configuration) and a closed position (corresponding to the retracted configuration). In the open position, the snare may be used to ensnare tissue for excision. In the closed position, the snare may be used as a general purpose haemostat.

The second enhancement relates to means for actuating (i.e. extending and retracting) the snare wire.

The third enhancement relates to the geometry and structure of the distal head assembly from which the loop of snare wire extends.

At its most general, embodiments of the invention provide an electrosurgical snare in which the loop of snare wire extends from an energy transfer surface which can act both as a physical reaction surface for mechanical cutting using the snare and as a region for emitting electromagnetic (e.g. microwave or RF) energy.

According to a first embodiment of the invention, there is provided a surgical snare comprising: a coaxial cable having an inner conductor, an outer conductor and a dielectric material separating the inner conductor from the outer conductor; a distal head assembly disposed at a distal end of the coaxial cable; and a snare wire mounted in the distal head assembly, wherein the distal head assembly comprises an end cap having: a distally facing energy transfer structure that is connected to the inner conductor, and a pair of channels, each of the pair of channels extending axially between an outlet on the distally facing energy transfer surface and an inlet on a proximal surface of the end cap, wherein the snare wire is disposed within the pair of channels to form a retractable loop beyond the distally facing energy transfer surface. The coaxial cable may be arranged to deliver electromagnetic energy to the distal head assembly. The distally facing energy transfer structure may be configured to transmit the electromagnetic energy conveyed to the distal head assembly by the coaxial cable into biological tissue at the distal head assembly.

The coaxial cable may be arranged (e.g. appropriately dimensioned) to convey microwave electromagnetic energy, wherein the energy transfer structure may be configured as an antenna for radiating microwave electromagnetic energy. The antenna can be formed of an electrically conductive material,

The sleeve may have an internal longitudinal partition which separates an internal volume of the sleeve into a first longitudinal cavity for carrying the coaxial cable and a second longitudinal cavity for carrying a push rod that is connected to the snare wire. The push rod may be a tube or sheath mounted around the co-axial cable and slidable relative to it.

The manner in which the snare is actuated in the first embodiment above may be a second embodiment of the invention. According to the second embodiment, there is provided a surgical snare comprising a coaxial cable having an inner conductor, an outer conductor and a dielectric material separating the inner conductor from the outer conductor; a distal head assembly disposed at a distal end of the coaxial cable, the distal head assembly having an end cap that is electrically connected to the inner conductor; and a snare wire slidably mounted in the distal head assembly to form a retractable loop beyond the end cap, wherein a first end of the snare wire is connected to a movable boss that is slidably mounted on the coaxial cable.

As discussed above, the snare wire may comprise an electrically conductive portion that is electrically connected to the outer conductor. This connection may be made at an opposite end of the snare wire to where the snare wire is connected to the moveable boss. However the snare wire may be electrically connected to the outer conductor at any suitable point, for example via the moveable boss. As with the first embodiment, the snare wire may be electrically insulated from the inner conductor if the device is to be configured for use with RF electromagnetic energy. Providing a movable boss on the coaxial cable assists in maintaining a secure spatial relationship between the snare wire and the coaxial cable, which can prevent the snare wire from twisting in use.

Features of the first embodiment mentioned above may also be provided in the second embodiment. For example, the distal head assembly may include a fixed boss mounted on the coaxial cable, and wherein a second end of the snare wire is attached to the fixed boss. The fixed boss may be electrically connected to the outer conductor.

However, in an alternative arrangement, a second end of the snare wire may also be attached to the movable boss. This means both sides of the snare wire move when the movable boss

slides along the coaxial cable. This can assist in shortening the length of the instrument, since the movable boss only needs to traverse half the distance along the coaxial cable to achieve the same size loop as an arrangement in which only one end of the snare wire is attached to the movable boss. This alternative may also provide a more evenly distributed cutting force at the end cap (i.e. at the reaction surface).

In a further alternative arrangement, a second end of the snare wire may be joined with the first end of the snare wire between the fixed boss and the moveable boss. In this arrangement the second end may pass through the fixed boss before connecting to the first end. Again, this can assist in shortening the length of the instrument and provide the other advantages discussed above.

The movable boss may be operated using a push rod or the like. In an embodiment, the push rod is a sleeve mounted around and slidable relative to the coaxial cable. This configuration may provide the user with more control over the movement of the snare because the coaxial cable is less susceptible to bending or twisting than a separate thin rod.

