

[54] CABLE DRUM HIGHLINE SYSTEM

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[51] Int. Cl. B66d 1/48

[58] Field of Search ... 214/13, 14; 104/114; 212/72; 254/172

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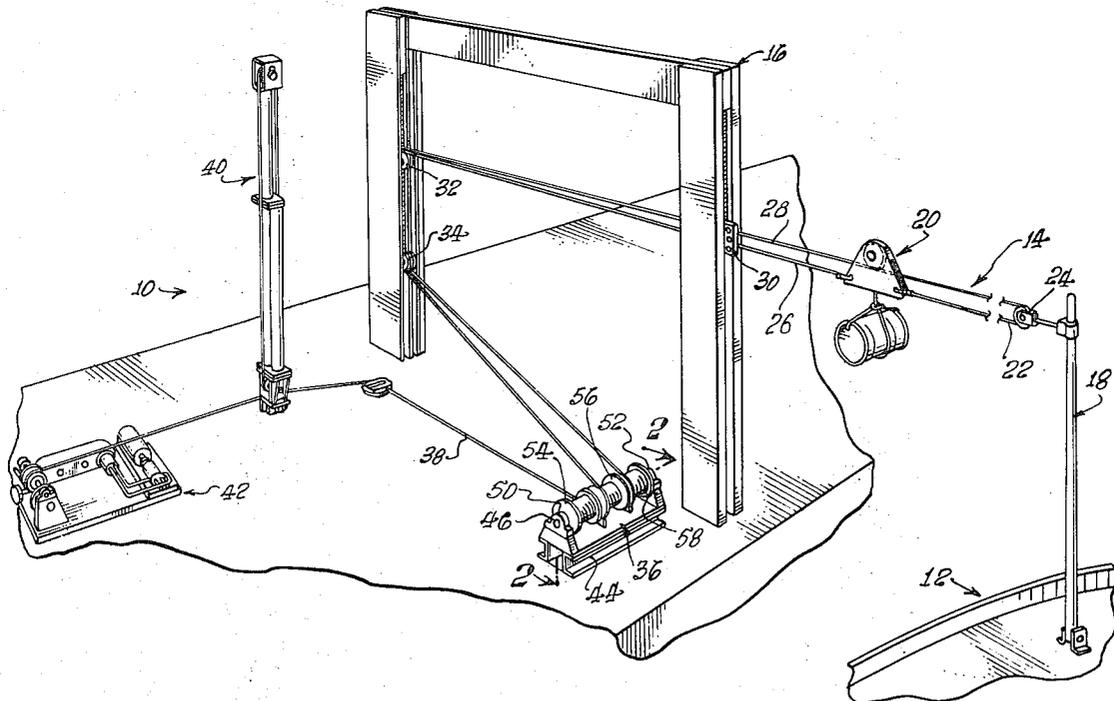
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[57] ABSTRACT

A load-carrying vehicle traverses between supply and receiving vessels at sea, on a closed loop highline of two cable whips terminating at one of the vessels on a pair of drums mechanically interconnected by a differential gear assembly whose spider is coupled to a third drum having a cable coupled to a ram tensioner. The vehicle is snubbed or secured to both the cable whips, and traverse is effected by motor power applied to the drums.

