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(54) Hydraulic control circuit for self-propelled lift truck

Hydraulischer Steuerkreislauf für einen selbstbetriebenen Hubwagen

Circuit de commande hydraulique pour un chariot-élévateur auto-propulsé

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Description

This invention relates to self-propelled lift trucks of the kind which are powered by a hydrostatic transmission incorporating one or more wheel motors; and more particularly to a hydraulic control circuit for such a truck.

Lift trucks such as fork lift trucks which are powered by hydrostatic transmissions usually comprise a diesel or gas engine driving a hydraulic transmission pump which supplies hydraulic fluid under pressure to one or more wheel motors. The same engine is used to drive a second hydraulic pump which supplies pressure to hydraulic cylinders which control other functions of the truck, such as steering and lifting.

Hydrostatic transmissions effectively operate as stepless automatic transmissions, and can be controlled by the driver through a conventional speed control pedal with a direction lever for forward and reverse drive, or through a cross-linked twin foot pedal arrangement which provides proportional drive speed in forward or reverse direction in response to the depression of the respective pedal by the driver's right or left foot. This latter arrangement means that the truck does not need a separate direction lever, thus leaving the drivers' hands free to steer and operate other functions of the truck.

Since maximum drive speed of the hydrostatic transmission is achieved at full pump delivery, a mechanical or electrical linkage is provided between the pedal and a speed controller on the engine which increases engine speed proportional to pedal depression. A similar engine speed controller is needed to boost delivery of the second hydraulic pump to the lifting circuit which controls the operation of the lift cylinder or cylinders. Maximum hoist speed requires maximum output from the pump, and a mechanism is provided which automatically speeds up the engine to meet the hydraulic demand in the lifting circuit when full speed lift is called for. Since any speeding up of the engine will increase the outputs from both transmission and lifting pumps, a pressure control valve is provided in the transmission circuit operable to prevent any pressure increase in the transmission circuit during a full rate lifting operation.

Since lifting performance is a crucial factor in truck operation, the size of the hydraulic pump supplying the lifting and auxiliary circuits is usually determined by the need to obtain the highest possible lift speed available from the engine. This in turn determines the size and nature of the associated valves and controls which operate the lifting and auxiliary circuits.

Unlike the cylinder or cylinders dedicated to lifting a load, the cylinders controlling auxiliary services such as mast tilt and carriage side shift require relatively small levels of pressure and displacement to operate them, and do not need any substantial increase in engine speed and pump output when they are operated. However, since these cylinders share the same hydraulic pump as the lift cylinders, their controls and supply cir-

cuits are usually configured to match the same pump delivery characteristics; for example they must be capable of operating under conditions of full pump delivery. One consequence of this mis-matching of controls to requirements is that when these auxiliary cylinders are operated, their control circuits rapidly reach relief pressure, and if the auxiliary cylinders are operated at engine idle speed, the engine will often stall as soon as relief pressure is reached, since the engine is not powerful enough at low speed to maintain pump operation. On a truck with a conventional transmission, this problem is overcome by pressing the accelerator to increase engine revs whilst operating the auxiliary function, but this is not possible with a hydraulic transmission since if this is done, the truck would drive away. The supply circuits for the auxiliary functions thus have to be provided with similar mechanisms to those provided in the supply circuits to the lift cylinders, to provide an automatic increase in engine speed when these functions are operated to avoid stalling the engine at low revs. It may not be possible to overcome this by reducing the size of these valves and other components since for economic reasons it is usually desirable to use valves of the same size for controlling all functions of the truck under manual control.

A typical hydraulic arrangement of the kind known in the art and comprising a hydraulic pump supplying fluid to steering, lifting and auxiliary control circuits is described and illustrated in EP-A-251 290, which is thus similar to the circuit defined in claim 1 but comprises only one pump.

