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CONTROL FOR AUTOMATIC TENSIONING OF HYDRAULIC WINCH

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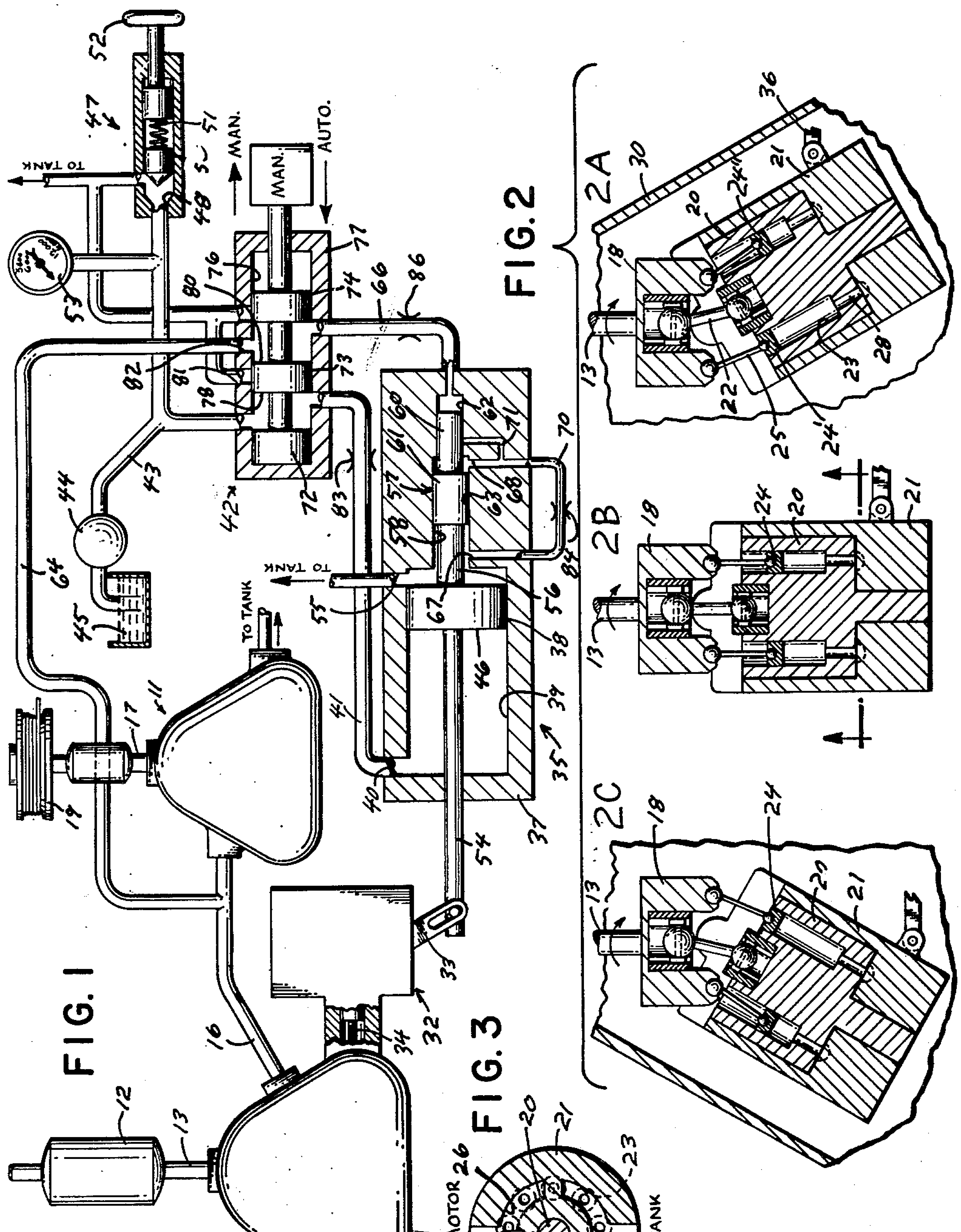

INVENTOR.
ROYAL T. HAWLEY
JO D. RAMHORST
BY Barnes & Seed
ATTORNEYS

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CONTROL FOR AUTOMATIC TENSIONING OF HYDRAULIC WINCH

Royal T. Hawley and Jo D. Ramhorst, Seattle, Wash., assignors to Western Gear Corporation, Seattle, Wash., a corporation of Washington

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This invention relates to a servo mechanism for a hydraulic pump and more particularly to a control device for the automatic tensioning of a hydraulic winch.

