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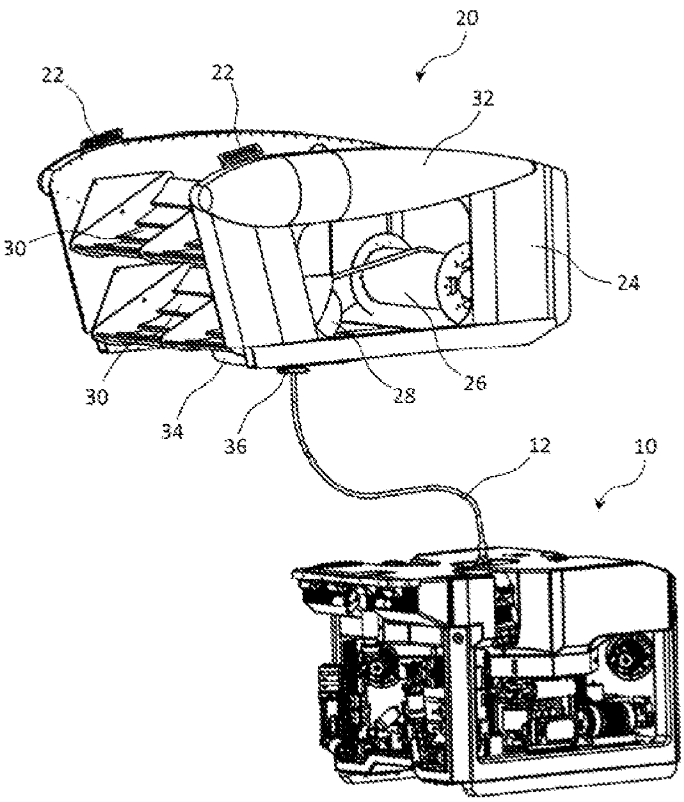
(54)	Title	**A tether management system for subsea operations**
(56)	References Cited:	WO 2015/020529 A1, US 2019/112011 A1, US 2018/043978 A1
(57)	Abstract	

A tether management system (TMS) for subsea operations, said system comprises: an ROV (10) connected to a towable submersible unit (20), said submersible unit (20) having one or more tow cable connections (22) for a tow cable running up to a surface and a tether cable connection for a tether cable (12) running down to said ROV (10), and the submersible unit (20) comprises an underwater winch (26), feeding the tether cable (12) in and out according to the need of the ROV (10). Said submersible unit (20) is a towed depressor, without any thrusters, creating downward depressor force in the water, and which comprises depressor flaps (30) for adjustment of the unit's downward depressor force in the water.



Field of the invention

The present invention relates to a tether management system (TMS) for subsea operations, wherein the system comprises an ROV connected to a towable submersible unit, said submersible unit having one or more tow cable connections for a tow cable running up to a surface and a tether cable connection for a tether cable running down to said ROV, and the submersible unit comprises an underwater winch, feeding the tether cable in and out according to the need of the ROV. The submersible unit is a towed depressor, without any thrusters, creating downward depressor force in the water, and which comprises depressor flaps for adjustment of the unit's downward depressor force in the water.

Background of the invention

Remotely operated vehicles (ROV) are used in conjunction with floating vessel operations to provide and deliver work and observation elements. ROVs are piloted tethered submersible vehicles controlled from the vessel via a reinforced umbilical cable as the main tethering device. The tether provides both the electrical power and allows the transfer of data between the vessel and ROV to be transmitted. Motion of the ROV is controlled by several thrusters that allow movement and manipulation in all directions and speeds. Camera and sensors provide critical data and visual information to be relayed back to the personnel to observe seabed and operating subsea, well, drilling-related tools, equipment, and surroundings. Sensors provide feedback on water depth, temperatures, currents, and ROV orientation.

Known TMS (Tether Management System) is a unit with an underwater winch that feeds a cable in and out according to what the ROV needs. Known Tether Management Systems can, in some cases, be equipped with thrusters to be able to keep them in position in strong currents during launching and collecting.