As discussed above with relation to the first and second embodiments of the invention, the loop may be retracted into an almost or completely retracted position in which it abuts or is very close to the reaction surface. When the loop is in the almost or completely retracted configuration, the device is useable in an alternative mode in which energy is delivered away from the end cap and into tissue which the device is near or abuts. Such a mode can be used to apply electromagnetic energy to points of tissue not encircled by the loop i.e. the device may be used as a point applicator. For example, before a polyp is removed, it is desirable to inhibit blood flow in the area around the stem. The device may be used in this alternative mode to apply electromagnetic energy to the bleeding tissue so as to aid coagulation in this region. The device may also be used to stop any residual bleeding following the removal of the polyp. In this situation, the loop will be pulled into the reaction surface and the device will be used as a point applicator in order to aid coagulation with the distal end of the snare-wire functioning as a microwave energy radiating antenna.

Thus, the coaxial cable can be connected (e.g. at its proximal end) to a suitable generator to receive microwave energy. The retractable loop may be movable between an extended configuration for delivering the microwave energy to tissue encircled by the snare wire and a retracted configuration for delivering microwave energy outwardly from a distal exposed portion of the snare wire, i.e. a portion of the snare wire that is not inside the end cap when retracted. The snare wire may be fully retracted, i.e. in contact with the distally facing conductive surface, when the retractable loop is in the retracted configuration. Alternatively, there may be a small gap between the snare wire and the distally facing conductive surface when the retractable loop is in the retracted configuration.

The geometry of the end cap may be a third embodiment of the invention. This embodiment may be used in both electrosurgical snares, where electromagnetic energy is supplied, and in "cold" snares, where only mechanical cutting is performed. According to the third embodiment of the invention, there is provided a surgical snare comprising: a distal head assembly; and a snare wire slidably mounted in the distal head assembly, wherein the distal head assembly comprises an end cap having: a distally facing reaction surface, and a pair of channels, each of the pair of channels extending between an outlet on the distally facing reaction surface and an inlet on a proximal surface of the end cap, wherein the snare wire is disposed within the pair of channels to form a retractable loop beyond the distally facing conductive surface, and wherein the distally facing reaction surface is arranged to contact the retractable loop when fully retracted. The pair of channels may extend parallel to each other. They may extend in an axial direction through the end cap. As discussed above with respect to the first embodiment, it may be desirable to include a small blade on or in the end cap to cut through the tissue, e.g. following application of microwave energy if available. Ideally, the blade should not protrude from the end cap, otherwise this presents a risk of damage to the wall of the colon or perforation due to the device being pushed against the wall of the bowel (or another organ).

Features of the first and second embodiments mentioned above may also be provided in the third embodiment. For example, the

CLAIMS

1. A surgical snare comprising:

a coaxial cable having an inner conductor, an outer conductor and a dielectric material separating the inner conductor from the outer conductor;

a distal head assembly disposed at a distal end of the coaxial cable, the distal head assembly having an end cap that is electrically connected to the inner conductor; and

a snare wire slidably mounted in the distal head assembly to form a retractable loop beyond the end cap,

wherein a first end of the snare wire is connected to a movable boss that is slidably mounted on the coaxial cable.

2. A surgical snare according to claim 1, wherein the snare wire is electrically connected to the outer conductor and electrically insulated from the inner conductor.

3. A surgical snare according to claims 1 or 32, wherein the distal head assembly includes a fixed boss mounted on the coaxial cable, and wherein a first end of the snare wire passes through the fixed boss.

4. A surgical snare according to claim 3, wherein a second end of the snare wire is attached to the fixed boss.

5. A surgical snare according to claim 3, wherein a second end of the snare wire joins the first end of the snare wire between the fixed boss and the moveable boss.

6. A surgical snare according to claim 5, wherein the second end of the snare wire passes through the fixed boss.

7. A surgical snare according to claim 2, wherein the fixed boss is electrically connected to the outer conductor.

8. A surgical snare according to claim 1, wherein a second end of the snare wire is attached to the movable boss.

9. A surgical snare according to any one of claims 1 to 8, wherein the movable boss is attached to a push rod that is axially slidable relative to the coaxial cable.