

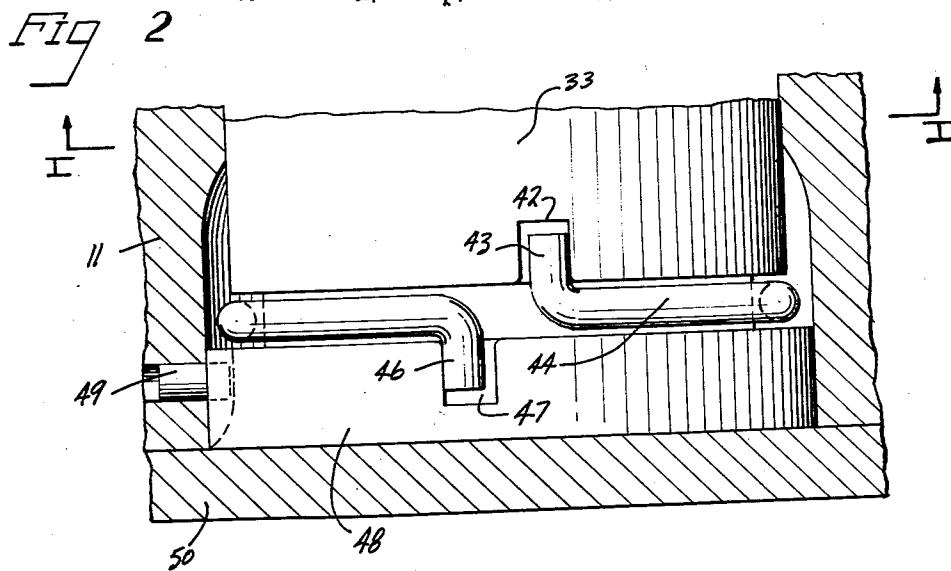
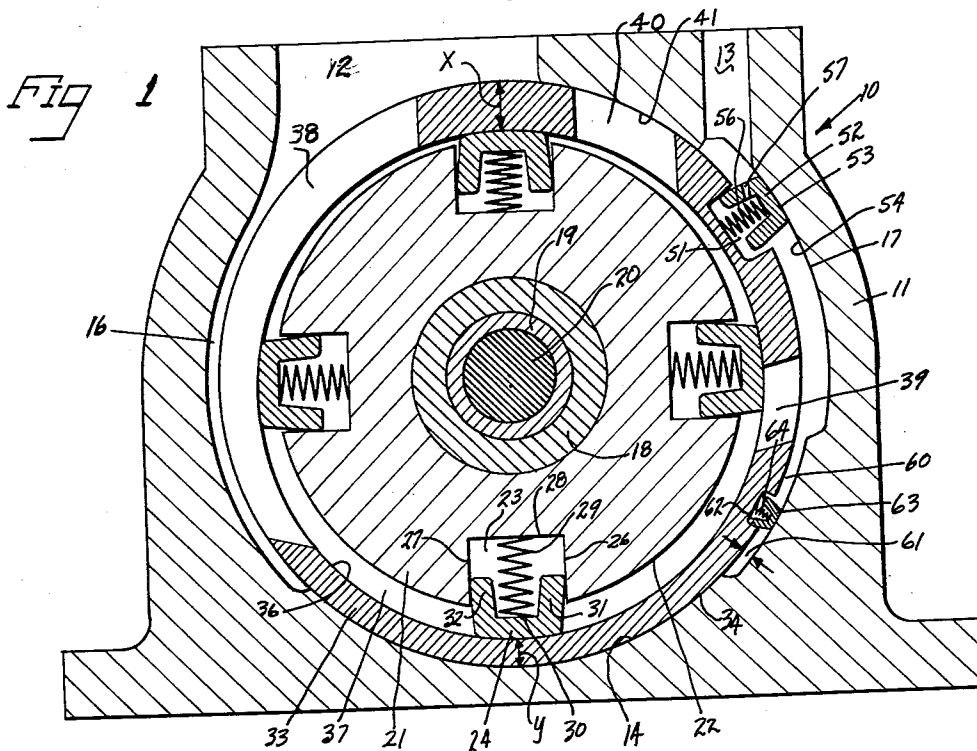
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SLIPPER-TYPE PUMP HAVING FLOW CONTROL MEANS

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SLIPPER-TYPE PUMP HAVING FLOW CONTROL MEANS

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This invention relates generally to slipper-type pumps and more specifically relates to a slipper-type pump having flow control means whereby excess pump discharge is automatically by-passed as a function of the rate of discharge flow.