A tether cable is a thin cable mainly for signals and electricity.

Disclosure of the state of art

WO 2015/020529 A1 discloses a system for subsea operation, comprising a free swimming, submersible garage and docking station, and also an associated free swimming ROV, where the garage and docking station comprises a framework arranged to function as a garage or docking for the free swimming ROV, and where the submersible garage and docking station comprises at least equipment in the form of several thrusters for operation in the vertical and horizontal directions, respectively, units and a steering system for positioning in the water, and also a winch connected to said ROV via a cable for the transfer of electricity and signals.

US 2019/112011 A1 relate to launch and recovery systems for a remotely operated vehicle. The system can include a launch and recovery assembly, a tether climbing component, and a remotely operated vehicle attached to a remotely operated vehicle tether. The launch and recovery assembly deploy the remotely operated vehicle and the tether climbing component overboard, and the remotely operated vehicle is configured for tethered operation while maintaining the tether climbing component at a desired depth.

US 2018/043978 A1 discloses a flying underwater imager device that operates in two modes, a tow mode and a free fly mode. In the tow mode for locating underwater objects, the imager device opens foldable wings for remaining depressed below the surface when the wings generate a negative buoyancy. Otherwise, neutral buoyancy characteristics bring the imager device back to surface. In the free fly mode for approaching and imaging underwater objects, the imager device closes the foldable wings and uses thrusters for moving into position to image the underwater objects.

Objects of the present invention

Traditionally, a TMS is a stationary unit submersed in water or it moves with the ship suspended in a lifting cable. When towed by a ship, the cable will have a large layback and the ROV might have to drag the cable trough the water column during operation, and which can influence and possibly limit operation.

The present invention aims to avoid that the ROV will have to drag the cable trough the water column in the same way as a traditionally TMS, in that the cable will have reduced layback in the water.

The present system will allow flying of an ROV on great depts, similar as in shallow waters.

The present invention also aims to increase survey speed for ROV in any water depths and bringing online data to surface.

Summary of the invention

According to the present invention, a tether management system (TMS) for subsea operations is provided. Said system comprises an ROV connected to a towable submersible unit, said submersible unit having one or more tow cable connections for a tow cable running up to a surface and a tether cable connection for a tether cable running down to said ROV. The submersible unit comprises an underwater winch, feeding the tether cable in and out according to the need of the ROV. The submersible unit is a towed depressor, without any thrusters, creating downward depressor force in the water, and which comprises depressor flaps for adjustment of the unit's downward depressor force in the water, wherein the depressor flaps of the submersible depressor unit comprise several overlapping and in relation to each other displaced flaps, which when closed creates an inclined flow path for flowing water and when open allows flowing water to pass through an opening between the flaps.

The submersible depressor unit can have an internally open frame, wherein underwater winch for feeding the tether cable is mounted within said internally open frame.

The submersible depressor unit comprises preferably on its underside connections means for latchably docking of the ROV. The connections means for latchably docking of the ROV can comprise a snubber and a latch.

The depressor flaps can be mounted on or in the submersible depressor unit facing a towing direction of said unit.

The depressor flaps of the submersible depressor unit can be grouped together, forming side-by-side groups of flaps and/or over-and-under groups of flaps.

The depressor flaps are preferably remote operated flaps.

The submersible depressor unit can have an internally open frame equipped with buoyancy means, and said tow cable connections for a tow cable are placed on a forward and upper part of the frame.

The tether cable, communicating signals and providing electricity, can be running from the underwater winch within the submersible depressor unit, over a guide sheave and to the ROV.

The depressor flaps can be placed with a horizontal orientation and transversely in a front opening of the frame, wherein each depressor flap is hingedly supported on a horizontal orientated axle driven by a drive means, like a motor.

