Dec. 19, 1939. A. J. CHANTRY 2,183,542

HOISTING APPARATUS

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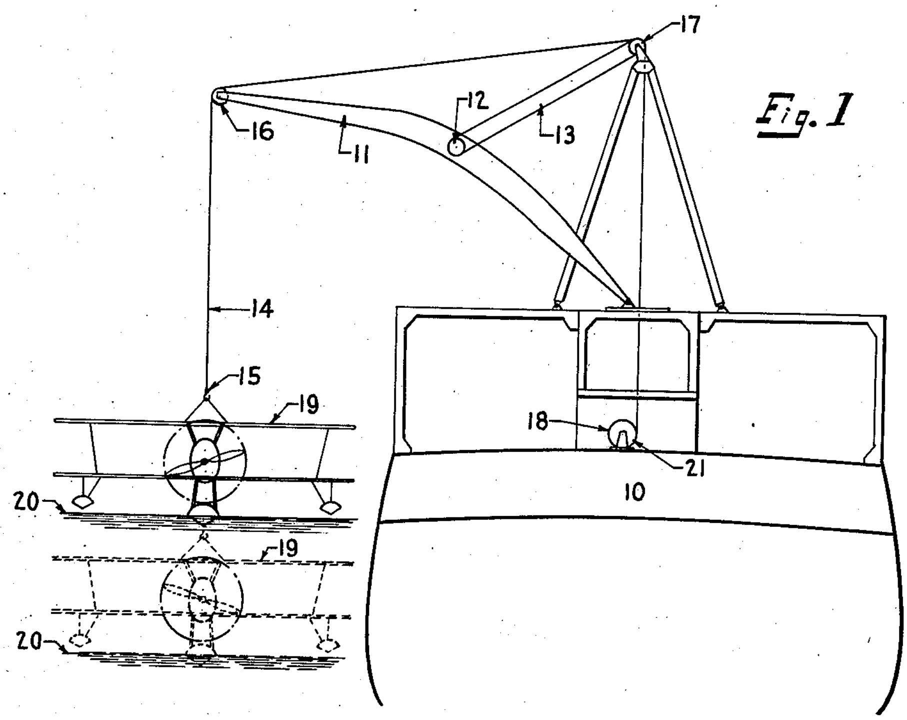

Fig. 1

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Fig 2

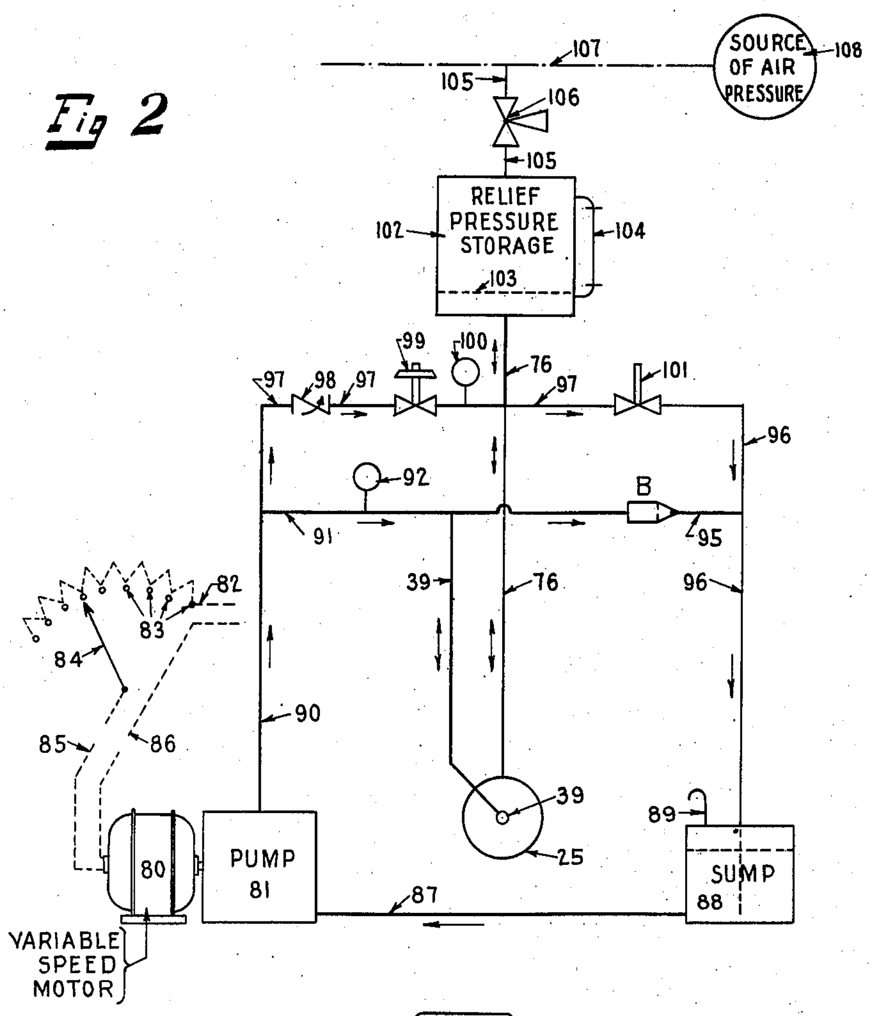


Fig 2b

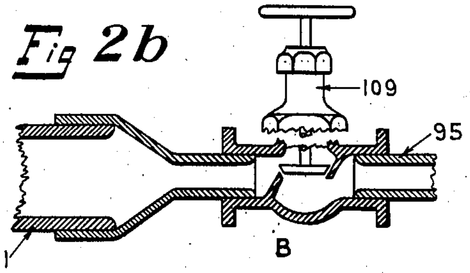
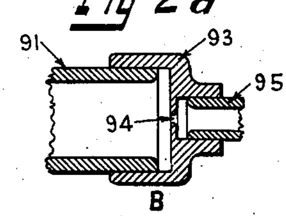


Fig 2a



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HOISTING APPARATUS

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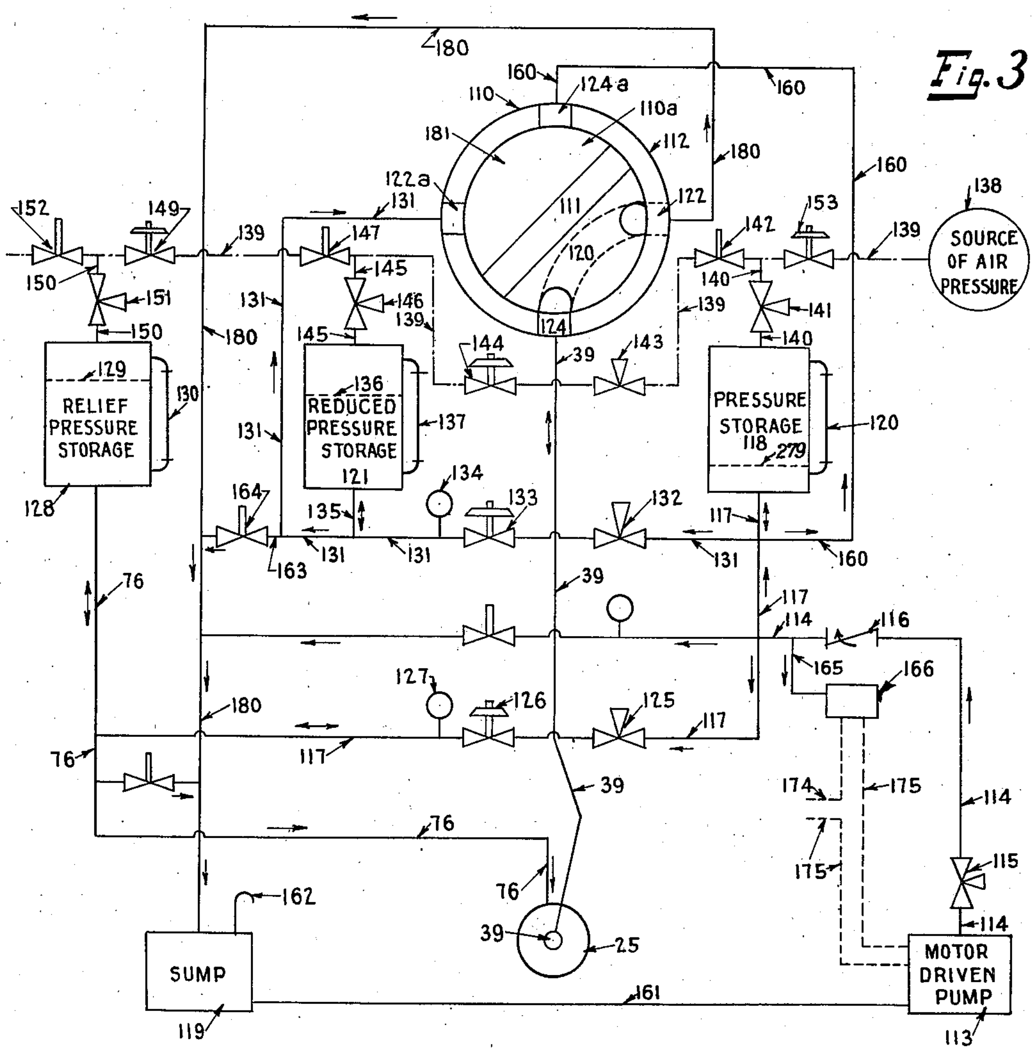

