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FLUID ENERGY TRANSLATING DEVICE

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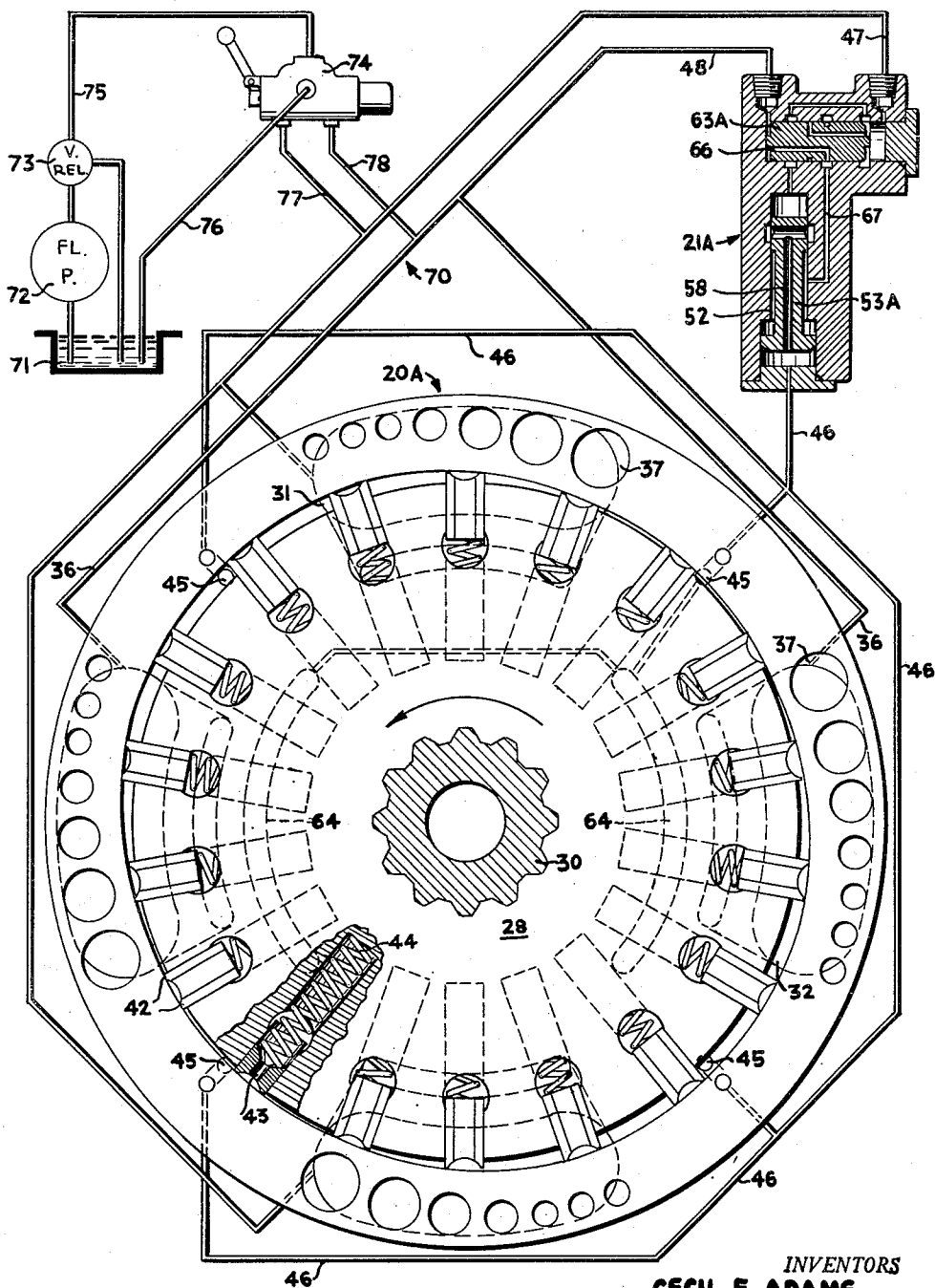


FIG. 3

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FLUID ENERGY TRANSLATING DEVICE

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14 Claims. (Cl. 103—136)

This invention relates generally to hydraulics and more particularly to fluid pressure energy translating devices of the type commonly called pumps and motors.