In shipboard use of a hydraulic winch, where cable is alternately paying out or being recovered, it is often desirable that there be a constant tension on the line. One example of this need is where a ship is traveling through a canal, and a forward and an aft line are secured to shore points, the forward line to pull the ship forward and the aft line to act as a brake and sometimes to move the ship to the rear. Constant cable tension at a safe level insures maximum control of the ship in the canal. Another example is the stringing of a line between the masts of two ships and suspending a load from the line to transfer the load from one ship to the other. In heavy seas the masts swing toward and from one another. To keep the line somewhat taut so that the load is out of the sea and yet safeguard the line against being overstressed, a winch must alternately reel in and pay out line and yet keep substantially the same tension on the line.

In providing a servo mechanism for this constant cable tensioning it is necessary to select a proper control source. One choice would be to measure cable tension directly by means of a dynamometer or cable tensioning device to feed cable tension data to an automatic control circuit. This entails complex appartus. Other methods are also possible, but these also entail certain complexities. Where there is a hydraulic pump and motor, a more convenient control source is the hydraulic pressure of the system. However, the difficulty is that this control source does not take into account the losses or inefficiencies of the motor and the winch.

To explain the foregoing, when cable is being recovered the pump supplies fluid under pressure to turn the hydraulic motor which turns the winch to reel in cable. Thus the fluid from the pump works to overcome the inefficiencies of the motor and the winch in addition to tensioning the cable. Consequently the fluid pressure must be higher than is required merely to apply the proper tensioning force to the cable. Now when cable is paying out, the pull of the cable itself turns the winch and the motor, and the motor actually reverses the flow of fluid in the line to drive fluid back through the pump. In this case, the fluid pressure is exerting a force in the same manner, i.e., to put tension on the cable. However the inefficiencies of the winch and motor now resist or place a drag on the unwinding of the cable, and this resistance or drag itself serves to put some tension on the cable. Thus the fluid pressure is lower than is required to properly tension the cable, since the motor and which inefficiencies supply the rest of the resisting force. Because of this, if the control mechanism is made responsive to fluid pressure of the system, accurate tensioning is not possible without somehow compensating for these inaccuracies caused by the losses in the system.

Therefore, it is the general object of my invention to provide a control mechanism for the automatic tensioning of a hydraulic winch which has the advantages of using hydraulic pressure as a control source and which overcomes the attendant difficulties of using such a control source.

Further, my invention purports to provide a simple

and accurate control device which uses hydraulic pump pressure as a control source, which is reliable and easy to maintain, and which adapts itself to the rigors of shipboard use.

It is a more specific object of my invention to solve the aforementioned difficulties of using hydraulic pressure as a control source by providing a double area piston which is responsive to the control pressure in such a manner that a smaller area is acted upon when recovering cable and a larger area is acted upon when paying out cable so as to compensate for the aforementioned inaccuracies.

It is also an object to provide a control source which peculiarly adapts itself to use with a variable volume, positive displacement, reversible flow pump.

It is yet another object to provide a control mechanism which has suitable speed and accuracy of response for the various shipboard uses of a winch.

Further, it is an object to provide an easily adjusted and accurate reference force, and to provide a valving means which acts in conjunction with the control source and the reference source to easily and reliably engage and disengage the control device.

More particular objects and advantages will appear in the course of the following description and claims, the invention consisting in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawing:

FIGURE 1 is a schematic view illustrating a hydraulic pump, a hydraulic motor and winch, and an associated control device which embodies preferred teachings of my invention.

FIG. 2 is a schematic view showing a hydraulic pump in an intake position, a neutral position, and in a driving position; and

FIG. 3 is a cross-sectional view on line 3—3 of FIG. 2.

