Sept. 10, 1935. R. C. LAMOND 2,013,690

HOISTING MECHANISM

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Fig. 1

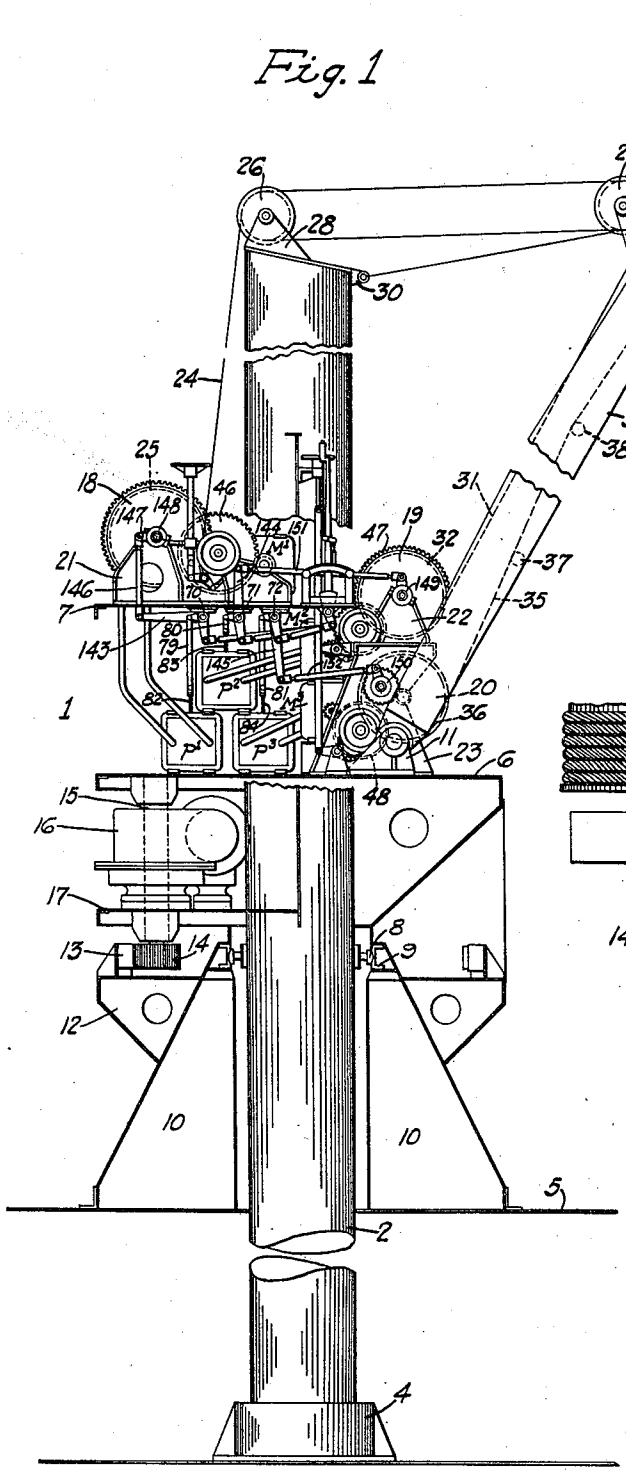
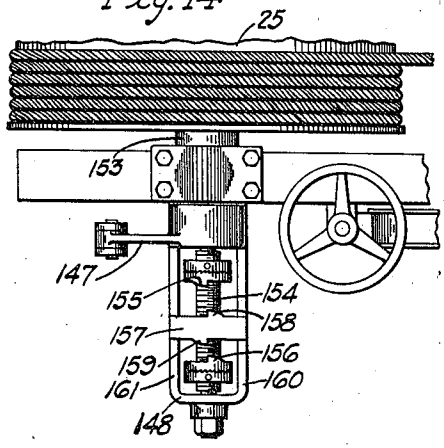


Fig. 14



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Fig. 2

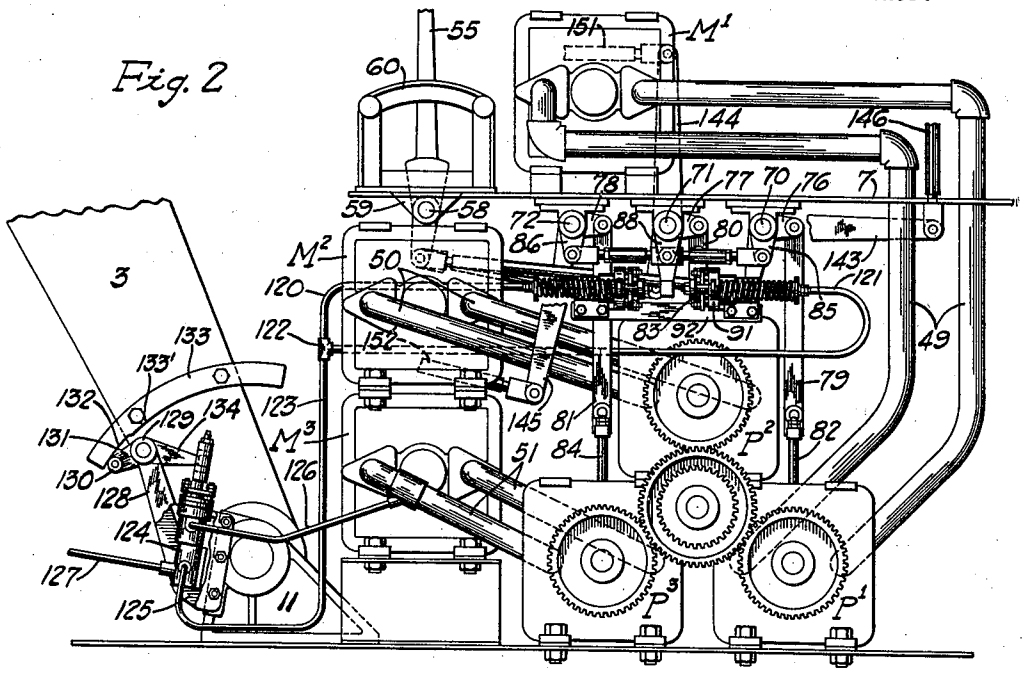
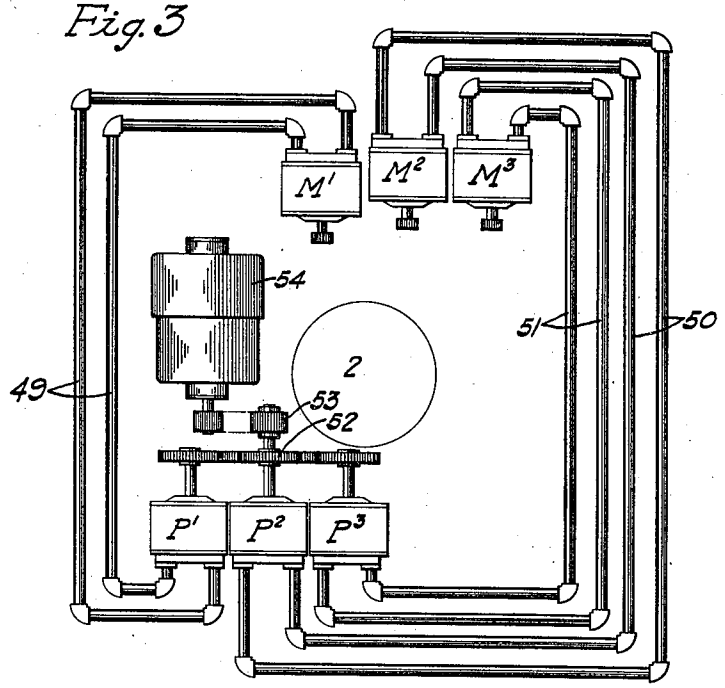


