

WHAT IS CLAIMED IS:

1. A remote operated vehicle (ROV) interface for transferring torque from an ROV to a shaft of a subsea well device, comprising:

a permanent module adapted to be coupled to the shaft of the well device to transmit rotation of the permanent module to the shaft;

a retrievable module having drive and driven members coupled together by a shear element for rotation in unison, the driven member being releasably coupled to the permanent module for transmitting rotation of the driven member to the permanent module;

the drive member of the retrievable module being engageable with a drive tool of the ROV to cause the drive member, the driven member, and the permanent module to rotate the shaft;

an ROV retrieval profile on the retrievable module for engagement by a retrieving tool of the ROV; and wherein

the drive and driven members are retrievable together by the ROV while the permanent module remains attached to the shaft.

2. The interface according to claim 1, wherein:

the drive and driven members have cylindrical surfaces that mate with each other;

a recess in one of the cylindrical surfaces mates with a recess in the other of the cylindrical surfaces to define a shear element cavity; and

the shear element is located in the shear element cavity.

3. The interface according to claim 1, further comprising:

a spring-biased retainer releasably retaining the driven member in engagement with the permanent module, allowing retrieval of the retrievable module from the permanent module by a straight pull with the ROV to overcome a force of the spring-biased retainer.

4. The interface according to claim 1, wherein the ROV retrieval profile is located on the driven member.

5. The interface according to claim 1, wherein the retrieval profile comprises:

at least two slots in a forward end of the driven member;

each of the slots having an entry portion with an opening sized to receive the retrieval tool of the ROV; and

each of the slots having a retainer portion that prevents removal of the retrieval tool, the retainer portion being accessible by the retrieval tool from the entry portion by rotating the retrieval tool.

6. The interface according to claim 1, further comprising:

a retainer mechanism that retains the drive and driven members together during retrieval.

7. An ROV interface for transferring torque from a remote operated vehicle (ROV) to a subsea well device, comprising:

a housing adapted to be mounted to the subsea well device, the housing having a forward end and a rearward end intersected by a housing axis;

a drive cavity for receiving a rotatable shaft of the subsea well device, the drive cavity extending axially into the housing from the rearward end and adapted to transmit rotation of the housing to the shaft;

a pod cavity extending axially into the housing from the forward end of the housing;

a pod body located in the pod cavity for rotation with the housing, the pod body having a cylindrical receptacle extending into the pod body from a forward end of the pod body;

a spring-biased retainer releasably retaining the pod body in the pod cavity;

a drive pin having a cylindrical base located within the receptacle of the pod body, the drive pin having a protruding polygonal portion for engagement by a drive member of the ROV;

a shear element located between the base of the drive pin and the receptacle, the shear element applying to the pod body torque imposed by the ROV on the drive pin to cause rotation of the housing and the drive shaft, the shear element being shearable in the event the ROV applies excessive torque; and

an ROV retrieval profile accessible from a forward side of the pod body and allowing retrieval of the pod body and the pin from the housing by a straight pull with the ROV in a forward direction with sufficient force to overcome a force exerted by the spring-biased retainer.

8. The interface according to claim 7, wherein:

the housing cavity has a major axis dimension and a minor axis dimension that are perpendicular to each other and measured in a plane perpendicular to the housing axis, the major axis dimension being greater than the minor axis dimension; and

the portion of the pod body that locates within the housing cavity has a mating configuration.

9. The interface according to claim 7, wherein the housing cavity has two sides that are flat and parallel with each other.

10. The interface according to claim 7, wherein:

the portion of the pod body that locates within the housing cavity has two flat sides that are parallel with each other;

the spring-biased retainer comprises a detent member protruding into the housing cavity; and

a depression is formed in at least one of the flat sides of the pod body for engagement by the detent member.

11. The interface according to claim 7, wherein:

the spring-biased retainer comprises a detent member protruding into the housing cavity; and

a depression is located in an exterior portion of the pod body for engagement by the detent member.

12. The interface according to claim 7, further comprising:

an axially extending slot in a sidewall of the base of the pin that mates with an axially extending slot in the cylindrical receptacle, defining a shear element cavity; and wherein

the shear element is located within the shear element cavity.