An object of this invention is to provide a fluid pressure energy translating device to be employed in transferring fluid under high pressures, the device serving either as a pump to generate high pressures or as a motor to be operated by fluid under high pressure.

Another object of the invention is to provide a fluid pump or motor so constructed as to secure the effect of a two stage device but actually have only one set of operating parts supplemented by suitable pressure regulating valve means, the latter being either separately formed or incorporated directly in the housing of the device.

A further object of the invention is to provide a fluid pump or motor of the vane type having a casing with inlet and outlet ports, the vanes cooperating with the casing to form pockets for transferring fluid from one port to another, the device being further provided with means for varying the pressure on the fluid in the pockets as they move between the ports so that the pressure differential of fluid on opposite sides of the vanes will never be more than a predetermined maximum.

A still further object of the invention is to provide a fluid pump or motor of the vane type having a casing with inlet and outlet ports, the vanes cooperating with the casing to form pockets for transferring fluid from one port to another, the casing having intermediate pressure ports preceding and following the port with the higher pressure, passages being provided to establish communication between the intermediate pressure ports and the other ports, a pressure regulating valve means being provided in connection with the passages to control the pressure of the fluid in the transfer pockets so that such pressure will be increased and decreased as the transfer pockets approach and move away from the various ports, the pressure changing in steps in moving from one port to another so that at no time will a predetermined pressure differential on opposite sides of the vanes be exceeded.

Another object of the invention is to provide a pump or motor of the type mentioned in the preceding paragraphs in which the valve mechanism is so constructed that the device may be operated in forward or reverse directions and still give the same results.

Still another object of the invention is to construct the valve mechanism mentioned in prior paragraphs with a spool element having opposed pressure engaged surfaces with areas of predetermined ratio, the valve mechanism serving to regulate the pressure obtaining in the fluid transfer pockets as they move from one port to another.

An object also is to provide the end walls of the casing with recesses or grooves disposed radially inwardly from certain of the inlet or outlet ports, such grooves or recesses being connected by suitable passages with the intermediate pressure ports whereby the same pressure will be maintained in these zones to the end that a selected port will be substantially surrounded by a zone in which a pressure bearing a predetermined ratio to that in the selected port exists at all times during operation of the device.

Further objects and advantages of the present invention

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will be apparent from the following description, references being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view of a portion of a hydraulic system provided with a pump and valve mechanism formed in accordance with the present invention, the valve being shown in section;

Fig. 2 is a sectional view showing a slightly modified form of valve;

Fig. 3 is a view similar to that shown in Fig. 1, the hydraulic system being provided with a motor embodying the present invention.

Referring more particularly to the drawings the numerals 20 and 20A designate fluid pressure energy translating devices. These are shown only diagrammatically being of the vane type and similar in general construction to the pump shown in the copending application Serial No. 288,476, filed May 17, 1952, in the names of Cecil E. Adams, and John English.

In this application the devices are modified, as will be apparent from the following description, and are employed in combination with valve mechanisms indicated generally by the numerals 21, and 21A.

In Fig. 1, the fluid pressure energy translating device 20, is employed as a pump to generate relatively high fluid pressure. The pump 20, is of the balanced vane type, having a casing 23, forming a substantially elliptical rotor chamber 24, having end and peripheral walls 25, and 26, respectively. The end walls are provided with ports spaced circumferentially of the chamber, the ports being arranged in diametrically opposed sets. The peripheral wall 26, serves to control the movement of vanes 27, which are slidably received by radially extending slots formed in a rotor 28, supported on a splined shaft 30, for rotation in the chamber. The peripheral wall is shaped to cause the vanes to move outwardly while they traverse the wall adjacent the ports 31, of one set, these ports being termed the inlet ports, and to move inwardly while moving past the ports 32, of the other set, these being termed the outlet ports. The vanes slidably engage the end walls of the chamber, and cooperate with these walls, the peripheral wall and rotor to form fluid transfer pockets designated by the numeral 33. Due to the shape of the peripheral wall and the continued engagement therewith by the vanes as they traverse, the volumetric capacity of the pockets 33, is varied. It increases when the pockets communicate with the inlet port and decreases when the pockets communicate with the outlet port. The rotation of the rotor will thus cause fluid to be transferred from the inlet to the outlet ports.

