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FLUID ENERGY TRANSLATING APPARATUSES

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2 Sheets-Sheet 1

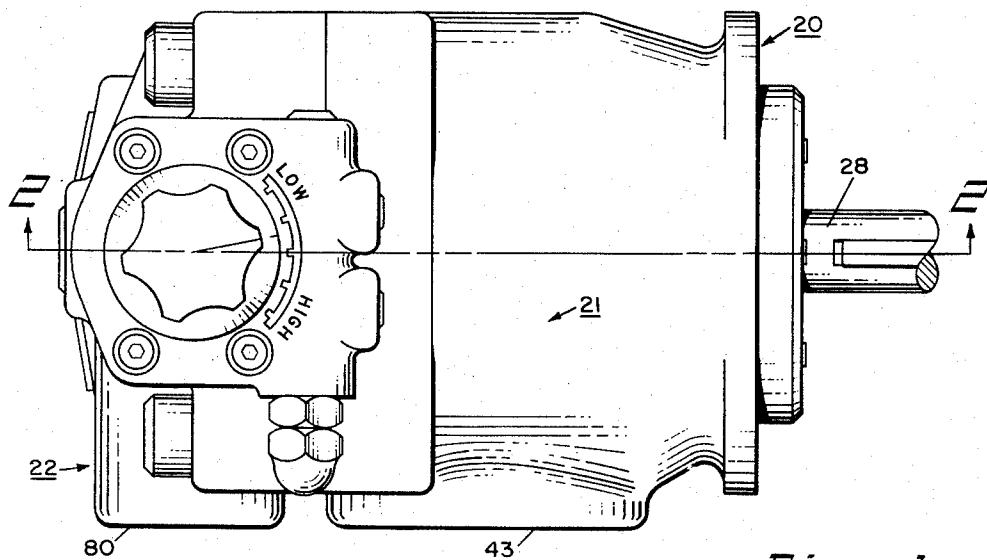


Fig. 1

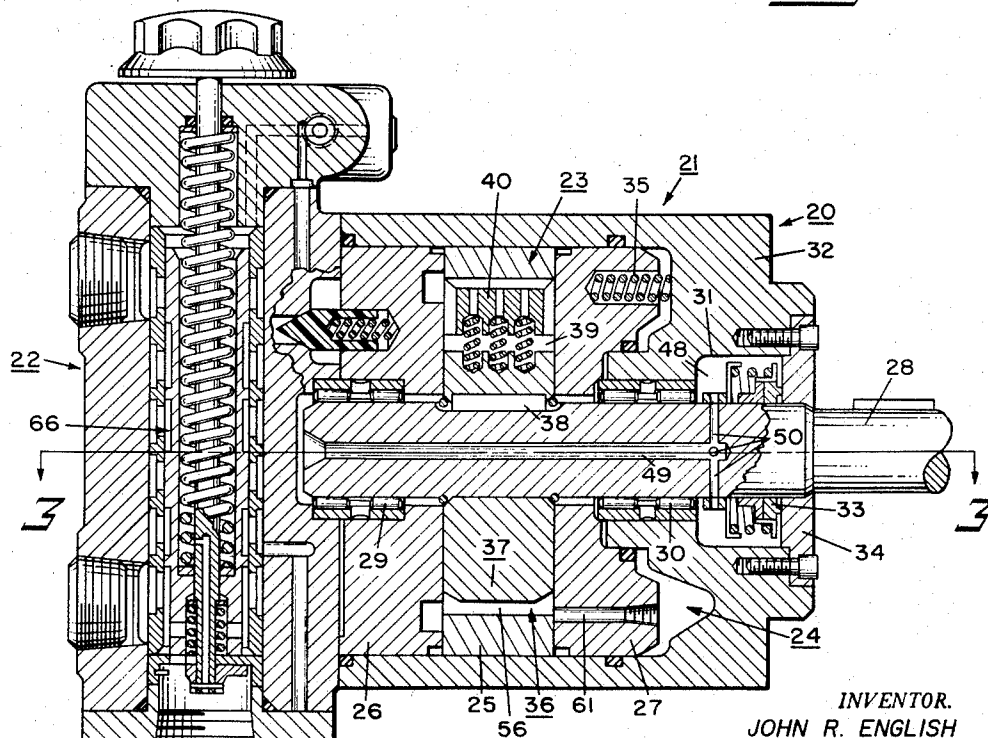


Fig. 2

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2 Sheets-Sheet 2

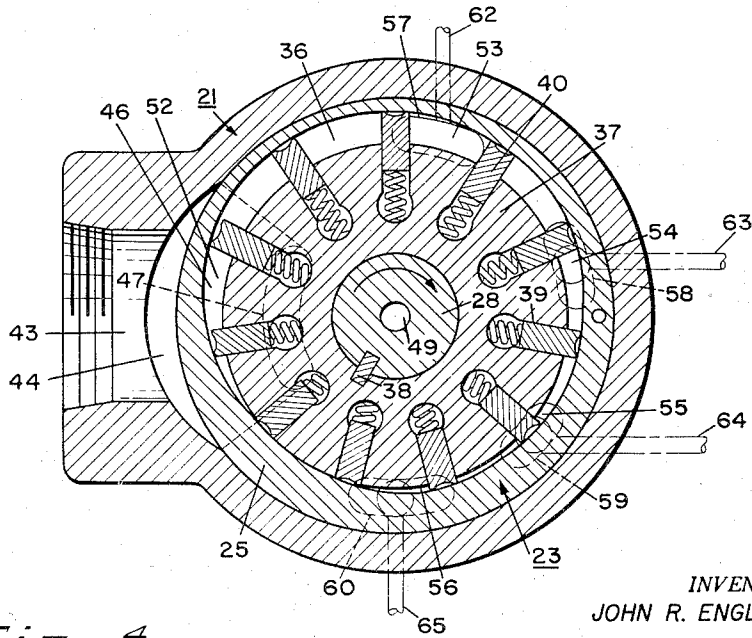
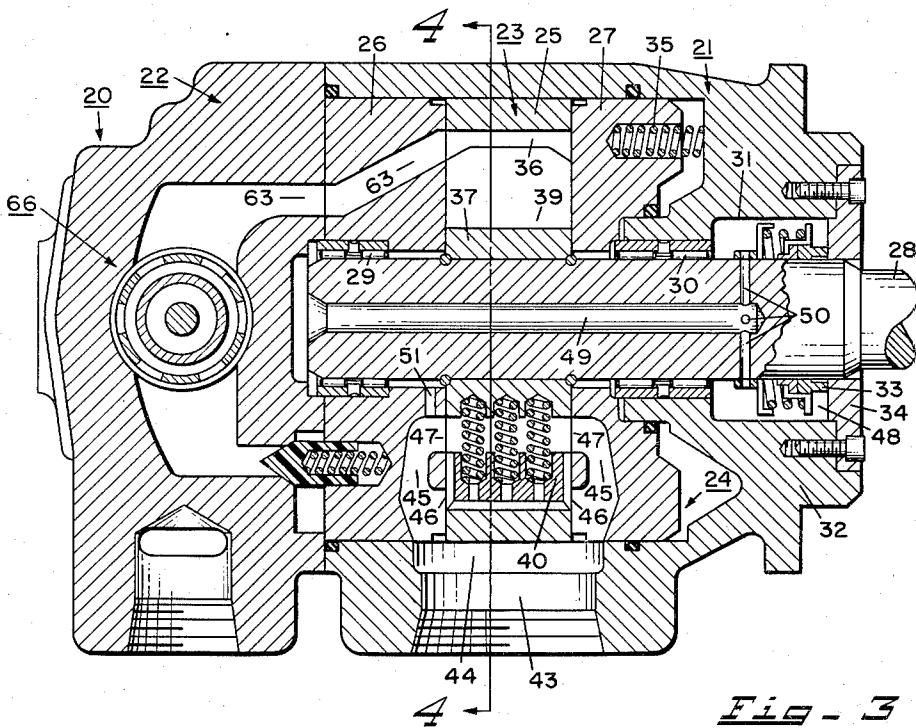


Fig. 4

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FLUID ENERGY TRANSLATING APPARATUSES

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2 Claims. (Cl. 103—136)

This invention relates to fluid energy translating apparatuses such as fluid pumps and motors.

One object of the invention is to provide improved construction in apparatuses of the types set forth.

Another object of the invention is to provide improved porting or passage means in fluid energy translating apparatuses of the types described.

Another object of the invention is to provide improved fluid energy translating apparatuses of the types described including improved porting or passage means which present low resistance to the flow of fluid therethrough thereby to minimize cavitation in the apparatuses.

A more specific object of the invention is to provide improved input or suction port or passage means in a fluid motor or pump wherein the flow of fluid with respect to the rotor chamber thereof is through substantially straight and preferably, but not necessarily, radially extending ports or passages opening into opposite ends of the rotor chamber.