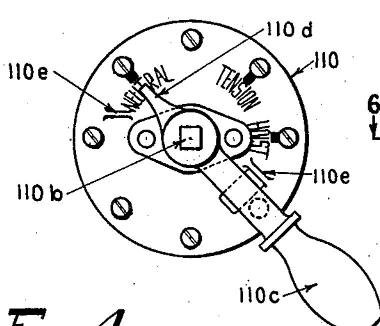

Fig. 4

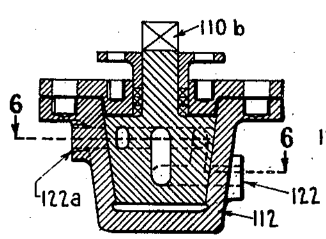

Fig. 5

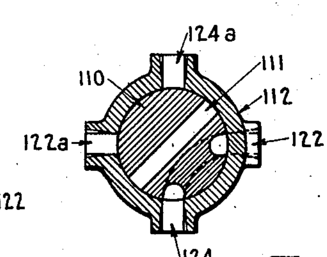

Fig 6

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HOISTING APPARATUS

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Fig. 7

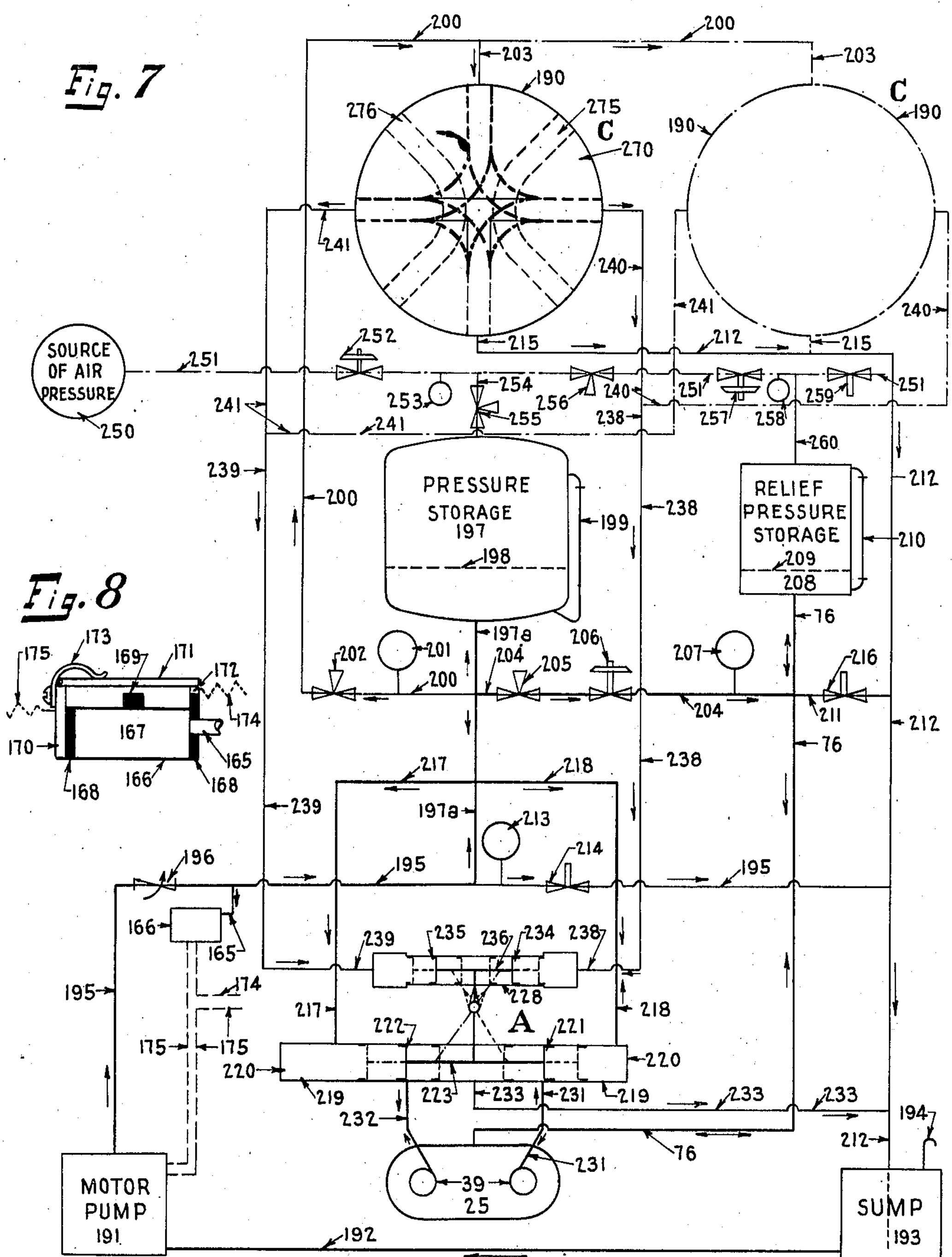

Fig. 8

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Fig. 9

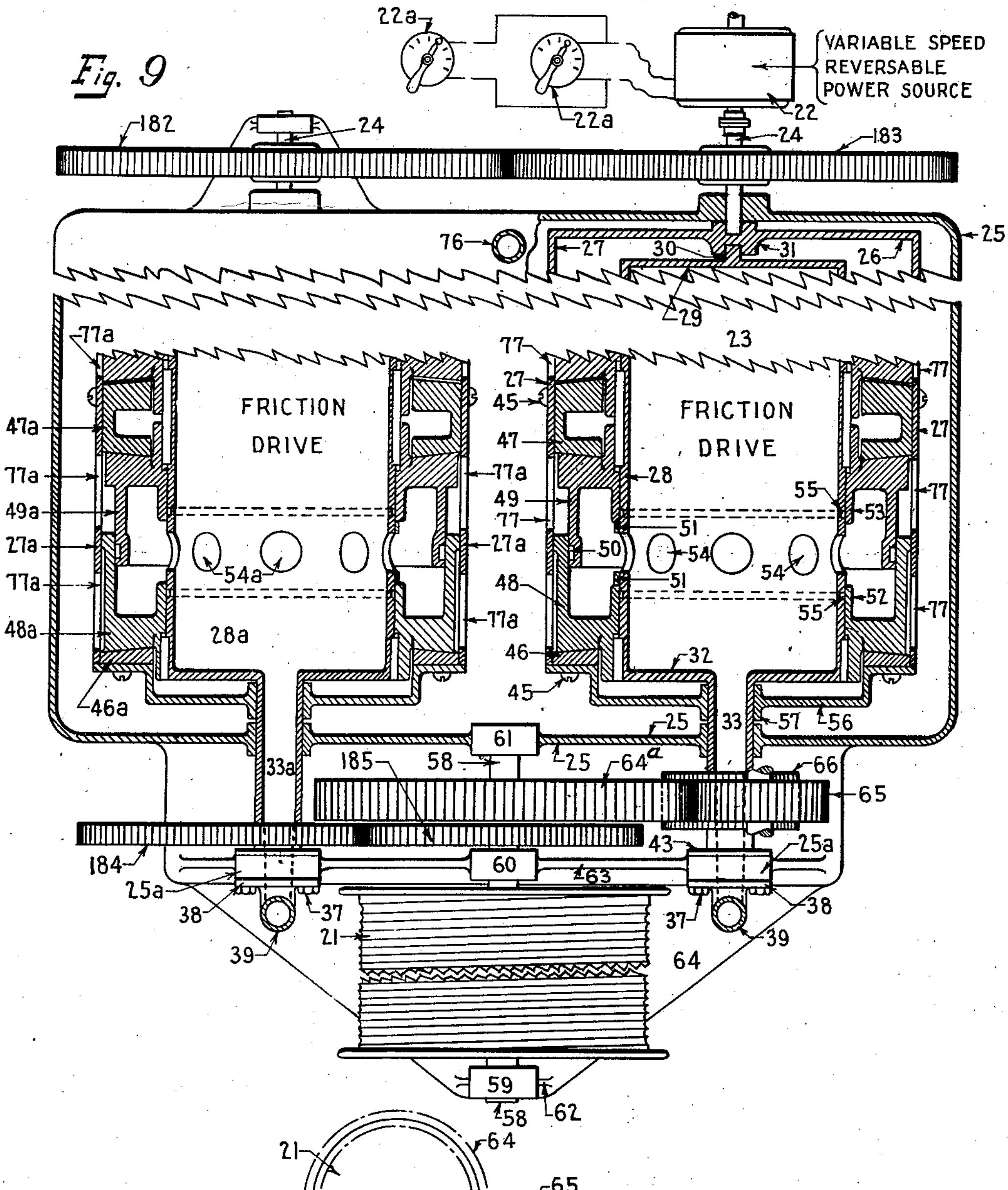
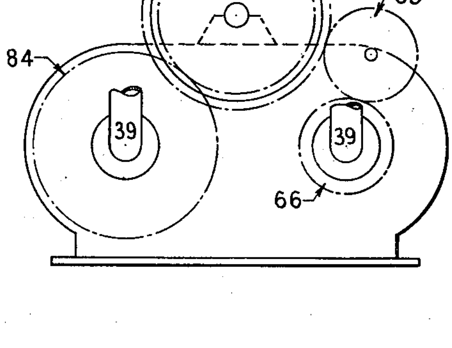


Fig. 10



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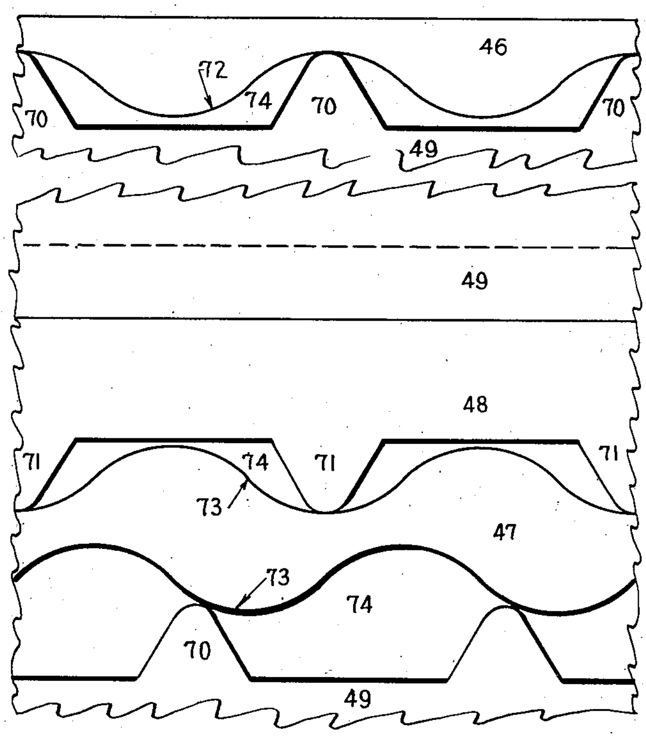