It is an object of the present invention to provide a slipper-type pump having integrated therein a simple by-pass means.

Another object of the present invention is to provide an improved pump construction suitable for use in the hydraulic systems of power assisting means requiring a constant flow rate.

Yet another object of the present invention is to provide a slipper-type pump having an angularly shiftable insert ring functioning to provide a bore contour suitable for establishing a working chamber for the pump and having a porting arrangement which permits the ring to develop the additional functions of flow control.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheet of drawings in which a preferred structural embodiment of a pump incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

FIGURE 1 is a cross-sectional view taken generally on line I—I of FIGURE 2 and showing a slipper-type pump incorporating the principles of the present invention; and

FIGURE 2 is a fragmentary view illustrating additional details of the pump of the present invention.

As shown on the drawings:

The pump of the present invention is of general utility but is specifically adapted for use in the hydraulic system of a power assisting means, for example, in an automotive power steering system wherein it is desirable to maintain a regulated flow rate.

The pump of the present invention is indicated generally at 10 and comprises a housing or casing 11 having formed therein an inlet 12 and an outlet 13, thereby permitting the pump to be incorporated into the hydraulic circuit of a power assisting system at one point in the circuit so that the pump can be utilized to drive a stream of fluid through the circuit, it being understood that the pump 10 obtains the fluid from a suitable source through the inlet 12 and discharges the same to a point of utilization through the outlet 13.

As will be manifest upon examining FIGURE 1, the casing 11 is formed with a cylindrical bore 14 and the bore wall of the bore 14 is characterized by the formation therein of a radially outwardly extending inlet recess 16 communicating with the inlet 12.

The bore wall of the bore 14 is further characterized by an annulus area forming an outlet recess 17 communicating with the outlet 13.

The casing 11 is provided with a boss 18 carrying suitable bearing means as indicated at 19 in which is journaled a shaft 20 carrying a rotor 21 for rotation on the axis of the bore 14.

The rotor 21 is particularly characterized by the formation of an outer cylindrical surface 22 notched at a plurality of circumferentially spaced points to provide one or

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more recesses 23, each adapted to receive a slipper means indicated generally at 24.

More specifically, each notch or recess 23 has spaced side walls 26 and 27, as well as a bottom wall 28. Bottomed against the bottom wall 28 is a coil spring 29, the opposite end of which is bottomed against a bight portion 30 of a generally U-shaped slipper member constituting the slipper means 24, the slipper means 24 further including a leg portion 31 positioned adjacent the wall 26 and a leg portion 32 positioned adjacent the wall 27.

Interposed between the casing 11 and the rotor 21 is an insert ring indicated generally at 33. The insert ring 33 has an outside peripheral surface 34 slidably engaging the bore wall of the bore 14 and supported thereby for angular adjustment within the casing 11.

The insert ring 33 is further provided with an inner peripheral surface 36 which is eccentrically offset relative to the axis of the rotor 21 and the bore 14. By virtue of such eccentricity, it will be noted that the insert ring 33 has a thickness designated X, as shown on the top of FIGURE 1 at which point the surfaces of the rotor 21 and the ring 33 are closest, thereby to form a sealing area, and a much thinner thickness designated Y at the bottom of FIGURE 1 at which point the respective surfaces are furthest apart.

Moreover, by virtue of such eccentricity, the inner peripheral surface 36 together with the outer surface 22 of the rotor 21 forms a generally crescent-shaped working chamber 37 through which the slipper means 24 are moved upon rotation of the rotor 21.