The present invention provides a hydraulic control circuit for a self-propelled lift truck which enables the various valves and controls to be more closely configured to the operating characteristics of the cylinders which they control; which permits the use of control valves of the same size; and which avoids the necessity for complicated and expensive mechanical and/or electrical interlocks operable to increase engine speed when an auxiliary function is operated. This provides a substantial cost saving, enables more precise control over the auxiliary functions, and generates less noise and heat from the engine, pumps and valves.

According to the present invention, there is provided a hydraulic control circuit for a self-propelled lift truck of the kind having a hydrostatic transmission operable to drive the truck through one or more wheel motors; at least one hydraulic lift cylinder for lifting and lowering a load; a hydraulic lift supply circuit connected to the lift cylinder; at least one auxiliary hydraulic cylinder for controlling an auxiliary function of the truck; an auxiliary hydraulic supply circuit connected to the auxiliary cylinder; hydraulic valve means operable to control fluid supply to the lift and auxiliary supply circuits; a first hydraulic pump operable to supply the hydrostatic transmission; a second hydraulic pump operable to supply the lift and auxiliary supply circuits via the valve means; and variable-speed drive means adapted to drive the

first and second hydraulic pumps; the circuit being characterised in that the lift supply circuit comprises at least two separate supply conduits supplying a chamber of the hydraulic lift cylinder (20), and the hydraulic valve means comprises separate hydraulic control valves each operable to control flow in a respective one of the supply conduits, and means are provided responsive to operation of the lifting cylinder to increase the speed of the drive means thereby to increase the output from the second hydraulic pump; and whereby the auxiliary hydraulic cylinder and its associated supply circuit are operable by the output from the second hydraulic pump substantially at the idle speed of the drive means.

By splitting the input to the lift supply circuit into at least two separate flows, the sizes of all the valves can be reduced, and the full pump flow supplied at maximum engine power is only required for lifting a load. Auxiliary functions are powered by reduced pump flow which is matched more accurately to the requirements of the circuit and the auxiliary cylinder or cylinders therein. This means that there is sufficient power to operate auxiliary functions at engine idle speed or slightly above (below drive engagement speed) without any danger of stalling the engine, thus saving on linkage, circuitry and operating costs.

Preferably, the lift supply circuit comprises two separate supply conduits and the hydraulic valve means comprises first and second hydraulic control valves each connected to a respective one of the supply conduits, and an auxiliary hydraulic control valve operable to direct fluid flow from the second hydraulic pump into the auxiliary supply circuit.

Preferably, the hydraulic control valves are spool valves disposed in a common housing and are operated manually, e.g. by means of a joystick control.

The second hydraulic pump is suitably operable to supply the first and second hydraulic control valves through first and second pump supply circuits. In the preferred embodiment, the pump comprises a two-chamber pump having first and second chambers, and the first and second pump supply circuits are connected respectively to the first and second pump chambers.

In one particular embodiment of the invention, the hydraulic control circuit further comprises a power steering hydraulic cylinder and a power steering hydraulic cylinder control circuit; and said first pump supply circuit is connected both to the power steering hydraulic cylinder control circuit and the first hydraulic control valve. In this arrangement, preferably the second pump supply circuit is connected both to the second hydraulic control valve and the auxiliary hydraulic control valve.

The auxiliary hydraulic cylinder may comprise, for example, a tilt cylinder or a side-shift cylinder, and more than one such auxiliary cylinder may be included. In one such arrangement, a second auxiliary hydraulic cylinder is served by a second auxiliary supply circuit, and the hydraulic valve means comprises a second auxiliary hydraulic control valve operable to direct fluid flow from

the second hydraulic pump into the second auxiliary supply circuit. In this construction the first and second auxiliary hydraulic control valves may share a common supply from the second hydraulic pump.

Suitably, linkage means interconnect the first and second hydraulic control valves and are connected to the speed controller of the drive means, e.g. by an electrical or mechanical connection. These linkage means also enable the first and second hydraulic control valves to be operated in sequence, thereby permitting finer control over the operation of the lift cylinder.