The inlet ports are supplied with fluid from a reservoir 34, through branched line 35. Fluid is conducted away from outlet ports through branched line 36. The inlet and outlet ports are formed in the end walls at both sides of the rotor in order to balance fluid pressures at both sides, and these ports are connected by a series of openings 37, formed in the casing or cam ring 38, forming a part thereof. As in the copending application, the end walls are provided with recesses 40, and 41, shown in dotted lines, which communicate directly with the inlet and outlet ports respectively, these recesses being disposed to register with the inner ends of the slots for the vanes 27. These vanes are formed with spaced sealing lips 42, at their outer and side edges, and have one or more openings 43, extending through the vanes to balance pressures at the inner and outer ends. Springs 44, constantly urge the vanes toward the peripheral wall to maintain contact therewith. Thus far described, the pump is substantially identical with the pump of the copending application mentioned previously.

This invention resides in providing the pump or motor with intermediate pressure ports 45, located either in the end or peripheral walls substantially half way between the ports 31, and 32. An intermediate pressure port is thus disposed in advance of and at the rear of each inlet and outlet port irrespective of the direction or rotation. All the ports are made of such size and so arranged that the space between adjacent ports of any kind is as great as the spacing between adjacent vanes. The vanes will therefore seal the ports and the fluid transfer pockets communicating therewith from one another.

One of the objects of the invention is to limit the pressure differential between opposite sides of the vanes or in adjacent pockets 33, to a predetermined amount. To accomplish this object, means are provided to supply the intermediate pressure ports with fluid under a predetermined fractional relation of the pressure in the port containing the highest pressures. In a pump such ports will be the outlet ports. The result of so supplying the intermediate ports with pressure less than the higher pressure in the outlet ports will be to cause the fluid under pressure in the pockets 33, to increase in increments while moving from the low to the high pressure ports, and decrease in like manner when moving from the high to the low pressure port. The means for supplying the fluid to the intermediate pressure ports includes a branched passage 46, connected with the intermediate pressure ports, a passage 47, connected with the line 36, leading from the outlet ports and a passage 48, connected with the line 35, leading to the inlet ports.

Passages 46, 47, and 48, all lead to a pressure regulating valve mechanism 21. This mechanism is shown in two forms 21, and 21A, in the drawings, but the principle of operation is the same in both. The regulating valve mechanism has a casing 51, forming a spool chamber 52, for slidably receiving a spool 53, which is formed with oppositely directed surfaces 54, and 55, having different areas, these bearing a predetermined ratio, in this instance two to one. The casing has a port or groove 56, disposed intermediate the ends of the chamber 52, communication between this groove and the chamber at either end of a head 57, on the spool 53, being controlled by the movement of the spool. Lines 36, and 47, leading from the outlet or highest pressure ports, supply fluid to the end of the chamber 52, to which surface 55, of the spool 53, is exposed. This surface is thus exposed to the pressure in the outlet ports of the pump.

The opposite end of the chamber is connected with the intermediate pressure ports 45, by line 46, thus exposing surface 54, of the spool to the pressure existing in ports 45, and the line 46. This line 46, is also connected by suitable passages 58, with the groove 56. The tendency of fluid pressure applied to the end surface 55, of the spool is to move the spool in the chamber until communication is established between line 47, and the intermediate ports through groove 56, passages 58, and line 46. Since there is no direct outlet from the intermediate pressure ports other than the movement of the transfer pockets toward the outlet ports, fluid pressure will build up in the intermediate pressure ports, the lines connected therewith and in the end of the spool chamber communicating with such lines. Due to the relatively larger area of surface 54, compared to surface 55, a lower pressure on the former will cause the spool to move to a position wherein flow from the outlet ports to the intermediate ports is interrupted. Should the pressure in the intermediate ports decrease, the spool will move to re-establish such flow. In the event the pressure in the intermediate pressure ports should increase beyond the predetermined amount, the force of this pressure on the surface 54, will move the spool until communication is established between groove 56, and the reservoir, through port 60, and line 61. The intermediate ports will in this manner be vented to reduce the pressure therein; as the pressure falls, spool 53,