In describing the invention, it is believed a more thorough understanding will achieved by first describing the operation of the pump and the motor which cooperate to drive the winch. Following this will be a description of the structure and operation of the control mechanism and finally a description of the overall operation of the entire mechanism.

The pump is designated **10** and the hydraulic motor is designated **11**. Both are identical in structure and differ only in their functions in that one drives the other. These pumps are variable volume, positive displacement, reversible flow pumps, and are widely used and well known prior art components. The pump **10** is driven by an electric motor **12** by means of a shaft **13**. Fluid is drawn from a reservoir or tank (not shown) through an inlet **14**, and is impelled through a line **16** to drive the hydraulic motor **11**. From the hydraulic motor the fluid returns to the tank. Motor **11** has an output shaft **17** which drives a mechanical winch (shown schematically at **19**) which also is or may be a standard prior art component.

Referring to FIG. 2 the pump **10** comprises a compound crank head **18** and a rotating block **20**, which is mounted in a journal box **21**. The crank head is rigidly attached to and is symmetrically shaped with respect to the rotary axis of the drive shaft **13**. A universal drive **22** connects the block **20** to head **18**. Nine parallel cylinders **23**, evenly spaced in a circular pattern, are bored into the block, and a piston **24** reciprocates in each cylinder. Each piston has a rod **25**, all nine of which are pivotally secured to the crank head in an evenly spaced circular pattern of substantially the same diameter as the circular pattern of the cylinders. Thus as the crank head **18** and the block **20** rotate together by virtue of the universal drive **22**, in one revolution each piston

24 goes through a complete cycle, pumping fluid out through one 180° of travel and drawing fluid from the tank during the other 180° of travel.

Two semi-circulr ports 26 and 27 are provided in the journal box 21 and are arranged to communicate with each cylinder by means of its related passageway 28. The port 26 leads to the fluid line 16, and the port 27 leads to the inlet 14 which communicates with a fluid reservoir. Thus as the shaft 13 rotates in the indicated clockwise direction, the left hand piston 24′ (refer now specifically to FIG. 2A) is beginning its pumping stroke and is beginning to communicate with the port 26. The right hand piston 24″ has completed discharge and is beginning its intake stroke by starting to communicate with the intake port 27.

In operation, the electric motor 12 turns the shaft 13 at a constant speed and in the same direction. The journal box 21 is secured to a stationary pump housing 30 so as to pivot about an axis 31 which lies in the plane defined by the points at which the rods 25 connect to the crank head 18. The output of the pump is controlled by moving the journal box 21 about the axis 31. Thus at the position indicated at FIG. 2A, the journal box is swung to the full right position and the pump is impelling fluid to the motor at full capacity. As the box is moved to the left, the piston strokes are shortened and the rate of flow of fluid becomes less. When the journal box reaches the position indicated at 2B, it is in a neutral position where, although the shaft 13 still rotates, there is no piston stroke and consequently no flow. As the journal box is moved from neutral position toward the left position indicated at 2C, the flow of the pump is actually reversed and the pump 10 is taking fluid from the motor 11 and discharging fluid through the port 27 into the tank.

The precise position of the journal box 21 is controlled by a pump servo mechanism (shown schematically) designated 32. This servo is or may be any of a number of standard prior art devices, and it is operated by means of a lever 33. When this lever is pushed forward (i.e., to the left in the drawing) the servo 32 actuates a rod 34 which moves a second pivotally connected rod 36 which swings the journal box 21 to the left. When the lever is pulled back (i.e., to the right), the journal box is in like manner swung to the right.