In order that the invention may be more fully understood, an embodiment in accordance therewith will now be described by way of example with reference to the accompanying drawing, which shows a hydraulic control circuit for a self-propelled lift truck.

Referring to the drawing, this shows a hydraulic control circuit for a masted fork lift truck fitted with a hydrostatic transmission. As will be described, the lift truck is of conventional design, having lift cylinders for raising and lowering a fork carriage along a mast, tilt cylinders for tilting the mast, a power steering cylinder, and hydraulic drive motors.

The main elements of the hydraulic circuit are a traction control circuit 10, and a load-handling and steering control circuit 12. Traction control circuit 10 is pressurised by hydraulic traction pump 13, while circuit 12 is supplied by hydraulic pump 15. Both pumps 13 and 15 are driven by the same drive means 16 which in this case comprises a diesel or gas engine. The circuits share a common supply and return tank 14.

The traction control circuit 10 is of generally conventional design. Traction pump 13, which comprises a primary pump 13a, a secondary pump 13b, and control system 13c, supplies hydraulic fluid under pressure to wheel motors 17, 18 as required by pedal control device 19. This consists of linked twin pedals 19a which operate pump control valve 40 to provide proportional drive speed in forward or reverse direction in response to depression of the pedals by the left or right foot of the driver. A servo connection 42 which in this case is electrical but which may be mechanical or hydraulic is provided between the pedal control device 19 and the speed control of engine 16 operable to speed up the engine when this is called for by depression of the pedals. A further servo connection 43, which in this case operates an electrical solenoid valve, is also provided for forward and reverse control valve 45 to enable forward or reverse drive to be selected.

Traction control circuit 10 is further provided with relief valves 48, 49 to prevent excess pressure due to overrun of the drive motors; hydraulic smoothing unit 50; and power brake cylinder 52. All these components are conventional and need not be described in further detail here.

Hydraulic circuit 12 is adapted to supply and control fluid flow to the operating functions of the truck, which in this case comprise a double-acting power steering cyl-

inder 34, a pair of lift cylinders 20, and a pair of auxiliary mast tilt cylinders 21. All these cylinders are supplied by hydraulic pump 15 which comprises twin chambers 30 and 31. Fluid supply from pump 15 to lift cylinders 20 and auxiliary cylinders 21 is controlled by a manually operated valve unit generally indicated at 80 which in this case incorporates three juxtaposed hydraulic spool valves 24, 25 and 27. A further valve 28 may be provided to operate an additional auxiliary function of the truck (such as a carriage side-shift cylinder) which is not illustrated in the drawing.

Fluid flow to power steering cylinder 34 is controlled by a conventional hand steer pump 70 connected to the steering column of the vehicle. Hand steer pump 70 is supplied by pump chamber 30 via flow divider 32 which incorporates diverter valve 72, and supply line 82. Diverter valve 72 is also operable to direct fluid through line 74 to valve unit 80. Valve unit 80 is also supplied by chamber 31 of pump 15 via line 62, as will be described.

Valve unit 80 is adapted to direct flow from hydraulic pump 15 into lifting cylinders supply circuit 68 through two separate supply conduits 83, 84. Conduit 83 is connected to spool valve 24 which receives fluid supply from chamber 30 of pump 15 via line 74. Conduit 84 receives fluid supply from spool valve 25 which is supplied by line 62 from pump chamber 31. Line 62 is also connected to valve 27 which supplies tilt cylinders 21 via line 86, and may also supply spool valve 28 if an additional auxiliary function is fitted to the truck.

Since pump chamber 30 supplies both steering cylinder 34 and lift cylinders 20, flow divider 32 is operable to divert fluid flow to steering cylinder 34 whenever steering power is required. When there is no steering demand, delivery from chamber 30 is automatically directed by valve 72 through line 74 to spool valve 24.

