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(54) **PRESSURE OIL FEED CIRCUIT DEVICE FOR HYDRAULIC CYLINDER OF OPERATION MACHINE**

ZUFUHRSCHALTUNGSVORRICHTUNG FÜR ÖL UNTER DRUCK ZUM HYDRAULISCHEM KOLBEN EINER BAUSTELLENVORRICHTUNG

DISPOSITIF DE CIRCUIT D'ALIMENTATION EN HUILE SOUS PRESSION POUR LE VERIN HYDRAULIQUE D'UN ENGIN DE CHANTIER

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(56) References cited:
DE-A- 3 713 824
JP-A- 5 969 505
US-A- 4 487 018

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Description

TECHNICAL FIELD OF THE INVENTION

This invention relates to a hydraulic circuit apparatus for supplying fluid under pressure discharged by a hydraulic pump into hydraulic cylinders for actuating a work implement of a construction vehicle such as a power shovel or the like.

BACKGROUND ART OF THE INVENTION

A hydraulic circuit apparatus arranged so as to supply fluid under pressure discharged by a hydraulic pump into hydraulic cylinders for a work implement through operating valves is heretofore well known.

In case of conducting earth scraping-off operation and slope correcting operation by a power shovel, it is necessary to perform inching operation of the work implement of the power shovel. This inching operation of the work implement is achieved by supplying extremely small amounts of fluid under pressure discharged by a hydraulic pump into hydraulic cylinders for the work implement.

However, it is quite difficult to control finely the amount of fluid under pressure to be supplied into the hydraulic cylinders for the work implement and it is also quite difficult to inch the work implement as desired. As a result the operational accuracy in earth scapping-off operation and slope correcting operation becomes low.

One solution to overcome the problems involved in inching operation is given in EP-A-0 349 092, which application was published after the priority date of the present application.

In EP-A-0 349 092 a hydraulic drive system is disclosed which may be operated in a normal mode and in a fine operation mode. In the normal mode the discharge rate of a hydraulic pump is controlled to hold a differential pressure between a discharged pressure of the hydraulic pump and a load pressure of an actuator at a setting value. In the fine operation mode the flow rate supplied to the actuator at the same stroke of a control lever as that in the ordinary work is reduced to facilitate operation of the actuator at a finely adjusted speed for permitting fine operation with ease. According to one embodiment of EP-A-0 349 092 an instruction unit is only operated when the fine operation mode should be obtained. The instruction unit is connected to a controller which operates a control force supplying device so arranged to apply a control force of a plunger to one end of a control valve. The control valve is a part of the load-sensing control device and further comprises a drive part on the same side as the plunger and another drive part and spring on the side opposite to the plunger.

The control valve is used to connect a large-diameter pressure receiving portion of a regulator with a tank, with a discharge line of the pump or to connect this portion with both the tank and the discharge line at a ratio corresponding to the position of the control valve.

Further, the regulator comprises a small-diameter pressure receiving portion connected to the discharge line of the pump. The regulator is used for changing a swash plate of the pump and to thereby control the discharge rate of the pump and to hold the differential pressure at a setting value.

SUMMARY OF THE INVENTION

The present invention has for its object to provide a hydraulic circuit apparatus for supplying fluid under pressure into hydraulic cylinders for a work implement whereby stable operation of the working implement is also ensured during inching operation whereby the number of parts of the apparatus is decreased and the costs of manufacturing the apparatus is reduced.

To achieve the above-mentioned object a hydraulic circuit apparatus according to claims 1 or 3 is provided.

Further features for advantageous embodiments of the invention are disclosed by the subclaims.

According to the present invention incorporating the above-mentioned aspects, since the flow rate of fluid discharged by the variable displacement pump is controlled in such a manner that the difference between the discharge pressure of the pump and the load pressure is always kept constant, a stable operation of the work implement is ensured, and also during inching operation of the work implement the displacement regulating member of the variable displacement member of the variable displacement pump can be actuated in such a direction as to reduce the displacement of the pump by applying pushing forces to the load sensing valve so as to push its spool in such a direction as to communicate the discharge passage of the pump with the pressure receiving chamber of the large diameter piston. Accordingly, since during inching operation of the work implement the flow rate of fluid discharged by the variable displacement pump can be reduced, the amount of fluid under pressure to be supplied into the hydraulic cylinders for the work implement can be controlled finely to an extremely small amount so that the inching operational characteristic can be enhanced.