Fig. 3



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HOISTING MECHANISM

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Fig. 4

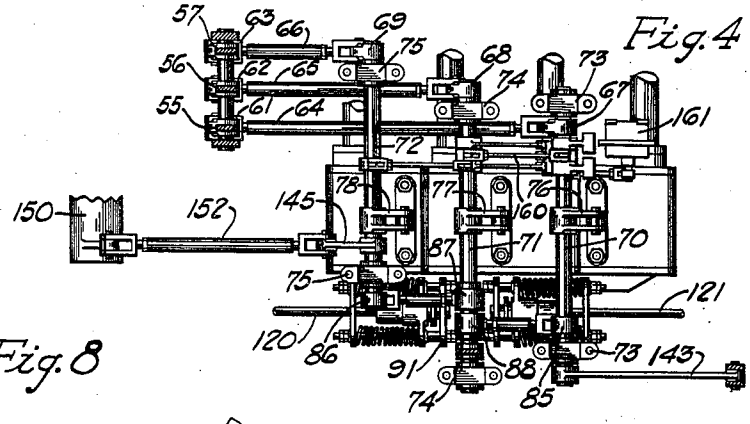


Fig. 8

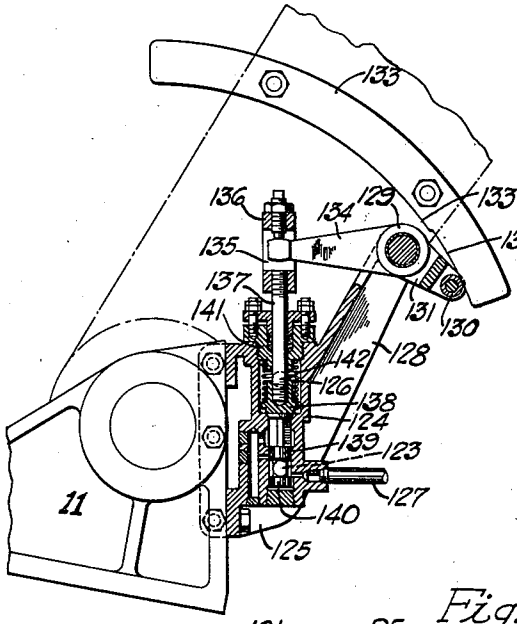


Fig. 5

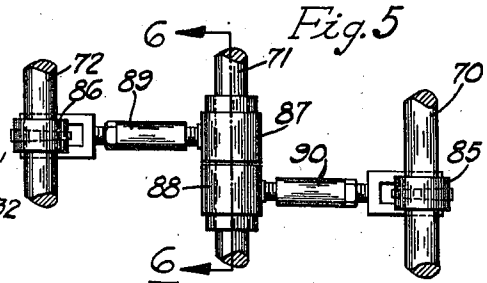


Fig. 6

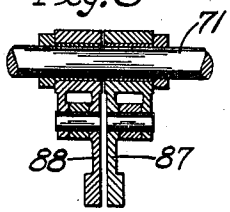
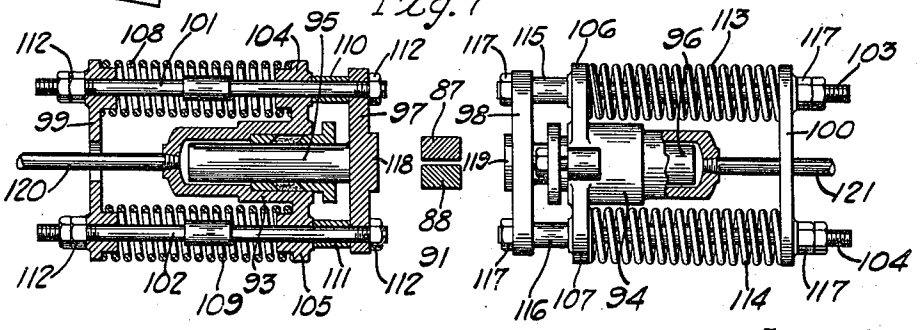