In accordance with the principles of the present invention, the insert ring 33 is formed with an opening 38 on one side of the sealing area which constitutes an inlet opening and which communicates one side of the working chamber 37 with the inlet recess 16 and the inlet 12.

The insert ring 33 is further characterized by the formation of a first outlet opening 39 on the opposite side of the sealing area which communicates an opposite side of the working chamber 37 with the annulus area forming the outlet recess 17, thereby communicating the working chamber 37 with the outlet 13.

Circumferentially spaced from the outlet opening 39 formed in the insert ring 33, and also on the opposite side of the sealing area there is provided a second outlet opening 40 in the insert ring 33 which may be movably positioned upon angular adjustment of the insert ring 33 to by-pass pump discharge directly to the inlet. Thus, in the position shown in FIGURE 1, the outlet opening 40 is closed since it is opposite the land portion 41 provided by the casing 11, however, upon angular adjustment in counterclockwise direction, using the orientation of FIGURE 1, the outlet opening 40 is capable of communicating the inlet 12 directly with the discharge side of the working chamber 37.

In order that angular shifting of the insert ring 33 can be effected automatically as a function of the rate of pump discharge flow, it is contemplated that the insert ring be preloaded in direction by a continuous biasing means. As shown in FIGURE 2, the insert ring 33 is notched along one edge as at 42, thereby to receive and seat a lug 43 formed on one end of a torsion spring 44, the opposite end of the torsion spring 44 having a lug 46 formed thereon received in and seated against the walls of a recess 47 formed in a header ring 48 carried within the pump casing 11 and held against rotation by means of a key pin 49. A cover plate 50 is also shown for the pump.

By virtue of the continuous biasing force exerted by the torsion spring 44, the insert ring 33 is preloaded in a clockwise direction using the orientation of FIGURE 1.

In order to provide flow-responsive means which will adjustably rotate the insert against the continuous biasing

force, the insert ring 33 has formed in its peripheral surface a notch or recess 51 receiving a slipper member 52. The notch 51 is located opposite the annulus area forming the outlet recess 17 and the slipper member 52 is provided with a contact surface 53 engaging against the wall surface 54 of the annulus area. The contact surface 53 and the wall surface 54 are under biased engagement by virtue of a coil spring 56 bottomed in said recess 51 and engaging against the slipper member 52 to bias the slipper member 52 outwardly.

The notch or recess 51 is located between the first and second outlet openings 39 and 40 in the insert ring, thus facilitating the formation of an orifice 57 in the slipper member 52 which will be located between the line receiving discharge pressure or, in other words, between the outlet 13 and the outlet opening 39 and through which all of the fluid pumped is normally discharged. The flow of fluid through the orifice 57 produces a pressure differential between the areas on opposite sides of the orifice, namely, the outlet 13 in the line downstream of the orifice 57 and the annulus area forming the outlet recess 17 outwardly of the outlet opening 39 and upstream of the orifice 57. Moreover, such pressure differential due to the pressure drop across the orifice is proportional to the pump discharge flow. Therefore, the higher pressure acting on the insert ring 33 through the slipper member 52 will urge rotational adjustment of the insert ring 33 in a counterclockwise direction against the continuous biasing force of the continuous biasing means or torsion spring 14. When the flow through the orifice 57 is sufficient to cause a pressure difference great enough to overcome the torsion spring 44, the insert ring 33 will be rotatably adjusted or angularly shifted sufficiently to move the outlet opening 40 so that the inlet 12 will be communicated with the discharge side of the working chamber 37, thus by-passing excess pump discharge, i.e. fluid in excess of the flow rate through the outlet 13 predetermined by selection of the size of the orifice 57 and the spring rate of the spring 44.

In order to balance the rotative forces acting on the radially facing surfaces of the insert ring 33 which are attributable to the difference in pressure area resulting from the taper of the ring wall as shown by the difference between the thickness X and the thickness Y, appropriate counterbalancing means may be provided. In this connection, an annulus area 60 is formed in the casing 11 and the thickness of the annulus area or depth is indicated at 61, which depth is made equal to the difference in thickness between the quantities X and Y.

