# United States Patent [19]

**Stewart**

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[54] **COMBINATION ASPIRATOR AND FLUID DELIVERING SURGICAL INSTRUMENT**


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[73] Assignee: **Stewart Research, Inc.**, West Palm Beach, Fla.



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[52] **U.S. Cl.** ..... **128/240**, 128/276

[51] **Int. Cl.** ..... **A61m 3/00**

[58] **Field of Search** ..... 128/240, 276, 239, 128/224; 32/33



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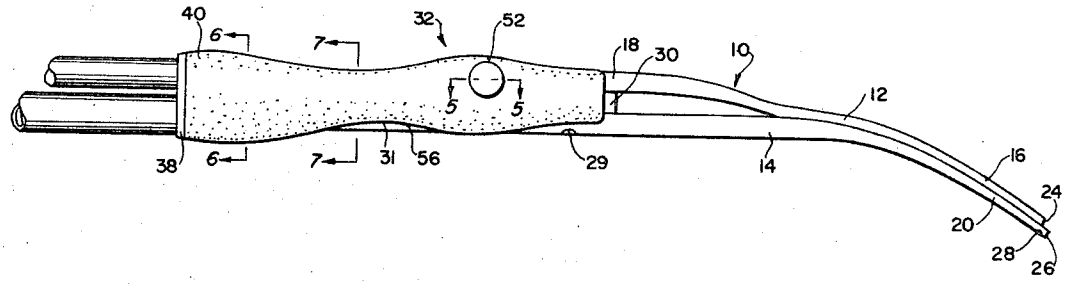
[57] **ABSTRACT**

A combination surgical instrument is provided for applying vacuum and delivering fluid to a work area. The instrument includes a readily detachable work tool having a fluid delivering tube and an integrally attached vacuum-applying tube, with the entrance end of the vacuum tube projecting beyond the entrance end of the fluid tube; and a handle connectable to sources of fluid and vacuum and resistant to sterilizing temperatures and having a first passage for receiving the fluid delivery tube; and a second passage having a cutaway portion to expose an elongated section of the passage along an exterior surface of the handle for receiving the vacuum-applying tube.


**11 Claims, 9 Drawing Figures**



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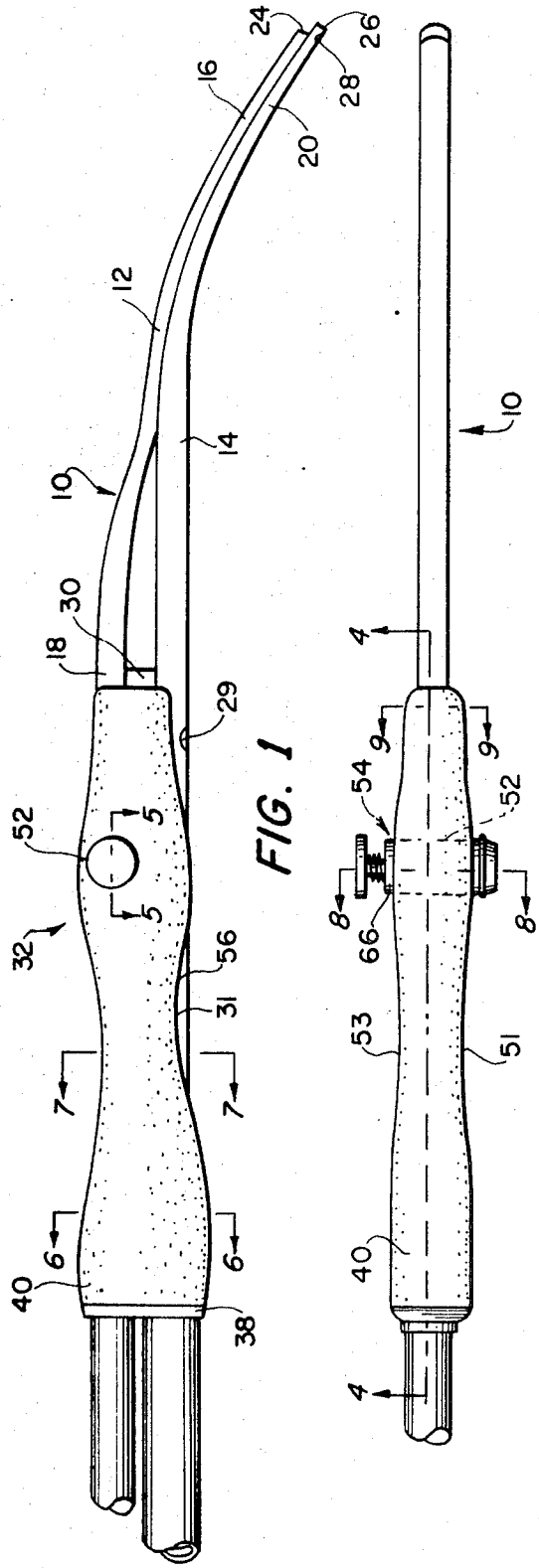