The above-mentioned and other objects, aspects and advantages of the present invention will become apparent to those skilled in the art when reference is made to the following description and the accompanying drawings in which preferred embodiments incorporating the principles of the present invention are shown by way of example only.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a hydraulic circuit diagram showing a first embodiment of the present invention;

Fig. 2 is a graph showing the relationship between the flow rate of fluid under pressure supplied into hydraulic cylinders for a work implement and the

stroke of an operating valve associated therewith; and

Fig. 3 is a hydraulic circuit diagram showing a second embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention will now be described in detail below by way of several preferred embodiments thereof with reference to the accompanying drawings.

Referring first to Figs. 1 and 2, the first embodiment of the present invention is described.

A variable displacement pump 2 driven by an engine 1 has a discharge passage 2a connected with inlets of a plurality of operating valves 3, whose outlet sides are connected by their respective conduits 4 with hydraulic cylinders 5 of work implements, respectively. Each conduit 4 is provided with a pressure compensating valve 6. The load pressures P_{LS} in the conduits 4 are compared by a shuttle valve 7, and a higher load pressure P_{LS} detected as a result of the comparison is introduced into spring chambers of the pressure compensating valves 6 so that the valves 6 may be set at a pressure corresponding to the higher load pressure P_{LS}.

By so doing, the fluid under pressure discharged by one variable displacement pump 2 can be supplied to the hydraulic cylinders 5 for work implement.

The displacement of fluid from the variable displacement pump 2 is controlled so that the difference between the discharge pressure P_1 and the load pressure P_{LS} is always kept constant.

Stating more specifically, a displacement regulating member 8 of the variable displacement pump 2 is actuated by a large piston 9 in such a direction as to reduce the displacement, and by a small piston 10 in such a direction as to increase the displacement. Further, a pressure receiving chamber 9a of the large piston 9 is controlled to be selectively connected through a load sensing valve 11 either with a fluid tank or with the discharge passage 2a, and a pressure receiving chamber 10a of the small piston 10 is connected with the discharge passage 2a.

The above-mentioned load sensing valve 11 has a spool arranged to be pushed by the pressure in the discharge passage 2a; that is, the discharge pressure P_1 and the thrust created by a proportional position action electromagnetic solenoid 12 in such a direction as to incresed the area of its port communicating with the pressure receiving chamber 9a of the large piston 9, and also pushed by the outlet pressure in the operating valves 3; that is, the load pressure P_{LS} in such a direction as to reduce the area of the port thereof communicating with the pressure receiving chamber 9a. This load sensing valve 11 is arranged to effect control such that where the thrust created by the proportional position action electromagnetic solenoid 12 is zero, and when the difference between the discharge pressure P_1 and the load pressure P_{LS} (P_1 - P_{LS}) is increased, the pressure in the pressure receiving chamber 9a of the large piston 9 is increased so as to actuate the displacement regulating member 8 in such a direction as to reduce the displacement to thereby reduce the discharge flow rate per one revolution to reduce the discharge pressure P_1. Whilst, where the thrust created by the solenoid 12 is zero, and when the difference between the discharge pressure P_1 and the load pressure P_{LS} (P_1 - P_{LS}) is reduced, the pressure in the pressure receiving chamber 9a of the large piston 9 is reduced so as to actuate the displacement regulating member 8 in such a direction as to increase the displacement to thereby increase the discharge flow rate per one revolution to incresae the discharge pressure P_1, whereby controlling the displacement of fluid from the variable displacement pump 2 so that the difference between the discharge pressure P_1 and the load pressure P_{LS} (P_1 - P_{LS}) may always be kept constant. Further, when a thrust is created by the proportion position action electromagnetic solenoid 12, the spool of the load sensing valve 11 is pushed in such a direction as to increase the area of the port thereof communicating with the pressure receiving chamber 9a so as to increase the pressure in the chamber 9a of the large piston 9 regardless of the pressure between the discharge pressure P_1 and the load pressure P_{LS} to move the displacement regulating member 8 in a direction to reduce the displacement, thereby reducing the flow rate of fluid per one revolution.

Stating in brief, the pressure difference between the discharge pressure P_1 and the load pressure P_{LS} is reduced by the thrust created by the proportional position action solenoid 12 so as to reduce the discharge flow rate of fluid from the variable displacement pump 12.