Still another object of the invention is to provide improved structure in a cartridge type fluid energy translating apparatus including features set forth in the foregoing objects.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the accompanying drawings:

Fig. 1 is a view in elevation of a hydraulic pump apparatus including the features of the invention;

Fig. 2 is a view in section, the section being taken on line 2—2 of Fig. 1, and showing internal features of construction of the apparatus;

Fig. 3 is a view in section, the section being taken on line 3—3 of Fig. 2, and showing other internal features of construction in the apparatus including details of the input or suction port or passage means, and

Fig. 4 is also a view in section, the section being taken on line 4—4 of Fig. 3, and showing other details of the construction of the apparatus including other details of the input or suction port or passage means.

The apparatus shown in the drawings includes the features of the invention in a preferred form and this apparatus, which includes pumping and valving means in combination, was designed to provide a source of hydraulic fluid under pressure for use in a hydraulic system. The construction and operation of the complete apparatus is fully described in a co-pending application of Cecil E. Adams and William E. Eschliman, Serial No. 524,856, filed July 28, 1955, for improvements in "Pump Apparatus." It is to be understood therefore, that the construction and operation of the apparatus which embodies this invention follows in detail the structure and operation set forth in said co-pending application and that only those features of it which are pertinent to this invention are described in detail herein.

The complete apparatus 20 shown in the drawings in-

cludes a casing or housing formed by two main sections or parts 21 and 22, each of which is preferably a casting. Part 21 forms that part of the casing or housing in which a multiple-stage hydraulic pump 23 is contained, and part 22 forms an end cap for closing the open end of said casing or housing section 21. Part 22 also forms the body or housing for certain valve structures which per se form no part of the present invention and which, therefore, are not described herein in detail.

The pump casing or housing including the sections or parts 21 and 22 provides a cylindrical chamber 24 in which all of the parts of the pump 23 are housed. Pump 23 is of the type now well known in the art as a cartridge type pump, that is, a pump in which the actual pump parts form a cartridge and are telescoped within a casing or housing. In the apparatus 20 the cartridge type pump 23 includes a cam ring or stator 25 which is sandwiched between two end, face or cheek plates 26 and 27 in the form of thick, rigid disks each of which is preferably a casting and includes a central axial bore or opening through which a pump shaft 28 extends. One end of shaft 28 is carried for high speed rotation in the axial bore or disk 26 through an anti-friction bearing 29 and the other end of shaft 28 is carried by an anti-friction bearing 30 mounted in a stepped bore 31 in the end wall 32 of casing section 21. The free end of shaft 28 extends through the end wall 32 of casing or housing section 21 and is sealed to the end wall 32 by a suitable shaft seal 33 and a closure ring 34 which is attached to the casing end wall 32 by screws.

By reference to Figs. 2 and 3 of the drawings, it will be seen that one end of the cheek plate 26 engages and seals with a wall of the casing section or end cap 22, that the opposite end of this cheek plate 26 is engaged by one end of the cam ring 25 and that cheek plate 27 is urged by a plurality of springs, one of which is indicated at 35 in Fig. 2 of the drawings, against the other end of the cam ring 25. Thus all of the pump casing or housing elements 25, 26 and 27 are held together and urged at all times towards the casing section or end cap 22 by the springs 35.

It may be mentioned here that the elements 25, 26 and 27 are of such diameter that they have a close but slidable fit within the main bore of casing section 21 whereby they may be urged together by said springs and may move axially within the cylinder bore during assembly of the apparatus and also in response to expansion and contraction of the parts. The elements 25, 26 and 27 are locked together and with the casing section or end cap 22 by pin means, not shown, to prevent relative rotation between them and the casing or housing formed by the sections or parts 21 and 22. Casing or housing section 22 is bolted to the housing or casing section 21 and is sealed thereto through an O-ring which surrounds one end of the cheek plate 26, cheek plate 27 is sealed with the casing or housing section 21 and with a central boss on the casing wall 32 which surrounds bearing 30 by O-rings in order that the cheek plate 27 may move axially within chamber 24.

By reference to Figs. 2 and 3 of the drawings, it will be seen that the cheek plate 27 may function as a piston in the cylindrical chamber 24 and that, as above set forth, it is at all times urged by the springs 35 toward the cam ring 25 to maintain the elements 22, 26, 25 and 27 in proper relation. The function of the springs 35 is aided by fluid under pressure admitted to a pressure chamber or compartment formed between the rigid cheek plate 27 and the end wall 32 of casing or housing section 21 by means hereinafter described.

From the description thus far given, it will be apparent that all of the elements 21, 22, 25, 26 and 27 cooperate to provide a casing or housing unit and that the

housing elements 25, 26 and 27 of the cartridge type pump 23 cooperate to form the rotor chamber 36 of the pump 23. Shaft 28 extends axially through the rotor chamber 36 and carries a rotor 37 which is within the rotor chamber 36 and fits closely with the parallel end walls or faces thereof which are formed by the spaced cheek plates 26 and 27.