will move to interrupt communication between groove 56, and the exhaust. By reason of the differential areas at the opposite ends of the spool 53, the pressure in the intermediate pressure ports will be maintained at the selected amount. As the fluid transfer pockets move from the low pressure ports toward the high pressure ports, the pressure in the pockets will increase to equal that in the intermediate pressure port as soon as communication is established between the pockets and the intermediate pressure ports. Since the ratio of areas of spool 53, is two to one, the pressure in the intermediate pressure ports and pockets communicating therewith, will be equal to the sum of the pressure in the low pressure port, and half the differential of pressure between the low pressure and high pressure ports. For example, assuming that the device is operating as a pump developing 4000 pounds pressure and the inlet of the pump is drawing fluid from a reservoir at atmospheric pressure. When the pockets 33 communicate with the inlet ports, they will fill with fluid at atmospheric pressure. As each pocket advances, the vane at the rear end will seal the pocket from the inlet port. Continued advancement will cause vane at the front end of the pocket to pass the adjacent intermediate pressure port. When this port communicates with the pocket, the pressure in the latter will instantly increase to that in the intermediate pressure port which will in this assumed case be one half of the pressure in the outlet port or 2000 p. s. i. Continued advancement of the pocket will cause the vane at the rear end to pass the intermediate pressure port and seal the pocket therefrom. Immediately thereafter the vane at the front end of the pocket will move beyond the edge of the outlet port and the pressure in the pocket will increase to that in the outlet port, i. e., 4000 p. s. i. When the pocket communicates with the intermediate pressure port disposed beyond the outlet port the pressure in the pocket will be reduced again to 2000 p. s. i., the pressure obtaining in the intermediate pressure ports. Obviously, when the pocket reaches the next inlet port, the pressure in the pocket will fall to atmospheric pressure.

It should be apparent that if the pump is supercharged or drawing fluid from a source under pressure, for example, of 1000 p. s. i., the pockets will receive fluid at such pressure when they communicate with the inlet ports. Then when they communicate with the intermediate pressure port following an inlet port the pressure in the respective pocket will increase by one half of the difference in pressure between the inlet and outlet port which, if the pump is operating at 4000 p. s. i., will be one half of 3000 p. s. i., or 1500 p. s. i. The pocket will therefore, contain fluid at 2500 p. s. i. When the pocket reaches the outlet port, the pressure in the pocket will immediately increase to 4000 p. s. i. As the pocket moves on to the next inlet port, the pressure will be reduced in step by step manner as before, falling to 2500 p. s. i., when communicating with the intermediate pressure port and then to 1000 p. s. i., when communicating with the outlet port. It should be obvious that irrespective of the pressures in the low and high pressure ports, at no time will the vanes be subjected to pressure differences at opposite sides thereof in excess of one half of the difference in pressures between such ports.

In some instances it has been found desirable to reverse the operations of the pump, in other words, to change the inlets to outlets, and vice versa. In doing so, the rotor and shaft of the pump are revolved in the opposite direction. The valve mechanism 21 has been designed to permit such reversal, yet operate in the same way to regulate the pressure supplied to the intermediate pressure ports. For this purpose, the casing 51, is provided with a second chamber 62, for the reception of a spool 63, one end of the chamber being connected with the inlet ports and the other being connected with the outlet ports. When the pump is reversed, the spool 63, will be moved from the position shown in Fig. 1, to the opposite end

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of the chamber, and line 48, now containing high pressure, will communicate with the end of the chamber 52, to which surface 55, is exposed. Spool 63, forms a valve which is responsive to fluid pressure to connect one or the other of two lines to the chamber 52.

