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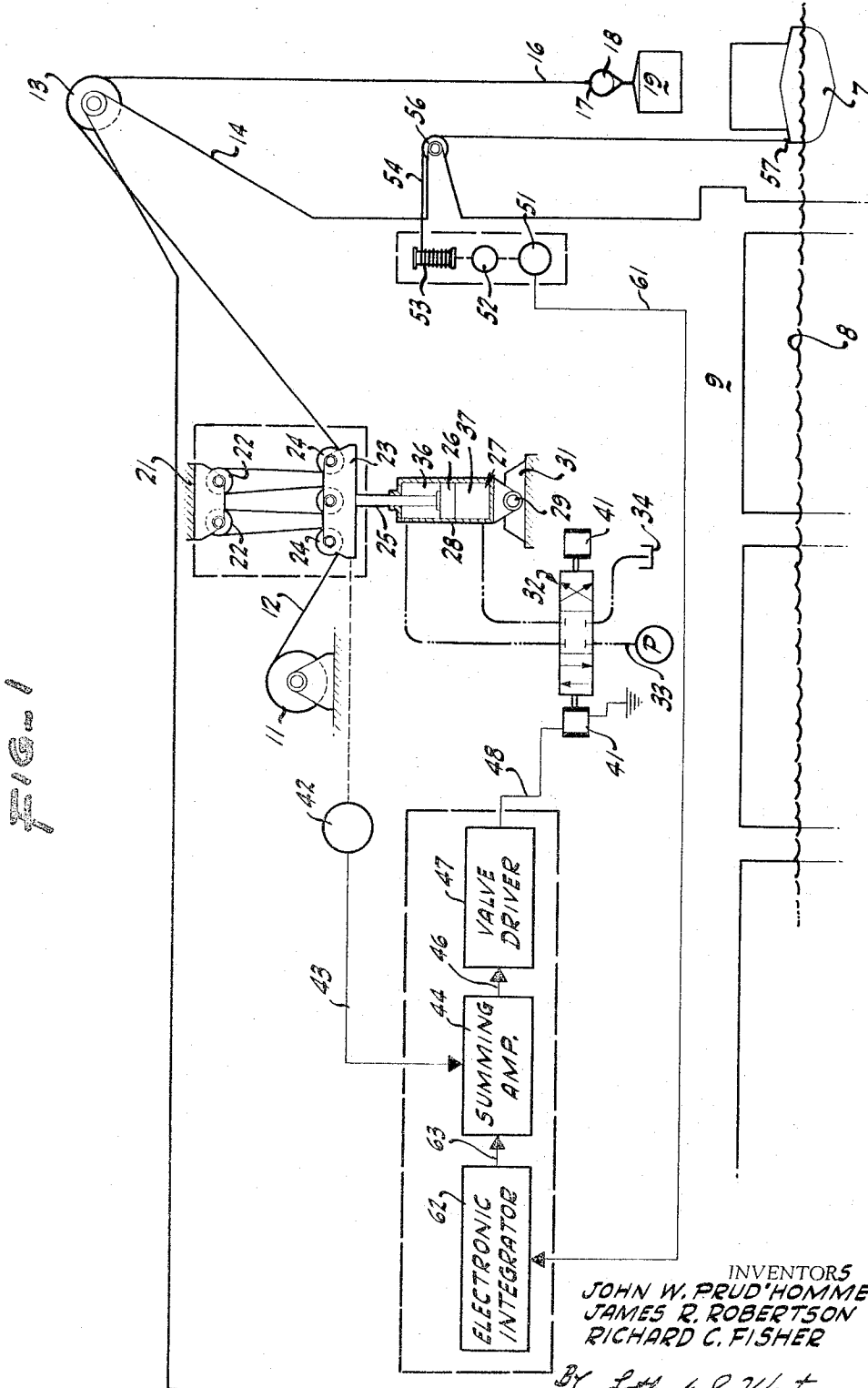
J. W. PRUD'HOMME ET AL