Rotor 37 is keyed to rotate with the shaft 28 by a key 38 and axial movement of shaft 28 with respect to rotor 37 is prevented by a pair of snap rings, one at each end of the rotor 37, that fit in circumferential grooves in the shaft 28 and chamfers at opposite ends of the central bore in rotor 37.

Rotor 37 includes a plurality of equally spaced, radially extending vane slots 39 (see Fig. 4) in each of which there is a vane 40 which is urged radially outwardly against the cam ring 25 by three springs (Figs. 2 and 3) each of which is seated at one end in a socket formed in the rotor body at the bottom of a vane slot 39.

Referring now to Figs. 3 and 4 of the drawings, the casing or housing section 21 is formed to include an internally threaded inlet or suction opening or port 43 through which hydraulic fluid is introduced into the apparatus 20. Inlet or suction opening 43 communicates directly with and terminates in an arcuate intake or suction chamber or recess 44 formed in the inside of the cylindrical wall of the bore or chamber 24 and this arcuate chamber or recess 44 is partly closed by the peripheral surface of cam ring 25 which overlays it. The cam ring 25 actually cooperates with the arcuate recess 44 to form two passages of substantially equal area which connect with radially extending channels or grooves 45 one of which is formed in each of the cheek plates 26 and 27 and which extend radially therein. The opposite ends of the cam ring 25 cooperate with these channels 45 to form conduits or passages one at each side of the cam ring 25 which terminate in ports 46 one at each of the opposite ends of the rotor chamber 36 and which ports 46 are also formed in part by the channels or grooves 45 and the peripheral wall of the rotor chamber formed by the annular wall of the cam ring 25.

Cored extensions of the channels or grooves 45 lead radially inwardly of the suction ports 46 to fluid supply ports 47 for the vane slots 39, the ports 47 being formed by the cheek plates 26 and 27. The fluid supply ports 47 function to connect the inner ends of the vane slots 39 to the pump suction ports 46 each time the slots 39 rotate past the ports 46 and 47 whereby the vane slots will become filled with hydraulic fluid.

Fluid which leaks to between the rotor 37 and the cheek plates 26 and 27 will pass radially inwardly to the shaft 28 and axially along it. As seen in Fig. 3, that portion of this hydraulic fluid which passes to the right from between the cheek plate 27 and rotor 37 passes along shaft 28 through the bearing 30 and into the shaft seal chamber 48. Shaft 28 includes a central axial bore 49 intersected by a plurality of radial bores 50 which open to the shaft seal chamber 48 and one intake or suction conduit or passage 45 through the bearing 29 and a conduit or passage 51 in cheek plate 26. Since there is a reduced pressure in the conduit or passage 45, hydraulic fluid is withdrawn from the shaft seal chamber 48 and returned through the passages mentioned to the conduit or passage 45. Hydraulic fluid which flows from between the rotor and the cheek plate 26 passes to the left along shaft 28 and is, of course, returned to the suction conduit or passage through passage 51.

As clearly shown in Fig. 4, the internal annular wall of the cam ring 25 forms the peripheral wall of the rotor chamber 36. This wall is generally circular but it includes a plurality of arcuate portions or lobes which cooperate with the rotor 37 to form a plurality of chambers or zones 52 through 56. Chamber 52 forms the fluid intake zone of the pump 23 and chambers 53 through

56 form pumping chambers or zones which decrease progressively in volumetric capacity. The pumping chambers or zones 53 through 56 are provided with outlet or output ports 57 through 60, respectively.

It will be seen that as the rotor 37 is rotated in the direction of the arrow seen in Fig. 4 that when the vanes 40 pass the intake or suction ports 46 which register with opposite ends of the intake chamber or zone 52 in the rotor chamber 36 that a reduced pressure will be created in said chamber or zone 52 and that fluid will be caused to flow directly from the inlet opening, passage or port 43 in the cylindrical housing wall into the suction chamber formed by the recess 44 and the cam ring 25 and to be divided by the latter to flow through the conduits or passages 45 (Fig. 3) and ports 46 into opposite ends of the chamber or zone 52. The vanes 40, which, of course, engage the spaced end walls of the rotor chamber 36 as well as its peripheral wall, force fluid from the intake chamber or zone 52 into the succeeding pumping chambers or zones 53 through 56 progressively and, because these chambers or zones decrease successively in volumetric capacity, a portion of such fluid is discharged from each of said chambers or zones 53 through 55 through the ports 57 through 59 and the remaining fluid is discharged from the pumping chamber or zone 56 through outlet port 60.

