

Claims

~~What is claimed is:~~

1. An ~~adapter~~endoscope, comprising:

~~a channel running through the length of the adapter from a first opening at a distal end of the adapter to a second opening at a proximal end of the adapter, wherein a shaft of an endoscope is configured to be threaded through the channel;—~~

~~a first coupler configured to removably secure the adapter to a second coupler of the endoscope after the shaft is threaded through the channel, the first coupler comprising the second opening; and~~

~~a~~ a shaft comprising:

a distal end; and

a proximal end comprising a rigid attachment segment ~~comprising a surface~~ configured to be removably ~~couple the~~ coupled to an adapter ~~to an or~~ instrument ~~or, a second adapter.~~

~~The adapter of claim 1, wherein the~~first surface of the rigid attachment segment ~~comprises~~comprising a first groove and a first section adjacent the first groove, ~~the section protruding relative to the groove and comprising a recessed indentation or protrusion.~~wherein:

~~The~~ the first groove is configured to be engaged by a protrusion of the adapter or the instrument,

the first section protrudes relative to the first groove, and

the first section comprises a first recessed indentation configured to secure a spring-loaded ball of the adapter or the instrument; and

a housing coupled to the shaft.

2. The endoscope of claim 1, wherein:

the first surface of the rigid attachment segment comprises ~~multiple~~a first plurality of grooves and ~~multiple~~a first plurality of sections alternating along ~~the~~a longitudinal length of the rigid attachment segment, the first plurality of grooves including the first groove, and the first plurality of sections including the first section;

each of the first plurality of sections protrudes relative to the first plurality of grooves, and comprises a recessed indentation ~~or protrusion~~; and

the ~~multiple~~first plurality of sections and the ~~multiple~~first plurality of grooves are configured such that the instrument or the ~~second~~ adapter can be coupled to the ~~adapter~~endoscope in a plurality of lengthwise positions.

3. The endoscope of claim 2, wherein:

the rigid attachment segment has at least two different surfaces running along the longitudinal length of the rigid attachment segment, the at least two different surfaces including the first surface and a second surface;

the second surface comprises a second plurality of grooves and a second plurality of sections alternating along the longitudinal length of the rigid attachment segment;

each of the second plurality of sections protrudes relative to the second plurality of grooves, and comprises a recessed indentation; and

the second plurality of sections and the second plurality of grooves are configured such that the instrument or the adapter ~~of any one of claims~~ can be coupled to the endoscope in a plurality of lengthwise positions.

~~3.4.~~ The endoscope of claim 1-3, further comprising: a rotatable joint attached to the rigid attachment segment and configured to enable longitudinal rotation of the rigid attachment segment relative to the ~~first coupler~~housing.

~~4. — The adapter of claim 4, wherein the rotatable joint comprises multiple apertures circumferentially arranged on a periphery of an inner surface of the rotatable joint, wherein the rotatable joint is configured to be secured in an angular position by a block pressed into one of the apertures by a spring contained within a housing of the coupler, wherein rotation of the rigid attachment segment relative to the first coupler with a sufficient torque is configured to cause the block to compress the spring and release the block from one of the apertures.~~

~~5. The adapter of claim 4, wherein the rotatable joint comprises: a circular extension configured to engage the first connector, the circular extension comprising a first circumferential lip that engages a wider circumferential lip within the first coupler.~~

~~6. The adapter of claim 1, wherein the rigid attachment segment has at least two different surfaces running along a longitudinal length of the rigid attachment segment, wherein each of the at least two different surfaces comprise: a groove and a section adjacent the groove, the section protruding relative to the groove and comprising a recessed indentation or protrusion.~~

~~5. The adapter of claim 1, wherein~~ The endoscope of claim 1, wherein:

the rigid attachment segment has at least two different surfaces running along a longitudinal length of the rigid attachment segment, ~~wherein each of the at least two different surfaces comprises: multiple grooves and multiple sections alternating along the longitudinal length of the rigid attachment segment, wherein each of the sections protrudes relative to the grooves and comprises a recessed indentation or protrusion, and the multiple sections and the multiple grooves are configured such that the instrument or the second adapter can be coupled to the surface in a plurality of lengthwise positions.~~ the at least two different surfaces including the first surface and a second surface; and

~~7. The adapter of claim 7 or 8, wherein the rigid attachment segment is configured to be fixed relative to the first coupler.~~

~~The adapter~~ the second surface comprises a second groove and a second section adjacent the second groove, the second section protruding relative to the second groove, and comprising a second recessed indentation.

