

1 "Apparatus and a Method for Use in Handling a Load"

2

3 This invention relates to apparatus for use in
4 handling a load which is capable of raising and
5 lowering, or of towing, a load and also handling
6 service cables and/or hoses connected to the load.

7 The invention is particularly, but not exclusively,
8 applicable to the handling of subsea equipment such
9 as grabs.

10

11 Providing services to underwater equipment often
12 involves the provision of a specific bundle of
13 cable(s) and/or hose(s) dedicated to each
14 application. For some applications, it is known to
15 incorporate the service bundle within an armoured
16 hoist rope. This approach has a number of
17 deficiencies. The resulting rope is costly, gives
18 inferior hoisting properties, and by virtue of
19 limitations on the diameter of rope which can be
20 handled, the services that can be incorporated are
21 limited. Further, in practice it is impossible with
22 this arrangement to add to the length of the rope or

1 to join different types of materials, for example
2 wire ropes with fibre ropes.

3

4 To avoid the necessity of using the expensive
5 armoured hoist rope, it is known to wind a service
6 cable around a rope, or vice versa, to service
7 underwater equipment. However, due to water
8 currents and/or movement of a ship from which the
9 apparatus operates, the service cable and rope are
10 placed under stress, which can cause the service
11 cables and the rope to pull away from each other,
12 and the service cable to slip or creep down the
13 rope.

14

15 According to an aspect of the present invention
16 there is provided apparatus for use in handling a
17 load comprising a load-bearing rope, a mechanism for
18 paying out and recovering the load-bearing rope, a
19 service cable and a service cable holder for holding
20 the service cable, a first wrapping device for
21 rotating one of the service cable and the load-
22 bearing rope around the other as they are payed out
23 to wrap the two together, and to unwrap them from
24 one another as they are recovered, a mechanism for
25 holding and paying out a securing member, and a
26 second wrapping device for wrapping the securing
27 member around the service cable and the load-bearing
28 rope, and to unwrap the securing member from the
29 service cable and load-bearing rope as either of
30 them is recovered.

31

1 The securing member is wound around the service
2 cable and the hoist rope, to hold the service cable
3 relative to the load-bearing rope and to reduce the
4 extent of creeping of the service cable down the
5 load-bearing rope.

6
7 The securing member can be planar, in the form of a
8 strip, tape or ribbon, or can have a circular cross-
9 section, in the form of a rope. In preferred
10 embodiments, the securing member is resilient and is
11 applied to the rope in tension.

12
13 The term "service cable" is used herein to denote a
14 flexible elongate member used for conveying power or
15 data, such as an electrical cable, a fibre optic
16 cable, or a pneumatic or hydraulic hose.

17 Typically, the first wrapping device comprises a
18 service cable drum being arranged for rotation about
19 a drum axis which coincides with the axis of the
20 rope. The cable may be guided by sheaves or pulleys
21 from the drum. Instead of rotating on its axis,
22 cable drum may be static and may have a winding
23 device rotating around it to pay out the service
24 cable. Preferably, the service cable drum has a
25 central aperture through which the load-bearing rope
26 passes.

27
28 The service cable drum may be rotatably mounted on a
29 structural member so that its axis is not co-
30 incident with the axis of the rope, and so that it
31 is moved in a circular path around the axis of the
32 rope as the cable is being paid out or recovered.

1 Sheaves and/or pulleys may again guide the cable as
2 it is being paid out or recovered. The axis of the
3 service cable drum in such embodiments can be
4 vertical so that it is parallel to the axis of the
5 rope, or horizontal, so that it is perpendicular to
6 the axis of the rope.

7
8 Optionally, the cable drum has an axis which
9 coincides with the axis of the load-bearing rope,
10 the cable drum typically having a central aperture
11 through which the load-bearing rope passes, with the
12 service cable passing over a cable sheave which is
13 mounted for movement in a circular path around the
14 axis of the load-bearing rope.