As previously indicated, the action of the springs 35 in urging the pump elements 25, 26 and 27 into engagement with each other and the casing cap section 22 is aided by fluid under pressure admitted to the pressure chamber in the housing or casing section 21 between the end wall 32 thereof and cheek plate 27. As indicated in Fig. 2 of the drawings, the above mentioned fluid pressure is admitted to said chamber through a conduit or passage 61 connected with pumping section 56.

The outlet or output ports 57 through 60 are connected, respectively, with conduits or passages 62 through 65 which lead to a main valve 66 in the casing section or end cap 62. Actually these conduits or passage means 62 through 65 are formed in part by cheek plate 26 of pump 23 and in part by the casing section or end cap 22 in the manner indicated in Fig. 3 of the drawings. It may be mentioned here that the abutting faces of the cheek plate 26 and end cap section 22 are ground and/or lapped in order that they may be held and sealed together solely by the action of the springs 35 and the fluid pressure assisting them to provide fluid tight connections between adjacent ends of the portions of conduits or passages 62 through 65 formed in the members 22 and 26.

Because the valve 66 and apparatus associated with it form no part of the present invention the structure and arrangement of them are not herein described. It suffices to say of this apparatus that it cooperates with the pump to cause the apparatus 20 to deliver any of numerous preselected output volumes at a substantially constant pressure.

From the foregoing description it will be seen that by this invention there has been provided improved construction in a fluid energy translating device that may be applied either to a pump or motor.

Among other things the improved construction includes improved porting structure exemplified herein by the intake or suction port or passage means for the pump 23. It will be seen, with reference to Fig. 3 of the drawings, that this improved porting includes the port or passage 43, arcuate recess 44, cam ring 25, channels or grooves 45 in cheek plates 26 and 27 and the ports 46 which open into opposite ends of the rotor chamber 36 and more specifically into the opposite ends of the fluid intake chamber or zone 53 of the pump. When the above enumerated passages and ports are employed as the intake or suction passage means of a pump, the flow of fluid through them is from the port 43 into the recess 44 where it is divided by the cam ring 25 to flow in substantially equal volumes through the straight radially extending pas-

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sages formed by the channels or grooves 45 and opposite ends of the cam ring 25 to the ports 46 which lead into the rotor chamber at opposite ends thereof.

It is well known in the art that there is a rate of rotation above which the rotor of a vane pump may not be driven since when the rotor is driven above the critical speed, fluid cannot enter the intake chamber or zone of the pump with sufficient rapidity to fill it. This incomplete filling of the intake chamber or zone is known in the art as "cavitation." It will be seen that in this invention the fluid intake chamber or zone 52 is supplied with fluid that flows through straight radially extending passageways spaced one at each end of the cam ring means 25 and into the intake chamber or zone 52 at opposite ends thereof through the ports 46 and that the chamber or zone 52 will be filled with hydraulic fluid from both of its ends and that one-half of the volume of fluid necessary to fill the chamber or zone 52 will enter it from each of its ends. Because of this arrangement and the fact that the passage arrangement herein described offer low resistance to the flow of fluid there-through, a pump including the features of this invention may be driven at a higher speed without cavitating.

It will also be seen that by this invention there has been provided an improved and simplified cartridge type fluid energy translating device which includes the porting features above described.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

I claim:

1. Structure in a fluid energy translating device of the floating cheek plate type, said structure including means forming a stator; a cheek plate means at each end of said stator cooperating with the latter to form a rotor chamber; a rotor in said chamber; means forming a housing telescoped over said stator and cheek plate means; wall means in said housing cooperating with one of said cheek plate means to form a pressure chamber in which said one cheek plate means functions as a piston to clamp said cheek plate means, stator and hous-

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ing together axially; a port in the housing wall radially opposite said stator, and a pair of passage means leading around opposite ends of said stator between said port and opposite ends of said rotor chamber, each of said passage means being formed at least in part by groove means in one of said cheek plate means and the adjacent end of said stator.

2. Structure in a fluid energy translating device of the floating cheek plate type, said structure including means forming a stator and cheek plate means at each end of said stator cooperating with the latter to form a rotor chamber, one of said cheek plate means being axially movable with respect to said stator; a rotor in said chamber; means forming a housing telescoped over said stator and cheek plate means; wall means in said housing cooperating with said axially movable cheek plate to form a chamber in which said axially movable cheek plate functions as a piston and may be moved toward said stator by pressure in said chamber; a port in the housing wall radially opposite said stator, and a pair of passage means, one through each of said cheek plate means leading around opposite ends of said stator and between said port and opposite ends of said rotor chamber.

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