16 Claims, 4 Drawing Figures



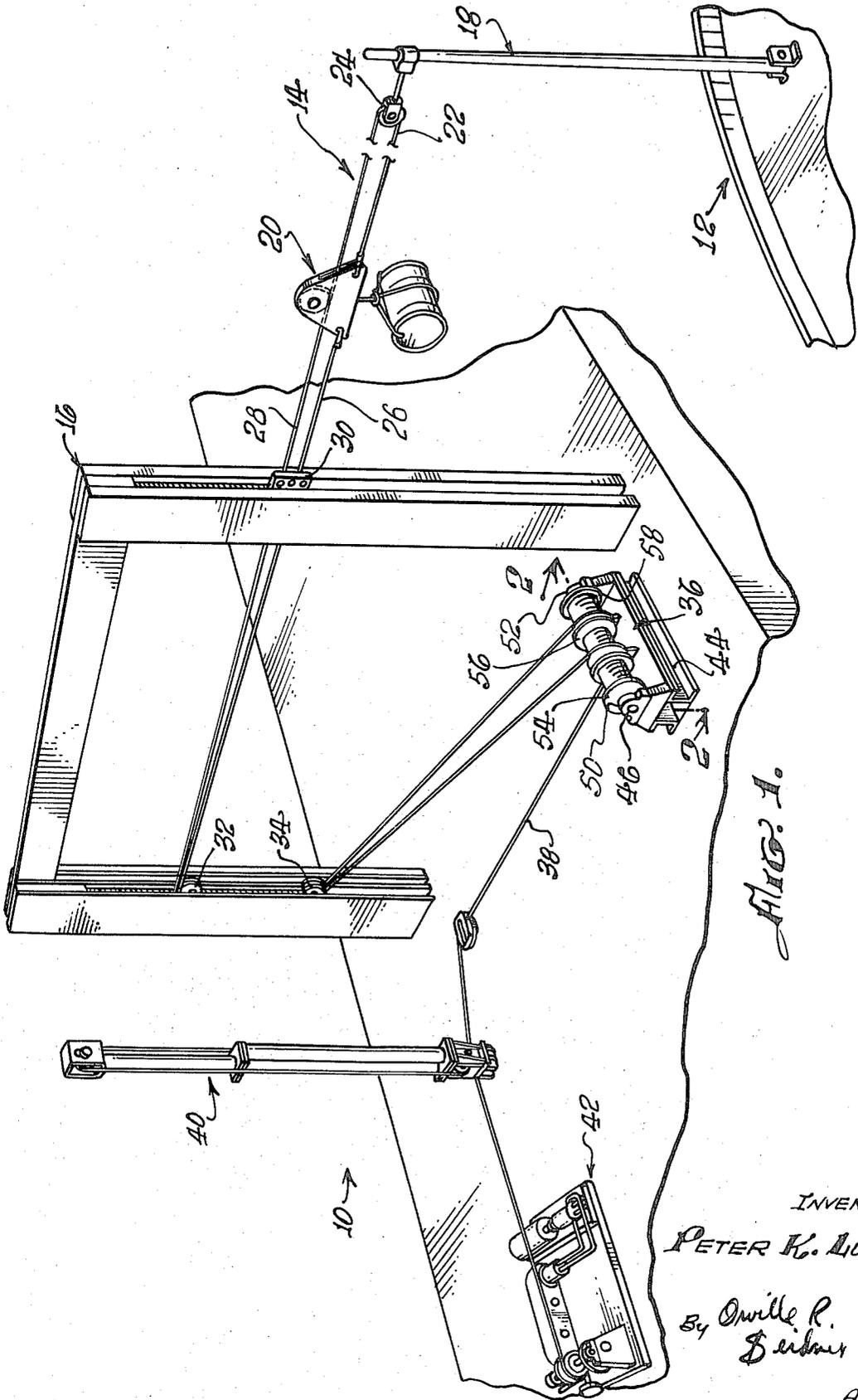


FIG. 1.