Fig.11

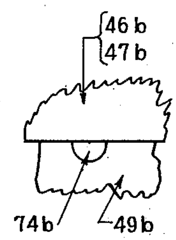

Fig.11a

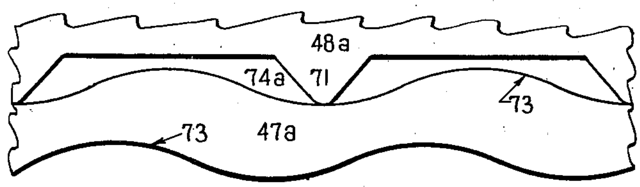

Fig.12

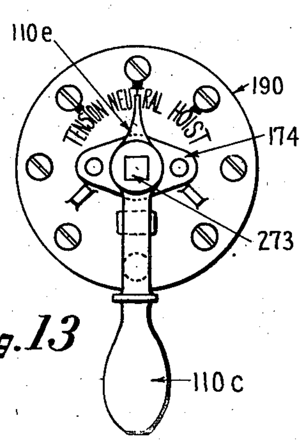

Fig.13

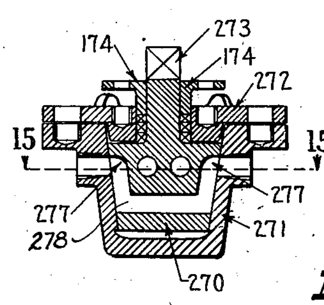

Fig.14

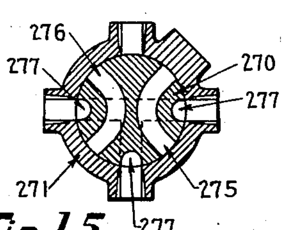

Fig.15

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Fig. 16

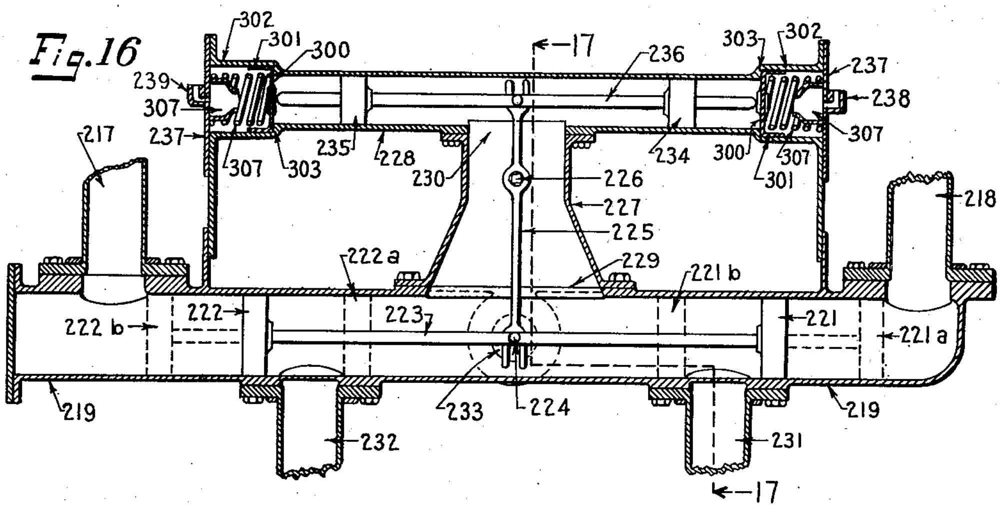
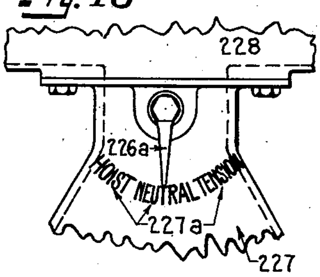


Fig. 18



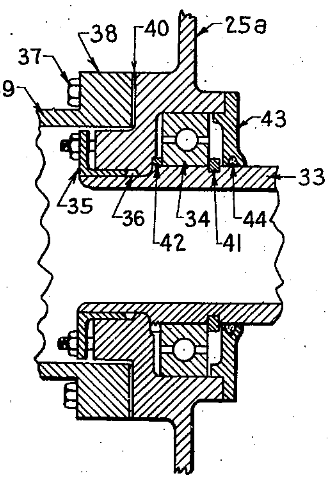


Fig. 20

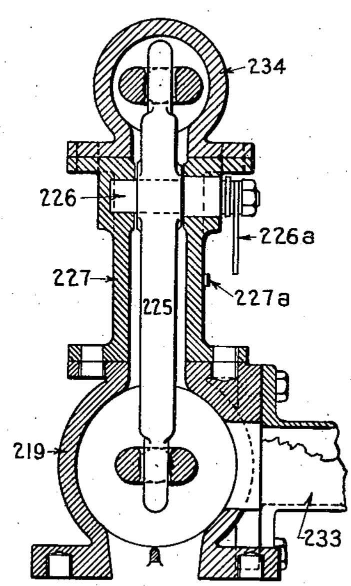


Fig. 17

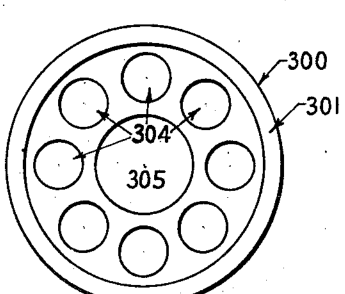


Fig. 19

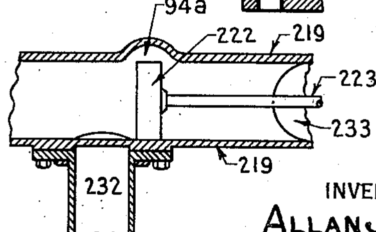


Fig. 16a

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Patented Dec. 19, 1939 2,183,542

UNITED STATES PATENT OFFICE

2,183,542

HOISTING APPARATUS

Allan J. Chantry, United States Navy

Application October 4, 1935, Serial No. 43,558

20 Claims. (Cl. 254—173)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

My present invention relates to an improved hoisting apparatus particularly useful in safely hoisting an object from a support which is subject to variable movement in the line of hoist. The support may be, and is in the instance illustrated, the ocean whose waves ordinarily make hazardous the hoisting of airplanes or other vessels or objects therefrom onto either a vessel or a dock. Any other support subject to movement similar to wave motion, or other variable movement, is within the scope of the present invention.

Attempts have heretofore been made to eliminate such hazard by providing a hoist driven by flowing oil under pressure, or electric current, in either of opposite directions in order to drive the hoisting mechanism backward to accommodate the recession of the wave, and forward to accommodate the rising of the wave and opportunely manually controlling the continuance of said forward drive to accomplish the hoisting of the object.

The objects of this invention are to provide an apparatus for facilitating and increasing the safety with which objects may be hoisted from water subject to wave motion, or from a support liable to similar or other variable or unexpected movement; to dispense with said driven hoisting mechanism and the complex means required to control the direction and rate of flow of their required power; to provide an improved means for driving the hoisting mechanism by friction comprising means for varying this friction such that the hoisting cable attachable to the object is kept free from objectionable slack during the non-hoisting period and means for controlling the increase of such friction to effect the hoisting operation; the operation of said apparatus resulting in the initial automatic maintenance, after the hoisting cable is attached to the object, of only sufficient idling friction in the drive of such hoisting mechanism as will enable the hoisting cable to move the hoisting mechanism backward against its light friction forward drive, for instance as the object goes down, and to enable the idling friction to move the hoisting mechanism forward as the object rises, thereby keeping the hoisting cable free from objectionable slack; and to provide a simple, durable, relatively inexpensive and highly efficient apparatus for this purpose, for use on board ship as well as on land.

These and other objects of my invention, as well as the details of my improved apparatus, will be rendered more apparent from the following description and the accompanying drawings, illustrating the embodiment of my invention in the form of an improved apparatus I have found most satisfactory.

Reference is to be had to the accompanying drawings forming a part of this specification in which like reference characters indicate corresponding parts throughout the several views and in which:

Fig. 1 illustrates the conventional application of my invention to a vessel whose boom is adapted to overhang the water, but the same may be as conveniently installed on a dock provided with a boom likewise overhanging the water, or at any other place where the hoisting rope may overhang a support for an object subjectable to like or other objectionable movement;

Fig. 2 is a diagrammatic view of one means of variably applying the requisite friction between the source of power and the hoisting means driven thereby;

Fig. 2A is an enlarged central longitudinal sectional view of the means located at B in Fig. 2;

Fig. 2B is a similar view of a modification of the means shown in Fig. 2A comprising the substitution of a variable orifice means in lieu of the fixed orifice of Fig. 2A;

Fig. 3 is a diagrammatic view of a modified means of variably applying the requisite friction between the source of power and the hoisting means driven thereby;

Fig. 4 is a top plan view of a plug valve for manually controlling the application of the requisite friction between the source of power and the hoisting means driven thereby, in the instance shown in Fig. 3;

Fig. 5 is a central vertical sectional side elevation view of said valve with its operating handle removed;

Fig. 6 is a sectional view on line 6—6 of Fig. 5;

Fig. 7 is a diagrammatic view of a further modified means of variably applying the requisite friction between the source of power and the hoisting means driven thereby;

Fig. 8 is a side elevation enlarged view of the typical means for controlling the maximum force of said friction applied in each of Figs. 3 and 7;

Fig. 9 is a top plan view of a conventional source of power and a hoisting means with an intermediate friction applying means shown in partial central longitudinal section;

Fig. 10 is a diagrammatic elevation view of the adjacent end of the parts shown in Fig. 9;

Figs. 11, 11*a* and 12 are enlarged top plan views of coacting portions of the friction surfaces optionally employable in the instance shown in Fig. 9;

Fig. 13 is a top plan view of the plug valve for manually controlling the application of the requisite friction between the source of power and the hoisting means driven thereby, in the instance shown in Fig. 7;

Fig. 14 is a central vertical sectional side elevation view of the valve shown in Fig. 13 with its operating handle removed;

Fig. 15 is a sectional view on line 15—15 of Fig. 14;

Fig. 16 is a central longitudinal sectional view of the fluid control means diagrammatically indicated at A in Fig. 7 for applying the requisite varying force to the friction drive of the hoisting mechanism;

Fig. 16*a* is a like view of a modified portion of Fig. 16;

Fig. 17 is a sectional view on line 17—17 of Fig. 16;

Fig. 18 is an exterior view of the central portion of the right side of Fig. 17;

Fig. 19 is an enlarged view of one of the centering pistons shown in Fig. 16; and

Fig. 20 is a central sectional side elevation view of certain details of construction of the parts joining the stationary fluid pressure supply pipes to their respective rotary elements comprising the controlled friction application means.

