

Claims

What is claimed is:

1. An endoscopic system comprising:

a main body, the main body having an elongated tubular structure with a proximal end and a distal end;

a plurality of actuation control members extending through the elongated tubular structure of the main body;

a navigation section, a proximal end of the navigation section securable to the distal end of the main body, the navigation section having a plurality of distal termination points, each distal termination point configured to receive a distal end of one or more of the actuation control members, wherein at least a portion of the navigation section is selectively controllable to bend based on a force applied to one or more of the actuation control members;

an anchor assembly, the anchor assembly including:

an anchor assembly body having an elongated structure forming a central axis, the anchor assembly body having a distal end and a proximal end, the proximal end securable to a distal end of the navigation section;

a first expandable member secured to the anchor assembly body, the first expandable member configurable to transition between an expanded configuration and a non-expanded configuration, wherein when the first expandable member is in the expanded configuration, the first expandable member includes a proximal side wall facing towards the proximal end of the anchor assembly body and a distal side wall facing towards the distal end of the anchor assembly body, wherein the distal side wall of the first expandable member includes one or more first protrusions;

a second expandable member secured to the anchor assembly body, the second expandable member configurable to transition between an expanded configuration and a non-expanded configuration, wherein when the second expandable member is in the expanded configuration, the second expandable member includes a distal side wall facing towards the distal end of the anchor assembly body and a proximal side wall facing towards the proximal end of the anchor assembly body, wherein the proximal side wall of the second expandable member includes one or more second protrusions; and

one or more pressure openings provided on the anchor assembly body at a location between the first and second expandable members, the one or more pressure openings configurable to provide a negative pressure;

wherein the first and second protrusions are configurable in such a way that, when the first and second expandable members are both in the expanded configuration, one or more of the first protrusions and one or more of the second protrusions contact each other and form a sieve portion between the first and second expandable members, the sieve portion configured to reduce an occurrence of solids blocking one or more of the pressure openings while allowing negative pressure to be applied to a body cavity wall through the one or more pressure openings; and

a connector assembly, the connector assembly having:

a connector assembly body, the connector assembly body having a plurality of proximal termination points, each proximal termination point configurable to receive a proximal end of one or more of the actuation control members; and

a connector interface portion, the connector interface portion having:

a main port for bridging the connector assembly body to the proximal end of

the main body;

a pressure source port for receiving negative pressure from an external pressure source and providing the negative pressure to the one or more pressure openings via the main port; and

an actuation control port for enabling the actuation control members to extend from the proximal termination points to the distal termination points in the navigation section.

2. The endoscopic system of claim 1, wherein one or more of the following apply:

the navigation section is selectively controllable to bend at a plurality of locations between the proximal and distal ends of the navigation section, each of the plurality of locations selected based on a selection of the one or more actuation control members that will receive an applied force;

each bendable portion of the navigation section is selectively controllable to bend in a plurality of different curvatures, each of the plurality of different curvatures selected based on a selection of an amount of force applied to one or more of the actuation control members; and/ or

each bendable portion of the navigation section is selectively controllable to bend in a plurality of different directions, each of the plurality of different directions selected based on a selection of the one or more actuation control members that will receive an applied force.

3. The endoscopic system of claim 1, wherein one or more of the following apply:

the navigation section includes two or more of the distal termination points positioned equidistant from the proximal end of the navigation section;

the navigation section includes two or more of the distal termination points positioned equidistant from a center axis formed by the navigation section; and/or

the navigation section includes a serially connected arrangement of sections, at least one of the sections having two or more of the distal termination points positioned equidistant from a

center axis formed by the navigation section.

4. The endoscopic system of claim 1, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions are formed as a thin wall extending along the distal side wall of the first expandable member in a radial manner away from the center axis; and/or

one or more of the second protrusions are formed as a thin wall extending along the proximal side wall of the second expandable member in a radial manner away from the center axis.

5. The endoscopic system of claim 1, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions are formed as a thin wall extending along the distal side wall of the first expandable member, each of the one or more first protrusions formed in a manner resembling a concentric circle with a common center being a point along the center axis; and/ or

one or more of the second protrusions are formed as a thin wall extending along the proximal side wall of the second expandable member, each of the one or more second protrusions formed in a manner resembling a concentric circle with a common center being a point along the center axis.

