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PRESSURE COMPENSATING MEANS FOR PUMP

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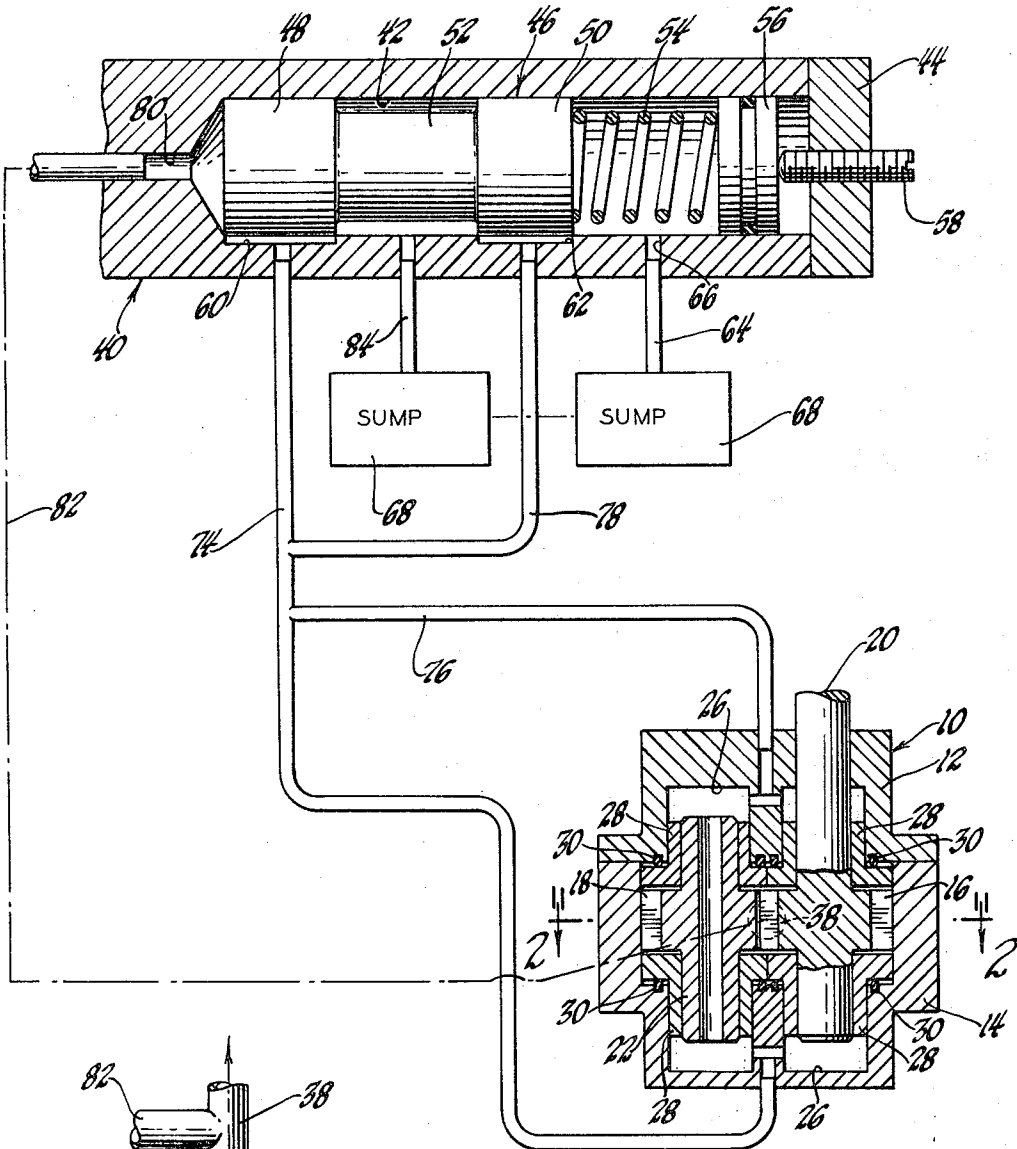