The above-mentioned proportional position action electromagnetic solenoid 12 is supplied with electric current from a controller 13, to which a mode signal from a mode change-over switch 14 is inputted. When a normal mode signal is inputted by the mode change-over switch 14 to the controller 13, the proportional position action electromagnetic solenoid 12 is not supplied with electric current, whilst when an inching operation mode signal is inputted by the mode change-over switch 14 to the controller 13, the electromagnetic solenoid 12 is supplied with electric current.

Such being the arrangement, during inching of the work implement, the flow rate of fluid discharged by the variable displacement pump 2 becomes less than that in the normal operation, so that the flow rate of fluid to be supplied into the hydraulic cylinders 5 for work implement changes in proportion to the stroke of the operating valves 3 as shown by a dotted line "A" in Fig. 2 and becomes less than the flow rate of fluid in the normal operation as shown by a solid line B in Fig. 2, thus rendering it possible to effect fine control of the amount of fluid supplied into the hydraulic cylinders 5 for the work implement to improve the inching operation characteristic.

Fig. 3 shows the second embodiment of the present invention. In this embodiment, a pilot pump 15 is driven by an engine 1, and a discharge passage 15a of the pump 15 is connected through a change-over valve 16 with a pressure receiving section 11a of a load sensing valve 11. The change-over valve 16 is arranged to be kept at its shut-off position I by the resilient force of a spring mounted therein, and also kept at its communicating position II when its solenoid 16 is energized. The solenoid 16 is supplied with electric current from a power supply through a mode change-over switch 14 and the controller 13.

Further, the component parts shown in Fig. 3 with the same reference numerals as those used in the first embodiment shown in Fig. 1 are the same component parts, and therefore description of them is omitted herein to avoid duplication of explanation.

In the second embodiment shown in Fig. 3, when a mode change-over switch 14 is located at its inching operation mode position so as to input an inching operation mode signal from the switch 14 to a controller 13 and send an electric current to a solenoid 16a, thereby energizing the same, a change-over valve 16 is changed over to its communicating position II so that the pilot fluid under pressure from a pilot pump 15 is supplied into a pressure receiving section 11a of a load sensing valve 11, and as a result, its spool is pushed in such a direction as to increase the area of the port thereof communicating with pressure receiving chamber 9a of a large piston 9, thereby reducing the amount of fluid discharged by a variable displacement pump 2.

Claims

1. A hydraulic circuit apparatus for supplying fluid under pressure into a plurality of hydraulic cylinders (5) for a work implement arranged so as to connect a discharge passage (2a) of a variable displacement pump (2) through operating valves (3) with the cylinders for the work implement, said apparatus comprising:

   a large diameter piston (9) for actuating a displacement regulating member (8) of said variable displacement pump (2) in such a direction as to reduce the displacement of the pump;

   a small diameter piston (10) having a pressure receiving chamber (10a) connected with said discharge passage (2a) of the pump and adapted to actuate the displacement regulating member (8) of said pump in such a direction as to increase the displacement of the pump (2);

   a load sensing valve (11) adapted to connect or disconnect a pressure receiving chamber (9a) of said large diameter piston (9) with or from the discharge passage (2a) of said pump (2);

   means (12, 13, 14) for applying pushing forces to the load sensing valve (11) so as to push its spool in such a direction as to communicate the discharge passage (2a) of said pump (2) with the pressure receiving chamber (9a) of said large diameter piston (9);

   pressure compensating valves (6) interposed between said hydraulic cylinders (5) for a work implement and said operating valves (3); and

   a shuttle valve (7) for comparing load pressures (P_{LS}) in the output conduits (4) of said pressure compensating valves (6) to introduce a higher load pressure into a pressure receiving section provided on one side of said load sensing valve (11),

   wherein during normal operation of the work implement the flow rate of fluid discharged by the pump (2) is controlled in such a manner that the difference between the discharge pressure (P_1) of the pump (2) and the load pressure (P_{LS}) is always kept constant, whilst during inching operation of the work implement the flow rate of the fluid discharged by the pump (2) is reduced.

2. A hydraulic circuit apparatus according to claim 1, **characterized in that** said pushing force applying means (12, 13, 14) comprises:

   a proportional position action electromagnetic solenoid (12) provided on one side of said load sensing valve (11) ;

   a mode change-over switch (14) for the electromagnetic solenoid (12); and

   a controller (13) adapted to receive an inching operation mode signal transmitted by the mode change-over switch (14) and to send an electric current to said electromagnetic solenoid (12).