FIG. 1




FIG. 2

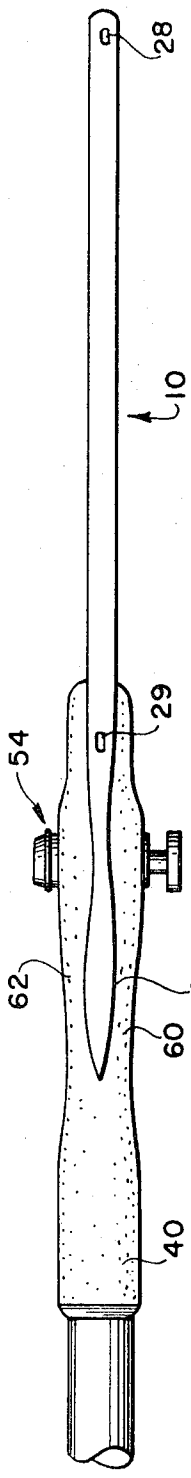


FIG. 3

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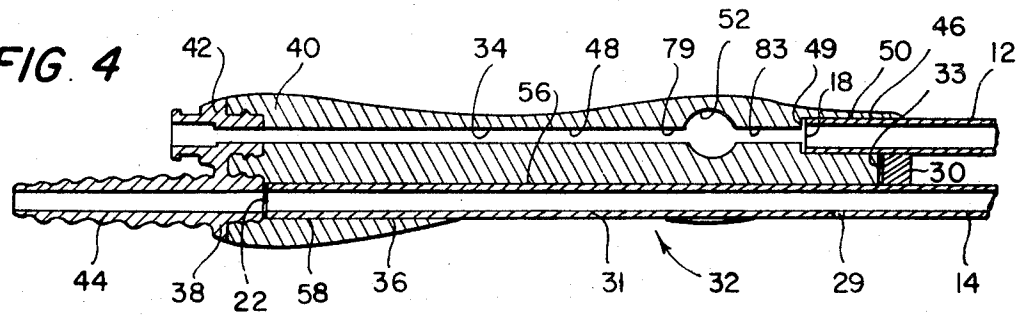
FIG. 4