Fig. 1

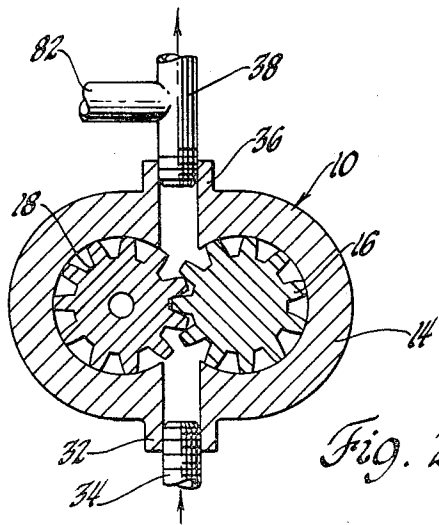


Fig. 2

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PRESSURE COMPENSATING MEANS FOR PUMP
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This invention relates to pumps and more particularly to a pressure compensating means adapted to increase the capacity.

The invention is particularly applicable to what is generally known as an internal gear type pump, and will be described with reference thereto, although it will be appreciated that the invention may be equally applied to vane type pumps, rotating cylinder type pumps, or the like as well.

It is not uncommon in the art to provide gear type pumps with movable pressure plates on one side or on opposite sides of the pumping gears, the pressure plates being separable from the gears to decrease clearance between pressure plates and gears when the output pressure from the pump increases for increasing pump efficiency at higher pressures. However, means for causing the pressure plates to move relative to the internal gears in response to both variable pressure and volume demands of a fluid system have not heretofore been devised.

Although devices utilizing other means than pressure plates for doing these things have been available in the past for certain types of vane and piston pumps, such devices are generally complicated and cumbersome affairs, expensive to manufacture and assemble, and require considerable engineering and design to adapt them to pumps of varying sizes and shapes.

The device in which this invention is embodied comprises, generally, a pressure compensating means including a valve assembly that may be formed as an integral part of the pump housing, or which may be formed of a separate structure and readily attached to an existing pump housing. The valve assembly includes a valve member operating in a valve passage, the valve member covering and uncovering orifice means which communicate with the pressure plates of the gear pump. A second orifice means in the valve body communicates between the first orifice and the sump, the pressure on the pressure plates being modulated by pressure differentials between the two orifice means. The valve member is actuated by the pump output pressure so that as the output pressure increases, the valve member will move to control the pressure differential imposed on the pressure plates between the two orifice means and thereby control any combinations of flow and pressure most suitable to system requirements. Also disposed in the valve assembly, and incorporating the orifice means, are metering grooves which can be so formed as to provide desirable characteristics for the pump.

A device of the character described is easily applied to an existing gear pump to provide a more constant output from the pump and to increase pump capacity. The formation of the metering grooves permits variations in pump characteristics to the desired parameters. Such a device is extremely simple and uncomplicated, inexpensively manufactured and produced, and versatile in its mounting and application.

These and other advantages will become more apparent from the following description and drawing in which:

FIGURE 1 is a schematic view of a typical gear pump structure, with the pressure compensating means embodying the invention incorporated therewith; and

FIGURE 2 is a cross-sectional view of the pump structure illustrated in FIGURE 1, taken substantially along the line 2—2 of FIGURE 1, and looking in the direction of the arrows.

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Referring more particularly to the drawings, the pump structure, illustrated generally by the numeral 10, is shown for convenience as being of the internal gear type, although other types of pumps might be used as well. Pump 10 includes a housing formed in two sections, 12 and 14, which may be suitably secured together to confine the pump gears 16 and 18. Gears 16 and 18 are in mesh in the usual fashion, gear 16 being driven by a suitable drive shaft 20 from which the gear 16 may be integrally formed, or to which the gear 16 may be suitably secured. Gear 18 may be integrally formed to include a shaft 22 extending from either side thereof, or the gear 18 may be secured on such shaft in any suitable manner.