~~8.6. The endoscope of claim 1, further comprising: a distal segment comprising~~ rotatable control positioned at a proximal end of the first opening, wherein ~~endoscope, the distal segment is~~ rotatable control configured to be rotated to stabilize the endoscope and the adapter after ~~digitally adjust an orientation of an image captured by the adapter is removably coupled to the endoscope.~~

~~9. The adapter of claim 1, wherein a distal end of the rigid attachment segment comprises the first opening.~~

~~10. The adapter of claim 1, wherein the second coupler comprises a groove, wherein the first coupler comprises:~~

~~a locking screw configured to be threaded into the groove to secure the first coupler to the second coupler;~~

~~a slidable control configured to slide into the groove of the second coupler to secure the first coupler to the second coupler; or~~

~~a button coupled to a lever arm, the button configured to be actuated to engage the lever arm into the groove to secure the first coupler to the second coupler.~~

~~11.7. The adapter~~The endoscope of claim 1, wherein the rigid attachment segment comprises a hinged joint between two portions of the rigid attachment segment, the hinged joint configured to enable pivoting or rotation of at least one of the two portions about at least one plane.

~~12.8. The adapter~~endoscope of claim 1 ~~or 4~~, further comprising: a hinged joint between the rigid attachment segment and the ~~first coupler~~housing, the hinged joint configured to enable pivoting or rotation of the rigid attachment segment.

~~13.9. The adapter~~endoscope of claim 1, further comprising: ~~an~~a cannula integrated ~~cannula~~into the shaft, the cannula comprising a suction or irrigation port.

~~14. An endoscope attachment assembly, comprising:~~

~~an endoscope comprising a shaft and a housing, the housing comprising a first coupler at its distal end; and~~

~~a first adapter comprising:~~

~~—— a channel running through the length of the adapter from a first opening at a distal end of the adapter to a second opening at a proximal end of the adapter, wherein the shaft of the endoscope is configured to be threaded through the channel;——~~

~~—— a second coupler configured to removably secure the adapter to the first coupler of the endoscope after the shaft is threaded through the channel, the second coupler comprising the second opening; and~~

~~—— a rigid attachment segment comprising a surface configured to removably couple the adapter to an instrument or a second adapter.~~

~~15.—— The endoscope attachment assembly of claim 16, wherein the first adapter is the adapter of any one of claims 2-15.~~

~~16.—— The endoscope attachment assembly of claim 16, further comprising: the second adapter, the second adapter comprising a first channel configured to be removably coupled to the rigid attachment segment, and a second channel configured to be removably coupled to an instrument.~~

~~17.—— The endoscope attachment assembly of claim 18, wherein the first adapter is the adapter of claim 2, wherein an interior surface of the first channel comprises a protrusion configured to engage the groove, and a spring loaded ball configured to engage the recessed indentation of the section.~~

~~18.—— The endoscope attachment assembly of claim 18, wherein the first adapter is the adapter of claim 3, wherein an interior surface of the first channel comprises two protrusions and a spring loaded ball, wherein the rigid attachment segment is configured to be secured to the second adapter by placing the rigid attachment segment into the first channel and sliding the rigid attachment segment relative to the first channel such that two of the grooves of the rigid attachment segment are secured by the two protrusions and the spring loaded ball is secured in one of the recessed indentations.~~

~~19. The endoscope attachment assembly of claim 18, wherein the second adapter is an H-channel adapter, wherein one of the first and second channel is a top open channel of the H-channel adapter, and one of the first channel and second channels is a lower open channel of the H channel adapter.~~

~~20. The endoscope attachment assembly of claim 16 or 17, further comprising: the instrument, the instrument comprising: a channel configured to be removably coupled to the rigid attachment segment.~~