Fig. 7



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Fig. 9

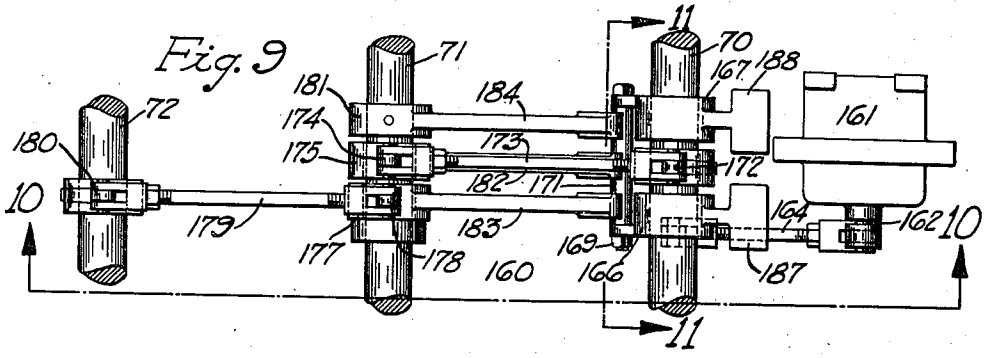


Fig. 10

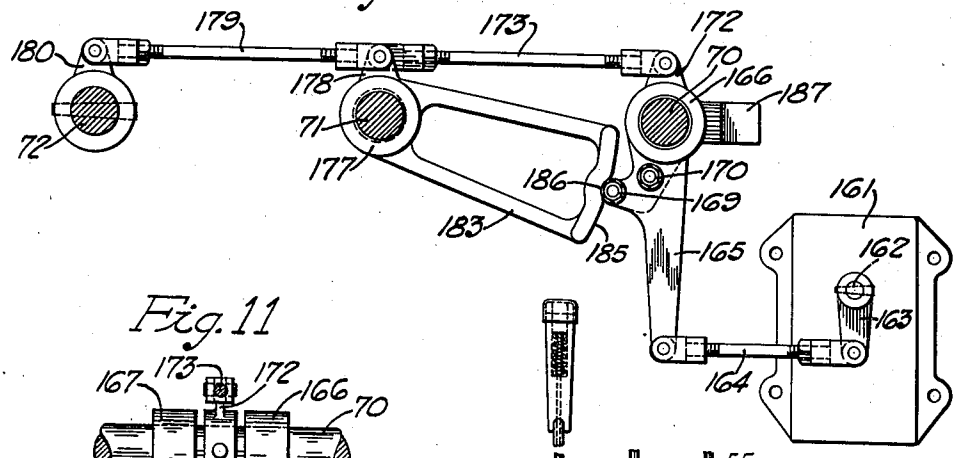


Fig. 11

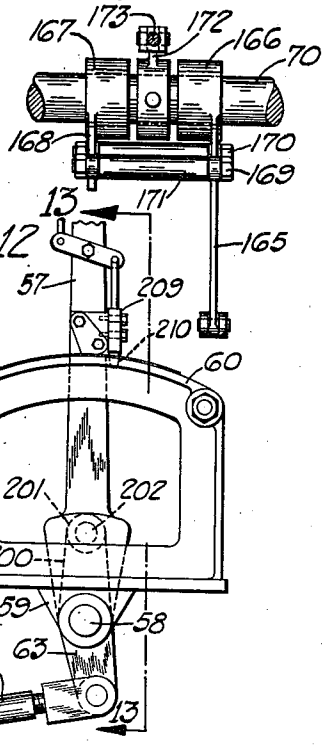
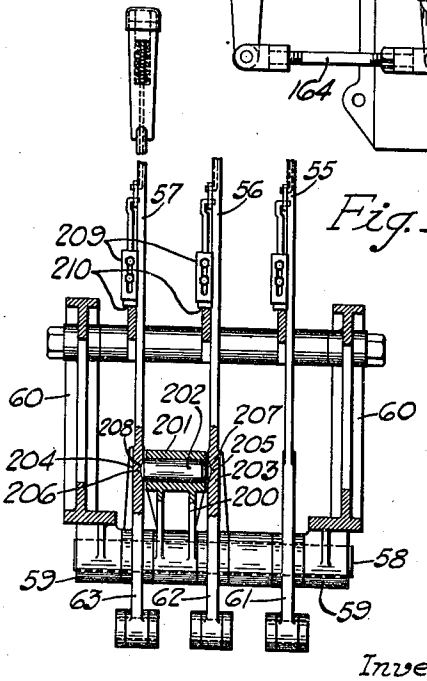


Fig. 12

Fig. 13



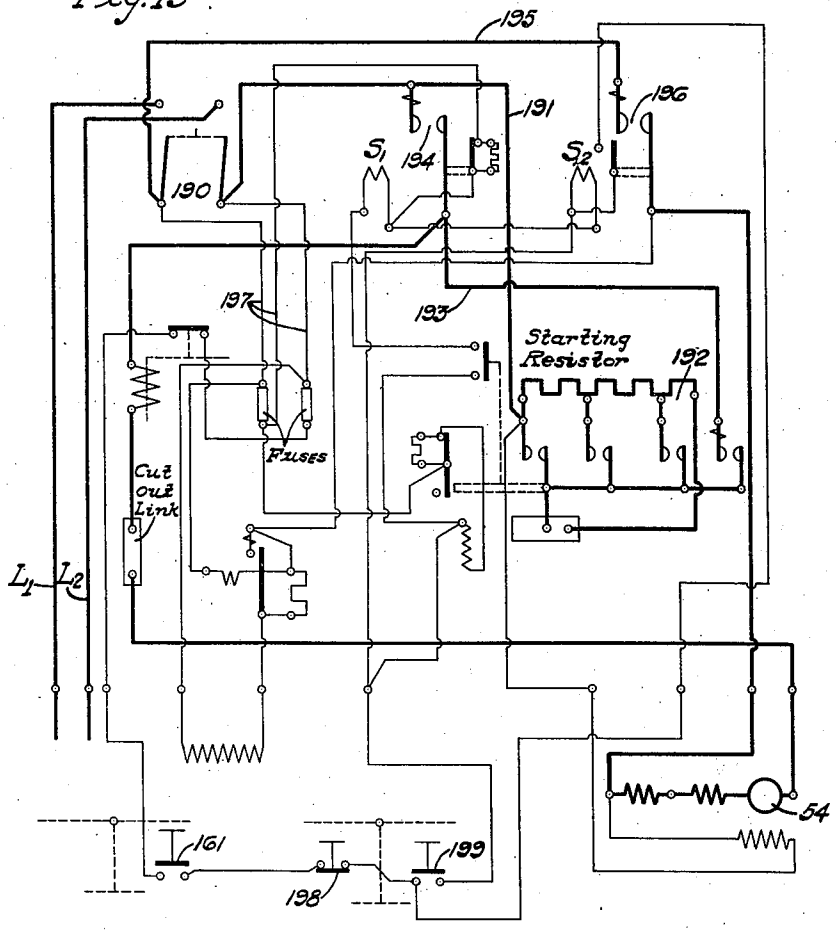
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HOISTING MECHANISM

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Fig. 15.



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2,013,690

UNITED STATES PATENT OFFICE

2,013,690

HOISTING MECHANISM

Robert C. Lamond, Philadelphia, Pa., assignor to American Engineering Company, Philadelphia, Pa., a corporation of Pennsylvania

Application October 26, 1933, Serial No. 695,272

17 Claims. (Cl. 212—39)

This invention relates to control mechanisms for cranes or winches, and more particularly to control mechanisms for cranes or winches of the electrohydraulic type.

The present invention, in the more specific sense, relates to boat and airplane handling apparatus employed on ships, or on wharves, and consists of a unit comprised of several electrohydraulic winches, one of which is employed to swing the boom, another for the handling of boats, and a third for the handling of airplanes. In devices of this character it is well known that the load imposed upon the cable becomes greater as the boom approaches a horizontal position. Thus when the boom has been swung to one of its lower positions of adjustment the load imposed upon the cable may become so great as to cause breaking of the cable with the result that serious damage may occur.

One object of the present invention is to provide a control mechanism for apparatus of the stated character which prevents such damage to the parts, and which has associated therewith an adjustable valve mechanism which conditions the control for operation when the boom has been swung downwardly a predetermined distance. When the apparatus has been so conditioned, in case the load to be lifted by one of the winches exceeds a predetermined value, the winch will be rendered inoperative. The operator will then realize that in order to carry the load the boom must be moved toward vertical position before the object may be handled thereby. By this construction the danger of snapping of the cable is prevented.

Another object of the present invention is to provide a limit control mechanism for each of the winches of the unit, which functions when the cable is substantially full wound on or paid out from the associated winding drum, the hydraulic transmission for driving the drum will be rendered inoperative.

A further object is to provide a control switch mechanism which functions to prevent starting of the electric motor for driving the hydraulic transmissions under load.

A further object of the present invention is to provide a compact control mechanism whereby the hydraulic transmissons for the several winches are interconnected so that some of them will be rendered inoperative when the load imposed upon one, exceeds a predetermined value, or when the cable associated with any of the winches is substantially fully wound on, or paid out from the associated winding drum.

A further object is to provide a control mechanism of the stated character which is compact in form, and which is comprised of but a few simple parts.

Other and further objects of the present invention will become apparent as the description thereof progresses.

