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## DESCRIPTION

### Field of Invention

[0001] The present invention relates generally to a swivel apparatus. More specifically, the present invention relates to a swivel apparatus for attachment to or incorporation with the smoke evacuation system of an electro-surgical unit (ESU) pencil. A swivel apparatus is also described that can be incorporated into the connection between an ESU pencil and the electrical cord of the ESU pencil where the ESU pencil may be used either with or without smoke evacuation.

### Background of the Invention

[0002] The use of ESU pencils for cutting tissue and coagulating blood vessels in surgical procedures is well known. When an ESU pencil is used for cutting or coagulation, smoke is produced. In the past, when a surgeon wanted to evacuate this smoke from the surgical field, the surgeon or an assistant had to hold a plastic suction wand, connected to vacuum tubing, near the site of smoke production. This became cumbersome in many surgical procedures, because two hands were required--one operating the ESU pencil and the other holding the suction device--and because the suction wand often obscured the surgeon's view of the surgical field. Therefore, smoke evacuation devices were developed which were either incorporated directly into the design of an ESU pencil or were attachable to an ESU pencil.

[0003] The document US 2007/129722 A1 discloses an electrosurgical pencil including a swivel device with a rotatable member rotatably coupled to a fixed member.

[0004] US 2002/019631 A1 describes an electro-surgical pencil of a type having an electrode projecting out one end of said pencil, an electrical coupling operative to couple the electrode to an external electrical source. The pencil has an elongated housing having a hollow interior passageway, an open electrode end through which the electrode projects and an open end opposite to the electrode end couplable to a vacuum source. The hollow interior passageway is of a diameter sufficiently large to permit a flow and velocity of air sufficient to aspirate and evacuate smoke produced by the pencil. An electrode support in the hollow interior passageway holds the electrode. The electrode support and the electrode present a cross-sectional area which is substantially less than that of the hollow interior passageway. An optical switch is coupled to the elongated housing. An optical reflector having at least two different types of reflective surfaces is also coupled to the elongated housing proximate the optical switch, and a light fiber is coupled to the switch. An end of the light fiber is proximate the reflector, and is positionable to reflect light selectively from one of the two different types of reflective surfaces back up the light fiber.

[0005] US 5 897 417 A relates to construction systems and describes a construction system where elements have connection components for a ball-to-socket or socket-to-socket connection. The ball-to-socket connection locks at orientations when one or more detents in the interior of the socket protrude into one or more of a plurality of dimples on the ball. The construction elements generally have an elongated body with a dimpled ball at one end and a socket at the other end, or dimpled balls at both ends, or sockets at both ends. In addition to the ball-and-socket connection, elements may connect in a socket-to-body connection, or a number of different types of socket-to-socket connections. The socket has at least two petals with a lip contour such that in one type of socket-to-socket connection the pair of sockets interlock to form a sphere. The irregular shape of the lip of the socket allows a ball to be leveraged out of a socket, and make orientations over at least 2 pi steradians available in a ball-to-socket interconnection.

[0006] Built-in or attachable smoke evacuation devices have also proved problematic, however. Like the suction wand, these devices must be connected to a vacuum source via a vacuum tube. The vacuum tubing generally used is stiff, corrugated rubber tubing. Due to its stiffness, the tubing often coils in such a way that it twists the ESU pencil in the hand of the surgeon and pulls down the other end of the ESU pencil. This pulling and twisting of the ESU pencil is problematic in delicate surgical procedures and often requires the surgeon to stop frequently to uncoil the tubing. Therefore, more flexible vacuum tubing has been tried. However, this tubing is either too soft, so that it collapses under suction, or too narrow, so that it obstructs airflow. These various problems with vacuum tubing have led many surgeons not to use built-in or attached smoke evacuation devices on ESU pencils. But the only alternative is the separate suction wand, which is often too cumbersome or visually obstructing. A separate suction wand also requires a second person to hold it on site which many times interferes with the work of the surgeon.

[0007] Therefore, a need exists for an improved connection between an ESU pencil's built-in or attached smoke evacuation system and a vacuum tube. Such a connection would allow the vacuum tube to twist and/or swivel without turning the ESU pencil

in the surgeon's hand. The vacuum tube may twist in a clockwise and/or counterclockwise direction. This improved connection would reduce the drag (or pulling down of) the distal end of the ESU pencil (i.e. that end of the ESU pencil opposite the electrode). In addition, the vacuum tube may also pivot in vertical up and down directions. The connection would also remain airtight, so that the force of the smoke evacuation system's vacuum is not reduced.