Housing portions 12 and 14 are formed to include pressure plate chambers 26 on opposite sides of the faces of gears 16 and 18. In each of the chambers 26 are pressure plates, indicated by the numeral 28, slidably received in the housing portions 12 and 14 and surrounding the shafts 20 and 22. As will become hereinafter more apparent, a single pressure plate on one side of the gears, and a single pressure plate chamber, may be sufficient for the operation of the structure. Suitable means, such as springs 30 may be used to bias the pressure plates 28 against the gear faces, or other resilient means, such as "O" rings, are equally applicable for such purposes.

Pump housing portion 14 is suitably formed, as at 32, to receive an inlet conduit 34 providing fluid from a suitable reservoir or other supply means. Housing portion 14 is also formed as at 36 to receive an outlet conduit 38 which conveys the fluid under pressure to the structure with which the pump is used.

It will be apparent from the foregoing that the fluid passing to the pump gears 16 and 18 through the inlet 34 is normally driven to the output 38 by the gears 16 and 18 rotating in the housing 14. With the pressure plates 28 separated from the faces of the gears 16 and 18, it will be apparent that the fluid may flow past the gears without being pumped and the degree of separation between the pressure plates and the gear faces can determine the output flow as related to pressure at the output 38. By closing the distance between the pressure plates and the gear faces, more fluid is pumped by the gears 16 and 18.

In order to modulate the movement of the pressure plates 28 relative to the gears 16 and 18, and to compensate for variances in output pressure of the pump 10, the pressure compensating means is provided. A suitable valve body, illustrated generally by the numeral 40, may be incorporated as an integral part of the pump housing 12—14, or may be formed as a separate assembly. Valve body 40 includes a valve passage 42 extending longitudinally therethrough and closed by a suitable end plate 44 secured to the valve body 40 in any suitable manner. Movably or slidably mounted in the valve passage 42 is a valve member, illustrated generally by the numeral 46, having a pair of annular land portions 48 and 50 separated by a portion of lesser diameter 52. Valve member 46 is biased in its leftward position, as viewed in FIGURE 1, by means of a spring 54 engaging the end of the valve member 46, spring member 54 being adjustable by a slidable piston 56 and a set screw 58 to vary the biasing pressure against the valve member 48. It will be readily apparent that other biasing means may be provided, such as a fluid pressure system or the like.

Valve passage 42 has formed therein a pair of sharp edged metering grooves or orifices 60 and 62, which are spaced along the length of the passage 42 and are located generally below the annular lands 48 and 50 on the valve member 46. A conduit 64 connects a passage 66 in the valve passage 42 with the sump or reservoir 68 to prevent any unwanted fluid pressure buildup in the valve passage 42 and against the right hand end of the valve member 46.

A conduit or fluid passage 74 extends between the orifice or groove 60 and one of the pressure plate chambers 26 in the pump 10. A branch passage line 76 extends between the conduit 74 and the other of the pressure plate chambers 26. From orifice or groove 62, a conduit or fluid passage 73 extends to the conduit 74 for purposes to become hereinafter more apparent.

Valve member 46 is movable in the valve passage 42 against the force of spring 54 in response to fluid pressure at the left hand end of valve member 46. Such fluid under pressure is conveyed to the valve passage 42 through a passage 80 in the valve member 40 and a conduit or fluid passage 82 extending to the output 38 of the pump 10. As the pressure against the left hand end of the valve member 46 is increased to a pressure greater than the force exerted by the biasing spring 54, the valve member 46 will move toward the right, as illustrated in FIGURE 1 to uncover a portion of the metering groove 60 and to uncover a portion at the left of the metering groove 62. Thus, there is a fluid flow path from the conduit or passage 82 through the groove 60, the conduits 74 and 76 to the pressure plates 28 in the gear pump 10. At the same time, there is a fluid path from the conduit 74 through the conduit 78 to the metering groove 62 in the valve body 40. This passage communicates with the valve passage 42 and through a passage or conduit 84 to the sump 68.