On the ship, or other support 10, is mounted a typical boom 11 having the usual cable and pulley means 12, 13 for varying the angularity of the boom. Cable 14, having on its outer end a hook or other securing means 15, runs over pulley 16 on the outer end of boom 11, thence over pulley 17, and thence to the hoisting means 18. The airplane, or other object, 19 adapted to float or rest on the undulatable top of the water, or other suitable variable support, 20, the dotted and full line positions indicating something of the variations in movement of the water or other support 20. However, such variations in movement only comprise a portion of the problem to be solved by my improved method and apparatus installed on a vessel. The other factor thereof is the roll to which the ship is subjected causing the overhanging boom end to be proportionately moved. The wave motion and the ship roll may be out of synchronism, in which case the distance between the object 19 and pulley 16 rapidly vary. In either case the usual hoisting practice subjects objects hoisted to severe jerks liable to injure, more or less seriously, the object or some of its components or content and/or the hoisting cable or its apparatus or both. My improved apparatus also dispenses with these liabilities.

The hoisting mechanism 18 comprises the typical drum 21, Figs. 1, 9, a typical manually controlled variable speed power source 22, and a manually controllable variable friction drive means 23, intermediate said elements 21, 22.

In the instance shown in Figs. 9, 11, and 12, the shaft 24 driven by power source 22 extends through a suitable oil retaining bearing in casing 25 where it is secured concentrically to the head 26 of tube 27. Within tube 27 is a second tube 28 having continuous head 29 at one end provided on its outer surface with a concentric bearing pin 30 seated in bearing 31 upon the inner surface of head 26. The opposite end of tube 28 is provided with head 32 concentrically outward from which extends a tube 33 of reduced diameter provided on its outer end with an anti-friction bearing 34, Fig. 20, seated in a recess in bearing projection 25*a* of the casing 25 through which tube 33 extends. Occupying a recess between the outer end of tube 33 and bearing portion 25*a* of casing 25 through which said tube extends is a packing gland 35, adjustably secured to the casing at one end while its opposite end is adapted to compress the packing ring which may be inserted in the packing space 36. Preferably concentric with tube 33 and secured to the outer surface of said bearing portion 25*a* by bolts 37 or otherwise is the flange 38 of a pipe 39, gasket 40 intervening between the juxtaposed surfaces of 25*a* and 38 to prevent the leakage of the friction control fluid. The bearing 34 is seated between rings 41, 42 surrounding the tube 33, surplus oil about bearing 34 is confined in bearing 34 by a plate 43 suitably secured over the mouth of the bearing recess in bearing portion 25*a* in which the bearing 34 is mounted, said plate 43 being provided in its surface contacting with the periphery of tube 33 with a sealing ring 44.

Referring to Fig. 9, secured to the inner surface of tube 27 by screws 45, or otherwise, are one or more spaced apart pairs of friction rings 46, 47, between which are mounted a pair of pistons 48, 49 whose skirts are telescoped the one over the other, between the juxtaposed telescoping surfaces of which is a sealing ring 50. The opposite outer ends or heads of pistons 48, 49 are adapted to bear against the friction rings 46, 47. The pistons 48, 49 are concentric with and slidable upon the outer surface of tube 28 to which they are keyed or feathered by key-way 51 which drives the pistons revolubly with tube 28. The pistons 48, 49 are provided with bearing flanges respectively 52, 53 of such length that the same leave a space between them when the pistons are telescoped to their minimum extent between the friction rings 46, 47. In this space intermediate said bearing flanges 52, 53 a plurality of holes 54 extend through the wall of tube 28 and on opposite sides of which holes are sealing rings 55 bearing upon the inner surfaces of flanges 52, 53. These sealing rings 50, 55 prevent the escape of pressure fluid through the joints sealed thereby.

Consider that a pressure fluid, preferably oil, be introduced through pipe 39 and tube 33 to the bore of tube 28, and that the structure of the tubes 27, 28 and their associated parts are duplicated between each pair of friction rings 46, 47, the pressure fluid will flow through openings 54 outwardly between the pistons 48, 49, moving them outwardly and maintainining the bearing surfaces of the heads of said pistons against the friction rings 46, 47 with a force proportionate to the pressure of the fluid, and that power source 22 rotating tube 27 with its attached friction rings 46, 47 will drive attached tubes 28 and 33 with a force proportionate to the friction exerted against rings 46, 47 by the heads of pistons 48, 49 driving the tube 28.

About the tube 33 intermediate head 32 and the adjacent wall of casing 25 is a head 56 secured to the opposite end of tube 27 and provided with the bearing 57 revolving upon the periphery of the tube 33 for supporting the end of tube 27 opposite its head 26.

The hoisting drum 21 is provided with the shaft 58 revoluble in bearings 59, 60, and 61 respectively on portions 62, 63 of base plate 64 and the outer wall of casing 25. Fixed on shaft 58 between bearings 60 and 61 is a gear 64*a* meshing with an intermediate gear 65, Fig. 10, which in turn meshes with the gear 66 fixed to tube 33 intermediate bearing portion 25a and the adjacent wall of casing 25.

It will be understood from the foregoing that any rotation of tube 28 imparted by tube 27 and its driving means will correspondingly drive the hoisting drum 21; and that when idling friction exists between bearing rings 46, 47 and bearing surfaces of the heads of pistons 48, 49 that the hoisting rope 14 attached to an object, for instance 19, adapted to rise or fall, the hoisting cable will be maintained free from objectionable slack by pulling cable drum 21 backward against the forward drive tendency of tube 27 during the period that the object is descending, and that said idling friction while the object is rising will cause the cable drum 21 to move forward only to the extent necessary to maintain the hoisting cable free from objectionable slack. It will further be appreciated that when the fluid pressure within tube 28 is increased from the degree necessary for idling friction to that necessary for hoisting the object 19, that the friction of pistons 48, 49 exerted between rings 46, 47 will drive said hoisting drum 21 to the extent necessary to complete the hoisting operation.

While the juxtaposed friction surfaces of rings 46, 47 and the heads of pistons 48, 49 may be in a plane, with an opening 74b therebetween for the lubricating disengaging oil pressure, as shown in Fig. 11a, in instances shown in Figs. 11 and 12 these surfaces are irregular and continuous cam surfaces requiring any slippage between such surfaces to telescope the pistons and vary the volume of oil or pressure fluid therebetween.

It will be noted from Fig. 11 that the friction rings 46 are differently constructed from the rings 47. This is due to the fact that the friction rings 46 are the terminal rings having but one friction surface, while the rings 47 have friction surfaces upon opposite sides. In instances shown in Figs. 11 and 12 the pistons 48, 49 are provided respectively with cam projections 70, 71 spaced apart to conform to the cam cycle of the cam surfaces 72, 73 respectively of friction rings 46, 47, there being spaces 74, or 74a, between the portions 70, 71, or 47a, 48a, and their coacting cam surfaces.

A pressure fluid, preferably lubricating oil, is maintained from pipe 76 leading into casing 25 and about tube 27 having oil holes 77 therein to supply said pressure lubricant to said openings 74. The last stated pressure is preferably less than the idling friction pressure of the fluid within tube 28 and pistons 48, 49. With such pressure differentials surrounding tube 27 and within tube 28 the pressure surrounding tube 27 may be constantly applied and satisfactorily perform its combined function of lubricating the friction surfaces between rings 46, 47 and the juxtaposed heads of pistons 48, 49 respectively as well as to release the frictional engagement of such surfaces by forcing the pistons away from contact with such rings when there is within the tube 28 either no pressure or a pressure less than that surrounding tube 27.

In the instance shown in Fig. 11 the friction ring 47 intermediate each pair of pistons 48, 49 is provided on opposite sides with cam surfaces 73 which are staggered relative to each other and with substantial distance between the low and the high points of each of said cam surfaces 73. The several pairs of pistons 48, 49 upon tube 28 are correspondingly staggered so that the cam projections 70, 71 of one pair of pistons will be, for instance, at the low point of their respective cam surfaces while the next pair of pistons may have their cam portions 70, 71 in engagement with a different portion of their respective cam surfaces.

In the instance shown in Fig. 12 the cam surfaces of the friction rings are less in height than those indicated in Fig. 11.

This initial understanding of my invention will clarify each of the different applications of the varying friction drives diagrammatically indicated in Figs. 2, 3, and 7.