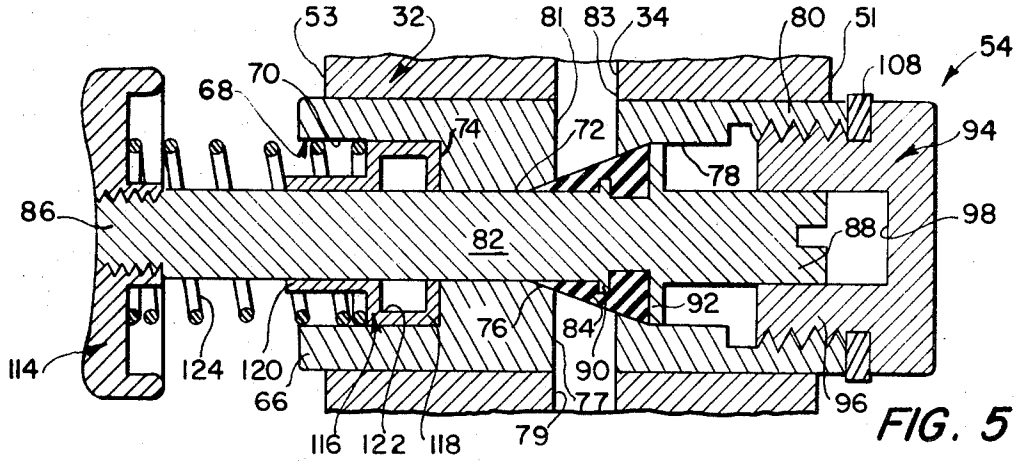




FIG. 5

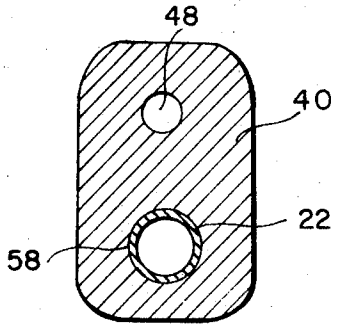



FIG. 6

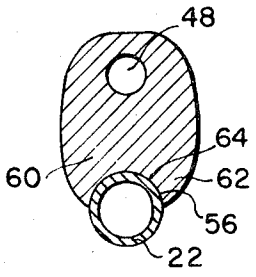



FIG. 7

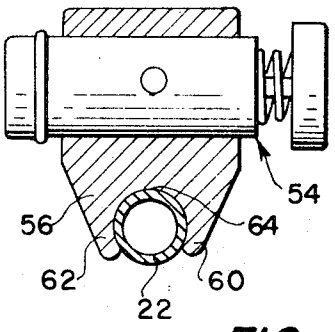



FIG. 8

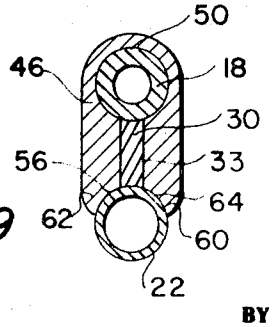



FIG. 9

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# COMBINATION ASPIRATOR AND FLUID DELIVERING SURGICAL INSTRUMENT

The present invention relates to surgical apparatus, and more particularly to a combination surgical instrument for delivering fluid and supplying vacuum to an operating area.

In surgery, it is important that the operating area be kept free of blood and other fluids and debris that could obstruct the surgeon's vision, and the contaminating influence of bacteria and dirt as in wounds that can cause serious infections. It is also generally important that the operating areas be maintained in a moist or lubricated condition and that overheating be prevented to avoid damage to or deterioration of the exposed tissues during surgery.

It has, therefore, been necessary to provide surgical instruments that facilitate the cleaning and sterilization of surgical wounds and prevent the drying out or overheating of the tissues, as occurs in cutting bone, to properly prepare and maintain the operating area during the operative procedure and to reduce post-surgical morbidity and suffering.

In the past, many separate and combination devices have been provided to perform these functions. Controlled vacuum or aspirating devices, for example, have been used to remove debris and suck fluids from surgical wounds. Irrigating or lavage devices for spraying the surgical area with the necessary sterilizing and cleansing fluids have also been provided and sometimes in combination with the aspirating devices to increase the effectiveness of the suction action.

The surgical equipment presently available, however, to perform the necessary suctioning and lavaging functions during an operative procedure has generally proven to be awkward and cumbersome in use as it is often provided in separate instruments; requires more than one hand to operate; requires special containers for the fluids; or does not facilitate rapid and convenient replacement of the work tools, depending upon the type of surgery being performed.

Another disadvantage of prior aspirating and suction instruments concerns increasing the degree of an iatrogenic disease, that is, disease which is initiated or results from the activity of a physician or surgeon. Such disease is inherent in any surgical procedure, but can be minimized through sterilization of the surgical instruments used during surgery, observance of good surgical technique and meticulous removal of debris and foreign material. While a number of surgical instruments now in use comprise a hand piece and detachable work tool, so that the work tool can be detached from the hand piece and replaced with a sterile one, the hand piece generally must be reused without sterilization, leaving an undesirable source of contamination.

Accordingly, it is a primary object of this invention to provide a new and improved combination surgical instrument that delivers fluid and supplies vacuum to an operating area during surgery, that is easy and convenient to handle and operate, and that is reliable and readily maintainable in a sterile condition.