3. A hydraulic circuit apparatus for supplying fluid under pressure into a plurality of hydraulic cylinders (5) for a work implement arranged so as to connect a discharge passage (2a) of a variable displacement pump (2) through operating valves (3) with the cylinders (5) for the work implement, said apparatus comprising:

   a large diameter piston (9) for actuating a displacement regulating member (8) of said variable displacement pump (2) in such a direction as to reduce the displacement of the pump;

a small diameter piston (10) having a pressure receiving chamber (10a) connected with said discharge passage (2a) of the pump (2) and adapted to actuate the displacement regulating member (8) of said pump in such a direction as to increase the displacement of the pump;

a load sensing valve (11) adapted to connect or disconnect a pressure receiving chamber (9a) of said large diameter piston (9) with or from the discharge passage (2a) of said pump (2); and

a means (13, 14, 15, 16, 16a) for applying pushing forces to the load sensing valve (11) so as to push its spool in such a direction as to communicate the discharge passage (2a) of said pump (2) with the pressure receiving chamber (9a) of said large diameter piston (9),

wherein during normal operation of the work implement a flow rate of fluid discharged by the pump (2) is controlled in such a manner that the difference between the discharge pressure (P1) of the pump (2) and load pressure (P_{LS}) is always kept constant, whilst during inching operation of the work implement the flow rate of fluid discharged by the pump (2) is reduced; and

said pushing force applying means (13, 14, 15, 16, 16a) comprises:

a pilot pump (15);

a conduit (15a) for introducing pilot fluid under pressure discharged by the pilot pump (15) into a pressure receiving section (lla) provided on one side of said load sensing valve (11);

a change-over valve (16) provided in the conduit (15a);

a proportional position action electromagnetic solenoid (16a) provided on one side of the change-over valve (16);

a mode change-over switch (14) for the electromagnetic solenoid (16a), and

a controller (13) adapted to receive an inching operation mode signal transmitted by the mode change-over switch (14) and to send an electric current to said electromagnetic solenoid (16a).

4. Hydraulic circuit apparatus according to claim 3, **characterized in that** pressure compensating valves (6) are interposed between said hydraulic cylinders (5) for a work implement and said operating valves (3) and a shuttle valve (7) is provided for comparing load pressures in the output conduits (4) of said pressure compensating valves (6) to introduce a higher load pressure into a pressure receiving section provided on one side of said load sensing valve (11).

Patentansprüche

1. Hydraulisches Schaltungsgerät zum Zuführen von Fluid unter Druck zu einer Vielzahl von Hydraulikzylindern (5) für ein Arbeitsgerät, wobei eine Abgabepassage (2a) einer variablen Verstellpumpe (2) durch Betätigungsventile (3) mit Zylindern für das Arbeitsgerät verbunden ist, wobei das hydraulische Schaltungsgerät aufweist:

einen Kolben (9) mit großem Durchmesser zum Betätigen eines Verstellregulierteils (8) der variablen Verstellpumpe (2) in einer solchen Richtung, um die Verstellung der Pumpe zu vermindern;

einen Kolben (10) mit kleinem Durchmesser mit einer Druckaufnahmekammer (l0a), die mit der Abgabepassage (2a) der Pumpe verbunden ist und das Verstellregulierteil (8) der Pumpe in einer solchen Richtung betätigt, um die Verstellung der Pumpe (2) zu vergrößern;

ein Ladungserfassungsventil (11) zum Verbinden oder Trennen einer Druckempfangskammer (9a) des Kolbens (9) mit großem Durchmesser mit oder von der Abgabepassage (2a) der Pumpe (2);

einer Einrichtung (12, 13, 14) zum Aufbringen von Verschiebekräften auf das Ladungserfassungsventil (11), um dessen Spindel in einer solchen Richtung zu verschieben, in der die Abgabepassage (2a) der Pumpe (2) mit der Druckaufnahmekammer (9a) des Kolbens (9) mit großem Durchmesser in Verbindung steht;