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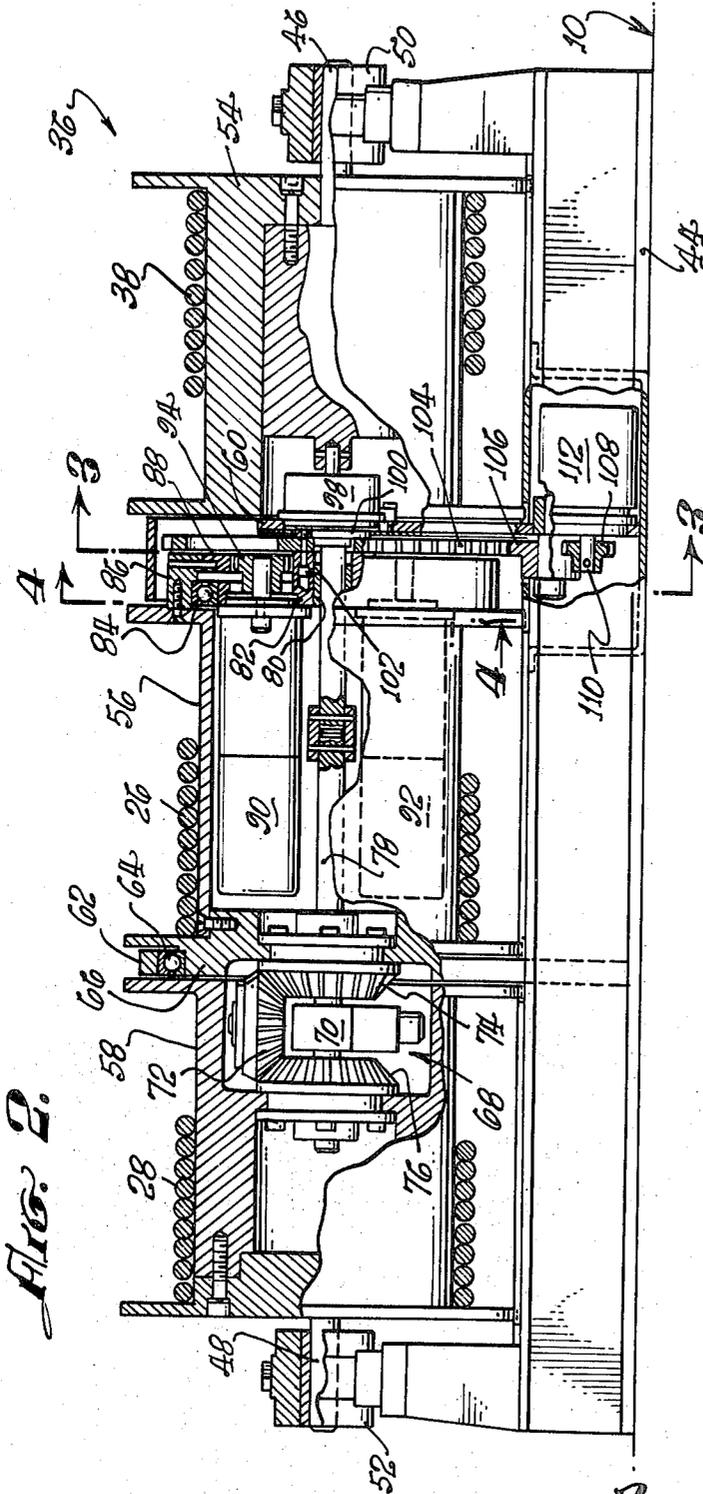


FIG. 2.

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CABLE DRUM HIGHLINE SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS:

United States patent application Ser. No. 92,739, filed Nov. 25, 1970, now U.S. Pat. No. 3,720,400 for CABLE DRUM AND GEAR APPARATUS by Harold L. Potts, is related.

BACKGROUND OF THE INVENTION:

In the aforesaid Potts application Ser. No. 92,739, the load-carrying vehicle is self-propelled over the highline whips rigged between two vessels at sea, the whips comprising a cable reeved over a sheave on the receiving vessel, the ends of the cable being secured to cable drums on the supply vessel. Power for the vehicle is supplied by a cable fed out from a winch on the supply vessel.

The apparatus according to the aforesaid patent application is efficacious for the novel manner in which a substantially constant tension is maintained on the cable whips by a ram tensioner acting upon the cable drums through a differential gear arrangement which permits docking of the vehicle at either end of its travel. The arrangement obviates the necessity for complicated apparatus of the prior art, such as inhaul and outhaul winch apparatus, for example.

As noted, however, the power supply for the vehicle adds the relatively minor complication of the power cable winch.