3,309,065

TRANSLOADER

Filed Aug. 24, 1965

2 Sheets-Sheet 1



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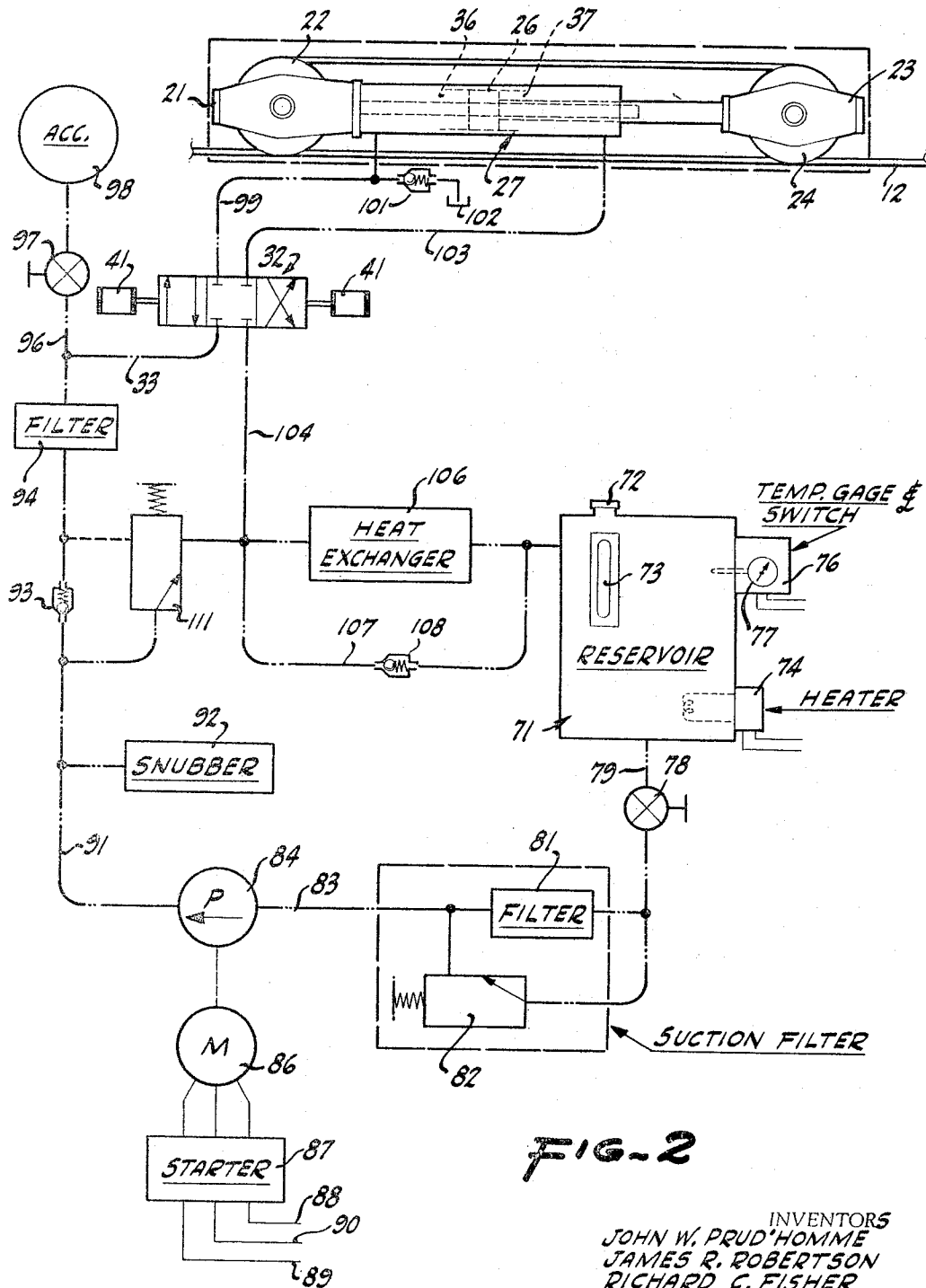


FIG-2

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3,309,065

TRANSLOADER

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Filed Aug. 24, 1965, Ser. No. 482,205
1 Claim. (Cl. 254-172)

Our invention relates to means primarily for use with two relatively moving bodies or supports in connection with the transfer of a load between them, the arrangement being especially designed to compensate for relative vertical movement between the supports during such transfer.