The structure of the motor 11 is identical to that of the pump 10, wherefor no need arises for a schematic showing of the component parts of the motor. It is important, however, to note an essential difference, and namely that the journal box 21 does not swing in the instance of the motor 11, being locked in a position corresponding to that shown in 2A. The port 26 of the motor communicates with port 26 of the pump, and the port 27 of the motor leads to the tank, the shaft of the motor rotating in a direction opposite to that of the pump. When the pump 10 is at full right position, the motor 11 and such pump 10 rotate at the same speed, and the drive shaft 13 rotates at the same speed as the output shaft 17. When the pump 10 shifts slightly from full right so as to pump fluid at a lower rate, the motor 11 receives less fluid and its rotary speed increases. At the neutral position of 2B, the pump 10 is still turning but is perforce pumping no fluid, and the motor 10 is at a standstill.

The apparatus as thus far described is composed of prior art components. The description will now be directed to the tension control which is designated generally 35. A relatively large cylinder 39 is drilled in the forward part of a housing 37 and a reference piston 38 is mounted for reciprocal motion in the cylinder. From a port 40 located at the forward end of the cylinder, a fluid line 41 leads to a spool valve 42 and from there (when the valve is in automatic position) through another line 43 to a small constant volume pump 44.

This pump 44 takes fluid from a reservoir 45 and

functions to supply a constant reference pressure against the front face 46 of the reference piston 38. The pressure delivered by this pump is controlled by a manually operated relief valve 47. This pressure relief valve comprises a relief port 48 which leads from the line 43 to the tank (which is merely a fluid reservoir with no pressure. A plug 50 is spring-loaded to close the orifice, and by adjusting the spring 51, through the medium of an adjusting knob 52, the pressure delivered by the pump 43 is controlled. A pressure gauge 53 is made subject to the pressure in the line 43.

The reference piston connects through a rod 54 to the lever arm 33 of the pump servo 32, and is so arranged that as the reference pressure exerts a force against the front piston face 46 to retract the piston (i.e., move the piston to the right), the lever arm 33 is pulled back to increase positive flow of the pump 10. A port 55 at the rear of the reference cylinder 39 leads to the tank to relieve any pressure on the back of the reference piston.

Extending from the back side of the reference piston 38 in a direction opposite that of the rod 54, is a second rod 56 which connects to a stepped control piston 57 which reciprocates in a stepped cylinder 58 drilled in the rear portion of the housing 37. The front end of this cylinder opens into the reference cylinder 39. The smaller piston portion 60 is at the extreme rear or lower end, and the larger piston portion 61 (i.e. of larger cross-sectional area) is adjacent to and forward of the smaller portion. The corresponding cylinder portions for the smaller and larger piston portions are designated, respectively, 62 and 63. Fluid is directed from the pump line 16 through a line 64 to the spool valve 41, and from there through a line 66 to the lower end of the smaller cylinder portion 62. In operation line pressure is always directed to the cylinder 62 to bear against the smaller piston 60.

In the larger cylinder portion 63, there is a forward and a rear port 67 and 68, respectively, which connect one to another through a passageway 70. The forward port 67, when open, communicates with the rear port 55 in the reference cylinder so that the passage 70 is then open to the tank. There is a passageway 71 which leads from the smaller cylinder portion 62 to the passageway 70, which passageway 71 is opened or closed by the smaller piston 60.

The spool valve 42 is a prior art component and has three spaced land-forming spols 72, 73, and 74 connected one to another and mounted for slide motion in a cylinder 76 of the valve housing 77, and which has two chambers 78 and 80 defined between the lands. At forward (i.e., automatic) position of the valve, the chamber 78 opens to the line 43 and 41 so that fluid from the constant volume pump 44 leads directly to the front port 40 of the reference cylinder 37. The spools 73 and 74 each block off ports 81 and 82 which lead to the tank. The second chamber 80 opens to the lines 64 and 66 so that main line pressure is directed from line 16 to the smaller cylinder portion 62. When the valve is in manual position, the spools are shifted back to the right. The forward spool 72 blocks the line 43 from the pump 44, and the middle spool 73 blocks the line 64 from the main line 16. The forward chamber 78 opens the tank port 81 to the line 41 and the rear chamber 80 opens the tank port 82 to the line 66. Thus no pressure is exerted against the reference piston 38 and the central piston 57.