Description of the figures

Embodiments of the present invention will now be described, by way of example only, with reference to the following figures, wherein:

Figure 1 shows a perspective view of a towed submersible depressor unit, which is connected to an ROV.

Figure 2 shows a perspective view of the ROV in docket position for launch and recovery.

Figure 3 shows a side view of the ROV in docket position for launch and recovery.

Figure 4 shows a front view of the ROV in docket position for launch and recovery.

Figure 5 shows a side view of the ROV in undocked/operational mode.

Figure 6 shows a front view of the ROV in undocked/operational mode.

Description of preferred embodiments of the invention

The present tether management system can be connected to surface equipment on a ship (not shown) in where a towing cable (not shown) is running down in the water. The surface equipment may comprise a winch, which may or may not be a heave compensated winch in a launch and recovery system (LARS). The surface system may also comprise a control container and a workshop.

Figure 1 shows the present invention in more detail, and shows a tether management system (TMS) comprising a towable submersible depressor unit 20 with tether management equipment mounted inside, and which is connected to an ROV 10.

The ROV 10 is shown below the submersible depressor unit 20, and is connected to the depressor unit 20 by a tether cable 12 communicating signals and providing electricity to the ROV. The ROV 10 according to the invention is a standard ROV depending on the operation, and as such the ROV is not explained in detail, as the skilled person is well acquainted with such an ROV.

The submersible unit 20, which also can be called submersible depressor unit 20, is submersible for subsea operations in the water together with the ROV 12. The submersible depressor unit 20 and the ROV 10 are shown in figures 2-4 in docket position for launch and recovery and in figures 5-6 in undocked/operational mode.

The submersible depressor unit 20 shall now be described in more detail. The submersible depressor unit 20 comprises an open frame 24 that allows water flowing through. The frame 24 can be equipped with buoyancy means 32 on one or both sides of the frame 24. The buoyancy can be adjusted dependent on the material of the frame, and any other parts of the submersible depressor unit, in where the material for instance is a composite material.

An underwater winch 26 with a drum for reeling and unreeling the tether cable 12 running to the ROV 10 is mounted within the open frame 24, wherein the tether cable 12 is running over a guide sheave 26 prior to leaving the frame 24. The winch 26 is for instance mounted in a rear part of the frame 24 and the guide sheave 28 is mounted in a central part of the frame 24. The frame 24 may further, on its underside facing the ROV 10, comprise connection means, such as a snubber 34 and a latch 36, for docketing of the ROV 10 to the submersible depressor unit 20. Said connection means 34,36 are used when releasing the ROV 10 to an undocked/ operational mode. When undocked the ROV 10 is free to swim wherever it wants, and is only restricted by the lightweight tether cable 12 and the reeling of the tether cable 12. If the submersible depressor unit 20 is being towed at for instance 3 knots, the ROV 10 will easily be able to follow at the same speed of 3 knots.

The frame 24 further comprises tow cable connections 22, preferably one on each side of the frame 24 and on a forward part of the frame 24. The frame 24 is an open frame structure with for instance a rectangular design having basically open side faces.

The submersible unit 20 is a towed depressor, and is therefore not equipped with any thrusters. In order to create a downward depressor force in the water, the submersible depressor unit 20 comprises one or more depressor flaps 30. Since the submersible depressor unit 20 is towable, the depressor flaps 30 are preferably mounted in a forward part of the frame 24 and facing the towing direction.

The depressor flaps 30 can be rigid and non-adjustable flaps mounted in the frame 24, but the depressor flaps 30 are preferably adjustable flaps 30 for adjustment of the submersible depressor unit's downwardly depressor force in the water. The depressor flaps 30 are preferably remote operated flaps.