Of the drawings:

Fig. 1 is an elevational view of the apparatus comprising the present invention.

Fig. 2 is an enlarged fragmentary view of the hydraulic transmissions for driving the several winches, and of the control mechanism therefor.

Fig. 3 is a plan view of the hydraulic transmissions for operating the several winches of the apparatus, and the motor for actuating said transmissions.

Fig. 4 is a plan view of a portion of the control mechanism comprising the present invention.

Fig. 5 is a plan view of a portion of the control mechanism shown in Fig. 4.

Fig. 6 is a sectional view taken substantially along line 6—6 of Fig. 5.

Fig. 7 is a plan view partly in section of the hydraulic motor associated with the control mechanism.

Fig. 8 is a fragmentary side view partly in section showing the valve means for conditioning the control mechanism for operation.

Fig. 9 is a plan view of the switch operating mechanism comprising a portion of the control means shown in Fig. 4.

Fig. 10 is a side view taken substantially along line 10—10 of Fig. 9.

Fig. 11 is an elevational view taken substantially along line 11—11 of Fig. 9.

Fig. 12 is a side elevational view of the control levers for the winches.

Fig. 13 is an end view partly in section taken substantially along line 13—13 of Fig. 12.

Fig. 14 is a fragmentary plan view of one of the drums showing the limit control means associated therewith.

Fig. 15 is a wiring diagram of the control for the electric motor associated with the driving mechanism for the winches.

Referring to the drawings, the numeral 1 designates generally a crane comprising a mast 2 and a boom 3. The lower end of mast 2 is mounted in a thrust bearing 4 and extends upwardly through a supporting structure 5, machine platform 6, and an auxiliary platform 7. Platforms 6 and 7 are secured to mast 2 by any suitable means. The mast 2 is provided with lateral thrust bearings 8 intermediate the ends

thereof which operate in a race 9 mounted at the upper end of a supporting bracket 10. The boom 3 is pivotally supported at the lower end thereof in bearing brackets 11 secured to the machine platform 6, as shown in Fig. 1. Mounted in a suitable framework 12 secured to brackets 10 is an internal gear 13 which meshes with a pinion 14. Pinion 14 is secured to the driven shaft 15 of an operating mechanism 16 for rotating platforms 6 and 7 and mast 2 in a well known manner. Operating mechanism 16 is secured to a framework 17 and machine platform 6 in any suitable manner.

Operatively associated with mast 2 and boom 3 are three winches 18, 19 and 20 respectively. Winch 18 is mounted in a suitable framework 21 secured to and extending upwardly from platform 7, and is employed for the purpose of swinging boom 3. Winches 19 and 20 are mounted, respectively, in frameworks 22 and 23 secured to and extending upwardly from machine platform 6. Winch 19 in the present apparatus is employed for handling airplanes and will be hereinafter referred to as the airplane winch, while winch 20 is employed for handling boats such as tenders, and will be hereinafter referred to as the boat winch. A cable 24 extends upwardly from the winding drum 25 of winch 18 and is trained around differential pulleys 26 and 27, the former being rotatably mounted in a bracket 28 secured to the top of mast 2, while the latter is similarly mounted in a bracket 29 secured to boom 3, and the end of the cable is secured to a bracket 30 secured to the upper end of mast 2, as shown in Fig. 1.

A cable 31 extending from the winding drum 32 of airplane winch 19 is trained around a sheave 33 rotatably mounted in suitable bearings provided near the upper end of boom 3, and the end thereof is provided with the usual hook 34. A cable 35 also extends from the winding drum 36 of boat winch 20 and is trained over guide rolls 37 and 38 provided in boom 3, and thence around sheave 39 rotatably mounted in a bearing bracket 40 secured to boom 3 a short distance from the upper end thereof. The cable 35 is then trained around differential pulleys 41 and 42, and the end thereof is secured to a block 43 mounted on pulley 41. Pulley 42 is rotatably mounted in a bracket 44 secured to boom 3, while pulley 41 is suspended therefrom by the cable 35, and the lower end of the block 43 mounted thereon is provided with the usual hook 45.

Winches 18, 19 and 20 are respectively driven by fluid motors M^1, M^2, and M^3, through the associated reduction gearing designated generally by the numerals 46, 47 and 48. Fluid motors M^1, M^2, and M^3 are operated by pumps P^1, P^2, and P^3 through piping connections 49, 50 and 51, as shown more particularly in Figs. 2 and 3. Pumps P^1, P^2, and P^3 are interconnected for simultaneous operation by gearing 52 which in turn is connected by a chain and sprocket mechanism 53 to an electric motor 54, or to any other suitable driving mechanism. Pumps P^1, P^2, and P^3, and motors M^1, M^2, and M^3 are of the general type shown and described in the United States Patent No. 1,077,979 to which reference may be had for a full disclosure thereof.

It therefore is seen that upon operation of electric motor 54 pumps P^1, P^2, and P^3 will be simultaneously operated and the fluid discharging therefrom will actuate motors M^1, M^2, and M^3, which in turn will operate the associated winches 18, 19 and 20, respectively.

The mechanism for controlling the operation of winches 18, 19 and 20 will now be described in detail.

Referring more particularly to Figs. 1, 2 and 4, the stroke and direction of discharge of pumps P^1, P^2, and P^3 are regulated by levers 55, 56 and 57 respectively. Levers 55, 56 and 57 are also operatively connected to a switch operating mechanism for electric motor 54 which prevents starting of the latter under load, as will appear hereinafter. These levers are pivoted upon a shaft 58 secured to brackets 59 depending from platform 7, and are guided for movement in the brackets 60 also secured to platform 7, as shown more particularly in Figs. 1 and 2. Levers 55, 56 and 57 have secured to the lower ends thereof, arms 61, 62 and 63, respectively, to which one end of links 64, 65 and 66 are pivotally connected. The other ends of links 64, 65 and 66 are pivotally connected to arms 67, 68 and 69 secured respectively to one end of shafts 70, 71 and 72. These shafts are rotatably mounted in bearing brackets 73, 73, 74, 74, and 75, 75, respectively, secured to and depending from platform 7. Secured to shafts 70, 71 and 72 respectively, intermediate the ends thereof, are a series of substantially horizontal arms 76, 77 and 78 to the free ends of which are pivotally connected the upper ends of links 79, 80 and 81 respectively, the lower ends of which being pivotally connected to the stroke adjusting means 82, 83 and 84 of pumps P^1, P^2, and P^3.

It therefore is seen that by means of the connections just described between levers 55, 56 and 57, and the stroke adjusting means 82, 83 and 84 of pumps P^1, P^2, and P^3 respectively, the strokes of the latter may be adjusted in one direction by swinging the associated levers 55, 56 or 57 in a clockwise direction and in the reverse direction by swinging said levers in a counter-clockwise direction. Referring to Figs. 2, and 4 to 6, it will be observed that shafts 70 and 72 have secured thereto near one end thereof depending arms 85 and 86 respectively, while shaft 71 has pivotally mounted thereon a pair of depending arms 87 and 88. A pair of links 89 and 90 operatively connect arms 86 and 87, and arms 85 and 88 respectively. Therefore, when shaft 70 is rocked by lever 55, arm 88 will swing about shaft 71 a corresponding amount through its connection 90 with the arm 85 secured to the shaft 70. Likewise, when shaft 72 is rocked by lever 57, arm 87 will also be swung about shaft 71 through its connection 89 with the arm 86 secured to the shaft 72.