Metering grooves 60 and 62 are so formed in shape and size as to modulate the pressure against the pressure plates 28 in the gear pump 10 in accordance with the output pressure of the pump through the output 38. By varying the respective orifice areas and the respective metering groove shapes and sizes, the desired characteristics of the pump output can be determined. The bleed-in pressure to the pressure plates 28, through the orifice 60 and the conduits 74 and 76, as compared to the bleed-out pressure through the conduit 78, and metering groove 62, control the movement of the pressure plates 28 in the desired manner.

With the parts of the assembly in the position shown in FIGURE 1; that is, the valve member 46 located in its leftward position and the pressure plates 28 in the gear pump are in light contact with the faces of gears 16 and 18, because of the springs 30, for pumping under "no load" conditions, and gear pump 10 will have a particular output pressure. When the load on pump 10 increases and the pressure at outlet 38 increases, flow is maintained through the conduit 82 and the passage 80 in the valve body 40 to act against the valve member 46 and move the valve member 46 to the right. This uncovers a portion of metering groove 60 and the leftward portion of metering groove 62 to provide pressure to the pressure plates through conduits 74 and 76. At the same time, the fluid under pressure is conveyed through conduit 78 to the orifice or metering groove 62. As long as the pressure demand on the pump is sufficient to maintain metering grooves 60 and 62 open, the pressure plates will control any volume of pump output flow as related to pressure by the clearance between the gears and pressure plates. Such clearance is, in turn, controlled by pressure differential modulation of metering grooves 60 and 62 as may be required by the fluid system. The stability of the flow through the pump 10 is maintained by the bleed-in and bleed-out ratios through the orifices 60 and 62. As the pressure demand at the pump output 38 decreases, the valve member 46 is urged toward the left by the spring 54 against the lessened pressure in the conduit 82.

Thus, a pressure compensating means is provided for a pump which modulates the pressure on pressure responsive devices in the pump structure to vary the output and capacity of the pump. As will now be apparent, the structure is extremely uncomplicated and simple to manufacture and produce, and may be easily incorporated in the pump structure, or may be formed as a separate assembly. Modifications and alterations to the structure

will become apparent to those having skill in the art after having had reference to the foregoing description and drawing. However, it is not intended to limit the scope of the invention by the foregoing, but by the scope of the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination with a pump having outlet means and pressure responsive means;

a valve body having a valve passage therein;

orifice means in said valve body and opening into said valve passage;

a valve member movably mounted in said valve passage and in one position closing said orifice means;

fluid inlet means in said valve body to convey fluid under pressure to move said valve member, said fluid inlet means communicating with said outlet means on said pump;

fluid passage means communicating between said orifice means and said pressure responsive means in said pump, said fluid passage means conveying fluid under pressure from said valve passage and said orifice means when said valve member moves to another position uncovering said orifice means to control the output from said pump;

and means for modulating the pressure of the fluid passing from said orifice means to said pressure responsive means in said pump.

2. In combination with a pump having outlet means and pressure responsive means for varying the output of said pump;

valve means including a valve passage having orifice means therein and a valve member reciprocally mounted in said valve passage and in one position covering said orifice means;

first fluid passage means between said valve passage and said outlet means on said pump for conveying fluid under outlet pressure from said pump to said valve passage to act against said valve member and uncover said orifice means;

second fluid passage means between said orifice means and said pressure responsive means in said pump for conveying fluid from said orifice means to said pressure responsive means to actuate said pressure responsive means and vary the output from said pump; and means for modulating the pressure of the fluid passing from said orifice means to said pressure responsive means in said pump.