The insert ring 33 is provided with a peripheral slot 62 receiving a slipper member 63 which is biased outwardly by a spring 64 to project through the annulus area 60 against the adjoining wall. Discharge pressure acting on the projecting area of the slipper will act against the insert ring, thereby to balance the excess pressure forces.

Each of the slipper means 24 carried by the rotor 21 is free to rock and is free to move reciprocatorily in the notches or recesses 23 in following the contour of the bore wall 36 provided by the insert ring 33. Moreover, the inlet opening 38 is made of sufficient circumferential extent so that regardless of the angular shifting of the insert ring 33 in response to flow conditions, the inlet side of the working chamber 37 will always be in communication with the inlet 12. Thus, in operation, as the rotor 21 is rotatably driven by appropriate connection of the shaft 20 to a motive source, the slipper means 24 move through the working chamber 37 and a supply of fluid is drawn into the space between adjoining slipper means 24, which space is expanding as the corresponding portion of the rotor 21 moves past the inlet opening 38 for discharge under increased pressure at the area of the outlet opening 39. The fluid discharged through the outlet opening 39 passes through the outlet recess 17 and through the orifice 57 to the outlet 13 for transmission to a point of utilization. When the flow through the orifice 57 is

sufficient to cause a pressure difference great enough to overcome the spring force of the spring 44, the insert ring 33 will be rotatably adjusted in the housing or casing 11 and will connect the outlet opening 40 with the inlet 13, thus by-passing excess pump discharge.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In a pump, a casing having a cylindrical bore and having an inlet and an outlet, an insert ring in said bore having an outer peripheral surface of an outside diameter formed to afford rotatable adjustment of said ring in said bore and having an inner surface eccentrically offset relative to said outer surface, a notched rotor in said ring and carrying slipper means engaging against said inner surface, said rotor being rotatable on the axis of the outer surface of said ring, thereby forming together with said inner surface a crescent-shaped working chamber and a sealing area at the ends of the chamber, said inlet and outlet being on opposite sides of said sealing area therethrough, said insert ring having an inlet port therethrough on one side of said crescent-shaped working chamber communicating said working chamber with said inlet and having first and second spaced outlet ports on the opposite side of and communicating with said crescent-shaped working chamber, one of said outlet ports being arranged to continuously communicate with said outlet, continuous biasing means preloading said insert ring in one direction to a position wherein the other outlet port is normally closed with respect to said inlet, and flow-responsive means between said one of said outlet ports and said outlet through which all of the pumped fluid is discharged and operative to angularly shift said insert ring against said continuous bias to communicate the other of said outlet ports with said inlet, thereby to by-pass pump discharge in excess of a predetermined flow passing through said flow-responsive means back to said inlet.

2. A pump comprising a slipper-carrying rotor rotatable on an axis, angularly adjustable means forming a cylindrical wall outwardly of said rotor and being eccentrically offset relative to said axis to form with said rotor a sealing area and a working chamber, means including said adjustable means forming an inlet and an outlet on opposite sides of said sealing area and said working chamber for said pump, and said cylindrical wall having an additional opening therethrough on the outlet side of said sealing area between said inlet and said outlet and communicating with said working chamber, said opening being normally closed with respect to said inlet but being movably positioned upon angular adjustment of said wall to position said additional opening between the outlet side of said working chamber and said inlet to by-pass a portion of pump discharge to said inlet.

3. A pump comprising a slipper-carrying rotor rotatable on an axis, angularly adjustable wall means outwardly of said rotor and being eccentrically offset relative to said axis to form with said rotor a sealing area and a working chamber, means including said angularly adjustable wall means forming an inlet and an outlet for said pump on opposite sides of said sealing area, said wall means having an additional opening therethrough on the outlet side of the pump between said inlet and said outlet and communicating with said working chamber, said opening being normally closed with respect to said inlet but being movably positioned upon angular adjustment of said wall means to position said additional opening between the outlet side of said working chamber and said inlet to by-pass a portion of pump discharge to said inlet, and flow-responsive means in said outlet operatively connected to said wall means for shifting said wall means

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angularly automatically as a function of the rate of flow.