As shown in Figs. 2 and 7, a fluid motor designated generally by the numeral 91 is suitably supported upon a bracket 92 in spaced relation with shafts 70, 71 and 72. Fluid motor 91 comprises a pair of cylinders 93 and 94 having pistons 95 and 96 respectively, operating therein. Pistons 95 and 96 extend through the ends of cylinders 93 and 94 and abut against the inner sides of crossheads 97 and 98, respectively. Spaced respectively from crossheads 97 and 98 are crossheads 99 and 100. Crossheads 97 and 99 are connected by a pair of tie rods 101 and 102, while crossheads 98 and 100 are likewise connected by a pair of tie rods 103 and 104. Tie rods 101 and 102 extend through and are guided in apertures provided in ears 104 and 105 integral with cylinder 93. Tie rods 103 and 104 are likewise mounted in ears 106 and 107 integral with cylinder 94. Ears 104 and 105, and crosshead 99 are provided with inwardly extending bosses which constitute spring seats for coil springs 108 and 109 which

respectively encircle tie rods 101 and 102, and spacing collars 110 and 111 extend between the ears 104 and 105 of cylinder 93 and crosshead 97. The ends of tie rods 101 and 102 are threaded to receive lock nuts 112, which not only retain the crossheads in position but afford a means for varying the tension of springs 108 and 109. Ears 106 and 107 of cylinder 94 and crosshead 100 are also provided with inwardly extending bosses which act as spring seats for springs 113 and 114, which encircle tie rods 103 and 104, respectively. A pair of spacing collars 115 and 116 are also provided between crossheads 98 and ears 106 and 107 of cylinder 94. The ends of tie rods 103 and 104 are also provided with lock nuts 117 which serve a similar purpose to the lock nuts 112 secured to the ends of tie rods 101 and 102. As shown in Fig. 2, the lower ends of arms 87 and 88 extend between crossheads 97 and 98 and are adapted to be engaged by the bosses 118 and 119 provided on crossheads 97 and 98 respectively.

A pair of pipes 120 and 121 are respectively connected to the ends of cylinders 93 and 94. These pipes are connected to a T-coupling 122 secured to one end of a pipe 123, the other end of which is connected to a valve 124 mounted in a bracket 125 secured to bearing bracket 11 for the boom 3. A pipe 126 connects valve 124 with one of the pipes 51 leading from pump P^3 to motor M^3, and a third pipe 127 conducts the overflow of valve 124 to a makeup tank (not shown). Pipe 51 of pump P^3 is subjected to pressure when a load is imposed on the boat winch 20 and this pressure is communicated to valve 124 through the connections just described. When the boom 3 is in the position shown in Fig. 2, valve 124 is inoperative and thus no fluid will be delivered therethrough to cylinders 93 and 94 of motor 91.

In order to condition valve 124 for operation the following mechanism is provided. Pivotally mounted on the upper end of an arm 128 extending upwardly from bracket 125 is a bell crank lever 129. A roller 130 provided at the free end of an arm 131 of bell crank lever 129 is adapted to engage in the cutaway portion 132 of a cam plate 133 secured to boom 3 when the latter is in its upper positions of adjustment, as shown in Fig. 2. The other arm 134 of bell crank lever 129 extends into a slot 135 provided in the block 136 secured to the upper end of valve stem 137. Valve stem 137 has secured thereto valves 138, 139 and 140 as shown in Fig. 8. When the parts are in the position shown in Figs. 2 and 8, valve 138 is closed and thus no fluid can pass through valve 124 to cylinders 93 and 94 of motor 91 from pipe 51. However, any fluid in said cylinders can drain through valve 124 through pipe 127 to the makeup tank. When the boom 3 is swung downwardly a predetermined distance the cam portion 133' of plate 133 will rock bell crank lever 129, causing the arm 134 thereof to lift valves 138, 139 and 140, thereby establishing communication between pipes 51 and 123, and causing the pressure delivered by pump P^3 to be delivered to cylinders 93 and 94 of fluid motor 91. At the same time valve 140 closes the outlet port of valve 124 leading to pipe 127. Fluid motor 91 is now conditioned for operation and when the pressure delivered by pump P^3 exceeds the tension of the springs 108, 109 and 113, 114, associated therewith, pistons 95 and 96 will force crossheads 97 and 98 into engagement with arms 87 and 88 actuating the latter to normal position. By this action shafts 70 and 72 will be rocked to normal position by virtue of the connection of the arms 85 and 86 respectively, secured thereto, with the arms 87 and 88, with the result that the stroke adjusting mechanisms 82 and 84 of pumps P^1 and P^3 will be actuated to normal no stroke position, thus interrupting the pumping action of said pumps. Extending between valve 138 and a packing plug 141 provided at the upper end of valve 124 is a coil spring 142. Thus when the boom 3 has been swung upwardly a distance sufficient to cause the cutaway portion 132 of cam plate 133 to register with roller 130, spring 142 will urge valves 138, 139 and 140 downwardly, to normal position, seating valve 138 and thus shutting off communication between pipe 51 and fluid motor 91. Fluid, however, can drain from cylinders 93 and 94 through the valve 124 to the makeup tank through pipes 123 and 127. By the mechanism just described, it is seen that in the event the winch 20 is subjected to unusually heavy loads when the boom 3 is in one of its lower positions, pump P^3, and consequently winch 20, will be rendered inoperative. Pump P^1, and its associated winch 18 will also be rendered inoperative. This directs the attention of the operator to the fact that the load is too great for the mechanism to handle when the boom is in that particular position of adjustment. In order to carry the load the boom 3 must then be swung toward vertical position to reduce the length of the moment arm thereof and thereby reduce the load on winch 20.

Referring to Figs. 1, 4 and 14, it is seen that shafts 70, 71 and 72 have also secured thereto arms 143, 144 and 145, respectively. Arm 143 is pivotally connected at the free end thereof to the lower end of a link 146, the upper end of which being connected to an arm 147 secured to a cradle 148 provided at one end of winch 18. Arms 144 and 145 are likewise connected to cradles 149 and 150 of winches 19 and 20 respectively, through links 151 and 152. Each of the cradles 148, 149 and 150, and the mechanism associated therewith are similar in construction and operation so that a description of one will suffice for all.