6. The endoscopic system of claim 1, wherein when the first and second expandable members are in the expanded configuration:

the distal side wall of the first expandable member includes a plurality of first protrusions, each of the first protrusions formed as a thin wall extending along the distal side wall of the first expandable member in a radial manner away from the center axis; and

the proximal side wall of the second expandable member includes one or more second

protrusions, each of the one or more second protrusions formed as a thin wall extending along the proximal side wall of the second expandable member, each of the one or more second protrusions formed in a manner resembling a concentric circle with a common center being a point along the center axis.

7. The endoscopic system of claim 1, wherein when the first and second expandable members are in the expanded configuration:

the distal side wall of the first expandable member includes one or more first protrusions, each of the one or more first protrusions formed as a thin wall extending along the distal side wall of the first expandable member, each of the one or more first protrusions formed in a manner resembling a concentric circle with a common center being a point along the center axis; and

the proximal side wall of the second expandable member includes one or more second protrusions, each of the one or more second protrusions formed as a thin wall extending along the proximal side wall of the second expandable member in a radial manner away from the center axis.

8. The endoscopic system of claim 1, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions includes one or more openings, gaps, and/ or non-uniform height regions for enabling negative pressure from one or more of the pressure openings to be applied through the first protrusions; and/ or

one or more of the second protrusions includes one or more openings, gaps, and/or non-uniform height regions for enabling negative pressure from one or more of the pressure openings to be applied through the second protrusions.

9. The endoscopic system of claim 1, wherein when the first and second expandable members are in the expanded configuration, one or more of the first protrusions and one or more of the second protrusions cooperate to form one or more openings and/or gaps for the sieve portion so as to enable negative pressure from one or more of the pressure openings to be applied through the sieve portion.

10. The endoscopic system of claim 1, wherein one or more of the following apply:

one or more of the first protrusions includes an expandable member configurable to transition from a non-protruded configuration to a protruded configuration, the protruded configuration occurring when the first expandable member is in the expanded configuration and the non-protruded configuration occurring when the first expandable member is in the non-expanded configuration; and/or

one or more of the second protrusions includes an expandable member configurable to transition from a non-protruded configuration to a protruded configuration, the protruded configuration occurring when the second expandable member is in the expanded configuration and the non-protruded configuration occurring when the second expandable member is in the non-expanded configuration.

11. The endoscopic system of claim 1, wherein one or more of the following apply:

the actuation control members are cables;

the distal end of each actuation control member is secured to one of the distal termination points;

when the first and second expandable members are in the expanded configuration, at least one first protrusion and at least one second protrusion are in contact with one another;

one or more of the pressure openings is configurable to provide a positive pressure;

the anchor assembly body is substantially cylindrical in shape;

the first and second expandable members, when in the expanded configuration, have a shape that resembles a tire; and/or

the pressure source port is configured to receive positive pressure from an external pressure source and provide the positive pressure to one or more of the following: the first expandable member, the second expandable member, and/or the one or more pressure openings.

12. The endoscopic system of claim 1, wherein each of the proximal termination points of the connector assembly body is configurable to selectively vary a force applied to the actuation control member that is received by the proximal termination point; and/ or

wherein the connector assembly body further includes a tension sensor for each actuation control member, each tension sensor for use in determining a tension state of the actuation control member.

13. The endoscopic system of claim 1, further comprising a controller in communication with the connector assembly, the controller configurable to perform one or more of the following:

control the bending of the navigation section by actuating one or more of the proximal termination points to selectively vary a force applied to one or more of the actuation control members;

control the transitioning of the first and second expandable members between the expanded configuration and non-expanded configuration;

control the negative pressure provided by the one or more pressure openings;

transition the one or more pressure openings between providing the negative pressure, providing a positive pressure, and not providing any pressure; and/or

determine a tension state of one or more of the actuation control members.

14. The endoscopic system of claim 1, wherein the connector assembly further includes a tension sensor assembly, and wherein one or more of the following apply:

the tension sensor assembly is configurable to monitor a tension for one or more of the actuation control members;

the tension sensor assembly is configurable to maintain, via one or more of the proximal termination points, a minimum threshold tension for one or more of the actuation control members; and/or

the tension sensor assembly is configurable to control, via one or more of the proximal termination points, an amount of tension for one or more of the actuation control members.