Druckkompensationsventile (6), welche zwischen den Hydraulikzylindern (5) für das Arbeitsgerät und Betätigungsventilen (3) angeordnet sind; und

ein Wechselventil (7) zum Vergleichen von Ladungsdrücken (P_{LS}) in Ausgabeleitungen (4) der Druckkompensationsventile (6) zum Einführen eines höheren Ladungsdruckes in einem Druckaufnahmebereich auf einer Seite des Ladungserfassungsventils (11), wobei während einer Normalbetätigung des Arbeits-

gerätes die Flußrate des von der Pumpe (2) abgegebenen Fluids in einer solchen Weise gesteuert ist, daß die Differenz zwischen dem Abgabedruck (P_1) der Pumpe (2) und dem Ladungsdruck (P_{LS}) immer konstant bleibt, während bei Tippbetrieb des Arbeitsgerätes die Flußrate des von der Pumpe (2) abgegebenen Fluids vermindert ist.

2. Hydraulisches Schaltungsgerät nach Anspruch 1, **dadurch gekennzeichnet**,
daß die Einrichtungen (12, 13, 14) zum Ausüben von Schiebekräften aufweist:

einen Elektromagneten (12) für proportional Stellungsaktionen, der auf einer Seite des Ladungserfassungsventils (11) angeordnet ist;

einen Moduswechselschalter (14) für den Elektromagneten (12); und

ein Steuergerät (13) zum Empfang eines Modussignales für Tippbetrieb, welches durch den Moduswechselschalter (14) übertragbar ist, und zum Senden eines elektrischen Stroms zu dem Elektromagneten (12).

3. Hydraulisches Schaltungsgerät zum Zuführen von unter Druck stehendem Fluid zu einer Vielzahl von Hydraulikzylindern (5) für ein Arbeitsgerät, um eine Abgabepassage (2a) einer variablen Verstellpumpe (2) durch Betätigungsventile (3) mit Zylindern (5) für das Arbeitsgerät zu verbinden, wobei das Gerät aufweist:

einen Kolben (9) mit großem Durchmesser zum Betätigen eines Verstellregulierteils (8) der variablen Verstellpumpe (2) in einer solchen Richtung, in der die Verstellung der Pumpe reduzierbar ist;

einen Kolben (10) mit kleinem Durchmesser mit einer Druckaufnahmekammer (IIa), die mit der Abgabepassage (2a) der Pumpe (2) verbunden ist und zur Betätigung des Verstellregulierteils (8) der Pumpe in einer solchen Richtung dient, in der die Verstellung der Pumpe zunimmt;

ein Ladungserfassungsventil (11) zum Verbinden oder Trennen einer Druckaufnahmekammer (9a) des Kolbens (9) mit großem Durchmesser mit oder von der Abgabepassage (2a) der Pumpe (2); und

eine Einrichtung (13, 14, 15, 16, 16a) zum Anlegen von Schiebekräften an dem Ladungserfassungsventil (11), um dessen Spindel in einer solchen Richtung zu verschieben, in der die Abgabepassagen (2a) der Pumpe (2) mit der Druckaufnahmekammer (9a) des Kolbens (9) mit großem Durchmesser in Verbindung steht, wobei während der Normalbetätigung des Arbeitsgerätes eine Flußrate des von der Pumpe (2) abgegebenen Fluids in einer solchen Weise gesteuert ist, daß der Unterschied zwischen dem Abgabedruck (P_1) der Pumpe (2) und dem Ladungsdruck (P_{LS}) immer konstant ist, während bei Tippbetätigung des Arbeitsgerätes die von der Pumpe (2) abgegebene Flußrate des Fluids vermindert ist, und wobei die Einrichtung (13, 14, 15, 16, 16a) zum Aufbringen der Schiebekraft eine Vorsteuerpumpe (15), eine Leitung (15a) zum Zuführen von durch die Vorsteuerpumpe (15) unter Druck abgegebenen Vorsteuerfluid zu einem Druckaufnahmebereich (IIa) auf einer Seite des Ladungserfassungsventils (11), ein Wechselventil (16) in der Leitung (15a), einen Elektromagneten (16a) zur proportionalen Positionierungsaktion auf einer Seite des Wechselventils (16), einen Moduswechselschalter (14) für den Elektromagneten (16a) und ein Steuergerät (13) aufweist, welches zum Empfang eines Signals für den Tippschaltungsmodus ausgebildet ist, welches Signal durch den Moduswechselschalter (14) übertragen wird, wobei das Steuergerät einen elektrischen Strom zu dem Elektromagneten (16a) übermittelt.