To more or less completely encircle the high pressure or outlet ports of the pump with a zone of pressure equal to that in the intermediate ports, the end walls of the rotor chamber are provided with arcuate recesses 64, shown in dotted lines in Fig. 1, located radially inwardly from the outlet ports 32, and extending through at least an equal number of degrees of rotation as such ports. These recesses 64, are connected by suitable passage means 65, with the intermediate pressure ports to receive fluid under the same pressure. The fluid pressure in the recesses 64 will also tend to center the rotor in its chamber.

In the modified form of regulator valve mechanism 21A, the passages 58 are formed in the spool 53A. This spool operates in the same manner as spool 53. The second spool 63A is formed with a pair of passages 66 either of which is operative, depending upon the position of the spool 63A to connect a passage 67 leading from the chamber 52 at the lower end of the head 57, with the line 47A or 48A containing fluid at the lower pressure. Such line will communicate with the pump port functioning at the respective time as the inlet port. When the pump is reversed, spool 63A will shift and the other passage 66 will become effective to connect the passage 67 with the other of lines 47A or 48A, which then contains fluid at the lower pressure.

Fig. 3 illustrates diagrammatically, a system in which a fluid pressure energy translating device and valve combination formed in accordance with the invention, is employed as a motor. This system 70 has a reservoir 71, a motor driven pump 72, a relief valve 73, and a reversing valve 74. A line 75 containing the pump and relief valve leads from the reservoir to the inlet of the reversing valve. A second line 76 extends from the exhaust port of the valve to the reservoir. The valve has two work ports from which lines 77 and 78 extend, these lines communicating with the inlet and outlet ports of the motor. As previously set forth, the direction of rotation of the rotor and shaft desired will determine which of the ports are inlet and outlet ports. In a motor, the inlet port receives the high pressure fluid, while the fluid in the outlet is under lower pressure. If this fluid is conducted directly to the reservoir, the lower pressure may be atmospheric. In the system shown in Fig. 3, a pressure regulating valve mechanism 21A the same as that shown in Fig. 2 is utilized. The lines 46, 47, and 48, are connected in the same manner with the ports in the valve mechanism and the motor. The operation of the motor is approximately the same as in the form first described except that the fluid drives the rotor and shaft. The intermediate pressure ports 45 function in the same way and are provided for the same purpose as in the form first described.

From the foregoing it will be apparent that a fluid energy translating device which will attain the objects set forth at the beginning of this specification has been provided. This device will function as a fluid pump or motor for delivering fluid under high pressure or for being operated by fluid under high pressure yet at no time during the cycle of operation will the vanes be subject to a differential in pressure at opposite sides thereof in excess of a predetermined fractional part of the maximum pressure in the device. The fluid pressure is increased and decreased in increments as the fluid transfer pockets approach and move away from the ports containing the fluid under the highest pressure.

It should be obvious that the invention is shown only diagrammatically and only one form has been described. The invention is susceptible to modification and the regulating valve mechanism could be separately formed or it could be incorporated directly in the casing of the pump

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or motor without departing from the principles of the invention.

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.

We claim:

1. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with inlet and outlet ports spaced circumferentially thereof; a rotor disposed for revolution in said chamber, said rotor being formed with radial slots; vane elements received by said slots, said vane elements engaging said side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to increase the volumetric capacity of said fluid transfer pockets while they communicate with said inlet port and decrease such capacity while said pockets communicate with said outlet port, said casing having intermediate pressure ports disposed on either side of said outlet port and communicating with the fluid transfer pockets between said inlet and outlet ports, the spaces between said intermediate and adjacent inlet and outlet ports being at least as great as the space between adjacent vanes; passage means connected with said outlet, said inlet, and said intermediate pressure ports; and a pressure responsive valve connected with said passage means, said valve serving to alternately establish communication between the passage connected with said intermediate pressure ports and passages connected with a port containing pressure and exhaust to apply fluid from the pressure containing port at a pressure less than that in such port to said intermediate pressure ports.

2. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with inlet and outlet ports spaced circumferentially thereof; a rotor disposed for revolution in said chamber, said rotor being formed with radial slots; vane elements received by said slots, said vane elements engaging said side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to increase the volumetric capacity of said fluid transfer pockets while they communicate with said inlet port, and decrease such capacity while said pockets communicate with said outlet port, said casing having intermediate pressure ports disposed on either side of said outlet port and communicating with the fluid transfer pockets between said inlet and outlet ports, the spaces between said outlet and intermediate pressure ports being at least as great as the space between adjacent vanes; passage means connected with said outlet, said inlet, and intermediate pressure ports; and a pressure regulating valve connected with said passage means, said valve being responsive to differences in pressures in certain of said passages to establish communication between said intermediate ports and said outlet ports for applying a fractional part of the outlet port pressure to said intermediate pressure ports.

3. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with inlet and outlet ports spaced circumferentially thereof; a rotor disposed for revolution in said chamber, said rotor being formed with radial slots; vane elements received by said slots, said vane elements engaging said side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to increase the volumetric capacity of said fluid transfer pockets while they communicate with said inlet port and decrease such capacity while said pockets communicate with said outlet port, said casing having intermediate pressure ports disposed on either side of said outlet port and communicating with the fluid transfer pockets between said inlet and outlet ports, the spaces between said intermediate pressure and adjacent inlet and outlet ports being at least as great as the space between adjacent vanes; pas-

sage means connected with said outlet, said inlet, said intermediate pressure ports and exhaust; a pressure regulating valve in said passage means, said valve having oppositely facing surface areas of predetermined ratio exposed to the pressures in said outlet and intermediate ports and responsive to predetermined changes therein to apply fluid from said outlet port at a predetermined fractional part of the pressure therein to said intermediate pressure ports.

4. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with inlet and outlet ports spaced circumferentially thereof; a rotor disposed for revolution in said chamber, said rotor being formed with radial slots; vane elements received by said slots, said vane elements engaging said side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to increase the volumetric capacity of said fluid transfer pockets while they communicate with said inlet port and decrease such capacity while said pockets communicate with said outlet port, said casing having intermediate pressure ports disposed on either side of said outlet port and communicating with the fluid transfer pockets between said inlet and outlet ports, the spaces between said intermediate and adjacent inlet and outlet ports being at least as great as the space between adjacent vanes; passage means connected with said outlet, said inlet, said intermediate pressure ports and exhaust; and a valve in said passage means, said valve having opposed areas of two to one size ratio exposed to pressures in the one port of said inlet and outlet ports containing the highest pressure and said intermediate pressure ports, said valve being operative to apply metered amounts of fluid from said one port at one-half the pressure in said port to said intermediate pressure ports.

5. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with inlet and outlet ports spaced circumferentially thereof; a rotor disposed for revolution in said chamber, said rotor being formed with radial slots; vane elements received by said slots, said vane elements engaging said side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to increase the volumetric capacity of said fluid transfer pockets while they communicate with said inlet port and decrease such capacity while said pockets communicate with said outlet port, said casing having intermediate pressure ports disposed on either side of said outlet port and communicating with the fluid transfer pockets between said inlet and outlet ports, the spaces between said intermediate and adjacent inlet and outlet ports being at least as great as the space between adjacent vanes; passage means connected with said outlet, said inlet, said intermediate pressure ports and exhaust; a valve in said passage to control the introduction of fluid from the port containing the higher pressure to said intermediate pressure ports, said valve having a casing and a spool member with opposed areas of different sizes, the smaller area being exposed to the higher pressure and the larger area being exposed to the pressure of said intermediate ports, movement of said spool serving to control flow of fluid from the port containing the higher pressure to said intermediate pressure ports.

6. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with inlet and outlet ports spaced circumferentially thereof; a rotor disposed for revolution in said chamber, said rotor being formed with radial slots; vanes elements received by said slots, said vane elements engaging said side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to increase the volumetric capacity of said fluid transfer pockets while they communicate with said inlet port and decrease such capacity while said pockets communicate with said outlet port, said casing having intermediate

pressure ports disposed on either side of said outlet port and communicating with the fluid transfer pockets between said inlet and outlet ports, the spaces between said intermediate pressure and adjacent inlet and outlet ports being at least as great as the space between adjacent vanes; and interconnected conduit and valve means responsive to the pressures in certain of said inlet and outlet and intermediate pressure ports for applying fluid from said certain port at a reduced pressure to said intermediate pressure ports to increase the pressure on the fluid in the pockets communicating with said intermediate pressure ports.

7. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with spaced alternately arranged inlet and outlet ports and intermediate pressure ports disposed between and communicating with said rotor chamber at points between said inlet and outlet ports; a rotor disposed for rotation in said chamber; vane elements carried by said rotor and engaged with side and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to move said vane elements to increase the volumetric capacity of said pockets while communicating with said inlet port and decrease such capacity while communicating with said outlet port, the spacing of adjacent ports being at least as great as the spacing of adjacent vanes; means forming passages connecting said ports for applying fluid from the particular port of said inlet and outlet ports containing the higher pressure to said intermediate pressure ports; and valve means in said passages responsive to the fluid pressures in certain of said ports to limit the pressure applied to said intermediate pressure ports.

8. A fluid pressure energy translating device comprising a casing having side and peripheral walls forming a rotor chamber with alternately arranged inlet and outlet ports and intermediate pressure ports between adjacent ports; a rotor disposed for rotation in said chamber; vane elements carried by said rotor and engaged with said side and peripheral walls to form fluid transfer pockets each of which communicates with an intermediate pressure port between periods of communication with said inlet and outlet ports, said peripheral wall being shaped to move said vane elements to increase the volumetric capacity of said pockets while they communicate with said inlet port and decrease such capacity while said pockets communicate with said outlet port, the spacing of adjacent ports being at least as great as the spacing of adjacent vanes; valve mechanism having a housing with a spool chamber with ports spaced longitudinally thereof one port communicating with said inlet port another communicating with said intermediate pressure ports and a third communicating with said outlet port; and a spool means in said chamber responsive to the pressures in certain of said ports to control communication between the port communicating with said intermediate ports and the other ports.

9. A fluid energy translating device comprising a casing with end and peripheral walls forming a rotor chamber having inlet and outlet ports and intermediate pressure ports preceding and following such ports, all of said ports communicating with said rotor chamber; a rotor journaled for rotation in said chamber; vane elements projecting from said rotor and engaging said end and peripheral walls to form fluid transfer pockets; said peripheral wall being shaped to vary the volumetric capacity of said pockets as the rotor revolves, the capacity increasing and decreasing while the pockets communicate with said inlet and outlet ports, respectively; fluid conducting passages connecting said intermediate pressure, said inlet and outlet ports to supply fluid to the former; and pressure regulating valve means in said passages, said valve means being operative to regulate the pressure of fluid supplied to the intermediate pressure ports so that the fluid transfer pockets will contain fluid at a pressure equal

to the average of the pressures in the inlet and outlet ports when moving between such ports.

10. A fluid pressure energy translating device comprising a casing with end and peripheral walls forming a rotor chamber having inlet and outlet ports and intermediate pressure ports disposed substantially midway between adjacent inlet and outlet ports, each of said ports communicating with said rotor chamber; a rotor journaled for rotation in said chamber; vane elements projecting from said rotor and engaging said end and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to vary the volumetric capacity of said pockets as the rotor revolves, the capacity increasing and decreasing while the pockets communicate with said inlet and outlet ports, respectively; means for supplying said intermediate ports with fluid under pressure from the particular port of said inlet and outlet ports containing the higher pressure, said means having passages leading from said inlet and outlet and pressure ports; means forming a valve casing communicating with said passages; valve means movable in said casing to control communication between said intermediate pressure and said inlet and outlet ports; and passage means for applying fluid pressure from said ports to said valve means to effect movement thereof.