Spool valves 24 and 25 supplying conduits 83 and 84 of lifting cylinder supply circuit 68 are mechanically connected by linkage 26 to provide simultaneous control over fluid supply to cylinders 20. Linkage 26 is also connected to the speed control of engine 16 by connection 76 and operates to speed up engine 16 so as to increase delivery of pump 15 when required for a full rate lifting operation.

It will be appreciated that conventionally, pump 15 would be connected to lift cylinders 20 through a single circuit and a single spool valve. Since the tilt cylinders 21 share the same valve housing and the same circuitry, valves of similar configuration would normally be needed to control these functions. By splitting the supply to the cylinders 80 into two parts, and controlling the lift cylinders with two valves each handling only half the pump output, smaller valves and fittings can be used throughout valve unit 20 which are more closely matched to the output of the pump 15 at engine idle speed. This avoids the necessity of speeding up engine 16 during operation of the tilt cylinders 21 and any other auxiliary functions, thus saving on linkage, costs and fuel, and generating less noise and heat.

The use of twin pump chambers 30 and 31 to provide two separate outputs (and two separate supplies to valve unit 80) further enables the delivery of pump 15 to be matched to the operating requirements of the hydraulic cylinders it supplies. However, it will be appreciated that the pump 15 could be a single-chamber pump, and could supply valve unit 80 via a single supply line.

The use of two separate spool valves 24 and 25 for controlling lift cylinders 20 gives rise to the possibility of phased operation of these valves in order to achieve finer control over the lifting operation. This can be done by appropriate adjustment of the mechanical linkage 26.

Claims

1. A hydraulic control circuit for a self-propelled lift truck of the kind having a hydrostatic transmission operable to drive the truck through one or more wheel motors (17, 18), at least one hydraulic lift cylinder (20) for lifting and lowering a load, a hydraulic lift supply circuit (68) connected to said lift cylinder; at least one auxiliary hydraulic cylinder (21) for controlling an auxiliary function of the truck; an auxiliary hydraulic supply circuit (86) connected to said auxiliary cylinder; hydraulic valve means (24, 25, 27) operable to control fluid supply to said lift and auxiliary supply circuits; a first hydraulic pump (13) operable to supply said hydrostatic transmission; a second hydraulic pump (15) operable to supply said lift and auxiliary supply circuits via said valve means; and variable-speed drive means (16) adapted to drive said first and second hydraulic pumps; characterised in that said lift supply circuit (68) comprises at least two separate supply conduits (83, 84) supplying a chamber of the hydraulic lift cylinder, (20) and said hydraulic valve means comprise separate hydraulic control valves (24, 25) each operable to control flow in a respective one of said supply conduits, and means (16, 26, 76) are provided arranged, in response to operation of said lifting cylinder, to increase the speed of the drive means thereby to increase the output from said second hydraulic pump; and whereby said auxiliary hydraulic cylinder and its associated supply circuit are operable by the output from said second hydraulic pump substantially at idle speed of said drive means.
2. A hydraulic circuit as claimed in Claim 1, wherein said lift supply circuit (68) comprises two separate supply conduits (83, 84) and said hydraulic valve means comprises first and second hydraulic control valves (24, 25) each connected to a respective one of said supply conduits (83, 84), and an auxiliary hydraulic control valve (27) operable to direct fluid flow from said second hydraulic pump into said auxiliary supply circuit (86).

3. A hydraulic control circuit as claimed in Claim 2, wherein said second hydraulic pump (15) is operable to supply said first and second hydraulic control valves through first and second pump supply circuits (74, 62).

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4. A hydraulic control circuit as claimed in Claim 3, wherein said second hydraulic pump (15) comprises a two chamber-pump having first and second chambers (30, 31), and said first and second pump supply circuits (74, 62) are connected respectively to said first and second pump chambers.