**[0008]** A need also exists for an improved connection between an ESU pencil and the electrical cord attached to the ESU pencil that allows the electrical cord to twist, thereby facilitating a surgeon's use of the ESU pencil by reducing the drag or pulling down of the distal end of the ESU pencil (i.e. that end of the ESU pencil opposite the electrode).

#### **Summary of the Invention**

**[0009]** The present invention is directed to a swivel device which includes a fixed member which can be attached to at least one of an outer body of an ESU pencil and an exhaust port of an ESU pencil with an integrated smoke evacuation system and a rotatable member having a first end and a second end. The first end of the rotating member is coupled to an interior of the fixed member.

**[0010]** In one aspect, the fixed member and rotatable member may be hollow tubular members each having first and second ends where the second end of the fixed member fits precisely around the first end of the rotating member, thereby allowing rotation of the rotatable member within the fixed member. In order to perform smoke evacuation, the second end of the rotating member is coupled to a vacuum tube such that the rotatable member forms a leak proof connection with the vacuum tube. The rotatable member preferably has a smooth interior cylindrical surface for conducting smoke and debris to the vacuum tube.

**[0011]** The fixed member may be capable of removable attachment to an outer body of an ESU pencil, an exhaust port of an ESU pencil with an integrated smoke evacuation system, and an exhaust port of an ESU pencil smoke evacuation shroud attachment.

**[0012]** At least a portion of an electrical cord for providing power to the ESU pencil is contained within the fixed member and the rotatable member. In addition, smoke evacuation may or may not also occur through the fixed member and the rotatable member.

**[0013]** The swivel device of the present invention includes a fixed member attached to an outer body of an ESU pencil or an exhaust port of an ESU pencil with an integrated smoke evacuation system, a rotatable member with first and second ends where the first end is coupled to an interior of the fixed member and the second end has a cup like shape, and a pivoting member having first and second ends where the first end includes a cup like shape and is coupled to an interior of the second end of the rotating member. The fixed member may be capable of removable attachment to an outer body of an ESU pencil, an exhaust port of an ESU pencil with an integrated smoke evacuation system, or an exhaust port of an ESU pencil smoke evacuation shroud attachment. The fixed member, rotatable member, and pivoting member may all be hollow and each include first and second ends such that the second end of the fixed member fits precisely around the first end of the rotating member to allow rotation of the rotatable member within the fixed member and the second end of the rotatable member fits precisely within the first end of the pivoting member to allow the pivoting member to pivot in at least a vertical up and down direction.

#### **Brief Description of the Drawings**

**[0014]** A more complete understanding of the present invention may be derived by referring to the detailed description and claims when considered in connection with the following illustrative figures, which may not be to scale. In the following figures, like reference numbers refer to similar elements throughout the figures.

Fig. 1 is a cross-sectioned view of an exemplary swivel device, for attachment to an outer body of an ESU pencil, an exhaust port of an ESU pencil with an integrated smoke evacuation system, or an exhaust port of an ESU pencil smoke evacuation shroud attachment.

Fig. 2 is a side view of an ESU pencil with an electrical cord for powering the ESU pencil permanently incorporated in the swivel device shown in Fig. 1 with the electrical cord shown in phantom.

Fig. 3 is a perspective view of an ESU pencil with a smoke evacuation shroud attachment shown connected to the swivel device shown in Fig. 1.

Fig. 4 is an embodiment of a swivel device according to the present invention, for attachment to an outer body of an ESU pencil or

an exhaust port of an ESU pencil with an integrated smoke evacuation system.

Fig. 5 is a cross-sectional view of the swivel device shown in Fig. 4.

Fig. 6 is a side view of an ESU pencil with an electrical cord for powering the ESU pencil permanently incorporated in the swivel device shown in Figs. 4-5 with the electrical cord shown in phantom.

Fig. 7 is a perspective view of an ESU pencil with a smoke evacuation shroud attachment shown connected to the swivel device shown in Figs. 4-5.

### **Detailed Description**

**[0015]** One exemplary swivel device 10 is shown in Fig. 1. Swivel device 10 includes a fixed member 12 having a first end 14 and a second end 16, and rotatable member 18 which is coupled to an interior of the fixed member 12. Rotatable member 18 includes a first end 20 (see Fig. 2), a second end 22, and an angled portion 24 located between first end 20 and second end 22. Second end 22 of rotating member 18 may further include a collar 26 which is capable of forming a leak proof connection with a vacuum tube (see Fig. 3).