In one embodiment, the depressor flaps 30 of the submersible depressor unit 20 can comprise several overlapping and in relation to each other displaced flaps 30, As seen in the figures, each following depressor flap 30 is displaced further back than the one in front. The depressor flaps 30 can when closed work as a shutter and create an inclined flow path for flowing water that depresses and forces the depressor unit downwardly, or for that matter upwardly if placed the outer way around. When the depressor flaps 30 are open, flowing water is allowed to pass through an opening between the flaps 30, thereby reducing or removing the downwardly depressor force. By "open" or "closed" is not meant necessarily completely open or close. The flow path of the water will also be influenced with partial open or closed depressor flaps 30.

Further, and as seen in the figures, the depressor flaps 30 of the submersible depressor unit 20 can be grouped together. The depressor flaps 30 can for instance form side-by-side groups of flaps. The depressor flaps 30 can for instance also form over-and-under groups of flaps.

Each depressor flap 30 can be individually adjustable. Each depressor flap 30 in a group can also be individually adjustable. However, in a practical configuration, all depressor flaps 30 in a group, or all groups together, are controlled simultaneously.

One or more depressor flaps 30 can for instance be hingedly supported on a horizontal orientated axle, wherein the axle is connected to a drive means, like a small motor. Several axles with depressor flaps 30 can be driven by the same motor. The depressor flaps 30 can thus be placed in a horizontal orientation and transversely in a front opening of the open frame structure of the frame 24.

Claims

1. A tether management system (TMS) for subsea operations, said system comprises:

an ROV (10) connected to a towable submersible unit (20), said submersible unit (20) having one or more tow cable connections (22) for a tow cable running up to a surface and a tether cable connection for a tether cable (12) running down to said ROV (10), and

the submersible unit (20) comprises an underwater winch (26), feeding the tether cable (12) in and out according to the need of the ROV (10),

said submersible unit (20) is a towed depressor, without any thrusters, creating downward depressor force in the water, and which comprises depressor flaps (30) for adjustment of the unit's downward depressor force in the water,

characterised in that the depressor flaps (30) of the submersible depressor unit (20) comprise several overlapping and in relation to each other displaced flaps (30), which when closed creates an inclined flow path for flowing water and when open allows flowing water to pass through an opening between the flaps (30).

2. The tether management system according to claim 1, wherein the submersible depressor unit (20) has an internally open frame (24), and said underwater winch (26) for feeding the tether cable (12) is mounted within said internally open frame (24).

3. The tether management system according to claim 1, wherein the submersible depressor unit (20) on its underside comprises connections means (34,36) for latchably docking of the ROV (10).

4. The tether management system according to claim 3, wherein the connections means (34,36) for latchably docking of the ROV (10) comprises a snubber (34) and a latch (36).

5. The tether management system according to claim 1, wherein the depressor flaps (30) are mounted on or in the submersible depressor unit (20) facing a towing direction of said unit (20).

6. The tether management system according to claim 1, wherein the depressor flaps (30) of the submersible depressor unit (20) are grouped together, forming side-by-side groups of flaps (30) and/or over-and-under groups of flaps (30).

7. The tether management system according to claim 1, wherein the depressor flaps (30) are remote operated flaps (30).

8. The tether management system according to claim 1, wherein the submersible depressor unit (20) has an internally open frame (24) equipped with buoyancy means (32), and said tow cable connections (22) for a tow cable are placed on a forward and upper part of the frame (24).

9. The tether management system according to claim 1, wherein the tether cable (12), communicating signals and providing electricity, is running from the underwater winch (26) within the submersible depressor unit (20), over a guide sheave (28) and to the ROV (10).

10. The tether management system according to claim 1, wherein the depressor flaps (30) are placed with a horizontal orientation and transversely in a front opening of the frame (24), wherein each depressor flap (30) is hingedly supported on a horizontal orientated axle driven by a drive means, like a motor.