With reference to Fig. 2, the variable speed electric motor 80, mounted upon a suitable base, drives an oil pump 81, the electric drive energy for motor 80 coming through wire 82 to a plurality of successive resistance connected contacts 83 to controller contact arm 84 to wire 85, thence through motor 80 to wire 86 completing the circuit. Pump 81 is connected by pipe 90 to cross pipes 91, 97. Pump 81 draws its oil through pipe 87 leading from sump 88 whose top is provided with a vent pipe 89 to the atmosphere. Pipe 39, heretofore described as leading to the interior of tube 28, connects with pipe 91. In pipe 91, intermediate pipes 39 and 90, is a pressure gauge 92. Pipe 91 crosses but does not connect with pipe 76 which has heretofore been described as leading into the casing 25. Continuing past pipe 76, pipe 91 connects with reducing nipple 93 provided with an orifice 94 leading into pipe 95 which connects with pipe 96 which leads through the top of oil sump 88 and terminates near the bottom thereof. Pipe 90 extends beyond pipe 91 and connects with pipe 97 which is adapted to lead pressure oil first through check valve 98, thence through pressure reducing valve 99, thence to oil pressure gauge 100, thence into and through cross pipe 76, thence through relief valve 101 to pipe 96. The upper end of pipe 76 enters the bottom of tank 102 in which the pressure oil is maintained at a definite level indicated at 103. Tank 102 is provided with a gauge glass 104 which visually indicates said oil level. From the upper end of tank 102 leads pipe 105 having a stop valve 106. Pipe 105 connects with pipe 107 which leads to a source of air pressure supply 108. Air pressure of, for instance, 25 pounds is adapted to be maintained in the top of tank 102.

In Fig. 2B a valve 109 is substituted in lieu of the pipe reducing nipple 93 having an orifice 94 as described in Fig. 2A. The valve 109 may be opened to different degrees. This opening of the valve provides an optional variable oil passageway therethrough whereas the area with orifice 94 is fixed.

The operation of the parts shown in Fig. 2 in connection with the heretofore described hoist and its friction drive, is as follows:

When motor 80 is running at a low speed, the flow of oil through the fixed orifice 94 back to sump 88 is such that it maintains a low or idling friction betwen the friction rings 46, 47 and their intermediate pistons 48, 49 with the result that undesirable slack is eliminated from the hoisting cable 14 and its attached object 19 may rise and fall at will, as heretofore explained. At the time an object 19 is to be hoisted, motor 80 is adjusted by control arm 84 to run at hoisting speed, which drives pump 81 faster and thus increases the friction drive between rings 46, 47 and piston heads 48, 49 from an idling friction to a more substantial and hoisting friction drive. The oil pressure gauge 92 indicates the different pressures of the oil during the idling friction as well as during the hoisting friction maintenance. When neither the idling nor the driving pressure is present within tube 28 the pressure of the oil in tank 102, maintained by the air therein enters spaces 74, 74a, and moves the pistons 48, 49 out of engagement with their respective rings 46, 47.

With the fixed orifice 94 the only means of obtaining the substantially different idling and hoisting frictions is by the variation of the speed of motor 80. With the valve 109 substituted for the fixed orifice 94 a second means for obtaining the different idling and hoisting frictions is available. Either of these means may be used alone or in conjunction with each other to obtain said friction drive differences. When the valve 109 is used alone, motor 80 may be run at a constant speed, in which case the degree to which the valve 109 is opened will determine the pressure, or substantially the absence of pressure, prevailing within the tube 28. When valve 109 and variable speed motor 80 are employed together to obtain the required differences in friction drive from an idling to a hoisting degree, motor 80 need not be subjected to as wide a range of speeds as required with fixed orifice 94, and valve 109 need not be subjected to the range of operation necessary where motor 80 is run at a substantially constant speed.

Substituting the structure disclosed in Fig. 3 for that of Fig. 2, the structure and operation are as follows:

The position of the valve 110 as shown in Fig. 3 is in neutral with for instance 25 pounds of oil pressure in tank 128, 150 pounds in tank 121, and 300 pounds in tank 118, which typical pressure differences remain substantially constant in neutral as well as all other of the operative positions. By neutral position is meant that there is no oil pressure in the friction tension tube 28 and that the same is open to the sump 119 through opening 120 in the plug valve 110 registering with openings 122, 124 in its casing 112.

By turning the plug valve 110 until its opening 111 registers with the openings 124a and 124 in its casing 112, oil pressure then flows from the motor driven pump 113 in order to fill the system, through pipe 114, having open stop valve 115, through check valve 116 to the cross-union with pipe 117 to tank 118, filling in the connected pipes until tank 118 is partially full of oil at a predetermined level 279, indicatable by gauge glass 120 on tank 118. At the same time oil is flowing downwardly in pipe 117 through open stop valve 125, thence across, but not connected with, independent pipe 39, thence through reducing valve 126, thence past an opening to pressure gauge 127, thence across, but not connected with, independent pipe 180, thence into pipe 76, thence downwardly into casing 25, which when filled causes the oil to rise into low pressure tank 128, partially filling the same to a predetermined level 129 indicatable through its gauge glass 130. The oil also flows, in filling the system, from pipe 117 to pipe 131 through open stop valve 132, thence past, but not through, independent pipe 39, thence through reducer valve 133, past the opening to pressure gauge 134, thence into its branch pipe 135 leading into the bottom of the medium pressure tank 121, thence filling the same to a predetermined level 136, indicatable upon its gauge glass 137. In order to complete the filling of the system, compressed air from a source of air pressure 138 is led through pipe 139 thence through pipe 140, having open stop valve 141, into the top of tank 118 until an air pressure of, for instance, 300 pounds is maintained therein above the oil level 119, whereupon the valve 141 may be closed, or left open if the pressure in source 138 is maintained at the pressure within tank 118. This air pressure flows also through relief valve 142, thence through open stop valve 143, thence across, but not through, independent pipe 39 and through reducer valve 144 to branch pipe 145, having open stop valve 146 into the top of tank 121 until it builds up an air pressure above the oil level 136 therein to, for instance, 150 pounds per square inch, thence through relief valve 147 across, but not through independent pipe 131, thence through reducer valve 149 to branch pipe 150, having stop valve 151 and entering the top of tank 128. Beyond branch pipe 150, pipe 139 is provided with a relief valve 152, which may relieve to the atmosphere. In case the source 138 of air pressure contain air substantially in excess of the maximum pressure in tank 118 the pipe 139 must be provided, between said source and branch pipe 140, with a reducer valve 153; but where source 138 contains merely the requisite air pressure for tank 118 the reducer valve 153 may be dispensed with. In order to fill the remainder of the system, including pipe 39, which is done before the air pressure is placed upon the tanks 128, 121 and 118, the stem 110a of the plug valve is turned until its opening 111 registers with openings 124a and 124 in its casing 112, in which position oil from pipe 117 enters branch pipe 160 leading across, but not connecting with pipe 180, to said opening 124a so that the oil therein flows through openings 124a, 111 and 124 into pipe 39 until it fills the tension space within tube 28 in casing 25.

In filling the system the motor driven pump 113 takes its oil supply by way of pipe 161 from sump 119 having a vent 162 to the atmosphere, and into which sump through pipe 180 the surplus oil flows from the system.

The sump connecting pipe 180 leads to opening 122 in valve casing 112 of valve 110. The pipe 131, receiving pressure oil from pipe 114 and 117, leads past its branch pipe 135 to opening 122a in casing 112 (opposite opening 122) of valve 110.

At a point between branch pipe 135 and valve 110, pipe 131 is provided with a branch pipe 163, having relief valve 164, connecting with said pipe 180.

Preferably in pipe 114 between its check valve 116 and its connection with pipe 117 is a branch pipe 165 leading the pressure oil to 166 which diagrammatically indicates, as conventionally shown in Fig. 8, a metallic diaphragm 167 receiving the pressure oil from pipe 165, insulation strips 168 secured on opposite sides thereof and insulation block 169 secured at the center of the head of the diaphragm 167. To the insulation element 168 is attached a metallic bar 170 to which is hinged a metallic bar or switch tongue 171 whose unpivoted end is normally held by spring 173 in contact with contact plate 172 secured on insulation 168, said switch tongue 171 extending across block 169 so that when the oil pressure swells diaphragm to the desired maximum the block 169 will break the electric circuit through wires 174, 175 through tongue 171 from the source of electric energy to the electric motor element of motor driven pump 113, thus stopping the pump and precluding a pressure higher than said maximum.

In Figures 3 and 4, the plug valve assembly 110 is set in neutral position, in which the curved opening 120 then connects said opening 122 (terminal of pipe 180) with said opening 124 (terminal of pipe 39), thus draining the surplus oil within tube 28, Fig. 9, through piping 180 to the sump 119.

When plug 110a of valve assembly 110 is turned to the tension position its opening 120 registers with said openings 122 and 124a in which position the tension pressure maintained on the oil in tank 121 causes the oil therein to flow through piping 135, 131, openings 122a, 120, 124 to pipe 39 into tube 28, Fig. 9, thence through openings 54 where it exerts this requisite tension pressure within and between pistons 48, 49 causing the heads of said pistons to exert the required tension friction against their juxtaposed surfaces of friction rings 46, 47 respectively. This keeps objectionable slack out of hoisting cable 14, Fig. 1, by said cable moving hoisting drum 21 and its drivingly attached tube 28, and its pairs of pistons 48, 49 slidingly keyed to tube 28, backward against the drive (of variable power source 22, through shaft 24, tube 27 and friction rings 46, 47 in light frictional engagement with the heads of said pistons) when object 19 goes down relative to pulley 16 on the end of boom 11, Fig. 1, and said slack is also kept out of cable 14 by said light friction drive causing the hoisting means to be driven forward by said light or tension friction when the support 20 of object 19 rises relative to said pulley 16.

Should for any reason a tension, less than that normally maintainable by the pressure within tank 121, be desired in the degree of the frictional engagement between rings 46, 47 and pistons 48, 49 normally maintained by the valve 110a when its opening 120 connects openings 122a and 124, said valve may be rocked back and forth between its neutral and tension positions.