15
16 Optionally, the securing member drum has an axis
17 which coincides with the axis of the load-bearing
18 rope, the securing member drum typically having a
19 central aperture through which the load-bearing rope
20 passes, the securing member passing over a rope
21 sheave which is mounted for movement in a circular
22 path around the axis of the load-bearing rope.

23
24 Optionally, the first and second wrapping devices
25 include respective arms arranged for rotation about
26 the load-bearing rope. Optionally, the arms support
27 spooling gear.

28
29 Preferably, the securing member leaves the securing
30 member drum and any associated sheaves radially
31 outward of the service cable to wind the securing

1 member around the service cable and the load-bearing
2 rope.

3
4 Preferably, the securing member has elastic
5 properties. Typically, the securing member is made
6 of neoprene with a nylon reinforcing strip or
7 sheath. The securing member can have a nylon
8 reinforcing strip woven into it to limit the maximum
9 extension of the member, or can be sheathed in
10 nylon. The securing member may be planar, and may
11 incorporate an adhesive to hold the securing member
12 to the rope.

13
14 Typically, the mechanism for paying out and
15 recovering the load-bearing rope includes a rope
16 winch, from which the load-bearing rope passes over
17 a rope sheave and thereafter extends to the load
18 along a substantially straight axis.

19
20 Optionally, the rope winch, the cable drum, the
21 securing member drum, and any winding devices each
22 have a respective driving motor. Alternatively, the
23 rope winch, the cable drum, the securing member drum
24 and any winding devices are driven by a single
25 source through appropriate mechanical linkages.

26
27 Typically, the service cable and/or the securing
28 member are payed out close to the axis of the rope.

29
30 Typically, the service cable comprises an electrical
31 cable, a fibre optic cable, a pneumatic cable or a
32 hydraulic hose.

1 Preferably, the load-bearing rope is a hoist rope
2 used for raising and lowering a load. Typically,
3 the load-bearing rope is a towing rope used for
4 paying out, towing and recovering a load.

5

6 Optionally, more than one service cable is provided,
7 each typically extending from a respective drum.

8

9 Optionally, the cable drum and the securing member
10 drum are both coaxial with the load-bearing rope,
11 one being positioned above the other and the load-
12 bearing rope extending through the centre.

13 Alternatively, one of the cable drum and the
14 securing member drum is coaxial with the load-
15 bearing rope and the other is arranged for movement
16 in a circular path around the rope on a winder
17 mechanism. Alternatively, neither the cable drum
18 nor the securing member drum is coaxial with the
19 load-bearing rope and both are moved in a circular
20 path around the rope on winder mechanisms. In any
21 of these cases, the axes of the cable and securing
22 member drums can be either parallel to or
23 perpendicular to the axis of the hoist rope.

24

25 Preferably, the apparatus also includes a guide
26 means for guiding the load-bearing rope.

27

28 Typically, the guide means comprises at least one
29 roller or sheave. Preferably, more than one roller
30 is provided. Optionally, four rollers are provided
31 around the circumference of the rope forming a
32 roller cage which encloses the load-bearing rope.

1 According to a second aspect of the present
2 invention there is provided a method for use in
3 handling a load, comprising:
4
5 paying out a load-bearing rope;
6 paying out a service cable;
7 wrapping one of the rope and the service cable
8 around the other as they are being paid out;
9 wrapping a securing member around the service cable
10 and load-bearing rope as they are being paid out;
11 and subsequently unwrapping the securing member and
12 service cable from the load-bearing rope as the
13 load-bearing rope is recovered.
14
15 Preferably, the securing member is wound around the
16 load-bearing rope in the opposite direction to the
17 service cable, typically over the top of the service
18 cable.
19
20 Winding the service cable and the securing member in
21 opposite directions could more strongly fix the
22 service cable to the load-bearing rope.
23
24 Optionally, the securing member is wrapped around
25 the rope and service cable(s) only at intervals
26 along the rope, but in most embodiments the securing
27 member is wrapped continuously down the length of
28 the rope as it is payed out. Such intermittent
29 wrappings can comprise discrete lengths of rope,
30 tape or ribbon, optionally formed of elastic
31 material and optionally with an adhesive element, in
32 order to avoid the need to wrap the securing member

1 continuously around the rope and cable. In some
2 embodiments, the tape can be applied intermittently
3 on top of the securing member, so that there are
4 several layers of securing member at certain points
5 on the rope, for example at the lower end of the
6 rope that will be at the deepest depths. Typically
7 the tape is applied at intervals eg every 100 - 300
8 metres.