SUMMARY OF THE INVENTION

The present invention starts from the apparatus disclosed in the aforesaid Potts application, utilizing the differential-motion-coupled arrangement of the two highline drums and a constant tensioning means for them, but eliminating the power means disposed on the vehicle for the traverse thereof on the highline whips between the vessels, thereby eliminating the need for the power cable and winch. The improvement to be described herein comprises a power means which applies a torque force to one or both of the highline drums to effect a running of the highline whips. The load-carrying vehicle is snubbed or otherwise secured to both whip ends to complete the continuous bight between the drums and is thus traversed between the vessels by powered contra-rotation of the highline drums.

Conveniently, the power means may comprise an electric, hydraulic, pneumatic motor means, or the like, disposed within one of the drums, thereby occupying space not normally utilized for a useful purpose. In the described embodiment one or more motors are mounted on a motor mounting plate arranged to be freely rotatable about the axis of the drum within which the motor means are located. The output shaft or shafts of the motor means are then coupled directly through pinion and ring gear means to the said drum.

The motor mounting plate is adapted to being coupled by a brake means to the mounting base of the apparatus or, alternatively, by a clutch means to the shaft carrying the spider of the differential gear assembly. With this arrangement a differential cable whip transfer function is superimposed upon the non-differential drum movement as occasioned by random to-and-from displacement of the vessels.

There is an important advantage to be obtained with the present invention in that brake and clutch arrangement to be described provides a stationary vehicle at the supply vessel for loading purposes or at the receiving vessel for unloading. This is achieved without the necessity of locking or otherwise anchoring the load-carrying vehicle to the highline frames and strongpoints on the respective supply and receiving vessels.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration in fragmentary perspective of a model of the invention in use;

FIG. 2 is an elevation view, partly in cross section, taken on the line 2—2 of FIG. 1;

FIG. 3 is an elevation view taken on the line 3—3 of FIG. 2 with a portion broken away to show the electrical slip ring arrangement; and

FIG. 4 is an elevation view taken on the line 4—4 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring to FIG. 1, transfer of supplies between vessels at sea while under way, such as the supply vessel schematically indicated fragmentarily at 10 and the receiving vessel similarly indicated at 12, is effected via a highline 14 rigged between conventional portal frame 16 disposed on the vessel 10 and a strongpoint 18 on the vessel 12. The load transfer is effected by a vehicle or trolley 20 traversing the highline 14 which comprises two highline cable whips 26 and 28 which are dead ended at vehicle 20, cable whip 28 being doubled back through a snatch block 24 secured to the strongpoint post 18 to provide a free running upper return support line for the vehicle 20.

Thus the highline 14 comprises lower return and upper outgoing cable whips 26 and 28, respectively, passing through the vertically adjustable block 30, thence over the pulleys 32 and 34 at the rear of frame 16, whereafter the cable ends terminate as cable wraps on drums on the drum apparatus 36 to be described hereinafter. It will be appreciated that the load-carrying vehicle 20 and cable 22 are normally stowed on the supply ship 10 until such time as a between-ships transfer is to be accomplished, at which time a messenger line is passed to the receiving ship 12 to haul over the cable 22 for reeving around the pulley of the snatch block 24.

The vehicle 20 is of known variety arranged for free running on the upper whip 28, being secured in known fashion by shackles or quick disconnect means to the lower whip 26 so as to be propelled outwardly from or inwardly to the supply vessel 10 by outgoing and incoming movement of the whip 26 and concurrent incoming and outgoing movement of the whip 28.

A tensioning cable 38 is coupled through a conventional ram tensioner device 40 with one cable end disposed on the cable winch apparatus 42 and the other end received on the drum apparatus 36, as will be more fully described in detail hereinbelow. The arrangement is such that the ram tensioner 40 pays out cable to the drum apparatus 36 when the latter pays out highline 14 upon divergent movement of the vessels 10 and 12, and vice versa upon convergent vessel movement, thereby maintaining a substantially constant tension on the whips 26 and 28 of the highline 14.