15. The endoscopic system of claim 1, wherein the connector assembly further includes a tension sensor assembly, the tension sensor assembly having a tension sensor body, a tension sensor portion for receiving one of the actuation control members, and a tension sensor/ switch;

wherein each tension sensor assembly is configurable to control a tension in the actuation control member received by the tension sensor portion based on a predetermined threshold value;

wherein, when the tension in the actuation control member received by the tension sensor portion is below the predetermined threshold value, the tension sensor body is positioned in such a way as to activate the tension sensor/ switch, wherein the tension sensor/ switch is configured to cause one of the proximal termination points to increase the tension in the actuation control member when activated; and

wherein, when the tension in the actuation control member received by the tension sensor portion is greater than or equal to the predetermined threshold, the tension sensor body is positioned in such a way as to not activate the tension sensor/ switch.

16. The endoscopic system of claim 1, wherein the connector assembly further includes a tension sensor assembly, the tension sensor assembly having a tension sensor body, a tension sensor portion for receiving one of the actuation control members, and a tension sensor/ switch;

wherein each tension sensor assembly is configurable to control a tension in the actuation

control member received by the tension sensor portion based on a predetermined threshold value;

wherein, when the tension in the actuation control member received by the tension sensor portion is greater than or equal to the predetermined threshold value, the tension sensor body is positioned in such a way as to activate the tension sensor/ switch, wherein the tension sensor/ switch is configured to cause one of the proximal termination points to maintain the tension in the actuation control member when activated; and

wherein, when the tension in the actuation control member received by the tension sensor portion is below the predetermined threshold, the tension sensor body is positioned in such a way as to not activate the tension sensor/ switch, wherein the tension sensor/ switch is configured to cause one of the proximal termination points to increase the tension in the actuation control member when not activated.

17. An endoscopic system comprising:

a main body, the main body having an elongated tubular structure with a proximal end and a distal end; and

a control section, the control section securable to the distal end of the main body, the control section including:

a navigation section, the navigation section configurable in such a way that at least a portion of the navigation section is selectively controllable to bend in a plurality of directions and curvatures;

a first expandable member, the first expandable member configurable to transition between an expanded configuration and a non-expanded configuration, the first expandable member, when in the expanded configuration, including a first side wall and a second side wall, the first side wall of the first expandable member having one or more first protrusions;

a second expandable member, the second expandable member configurable to

transition between an expanded configuration and a non-expanded configuration, the second expandable member, when in the expanded configuration, including a first side wall and a second side wall, the first side wall of the second expandable member having one or more second protrusions, wherein when the first and second expandable members are both in the expanded configuration:

the first side wall of the first expandable member faces the first side wall of the second expandable member; and

one or more of the first protrusions and one or more of the second protrusions contact each other and form a sieve portion between the first and second expandable members, the sieve portion configured to reduce an occurrence of solids blocking one or more pressure openings while allowing negative pressure to be applied to a body cavity wall through the one or more pressure openings; and

the one or more pressure openings, the one or more pressure openings provided at a location between the first and second expandable members, the one or more pressure openings configurable to provide a negative pressure.

18. The endoscopic system of claim 17, wherein one or more of the following apply:

the navigation section is selectively controllable to bend at a plurality of locations between the proximal and distal ends of the navigation section;

each bendable portion of the navigation section is selectively controllable to bend in a plurality of different curvatures; and/or

each bendable portion of the navigation section is selectively controllable to bend in a plurality of different directions.

19. The endoscopic system of claim 17, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions are formed as a thin wall extending along the first side wall of the first expandable member in a radial manner away from a center axis of the first expandable member; and/or

one or more of the second protrusions are formed as a thin wall extending along the first side wall of the second expandable member in a radial manner away from a center axis of the second expandable member.

20. The endoscopic system of claim 17, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions are formed as a thin wall extending along the first side wall of the first expandable member, each of the one or more first protrusions formed in a manner resembling a concentric circle with a common center; and/ or

one or more of the second protrusions are formed as a thin wall extending along the first side wall of the second expandable member, each of the one or more second protrusions formed in a manner resembling a concentric circle with a common center.

21. The endoscopic system of claim 17, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions includes one or more openings, gaps, and/ or non-uniform height regions for enabling negative pressure from one or more of the pressure openings to be applied through the first protrusions; and/ or

one or more of the second protrusions includes one or more openings, gaps, and/ or non-uniform height regions for enabling negative pressure from one or more of the pressure openings to be applied through the second protrusions.