3. In combination with a pump having outlet means and pressure responsive means for varying the output of said pump;

valve means including a valve passage having first and second orifice means therein and a valve member movably mounted in said valve passage and in one position covering said orifice means;

first fluid passage means communicating between said outlet means in said pump and said valve passage for conveying fluid under outlet pressure from said outlet means to said valve passage to act against said valve member and uncover said orifice means;

second fluid passage means communicating between said first orifice means and said pressure responsive means in said pump to convey fluid from said first orifice means to said pressure responsive means to vary the output of said pump;

and third fluid passage means communicating between said first orifice means and said second orifice means to convey fluid under pressure from said first orifice means to said second orifice means and control the pressure of the fluid conveyed from said first orifice means to said pressure responsive means in said pump.

4. In combination with a pump having outlet means and pressure responsive means for varying the output of said pump and a fluid sump;

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valve means including a valve passage having first and second orifice means therein and a valve member movably mounted in said valve passage;

first fluid passage means communicating between said pump outlet means and said valve passage for conveying fluid at outlet pressure from said pump to said valve passage to act against said valve member;

second fluid passage means communicating between said first orifice means and said pressure responsive means in said pump to convey fluid under pressure from said first orifice means to said pressure responsive means;

third fluid passage means communicating between said first orifice means and said second orifice means to convey fluid therebetween;

and fourth fluid passage means between said second orifice means and said sump;

said valve member being movable between at least two positions, the first of said positions covering said first orifice means and the second of said positions opening said first orifice means for communication between said valve passage and said pressure responsive means in said pump to actuate said pressure responsive means and vary the capacity of said pump;

said first orifice means and said second orifice means being relatively so calibrated as to modulate the pressure on said pressure responsive means.

5. The combination set forth in claim 4 and further including means for biasing said valve member in said first position.

6. In combination with a pump having outlet means and pressure responsive means for varying the output of said pump and a fluid sump;

valve means including a valve passage having first and second metering grooves in spaced relation therein and a valve member mounted in said valve passage and movable to progressively uncover and cover said metering grooves;

first fluid passage means communicating between said pump outlet means and said valve passage for conveying fluid at outlet pressure from said pump to said valve means to act against said valve member;

second fluid passage means communicating between said first metering groove and said pressure responsive means in said pump to convey fluid from said first metering groove to said pressure responsive means;

third fluid passage means communicating between said second fluid passage means and said second metering groove to convey fluid therebetween;

said valve member being movable in response to pressure increase in said first fluid passage means to uncover at least a portion of said first metering groove and permit fluid flow through said first metering groove and through said second fluid passage means to said pressure responsive means in said pump

and through said third fluid passage means to said second metering groove;

said first and second metering grooves being relatively calibrated as to modulate the pressure on said pressure responsive means in said pump.

7. Pressure compensation means for a gear pump having pressure responsive plates actuatable to vary the output of said pump and said pump having an outlet, said means comprising:

a valve body having a valve passage formed therein and orifice means therein communicating with said valve passage;

a valve member movably mounted in said valve passage and in one position covering said orifice means;

first fluid passage means connecting said valve passage with said pump outlet;

and second fluid passage means connecting said orifice means with said pressure responsive plates;

said valve member being movable with an increase in pump outlet pressure to uncover said orifice means and vary the pressure on said pressure responsive plates to increase the output of said pump;

and means for modulating the pressure of the fluid passing from said orifice means to said pressure responsive means in said pump.

8. The pressure compensation means set forth in claim 7 wherein said means for modulating pressure includes second orifice means in said valve body, and fluid passage means connecting said second fluid passage means and said second orifice means, said orifice means and said second orifice means being calibrated to modulate the pressure on said pressure responsive plates.

9. The pressure compensation means set forth in claim 8 wherein said orifice means and said second orifice means include metering grooves in said valve body, said metering grooves being formed to provide predetermined output characteristics of said pump.

10. The pressure compensation means set forth in claim 9 and further including biasing means in said valve body and engaging said valve member for biasing said valve member in an orifice means closing position.

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