13. The interface according to claim 7, wherein the retrieval profile comprises:
at least two slots in a forward end of the pod spaced circumferentially from each other about the receptacle;
each of the slots having an entry portion with an opening sized to receive a retrieval tool of the ROV; and
each of the slots having a retainer portion that prevents removal of the retrieval tool, the retainer portion being accessible by the retrieval tool from the entry portion by rotating the retrieval tool.

14. The interface according to claim 13, wherein the retainer portion of each of the slots extends in a circumferential direction from the entry portion relative to the cylindrical receptacle.

15. The interface according to claim 14, wherein:
the retainer portion of each of the slots has an opening leading to an enlarged portion, defining a rearward facing ledge for engagement by a forward facing shoulder of the retrieval tool.

16. The interface according to claim 7, further comprising:
a retaining ring in the receptacle of the pod body and in engagement with the base of the drive pin to retain the base of the drive pin in the receptacle.

17. A method of rotating a shaft of a subsea well device, comprising:

providing a remote operated vehicle (ROV) interface with a permanent portion and a retrievable portion, the retrievable portion having drive and driven members coupled together for rotation in unison by a shear element, the driven member being releasably coupled to the permanent portion;

mounting the permanent portion of the interface to the shaft of the well device;

engaging the drive member of the retrievable portion with a drive tool of the ROV and rotating the drive tool, causing the drive member, the driven member, and the permanent portion to rotate the shaft;

if torque imposed by the ROV exceeds a selected level, shearing the shear element, thereby stopping rotation of the shaft; then

with a retrieving tool of the ROV, removing and retrieving the retrievable portion while leaving the permanent portion of the interface attached to the shaft.

18. The method according to claim 17, further comprising:

after retrieving the retrievable portion, replacing the shear element; then

lowering the retrievable portion with the ROV and re-coupling the driven member with the permanent portion.

19. The method according to claim 17, wherein removing the retrievable portion comprises engaging the retrieving tool with the drive member, then pulling in a straight direction with the retrieving tool.

20. The method according to claim 17, wherein:

the driven member is releasably coupled to the permanent portion by a spring
detent member; and

removing the retrievable portion from the permanent portion comprises
overcoming a retaining force exerted by the spring detent member.

CLAIMS

1. A remote operated vehicle (ROV) interface for transferring torque from an ROV to a shaft of a subsea well device, comprising:

a permanent module adapted to be coupled to the shaft of the well device to transmit rotation of the permanent module to the shaft;

retrievable module having drive and driven members coupled together by a shear element for rotation in unison, the driven member being releasably coupled to the permanent module for transmitting rotation of the driven member to the permanent module;

the drive member of the retrievable module having a polygonal portion engageable with a drive tool of the ROV to cause the drive member, the driven member, and the permanent module to rotate in unison to drive the shaft;

an ROV retrieval profile on the retrievable module for engagement by a retrieving tool of the ROV; and wherein

the drive and driven members are retrievable together by the ROV while the permanent module remains attached to the shaft.

2. The interface according to claim 1, wherein:

the drive and driven members have concentric cylindrical surfaces that mate with each other;

a recess in one of the cylindrical surfaces mates with a recess in the other of the cylindrical surfaces to define a shear element cavity; and

the shear element is located in the shear element cavity.

3. The interface according to claim 1 further comprising:

a spring-biased retainer releasably retaining the driven member in engagement with the permanent module, allowing retrieval of the retrievable module from the permanent module by a straight pull with the ROV to overcome a force of the spring-biased retainer.

4. The interface according to claim 1, wherein the ROV retrieval profile is located on the driven member.

5. The interface according to claim 1, wherein the retrieval profile comprises:

at least two sits in a forward end of the driven member;

each of the slots having an entry portion with an opening sized to receive the retrieval tool of the ROV; and

each of the slots having a retainer portion that prevents removal of the retrieval tool, the retainer portion being accessible by the retrieval tool from the entry portion by rotating the retrieval tool.

6. The interface according to claim 1, further comprising:

a retainer mechanism that retains the drive and driven members together during retrieval.