A further object of this invention is to provide a surgical instrument for applying suction and selectively delivering an appropriate sterile fluid to a limited area that can be operated by one hand, readily detached from its source of suction and fluid, and readily adaptable to a wide variety of applications.



Additional objects and advantages of the invention will be set forth in part in the description which follows, or in part may be learned by practice of the invention.

To achieve the foregoing objects and in accordance with its purpose, this invention provides a combination surgical instrument for applying vacuum and delivering fluid to a work area. The instrument comprises a work tool having a first tubular member for delivering fluid and a second tubular member for applying vacuum, respectively, to a work area, with each member having an entrance end and an exit end, the entrance end of the second tubular member being located on an extension of the second tubular member that projects beyond the entrance end of the first member; and an elongated tubular handle resistant to sterilizing temperatures and conditions and having a first enclosed passage for detachably receiving the entrance end of the first tubular member of the work tool and communicating with a supply of fluid, and a second passage spaced from the first passage and having a cutaway portion exposing an elongated section of the passage along an exterior surface of the handle for detachably receiving the extension of the second tubular member and an enclosed portion for receiving the entrance end of the second tubular member of the work tool and communicating with a source of vacuum.

Preferably, the cutaway portion is defined by two exposed side walls which partially wrap around and grip the extension of the second tubular member to provide increased rigidity to the instrument.

It is also preferred to provide a valve means in the handle for controlling the flow of fluid through the first tubular member. The valve means intersects the first passage and preferably comprises a valve housing having a conically divergent surface which serves as a valve seat, a valve plunger positioned in the housing, a plastic valve seal resistant to sterilizing temperatures and conditions attached to the plunger and having an external configuration to seat the conically divergent surface, an actuator connected to one end of the plunger, and a coil spring in contact with the actuator to bias the valve seal against the conically divergent surface in a fluid flow preventing position.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory, and are not restrictive of the invention.

The accompanying drawings illustrate an example of a preferred embodiment of the invention and together with the description serve to explain the principles of the invention.

Of the drawings:

FIG. 1 is a side view of a surgical instrument constructed in accordance with the teachings of the present invention.

FIG. 2 is a top plan view of the surgical instrument of FIG. 1.

FIG. 3 is a bottom view of the surgical instrument of FIG. 1.

FIG. 4 is a vertical sectional view taken along the lines 4—4 of FIG. 2, and shows a detailed view of the assembled instrument according to the teachings of the present invention, but without the valve means illustrated in FIG. 2.

FIG. 5 is a horizontal sectional view taken along lines 5—5 of FIG. 1 and shows the valve means constructed

in accordance with the teachings of the present invention.

FIG. 6 is a vertical sectional view taken along lines 6—6 of FIG. 1.

FIG. 7 is a vertical sectional view taken along lines 7—7 of FIG. 1.

FIG. 8 is a vertical sectional view taken along lines 8—8 of FIG. 2.

FIG. 9 is a vertical sectional view taken along lines 9—9 of FIG. 2.

In accordance with the invention, the surgical instrument includes a work tool having integrally connected first and second tubular members, with one of said members being longer than the other. As here embodied, and as shown in FIG. 1, a work tool, generally 10, comprises a first tubular member 12 for carrying an irrigating solution, and a second tubular member 14 vertically aligned below and integrally connected with member 12 for drawing suction. Irrigating member 12 has an exit or work end 16 and an opposite entrance or connector end 18. Suction member 14 has an exit or work end 20 abutting work end 16 of irrigating member 12, and an entrance or connector end 22 (See FIG. 4).

Work ends 16 and 20 of members 12 and 14 generally have a downwardly curved shape as illustrated in FIG. 1 to facilitate their placement in the area where surgery is occurring. Work ends 16 and 20 are joined together as with solder to provide a unitary structure to be inserted into the work area.