Referring to Fig. 14, the shaft 153 of winding drum 25 has operatively associated therewith a screw shaft 154 having secured thereto in spaced relation a pair of stops 155 and 156. Mounted for reciprocation on screw shaft 154 is a traveling nut 157 having a pair of laterally extending projections 158 and 159 provided thereon which are adapted respectively to engage stops 155 and 156. Traveling nut 157 is notched at the sides thereof to receive the side arms 160 and 161 of cradle 148 in such a manner that any rotary movement of said nut in either direction will impart a corresponding rocking movement to the cradle. The stops 155 and 156 are so spaced on shaft 154 as to be engaged by the traveling nut 157 when the cable is substantially fully wound on drum 25 or substantially paid off therefrom. By this construction it is seen that when traveling nut 157 engages either of the stops 155 or 156 the cradle 148 will be rocked about its pivotal connection with shaft 154 correspondingly. When the cradle is operated in this manner shaft 70 will also be rocked in the reverse direction from which it was operated by adjustment of lever 55, and consequently the stroke adjusting mechanism associated with pump P^1 will be adjusted to neutral position. In a like manner, when the cables 31 and 35 of winches 19 and 20 are either substantially fully wound on or paid off from the

associated drums 32 and 36, the cradles 149 and 150 respectively associated therewith will effect rocking of shafts 71 and 72 in the reverse direction from which they are operated by levers 56 and 57, thereby adjusting the strokes of pumps P^2 and P^3 to neutral position and thus rendering said pumps ineffective.

In case the strokes of pumps P^1, P^2, and P^3 are adjusted to "on stroke" position, as hereinafter described, before the electric motor 54 has been started mechanism is provided to open the switch to the said electric motor thereby preventing operation of the latter. The purpose of this mechanism is to prevent damage to the parts, which may occur if the motor is started up under heavy loads. Referring to Figs. 4, 9 to 11, and 13, it is seen that shafts 70, 71 and 72, have provided intermediate the ends thereof a link and lever mechanism designated generally by the numeral 160 for actuating the interlocking switch 161 provided in the control circuit for motor 54.

Switch 161 is of a well known construction and a detailed description thereof is unnecessary. Switch 161 includes an operating shaft 162 having secured to one end thereof a depending arm 163 to the free end of which is pivotally connected one end of a link 164. The other end of link 164 is pivotally connected to the lower end of an arm 165 having a hub 166 integral therewith which is loosely mounted on shaft 70. Spaced from hub 166 is a second hub 167, also loosely mounted on shaft 70 and which has integral therewith a short depending arm 168. A pair of bolts 169 and 170 connect arms 165 and 168, the bolt 169 having an anti-friction roller 171 rotatably mounted thereon. Secured to shaft 70 intermediate hubs 166 and 167 is a vertically extending arm 172 to which one end of a link 173 is pivotally connected. The other end of link 173 is pivotally connected to the vertical arm 174 of a cam member 175 loosely mounted on shaft 71. Adjacent to one side of cam member 175 and spaced slightly therefrom is a second cam member 177. Cam member 177 is also loosely mounted on shaft 71 and has integral therewith a vertically extending arm 178 to which one end of a link 179 is pivotally connected. The other end of link 179 is pivotally connected to the upper end of an arm 180 rigidly secured to shaft 72. At the other side of cam member 175 is a third cam member 181 rigidly secured to shaft 71, as shown in Fig. 9. Cam members 175, 177 and 181 comprise slightly inclined arms 182, 183 and 184 respectively, extending between shaft 71 and anti-friction roller 171. The right hand ends (Figs. 9 and 10) of arms 182, 183 and 184 are each provided with an arcuate end portion 185 concentric with shaft 71. Each end portion 185 has an arcuate cam notch 186 provided therein intermediate the ends thereof for receiving the anti-friction roller 171 mounted on bolt 169. By this construction it is seen that when any one of shafts 70, 71, or 72 is rocked in either direction, arm 165 will be rocked in a counter-clockwise direction (Fig. 10) thereby rocking shaft 162 of switch 161 to open said switch. Switch 161 will be retained in open position by the arcuate end portions 185 of arms 182, 183 or 184 until all of the shafts 70, 71 and 72 have returned to normal position, when the respective cam notches 186 register with roller 171. Referring to Figs. 9 and 10, it is seen that hubs 166 and 167 are provided with weights 187 and 188 respectively, which, when the cam notches 186 register with roller 171, cause arms 165 and 163 to rock in a clockwise direction (Fig. 10) thereby closing switch 161.

Fig. 15 shows a conventional wiring diagram of the control circuit for electric motor 54 including the switch 161. The specific character of motor controls of this type is well known and accordingly a detailed description thereof is unnecessary. Current is supplied to electric motor 54 from bus bars L_1 and L_2 respectively, connected to a line switch 190. A wire 191 leads from one of the poles of switch 190 to one end of an automatic starting resistor 192 for electric motor 54. A branch connection 193 having a switch 194 therein connects wire 191 with the other end of starting resistor 192. A second wire 195 leads from the other pole of switch 190 to motor 54 and also has a switch 196 provided therein. Switches 194 and 196 are operated by solenoids S_1 and S_2 provided in an auxiliary circuit connected to switch 190 and designated generally by numeral 197. Solenoids S_1 and S_2 are controlled by starting switch 198 and stop switch 199 and interlocking switch 161.

Thus, in order to start the operation of electric motor 54, starting switch 198 is closed. Interlocking switch 161 must also be closed to complete the circuit from line switch 190 to solenoids S_1 and S_2. As hereinbefore described, all of the levers 55, 56 and 57 must be in normal position before weights 187 and 188 can effect closing of switch 161. Thus it will be impossible to start the operation of electric motor 54, unless all of the pumps P^1, P^2, and P^3 are in neutral ineffective position, thereby imposing no load upon the electric motor 54. Upon closing of switches 198 and 161 solenoids S_1 and S_2 respectively close switches 194 and 196 closing the circuit to electric motor 54 through starting resistor 192 which functions automatically to cut out resistances during starting of the motor, thereby gradually increasing the speed thereof. Switches 194 and 196 will now remain closed until stop switch 199 is closed, even though switch 161 is subsequently opened by operation of levers 55, 56 or 57. Thus when electric motor 54 has been brought up to full speed the winches 18, 19 or 20 may be operated by adjusting the strokes of pumps P^1, P^2, or P^3 as hereinbefore described. To stop the electric motor 54 the operator simply closed switch 199 which through the auxiliary circuit 197 causes switches 194 and 196 to open, thereby interrupting the circuit to said motor 54.

In order to prevent overloading of boom 3, mechanism is provided to prevent simultaneous operation of winches 19 and 20. Referring to Figs. 12 and 13, a bracket 200, secured to shaft 58, extends upwardly therefrom between levers 56 and 57. The upper enlarged portion 201 of bracket 200 is provided with a transverse cylindrical bore for receiving a lock pin 202. The extended flat surfaces 203 and 204 of levers 56 and 57, respectively, lie in close juxtaposition to the ends of portion 201, and are provided with circular recess 205 and 206, respectively, intermediate the sided edges thereof for receiving the rounded ends 207 and 208 of pin 202 when the levers are in normal position. It therefore is seen that if, for example, lever 56 is operated pin 202 will be shifted to the left (Fig. 13) causing the rounded end 208 thereof to enter recess 206. The flat surface of lever 56 will now engage the end 207 of pin 202 and thus hold the latter in locking engagement with lever 57, thereby preventing operation of the latter until lever 56 has

been returned to normal position. Lever 56 will be locked against movement in a similar manner in the event that lever 57 is first moved from normal position.