7. An ROV interface for transferring torque from a remote operated vehicle (ROV) to a subsea well device, comprising:

a housing adapted to be mounted to the subsea well device, the housing having a forward end and a rearward end intersected by a housing axis;

a drive cavity for receiving a rotatable shaft of the subsea well device, the drive cavity extending axially into the housing from the rearward end and adapted to transmit rotation of the housing to the shaft;

a pod cavity extending axially into the housing from the forward end of the housing;

a pod body located in the pod cavity for rotation with the housing, the pod body having a cylindrical receptacle extending into the pod body from a forward end of the pod body;

a spring-biased retainer releasably retaining the pod body in the pod cavity;

a drive pin having a cylindrical base located within the receptacle of the pod body, the drive pin having a protruding polygonal portion for engagement by a drive member of the ROV;

a shear element located between the base of the drive pin and the receptacle, the shear element applying to the pod body torque imposed by the ROV on the drive pin to cause rotation of the housing and the drive shaft, the shear element being shearable in the event the ROV applies excessive torque; and

an ROV retrieval profile accessible from a forward side of the pod body and allowing retrieval of the pod body and the pin from the housing by a straight pull with the ROV in a forward direction with sufficient force to overcome a force exerted by the spring-biased retainer.

8. The interface according to claim 7, wherein:
the housing cavity has a major axis dimension and a minor axis dimension that are perpendicular to each other and measured in a plane perpendicular to the housing axis, the major axis dimension being greater than the minor axis dimension; and
the portion of the pod body that locates within the housing cavity has a mating configuration.
9. The interface according to claim 7, wherein the housing cavity has two sides that are flat and parallel with each other.
10. The interface according to claim 7, wherein:
the portion of the pod body that locates within the housing cavity has two flat sides that are parallel with each other;
the spring-biased retainer comprises a detent member protruding into the housing cavity; and
a depression is formed in at least one of the flat sides of the pod body for engagement by the detent member.
11. The interface according to claim 7, wherein:
the spring-biased retainer comprises a detent member protruding into the housing cavity; and
a depression is located in an exterior portion of the pod body for engagement by the detent member.
12. The interface according to claim 7, further comprising:
an axially extending slot in a sidewall of the base of the pin that mates with an axially extending slot in the cylindrical receptacle, defining, a shear element cavity; and wherein
the shear element is located within the shear element cavity.
13. The interface according to claim 7, wherein the retrieval profile comprises:
at least two slots in a forward end of the pod spaced circumferentially from each other about the receptacle;
each of the slots having an entry portion with an opening sized to receive a retrieval tool of the ROV; and

each of the slots having a retainer portion that prevents removal of the retrieval tool, the retainer portion being accessible by the retrieval tool from the entry portion by rotating the retrieval tool.

14. The interface according to claim 13, wherein the retainer portion of each of the slots extends in a circumferential direction from the entry portion relative to the cylindrical receptacle.

15. The interface according to claim 14, wherein:
the retainer portion of each of the slots has an opening leading to an enlarged portion, defining a rearward facing ledge for engagement by to forward facing shoulder of the retrieval tool.

16. The interface according to claim 7, further comprising:
a retaining ring in the receptacle of the pod body and in engagement with the base of the drive pin to retain the base of the drive pin in the receptacle.

17. A method of rotating a shaft of a subsea well device, comprising:
providing a remote operated vehicle (ROV) interface with a permanent portion and a retrievable portion, the retrievable portion having drive and driven members coupled together for rotation in unison by a shear element, the driven member being releasably coupled to the permanent portion;

mounting the permanent portion of the interface to the shaft of the well device;

the drive member of the retrievable portion with a drive tool of the ROV and rotating the drive tool, causing the drive member, the driven member, and the permanent portion to rotate the shaft;

if torque imposed by the ROV exceeds a selected level, shearing the shear element, thereby stopping rotation of the shaft; then

with a retrieving tool of the ROV, removing and retrieving the retrievable portion while leaving the permanent portion of the interface attached to the shaft.

18. The method according to claim 17, further comprising:
after retrieving the retrievable portion, replacing the shear element; then

lowering the retrievable portion with the ROV and re-coupling the driven member with the permanent portion.

19. The method according to claim 17, wherein removing the retrievable portion comprises engaging the retrieving tool with the drive member, then pulling in a straight direction with the retrieving tool.

20. The method according to claim 17, wherein:
the driven member is releasably coupled to the permanent portion by a spring detent member; and

removing the retrievable portion from the permanent portion comprises overcoming a retaining force exerted by the spring detent member.