4. Hydraulisches Schaltungsgerät nach Anspruch 3, **dadurch gekennzeichnet**,
daß Druckkompensationsventile (6) zwischen den Hydraulikzylindern (5) für ein Arbeitsgerät und den Betätigungsventilen (3) angeordnet sind und ein Wechselventil (7) zum Vergleich von Ladungsdrükken in den Ausgabeleitungen (4) der Druckkompensationsventile (6) zum Einführen eines höheren Ladungsdrucks in einen Druckaufnahmebereich auf einer Seite des Ladungserfassungsventils (11) vorgesehen ist.

Revendications

1. Dispositif de circuit hydraulique qui permet d'envoyer un fluide sous pression dans plusieurs vérins hydrauliques (5) prévus pour un outillage de travail et qui est agencé de façon à relier le passage de refoulement (2a) d'une pompe à débit variable (2) aux vérins de l'outillage de travail par l'intermédiaire de valves de manoeuvre (3), le dispositif comprenant :

un piston (9) de grand diamètre servant à actionner l'organe de régulation de volume déplacé (8) de la pompe à débit variable (2) dans le

sens permettant de réduire le volume déplacé de la pompe,
un piston (10) de petit diamètre qui comporte une chambre de réception de pression (10a) reliée au passage de refoulement (2a) de la pompe et qui est agencé de façon à actionner l'organe de régulation de volume déplacé (8) de la pompe dans le sens permettant d'augmenter le volume déplacé de la pompe (2),
une valve de détection de charge (11) agencée de façon à relier une la chambre de réception de pression (9a) du piston (9) de grand diamètre au passage de refoulement (2a) de la pompe (2) ou à isoler cette chambre de ce passage,
des moyens (12, 13, 14) servant à appliquer une force de poussée à la valve de détection de charge (11) de manière à repousser son obturateur-tiroir dans le sens permettant de faire communiquer le passage de refoulement (2a) de la pompe (2) avec la chambre de réception de pression (9a) du piston (9) de grand diamètre,
des valves de compensation de pression (6) interposées entre les vérins hydrauliques (5) de l'outillage de travail et les valves de manoeuvre (3) et
une valve (7) à deux voies servant à comparer les pressions de charge (P_{LS}) régnant dans les conduites de sortie (4) des valves de compensation de pression (6), en vue d'introduire la pression de charge la plus grande dans la section de réception de pression prévue sur un premier côté de la valve de détection de charge (11),
de sorte que, pendant une manoeuvre normale de l'outillage de travail, le débit de fluide refoulé par la pompe (2) est réglé d'une manière telle que la différence entre la pression de refoulement (P_1) de la pompe (2) et la pression de charge (P_{LS}) est maintenue constante en permanence, tandis que, pendant une manoeuvre pouce par pouce de l'outillage de travail, le débit de fluide refoulé par la pompe (2) est réduit.

2. Dispositif de circuit hydraulique selon la revendication 1, caractérisé en ce que les moyens d'application de force de poussée (12, 13, 14) comprennent :

un électro-aimant (12) à action de position proportionnelle qui est prévu sur un premier côté de la valve de détection de charge (11),
un commutateur de changement de mode (14) prévu pour l'électro-aimant (12) et
un dispositif de commande (13) agencé de façon à recevoir un signal de mode de manoeuvre pouce par pouce transmis par le commutateur de changement de mode (14) et à envoyer un courant électrique à l'électro-aimant (12).

3. Dispositif de circuit hydraulique qui permet d'envoyer un fluide sous pression dans plusieurs vérins hydrauliques (5) prévus pour un outillage de travail et qui est agencé de façon à relier le passage de refoulement (2a) d'une pompe à débit variable (2) aux vérins (5) de l'outillage de travail par l'intermédiaire de valves de manoeuvre (3), le dispositif comprenant :

