

[54] PUMP

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[58] Field of Search. 417/212, 218, 222, 270, 292,
417/32

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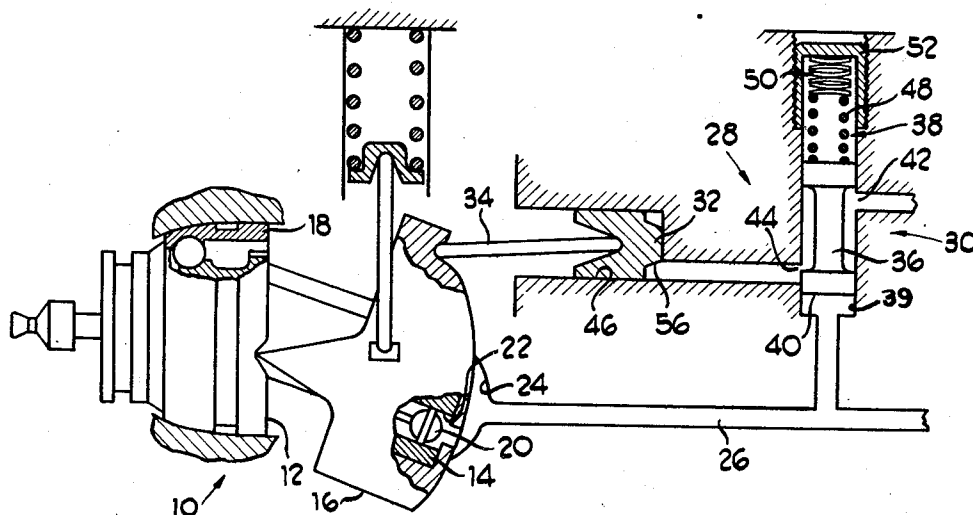
