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Nishikawa et al.

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[54] **BACKPRESSURE GENERATING APPARATUS IN AN OIL PRESSURE OPERATED CIRCUIT**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **137/106,** 91/420, 137/110

[51] **Int. Cl.** **F15b 11/08**

[58] **Field of Search** 137/106, 110; 91/420, 452

[56] **References Cited**

UNITED STATES PATENTS

2,845,901 8/1958 MacDuff 91/420

2,674,138 4/1954 Mize ..... 91/452 X

Primary Examiner—Robert G. Nilson

Attorney—Eric H. Waters et al.

[57] **ABSTRACT**

A backpressure generating apparatus in an oil pressure-operated circuit in which an oil supply circuit and an oil return circuit are formed between an oil pressure source and an oil pressure-operated device and supply of oil to the device is regulated by a control valve interposed in the circuits; a no-load passage and a throttle passage are interposed in the oil return circuit in parallel with one another, such that the no-load passage is open during ordinary operation when the oil is at low pressure when the device is not operated, whereas when a high pressure is generated in the oil supply circuit during operation of the device, the no-load passage is closed by the action of the high pressure and the oil is by-passed through the throttle passage. An orifice is interposed in the oil supply circuit to heat the oil when the pressure is high due to cold operation conditions.

7 Claims, 3 Drawing Figures

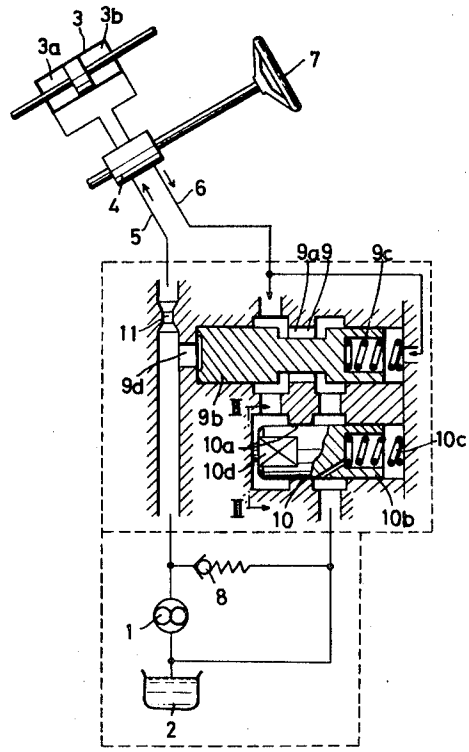


Fig. 1

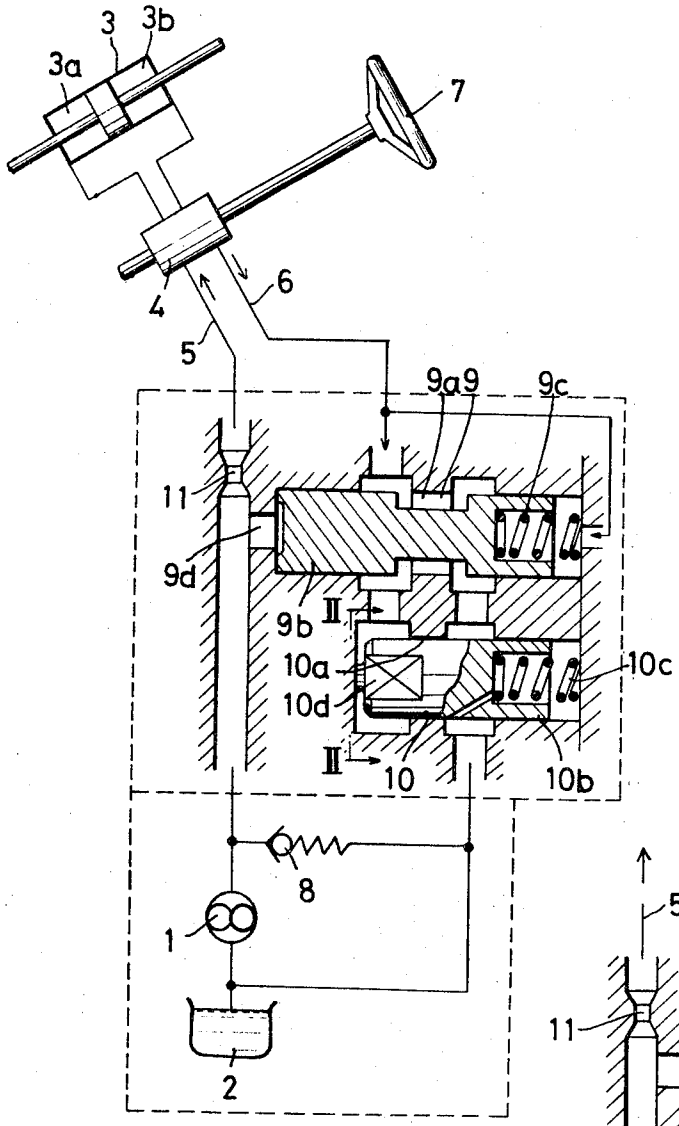


Fig. 2

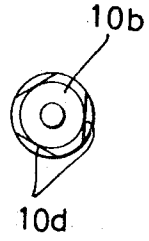
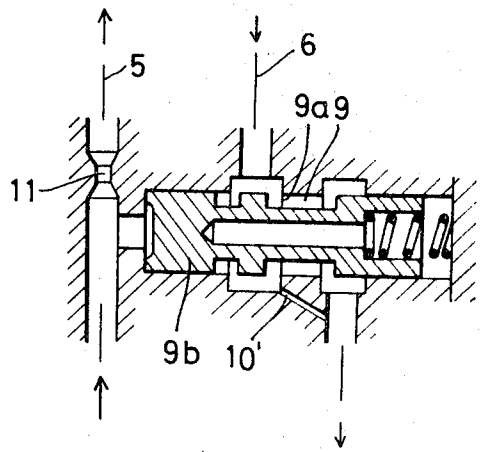


Fig. 3



BACKPRESSURE GENERATING APPARATUS IN AN OIL PRESSURE OPERATED CIRCUIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a backpressure generating apparatus in an oil pressure-operated circuit.

2. Prior Art

It has been conventional that when, by the operation of a control valve, pressure oil from an oil pressure pump is supplied to an oil pressure operated device, for example, a power cylinder in a power steering apparatus, the pressure oil is throttled by the control valve and thereby there occurs a cavitation phenomenon which is a cause of noise. To prevent this, an arrangement has been previously proposed in which a throttle member is interposed in the oil return circuit of the oil pressure-operated device for generating a backpressure therein. This, however, has the disadvantage that, since the throttle member always exists in the oil return circuit, even when the throttle valve is inoperative and the oil is merely circulated, the throttle member acts on the oil to produce a power loss while also the oil temperature is unnecessarily raised.

SUMMARY OF THE INVENTION

An object of this invention is to provide backpressure generating apparatus free from the foregoing disadvantage and it is characterized in that, in an oil pressure operated circuit of the type in which an oil supply circuit and an oil return circuit are formed between an oil pressure source (such as an oil pressure pump) and an oil pressure-operated device (such as an oil pressure cylinder) and a control valve is interposed therein, a no-load passage and a throttle passage are interposed in the oil return circuit in parallel with one another, the arrangement being such that the no-load passage is open during ordinary operating conditions but when a high pressure is generated in the oil supply passage the no-load passage is closed by the action of this high pressure.