At its outermost portion, work end 16 is provided with an outlet opening 24, and work end 20 is provided with an outlet opening 26. Work end 20 extends past work end 16 so that outlet opening 26 of suction member 14 is several millimeters beyond outlet opening 24 of irrigating member 12. This arrangement permits the irrigating solution to be projected past outlet opening 26 of suction member 14, and insures that the solution is allowed to contact the work area and is not immediately drawn into outlet opening 26 upon issuance from its outlet opening 24. A relief hole 28 is provided adjacent outlet opening 26 of suction member 14 on its bottom surface, as best seen in FIGS. 1 and 3. Preferably, and as best shown in FIGS. 1, 3 and 4, a second relief hole 29 is provided on the bottom surface of suction member 14. Relief hole 29 is used to increase temporarily the amount of suction when necessary, while at the same time preventing an undue amount of vacuum to be present when delicate tissues are in contact with work tool 10.

Generally, suction and irrigating members 12 and 14 of work tool 10 gradually expand in diameter from narrow work ends to wider entrance ends to provide relative freedom from accidental clogging of the suction member, and to reduce the flow resistance in the irrigating member. If clogging should occur, the work tool is easily removed and replaceable with an identical new tool. The caliper or diameter of the work end and size and shape of suction member 14 is, of course, related to the type nasal surgery for which it is to be used. Thus, abdominal, masal or sinus work tools are usually provided with tubular members of constant diameter throughout because, in abdominal surgery, the suction tubular members of such work tools require a large diameter at its work end and in nasal or sinus surgery it is impractical to make the remainder of these tubular members larger than their work ends because the increased size of such a member can interfere with good visibility of the work area.

As best seen in FIG. 1, a vertical brace 30 joins the tubular members to each other near entrance end 18 and provides rigidity to this end of work tool 10 as well as to prevent rotation of the work tool by engaging in a slot 33 (FIGS. 4 and 9), in the handle 32, described in greater detail hereafter. Work ends 16 and 20 gradually diverge from each other so that the entrance ends are vertically spaced and parallel to each other. In accordance with the invention, and as best shown in FIG. 4, the entrance end 18 of irrigating member 12 terminates shortly beyond brace 30, whereas the entrance end 22 is located on an extension 31 of suction member 14 and projects beyond the end of irrigating tube 12.

Work tool 10 can be made of metal, such as stainless steel, or plastic, such as polyvinyl chloride, polyethylene, polypropylene, or the like. When using metal work tools, the tools are preferably sterilized after use so that they can be reused. When using plastic work tools, the tools are preferably disposed of and replaced with new sterile work tools. The work tools, of course, are easily removed, and tools used for the same purpose are made identical in size and shape so that they are readily interchangeable. Further, the work tools can be provided in a wide variety of configurations, diameters and lengths to satisfy particular surgical requirements. For example, the work tools used for gross procedures are larger in all respects than the delicate type tools used in ear surgery.

In accordance with the invention, the surgical instrument further includes an elongated plastic tubular handle having a first enclosed passage for detachably receiving the fluid supplying tube of the work tool and a second passage vertically spaced from the first passage for detachably receiving the vacuum tube of the tool.

As here embodied, and as best shown in FIGS. 1 and 4, the handle comprises an elongated tubular handle grip, generally 32, having a first axially extending passage 34 for supplying irrigating solution, and a second axially extending passage 36, for drawing a vacuum, vertically spaced below passage 34. An end plate 38 is attached to a supply end 40 of handle 32 and has vertically spaced fittings 42 and 44 which are aligned with and communicate with first and second passages 34 and 36, respectively, of handle 32.

Fitting 42 is a coupling for a hose unit connected to a supply of sterile irrigating solution. Sterile isotonic salt solutions of diverse compositions are commonly available in convenient packaging for cleaning surgical wounds. It is well known that tap water should not be used because of its chemical composition, contamination, and hypotonicity, and that sterile water is also unsatisfactory because of its hypotonicity. Sterile normal saline solutions or .9 normal solutions are most commonly used.

Fitting 44 serves as a connection for a suitable source of vacuum. Fittings 42 and 44 have irregular exterior surfaces to facilitate sealed coupling of hose units thereto, but the hose units can be quickly disconnected from the fittings to disconnect the entire surgical instrument from the source of the vacuum and irrigating fluid.