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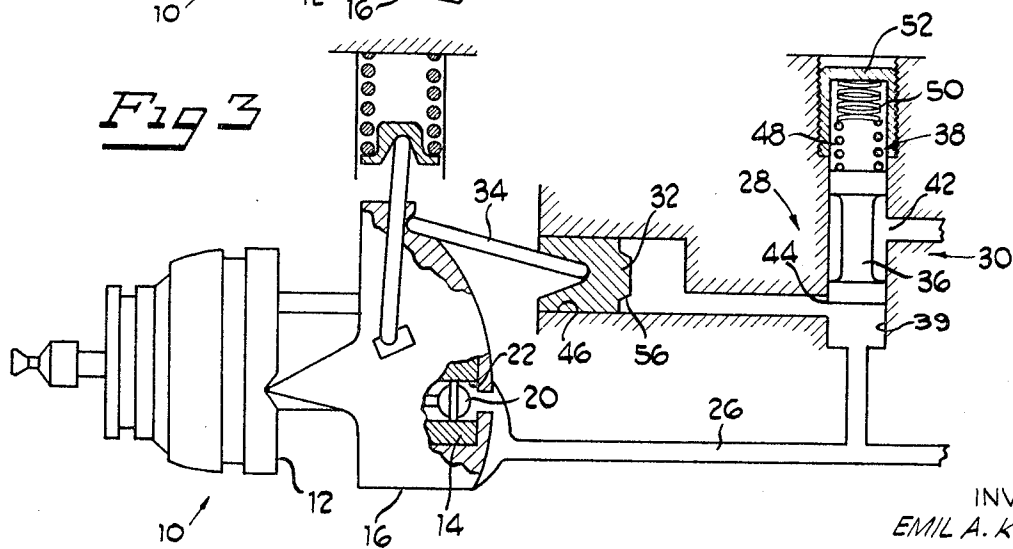
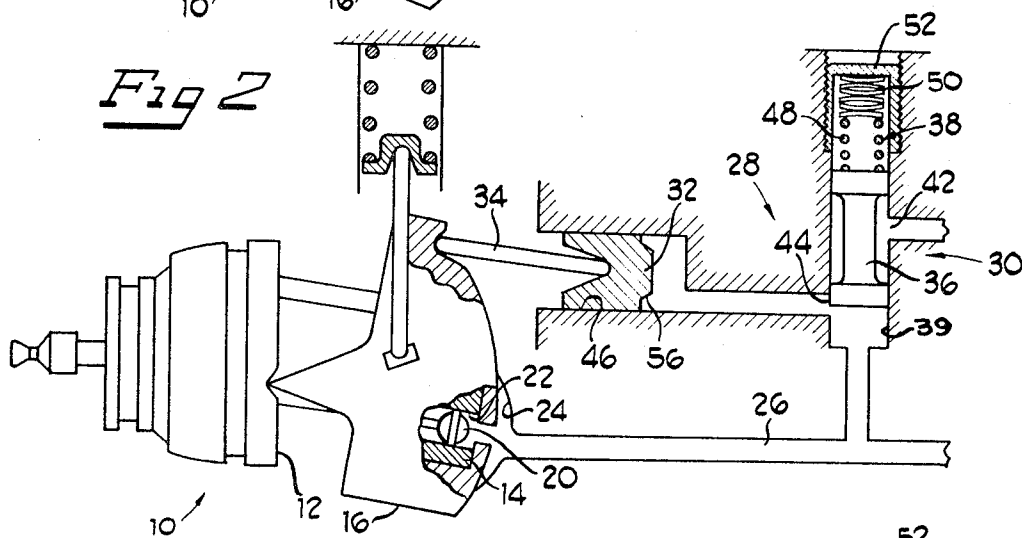
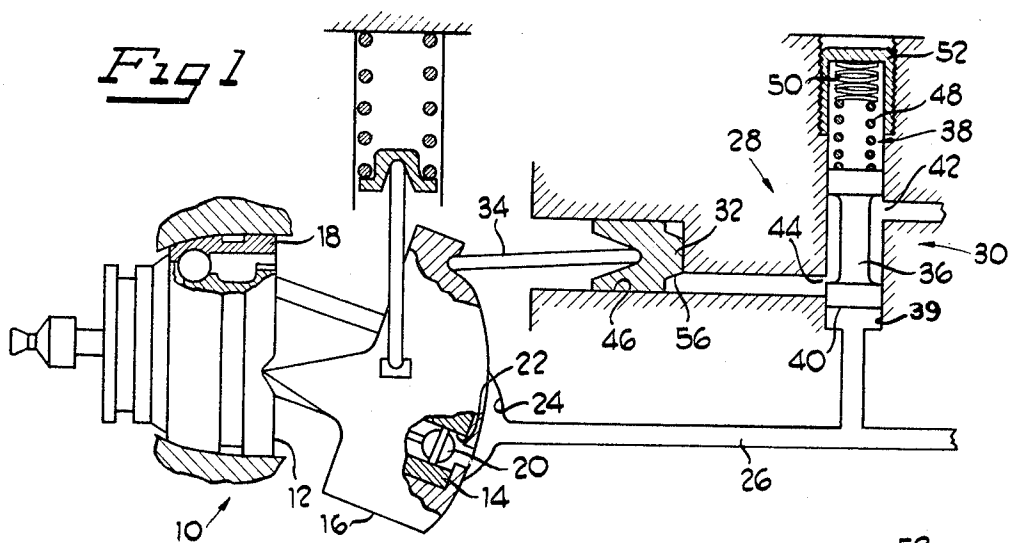
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[57] ABSTRACT