22. The endoscopic system of claim 17, wherein when the first and second expandable members are in the expanded configuration, one or more of the first protrusions and one or more

of the second protrusions cooperate to form one or more openings and/or gaps for the sieve portion so as to enable negative pressure from one or more of the pressure openings to be applied through the sieve portion.

23. The endoscopic system of claim 17, wherein one or more of the following apply:

one or more of the first protrusions includes an expandable member configurable to transition from a non-protruded configuration to a protruded configuration, the protruded configuration occurring when the first expandable member is in the expanded configuration and the non-protruded configuration occurring when the first expandable member is in the non-expanded configuration; and/or

one or more of the second protrusions includes an expandable member configurable to transition from a non-protruded configuration to a protruded configuration, the protruded configuration occurring when the second expandable member is in the expanded configuration and the non-protruded configuration occurring when the second expandable member is in the non-expanded configuration.

24. An endoscopic system comprising:

a main body, the main body having an elongated tubular structure with a proximal end and a distal end;

an anchor assembly, the anchor assembly including:

an anchor assembly body having an elongated structure forming a central axis, the anchor assembly body having a distal end and a proximal end, the proximal end securable to the distal end of the main body;

a first expandable member secured to the anchor assembly body, the first expandable member configurable to transition between an expanded configuration and a non-expanded configuration, wherein when the first expandable member is in the expanded

configuration, the first expandable member includes a proximal side wall and a distal side wall facing in an opposite direction to the proximal side wall of the first expandable member, wherein the distal side wall of the first expandable member includes one or more first protrusions;

a second expandable member secured to the anchor assembly body, the second expandable member configurable to transition between an expanded configuration and a non-expanded configuration, wherein when the second expandable member is in the expanded configuration, the second expandable member includes a distal side wall and a proximal side wall facing in an opposite direction to the distal side wall of the second expandable member, wherein the proximal side wall of the second expandable member includes one or more second protrusions; and

one or more pressure openings provided on the anchor assembly body at a location between the first and second expandable members, the one or more pressure openings configurable to provide a negative pressure;

wherein the first and second protrusions are configurable in such a way that, when the first and second expandable members are both in the expanded configuration, one or more of the first protrusions and one or more of the second protrusions contact each other and form a sieve portion between the first and second expandable members, the sieve portion configured to reduce an occurrence of solids blocking one or more of the pressure openings while allowing negative pressure to be applied to a body cavity wall through the one or more pressure openings.

25. The endoscopic system of claim 24, wherein one or more of the following apply: one or more of the pressure openings is configurable to provide a positive pressure;

the anchor assembly body is substantially cylindrical in shape;

the first and second expandable members, when in the expanded configuration, have a shape that resembles a tire; and/or

the pressure source port is configured to receive positive pressure from an external pressure source and provide the positive pressure to one or more of the following: the first expandable member, the second expandable member, and/or the one or more pressure openings.

26. The endoscopic system of claim 24, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions are formed as a thin wall extending along the distal side wall of the first expandable member in a radial manner away from the center axis; and/or

one or more of the second protrusions are formed as a thin wall extending along the proximal side wall of the second expandable member in a radial manner away from the center axis.

27. The endoscopic system of claim 24, wherein when the first and second expandable members are in the expanded configuration, one or more of the following apply:

one or more of the first protrusions includes one or more openings, gaps, and/ or non-uniform height regions for enabling negative pressure from one or more of the pressure openings to be applied through the first protrusions; and/ or

one or more of the second protrusions includes one or more openings, gaps, and/or non-uniform height regions for enabling negative pressure from one or more of the pressure openings to be applied through the second protrusions.

28. The endoscopic system of claim 24, wherein when the first and second expandable members are in the expanded configuration, one or more of the first protrusions and one or more of the second protrusions cooperate to form one or more openings and/or gaps for the sieve portion so as to enable negative pressure from one or more of the pressure openings to be applied through the sieve portion.

29. The endoscopic system of claim 24, wherein one or more of the following apply:

one or more of the first protrusions includes an expandable member configurable to transition from a non-protruded configuration to a protruded configuration, the protruded configuration occurring when the first expandable member is in the expanded configuration and the non-protruded configuration occurring when the first expandable member is in the non-expanded configuration; and/or

one or more of the second protrusions includes an expandable member configurable to transition from a non-protruded configuration to a protruded configuration, the protruded configuration occurring when the second expandable member is in the expanded configuration and the non-protruded configuration occurring when the second expandable member is in the non-expanded configuration.