To attain the requisite hoisting friction between rings 46, 47 and pistons 48, 49, the plug valve 110a is turned to the maximum tension position, in which openings 120, 122 and 124a are connected, to the hoisting position indicated in Fig. 4, in which opening 111 in 110a registers with openings 124, 124a and the terminals of opening 120 are on opposite sides of opening 122a. In said hoisting position oil from pump 113 flows through piping 114, 117, 160 and/or tank 118 and piping 117, 160, through openings 124a, 111, 124 and pipe 39 to tube 28, at the pressure maintained in tank 118, where it increases the idling or tension friction to the required hoisting friction. By varying the speed of power source 22, by control means 22a diagrammatically shown in the hoisting operation may be performed at the desired rate, and the valve assembly 110 and the speed and direction control means 22a of power source 22 are preferably conveniently juxtaposed for their convenient operation by one person.

The stem 110b of plug 110a of valve assembly 110 is provided with operating handle 110c having a pointer 110d indicating the several "neutral", "tension" and "hoist" positions designated upon the exposed portion of valve assembly 110 which is provided with lugs 110e between which handle 110c may only move between the said "neutral" and "hoist" limits of movement.

When the hoisting operation is completed by the deposit of object 19 upon ship 10, or other desired support, the plug valve 110a is moved first to the "tension" position, Fig. 4, and thence to "neutral" when cable 14 is desired to be detached.

In the species of apparatus disclosed in Figs. 3, 4, 5, 6, the plug valve 110a was subjected to the pressure of the oil in pipes 131, 160 and was therefore not readily movable. This is overcome in the species disclosed in Fig. 7, by the provision of a master control diagrammatically indicated at "A" in Fig. 7, and in detail in Figs. 16, 17, 18, for the control of the presence or absence of the tension and the hoisting oil pressures within the pair of tubes 28, Fig. 9 and the pilot valve assembly 190 shown diagrammatically in duplicate in Fig. 7 (the duplicates being located at different places one of which may be more convenient than the other for different hoisting operations or portions thereof) and in detail in Figs. 13, 14, 15.

In connection with the species of apparatus disclosed in Fig. 7, a second pair of tubes 27, 28 and their associated mechanism is mounted within casing 25, the second tube 27 having gear 182 fixed on its shaft 24 and meshing with gear 183 fixed on shaft 24 of the first tube 27, while the second tube 28 has fixed to its tube 33 a gear 184 meshing with gear 185 conveniently fixed on shaft 58 of hoisting drum 21. The friction or cam surface or surfaces of rings 46a, 47a and pistons 48a, 49a, (instead of their friction or cam surfaces being formed exactly like those of rings 46, 47 of the first described tubes 27, 28 shown at the right portion of Fig. 9 and in Fig. 11) may be formed of plane surfaces, with one or more openings 74a therebetween, as indicated in Fig. 11a, but preferably the same are formed as shown in Fig. 12 in which the undulations in the cam surface of ring 47a (and those of corresponding ring 46a) are less in degree than shown in Fig. 11 for the corresponding rings 46, 47.

In Fig. 7 the constant speed motor pump 191 draws its oil supply through pipe 192 from sump 193 having vent 194 to the atmosphere, and supplies the same under, for instance substantially 300 pounds per square inch of pressure, to pipe 195, having check valve 196, to branch pipe leading into the bottom of tank 197 until the oil therein is at, for instance, said 300 pounds pressure and a definite level 198 indicated upon gauge glass 199 with which said tank is provided. Connecting with pipe 197a is a branch pipe 200, having pressure gauge 201 and open stop valve 202 and branch pipes 203 leading to the upper quarter of each of the plug valve assemblies 190.

Pipe 197a is also provided with a branch pipe 204, provided with stop valve 205, reducing valve 206 and pressure gauge 207, and connects with pipe 76 which crosses, but does not connect with pipe 195, and does connect the interior of casing with the bottom of the friction relief pressure tank 208, in which and in said casing 25, pipes 76 and 204 oil pressure is maintained at, for instance, 25 pounds per square inch, at a level of 209 indicated by gauge glass 210 on said tank 208, by said reducing valve 206, and which pressure is indicated by gauge 207.

Pipe 76 is provided with a branch pipe 211 having relief valve 216, connecting with pipe 212 leading into and terminating preferably near the bottom of sump tank 193. Pipe 195 extends preferably past pipe 197a and is provided with a pressure gauge 213, relief valve 214 and leads into sump pipe 212 which rises above branch pipe 211 and is connected by branch pipes 215 to the lower quarter of each of valve assemblies 190.

From pipe 197a branch pipes 217, 218 lead therefrom each past, but not connected with, pipe 195 to near the opposite interiors of tube 219, Figs. 7, 16, having closed or closable opposite ends 220. Slidably mounted in the bore of tube 219, and between pipes 217, 218, are pistons 221, 222 substantially separated from each other by piston rod 223 rigidly secured to and extending between said pistons. At a point intermediate pistons 221, 222 said rod 223, in the instance shown in Figs. 16, 17, is bifurcated and provided with a pin 224 into which bifurcation and over which pin 224 fits the bifurcated end of lever 225 fulcrumed, in the instance shown, intermediate its ends on pin 226 rigid with or secured to said lever, said pin 226 being provided with bearings in the walls of housing 227 connecting tube 219 with a tube 228 and covering and connecting openings 229, 230 through the walls of said tubes respectively and through which openings the opposite ends of said lever 225 extend. From the bore of tube 219 and adjacent the inner faces of pistons 221, 222 lead pipes 231, 232 respectively to the inlet of the first and second tubes 28, and each of which last stated pipes perform the function heretofore stated of pipe 39 heretofore described in connection with Figs. 2 and 3. At a point intermediate pipes 231, 232 and from the bore of tube 219 leads a pipe 233, as indicated in Fig. 7, across, but uncommunicating with, each of pipes 231 and 76, thence said pipe leads into pipe 212.

Within said tube 228, on opposite sides of its opening 230, are reciprocatable pistons 234, 235 rigidly secured near opposite ends of piston rod 236. The opposite ends of tube 228 are provided with removable heads 237 through which respectively pass pipes 238, 239. In the instance shown in Fig. 7, the pipe 238 crosses over, but is not in communication with, each of pipes 218, 195, to branch pipes 240 leading to the right quarter of each of the plug valve assemblies 190, and both branch pipes 240 pass over, but are not in communication with, sump return pipe 212. In like instance, said pipe 239 extends across, but is not in communication with, pipe 195, and terminates in two branch pipes 241, to the left quarter of each plug valve assembly 190, the left of which branch 241 crosses over, but is out of communication with pipe 200, and the right of which branch 241 crosses over, but is out of communication with, each of pipes 200, 238, the right branch of 240, and pipe 212.

From a source of air pressure supply 250 extends air supply pipe 251 across, but not communicating with, the left branch of pipe 241, the pipe 200, and having reducer valve 252, pressure gauge 253 and branch pipe 254 leading air through openable stop valve 255 through the top of tank 197 while in said valve 252 is adapted to maintain a pressure of air of, for instance 300 pounds per square inch against the top 198 of the oil therein. Pipe 251 extends past branch pipe 254, through openable stop valve 256, thence across, but not communicating with, pipe 238, the right branch of pipe 240, to reducer valve 257, and pressure gauge 258 to relief valve 259 to the atmosphere, and preferably between valves 257, 259, from pipe 251 leads a branch pipe 260 into the top of tank 208 wherein said valves 257, 259 maintain a definite air pressure of, for instance, 25 pounds per square inch against the top 209 of the oil therein.

From the oil pressure assembly 166, heretofore described in connection with Figs. 3 and 8, oil supply pipe 165 leads into said pipe 195 past check valve 196.

Each of the plug valve assemblies comprises in the instance shown a tapering plug valve 270, Figs. 7, 14, 15, mounted in casing 271, cover 272 suitably secured thereto and through which stem 273 of valve 270 extends surrounded by a conventional packing assembly 174 preventing leakage about stem 273.

Substantially the same handle 110*c* with indicator 110*d* and lugs 110*e* employed in Fig. 4 with valve assembly 110 are employed in Fig. 13 with valve assembly 190.

Extending laterally through the plug valve 270 in a common plane are separated elbow openings 275, 276, Figs. 7, 15, whose termini are located at substantially 90° apart relative to their own ends as well as between the termini of said different elbow openings. In the same plane with but intermediate said termini are the terminals 277 of a three way opening 278 whose intermediate portion, in the instance shown, dips below the elbow openings 275, 276, Fig. 14 to conveniently and inexpensively attain a path independent of openings 275, 276.

In the diagrammatic view of said assembly 190, Fig. 7, the three way opening 278 and its said terminals 277 are shown in light full lines, while the elbow openings 275, 276 are shown in light dotted lines, each in their "neutral" position, and the elbow openings are there shown in their respective other positions by heavy dotted lines.

But one of the valve assemblies 190 is usable in any one tensioning and hoisting operation, and the one so used is returned to "neutral" position so that either assembly 190 may be efficiently subsequently employed.

In the "neutral" position of the elements A and C, shown in Fig. 7, the pipes 238, 239, 215, 212 are connected to sump 193 by the three way opening 277—278 of valve assembly 190. In this position there is an equalization of substantially zero pressure on the outer surfaces of pistons 234, 235 in tube 228 of assembly A.