4. A pump comprising a slipper-carrying rotor rotatable on an axis, angularly adjustable wall means outwardly of said rotor and being eccentrically offset relative to said axis to form with said rotor a working chamber, means including said adjustable wall means forming an inlet and an outlet opposite sides of said working chamber for said pump, said wall means having an additional opening therethrough on the outlet side between said inlet and said outlet and being movably positioned upon angular adjustment of said wall means towards the inlet side to by-pass a portion of pump discharge from the working chamber directly to said inlet, said adjustable wall means comprising an insert ring surrounding said rotor, and a casing journaling said ring for angular adjustment and having said inlet and outlet and an additional opening formed therethrough, a continuous biasing means between said casing and said insert ring preloading said ring angularly in one direction to position said additional opening in closed position, and flow-responsive means in said outlet operatively connected to said ring for shifting said ring angularly as a function of the rate of flow to place said additional opening in position to communicate pump discharge from said working chamber to the inlet.

5. A pump comprising a casing having a cylindrical bore formed therein with an inlet and an outlet, said casing having an inlet recess in the bore walls and having an annulus area forming an outlet recess in the bore walls, a rotatable peripherally notched rotor in said casing rotatable on the axis of said bore, slipper means carried by said rotor and being free to rock and to reciprocate, thereby to follow the contour of an adjoining wall surface, an insert ring interposed between said rotor and the casing having an outside surface slidably engaging said bore walls and supported thereby for angular adjustment, and having an inside wall surface forming a cylindrical bore eccentrically offset relative to said axis, thereby to form with said rotor a crescent-shaped working chamber through which said slipper means are moved and a sealing area, said inlet and outlet being on opposite sides of said sealing area, said insert ring having an inlet opening formed therethrough on one side of said working chamber communicating said inlet with said one side of said working chamber, and a pair of spaced outlet openings through said insert ring on the opposite side of and communicating with said working chamber, one of said outlet openings normally communicating the other side of said working chamber with said outlet recess, the other of said outlet openings being disposed between said one outlet opening and said inlet opening and being movably positioned from a normally closed position with respect to said inlet to an open position with respect to said inlet to by-pass a portion of pump discharge directly to said inlet from the outlet side of the working chamber.

6. A pump comprising a casing having a cylindrical bore formed therein with an inlet and an outlet, said casing having an inlet recess and an outlet recess formed in the bore walls thereof, a rotatable peripherally notched rotor in said casing rotatable on an axis of said bore, slipper means carried by said rotor and being free to rock and to reciprocate, thereby to follow the contour of the adjoining wall surface, an insert ring interposed between said rotor and said casing having an outside surface slidably engaging the bore walls and supported thereby for angular adjustment, and having an inside wall surface forming a cylindrical bore eccentrically offset relative to said axis, thereby to form with said rotor a crescent-shaped working chamber through which said slipper means are moved and a sealing area, said inlet and outlet being on opposite sides of the sealing area, said insert ring having an inlet opening formed therethrough on one side of the working chamber communicating said inlet with one side of said working chamber, a pair of spaced outlet openings through said insert ring

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on the opposite side of and communicating with said working chamber, one of said outlet openings normally communicating the other side of said working chamber with said outlet recess, the other of said outlet openings being disposed between said inlet opening and the said one of said outlet openings and being movably positioned upon angular adjustment of said insert ring from a normally closed position with respect to said inlet to an open position with respect to said inlet to by-pass a portion of pump discharge directly to said inlet from said outlet side of said working chamber, said insert ring having a notch formed in the periphery thereof opposite said outlet recess, and a slipper member in said notch engaged against the casing, said slipper member having an orifice formed therein through which all of the pumped fluid from said one outlet opening flows to said outlet and being operative to angularly shift said insert ring to by-pass pump discharge in excess of the flow rate through said orifice directly to the inlet.