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5. A hydraulic control circuit as claimed in Claim 4, further comprising a power steering hydraulic cylinder (34) and a power steering hydraulic cylinder control circuit (82); and said first pump supply circuit (74) is connected both to said power steering hydraulic cylinder control circuit and said first hydraulic control valve (24).

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6. A hydraulic control circuit as claimed in any one of Claims 3 to 5, wherein said second pump supply circuit is connected both to said second hydraulic control valve (25) and said auxiliary hydraulic control valve (27).

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7. A hydraulic control circuit as claimed in any of Claims 2 to 6, further comprising a second auxiliary hydraulic cylinder and a second auxiliary supply circuit, and wherein said hydraulic valve means comprises a second auxiliary hydraulic control valve (28) operable to direct fluid flow from said second hydraulic pump (15) into said second auxiliary supply circuit.

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8. A hydraulic control circuit as claimed in Claim 7, wherein said first and second auxiliary hydraulic control valves share a common supply (62) from said second hydraulic pump (15).

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9. A hydraulic control circuit as claimed in any one of Claims 2 to 8, further comprising linkage means (26) interconnecting said first and second hydraulic control valves (24, 25) and being connected to said means (76) operable to increase the speed of said drive means.

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10. A hydraulic control circuit as claimed in Claim 9, wherein said first and said second hydraulic control valves are operable in sequence.

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Patentansprüche

1. Hydraulische Steuerschaltung für einen selbstgetriebenen Hubwagen mit einem hydrostatischen Getriebe zum Antrieb des Wagens über einen oder mehrere Achsantriebsmotoren (17,18), wenig-

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stens einem hydraulischen Hubzylinder (20) zum Heben und Senken einer Last, einem mit dem Hubzylinder verbundenen hydraulischen Hubversorgungskreis (68); wenigstens einem hydraulischen Hilfszylinder (21) zum Steuern einer Hilfsfunktion des Wagens; einem hydraulischen Hilfsversorgungskreis (86), der mit dem Hilfszylinder verbunden ist; hydraulischen Ventileinrichtungen (24,25,27) zum Steuern der Fluidzuführung zum Hub- und Versorgungshilfskreis; einer ersten Hydraulikpumpe (13) zum Versorgen des hydrostatischen Getriebes; einer zweiten Hydraulikpumpe (15) zur Versorgung des Hub- und Versorgungshilfskreises über die Ventileinrichtungen; und einer Antriebseinrichtung (16) mit veränderlicher Drehzahl zum Antreiben der ersten und zweiten Hydraulikpumpe; dadurch gekennzeichnet, daß der Hubversorgungskreis (68) wenigstens zwei getrennte Versorgungsleitungen (83,84) zur Versorgung einer Kammer des hydraulischen Hubzylinders (20) aufweist und die hydraulischen Ventileinrichtungen getrennte hydraulische Steuerventile (24,25) jeweils zum Steuern der Strömung in je einer der Versorgungsleitungen aufweist und Einrichtungen (16,26, 76) vorgesehen sind, die auf den Betrieb des Hubzylinders ansprechen, um die Drehzahl der Antriebseinrichtung zu erhöhen und dadurch den Ausstoß aus der zweiten Hydraulikpumpe zu vergrößern, und daß der hydraulische Hilfszylinder und sein zugehöriger Versorgungskreis durch den Ausstoß aus der zweiten Hydraulikpumpe im wesentlichen bei Leerlaufdrehzahl der Antriebseinrichtung betätigbar ist.

2. Hydraulische Steuerschaltung nach Anspruch 1, bei welcher der Hubversorgungskreis (68) zwei getrennte Versorgungsleitungen (83,84) aufweist und die hydraulischen Ventileinrichtungen ein erstes und zweites hydraulisches Steuerventil (24,25) umfassen, deren jedes jeweils mit einer der Versorgungsleitungen (83,84) verbunden ist, sowie ein hydraulisches Hilfssteuerventil (27) zum Leiten einer Fluidströmung von der zweiten Hydraulikpumpe in den Hilfsversorgungskreis (86).