When handle 110*c* of, for instance, the left valve assembly 190 is moved to "tension" position, the elbow opening 275 connects the left pipe 203 and pipe 200 with, for instance, the left branch pipe 240 and pipe 238, and elbow opening 276 connects pipe 215—212 and sump 193 with left branch of pipe 241 and pipe 239, while the three way opening 277—278 occupies a blanked intermediate position. In such position the pressure oil flows from tank 197 to pipes 197*a*, 200, 203 (and/or from pump 191 through pipes 195, 197*a*, 200, 203) thence through registering elbow opening 275 to pipe 240—238 and exerts its pressure against and moves piston 234 to the left in tube 228. This movement likewise moves piston rod 236 and its attached piston 235, and, through lever 225 piston rod 223 and its attached pistons 221, 222 with piston 222, from the "neutral" position shown in full lines more clearly in Fig. 16 to the dotted position of pistons 221, 222 shown respectively at 221*a*, 222*a*. This latter movement disconnects pipe 232 from connection with the sump 193 through pipes 233 and 212, and leaves pipe 231 connected to sump 193 through pipes 233 and 212, and admits the oil pressure in tank 197 through pipes 197*a*, 217, (and/or the oil pressure from pump 191 through pipes 195, 197*a*, 217) to the left end of tube 219 and thence through pipe 232 into tube 28*a* and through openings 54*a* to exert its pressure between the pairs of pistons 48*a*. 49*a* and produces the requisite idling friction between the outer surfaces of said pistons and the juxtaposed surfaces of rings 46*a*, 47*a* shown in Fig. 12 or optionally of the rings 46*b*, 47*b* indicated in Fig. 11*a*. This idling friction functions as heretofore indicated generally as well as in connection with Figs. 2 and 3.

In the species of my invention illustrated typically in Fig. 7 the same oil pressure within tank 197, and/or that provided by pump 191, produces the idling as well as the hoisting friction. However, in any adaptation of said species of my invention wherein the pressure of the oil thus supplied to affect the idling friction is desired to be less than such pressure affecting the hoisting friction, such lesser pressure may be conveniently achieved, for instance, by the following adaptation of the pressure relief opening 94 employed in Figs. 2 and 2A:

In the instance shown in Fig. 16*a*, only at the "tension" position of piston 222, indicated in dotted lines in Fig. 16 and in full lines in Fig. 16*a*, the bore of tube 219 is provided with a depression of the desired area extending around the piston 222 in said position and which depression forms an orifice 94*a* functioning only in said "tension" position of piston 222 to bypass some of "tension" oil past piston 222 and into the sump connecting pipe 233. In said instance, the "tension" oil, which comes only through pipe 217 to the left end of tube 219, thence part of the "tension" oil passes into tube 232 and thence into "tension" tube 28*a*, while the other part of the "tension" oil bypasses around piston 222, only when in its "tension" position 222*a*, and into the sump 193 through pipe 233. The area of said orifice 94*a* is such as to affect the desired reduction of the oil pressure affecting the "tension" or idling friction.

In all the other positions of piston 222 said orifice 94*a* becomes only a localized increment in the area of tube 219.

When the hoisting operation is desired in the instance of the structure disclosed in Fig. 7, the operating handle 110*c* of valve assembly 190, Figs. 13, 7, is moved from the last stated "tension" position rapidly to the "hoist" position. In this position the elbow openings 275, 276 of plug valve 270 register respectively with pipes 240, 215 and 203, 241. Such position connects pipe 238 and the, for instance, left branch of pipe 240 through elbow opening 275 to, in said instance, the left branch of pipe 215, and pipe 212 to sump 193 so that oil in the right end of tube 228 may be displaced therefrom and drained into the sump 193. This "hoist" position, in said instance, enables the pressure oil in tank 197 to flow through pipes 197*a*, (and/or from pump 191 through pipe 195 and the intermediate portion of pipe 197*a*), thence through pipe 200, the left branch pipe 203, thence through elbow opening 276 to and through the left branch of pipe 241 to and through pipe 239 into the left end of tube 228 where it exerts its pressure against piston 235. Such pressure moves pistons 234, 235, with their rod 236, to the right, and through lever 225 also moves piston rod 223 and its pistons 221, 222 to the left to the dotted positions respectively shown at 221*b*, 222*b*, in Fig. 16. In the last stated positions the oil pressure from tank 197 flows through pipes 197*a* and 218 (and/or from pump 191 through pipes 195, 197*a* and 218) into the right end of tube 219 and thence into pipe 231 and tube 28 of Fig. 9, thence through openings 54 into the space between the pairs of pistons 48, 49 where it causes the outer surfaces of said pistons to engage, with the force requisite to affect the hoisting operation, the juxtaposed surfaces of rings 46, 47, fixed to tube 27, driven by the power source 22, which source may be driven at the requisite speed by the manual manipulation of the appropriate one of a pair of control assemblies 22*a*, Fig. 9, each of which is located adjacent its respective one of the duplicate control valve assemblies 191 diagrammatically indicated in Fig. 7.

When the hoisting operation is completed by the deposit of the hoisted object 19 upon the vessel 10, or other desired place, the employed assemblies 22*a* and 190 are then each positioned at neutral for the efficient use of either of such duplicate assemblies in and incident to the succeeding operation of the mechanism.

When valve assembly 190 is set at "neutral" position, the pressure of the oil in tank 208, reduced by the air pressure reducing valve 257, as well as by the oil pressure valve 206, flows, to supply any slight leakage loss in casing 25, from tank 208, through pipe 76 (and/or from tank 197 to pipe 197*a*, and/or from pump 191 through pipes 195 and 197*a*), thence through pipe 204 and its then open stop valve 205 and its reducer valve 206 to pipe 76, thence through the remainder of pipe 76 to within the casing 25, thence through openings 77, 77*a*, to the spaces 74, 74*a*, respectively of tubes 28, 28*a*, if the instance shown in Figs. 11, 12, or into space 74*b* of the instance shown in Fig. 11*a*. In said spaces 74, 74*a*, or 74*b*, said pressure oil accomplishes the efficient lubrication of the juxtaposed surfaces of the rings and their coacting pistons, as well as to affect the disengagement of said juxtaposed surfaces. In the "tension" position the oil pressure in the space 74 of the hoisting tension tube 28 (the higher hoisting pressure of the oil being then absent from tube 28) accomplishes the same lubricating and disengagement functions. In the "hoist" position, the hoisting pressure of the oil being then within tube 28, and which pressure is substantially in excess of the lubricating and disengaging pressure of the oil within casing 25 and about tubes 28, 28*a* and in the spaces 74, 74*a* or 74*b*, the oil in said spaces is displaced from said spaces to the extent necessary to attain the requisite hoisting engagement of the juxtaposed surfaces of the hoisting rings and pistons. The oil confined by casing 25 and between these juxtaposed tension and hoisting surfaces will, by any slippage of said surfaces, be caused to pulsate as such spaces are thereby varied in volume, and the pulsating oil may correspondingly pulsate through openings 54, 54*a* and pipe 76 and its connections. Such slippage of said juxtaposed tension, or idling friction, surfaces keeps the hoisting cable 14 free from objectionable slack as heretofore explained. Such slippage of the juxtaposed surfaces affecting the hoisting tension is designed to prevent the liability of the breakage of the hoisting cable and/or the stalling of the source of hoisting power 22 at its then speed, and in the latter case said slippage affords indication of the necessity of, for instance, an increase in the speed of source 22 by means of the convenient one of the control assemblies 22*a*.

In the instance disclosed in Figs. 11, 12, slippage of the pistons upon their cooperating rings involves as factors the extent of the pressure of the oil, within the pistons exerted upon the rings, and displacements, through openings 54, of some of such oil from within the pistons. Such displacements also occasion corresponding pulsations of the pressure oil within the affected tube 28 or 28*a*, and the oil connections therewith.

The shaft 226, forming the fulcrum of and secured to lever 225, projects through one wall of the housing 227, and on said projection is secured indicating hand 226*a*, Figs. 17, 18, adapted to indicate the appropriate one of the positions

227*a* designated in Fig. 18 as "hoist", "neutral" and "tension."

In order to center the pistons 234, 235, their rod 236, lever 225 and indicating hand 226*a* at "neutral" position, in the instance shown in Fig. 16, the opposite ends of tube 228 are provided with an enlarged bore 302 leaving a shoulder 303, and each enlarged bore of tube 228 is provided with a preferably free piston 300, having a skirt 301 slidable within its appropriate enlarged bore. Each piston 300 is adapted, at "neutral" position 227*a*, to rest against its said shoulder 302 and against the adjacent end of piston rod 236. Within the skirt 301 and extending through the head of each piston 300 are a plurality of oil ports 304, Fig. 19, preferably surrounding a central boss 305 which thickens said head at the point of contact with the end of piston rod 236, whose length is such as to afford such contact at opposite ends when pistons 300 bear against their respective shoulders 303. Within the skirt 301 of each piston 300 is an end of a coil spring 306, Fig. 16, whose outer ends abut against their respective adjacent surface of heads 237 of the opposite ends of tube 228. To retain and center the outer end of each spring 306 is a cone 307 secured to and projecting within spring 306 from each head 237. In the instance shown in Fig. 16, wherein the obvious difficulties of an off center inlet of the pipes 238, 239 through their respective heads 237 are avoided, said cones 307 are formed hollow, to receive the pressure oil from their respective pipes 238, 239 and communicate the same to tube 228 through the open apex of cones 307 and ports 304 through pistons 300. The function of pistons 300 and their springs 307 is to center piston rod 236 and its connected parts, heretofore described, at "neutral" position shown by the full line position of the movable parts of Fig. 16 and in Fig. 18.

The rapidity with which either valve assembly 190, Figs. 7, 13, 14, 15, is most advantageously operable would be impeded should it be required to directly affect the flow of the pressure oil respectively into pipes 231, 232. Such impedance is overcome by having either valve assembly 190 control merely the flow of pressure oil into one or the other end of tube 228, Fig. 16 where the force of such oil operates connected pistons 234, 235, which correspondingly operate pistons 221, 222 in tube 233 to appropriately control the flow of the pressure oil into either of pipes 231, 232. However, where such impedance is unobjectionable the valve assembly 190, or its mechanical equivalent, may directly control the flow of oil to and from pipes 231, 232, in which case the means disclosed in Figs. 16, 17, 18 may be dispensed with and pipe 237, instead of leading into one end of tube 228, will be connected to pipe 231, while pipe 239, instead of leading into its end of tube 228, will be connected to pipe 232, as those skilled in the art will appreciate from the drawings and the preceding description thereof.