un piston (9) de grand diamètre servant à actionner l'organe de régulation de volume déplacé (8) de la pompe à débit variable (2) dans le sens permettant de réduire le volume déplacé de la pompe,
un piston (10) de petit diamètre qui comporte une chambre de réception de pression (10a) reliée au passage de refoulement (2a) de la pompe (2) et qui est agencé de façon à actionner l'organe de régulation de volume déplacé (8) de la pompe dans le sens permettant d'augmenter le volume déplacé de la pompe,
une valve de détection de charge (11) agencée de façon à relier une la chambre de réception de pression (9a) du piston (9) de grand diamètre au passage de refoulement (2a) de la pompe (2) ou à isoler cette chambre de ce passage et
des moyens (13, 14, 15, 16, 16a) servant à appliquer une force de poussée à la valve de détection de charge (11) de manière à repousser son obturateur-tiroir dans le sens permettant de faire communiquer le passage de refoulement (2a) de la pompe (2) avec la chambre de réception de pression (9a) du piston (9) de grand diamètre,
de sorte que, pendant une manoeuvre normale de l'outillage de travail, le débit de fluide refoulé par la pompe (2) est réglé d'une manière telle que la différence entre la pression de refoulement (P_1) de la pompe (2) et la pression de charge (P_{LS}) est maintenue constante en permanence, tandis que, pendant une manoeuvre pouce par pouce de l'outillage de travail, le débit de fluide refoulé par la pompe (2) est réduit et

lesdits moyens d'application de force de poussée (13, 14, 15, 16, 16a) comprennent :

une pompe pilote (15),
une conduite (15a) servant à introduire un fluide de pilote sous pression, refoulé par la pompe pilote (15), dans une section de réception de pression (lla) prévue sur un premier côté de la valve de détection de charge (11),
une valve de commutation (16) prévue dans la conduite (15a),
un électro-aimant (16a) à action de position

proportionnelle qui est prévu sur un premier côté de la valve de commutation (16),
un commutateur de changement de mode (14) prévu pour l'électro-aimant (16a) et
un dispositif de commande (13) agencé de façon à recevoir un signal de mode de manoeuvre pouce par pouce transmis par le commutateur de changement de mode (14) et à envoyer un courant électrique à l'électro-aimant (16a).

4. Dispositif de circuit hydraulique selon la revendication 3, caractérisé en ce que des valves de compensation de pression (6) sont interposées entre les vérins hydrauliques (5) de l'outillage de travail et les valves de manoeuvre (3) et en ce qu'une valve (7) à deux voies est prévue pour comparer les pressions de charge régnant dans les conduites de sortie (4) des valves de compensation de pression (6), en vue d'introduire la pression de charge la plus grande dans la section de réception de pression prévue sur un côté de la valve de détection de charge (11).