3. Hydraulische Steuerschaltung nach Anspruch 2, bei welcher die zweite Hydraulikpumpe (15) betätigbar ist, um das erste und zweite hydraulische Steuerventil über den ersten und zweiten Pumpenversorgungskreis (74,62) zu versorgen.

4. Hydraulische Steuerschaltung nach Anspruch 3, bei welcher die zweite Hydraulikpumpe (15) aus einer Zweikammerpumpe mit einer ersten und zweiten Kammer (30,31) besteht, und der erste und zweite Pumpenversorgungskreis (74,62) jeweils mit der ersten und zweiten Pumpenkammer verbunden ist.

5. Hydraulische Steuerschaltung nach Anspruch 4, mit einem Leistungssteuer-Hydraulikzylinder (34) und einem Leistungssteuer-Hydraulikzylinder-Steuerkreis (82), wobei der erste Pumpenversorgungskreis (74) sowohl mit dem Leistungssteuer-Hydraulikzylinder-Steuerkreis als auch ersten hydraulischen Steuerventil (24) verbunden ist. 5
6. Hydraulische Steuerschaltung nach einem der Ansprüche 3 bis 5, bei welcher die zweite Pumpenversorgungsleitung sowohl mit dem zweiten hydraulischen Steuerventil (25) als auch mit dem hydraulischen Hilfssteuerventil (27) verbunden ist. 10
7. Hydraulische Steuerschaltung nach einem der Ansprüche 2 bis 6, mit einem zweiten hydraulischen Hilfszylinder und einem zweiten Hilfsversorgungskreis, wobei die hydraulischen Ventileinrichtungen ein zweites hydraulisches Hilfssteuerventil (28) zum Leiten einer Fluidströmung von der zweiten Hydraulikpumpe (15) in den zweiten Hilfsversorgungskreis aufweisen. 15 20
8. Hydraulische Steuerschaltung nach Anspruch 7, bei welcher das erste und zweite hydraulische Hilfssteuerventil gemeinsam an eine Versorgungsleitung (62) aus der zweiten Hydraulikpumpe (15) angeschlossen sind. 25
9. Hydraulische Steuerschaltung nach einem der Ansprüche 2 bis 8, mit einer Verknüpfungseinrichtung (26), welche das erste und zweite hydraulische Steuerventil (24,25) verbindet und mit der Einrichtung (76) zur Erhöhung der Drehzahl der Antriebseinrichtung verbunden ist. 30 35
10. Hydraulische Steuerschaltung nach Anspruch 9, bei welcher das erste und zweite hydraulische Steuerventil nacheinander betätigbar sind. 40

Revendications

1. Circuit de commande hydraulique pour chariot élévateur autopropulsé du type comportant une transmission hydrostatique adaptée à entraîner le chariot via un ou plusieurs moteurs de roues (17, 18), au moins un cylindre de levage hydraulique (20) pour lever et abaisser une charge, un circuit d'alimentation de levage hydraulique (68) relié audit cylindre de levage ; au moins un cylindre hydraulique auxiliaire (21) pour commander une fonction auxiliaire du chariot ; un circuit d'alimentation hydraulique auxiliaire (86) relié audit cylindre auxiliaire ; un moyen de soupape hydraulique (24, 25, 27) adapté à commander l'alimentation en fluide desdits circuits d'alimentation de levage et auxiliaire ; une première pompe hydraulique (13) adaptée à alimenter ladite transmission hydrostatique ; 45 50 55