**[0016]** Fixed member 12 and rotatable member 18 may comprise hollow tubular members with smooth interior cylindrical surfaces which facilitate evacuation of smoke from a surgical site through a vacuum tube. Second end 16 of fixed member 12 is friction fit around first end 20 of rotatable member 18, thereby allowing rotation of rotatable member 18 within fixed member 12 as indicated by arrow X. The rotatable member 18 may rotate in both clockwise and counterclockwise directions. This rotation of rotatable member 18 which is connected to a vacuum tube (see Fig. 3) reduces the drag or pulling down of the distal end of the ESU pencil (i.e., the end of the ESU pencil opposite the electrode).

**[0017]** Fixed member 12 and rotatable member 18 of swivel device 10 are preferably made of a sturdy and durable material which enables the friction fit of rotatable member 18 within fixed member 12 while still allowing for the rotation of rotatable member 18 within fixed member 12. Examples of such materials include, but are not limited to, polymers, plastics, and fiberglass.

**[0018]** A side view of an ESU pencil 402 with an electrical cord for powering the ESU pencil 402 permanently incorporated in swivel device 10 with the electrical cord 28 shown in phantom is depicted in Fig. 2. Electrical cord 28 is routed through swivel device 10 so that electrical cord 28 does not twist the ESU pencil in the hand of the surgeon during an electrosurgery procedure. In another exemplary case, ESU pencil 402 may comprise a telescopic ESU pencil as shown in Fig. 2 which may accommodate smoke evacuation through its interior. In the event that smoke evacuation is accommodated through an interior of ESU pencil 402, swivel device 10 may also be coupled to a vacuum tube as shown in Fig. 3 to evacuate smoke from the surgical site.

**[0019]** Fig. 3 shows a perspective view of an ESU pencil 402 with a smoke evacuation shroud attachment 410 shown connected to swivel device 10. Collar 26 of rotatable member 18 fits over vacuum tube 30 to create an airtight connection between vacuum tube 30 and rotatable member 18. Alternatively, second end 22 of rotatable member 18 may be tapered to fit inside of vacuum tube 30, also creating an airtight connection between rotatable member 18 and vacuum tube 30. Like the connection of swivel device 10 with ESU pencil 402 shown in Fig. 2, the connection between swivel device 10 and smoke evacuation shroud attachment 410 reduces the drag, or pulling down of, the distal end of the smoke evacuation shroud attachment 410 while the surgeon performs an electrosurgery procedure.

**[0020]** An exemplary embodiment of swivel device 50 in accordance with the present invention is shown in Figs. 4-5. Swivel device 50 may be attached to an outer body of an ESU pencil or an exhaust port of an ESU pencil with an integrated smoke evacuation system. Swivel device 50 includes a fixed member 52 having a first end 54 and second end 56, a rotatable member 58 having a first end 60 and a second end 62, and a pivoting member 70 having a first end 72 and second end 74. Second end 56 of fixed member 52 is friction fit around first end 60 of rotatable member 58 such that rotatable member 58 is capable of rotating within fixed member 52. Second end 62 of rotatable member 58 comprises an open-ended hollow half sphere shape, or cup like shape. In addition, first end 72 of pivoting member 70 also comprises an open-ended hollow half sphere shape, or cup like shape, which is friction fit within an interior of the cup like shape of first end 60 of rotatable member 58, thereby allowing pivoting member 70 to pivot within rotatable member 58 at least in a vertical up and down direction as indicated by arrow Y. In addition, pivoting member 70 may also pivot in a number of different directions relative to second end 62 of rotatable member 58. This exemplary embodiment of swivel device 10 of the present invention provides a broader range of motion for the movement of a vacuum tube 30 or electrical cord 28 with respect to an ESU pencil 402 or smoke evacuation shroud attachment 410 to further decrease drag

on the distal end of the ESU pencil and to reduce twisting of vacuum tube 30 and/or electrical cord 28 while a surgeon performs an electrosurgery procedure.

[0021] With respect to the exemplary embodiment of swivel device 50 shown in Figs. 4-5, the present invention also contemplates a swivel device which includes only rotary member 58 and pivoting member 70 whereby first end 60 of rotating member 58 would be attached in a leak proof manner to an outer body of an ESU pencil, and exhaust port of an ESU pencil with an integrated smoke evacuation system, or a exhaust port of an ESU pencil smoke evacuation shroud attachment. The connection between second end 62 of rotating member 58 and first end 72 of pivoting member 70 would then provide the sole means for vacuum tube 30 and/or electrical cord 28 to swivel, rotate, and/or pivot in relation to ESU pencil 402 or ESU pencil smoke evacuation shroud attachment 410.