It should be noted that damping orifices are provided at 83, 84, and 86 to the lines 41, 70, and 66 to prevent fluctuating instability in the system. Also the arrangement of the orifices is such that by adjusting the flow through these orifices, the sensitivity and response time of the control mechanism can be controlled.

Before describing the operation of the mechanism it is essential that the significance of the three locations of the pump 10 be particularly pointed out. The position shown in 2A where the journal box is swung to the right is pumping position, in which fluid is delivered to the motor. The position shown in 2B is the neutral position where there is no flow and the motor 11 is at a standstill. The position at 2C is the discharge position, in which fluid is delivered under pressure from the motor 11 into the pump 10, and the pump 10 is discharging fluid into the tank. The positions of 2A and 2C occur at the extreme limits of swing travel, and intermediate positions of course develop progressively lessening rates of pumping or discharge.

The operation of this mechanism will now be described. The spool valve 42 is initially placed at manual position, and the lever arm 33 is moved manually until tension is applied to the winch cable. Then the spool valve is moved to automatic position.

The constant volume pump 44 supplies a constant pressure against the front face 46 of the reference piston 38. As long as the pressure in the line 16 is low, this reference pressure will hold the piston 46 to the right and the pump 10 will deliver fluid to the motor 11 at full capacity. However, as the winch cable tightens and exerts a torque against the motor 11, line pressure at 16 will be increased. Since fluid pressure is led from the line 16 through lines 64 and 66 into the smaller cylinder portion 62, the pressure within this cylinder 62 will also be increased and will tend to move the control cylinder 57 forward to responsively move the lever 33 forward and cut down output of the pump 10. When the pump output is decreased so as to lessen tension on the cable, fluid pressure in line 16 drops to the point where the reference force exerted against the reference piston 38 will balance the control force exerted against the small control piston 60, and the control piston and reference piston will be in a position of equilibrium. This state will continue until tension on the cable again changes to change the line pressure. The small piston will then react to the pressure change and move the pump 10 accordingly.

The critical position is reached when cable tension remains above the desired level long enough to move the pump to the neutral position. That is to say that line pressure has exerted a force on the smaller piston 60 to continue to move this piston to the left until the lever 33 is brought to the position where the pump 10 is in neutral position. At this point, the smaller piston 60 is beginning to uncover the port to the passageway 71. Simultaneously the larger piston portion 61 is beginning to close the forward port 67. Thus main line pressure is directed from the smaller cylinder 62 through the passageway 71, through the rear port 68 into the larger cylinder portion 63. Now line pressure is directed into both cylinder portions 62 and 63, and the effective pressure is against the larger cross-sectional area of the piston 61.

The reason for this change in the pressure area at this particular point is as follows. When the pump 10 passes the neutral position and begins discharging, the winch 19 has stopped reeling in cable and is starting to pay out cable. The cable pulls so as to reverse the direction of the output shaft 17 and to reverse the direction of the motor 11. Fluid is pumped in a reverse direction through the line 16 and into the pump 10. In such a case, the pump 10 itself is now driven like a motor, while the motor 11 now acts as a pump. Assuming then that in this period when the reeling-in of the cable is being arrested and the cable is starting to pay out, the tension on the cable is to remain substantially constant, and further assuming that as the winch begins slowly to pay out cable, the load on the cable is at the desired level, the control mechanism must now be in a state of equilibrium to keep the pump in this desired position. However, for the cable tension to remain at the same value as cable begins to pay out the pressure in line 16 must drop to a lower value. The reason is that the losses of the winch 19 and the motor 11 now act as a drag on the cable, and less fluid pressure is needed to resist the paying out of cable under the same cable tension as when cable is recovered.

Since the reference force against the piston 46 is constant when there is proper tension on the cable, the balancing force should also be constant so as to hold the control device in equilibrium. The drop in control pressure in discharge position then is compensated for by the increase of control pressure area by bringing the larger piston 61 into communication with the line pressure.