In various marine installations, it is necessary to move a body from a lighter or ship, for example, supported on the water and having substantial vertical movement onto a pier with respect to which the ship is otherwise restrained. It is also necessary to transfer loads between two ships which move relative to each other with a substantial vertical component. The transfer of loads of this sort is usually accomplished by means of a cable and winch mechanism located on the stationary pier or one of the movable vessels. The winch is effective to take in and pay out the cable, which has at its free end a sling or hook connected to the load. As best he can, the operator of the winch must observe visually the rising and falling movement of the other vessel to which or from which the load is moved and coordinate the taking in or paying out of line with his winch in order to ease the settlement of the load onto the vessel being loaded or to assist in easing the load strain on the line as the load leaves the unloading vessel. This operation not only requires a good deal of skill, but is not particularly susceptible to careful control. One of the reasons is that the conditions may be very severe, and another reason is that the winch mechanism may not respond rapidly enough to take care of the relative motion between the two supports.

It is therefore an object of our invention to provide a transloader which can be utilized in connection with an operation of the described sort and which automatically will compensate for or adjust to the relative vertical motion between two supports so that the load is automatically moved in accordance with the motion of the vessel onto which it is being loaded or is automatically moved therefrom so that the strain on the cable is kept within bounds and so that the distance between the vessel and the load increases in a controlled, expected way.

It is an object of the invention to provide a transloading mechanism effective to compensate for the vertical motion between two support devices in transferring loads from one to the other.

Another object of the invention is to provide a transloader effective for use with winch and cable mechanism of the sort already available and which will impart to the present handling mechanism the additional capabilities described.

Another object of the invention is to provide a transloader which will automatically make compensation for the difference in vertical position between two relatively moving load supports.

A still further object of the invention is in general to provide an improved transloading device.

A still further object of the invention is to provide a means which will take in and pay out cable automatically in accordance with the rising and falling movement of one vessel with respect to another vessel or with respect to a stationary pier.

Other objects together with the foregoing are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawings, in which:

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FIGURE 1 is a schematic diagram showing the transloader of our invention in one of its embodiments; and

FIGURE 2 is also a schematic diagram showing the control and actuating structure for a portion of the transloader mechanism.

While the transloader can be adapted to numerous different installations, it is for convenience herein described as it is utilized in connection with the handling of a load borne by a ship 7 or other suitable support which rests in the water 8 adjacent a support such as a stationary pier or dock 9. The pier and the ship 7 move relative to each other with a substantial vertical component. It is assumed that there are sufficient mooring lines or other devices for confining the ship 7 in all horizontal directions but that the ship 7 is free to move vertically with respect to the pier 9 because of the rising and falling of the water 8.

It is customary to have on the pier 9 a suitably driven and operator supervised crane winch 11. The power-driven winch pays out or takes in a cable 12 extending over a sheave 13 mounted on a superstructure 14 such as a boom indirectly or directly supported on the pier 9. The cable 12 extends to an end 16 disposed above the ship 7 and usually terminates in a hook 17 engageable with a ring 18 on a load 19 or cargo to be taken from or loaded upon the ship 7.

In the usual operation, an operator by manual control regulates the power and operates the winch 11 so that the hook 17 rises and falls, but this rising and falling movement is not necessarily in synchronism with the rising and falling movement of the boat 7. Except under unusual circumstances, the hook 17 is entirely out of phase with the rising and falling movement of the water 8.

In accordance with our invention, we provide in addition to the winch 11 a means engaging the line or cable 12 for paying it out or taking it in. This device may well include a stationary sheave block 21 mounted firmly with respect to the winch or pier and having a plurality of sheave block 21, the cable 12 is moved in direct acting part of the structure is a travelling sheave block 23 movable with respect to the block 21 and carrying a plurality of sheaves 24 over which the cable 12 is also reaved. When the sheave block 23 is stationary, the winch 11 operates the hook 17 in the standard fashion, but when the sheave block 23 is moved relative to the sheave block 21, the cable 12 is moved in direct accordance therewith. When both the sheave block 23 and the winch 11 are operated, the cable responds to the net result of the two operations. It is thus possible by appropriately moving the sheave block 23 not only to cause the load 19 to rise or fall as desired, but also to follow the rising and falling movements of the ship 7. The load 19 is placed virtually in synchronism or in phase with the rising and falling motion of the ship. The load transfer can then be made in a fashion entirely equivalent to the load transfer that would be made were the ship 7 stationary.