~~21. The endoscope attachment assembly of claim 22, wherein the first adapter is the adapter of claim 2, wherein an interior surface of the instrument's channel comprises a protrusion configured to engage the groove, and a spring-loaded ball configured to engage the recessed indentation of the section.~~

~~22. The endoscope attachment assembly of claim 22, wherein the first adapter is the adapter of claim 3, wherein an interior surface of the instrument's channel comprises two protrusions and a spring-loaded ball, wherein the rigid attachment segment is configured to be secured to the second adapter by placing the rigid attachment segment into the instrument's channel and sliding the rigid attachment segment relative to the instrument's such that two of the grooves of the rigid attachment segment are secured by the two protrusions and the spring-loaded ball is secured in one of the recessed indentations.~~

~~23. The endoscope attachment assembly of claim 16, wherein the first adapter is the adapter of claim 7 or 8, wherein the endoscope comprises a rotatable control positioned at a proximal end of the endoscope, wherein the control is configured to be rotated to digitally adjust an orientation of an image captured by the endoscope.~~

~~24. The endoscope attachment assembly of claim 16 or 17, further comprising: the second adapter, the second adapter comprising a first channel configured to be removably coupled to~~

~~the rigid attachment segment, and a second channel, the second channel comprising a plurality of clips configured to be removably coupled to an instrument.~~

~~25. An endoscope, comprising:~~

~~a shaft comprising:~~

~~—— a distal end; and~~

~~—— a proximal end comprising a rigid attachment segment configured to be~~

~~removably coupled to an adapter or instrument, a surface of the rigid attachment segment~~

~~comprising: a groove and a section adjacent the groove, the section protruding relative to the groove and comprising a recessed indentation or protrusion; and~~

~~a housing coupled to the shaft.~~

~~26. The endoscope of claim 27, wherein:~~

~~the surface of the rigid attachment segment comprises multiple grooves and multiple sections alternating along the longitudinal length of the rigid attachment segment;~~

~~each of the sections protrudes relative to the grooves and comprises a recessed indentation or protrusion; and~~

~~the multiple sections and the multiple grooves are configured such that the instrument can be coupled to the endoscope in a plurality of lengthwise positions.~~

~~27.10. The endoscope of any one of claims 27 or 281, further comprising: a rotatable joint attached to the rigid attachment segment and configured to enable longitudinal rotation of the rigid attachment segment relative to the housing.~~

~~11. TheAn endoscope of any one of claim 27 to 29, wherein the assembly, comprising:~~

~~an endoscope, comprising:~~

~~—— a shaft comprising:~~

~~—— a distal end; and~~

~~—— a proximal end comprising a rigid attachment segment has at least two~~

~~different surfaces running along~~configured to be removably coupled to an adapter or instrument, a
~~longitudinal length~~first surface of the rigid attachment segment,~~wherein each of the at least two~~
~~different surfaces comprise:~~ comprising a first groove and a first section adjacent the first groove,
wherein:

the section protruding relative to the first groove and comprising a
configured to be engaged by a protrusion of the adapter or the instrument,

the first section protrudes relative to the first groove, and

28. the first section comprises a first recessed indentation.

~~The endoscope of any one of claims 27 to 29, wherein the rigid attachment segment has at least two~~
~~different surfaces running along a longitudinal length of the rigid attachment segment, wherein each~~ configured
to secure a spring-loaded ball of the at least two different surfacesadapter or the instrument; and
a housing coupled to the shaft; and
the adapter or the instrument.

12. The endoscope assembly of claim 11, wherein:

the first surface of the rigid attachment segment comprises:~~multiple~~ a first plurality of
grooves and ~~multiple~~ a first plurality of sections alternating along ~~the~~ longitudinal length of the
rigid attachment segment,~~wherein:~~

each of the first plurality of ~~the~~ sections protrudes relative to the first plurality of
grooves, and comprises a recessed indentation; and

the ~~multiple~~ first plurality of sections and the ~~multiple~~ first plurality of grooves are
configured such that the instrument or the adapter can be coupled to the ~~surface~~ endoscope in
a plurality of lengthwise positions.

13. The endoscope assembly of claim 11, comprising: the adapter, the adapter including:
a first channel configured to be removably coupled to the rigid attachment segment,
and

a second channel configured to be removably coupled to an instrument.