Assuming now that the pump is in discharge position, as the load is relieved on the cable, line pressure drops and the reference piston 38 moves to the right. As the pump 10 moves past neutral position the pump begins to push fluid to the motor 11, and since the pump is now driving the winch and motor, line pressure must be higher to maintain cable tension. The passageway 71 is then closed by the small piston 60, and the smaller cross-sectional area of piston 60 only is acted on by the control force, since the front port 67 will open and tank pressure will be directed to both sides of the piston portion 61.

It is believed that the invention will have been clearly understood from the foregoing detailed description of my now preferred illustrated embodiment. Changes in the details of construction will suggest themselves and it is accordingly my intention that no limitations be implied and that the hereto annexed claims be given the broadest interpretation to which the employed language fairly admits.

What we claim is:

1. In a hydraulic system having a pump with positive and negative directions of flow and means to load said system, a control device comprising; control means connected to said pump and having a center position and movable in opposite directions therefrom for effecting positive and negative flow of fluid from said pump, constant force means to move said control means in the direction to cause positive flow, said control means having two pressure surfaces and arranged to receive pressure related to the pressure of said system, the resultant force exerted on said surfaces moving said control in opposition to said constant force means, the force on said second surface operative only after positive flow of fluid has ceased.

2. The device as recited in claim 1, wherein the force exerted on said first surface is operative in periods of both positive and negative flow of the pump.

3. The device as recited in claim 2, wherein the pressure exerted on said surfaces is substantially equal to the hydraulic pressure of said pump.

4. In a hydraulic system having a pump with positive and negative directions of flow and means to load said system, a control device comprising; control means connected to said pump and having a center position and movable in opposite directions therefrom for effecting positive and negative flow of fluid from said pump, constant reference force means to move said control means in the direction to cause positive flow, first and second control force means to move said control means in opposition to said reference force, both of said control force means being proportional to the hydraulic pressure of said pump, said second control force means being operative only after positive flow of fluid from said pump has ceased.

5. The device as recited in claim 4, wherein said first force is operative during both positive and negative flow from said pump fluid.

6. In a hydraulic system having a pump with positive and negative directions of flow and means to load said system, a control device comprising; control means connected to said pump and having a center position and movable in opposite directions therefrom for effecting positive and negative flow of fluid from said pump, con-

stant reference force means to move said control means in the direction to cause positive flow, a piston connected to said control member, said piston having two pressure surfaces for receiving hydraulic pressure proportional to the hydraulic pressure of the pump fluid, said second pressure surface receiving said proportional hydraulic pressure when positive flow of fluid from said pump ceases, the force exerted on said pressure surfaces tending to move said control member in opposition to said reference force means.

7. The device as recited in claim 6, said first pressure surface receiving said proportional hydraulic pressure during periods of both positive and negative flow from said pump fluid.

8. In a hydraulic system having a pump with positive and negative directions of flow and means to load said system, a control device comprising; a control member connected to said pump and movable in one direction from a center position to effect positive flow of fluid from said pump and movable in a second direction to effect negative flow of fluid from said pump, a reference means creating a force operating so as to move said control member in said first direction, a stepped hydraulic cylinder having a larger and a smaller chamber, a stepped piston having a larger portion to fit into said larger chamber and a smaller portion to fit into said smaller chamber, means to direct hydraulic pressure from said pump into said smaller chamber to exert a force against said smaller piston portion, means to connect said piston to said control member for moving said control member in opposition to said reference means, and means to direct said pump pressure into said larger chamber when said control member has reached the center position so as to exert pressure against said larger piston portion, said pressure against said larger piston portion tending to move said control member in said second direction.

9. In a fluid system having a reversible pump with positive and negative directions of flow and motor means for imposing a variable load on one side of said pump, a device for controlling the volume and direction of flow of fluid from said pump comprising; control means movable in a first direction from a center position to increase positive flow of fluid from said pump toward said motor and movable in a second direction from said center position to increase negative flow of fluid from said pump away from said motor, means to exert a constant force to move said control means in said first direction, said control means having two pressure surfaces each arranged to receive a pressure related to the fluid pressure between said pump and said motor, the resultant force exerted on said surfaces operating to move said control in opposition to said constant force, the force exerted on said second surface operative only after positive fluid flow has ceased.