In order to retain the levers 55, 56 and 57 in normal position, each is provided with a manually operable latch 209, the lower end of which engages in a notch 210 provided in the upper end of guide bracket 60.

From the foregoing description it is thought that the operation of my improved device is obvious. However, in order to correlate the various elements thereof a brief summary of the operation thereof will now be given. Let us assume that the levers 55, 56 and 57 are in normal position and that it is desired to swing the boom 3 downwardly so as to render the hooks 34 or 45 accessible to the crafts to be handled. The operator first closes switch 198 to start the operation of motor 54 which in turn then operates pump P^1, P^2, and P^3. Lever 55 is then unlatched and moved in the proper direction, which movement is transmitted to shaft 70 through link 64 and arm 67, which in turn through arm 76, link 79 and stroke adjusting means 82 places pump P^1 on stroke. At the same time, arm 143 will also be correspondingly rocked which through link 146 and arm 147 will tilt cradle 148 associated with the drum 25 of winch 18. Fluid discharging from pump P^1 now drives the associated fluid motor M^1, which in turn drives winch 18 through the gearing 46. The winding drum 25 of winch 18 will now be rotated to pay out cable thereby permitting the boom 3 to swing downwardly by gravity. When the boom has moved in this manner to approximately its lower limiting position, traveling nut 157 (Fig. 14) will have moved in such a direction as to cause stop 155 to engage projection 158 thereon, with the result that cradle 148 will be actuated to normal position. When this occurs pump P^1 will be adjusted to neutral position through arm 147, link 146, arm 143, shaft 70, link 79 and stroke adjusting mechanism 82. Arm 182 of cam 175 will also be rocked to normal position wherein notch 186 registers with the anti-friction roller 171. Weights 187 and 188 will now rock arm 165 in a clockwise direction (Fig. 10) thereby closing switch 161. Similar action takes place when winches 19 and 20 respectively, are operated. By this construction, it is clear that winches 18, 19 and 20 may be operated independently of each other.

Now let us assume that boat winch 20 is in operation and the boom 3 has been swung downwardly to one of its lower positions. When the boom has been operated in this manner, the cam plate 133 thereon rocks bell crank lever 129 about its pivot causing the arm 134 thereof to lift valves 138, 139 and 140, and thereby permit the fluid pressure developed in pump P^3 to pass through valve 124 to cylinders 93 and 94 of fluid motor 91. The apparatus is now so conditioned that in case the load imposed upon the winch 20 exceeds a predetermined value, the pressure developed by pump P^3 will increase until it exceeds the tension of springs 108, 109, 113 and 114 of motor 91, causing pistons 95 and 96 thereof to actuate crossheads 97 and 98, respectively, into engagement with levers 87 and 88, thereby actuating the latter to normal position. When this occurs shafts 70 and 72 will be rocked to normal position through the connections 89 and 90, respectively, with levers 87 and 88, with the result that the stroke adjusting mechanism 84 of pump P^3 will be adjusted to neutral position. If pump P^1 is also on stroke it is obvious that it also will be adjusted to neutral position when arms 87 and 88 are actuated by motor 91 as just described. It also is seen that cam members 175 and 177 will also be adjusted to normal position causing the cam notches 186 therein to register with anti-friction roller 171. Weights 187 and 188 will now swing arm 165 in a clockwise direction to close switch 161. If it is desired to stop the operation of motor 54 the operator simply closes switch 199, which in turn causes main switches 194 and 196 to open and thus interrupt the circuit to said motor. Inasmuch as interlocking switch 161 is held in closed position by weights 187 and 188, electric motor 54 may again be started by simply closing switch 198. In case one of the levers 55, 56 or 57 is operated from normal position before switch 198 is first closed, interlocking switch 161 will be actuated to open position and consequently electric motor 54 will remain at rest.

It therefore is seen that an effective control mechanism has been provided which prevents overloading of the apparatus and also prevents damage to the driving motor and associated parts.

While the apparatus herein described is admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to limit the invention to the embodiment herein shown since it may be embodied in other forms all coming within the scope of the claims which follow.

What is claimed is:

1. In a device of the class described, the combination with a plurality of driven members, of a plurality of driving means, one for each of said driven members, each of said driving means comprising a fluid pump and motor, and automatic means for rendering one or more of said pumps inoperative when the load imposed upon the associated driven means exceeds a predetermined value, said automatic means comprising a fluid motor operatively connected to one of said pumps, and individual mechanical connections between said motor and some of said pumps.

2. In a device of the class described, the combination with a plurality of driven members, of a plurality of driving means, one for each of said driven members, each of said driving means comprising a fluid pump and motor, an electric motor for operating said pumps, a switch for controlling the operation of said electric motor control means for each of said driving means, including means for conditioning each of said pumps for operation, automatic means for rendering one or more of said pumps ineffective when the load imposed upon the associated driven member exceeds a predetermined value, additional means for rendering said pumps ineffective when said driven member has been operated a predetermined amount in either direction, and mechanism operatively connecting each of said conditioning means with said switch, whereby movement of any of the former from normal position, opens said switch and thereby prevents starting of said electric motor under load.

3. In a device of the class described, the combination with a plurality of driven members, of a plurality of driving means, one for each of said driven members, each of said driving means comprising a fluid pump and motor, an electric motor for actuating said pumps, means for conditioning each of said pumps for operation, au-

tomatic means for rendering one or more of said pumps ineffective when the load imposed upon one of said driven members exceeds a predetermined value, means operatively connecting each of said driven members with the conditioning means for the associated pump whereby said pump will be rendered ineffective when said driven member has been operated a predetermined amount in either direction, means for controlling the operation of said electric motor, and mechanism operatively connecting each of said conditioning means with said last mentioned means whereby movement of any of the former from normal position prevents starting of said electric motor under load.

4. In a device of the class described, the combination with a plurality of winches, of driving means for each of said winches comprising a fluid pump and motor, an electric motor for driving all of said pumps, independent means for controlling the stroke and direction of discharge of each of said pumps whereby each of said winches may be driven independently in either direction, automatic means for rendering two of said pumps ineffective when the load to which one of said winches is subjected exceeds a predetermined value, said automatic means comprising a motor operatively connected to one of said pumps, and individual mechanical connections between said motor and said pump.

5. In a device of the class described, the combination with a plurality of winches, of a driving means for each of said winches, including a fluid pump and motor, an electric motor for simultaneously driving all of said pumps, a switch for controlling the operation of said electric motor independent means for controlling the stroke and direction of discharge of each of said pumps whereby the associated winches may be operated in either direction, automatic means for rendering two of said pumps ineffective when the load to which one of said winches is subjected exceeds a predetermined value, limit control means operatively connecting each of said winches to the stroke adjusting mechanism of its associated pump whereby said pump will be rendered ineffective when said winch has been operated a predetermined amount in either direction, and mechanism operatively connecting said independent means with said switch whereby movement of any of the former from normal position, opens said switch and prevents starting of said electric motor under load.