As best seen in FIG. 4, irrigating passage 34 extends from supply end 40 of handle 32 to its opposite tool receiving end 46 of the handle and is completely enclosed by the material of the handle. Irrigating passage 34 in-

cludes a uniformly cylindical main section 48 that extends the greater length of handle 32, and a shorter enlarged cylindrical tool receiving section 50 at end 46 of the handle for detachably receiving entrance end 18 of irrigator member 12. The maximum inward movement of entrance end 18 into section 50 is limited by interior shoulder 49 formed at the point where irrigator passage 34 expands from main section 48 to tool receiving section 50. A transverse bore 52 perpendicularly intersects main section 48 of passage 34 at a point closely adjacent tool receiving section 50. As seen in FIG. 2, bore 52 extends from a first side 51 of handle 32 completely through to the opposite second side 53 of the handle. As best seen in FIGS. 2, 3, 5, and 8, a valve means, generally 54, described in greater detail hereafter, is positioned in bore 52 for controlling the flow of irrigating fluid through handle 32 and to work tool 10.

As seen in FIGS. 1, 3, 4, and 7–9, second passage 36 of handle 32 has a cutaway portion that exposes an elongated section 56 of the passage along the bottom exterior surface of the handle for receiving the extension 31 of the member 14 of the work tool and an enclosed portion 58 adjacent supply end 40 of handle 32, which receives entrance end 22 of member 14. As seen in FIGS. 3 and 7–9, opened section 56 is defined by two opposed side walls 60 and 62 which are joined together by a bottom curved surface 64. Side walls 60 and 62, as best seen in FIGS. 3 and 8, partially wrap around extension 31 of suction member 14 and provide a snap or friction-type fit when the work tool is inserted into handle 32. This construction adds support and rigidity to the assembled instrument when work tool 10 is inserted into the handle, yet permits the tool to be readily removed and interchanged with any other type of tool. As shown in FIG. 6, extension 31 extends the length of exposed section 56 and the entrance end 22 on extension 31 of suction tube 14 is received in the enclosed portion 58 of suction passage 36 to provide a closed path for the drawing of vacuum.

Thus, by providing a work tool in which the tubular members 12 and 14 of the tool are of different lengths and a compatible handle as described above for receiving the tool, it can be seen that the combination surgical instrument of this invention can be easily, quickly and reliably assembled, without any chance of incorrectly aligning the work tool in the handle and without fear of accidental disjoining during use.

Further, the provision of a cutaway portion in suction passage 36 of handle 32 is particularly important in reducing the enclosed area of suction passage 36 that must be thoroughly cleaned and sterilized, thus reducing the chance of infections due to improper sterilization. Another advantage is that the cutaway portion permits relief hole 29 in suction member 14, to be located adjacent the tool receiving end 46 of handle 32 and in a convenient position for operation by the user of the present device.

In a preferred embodiment of the invention, and as best seen in FIGS. 4 and 9, a vertically extending slot 33 connects tool receiving section 50 of first passage 34 with opened section 56 of second passage 36 at the tool receiving end 46 of handle 32. Slot 33 receives vertical brace 30 of work tool, and this construction of the instrument prevents rotation of work tool 10 when it is positioned within handle 32.

In accordance with the invention, handle 32 is formed from plastic materials which are highly resistant to heat so that the handle can withstand all commonly used forms of sterilizing equipment including the steam autoclave. A preferred plastic for use in the present invention is polytetrafluoroethylene such as that sold under the tradename Teflon. Teflon is substantially impervious to fluid penetration, does not readily discolor, and can be cleaned as easily as more expensive stainless steels. In fact, because of their lower density, plastic pieces reach sterilizing temperature and cool far more rapidly than stainless steels and thus can be reused quicker than stainless steel.

The plastic handles are easily molded by conventional molding techniques, to a shape to which a person's hand can easily conform, so that he can easily grip and hold the instrument by the handle in one hand.

The shape of handle 32 tends to properly preposition the instrument in the hand and thereby automatically correctly direct the extending work tool 10.

In accordance with a preferred embodiment of the invention, a valve means 54 is provided to control the flow of irrigating solution through irrigating passage 34. As best seen in FIGS. 2 and 5, valve means 54 includes a tubular valve housing 66 which is positioned in transverse bore 52 and extends past the opposing sides 51 and 53 of handle 32.