[0022] Fig. 6 is a side view of an ESU pencil with an electrical cord for powering the ESU pencil permanently incorporated in swivel device 50 shown in Figs. 4-5 with electrical cord 28 shown in phantom. Electrical cord 28 is routed through swivel device 50 so that electrical cord 28 does not twist the ESU pencil in the hand of the surgeon during an electrosurgery procedure. In another exemplary embodiment, ESU pencil 402 may comprise a telescopic ESU pencil as shown in Fig. 6 which may accommodate smoke evacuation through its interior. In the event that smoke evacuation is accommodated through an interior of ESU pencil 402, swivel device 50 may also be coupled to a vacuum tube as shown in Fig. 7 to evacuate smoke from the surgical site.

[0023] A perspective view of an ESU pencil with a smoke evacuation shroud attachment shown connected to swivel device 50 is shown in Fig. 7. Second end 74 of pivoting member 70 is coupled to vacuum tube 30 to create an airtight connection between vacuum tube 30 and pivoting member 70. Second end 74 of rotatable member 70 may be tapered to fit inside of vacuum tube 30. Like the connection of swivel device 50 with ESU pencil 402 shown in Fig. 6, the connection between swivel device 50 and smoke evacuation shroud attachment 410 reduces the drag, or pulling down of, the distal end of the smoke evacuation shroud attachment 410 while the surgeon performs an electrosurgery procedure.

#### **OPERATION**

[0024] Referring to Fig. 3, before beginning a surgical procedure, the second end 22 of rotating member 18 is connected to the vacuum tube 30 which is connected to a vacuum source (not shown) and the power cord 28 for the ESU pencil 402 is connected to a power source (not shown). When desired, the surgeon then uses hand switch 404 to send radio frequency energy to the ESU pencil's 402 electrode 406, for cutting and coagulation. When the vacuum source is activated, smoke and debris from cutting and coagulation are sucked into the exhaust opening 424 at the distal end of nozzle 412 of the ESU pencil's 402 smoke evacuation shroud attachment 410. The smoke and debris then travel through the smoke evacuation shroud attachment 410, swivel device 10, and vacuum tube 30, to a vacuum canister (not shown). The operation of the ESU pencil 402 with smoke evacuation shroud attachment 410 is described in full detail in U.S. Patent Nos. 5,836,944 and 6,099,525.

[0025] Second end 16 of fixed member 12 and first end 20 of rotatable member 18 may take the form of alternative configurations and shapes to enable an airtight seal between fixed member 12 and rotatable member 18. For example, second end 16 of fixed member 12 may take the shape and form of a larger outer-diameter portion of the fixed member as described in U.S. Patent application having Serial No. 11/164,712, filed December 2, 2005. In addition, first end 20 of rotatable member 18 may include an inverted distal end on the interior surface of the rotatable member and a central inversion on the exterior surface of the rotatable member as previously described in detail in U.S. Patent application having Serial No. 11/164,712, filed December 2, 2005.

[0026] The swivel device may also be used or incorporated with laser or fiber optic surgical pencils that are employed along with suction devices to eliminate smoke and debris from the the surgical site.

## **REFERENCES CITED IN THE DESCRIPTION**

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

#### **Patent documents cited in the description**

- US2007129722A1 [0003]
- US2002018631A1 [0004]
- US5897417A [0005]
- US5836944A [0024]
- US6099525A [0024]
- US16471205A [0025] [0025]

**Patentkrav****1.** Drejeindretning (10) omfattende:

et faststående element (12,52) fastgjort til mindst en af et ydre legeme af en ESU-stift (402) og en udstødningsåbning af en ESU-stift med et integreret røgevakueringsystem; og

et roterbart element (58) med en første ende (60) og en anden ende (62) hvor den første ende (60) er roterbart koblet til det faststående element (52), **kendetegnet ved at** den første ende (60) er roterbart koblet til et indre af det faststående element (52) og den anden ende omfatter en bægerform; **ved at** indretningen yderligere omfatter et drejeelement (70) med en første ende (72) og en anden ende (74) hvor den første ende (72) omfatter en bægerform og er roterbart koblet til et indre af den anden ende af det roterbare element;

og **ved at** mindst en del af en elektrisk ledning (28) til at tilvejebringe strøm til ESU-stiften eller ESU-stiften med et integreret røgevakueringsystem er indeholdt inde i det faststående (12,52) element og det roterbare element (18,58).

**2.** Drejeindretningen ifølge krav 1, hvor det faststående element (12) omfatter et hult rørformet element med en første ende (14) og en anden ende (16).

**3.** Drejeindretningen ifølge krav 2, hvor det roterbare element (18) omfatter et hult rørformet element og den anden ende (16) at det faststående element (12) passer præcist rundt om den første ende (20) af det roterbare element (18) for derved at tillade rotation af det roterbare element inde i det faststående element.