9

10 Examples of apparatus and a method for use in
11 handling a load in accordance with the invention
12 will now be described with reference to the
13 drawings, in which:-

14

15 Fig. 1 is a schematic perspective view
16 illustrating the principle of operation of a
17 first example of the invention;
18 Fig. 2 is a side view showing details of a part
19 of the apparatus of Fig. 1;
20 Fig. 3 is a cross-section view of an embodiment
21 of Fig 1;
22 Fig. 4 is a cross-section view of an
23 alternative embodiment of Fig. 1;
24 Fig. 5 is a schematic perspective view of a
25 second example of the invention;
26 Fig. 6 is a more detailed side view of a part
27 of Fig. 5;
28 Fig. 7 is a cross-section view of an embodiment
29 of Fig. 5;
30 Fig. 8 is a cross-section view of an
31 alternative embodiment of Fig. 5; and

1 Fig. 9 is a schematic perspective view of Fig.
2 1, adapted for towing rather than lifting.

3
4 Referring to Fig. 1, a hoist rope 1 extends from a
5 hoist rope winch 13 over a hoist rope sheave 4 to
6 support a load (not shown) for raising and lowering.
7 The hoist rope 1 may be any suitable form of hoist
8 rope such as flexible steel wire rope or synthetic
9 fibre rope, for example of "Kevlar". A service
10 cable 2 is held on a service cable drum 3, which is
11 rotatably mounted around the rope 1. One end of the
12 cable 2 extends from the drum 3 and is wound around
13 the rope 1. A securing member in the form of a
14 planar strip 17 of elastic material such as neoprene
15 is held on a rope drum 30, which is also rotatably
16 mounted for movement in a circular path around the
17 rope 1. An end of the strip 17 extends from the
18 rope drum 30 and is wound around the entwined rope
19 and service cable 2, preferably at a different pitch
20 or in a different direction. The drums 3, 30 are
21 preferably rotatable independently of each other,
22 but they could be rotatable together. Additional
23 service cables could be wound around the hoist rope
24 1 from additional respective drums rotatably mounted
25 around the hoist rope 1. The securing member drum
26 30 should be mounted to wrap the strip 17 around the
27 only or outer service cable 2 (i.e. on an arm which
28 extends outward of the service cable drum(s)).

29
30 The strip 17 is preferably elastic, but this is not
31 essential. Certain preferred forms of securing

1 member such as the strip 17 can also be tacky or
2 adhesive

3
4 Fig. 2 shows a more detailed view of the connection
5 of the cable drum 3 with the rest of the apparatus.
6 The service cable drum 3 is removably mounted on a
7 hub motor 11 which is carried on the end of an arm
8 18 rotatably mounted on a fixed frame 20 and driven
9 by a motor 10. The frame 20 is attached to the rope
10 sheave 4.

11
12 Fig. 3 is also a more detailed version of Fig. 1,
13 also showing the strip drum 30. The strip drum 30
14 is attached to the end of an L-shaped arm 6. The
15 arm 6 has a horizontal limb 6a extending radially
16 from the axis of the apparatus to a point outward of
17 the cable drum 3 and a vertical limb 6b on the end
18 of which the strip drum 30 is located, to suspend
19 the strip drum 30 radially outward and below the
20 cable drum 3. This ensures that the securing member
21 17 is always wound the top of the service cable 2
22 and that the securing member 17 and the cable 2 do
23 not become entangled.