Various modifications and changes may be made in the application and practice of my invention without departing from its essence and without exceeding the due scope of the appended claims.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Having now so fully described my invention that others skilled in the art may therefrom make and use the same, what I claim and desire to secure by Letters Patent is:

1. In a hoisting apparatus, the combination of hoisting means including an element adapted to be connected to the object to be hoisted, said object being liable to impairment due to shock incident to sudden motion, the support of said object being subject to sudden variable movement coincident with the direction of hoist, a source of power, means having juxtaposed friction surfaces for drivingly connecting the hoisting means and said source of power, means for applying power from said source to the friction surfaces in the direction of hoist, means for contacting said friction surfaces with forces of different magnitude, one of which forces when applied to said friction surfaces being sufficient only to maintain the element of the hoisting means free from objectionable slack while admitting of movement of said element by a part of the force of gravity of the object in an opposite direction and against the force of said applied power to compensate for such movement of the support, the second of said forces contacting said friction surfaces being of such magnitude as to afford sufficient friction to hoist the object, and means for increasing the magnitude of said power for hoisting the object.

2. In a hoisting apparatus, the combination of hoisting means including an element adapted to be connected to the object to be hoisted, which is liable to impairment due to shock incident to sudden motion, the support of said object being subject to sudden variable movement coincident with the direction of hoist, power means adapted to move the hoisting means only in the direction of hoist, friction clutch means having juxtaposed friction surfaces provided with lubricating spaces at intervals between and connecting the power means to the hoisting means, and means for engaging the friction members of the friction clutch means with forces of different magnitude, one of which forces being sufficient to hoist the object and the other force being sufficient only to maintain the element of the hoisting means free from objectionable slack while admitting of movement of said element against the direction thereon of the power means and in a direction opposite to the direction of hoist by only a portion of the force of gravity of the object when exerted upon said element by such motion of the object in a direction opposite to the direction of hoist, the other stated force for engaging the friction members of the friction clutch being adapted to be applied only to maintain the tautness of the element without shock to the object notwithstanding such motion of the element.

3. In a hoisting apparatus for hoisting a fragile object from a support subject to variable movement along the direction of hoist, the combination of power means, hoisting means including an element adapted to be connected to said object, means comprising a pair of separate members, one of said members being connected to said hoisting means and the other to said power means, said members having juxtaposed friction surfaces of varying projection, said surfaces having only portions of their areas in frictional engagement, means for forcing said surfaces into contact with sufficient frictional engagement only to maintain the element of the hoisting means free from objectionable slack upon the operation of said power means in the direction of hoist, while admitting of movement of said element in an opposite direction by the exertion of a part of

the force of gravity of the object upon said element to compensate for movement of the support, and means for forcing said surfaces together with a sufficient degree of frictional engagement to cause the operation of said power means to hoist the object.

4. In a hoisting apparatus for hoisting a fragile object from a support subject to variable movement along the direction of hoist, the combination of power means, hoisting means including an element adapted to be connected to said object, means comprising a pair of separate members, one of said members being connected to said hoisting means and the other to said power means, said members having juxtaposed friction surfaces of varying projection, said surfaces having only portions of their areas in frictional engagement, fluid pressure means for forcing said surfaces into contact with sufficient frictional engagement only to maintain the element of the hoisting means free from objectionable slack upon the operation of said power means in the direction of hoist, while admitting of movement of said element in an opposite direction by the exertion of a part of the force of gravity of the object upon said element to compensate for movement of the support, and means for forcing said surfaces together with a sufficient degree of frictional engagement to cause the operation of said power means to hoist the object.

5. In a hoisting apparatus, the combination of hoisting means including an element adapted to be connected to the object to be hoisted, which object may be liable to impairment due to shock incident to variable movement coincident with the direction of hoist, means including a pair of members having frictionally engageable surfaces for applying torque to the element in the direction of hoist; said surfaces being of different lateral projection with only a portion of the areas of said surfaces in frictional engagement, and fluid pressure means for frictionally engaging said members with a force whose torque upon the element is sufficient only to hold the element taut against a minor portion of the gravity of the object and which torque will be overcome by a substantial portion of the gravity of the object, and at a different time with a force of greater magnitude whose torque will hoist the object.

6. In a hoisting apparatus, the combination of hoisting means including an element adapted to be connected to the object to be hoisted, which object may be liable to impairment due to shock incident to variable movement coincident with the direction of hoist, means including a pair of members having frictionally engageable surfaces for applying torque to the element in the direction of hoist; and fluid pressure means for frictionally engaging said members with a force whose torque upon the element is sufficient only to hold the element taut against a minor portion of the gravity of the object and which torque will be overcome by a substantial portion of the gravity of the object, and at a different time with a force of greater magnitude whose torque will hoist the object.

7. In a hoisting apparatus, the combination of power means exerting power in the direction of hoist, hoisting means including an element adapted to be connected to the object to be hoisted and driven by said power means only in the direction of hoist, which object may be liable to impairment due to shock incident to sudden motion, the support of said object being subject to sudden variable movement coincident with the direction of hoist, two members provided with juxtaposed surfaces of varying lateral projection with only a portion of the areas of said surfaces being adapted when in engagement to frictionally transmit driving torque; means for operatively connecting one of said members to the hoisting means and the other of said members to the power means; and means for producing relative movement between said members and for engaging the surfaces of said members with forces of different magnitudes for maintaining the element of the hoisting means free from objectionable slack preliminary to hoisting while admitting of movement of said element opposite to the direction of hoist by a minor portion of the force of the gravity of the object to compensate for such movement of the support, and for hoisting the object, the torque of said power means being adapted, while said force of lesser magnitude engages said surfaces, to be overcome and the element moved in a direction opposite to hoist by only a minor portion of the gravity of the object, and said element being adapted to hoist the object only when said force of greater magnitude engages said surfaces.

8. The combination of claim 7 characterized by the means for producing relative movement between said members being fluid pressure means adapted to apply fluid pressure of varying magnitudes to one of said members, said fluid pressure means being provided with a fluid pressure chamber whose volume is variable by the variation in projection of the portions of the surfaces of said members in engagement.

9. The combination of claim 7 characterized by means for applying fluid under pressure to the engageable surfaces of the members to at times drivingly disconnect said surfaces.

10. The combination of claim 7 characterized by the means for producing relative movement between said members being fluid pressure means adapted to apply fluid pressures of varying magnitude to one of said members, and means for applying fluid under pressure between said surfaces for lubrication and for breaking the frictional engagement thereof.

11. In a hoisting apparatus, the combination of hoisting means adapted to be connected to and hoist an object, said hoisting means being mounted adjacent water subjectable to wave action and said object being floatable on the water adjacent said means and being liable to impairment by shock, power means, at least one pair of members having juxtaposed engageable friction power transmitting surfaces having at least one space between said surfaces and adapted when said surfaces are in engagement to operatively connect the hoisting and the power means; means for applying lubricating fluid to said space; and means for engaging said surfaces for transmitting torque in the direction of hoist from the power to the hoisting means while the latter is connected to the object, said torque being insufficient to overcome the gravity of the object, whereby the object may be maintained free from shock arising from and while connected to the hoisting means.

12. The combination of claim 11 further characterized by means for increasing such torque to a degree sufficient to hoist the object.

13. In a hoisting apparatus, the combination of hoisting means adapted to be connected to and hoist an object, said hoisting means being mounted adjacent water subjectable to wave action and said object being floatable on the water adja-

cent said means and being liable to impairment by shock, power means, at least one pair of members having juxtaposed engageable friction power transmitting surfaces having only portions of such surfaces adapted to be in frictional engagement with spaces intermediate said engaged portions and adapted when said surfaces are in engagement to operatively connect the hoisting and the power means; and means for engaging said surfaces for transmitting torque in the direction of hoist from the power to the hoisting means while the latter is connected to the object, said torque being insufficient to overcome the gravity of the object, means for increasing such torque to a degree sufficient to hoist the object, and means for maintaining a lubricating fluid in said spaces between said surfaces of said members.

14. The combination of claim 11 further characterized by at least one of said surfaces of the members being undulating with only portions of said surfaces being adapted to be in frictional engagement, and by means for relatively longitudinally movably mounting said members.

15. The combination of claim 11 further characterized by at least one of said surfaces of the members being undulating with only portions of said surfaces being adapted to be in frictional engagement, means for increasing said transmitted torque to a degree sufficient to hoist the object, and by said engaging means and increasing means being yieldable in the direction of said undulation.

16. The combination of claim 11 further characterized by at least one of said surfaces of the members being undulating with only portions of said surfaces being adapted to be in frictional engagement; means for relatively longitudinally movably mounting said members; means for increasing said transmitted torque to a degree sufficient to hoist the object; and by hydraulic means, yieldable in the direction of said undulation, for operating said engaging and increasing means.

17. The combination of claim 11 further characterized by means for maintaining the disengagement of said surfaces of the members while said engaging means is not performing its engaging function.

18. The combination of claim 11 further characterized by means for applying a lubricating fluid under pressure to and between said engageable surfaces for lubricating and maintaining the disengagement of said surfaces of the members while said engaging means is not performing its engaging function.

19. The combination of claim 11 further characterized by means for increasing said transmitted torque to a degree sufficient to hoist the object, and by means for maintaining the disengagement of said surfaces of the members with a force less than that exerted by said engaging means.

20. The combination of claim 11 further characterized by means for increasing said transmitted torque to a degree sufficient to hoist the object, by means for maintaining the disengagement of said surfaces of the members with a force less than that exerted by either the engaging means or the increasing means; and by hydraulic means for operating said engaging, increasing and maintaining means.

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