Patentkrav

1. Et kabelstyringssystem (TMS) for undervannsoperasjoner, der systemet omfatter:

en ROV (10) forbundet med en taubar og nedsenkbar enhet (20), der den nedsenkbare enheten (20) har en eller flere tauekabel tilkoblinger (22) for en tauekabel som løper opp til en overflate og en følgekabel tilkobling for en følgekabel (12) som løper ned til nevnte ROV (10), og

den nedsenkbare enheten (20) omfatter en undervannsvinsj (26) som mater følgekabelen (12) inn og ut avhengig av behovet til nevnte ROV (10),

nevnte nedsenkbare enhet (20) er en tauet nedtrykker, uten thrustere, som skaper nedoverrettet nedtrykkerkraft i vannet, og som omfatter nedtrykkerklaffer (30) for justering av enhetens nedoverrettete nedtrykkerkraft i vannet,

karakterisert ved at nevnte nedtrykkerklaffer (30) til den nedsenkbare nedtrykkerenheten (20) omfatter flere overlappende og i forhold til hverandre forskjøvne klaffer (30), som når lukket danner en skråstilt strømningsbane for strømmende vann og som når åpen tillater strømmende vann å passere gjennom en åpning mellom klaffene (30).

2. Styringssystemet i samsvar med krav 1, hvori den den nedsenkbare neddykkerenheten (20) har en intern, åpen ramme (24), og nevnte undervannsvinsj (26) for mating av følgekabelen (12) er montert inne i nevnte internt åpne ramme (24).

3. Styringssystemet i samsvar med krav 1, hvori den nedsenkbare neddykkerenheten (20) på sin underside omfatter tilkoblingsmidler (34,36) for låsbar sammenkobling av nevnte ROV (10).

4. Styringssystemet i samsvar med krav 3, hvori tilkoblingsmidlene (34,36) for låsebar sammenkobling av nevnte ROV (10) omfatter en snubber (34) og en lås (36).

5. Styringssystemet i samsvar med krav 1, hvori nedtrykkerklaffene (30) er montert på eller i den nedsenkbare nedtrykkerenheten (20) vendende i en taueretning til nevnte enhet (20).

6. Styringssystemet i samsvar med krav 1, hvori nedtrykkerklaffene (30) til den nedsenkbare nedtrykkerenheten (20) er gruppert sammen, og danner side-ved-side grupper av klaffer (30) og/eller over-og-under grupper av klaffer (30).

7. Styringssystemet i samsvar med krav 1, hvori nedtrykkerklaffene (30) er fjernstyrte klaffer (30).

8. Styringssystemet i samsvar med krav 1, hvori den nedsenkbare neddykkerenheten (20) har en intern åpen ramme (24) utstyrt med oppdriftsmidler (32), og nevnte tauekabel tilkoblinger (22) for en tauekabel er plassert på en fremre og øvre del av rammen (24).

9. Styringssystemet i samsvar med krav 1, hvori følgekabelen (12), som kommuniserer signaler og gir strøm, løper fra undervannsvinsjen (26) i den nedsenkbare neddykkerenheten (20), over en ledeskive (28) og til nevnte ROV (10).

10. Styringssystemet i samsvar med krav 1, hvori neddykkerklaffene (30) er plassert med en horisontal orientering og tversgående i en fremre åpning i rammen (24), hvori hver neddykkerklaff (30) er hengslende opplagret på en horisontalt orientert aksling som drives av en drivinnretning, så som en motor.