As thus far described, the transfer cable rigging and auxiliary apparatus, together with the vehicle apparatus on the highline, is well known and need not be described further in tedious detail since the inventive novelty is considered to reside in the arrangement of the drum apparatus 36 and its combination with the various elements shown in FIG. 1. The drum apparatus is depicted in greater detail in FIGS. 2, 3 and 4 to which reference is now made.

The drum apparatus 36 has a mounting base 44 which supports shafts 46 and 48 for rotation in pillow blocks 50 and 52, respectively. Shaft 46 has mounted to it the cable drum 54 upon which is disposed the wraps of the tensioning cable 38. A pair of cable drums 56 and 58 are coaxially disposed with respect to drum 54, with the drum 58 mounted to the shaft 48. The drums 56 and 58 have disposed upon them the respective wraps of the lower return and upper outgoing cable whips 26 and 28.

Support means secured to the base 44 are provided between the three drums, comprising a plate member 60 between the drums 54 and 56, and a plate member 62 between the drums 56 and 58. The plate member 62 encloses a ball bearing assembly 64 within which is disposed the left end portion 66 of the drum 56.

Centrally disposed within the drum 58 is a differential gear arrangement 68 having a spider 70 upon which is rotatively disposed the bevel planet gear 72 which meshes with the bevel side gears 74 and 76 which are coaxially secured to the drums 56 and 58, respectively. A shaft 78, freely journaled within the gears 74 and 76, has one end secured to the spider 70. It is thus seen that the gear arrangement 68 is mechanically conventional in all respects vis-a-vis the drums 56 and 58 and the shaft 78. Furthermore, the arrangement provides mutually dependent support for the adjacent ends of the drums 58 and 56, the latter of which is supported by the plate 62 and bearing 64 as aforesaid.

Distal of the left end, the shaft 78 is journaled in a sleeve bearing 80 which is disposed in the hub of a circular motor mounting plate member 82 which is secured within the inner race of a ball bearing 84. The outer race of the bearing 84 is disposed within an annular ring member 86 secured to the right end of the drum 56. The member 86 forms a housing for an internal gear 88 secured to the member 86.

The motor mounting plate 82 has mounted on it the planetary gear motor assemblies 90 and 92 whose output shafts have secured thereon the pinion gears 94 and 96, respectively, gear 96 being best seen on FIG. 4. The pinion gears 94 and 96 are meshed with and arranged to drive the internal gear 88 and the drum 56 through the ring member 86.

The aforementioned plate member 60 which is secured to the base 44, provides a supporting mount for the housing of an electromagnetic clutch 98 within which (not shown) are disc and plate elements of known construction. One of the said elements is drivingly coupled to the aforementioned shaft 78 which extends through the clutch 98 to be coupled to the drum 54. The other of said clutch elements is drivingly coupled to an output flange 100 which, in turn, is drivingly coupled by means of screws 102 to the motor mounting plate member 82. The clutch arrangement is such that when the electromagnetic clutch 98 is energized through electrical conductors (not shown) a driving coupling is obtained between the motor mounting plate

82 and the spider 70 of the differential gear 68 by way of the shaft 78. The same coupling will, of course, exist between plate 82 and the drum 54 which is wrapped with the tensioning cable 38.

Interposed between the motor mounting plate member 82 and the output flange 100 of the clutch 98 is a large gear 104 engaged with an idler gear 106, which engages a third gear 108 mounted on the shaft 110 of the electric brake 112 which is secured to the base 44, all as best seen in both FIGS. 2 and 3. The large gear 104 is constrained to rotation with the motor mounting plate 82 and the clutch flange 100 about the axis of the shaft 78 since the gear, plate and flange are all secured together as a single unit by the screws 102. However, the unit is restrained from rotation when the brake 112 is energized, as will be explained in more detail hereinbelow.