6. In a device of the class described, the combination with a plurality of winches, of a plurality of driving means, one for each of said winches, said driving means including a fluid pump and motor, an electric motor for actuating said pumps, a control circuit for said electric motor, independent control means for each of said pumps whereby the stroke and direction of discharge thereof may be varied, limit control means operatively connecting each of said winches with the stroke adjusting means of its associated pump for rendering the latter ineffective when its associated winch has been operated a predetermined amount in either direction, means operated by said first mentioned means for opening a switch controlling the circuit to said electric motor, and means for closing said switch when said pumps have been actuated to ineffective position.

7. In a device of the class described, the combination with a plurality of winches, of a plurality of driving means, one for each of said winches, said driving means including a fluid pump and motor, an electric motor for actuating said pumps, a control circuit for said electric motor including a switch, independent control means for each of said pumps whereby the stroke and direction of discharge thereof may be varied, automatic means associated with said control means for rendering two of said pumps ineffective when the pressure developed by one of said pumps exceeds a predetermined value, and means for opening said switch to prevent starting of said electric motor when any one of said independent control means has been previously moved to operative position.

8. In a device of the class described, the combination with a plurality of driven members, of a plurality of driving means, one for each of said driven members, each of said driving means including a fluid pump and motor, an electric motor for actuating said pumps, independent means for conditioning each of said pumps for operation, switch means for controlling the starting operation of said electric motor, and means actuated by said independent means for opening said switch means, thereby preventing starting of said electric motor under load.

9. In a device of the class described, the combination with a plurality of driven members, of a plurality of driving means, one for each of said driven members, each of said driving means including a fluid pump and motor, an electric motor for actuating said pumps, independent means for conditioning each of said pumps for operation, switch means for controlling the starting operation of said electric motor, means actuated by said independent means for opening said switch means, thereby preventing starting of said electric motor under load, and an interlock between two of said independent means for preventing simultaneous movement thereof.

10. In a boat and airplane handling device, the combination with a mast and a boom, of a plurality of winches, one of said winches being adapted to adjust the position of said boom, another of said winches being adapted for handling airplanes, and still another of said winches being adapted for handling boats, independent driving means for each of said winches including a fluid pump and motor, an electric motor for simultaneously operating all of said pumps, independent control means for adjusting the stroke and direction of discharge of each of said pumps, automatic means for rendering ineffective the pumps associated with said boom and boat winches, control means for said automatic means including a valve and a fluid motor, cam means provided on said boom for opening said valve when said boom has been operated a predetermined amount to condition said last mentioned motor for operation.

11. In a boat and airplane handling device, comprising in combination a mast and a boom, a plurality of winches, one of said winches being adapted to actuate said boom, another of said winches being adapted to handle airplanes, and still another of said winches being adapted to handle boats, individual driving means for each of said winches including a fluid pump and motor, an electric motor for driving said pumps, independent control means for adjusting the stroke and direction of discharge of each of said pumps, automatic means for rendering the pumps associated with said boom and boat winches ineffective when the load imposed upon the latter exceeds a predetermined value,

said last mentioned means including a fluid motor, valve means for controlling the operation of said fluid motor, and means operated by the boom when the latter has been actuated a predetermined amount for opening said valve to condition said last mentioned motor for operation.

12. In a boat and airplane handling device, comprising in combination a mast and a boom, a plurality of winches, one of said winches being adapted to actuate said boom, another of said winches being adapted for handling airplanes, and still another of said winches being adapted to handle boats, independent driving means for each of said winches including a fluid pump and motor, an electric motor for actuating said pumps, individual means for controlling the stroke and direction of discharge of each of said pumps, means associated with said last mentioned means for conditioning said electric motor for operation, and automatic means for rendering the pumps associated with said boom and boat winches ineffective when the load imposed upon the latter exceeds a predetermined value, and means actuated by movement of said boom in one direction for conditioning said last mentioned means for operation.

13. In a boat and airplane handling device, comprising in combination a mast and a boom, a plurality of winches, one of said winches being adapted to actuate said boom, another of said winches being adapted for handling airplanes, and still another of said winches being adapted to handle boats, independent driving means for each of said winches including a fluid pump and motor, an electric motor for actuating said pumps, individual means for controlling the stroke and direction of discharge of each of said pumps, an interlock disposed between two of said individual means for preventing simultaneous operation thereof, and automatic means for rendering the pumps associated with said boom and boat winches ineffective when the load imposed upon one of said winches exceeds a predetermined value, said automatic means comprising a fluid motor operatively connected to the pump associated with said boom winch, and mechanical connections between said motor and the pumps associated with said boom and boat winches.

14. In a device of the class described, the combination of a plurality of driven members, a plurality of driving means, one for each of said driven members, each of said driving means including a fluid pump and motor, an electric motor for actuating said pumps, independent stroke adjusting means for said pumps, an operating lever for each of said last mentioned means, a switch for controlling the operation of said electric motor, operating means for said switch, and individual cam members operatively connected to each of said levers and in operative relation with said switch operating means whereby movement of any of said levers causes said switch operating means to actuate said switch to open position thereby preventing starting of said electric motor under load.

15. In a device of the class described, the combination of a plurality of driven members, a plurality of driving means, one for each of said driven members, each of said driving means including a fluid pump and motor, an electric motor for actuating said pumps, independent stroke adjusting means for each of said pumps, an operating member for each of said last mentioned means, a switch controlling the operation of said electric motor, operating means for said switch including an extended projection, individual cam members having recesses therein for normally receiving said projections, means for maintaining said projection in engagement with said recesses when said cam members are in normal position to normally retain said switch in closed position, and means operatively connecting said cam members to said operating members, whereby movement of any one of said operating members from normal position before starting of said electric motor opens said switch and thereby prevents starting of said motor under load.

16. In a device of the class described, the combination with a plurality of driven members, of a plurality of driving means, one for each of said driven members, each of said driving means comprising a fluid pump and motor, power means for actuating said pumps, independent stroke adjusting means for each of said pumps, an operating member for each of said last mentioned means, and automatic means for adjusting said stroke adjusting means toward neutral position when the load imposed upon the associated driven means exceeds a predetermined value, said automatic means comprising a fluid motor operatively connected to one of said pumps.

17. In a device of the class described, the combination with one or more driven members, of individual driving means for each of said driven members, each of said driving means comprising a fluid pump and motor, stroke adjusting means for each of said pumps, an electric motor for actuating said pumps, independent means for conditioning each of said pumps for operation, said means comprising one or more rock shafts, one for each of said pumps, an operating member operatively connected to each of said shafts, and means for connecting said shafts to said stroke adjusting means, a normally closed switch for controlling the operation of said electric motor, operating means for said switch mounted on one of said shafts, said operating means including an anti-friction roller, cam members mounted on another of said shafts each having a recess provided therein for normally receiving said roller, and means operatively connecting said cam members to said operating members whereby movement of any one of said operating members from normal position before starting of said electric motor opens said switch and thereby prevents starting of said motor under load.

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