Claims

1. A system for capturing a client vehicle having an engine, comprising:

a propulsion mechanism for maneuvering the system in space;

a capture mechanism for at least temporarily joining the system to the client vehicle, wherein the capture mechanism includes a probe with one or more movable elements positioned at a distal end of the probe, wherein the distal end of the probe is adapted to be inserted into a cavity of the client vehicle and to engage with a portion of the client vehicle defining the cavity, the one or more movable elements configured to pivot laterally outward and inward relative to the probe to engage with and disengage with the portion of the client vehicle defining the cavity;

an engagement assembly to engage with another portion of the client vehicle; and

an actuator to move the one or more movable elements relative to the engagement assembly, wherein the actuator is configured to move the engagement assembly relative to the one or more movable elements in order to engage the engagement assembly with the another portion the client vehicle and to pivot the one or more movable elements laterally outward relative to the probe and toward the client vehicle in order to engage with the portion of the client vehicle defining the cavity or laterally inward relative to the probe and away from the client vehicle in order to disengage with the portion of the client vehicle defining the cavity to assist in docking or undocking of the system with the client vehicle.

2. The system of claim 1, wherein the capture mechanism is sized and configured to dock with a liquid apogee engine of the client vehicle.

3. The system of claim 1, wherein the engagement assembly is configured to engage with the another portion of the client vehicle defining the cavity.

4. The system of claim 1, wherein the engagement assembly comprises a quillon assembly having one or more quillions including a roller.

5. The system of claim 1, further comprising a deployment mechanism for moving the one or more movable elements, the deployment mechanism configured to move independently of the one or more movable elements.

6. The system of claim 1, wherein the probe is configured to be actuated at a rate greater than or equal to 10 millimeters per second in order to minimize an amount of friction during capture of the client vehicle.

7. The system of claim 1, wherein the probe comprises at least two spring-loaded barb fingers adapted to be inserted into the cavity of the client vehicle.

8. The system of claim 1, wherein the engagement assembly is configured to slide relative to the probe in order to translate in an axial manner toward or away from a probe tip of the probe.

9. The system of claim 1, wherein the probe comprises a spring adapted to be used to detect a throat of the engine of the client vehicle.

10. The system of claim 1, wherein the probe comprises a spring adapted to passively cinch the engine of the client vehicle.

11. The system of claim 1, wherein the probe comprises a spring adapted to reduce frictional force imparted on the client vehicle.

12. A system for capturing a client vehicle, comprising:

a propulsion mechanism for maneuvering the system in space;

a capture mechanism for at least temporarily joining the system to a portion of the client vehicle, wherein the capture mechanism includes a probe with a cinch mechanism, the cinch mechanism comprising one or more movable elements for engaging with the client

vehicle in a deployed position, wherein the one or more movable elements are biased into the deployed position;

a deployment mechanism for moving the one or more movable elements of the cinch mechanism, the deployment mechanism configured to move the one or more movable elements against a biasing force from the deployed position to a retracted position, wherein the deployment mechanism is configured to move linearly relative to the capture mechanism in order to actuate the capture mechanism, wherein the biasing force is configured to return the one or more movable elements back to the deployed position; and

an engagement assembly to engage with another portion of the client vehicle, the engagement assembly being spaced from the capture mechanism along a length of the probe, the deployment mechanism configured to move the engagement assembly relative to the capture mechanism.

13. The system of claim 12, wherein the capture mechanism is sized and configured to dock with a liquid apogee engine of the client vehicle.

14. The system of claim 13, wherein the cinch mechanism is configured to contact at least two points of an apex of a throat of the engine.

15. The system of claim 12, wherein the one or more movable elements are configured to rotate between the retracted position and the deployed position, wherein linear movement of the deployment mechanism relative to the one or more movable elements is configured to rotate the one or more movable elements inward to the retracted position.

16. The system of claim 14, wherein the cinch mechanism is configured to limit motion of the client vehicle about the apex to between approximately +/- three degrees.

17. A system for capturing a client vehicle, comprising:

a probe for at least temporarily joining the system to the client vehicle, the probe comprising:

a capture mechanism having one or more movable elements for engaging with a first portion of the client vehicle positioned at a distal end of the probe, the distal end of the probe adapted to be inserted into a cavity of the client vehicle in a deployed position, the one or more movable elements being biased in one of the deployed position or a stowed position;

a deployment mechanism configured to move relative to the capture mechanism to move the one or more movable elements of the capture mechanism between the deployed position and the stowed position, the deployment mechanism configured to move independently of the one or more movable elements to selectively engage with and apply a force to the one or more movable elements at an outer engagement surface in order to move the one or more movable elements between the deployed position and the stowed position, the deployment mechanism exhibiting at least one substantially constant dimension at the outer engagement surface that is further configured maintain the one or more movable elements in one of the deployed position or the stowed position as at least a portion of the deployment mechanism exhibiting the at least one substantially constant dimension at the outer engagement surface moves beyond the one or more movable elements in a direction toward the client vehicle; and

an engagement assembly to engage with another portion of the client vehicle, the engagement assembly being spaced from the capture mechanism along a length of the probe, the probe configured to move the engagement assembly relative to the capture mechanism, wherein the deployment mechanism is configured to move with the engagement assembly relative to the capture mechanism.

18. The system of claim 17, further comprising a compliant extension assembly for carrying the capture mechanism and the engagement assembly and for movably positioning the capture mechanism and the engagement assembly in unison relative to the client vehicle, the

compliant extension assembly being movable independently from the capture mechanism and the engagement assembly, and wherein at least a portion of the compliant extension assembly is flexible in a manner to reduce friction by reducing normal forces exerted on the client vehicle by the system.

19. The system of claim 1, further comprising a cam element configured to move relative to the capture mechanism to rotate the one or more movable elements between a deployed position and a stowed position, the cam element being configured to move independently of the one or more movable elements to selectively engage with and apply a force to the one or more movable elements in order to rotate the one or more movable elements laterally outward or laterally inward relative to the probe between the deployed position and the stowed position.

20. The system of claim 12, wherein the deployment mechanism comprises a cam element comprising one or more engagement surfaces configured to move through and beyond the cinch mechanism in an outward direction toward an intended position of the client vehicle to move the one or more movable elements to an actuated state and to maintain the one or more movable elements in the actuated state as the cam element moves beyond the cinch mechanism, the cam element being configured to move independently of the one or more movable elements to selectively engage with and apply a force to the one or more movable elements with the one or more engagement surfaces in order to move the one or more movable elements between the deployed position and the retracted position.