The gear motor assemblies 90 and 92 are comprised in the model embodiment of electrical motors having planetary stepdown gearing between the motors and their respective power output pinion gears 94 and 96. Since the motors are mounted on the rotational plate 82, power to the motors is supplied through a slip ring arrangement comprising a pair of slip rings 114 and 116 which are secured upon but insulated from the stationary support plate 60, best seen on FIG. 3. The slip rings 114 and 116 are arranged to be connected by conductor means, not shown, to any convenient electrical power outlet. Co-operatively arranged with the slip rings are a pair of brushes 118 and 120 slidably disposed within insulating brushholders 122 and 124 which are secured to the motor mounting plate 82. The brushes 118 and 120, which are spring biased in known manner into sliding contact with the respective slip rings 114 and 116, are coupled by electrical conductors, not shown, to the electric motors of the motor assemblies 90 and 92. The arrangement of conductors is conventional and need not be described in tedious detail, it being understood that electrical power is thus available to the motors from the exterior power source through the slip rings and brushes. While the motive power source for the drum apparatus 36 has been shown and described as comprising electrical power components, it is obvious that other types of rotary power components, such as hydraulic, could have been employed.

It should also be noted that the planetary gear motors 90 and 92 are provided with brakes or with integral non-backdriving gear boxes which prevent the rotation of the pinion gears 94 and 96 when the electrical motors of the gear motors 90 and 92 are unenergized.

OPERATION

It will be appreciated that when the trolley vehicle 20 approaches either of the vessels 10 or 12 for docking, the transition from a smooth running mode to a stationary docked mode ought to occur without risk of collision with the vessel due to random changes of separation distance due to the state of the sea, and the final docked mode should result in a substantially motionless vehicle with respect to that vessel. The instant invention accomplishes both these requirements as will now be apparent from the following description of the operational modes.

Assuming the vehicle 20 is docked motionless at the supply vessel 10, it is seen that this is maintained by holding the lower cable whip 26 stationary with respect to the vessel 10. Any random convergent or divergent

motions of the vessels 10 and 12 will be justified by respective reeling on or paying out of the upper whip cable 28 on its drum 58, rotation of which is transmitted from its side gear 76 through the planet gear 72, spider 70 and shaft 78 to the tensioner drum 54 where the tensioner cable 38 is respectively taken on and 5 paid out by the ram tensioner 40. The lower cable whip 26 is maintained motionless by the energized brake 112 which maintains the motor mounting plate 82 stationary. Since the planetary gear motors 90 and 92 resist rotation of their pinion gears 94 and 96 by the internal ring gear 88, and hence the drum 56, the drum with the wraps of the lower whip cable 26 is maintained stationary.

The vehicle 20 is caused to traverse the space from the vessel 10 to the vessel 12 by maintaining the brake 112 energized and energizing the motors 90 and 92. Since the motor mounting plate 82 is locked against rotation, the power of the motors 90 and 92 will be applied directly to the drum 56 to pay out the lower whip 20 cable 26 and simultaneously cause the drum 58 to contra-rotate to reel in the upper cable whip 28, thus causing the vehicle to traverse to the vessel 12.

It will be noted that random vessel movements during this traverse mode result in superimposition of the random cable movements on the traverse cable movement. These superimposing movements are readily and easily accomplished with the structural combination disclosed, as will be apparent to those skilled in the art.

When the vehicle 20 approaches the vessel 12, the operator deenergizes the brake 112 and energizes the clutch 98. Upon arrival, the motors 90 and 92 are deenergized, whereupon both whip cables 26 and 28 become stationary with respect to the snatch block 24 and cable movements caused by random vessel movements are simultaneously spooled on or payed out in unison on the drums 56 and 58, which transmit the movements to the tensioner drum 54 through the differential apparatus 68 and shaft 78.

Departure of the vehicle 20 from the vessel 12 is effected by energizing the motors 90 and 92 in a reverse direction. This causes the drums 56 and 58 to be contra-rotated with respect to each other and in the opposite directions to that in the supply-to-receiving vessel mode. That is, the drum 58 pays out cable to the upper whip 28 and the drum 56 spools on cable from the lower whip 26.

When the vehicle 20 arrives back at the supply vessel 10, the motors are de-energized while the brake 112 is maintained in energized condition, as aforesaid in connection with docking the vehicle at the supply vessel.