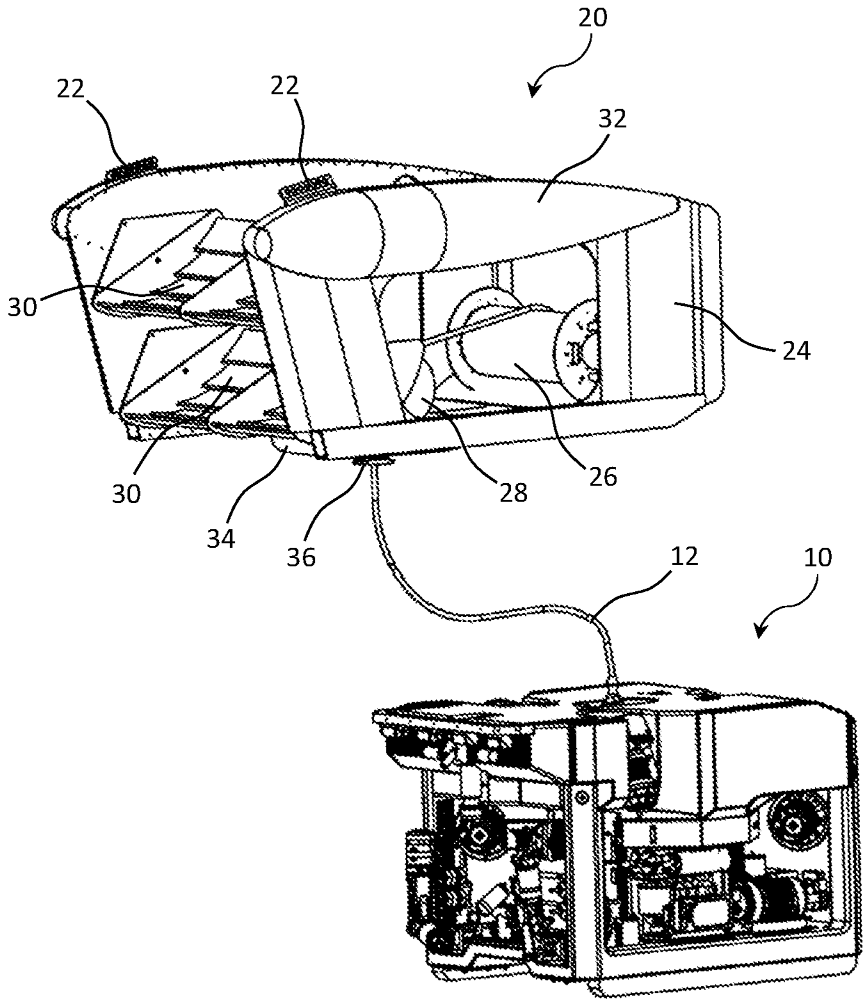


Fig. 1

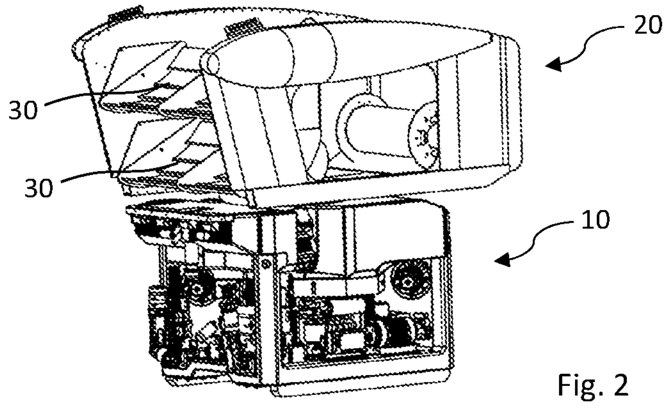


Fig. 2

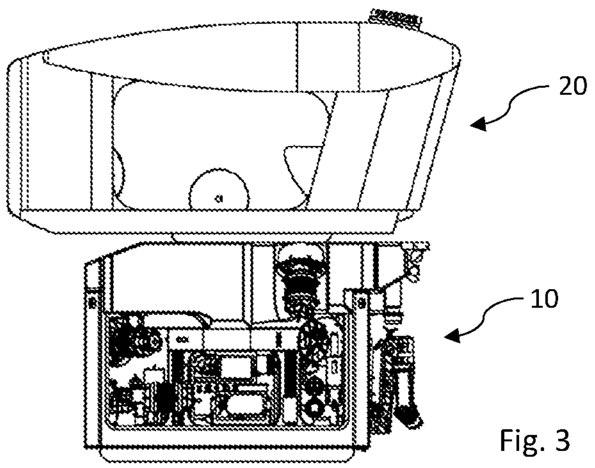


Fig. 3