10. A control device comprising; a servo control unit including a control member having a center position and movable in both directions from said center position, operating means connected to move said control member in both directions from said center position, means to exert a constant reference force to move said operating means in one direction away from said center position, said operating means including two pressure surfaces, means to maintain the first one of said surfaces in communication with a variable control pressure acting to move said operating means in opposition to said reference force, and means to connect the second one of said surfaces to said control pressure only after said operating means has moved said control member to the center position.

11. In combination with a hydraulic pressure system including a reversible flow hydraulic pump and a variable pressure load on said pump, a control device comprising; a control member movable in one range from a center position to effect positive fluid flow from said hydraulic pump and movable in a second range from said center position to effect negative fluid flow from said hydraulic pump, a reference means creating a force operating so as to move said member in a first direction, a piston operatively connected to said control member, the end portion of said piston having a smaller cross-sectional area and a second portion of said piston having a larger cross-sectional area, the piston having a retracted position where the control member effects positive flow of said pump, a neutral position where the flow of said pump is substantially zero, and an extended position where the pump flow is negative, a cylinder having a smaller and larger chamber to accommodate respectively the smaller and larger piston portions, a first port leading to said smaller chamber to so direct fluid under pressure from the pump against said smaller piston portion as to tend to move the piston in a direction to move the control member in an opposite direction, said port being open at all three positions of the piston, a by-pass leading from a second port in the larger chamber to a third port in the larger chamber, said larger piston portion being between said ports when the piston is in the retracted position, said second port leading to a low pressure reservoir, said second port being covered by said larger piston portion when said piston is in the extended position, and a passageway leading to the rear of said larger chamber portion to which said third port leads, said passageway directing fluid under pressure from said pump to said larger chamber only when said piston is in the neutral or extended position, said pressure tending to extend said piston.

12. The device as recited in claim 11, wherein said passageway leads from said smaller chamber to said larger chamber, said smaller portion of said cylinder exposing said passageway to the smaller chamber when the piston is in the extended position.

13. The device as recited in claim 12, wherein the reference force is supplied by a controlled hydraulic pressure so exerted against a piston which is operatively connected to said control member as to tend to move said control member in said first direction.

14. In combination with a hydraulic pressure system including a reversible flow hydraulic pump and a variable pressure load on said pump, a control device comprising; a control member movable in one range from a center position to effect positive fluid flow from said hydraulic pump and movable in a second range from said center position to effect negative fluid flow from said hydraulic pump, a reference means creating a force operating so as to move said member in a first direction, a piston having a lower portion of smaller cross-sectional area and an upper portion of larger cross-sectional area, a cylinder having a lower and upper portion to accommodate respectively the lower and upper piston portions, said piston having a lower end limit of travel, a port directing fluid under pressure from the pump into the smaller chamber even when said piston is at the lower limit of travel, a by-pass leading from a lower port in said larger chamber to a higher port, said higher port becoming covered by said larger piston portion when said control member reaches a position where the fluid flow of said pump is zero, and a passageway leading from said smaller chamber to said larger chamber, said passageways small chamber port being uncovered by said smaller piston portion as said upper port of the larger chamber becomes closed, so as to direct hydraulic pressure from said pump to said larger chamber so as to exert a pressure on said piston to move said control member in an opposite direction.

15. The device as recited in claim 14, wherein there is a constant volume pump, the pressure produced by said pump being controlled by a relief valve, said pressure being directed against a reference piston which tends to move said control member in said first direction.

16. The device as recited in claim 15, wherein a valve in one position directs the reference pressure against the

reference piston and the main pump pressure against the two-area piston, and in a second position exerts only reservoir pressure to said pistons.