24
25 In use, the winch 13 is rotated to lower the hoist
26 rope 1. At the same time, the motor 10 is activated
27 to rotate the arm 18 around the hoist rope 1, and
28 the arm 6 is also rotated (typically by its own
29 similar motor arrangement, or it may be powered from
30 the motor 10). The arm 6 is typically rotated in
31 the opposite direction to the arm 18, which rotates
32 the cable drum 3 and the strip drum 30 around the

1 hoist rope 1, to wind the strip 17 around the hoist
2 rope 1 in the opposite direction to the winding of
3 the service cable 2. The service cable 2 is thus
4 entwined around the hoist rope 1 which is attached
5 to a load, and the strip 17 is wound around the
6 entwined hoist rope 1 and cable 2. Thus, the hoist
7 rope 1 can take the strain of an object lifted
8 without placing the service cable 2 under strain,
9 and the strip 17 binds the service cable 2 to the
10 hoist rope 1, preventing it from slipping down the
11 hoist rope 1.

12

13 In most preferred embodiments the strip has an
14 elastic component and is applied to the rope in
15 tension, so that once applied the strip keeps the
16 cable close to the rope. The tension applied to the
17 strip by e.g. a self tensioning device on the
18 wrapping mechanism is not generally sufficient to
19 overcome the tension in the main hoist rope, and so
20 does not affect the assembly of the rope, cable and
21 securing member.

22

23 To recover the hoist rope 1 and the service cable 2,
24 the procedure is simply reversed. The direction of
25 the motor(s) is reversed to rotate the arms 6, 18 in
26 the opposite directions, to wind the service cable 2
27 and the securing member 17 back onto their
28 respective drums. If tape has been used, this is
29 unwound or cut (by hand or automatically) from the
30 entwined ropes/cable(s).

31

1 Fig. 4 shows an alternative embodiment, where the
2 securing member drum 30 is located on top of the
3 horizontal limb 6a. The securing member 17 extends
4 over the limbs 6a and 6b, guided by guides 9, 11,
5 which are typically sheaves or rollers. The guide 9
6 is at the apex of the arm 6; guide 11 is on the end
7 of the vertical limb 6b. The securing member 17
8 extends from the guide 9 towards the rope 1 on the
9 exterior of service cable 2, in a similar way to the
10 Fig. 3 embodiment.

11
12 Fig. 5 shows a schematic diagram of an alternative
13 embodiment. In this modification, the service
14 cables 2 and the securing member 17 are each
15 provided with a respective storage drum 16, 15
16 stacked on top of each another with their axes
17 parallel to the axis of the rope 1. The service
18 cable 2 and the securing member 17 each have a
19 respective sheave 5, 14 which may suitably be
20 carried on a common supporting frame for rotation in
21 unison. Alternatively the frames may be separate so
22 that the sheaves 5, 14 can rotate independently of
23 one another. The apparatus may be further modified
24 by adding further drums and sheaves to handle more
25 service cables.

26
27 Fig. 6 shows the cable drum 16, the member drum 15
28 and associated parts in greater detail. The rope
29 sheave 4 is journalled to a fixed frame 20 that is
30 secured to any suitable supporting structure such as
31 an A-frame (not shown). The member drum 15 and the

1 cable drum 16 are rotatably mounted one above the
2 other on the lower part of the frame 20.

3

4 The inner end of the service cable 2 can be
5 connected to any appropriate service if needed by
6 any convenient means (not shown) but is otherwise
7 connected to the cable drum 16.

8

9 The member drum 15 is driven in rotation by a motor
10 6. Optionally, a shaft (not shown) passes through
11 the centre of the member drum 15 and the shaft
12 meshes with a cog engagement mechanism inside the
13 bore of the member drum 15 to rotate the member drum
14 15. The cable drum 16 is could be driven in
15 rotation by a separate motor (not shown);
16 alternatively, the cable drum 16 could be driven in
17 rotation from the motor 6. This could be done from
18 an inner shaft, inside the shaft that drives the
19 member drum 15, connecting inside the bore of the
20 cable drum by a similar engaging cog mechanism. A
21 gear mechanism would preferably be provided to
22 rotate the inner shaft in the opposite direction to
23 the outer shaft.