A variable displacement pump is provided with a temperature compensated displacement compensator valve adjusted to obtain a desired constant pressure output under variable fluid medium temperature conditions. The valve incorporates, in addition to spring biasing means, temperature responsive means which vary the force applied to the spring in response to temperature changes in the environment.

1 Claims, 3 Drawing Figures





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PUMP

BACKGROUND OF THE INVENTION

Variable displacement pumps incorporating compensator valves for maintaining substantially constant pressure output under variable flow conditions are known in the art. One example of such a pump is described in Wahlmark, U.S. Pat. No. 3,136,264, issued June 9, 1964. One of the major drawbacks to such a pump is the change in output pressure which occurs when operating temperatures change. Such changes manifest themselves, at least, in temperature changes in the fluid and in the pump parts. This undesirable situation has resulted in designing pumps to deliver a minimum rated pressure over a range of operating temperatures. In such pumps, the output pressure is not constant over the temperature range as is desirable.

THE INVENTION

According to this invention, the pressure compensator valve is made temperature responsive and by doing so, the output pressure of the pump is maintained substantially constant over the desired operating temperature range. Temperature compensation can be accomplished by incorporating bimetallic elements in the compensator valve, so as to provide a temperature compensated biasing force to the compensator valve spool, the bimetallic elements being in the form of Bellville springs located between an adjusting screw (to set the desired pressure) and the biasing spring of the valve.

THE DRAWINGS

FIG. 1 is a schematic of a variable displacement pump delivering full flow and a displacement control compensator constructed according to the invention.

FIG. 2 is a schematic similar to FIG. 1 wherein the pump is delivering partial flow.

FIG. 3 is a schematic similar to FIG. 1 wherein the pump is delivering zero flow.

THE PREFERRED EMBODIMENT

Looking now at the drawings, there is schematically illustrated a variable displacement pump, generally identified as 10, which comprises a rotatable swash member 12 and a rotatable cylinder barrel 14 driven by a prime mover (not shown), the cylinder barrel being rotated in a nonrotating cylinder block 16 and the swash member being received in a stationary bearing race 18. The cylinder block 16 is pivotable with respect to the bearing race as shown. A plurality of pistons 20 pivotable with respect to the swash member reciprocate in bores 22 in the cylinder block 16, and pump fluid from an outlet conduit 26. The displacement of the pump and the length of the stroke of the pistons changes as the inclination of the cylinder block changes.

A displacement control mechanism 28 is provided and it in-

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cludes a compensator valve 30 and an actuator piston 32 connected to the cylinder block 16 by means of a connector 34. The valve 30 comprises a spool 36 biased by a spring assembly 38 in one direction and having a fluid pressure area 40 at one end. The spool 36 is movable in a valve bore 39 having communication at one end with the pump outlet conduit 26, the outlet pressure acting on the area 40. The valve bore has ports 42 and 44 connected respectively to the inlet fluid and its pressure and to a cylinder 46 in which the piston 32 is received.

The spring assembly 38 includes a coil spring 48 and a plurality of bimetallic Bellville springs 50, such that the biasing force of the assembly is temperature compensated, re, substantially uniform at its set value over the working temperature range. To set the desired pump pressure, an adjusting screw 52 is provided. The actuator piston 32 is slidable in a valve bore 46 and has a pressure receiving surface 56 subjected to fluid pressure as determined by the position of the spool 36.

At full displacement, the surface 56 is subjected to inlet pressure, as illustrated in FIG. 1. At partial displacement, i.e., when the outlet pressure has increased to a value above that desired, the spool 36 is moved to a position blocking the communication between the ports 42 and 44 and opening communication between the port 44 and the end 39, such that the actuator piston 32 moves to the left and through its connection with the cylinder block, the block is pivoted to a position in which the strokes of the pistons are shortened and the displacement of the pump is reduced. In some situations, the displacement of the pump can be reduced to zero, as indicated in FIG. 3.

What is claimed is:

1. In a variable displacement fluid device wherein a plurality of pistons are arranged for reciprocation each in a cylinder barrel and the strokes of each is variable to vary the displacement of the device, and wherein there is a compensator valve member connected to the fluid inlet of said device and to the outlet of said device so as to control the length of said strokes in response to the outlet pressure and in accordance with output flow requirements thereby to maintain the outlet pressure substantially constant throughout the range from zero displacement to full displacement, said valve including a spool subject to said outlet pressure at one end and a coil spring for biasing said spool against said outlet pressure, and in which undesirable variations are likely to occur in the outlet pressure as a result of operating temperature changes, the improvement which comprises:

a temperature responsive bimetallic spring, in series with and in addition to said coil spring, for varying the compression on said coil spring in response to changes in temperature to provide, by the series combination, a substantially uniform net biasing force on said spool in order to maintain the outlet pressure substantially constant over the working temperature range.

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