11. A fluid pressure energy translating device comprising a casing with end and peripheral walls forming a rotor chamber having inlet and outlet ports and intermediate pressure ports disposed substantially midway between adjacent inlet and outlet ports, each of said ports communicating with said rotor chamber; a rotor journaled for rotation in said chamber; vane elements projecting from said rotor and engaging said end and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to vary the volumetric capacity of said pockets as the rotor revolves, the capacity increasing and decreasing while the pockets communicate with said inlet and outlet ports, respectively; means for supplying said intermediate ports with fluid under pressure from the particular port of said inlet and outlet ports containing the higher pressure, said means having passages leading from said inlet and outlet and pressure ports; means forming a valve casing communicating with said passages; and a valve element having opposed surfaces of different areas disposed for movement in said casing, the smaller area of said element being exposed to the pressure in the particular port of said inlet and outlet ports containing the higher pressure, the larger area being exposed to the pressure in said intermediate ports, said element being responsive to predetermined differences in pressures in said ports to control the flow of pressure fluid from said particular port to said intermediate ports.

12. A fluid pressure energy translating device comprising a casing with end and peripheral walls forming a rotor chamber having inlet and outlet ports and intermediate pressure ports disposed substantially midway between adjacent inlet and outlet ports, each of said ports communicating with said rotor chamber; a rotor journaled for rotation in said chamber; vane elements projecting from said rotor and engaging said end and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to vary the volumetric capacity of said pockets as the rotor revolves, the capacity increasing and decreasing while the pockets communicate with said inlet and outlet ports, respectively; means for supplying said intermediate ports with fluid under pressure from the particular port of said inlet and outlet ports containing the higher pressure, said means having passages leading from said inlet and outlet and pressure ports; means forming a valve casing communicating with said passages; and a valve element having opposed surfaces with area ratios of two to one disposed for movement in said casing, the smaller area of said element being exposed to the pressure in the particular port of said inlet and outlet ports containing the higher pressure, the larger area being exposed to the pressure in said intermediate ports, said

element being responsive to predetermined differences in pressures in said ports to control the flow of pressure fluid from said particular port to said intermediate pressure ports.

13. A fluid pressure energy translating device comprising a casing with end and peripheral walls forming a rotor chamber having inlet and outlet ports and intermediate pressure ports disposed substantially midway between adjacent inlet and outlet ports, each of said ports communicating with said rotor chamber; a rotor journaled for rotation in said chamber; vane elements projecting from said rotor and engaging said end and peripheral walls to form fluid transfer pockets, said peripheral wall being shaped to vary the volumetric capacity of said pockets as the rotor revolves, the capacity increasing and decreasing while the pockets communicate with said inlet and outlet ports, respectively; means for supplying said intermediate ports with fluid under pressure from the particular port of said inlet and outlet ports containing the higher pressure, said means having passages leading from said inlet and outlet and pressure ports; means forming a valve casing communicating with said passages; a valve element disposed for movement in said casing, said element having opposed surfaces of different areas; and a second valve element disposed for movement in said casing, said second valve being exposed to the pressures in said inlet and outlet ports and responsive to the higher pressure to move to apply such pressure to the smaller area of the first-mentioned valve element, the larger area of the first-mentioned valve element being exposed to the pressure in said intermediate ports, said element moving in response to predetermined differences in pressures applied thereto to control the flow of pressure fluid from said valve casing to said intermediate pressure ports.

14. Hydraulic apparatus comprising a source of fluid pressure; a reversing valve communicating with said pressure source and having a pair of working fluid ports; a fluid motor having a casing with inlet and outlet ports connected with the working fluid ports of said reversing valve; means mounted for movement in said casing, said means forming fluid transfer pockets which alternately communicate with said inlet and outlet ports upon movement of said means; said casing having intermediate pressure ports disposed for communication with said fluid transfer pockets between periods of communication thereof with said inlet and outlet ports; means for connecting either of said inlet and outlet ports with said intermediate ports, said means forming a pair of valve chambers; a first valve element disposed for movement in one of said chambers, said first valve element having opposed surfaces of different areas, the larger area being exposed to the fluid pressure in said intermediate ports; and a second valve element in the other of said chambers, said second valve element being movable in response to differentials in pressure in said inlet and outlet ports to apply fluid from the port containing the higher pressure to the smaller area of said first valve element, the latter valve element moving in response to predetermined pressure differences to alternately connect said intermediate pressure ports with said inlet and outlet ports to maintain a predetermined pressure ratio between said intermediate pressure ports and the motor ports containing the highest pressure.

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