I claim:

1. Cable drum apparatus comprising:

- a. base means;
- b. first and second cable drums mounted for rotation on said base means about a common axis;
- c. differential gear means having side gear means coupled to said drums and planet gear means rotatively disposed on spider means secured to and revolvably disposed on shaft means, said drums being freely rotatable about said shaft means in the same or opposite rotation direction sense relative to each other;
- d. first force means for applying a first torque force on said drums; and
- e. second force means for superimposing a second torque force on said drums to effect opposite rota-

tion direction sense thereof relative to each other.
2. The apparatus of claim 1 in which said second force means comprise:

- a. mounting plate means disposed for rotation about the common axis of said drums;
- b. motor means mounted on said plate means; and
- c. power transmission means arranged to couple the output of said motor means to said differential motion means.

3. The apparatus of claim 2 in which said power transmission means comprises clutch means arranged to couple said plate means to said shaft means.

4. The apparatus of claim 2 in which said power transmission means comprises brake means mounted on said base means and arranged to apply a braking action to said plate means.

5. The apparatus of claim 2 in which said power transmission means comprises clutch means arranged to couple said plate means to said shaft means, and brake means mounted on said base means and arranged to apply a braking action to said plate means.

6. The apparatus of claim 1 in which said second force means comprises:

- a. mounting plate means disposed for rotation about the common axis of said drums;
- b. motor means mounted on said plate means and having an output coupled to one of said drums; and
- c. brake means mounted on said base means and arranged to apply a braking action to said plate means.

7. The apparatus of claim 1 in which said second force means comprises:

- a. mounting plate means disposed for rotation about the common axis of said drums;
- b. motor means mounted on said plate means and having an output coupled to one of said drums; and
- c. clutch means arranged to couple said plate means to said shaft means.

8. The apparatus of claim 1 in which said second force means comprises:

- a. mounting plate means disposed for rotation about the common axis of said drums;
- b. motor means mounted on said plate means and having an output coupled to one of said drums;
- c. brake means mounted on said base means and arranged to apply a braking action to said plate means; and
- d. clutch means arranged to couple said plate means to said shaft means.

9. Cable drum apparatus comprising:

- a. base means;
- b. first and second cable drums mounted for rotation on said base means and having cables attached thereto;
- c. first drum driving means for rotating said first drum with respect to said base means;
- d. second drum driving means for simultaneously rotating said drums in the same rotation direction sense relative to each other;
- e. third drum driving means for simultaneously rotating said drums in the opposite direction sense relative to each other; and
- f. means for selectively superimposing the motion caused by said third drum driving means on the motion caused by said first or second drum driving means.

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10. Cable drum apparatus according to claim 9 wherein said first drum driving means comprises:

- a. brake means mounted on said base means to apply a braking action to said second cable drum; and
- b. means for driving said first drum in response to changes in the force exerted on the cable attached and said first drum.

11. Cable drum apparatus according to claim 10 wherein said second drum driving means comprises:

- a. means for selectively connecting said first drum to said second drum for simultaneous rotation thereof in the same rotation direction relative to each other;
- b. means for rotatively driving said drums in response to changes in the force exerted on the cables attached to said drums for maintaining the force thereon substantially constant.

12. Cable drum apparatus according to claim 11 wherein said cable drums are rotatably mounted on shaft means for rotation about a common axis.

13. The apparatus of claim 12 in which said third drum driving means comprises a differential gear

means having side gear means coupled to said drums and planet gear means rotatively disposed on spider means secured to and revolvably disposed on said shaft means, said drums being freely rotatable about said shaft means.

14. The apparatus of claim 13 and further comprising:

- a. mounting plate means disposed for rotation about the common axis of said drums;
- b. motor means mounted on said plate means; and
- c. power transmission means arranged to couple the output of said motor means to said differential gear means.

15. The apparatus of claim 14 and further comprising clutch means arranged to selectively couple said plate means to said shaft means.

16. The apparatus of claim 15 and further comprising brake means mounted on said base means and arranged to selectively apply a braking action to said plate means.

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