For that purpose, the movable sheave block 23 is mounted on a piston rod 25 joined to a piston 26 movable within an expansible chamber mechanism 27. This includes a cylinder 28 closed at both ends and having a connection 29 to a stationary base 31 on the pier 9. This mechanism, that is to say, the expansible chamber 27 and the sheave blocks 21 and 23, can be substantially the same device as is shown in the copending application of Prud'homme and Reynolds entitled "Hydropneumatic Cable Tensioner" filed Aug. 23, 1965, Ser. No. 481,794.

Herein, the piston 26 is subjected to power fluid on opposite sides thereof under control of a valve 32. This valve is a proportioning hydraulic valve and, depending on its position, controls the amount of flow in either direction between a pressure source 33, the cylinder 28 and a

return reservoir 34, which may be connected to the pressure source 33. When the valve 32 is in the position shown in FIGURE 1, flow from the pressure source 33 is prevented and the chambers 36 and 37 on opposite sides of the piston 26 in the cylinder 28 are entirely blocked and the movable sheave block 23 is held stationary.

When the valve is shifted to the right in FIGURE 1, flow is then from the pressure source 33 into the upper chamber 36, moving the movable sheave block 23 downwardly in FIGURE 1, taking in the cable 12 and raising the hook 17. When the valve is shifted to the left in FIGURE 1, the connections are crossed and pressure from the pressure source 33 is available within the chamber 37 with the chamber 36 then being connected to discharge into the reservoir. Under these circumstances, the movable sheave block 23 is moved upwardly and the cable 12 is paid out, thus lowering the hook 17. The valve 32 is servo-operated and is provided with an electrical proportioning actuator 41 to move the valve into any corresponding position within its stroke limits.

Particularly pursuant to the invention, we afford special means for controlling the actuator 41. One of the controls is in response to the position of the movable sheave block 23 with respect to the stationary sheave block 21 and in the absence of any other, predominant signal is effective to keep the piston 26 in mid-position available for maximum excursion in either direction. Connected to the movable sheave block 23 is a position responsive device 42, for example a mechanically connected potentiometer supplying an electrical signal through a path 43 in direct relationship to the position of the movable sheave block 23. This signal is introduced into one portion of a summing amplifier 44, the output of which is supplied through a line 46 to a valve driver 47 effective through a connection 48 to energize the actuator 41. Thus, as the piston 26 is moved in response to the position of the valve 32 and the movable sheave block 23 is moved accordingly, this motion or position change is translated by the potentiometer 42 into a signal fed into the amplifier 44 and in turn is effective through the valve driver 47 to correct or restore the position of the servo valve 32 and to centralize the piston 26 and the sheave block 23.

In addition, predominating or overriding means are provided to respond to the position of the ship 7 compared to the relatively stationary pier 9 and to move the sheave block 23 accordingly and despite a signal from the device 42. The vertical displacement between the ship and the pier is observed or measured in any convenient way, by radar, sonar, light or the like. A simple way is by a direct, mechanical convection. Mounted on the pier 9, preferably in the superstructure 14 thereof, is a tachometer 51 actuated through suitable gearing 52 by a reel 53. On the reel is a supply of cord 54 leading over a pulley 56 to a fastener 57.

When the loading or unloading operation is about to take place, an attendant attaches the fastener 57 on the line 54 to the ship 7. The rising and falling motion of the ship relative to the pier 9 causes the spring-loaded reel 53 to take in or pay out the line 54 accordingly. Rotation of the reel 53 produces a corresponding rotation of the tachometer 51 and thus provides a varying signal proportional to velocity that is carried by the conduit 61 to an electronic integrator 62. The various wave motions vertically effective upon the ship or the vertical variations in the boat position with respect to the pier 9 are integrated as to time to afford an indication of relative position without the limitation of an absolute position. The electronic integrator 62 provides this signal and feeds it through a path 63 into another portion of the summing amplifier 44. In this amplifier, the signal from the integrator 62 and the signal from the potentiometer 42 are effective through the line 46 upon the valve driver 47. The hydraulic valve 32 follows the result of signals from the

movement of the ship 7 and the movement of the travelling sheave block 23 to move the piston 26 accordingly.

As the ship 7 rises, for example, the line 54 is taken in and a resulting signal is impressed upon the valve 32 so that pressure fluid is supplied to the chamber 36 and the sheave block 23 travels downwardly far enough to take in an exactly corresponding amount of the cable 12. On the other hand, as the ship 7 falls with respect to the pier 9, the line 54 is drawn out from the reel 53 and the tachometer 51 is correspondingly affected. The valve 32 is correspondingly moved to provide pressure fluid to the chamber 37, thus lifting the travelling sheave block 23 and paying out cable 12 to lower the load 19 proportionately.