**4.** Drejeindretningen ifølge krav 1, hvor den anden ende (22) af det roterbare element (18) er i stand til at danne en udsivningsfri forbindelse med en vakuumslange.

**5.** Drejeindretningen ifølge krav 4, hvor det roterbare element (18) omfatter en glat indre cylindrisk flade til at lede røg og affald til vakuumslangen.



**6.** Drejeindretningen ifølge krav 1, hvor det faststående element (12) er i stand til aftagelig fastgørelse til mindst en af gruppen bestående af et ydre legeme af en ESU-stift, en udstødningsåbning af en ESU-stift med et integreret røgevakueringsystem, og en udstødningsåbning af en ESU-stift-røg-evakuerings-  
5 kravfastgørelse.

**7.** Drejeindretningen ifølge krav 1, hvor det roterbare element (58) omfatter et hult rørformet element og den anden ende (56) at det faststående element (52) passer præcist rundt om den første ende (60) af det roterbare element (58) for  
10 derved at tillade rotation af det roterbare element (58) inde i det faststående element (52).

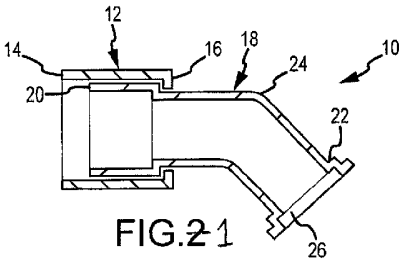
**8.** Drejeindretningen ifølge krav 7, hvor svingbare element (70) omfatter et hult rørformet element og den anden ende (62) af det roterbare element (58) passer  
15 præcist inde i det den første ende (72) af det drejelige element (70) for derved at tillade det drejelige element at dreje i mindst en vertikal op- og nedgående retning.

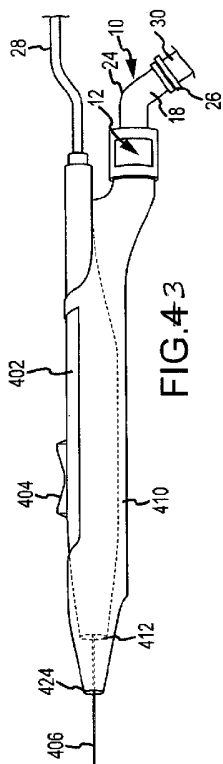
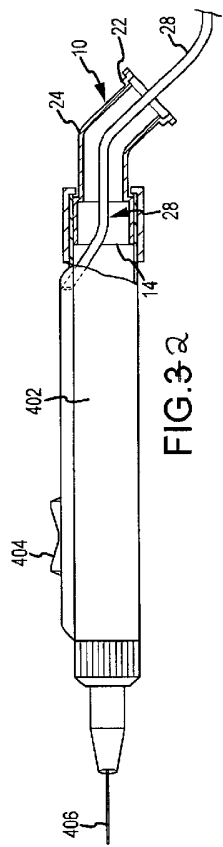
**9.** Drejeindretningen ifølge krav 1, hvor det roterbare element (58) og det  
20 drejelige element (70) hver har en glat cylindrisk flade til at lede røg og affald til vakuumslangen.

**10.** Drejeindretningen ifølge krav 1, hvor den anden ende (74) af det drejelige element (70) er i stand til at danne en udsivningsfri forbindelse med en  
25 vakuumslange.

**11.** Drejeindretningen ifølge krav 1, hvor det faststående element (52) er i stand til aftagelig fastgørelse til mindst en af et ydre legeme til en ESU-stift og en udstødningsåbning af til en ESU-stift med et integreret røgevakueringsystem.

DRAWINGS





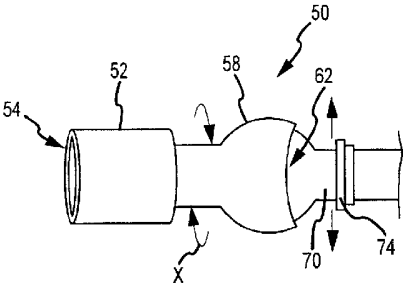


FIG. 5 4

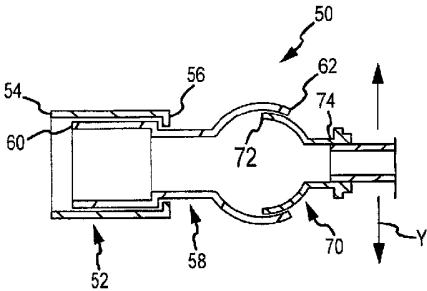


FIG. 6 5