une deuxième pompe hydraulique (15) adaptée à alimenter lesdits circuits d'alimentation de levage et auxiliaire via ledit moyen de soupape ; et un moyen d'entraînement à vitesse variable (16) adapté à entraîner lesdites première et deuxième pompes hydrauliques ; caractérisé en ce que ledit circuit d'alimentation de levage (68) comprend au moins deux conduits d'alimentation distincts (83, 84) alimentant une chambre du cylindre de levage hydraulique (20) et ledit moyen de soupape hydraulique comprend des soupapes de commande hydraulique distinctes (24, 25) adaptées chacune à commander l'écoulement dans un desdits conduits d'alimentation respectifs, et des moyens (16, 26, 76) sont adaptés, en réponse à l'actionnement dudit cylindre de levage, à augmenter la vitesse du moyen d'entraînement de manière à accroître la sortie depuis ladite deuxième pompe hydraulique ; et de manière que ledit cylindre hydraulique auxiliaire et son circuit d'alimentation associé soient actionnés par la sortie depuis ladite deuxième pompe hydraulique avec ledit moyen d'entraînement pratiquement au ralenti.

2. Circuit de commande hydraulique selon la revendication 1, dans lequel ledit circuit d'alimentation de levage (68) comprend deux conduits d'alimentation distincts (83, 84) et ledit moyen de soupape hydraulique comprend des première et deuxième soupapes de commande hydraulique (24, 25) reliées chacune à un desdits conduits d'alimentation respectifs (83, 84), et une soupape de commande hydraulique auxiliaire (27) adaptée à diriger l'écoulement de fluide de ladite deuxième pompe hydraulique audit circuit d'alimentation auxiliaire (86).
3. Circuit de commande hydraulique selon la revendication 2, dans lequel ladite deuxième pompe hydraulique (15) est adaptée à alimenter lesdites première et deuxième soupapes de commande hydraulique via des premier et deuxième circuits d'alimentation de pompe (74, 62).
4. Circuit de commande hydraulique selon la revendication 3, dans lequel ladite deuxième pompe hydraulique (15) comprend une pompe à deux chambres comportant des première et deuxième chambres (30, 31), et lesdits premier et deuxième circuits d'alimentation de pompe (74, 62) sont reliés respectivement auxdites première et deuxième chambres de pompe.
5. Circuit de commande hydraulique selon la revendication 4, comprenant en outre un cylindre hydraulique de conduite assistée (34) et un circuit de commande de cylindre hydraulique de conduite assistée (82); et ledit premier circuit d'alimentation de pompe (74) est relié à la fois audit circuit de

commande de cylindre hydraulique de conduite assistée et à ladite première soupape de commande hydraulique (24).

6. Circuit de commande hydraulique selon l'une quelconque des revendications 3 à 5, dans lequel ledit deuxième circuit d'alimentation de pompe est relié à la fois à ladite deuxième soupape de commande hydraulique (25) et à ladite soupape de commande hydraulique auxiliaire (27). 5 10
7. Circuit de commande hydraulique selon l'une quelconque des revendications 2 à 6, comprenant en outre un deuxième cylindre hydraulique auxiliaire et un deuxième circuit d'alimentation auxiliaire, et dans lequel ledit moyen de soupape hydraulique comprend une deuxième soupape de commande hydraulique auxiliaire (28) adaptée à diriger l'écoulement de fluide de ladite deuxième pompe hydraulique (15) audit deuxième circuit d'alimentation auxiliaire. 15 20
8. Circuit de commande hydraulique selon la revendication 7, dans lequel lesdites première et deuxième soupapes de commande hydraulique auxiliaires partagent un conduit d'alimentation (62) depuis ladite deuxième pompe hydraulique (15). 25
9. Circuit de commande hydraulique selon l'une quelconque des revendications 2 à 8, comprenant en outre un moyen d'embellage (26) reliant lesdites première et deuxième soupapes de commande hydraulique (24, 25) et étant relié audit moyen (76) adapté à augmenter la vitesse dudit moyen d'entraînement. 30 35
10. Circuit de commande hydraulique selon la revendication 9, dans lequel lesdites première et deuxième soupapes de commande hydraulique sont adaptées à être actionnées en séquence. 40

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