This apparatus can also be used to raise the oil temperature when it is low and the oil viscosity is high, for example, at the time of starting in winter, and for this purpose an orifice is interposed in the oil supply circuit.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic illustration showing one embodiment of this invention;

FIG. 2 is a sectional view taken along line II — II in FIG. 1; and

FIG. 3 is a detail view showing a modified embodiment thereof.

DETAILED DESCRIPTION

The drawing shows an oil pressure-operated circuit for a power cylinder in a power steering apparatus. Referring to the drawing, numeral 1 denotes an oil pressure pump and numeral 2 denotes an oil tank connected to the negative pressure side thereof. An oil supply circuit 5 and an oil return circuit 6 are formed between the pump 1 and power cylinder 3, and a control valve 4 is interposed therein.

The control valve 4 is coupled to a steering wheel 7 for movement from a neutral position selectively to one side operating position or to its other side operating position, so that at its one side operating position or at its other side operating position the pressure oil within the oil supply circuit 5 is supplied to one side chamber 3*a* of the power cylinder 3 or to the other side chamber 3*b*, while at its neutral position there is formed a short-circuit condition wherein the oil within the supply circuit 5 is merely returned to the return circuit 4 without being supplied to the cylinder 3. The above construction is conventional and not described in detail. Numeral 8 denotes a pressure governing valve interposed between the two circuits 5 and 6.

With this arrangement, when the oil pressure is supplied to the side chamber 3*a* or the side chamber 3*b* of the power cylinder 3 by the operation of the control valve 4 moving in one direction or in the other direction, the oil is throttled within the valve 4 and thereby there is created a cavitation phenomenon which is a cause of noise.

This invention seeks to prevent this and it is characterized in that a no-load passage 9 and a throttle passage 10 are interposed in the oil return circuit 6 in parallel with one another. The no-load passage 9 comprises a valve opening 9*a* with a slide valve 9*b* therein for opening and closing the opening 9*a*. The slide valve 9*b* is urged by a spring 9*c* to the left to open the valve opening 9*a*. The other end of the valve 9*b* faces an oil pressure chamber 9*d* branched off the oil supply circuit 5, so that when a high pressure is produced within the passage 5, the valve 9*b* is moved to the right against the action of spring 9*c* to close the valve opening 9*a*. The throttle passage 10 in FIGS. 1 and 2 comprises a valve opening 10*a* and a slide valve 10*b* slidably mounted therein. The valve 10*b* is urged by a spring 9*c* to the left in the drawing so as to close the valve opening 10*a*. The valve 10*b* has at the left end portion thereof several peripheral chamfered portions 10*d* as shown clearly in FIG. 2, so that when the valve 9*b* is closed and consequently a rise in oil pressure is produced in front of the valve 10*b*, the valve 10*b* is displaced to the right so that the chamfered portions 10*d* become positioned within the valve opening 10*a* and thereby the interior of the valve opening 10*a* is formed as a throttle opening defined by the chamfered portions 10*d*.