7. A pump comprising a casing having a cylindrical bore formed therein with an inlet and an outlet, said casing having an inlet recess and an outlet recess formed in the bore walls thereof, a rotatable peripherally notched rotor in said casing rotatable on an axis of said bore, slipper means carried by said rotor and being free to rock and to reciprocate, thereby to follow the contour of the adjoining wall surface, an insert ring interposed between said rotor and said casing having an outside surface slidably engaging the bore walls and supported thereby for angular adjustment, and having an inside wall surface forming a cylindrical bore eccentrically offset relative to said axis, thereby to form with said rotor a crescent-shaped working chamber through which said slipper means are moved and a sealing area, said inlet and outlet being on opposite sides of the sealing area, said insert ring having an inlet opening formed therethrough on one side of the working chamber communicating said inlet with one side of said working chamber, a pair of spaced outlet openings through said insert ring on the opposite side of and communicating with said working chamber, one of said outlet openings normally communicating the other side of said working chamber with said outlet recess, the other of said outlet openings being disposed between said inlet opening and said one of said outlet openings and being movably positioned from a normally closed position with respect to said inlet to a position in register with said inlet upon angular adjustment of said insert ring to by-pass a portion of pump discharge directly to said inlet from the outlet side of the working chamber, said insert ring having a notch formed in the periphery thereof opposite said outlet recess, a slipper member in said notch engaged against the casing, said slipper member having an orifice formed therein through which all of the pumped fluid from said one outlet opening flows to said outlet, said slipper member responsive to excessive flow rates and being operative to angularly shift said insert ring to by-pass pump discharge in excess of that flowing through said orifice, and a control spring between said casing and said insert ring to preload said ring angularly to a normal operating position with said other outlet opening closed, whereby said slipper member operates to shift said ring thereby to place said other outlet opening in open position with respect to said inlet to maintain a constant flow rate at said outlet.

8. A pump as defined in claim 7, and means to balance unequal forces acting on said insert ring comprising means forming in said casing on the outlet side of said pump and radially outwardly of said insert ring an annulus area of a depth equal to the difference in the thickness of said insert ring and being subject to discharge pressure, and a slipper member carried by said insert ring and movable in said annulus area to act on the insert ring with a balancing force.

9. A pump comprising a slipper-carrying rotor rotatable

ble on an axis, ring means having an outside surface concentric with the axis of said rotor and having an inside surface eccentric with respect to the axis of the rotor and surrounding said rotor to form together therewith a sealing area and a working chamber inside of said ring means, casing means having an inlet and an outlet on opposite sides of said sealing area and working chamber and having a cylindrical chamber in which said ring means are adjustably angularly positioned, said ring means having an inlet opening formed therethrough on the inlet side of the pump to communicate said inlet with said working chamber, said ring means having a pair of outlet openings therethrough on the opposite side of the pump in communication with the working chamber, one of said outlet openings normally communicating said outlet with the other side of said working chamber continuously and the other of said outlet openings being disposed between said inlet opening and said one of said outlet openings and being movably positioned from a normally closed position with respect to said inlet to a position in register with said inlet upon angular adjustment of said ring means to by-pass a portion of pump discharge directly to said inlet from the outlet side of said working chamber, continuous biasing means between said casing means and said ring means to preload said ring means angularly to a normal operating position with said other outlet opening closed, flow-responsive means operatively connected to said ring means and responsive to the flow rate through said outlet for shifting said ring means with said other outlet opening in open position with respect to said inlet for maintaining a con-

stant flow rate at said outlet, and means to balance unequal forces acting on said ring means, comprising means forming in said casing on the outlet side of said pump and radially outwardly of said ring means an annulus area of a depth equal to the eccentricity of said inner surface of said ring means and being subject to pump discharge pressure, and a slipper member carried by said ring means and movable in said annulus area to act on said ring means with a balancing force.

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