A central passage, generally 68, in valve housing 66 intersects passage 34 of handle 32 and extends the full length of the housing transversely of the handle. Passage 68 includes a first cylindrical section 70 adjacent side 53 of handle 32 and a reduced cylindrical shaft receiving section 72 spaced immediately inwardly of section 70. A shoulder 74 is formed at the point where first cylindrical section 70 meets shaft section 72. Spaced inwardly of shaft section 72, passage 68 is conically expanded in cross section to provide a conically divergent surface 76 which serves as a valve seat. The conically expanded portion of passage 68 is followed by a cylindrical section 78 having the same diameter as cylindrical section 70, and then by a threaded section to provide an internally threaded end 80 for valve housing 66.

A valve plunger 82 is movably positioned in passage 68 of valve housing 66 and a conically shaped valve seal 84 is attached to the plunger. Valve seal 84 has an external configuration to seat in conical surface 76. An annular fin 90 and a larger diameter annular flange 92 abutting the divergent end of seal 84 are provided on valve plunger 82 to secure and retain the valve seal to the valve plunger.

Valve seal 84 is preferably made of a plastic material that can repeatedly withstand sterilization temperatures and procedures. Silicone rubbers, such as those sold by General Electric under the tradenames RTV 632A and RTV 63 2B are suitable for use in the present invention. Valve seal 84 is molded to valve plunger 82 by using conventional molding conditions well known to those of ordinary skill in the art.

Conically divergent surface 76 of valve housing 66 contains an inlet opening 77 which is aligned with an upstream section 79 of main section passage 48 of passage 34, and an outlet opening 81 which is aligned with a downstream section 83 of main section 48 of passage 34. As best seen in FIGS. 4 and 5, the upstream and downstream sections 79 and 83 are axially aligned along the axis of passage 34. Valve seal 84 is normally seated in sealing relation to conical surface 76 and completely intercepts the inlet and outlet openings 77 and 81 of conically divergent surface 76 and thereby

intercepts passage 34 in a fluid flow preventing position as illustrated in FIG. 5.

A valve cap, generally 94, is removably secured to threaded end 80 of valve housing 66 and comprises an externally threaded stem 96 and an internal bore 98 for receiving and supporting one end 88 of valve plunger 82. As shown in FIG. 5, the maximum amount of axial movement of plunger 82 is defined by the depth of bore 98. An O-ring 108 is positioned between cap 94 and valve housing 66 to seal the cap to the valve. After repeated use and sterilization, minerals sometimes precipitate and deposit on the inner surfaces of the valves and removable valve cap 94 is therefore provided to allow access to these surfaces so that they can be periodically cleaned.

A cup shaped actuator, generally 114, is threadably secured to the opposite threaded end 86 of valve plunger 82. A shaft seal 116 is positioned within cylindrical section 70 of passage 38 of valve housing 60 and abuts against the external surface of valve plunger 82 and shoulder 74. Shaft seal 116 comprises a head portion 118 having an internal annular void 122 and a stem portion 120. Void 122 imparts flexibility to the shaft seal 116 and permits easier movement of plunger 82 within the seal and more positive sealing of the valve.

A coil spring 124 is interposed between the inner surface of actuator 114 and head 118 of shaft seal 116 to bias valve seal 84 against conical surface 76. Coil spring 124 presses against head 118 of shaft seal 116 so that a positive seal is formed in cylindrical section 70 around plunger 82 adjacent shoulder 74 of valve housing 66.

To operate the valve means, pressure is applied to actuator 114 to overcome the bias of coil spring 124 and move plunger 82 toward valve cap 94. Movement of plunger 82 toward the valve cap displaces valve seal 84 from conical surface 76 of valve housing 66 and enables inlet opening 77 of the valve housing to communicate with outlet opening 81 of the valve housing and thereby permits fluid under pressure to pass out through irrigating tube 12.

In using the apparatus of the present invention, the surgeon of his assitant can easily and naturally grip handle 32 in one hand using his thumb or a finger to operate the valve and another finger to operate the vacuum relief hole 29. Where incisions have been previously made and the lips thereof spread to expose the area of the operation, the surgeon or this assitant with one hand can manipulate the apparatus and selectively flush, wash or cleanse the operating area and continuously and immediately such away fluids and debris from the operating area while he continues uninterrupted with the operative procedure. The apparatus is therefore extremely flexible and efficient to use. It obviates the need for interference and delay occasioned by the many hands normally employed to maintain an operating area in a safe condition during surgery.