The operation thereof will now be explained.

When the control valve 4 is in an inoperative condition at the neutral position, the oil within the oil supply circuit 5 is merely sent to the oil return circuit 6 through a short-circuit passage within the valve 4 and a large pressure is not produced within the circuit 5, so that the valve 9b within the no-load passage 9 is positioned at the illustrated left position so as to fully open the valve opening 9*a*, whereby the return oil is returned to the tank 2 therethrough. If, then the control valve 4 is moved in one direction or the other, the oil within the oil supply circuit 5 is supplied to one side chamber, for example, 3*a* of the power cylinder 3 and, at the same time, the oil within the other chamber 3*b* is returned to the tank 2 from the return circuit 6 through the valve 4. In this case, the oil supply circuit 5 becomes pressurized, whereby the valve 9*b* in the no-load passage 9 is displaced to the right to close the valve opening 9*a* and, at the same time, the valve 10*b* in the throttle passage 10 is displaced by the pressure on its front surface to retract to form a plurality of throttle openings at valve opening 10*a*. Accordingly, the return oil returning through the return circuit 6 is subjected to flow resistance at throttle passage 10 and thereby a backpressure is generated within the return circuit 6 Thus, the gener-

ation of cavitation phenomenon as mentioned before can be prevented.

FIG. 3 shows a modified embodiment. Therein instead of the throttle passage **10** being formed by the valve opening **10***a* and the slide valve **10***b* mounted in the valve opening **10***a* as described before, the throttle passage is formed of only a single narrow opening **10'**. Almost the same purpose can be achieved thereby.

Thus, according to this invention, when the pressure oil from the oil pressure source is supplied to the oil pressure operated machine by the operation of the control valve, a throttle is automatically formed within the return circuit so as to generate a backpressure therein and thereby avoid the creation of cavitation phenomenon and the corresponding generation of noise caused thereby. Additionally, when the control valve is inoperative, the throttle for generating the backpressure is automatically removed and the power loss and other disadvantages inherent in conventional apparatus with a permanent throttle member are eliminated.

According to a second feature of this invention, the oil supply circuit **5** is provided with an orifice **11** in the region of the juncture of circuit **5** and the oil pressure chamber **9***d*. By this arrangement, if the oil temperature is low and accordingly the viscosity of the oil is high when the pump **1** is started, for example in winter, a high pressure is generated within the oil supply circuit **5** by the action of the orifice **11**, so that in almost the same manner as mentioned above, the no-load passage **9** is closed and the throttle passage **10** assumes its operative condition. Accordingly, the oil returning to the oil return circuit **6** from the oil supply circuit **5** through the short-circuit passage within the control valve **4** is subject to the throttle action through the throttle passage **10**, becomes heated, and thus the oil temperature is gradually increased. When the oil reaches a predetermined temperature and the viscosity is lowered, the pressure drops so that the no-load passage **9** is opened for regular operation.

Thus, according to the second feature of this invention, an increase in the oil temperature can be automatically effected only by the provision of the additional orifice **11**.

What is claimed is:

1. In a hydraulic circuit wherein liquid is supplied from a pressure source through a supply passage to a pressure-operative device and therefrom to a return passage, the flow of liquid to the pressure-operative device being controlled by a valve, an improvement comprising means defining a no-load passage and a throttle passage in the return passage in parallel with one another, and operating means for maintaining the no-load passage open during ordinary operation in the hydraulic circuit when the liquid is at low pressure for closing said no-load passage to bypass the liquid through said throttle passage when the liquid pressure is increased, and a throttle orifice in said supply passage between the pressure source and the valve.

2. An improvement as claimed in claim **1** wherein said operating means comprises a valve member in said no-load passage, spring means urging said valve member to a normal position in which the no-load passage is open, and passage means connecting said valve member with the supply passage such that when the pressure of the liquid rises in the supply passage, the valve member will be displaced thereby against the opposition of the spring means to a position in which the no-load passage is closed.

3. An improvement as claimed in claim **2** wherein said throttle orifice is in the vicinity of the passage means which connects the supply passage and said valve member.

4. An improvement as claimed in claim **2** wherein said throttle passage includes an opening, a second valve member in said opening, second spring means acting on the second valve member to urge the same to a normal position in which said opening is blocked, and means for subjecting the second valve member to the pressure of the liquid in the return passage to displace the second valve member against the opposition of the second spring means to an operative position in which said opening is open when the first valve member closes the no-load passage.

5. An improvement as claimed in claim **4** wherein said second valve member includes a portion which forms a throttle channel in said opening when the second valve member is in its operative position.

6. An improvement as claimed in claim **5** wherein said portion of the second valve member includes at least one peripheral chamfer thereon to define said throttle channel in said opening when the second valve member is in operative position.

7. An improvement as claimed in claim **1** wherein said throttle passage is constituted by a single narrow opening.

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