and defining an elongated annular chamber therewith, a plurality of elongated light-conducting fibers disposed within said annular chamber and extending from the distal end of said tubes to a point outside said outer tube, means for connecting the proximal ends of said fibers to a source of illumination, means for connecting said inner tube to a source of suction, and means on the distal end of said inner tube for preventing blocking of the same by mucosa.

2. A suction and illumination device for removing fluids from a surgical wound while simultaneously illuminating the wound, comprising a pair of tubes one mounted within the other and forming an elongated annular chamber therebetween, the distal ends of said tubes being substantially in alignment and the proximal end of the inner tube extending beyond the proximal end of the outer tube, a rigid mass of a plurality of elongated light-conducting fibers extending in said elongated chamber with the distal ends thereof forming an annulus substantially in alignment with the distal ends of said tubes, the proximal end portions of said fibers forming a substantially rod-shaped projection extending laterally from the inner tube, means connected to said tubes and forming an enclosure about the inner tube adjacent to the proximal end of the outer tube, said enclosure means including a jack for enclosing said rod-shaped portion of said fibers and adapted for connection to a source of illumination, a handle mounted on the inner tube on the proximal side of said enclosure means, means for connecting said inner tube to a source of suction, and means on the distal end of said inner tube for preventing blocking of the same by mucosa.

3. A suction and illumination device for removing fluids from surgical wounds while simultaneously illuminating the wound, comprising a pair of tubes one mounted within the other and forming an elongated annular chamber therebetween, the distal ends of said tubes being substantially in alignment and the proximal end of the inner tube extending beyond the proximal end of the outer tube, a rigid mass of a plurality of elongated light-conducting fibers extending in said elongated chamber with the distal ends thereof forming an annulus substantially in alignment with the distal ends of said tubes, the proximal end portions of said fibers forming a substantially rod-shaped projection extending laterally from the inner tube, means connected to said tubes and forming an enclosure about the inner tube adjacent to the proximal end of the outer tube, said enclosure means including a jack for enclosing said rod-shaped portion of said fibers and adapted for connection to a source of illumination, a handle mounted on the inner tube on the proximal side of said enclosure means, a nipple connected to the proximal end of the inner tube adapted for connecting the same to a source of suction, and a perforated annular tip connected to the distal end of the inner tube.

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