14. The endoscope assembly of claim 13, wherein an interior surface of the first channel comprises the protrusion configured to engage the first groove, and the spring-loaded ball configured to engage the first recessed indentation of the first section.

15. The endoscope assembly of claim 14, wherein:

the interior surface of the first channel further comprises another protrusion and another spring-loaded ball;

the first surface of the rigid attachment segment further comprises a second groove and a second section adjacent the second groove;

the second groove is configured to be engaged by the other protrusion; and

the second section comprises a second recessed indentation configured to secure the other spring-loaded ball.

16. The endoscope assembly of claim 13, wherein:

the adapter is an H-channel adapter,

one of the first channel and the second channel is a top open channel of the H-channel adapter, and

one of the first channel and the second channel is a lower open channel of the H-channel adapter.

17. The endoscope assembly of claim 11, comprising: the instrument, the instrument comprising a channel configured to be removably coupled to the rigid attachment segment.

18. The endoscope assembly of claim 17, wherein ~~the endoscope comprises an interior surface of the channel comprises the protrusion configured to engage the first groove, and the spring-loaded ball configured to engage the first recessed indentation of the first section.~~

29.19. The endoscope assembly of claim 11, further comprising: a rotatable control positioned at a proximal end of the endoscope, ~~wherein the~~ rotatable control ~~is~~ configured to be rotated to digitally adjust an orientation of an image captured by the endoscope.

~~30. The endoscope of any one of claims 27-32, wherein the rigid attachment segment comprises a hinged joint between two portions of the rigid attachment segment, the hinged joint configured to enable pivoting or rotation of at least one of the two portions about at least one plane.~~

~~31. The endoscope assembly of claim 27 or 29, further comprising: a hinged joint between the rigid attachment segment and the housing, the hinged joint configured to enable pivoting or rotation of the rigid attachment segment.~~

~~32. The endoscope of claim 27, further comprising: an integrated cannula, the cannula comprising a suction or irrigation port.~~

~~33.20. An the adapter, comprising: the adapter including:~~

~~a closed first channel running through the length of the adapter from a first opening at a distal end of the adapter to a second opening at a proximal end of the adapter, wherein a shaft of an endoscope is configured to be threaded through the closed first channel;~~

~~a channel housing comprising an open second channel, an interior of the open second channel comprising an attachment mechanism for removably coupling coupled to the adapter to an instrument; rigid attachment segment, and~~

~~a first coupler configured to removably secure the adapter to a second coupler of the endoscope after the shaft is threaded through the channel, the first coupler comprising the second opening.~~

~~34. The adapter of claim 36, wherein the attachment mechanism comprises a protrusion configured to engage a groove of the instrument, and a spring-loaded ball configured to engage a recessed indentation of the instrument.~~

~~35. The adapter of claim 36, further comprising: a rotatable joint attached to the channel housing and configured to enable longitudinal rotation of the channel housing segment relative to the first coupler.~~

36. ~~An endoscope attachment assembly, comprising:~~
~~an endoscope comprising a shaft and a housing, the housing comprising a first coupler~~
~~at its distal end; and~~

~~an adapter, comprising:~~

~~—— a closed first channel running through the length of the adapter from a first~~
~~opening at a distal end of the adapter to a second opening at a proximal end of the adapter,~~
~~wherein the shaft is a plurality of clips configured to be threaded through the closed first~~
~~channel;~~

~~—— a channel housing comprising an open second channel, an interior of the open~~
~~second channel comprising an attachment mechanism for removably coupling the~~
~~adapter coupled to an instrument; and~~

~~a second coupler configured to removably secure the adapter to the first coupler after~~
~~the shaft is threaded through the channel, the second coupler comprising the second opening.~~

37. ~~The endoscope attachment assembly of claim 39, wherein the attachment mechanism~~
~~comprises a protrusion configured to engage a groove of the instrument, and a spring loaded~~
~~ball configured to engage a recessed indentation of the instrument.~~

38. ~~The endoscope attachment assembly of claim 40, wherein the endoscope attachment~~
~~assembly comprises the instrument, the instrument comprising the handle, wherein the groove~~
~~and the recessed indentation are on a handle of the instrument.~~