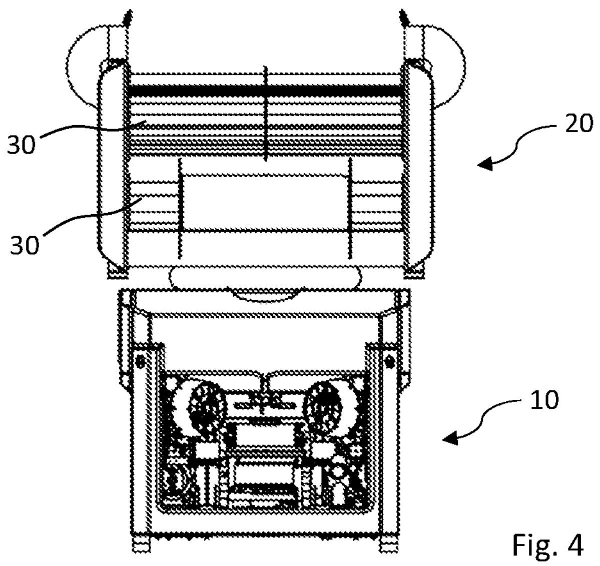


Fig. 4

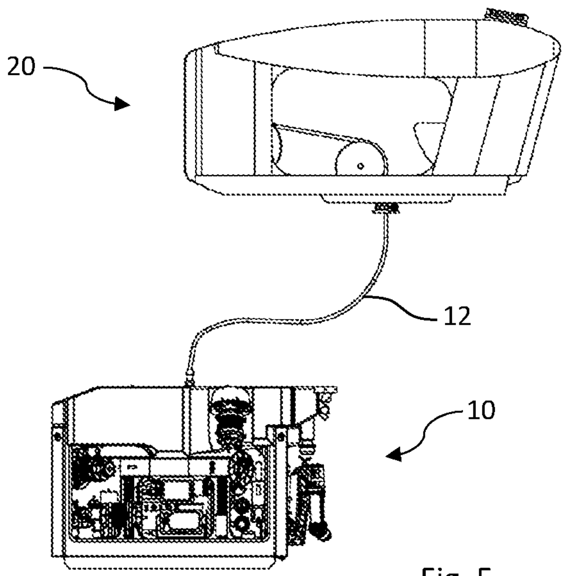


Fig. 5

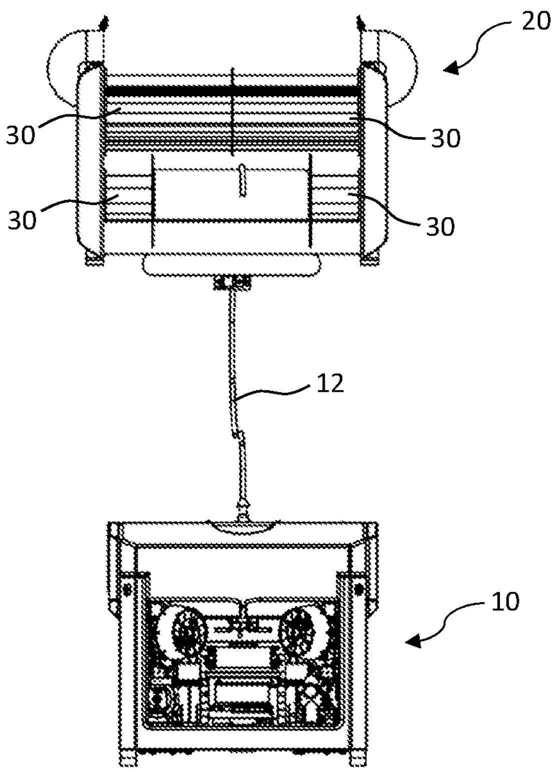


Fig. 6