24

25 The member sheave 14 is journaled on a mounting
26 frame 9 that is rotatable about the fixed frame 20
27 by means of a motor 7. Likewise, the service cable
28 sheave 5 is journaled on a mounting frame 50 that
29 is rotatable about the fixed frame 20. Again, the
30 service cable sheave 5 could be driven in rotation
31 from the same motor 7 via an interior shaft and
32 cogs, or from a separate motor (not shown).

1 The motors 6 and 7 are driven at speeds related to
2 the axial speed of the hoist rope 1. The speed
3 correlation may be fixed. Preferably, however, this
4 correlation will be controllable to alter both the
5 length of twist (pitch) of the lay of the member 17
6 on the hoist rope 1, and the tension in the securing
7 member 17. The pitch and the lay of the cable 2 on
8 the hoist rope 1 will also be controlled in a
9 similar way, whether these are controlled by the
10 same motors 6, 7 or different ones not shown.

11
12 Fig. 8 shows a more detailed view of the embodiment
13 of Fig. 5. The service cable 2 extends from the
14 rope drum 16 over guides 32, 34 to pass the service
15 cable 2 around the lower lip 36 of the service cable
16 drum 16 without dragging on the lip 36. The guides
17 32, 34 are located on an arm (not shown) adapted for
18 rotation around the cable drum 16, as shown in Fig.
19 6.

20
21 Likewise, the securing member 17 extends over a
22 second L-shaped arm 6 (only the vertical portion of
23 the arm is shown) over guides 9, 11. In this
24 embodiment the securing member is in the form of an
25 elasticated rope. The guides 9, 11 are typically
26 rollers or sheaves. The arms are preferably
27 rotatable independently of each other.

28
29 After passing over their respective guides, service
30 cable 2 and securing member 17 extend towards the
31 hoist rope 1 to wind around the rope 1, as in the
32 other embodiments.

1 Fig. 7 shows an embodiment similar to that of Fig.
2 4, but having the rope drum 15 positioned around the
3 hoist rope 1, with its axis aligned with the hoist
4 rope's axis. The service cable 2 extends over a
5 rotatable arm (not shown) and over guides 32, 34,
6 which are typically rollers or sheaves, as shown and
7 described above for the Fig. 8 embodiment.

8
9 Fig. 9 illustrates the example of Fig. 1 modified
10 for use in a marine towing application, for example
11 in paying out, towing and recovering a sensor array
12 such as a sonar sensor or seismographic surveying
13 sensor, the sensor array being towed underwater or
14 on the surface. The service cable drum 3 is hinged
15 to the main structure of the towing vessel (not
16 shown) and can be tilted to a desired towing angle
17 by hydraulic or other mechanisms.

18
19 Other modifications may be made within the scope of
20 the invention. For example, the positions of the
21 hoist rope 1 and the service cable 2 could be
22 reversed so that the hoist rope 1 is on a drum and
23 the cable 2 is fed from a winch, to wind the hoist
24 rope 1 around the service cable 2. When tension is
25 put on the hoist rope 1, the hoist rope 1
26 straightens and the service cable 2 becomes wound
27 around the hoist rope 1 in any case.

28
29 More service cable drums could be provided: in the
30 embodiment of Fig. 1, further service cable drums
31 could be provided rotatably mounted around the hoist
32 rope 1; in the embodiment of Fig. 5 there could be

1 further arms extending radially outward of the hoist
2 rope 1 axis, each with a respective cable sheave.
3
4 Further rollers and/or guide sheaves could be used
5 to conveniently position the cable relative to the
6 rope, e.g. to deflect one away from the axis of the
7 other, or to pass the cable around the lip of an arm
8 to align the cable with the rope.
9
10 The securing member 17 is preferably wrapped around
11 the hoist rope 1 in the opposite direction to the
12 wrapping of the outer or only service cable 2, but
13 this is not essential, and the securing member could
14 be wrapped onto the rope and cable at a different
15 pitch to the cable. Tape could also be wrapped
16 around the entwined cable/ropes, either at intervals
17 or in a long continuous length. To unwind the
18 cable/ropes, the tape may be unwrapped or cut
19 therefrom.