Thus, an extremely simple and effective structure is provided which may be applied to many other cleansing or lubricating applications as well. Such other applications are clearly contemplated and will be understood by those versed in the art as within the scope of the invention.

After use, the entire surgical instrument is disconnected from the hose units. Work tool 10 is then detached from handle 32, and if it is made of a material that can withstand sterilization procedures, both it and the handle are sterilized. After sterilization is completed, handle 32 is again connected to the appropriate hose units and a sterilized work tool 10 is inserted into tool receiving end 46 of the handle to provide a sterilized surgical instrument that can be immediately used with a minimum likelihood of transmitting iatrogenic disease to a patient.

The invention in its broader aspects is not limited to the specific details shown and described and departures may be made from such details without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A combination surgical instrument having a readily detachable and replaceable work tool for applying vacuum and delivering fluid to a work area, said instrument comprising:

a. a work tool having first and second tubular members for delivering fluid and applying vacuum, respectively, to a work area with each member having an entrance end and an exit end, the entrance end of the second member being located on an extension of the second tubular member that projects beyond the entrance end of the first member, and said first and second members being interconnected to form a unitary work tool; and

b. an elongated tubular handle resistant to sterilizing temperatures and conditions and having a first enclosed passage extending the length of the handle which slidably and detachably receives at a first end of the handle the entrance end of the first tubular member of the work tool and communicates with a supply of fluid; and a second passage spaced from the first passage and communicating with a source of vacuum, said second passage having an enclosed portion rearwardly spaced from said first handle end which slidably and detachably receives the entrance end of the extension of the second tubular member and a cutaway portion between the enclosed portion and said first handle end exposing an elongated section of the passage along an exterior surface of the handle which slidably and detachably receives the extension of the second tubular member while leaving exposed a portion of the extension of the second tubular member so that a vacuum relief hole can be provided in the extension of the second tubular member of the replaceable work tool for control by the operator when the handle is gripped to permit control of the amount of vacuum applied to the work area.

2. The instrument of claim 1, wherein said cutaway portion is defined by two opposed side walls which partially wrap around and grip the extension of the second tubular member.

3. The instrument of claim 1, wherein said handle includes a slot connecting the first passage with the elongated section of the second passage at said handle end, and the first and second tubular members are interconnected by a brace adjacent the entrance end of the first member which is received in said slot for preventing rotation of the work tool with respect to the handle.

4. The instrument of claim 1, including a valve means in said handle intersecting said first passage and operable by a finger of the operator for controlling the flow of fluid through said first tubular member.

5. The instrument of claim 4, wherein the valve means comprises a valve housing having a conically di-

vergent surface which serves as a valve seat, a valve plunger positioned in said housing, a plastic valve seat resistant to sterilizing temperatures and conditions attached to the plunger and having an external configuration to seat to said conically divergent surface, an actuator connected to one end of said plunger, and a coil spring contacting the actuator to bias the valve seal against said conically divergent surface in a fluid flow preventing position.

6. The instrument of claim 5, wherein a valve cap is secured to an end of said housing, said cap having a bore to slidably receive one end of the plunger opposite the end connected to the actuator, said valve cap being removable to expose internal surfaces of the valve means to permit cleaning of these surfaces.

7. The instrument of claim 5, including a shaft seal surrounding said plunger to seal the end of the housing adjacent to said actuator.

8. The instrument of claim 6, wherein said shaft seal comprises an annular stem and a head having an internal annular void which imparts flexibility to the shaft seal, said coil spring being interposed between the actuator and said head.

9. The instrument of claim 1, wherein said second member is spaced vertically below said first member and the exposed portion of the extension of the second tubular member extends along the bottom of the handle.

10. The instrument of claim 9, including a relief hole in the exposed portion of the extension of the second tubular member.

11. The instrument of claim 1 wherein the first and second tubular members gradually expand in diameter from their entrance ends.

* * * * *