The inputs in accordance with the vertical movements of the ship and of the travelling sheave block are not dependent upon the operation of the winch 11. The mechanism, including the travelling sheave block 23, is effective as a compensator to reflect the relative motion between the ship 7 and the pier 9. The winch operator then is free to pay out or take in the cable to lift or lower the load solely in the amount and direction that he wishes. The operator does not have to pay any attention to the lifting and lowering of the ship with respect to the pier since cable movement to take care of that is automatically accomplished.

While numerous different arrangements can be provided for the hydraulically expansible mechanism, it is preferably arranged substantially as shown in FIGURE 2.

Hydraulic fluid is supplied from a reservoir 71 having a filler cap 72 and an indicator glass 73 thereon. Since the mechanism must often work under adversely cold temperature conditions, it is preferred to provide an electric heater 74 in the reservoir, the heater being controlled by a temperature responsive switch 76 having a temperature gauge 77 incorporated therewith. This mechanism maintains a satisfactory viscosity of the operating oil. A normally open shut-off valve 78 is provided in a conduit 79 leading from the reservoir through a filter 81. As a precautionary measure in the event of filter clogging, a bypass valve 82 is provided shunting the filter 81. The output of the filter and shunting arrangement is connected by a line 83 to the inlet of a force pump 84. This pump is driven by an electric motor 86 which supplies the power for the operation, the motor being connected through a starter 87 to electrical lines 88, 89 and 90.

The pump 84 discharges into a conduit 91 carrying a snubber 92 or expansion volume to even out any surges. The conduit 91 leads through a check valve 93 to a second filter 94, the output 33 of which goes to the valve 32. There is a branch line 96 extending through a normally open shut-off valve 97 to an accumulator 98 so that a satisfactory supply of hydraulic fluid under pressure is always available for the valve 32. One of the valve outlets extends through a line 99 to the chamber 36 of the cylinder 28, there being provided an over-pressure relief valve 101 leading to a sump 102 which conveniently can also be the reservoir 71. Another output line 103 from the valve 32 extends to the other chamber 37 of the cylinder 28. A return line 104 from the valve 32 extends through a heat exchanger 106 acting as a cooler and extends to the reservoir 71. A bypass line 107 is provided with a check valve 108 in it so that there is always an open return path even though the heat exchanger 106 should become clogged.

As protection should the hydraulic mechanism reach a maximum designed pressure, an unloading valve 111 connected between the conduit 91 and the line 104 opens to discharge the fluid either through the heat exchanger or through the bypass line 107 back to the reservoir.

With this mechanism, there is readily available a supply of hydraulic fluid at a proper viscosity to afford a rapid operation of the movable sheave block 23 so that rapid taking in or paying out of the cable 12 can be effectuated in response to the rising and falling motion of the ship 7 relative to the pier 9.

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What is claimed is:

A transloader for use with a relatively stationary first support and a second support moving vertically with respect to said first support comprising a winch on said first support, a line extending from said winch and having an end disposed above said second support, a first sheave block engaging said line between said winch and said end and fastened on said first support, a second sheave block engaging said line between said winch and said end and movable with respect to said first support, a fluid-actuated expansible mechanism arranged to move said second sheave block, means responsive to relative vertical movement between said first support and said second support for controlling the operation of said expansible mechanism, said responsive means including a valve for controlling said expansible mechanism, a valve driver for actuating said valve, a summing amplifier for operating said valve driver, means responsive to the position of said

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second sheave block relative to the position of said first sheave block for supplying an indication thereof to said summing amplifier, an integrator, means responsive to the position of said second support relative to said first support for supplying an indication thereof to said integrator, and means for feeding the output of said integrator to said summing amplifier.

References Cited by the Examiner

UNITED STATES PATENTS

2,854,154	9/1958	Hepinstall	214—14
2,946,466	7/1960	Weiner	214—14
3,001,396	9/1961	Cleveland	254—172
3,150,860	9/1964	Nelson	254—172
3,189,195	6/1965	Fox et al.	214—14
3,189,196	6/1965	Carl et al.	214—14

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