Claims:

1 Apparatus for use in handling a load comprising a load-bearing rope, a mechanism for paying out and recovering the load-bearing rope, a service cable and a service cable holder for holding the service cable, a first wrapping device for rotating one of the service cable and the load-bearing rope around the other as they are payed out to wrap the two together, and to unwrap them from one another as they are recovered, a mechanism for holding and paying out a securing member, and a second wrapping device for wrapping the securing member around the service cable and the load-bearing rope, and to unwrap the securing member from the service cable and load-bearing rope as either of them is recovered , wherein the securing member is wrapped around the rope and service cable in the form of a planar strip, tape or ribbon.

2 Apparatus as claimed in any preceding claim, wherein the securing member is resilient.

3 Apparatus as claimed in any preceding claim, wherein the securing member is tensioned as it is applied to the rope.

4 Apparatus as claimed in any preceding claim, wherein the first wrapping device rotates a service cable drum in a circular path around the axis of the rope.

5 Apparatus as claimed in any one of claims 1-3, wherein the service cable is stored on a drum having an axis that is co-axial with the axis of the rope and wherein the service cable wrapping device rotates around the drum to pay out the service cable.

6 Apparatus as claimed in any preceding claim, wherein the securing member is stored on a securing member drum and wherein the second wrapping device rotates the securing member drum in a circular path around the axis of the rope.

7 Apparatus as claimed in one of claims 1-5, wherein the securing member is stored on a drum that has an axis which coincides with the axis of the load-bearing rope, the securing member drum having a central aperture through which the load-bearing rope passes, and wherein the securing member passes over a sheave which is mounted for movement in a circular path around the axis of the load-bearing rope.

8 Apparatus as claimed in any preceding claim, wherein the second winding device is arranged to discharge the securing member radially outward of the service cable to wind the securing member around the service cable and the load-bearing rope.

9 Apparatus as claimed in any preceding claim, wherein the securing member comprises an elastic strip with a non-elastic reinforcing member to limit the maximum extension of the securing member.

10 Apparatus as claimed in any preceding claim, wherein the securing member incorporates an adhesive to hold the securing member to the rope and service cable.

11 Apparatus as claimed in any preceding claim, wherein the wrapping devices are arranged to pay out the service

cable and/or the securing member close to the axis of the rope.

12 Apparatus as claimed in any preceding claim, having more than one service cable wrapping device to accommodate respective service cables and to wrap them on to the rope.

13 Apparatus as claimed in any preceding claim, having guide means to guide the service cable (s), the securing member and/or the rope, the guide means comprising at least one roller or sheave.

14 Apparatus as claimed in claim 13, wherein the guide means comprises a roller cage provided around the circumference of the securing member, the guide means and/or the rope.

15 A method for use in handling a load, comprising: paying out a load-bearing rope; paying out a service cable; wrapping one of the rope and the service cable around the other as they are being paid out; wrapping a securing member around the service cable and load-bearing rope as they are being paid out; and subsequently unwrapping the securing member and service cable from the load-bearing rope as the load-bearing rope is recovered, wherein the securing member is wrapped around the rope and service cable in the form of a planar strip, tape or ribbon.

16 A method as claimed in claim 15, wherein the securing member is wound around the load-bearing rope in the opposite direction to the service cable.

17 A method as claimed in claim 15 or claim 16, wherein the securing member is wrapped around the rope and service cable (s) only at intervals along the rope.

18 A method as claimed in claim 15, wherein the securing member is wrapped continuously around the length of the rope as it is payed out.

19 A method as claimed in any one of claims 15-18, wherein the securing member is tensioned as it is wound around the rope.

20 A method as claimed in any one of claims 15-19, wherein tape is applied intermittently on top of the securing member.

21 A method as claimed in any one of claims 15-20, wherein at least two service cables are entwined with the rope before the securing member is applied.