17. In combination with a hydraulic pressure system including a variable volume, positive displacement, reversible flow hydraulic pump and a variable pressure load on said pump, a control device comprising; a control member movable in one range from a center position to effect positive fluid flow from said pump and movable in a second range from said center position to effect negative fluid flow from said pump, a reference means creating a force operating so as to move said member in a first direction, a piston operatively connected to said control member, the end portion of said piston having a smaller cross-sectional area and a second portion of said piston having a larger cross-sectional area, the piston having a retracted position where the control member effects positive flow of said pump, a neutral position where the flow of said pump is substantially zero, and an extended position where the pump flow is negative, a cylinder having a smaller and larger chamber to accommodate respectively the larger and smaller piston portions, a first port leading to said smaller chamber to so direct fluid under pressure from the pump against said smaller piston portion as to tend to move the piston in a direction to move the control member in an opposite direction, said port being open at all three positions of the piston, a by-pass leading from a second port in the larger chamber to a third port in the larger chamber, said larger piston portion being between said ports when the piston is in the retracted position, said second port leading to a low pressure reservoir, said second port being covered by said larger piston portion when said piston is in the extended position, and a passageway leading to said larger chamber portion to which said third port leads, said passageway directing fluid under pressure from said pump to said larger chamber only when said piston is in the neutral or extended position.

18. In combination with a hydraulic pressure system including a variable volume, positive displacement, reversible flow hydraulic pump and a variable pressure load on said pump, a control device comprising; a control member movable in one range from a center position to effect positive fluid flow from said pump and movable in a second range from said center position to effect negative fluid flow from said pump, a reference means creating a force operating so as to move said member in a first direction, a piston having a lower portion of small cross-sectional area and an upper portion of larger cross-sectional area, a cylinder having a lower and upper portion to accommodate respectively the lower and upper piston portions, said piston having a lower end limit of travel, a port directing fluid under pressure from the pump into the smaller chamber even when said piston is at the lower limit of travel, a by-pass leading from a lower port in said larger chamber to a higher port, said higher port becoming covered by said larger piston portion when said control member reaches a position where the fluid flow of said pump is zero, and a passageway leading from said smaller chamber to said larger chamber, said passageway small chamber port being uncovered by said smaller piston portion as said upper port of the larger chamber becomes closed so as to direct hydraulic pressure from said pump to said larger chamber so as to exert a pressure on said piston to move said control member in an opposite direction.

19. A device to control the tension on a hydraulic winch comprising; a hydraulic pump, a winch operating motor driven by said pump, a control means movable in one range from a center position to effect positive flow of fluid from said hydraulic pump, and movable in a second range from said center position to effect negative flow of fluid from said hydraulic pump, a reference means creating a force operating so as to move said control means in a first direction, said control means presenting two pressure surfaces each arranged to receive a pressure related to the hydraulic pressure of the fluid of said pump, the resultant force exerted on said pressure surfaces operating to move said control means in an opposite direction, the force exerted by the second of said surfaces becoming operative only after the positive flow of said pump has ceased.

20. A device to control the tension of a hydraulic winch comprising; a variable volume, positive displacement, reversible flow pump, a winch operating motor driven by said pump, a control member movable in one range from a center position to effect positive flow of fluid from said pump, and movable in a second range from said center position to effect negative flow of fluid from said pump, a reference means creating a force operating so as to move said member in a first direction, a piston operatively connected to said control member, the end portion of said piston having a smaller cross-sectional area and a second portion of said piston having a larger cross-sectional area, the piston having a retracted position where the control member effects positive flow of said pump, a neutral position where the flow of said pump is substantially zero, and an extended position where the pump flow is negative, a cylinder having a smaller and larger chamber to accommodate respectively the larger and smaller piston portions, a first port leading to said smaller chamber to so direct fluid under pressure from the pump against said smaller piston portion as to tend to move the piston in a direction to move the control member in an opposite direction, said port being open at all three positions of the piston, a by-pass leading from a second port in the larger chamber to a third port in the larger chamber, said larger piston portion being between said ports when the piston is in the retracted position, said second port leading to a low pressure reservoir, said second port being covered by said larger piston portion when said piston is in the extended position, and a passageway leading to said larger chamber portion to which said third port leads, said passageway directing fluid under pressure from said pump to said larger chamber only when said piston is in the neutral or extended position.

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LAURENCE V. EFNER, *Primary Examiner.*

JOSEPH H. BRANSON, JR., *Examiner.*