FIG. 1

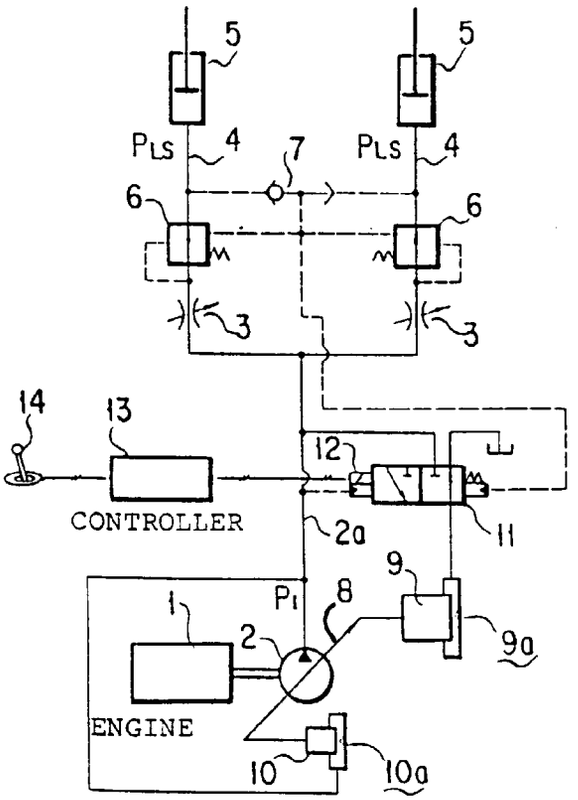

5
5
PLS
4
7
PLS
4
6
6
3
3
14
13
12
CONTROLLER
2a
11
9
P1
8
1
2
9a
ENGINE
10
10a

FIG. 2

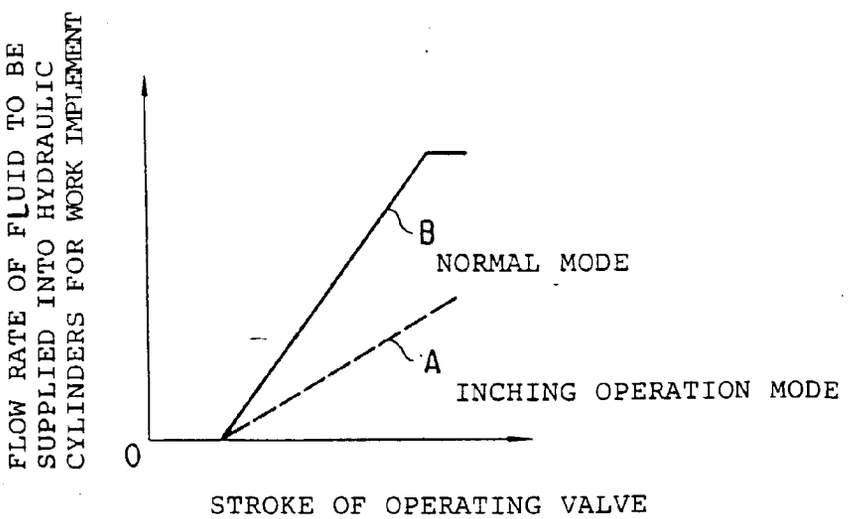
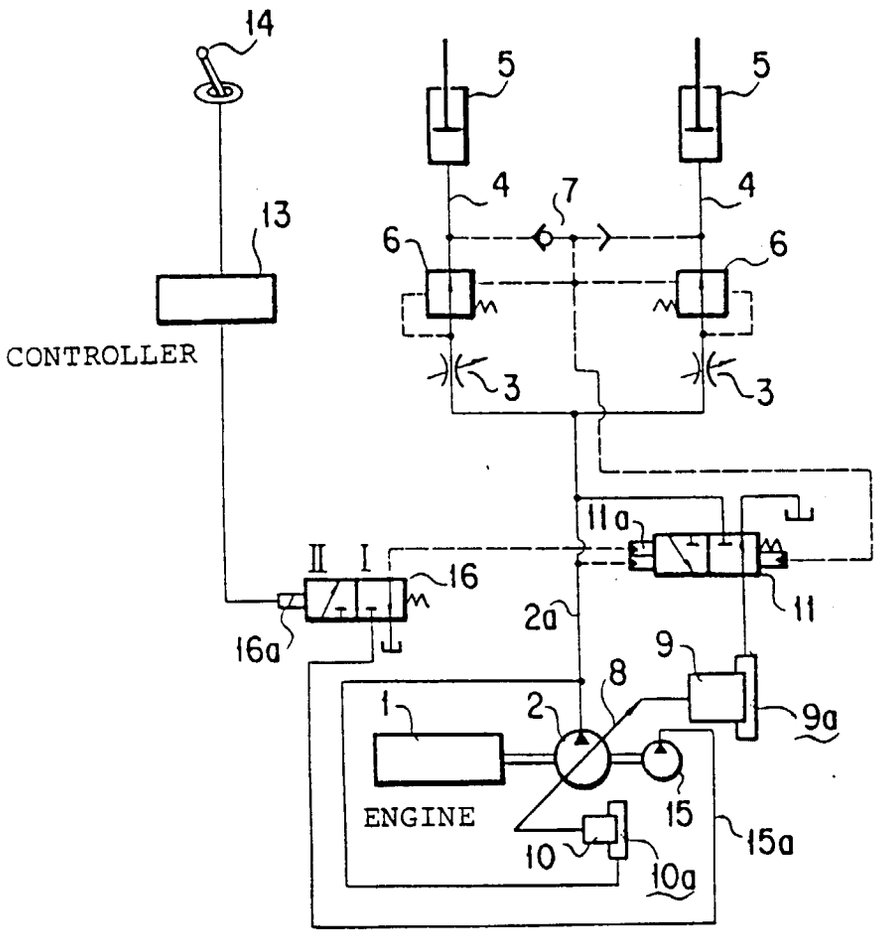

FLOW RATE OF FLUID TO BE SUPPLIED INTO HYDRAULIC CYLINDERS FOR WORK IMPLEMENT
B
NORMAL MODE
A
INCHING OPERATION MODE
0
STROKE OF OPERATING VALVE

FIG. 3


14
5
5
4
7
4
13
6
6
CONTROLLER
3
3
11a
II I
16
11
2a
16a
9
8
9a
1
2
ENGINE
15
15a
10
10a