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HYDRAULIC MOTOR AND PUMP COMBINATIONS

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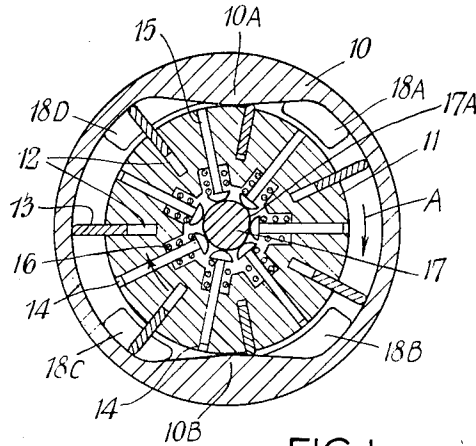


FIG. 1

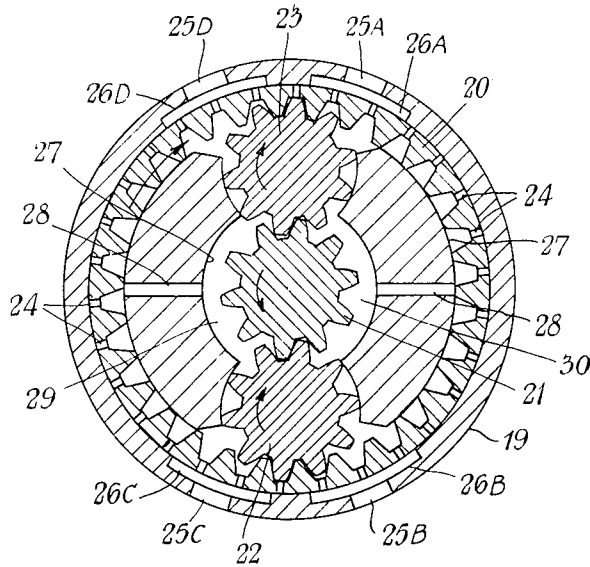


FIG. 2

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HYDRAULIC MOTOR AND PUMP COMBINATIONS

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3 Claims. (Cl. 103—118)

This invention relates to hydraulic motor and pump combinations.

In systems such as the central heating circuit of a multi-story building or a hydraulic cooling circuit of a mine, difficulties are encountered due to the difference in pressure between the fluid in the upper part of the system and that in the lower part. As regards the mine cooling circuit, water cooled at ground level is fed to cooling coils underground. Owing to the depth of the mine there is a high pressure in the lower part of the circuit which has the disadvantage that standard cooling coils cannot be used as they are unable to withstand the high pressures involved. If the cooled water flowing into the mine is merely discharged into, for example, a tank before being passed to the cooling coils then the disadvantage arises that all the potential energy of the water is lost and furthermore considerable energy must be expended in pumping the water, after it has passed through the cooling coils, back to the surface.

It is an object of the present invention to provide a hydraulic motor and pump combination which overcomes these disadvantages.

According to the present invention there is provided a hydraulic motor and pump combination comprising a stationary casing, a high pressure fluid inlet to the casing, a low pressure fluid outlet to the casing, a low pressure fluid inlet to the casing, a high pressure fluid outlet to the casing, rotatable means for conveying fluid from the first-mentioned inlet to the first-mentioned outlet and for conveying fluid from the low pressure inlet to the high pressure outlet, said rotatable means allowing the pressure of fluid passing from said high pressure inlet to said low pressure outlet to drop, and causing the pressure of fluid passing from said low pressure inlet to said high pressure outlet to be raised, parts of said rotatable means projecting from the remainder of said means and presenting surfaces upon which high pressure fluid entering at the first-mentioned inlet acts and tends to turn the rotatable means.

For a better understanding of the invention reference will now be made to the accompanying drawing, in which:

FIGURE 1 is a cross section of a hydraulic motor and pump combination having radially moving vanes, and

FIGURE 2 is a cross section of a further hydraulic motor and pump combination.

The hydraulic motor and pump combination shown in FIGURE 1 includes a stationary main casing 10 within which a hollow rotor 11 is mounted. A motor (not shown) is mounted outside the casing 10 for driving the rotor 11. The interior configuration of the casing 10 is substantially cylindrical but includes upper and lower lobes 10A, 10B which protrude inwardly towards the rotor 11. The rotor 11 has a plurality of slots 12 therein and a vane 13 is mounted in each slot 12 for movement radially of the rotor 11. The radially outer edge of each vane slides on the casing 10 so that the space between the casing 10 and rotor 11 is divided into a number of separate chambers.

Between each pair of adjacent slots 12 there is formed a bore 14 which passes through the rotor 11 and opens into the central cavity of the rotor. A mushroom-headed plunger 15 is mounted in each bore 14 and a spring 16 holds the head of each plunger against a sta-

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tionary shaft 17. The shaft 17 is unsymmetrical in cross section and when the rotor 11 turns this shaft causes the plungers 15 to be displaced radially outwardly against the action of said springs 16.

The main casing 10 is formed with four ports 18A, 18B, 18C, 18D and, assuming rotation in the direction indicated by the arrow A in FIGURE 1, the ports 18A and 18C act as inlets and the ports 18B and 18D as outlets.

In use of the motor and pump combination in, for example, the central heating system of a multi-story building, the port 18C is connected to the boiler to receive hot water at low pressure therefrom, the port 18D is connected to the riser leading to the radiator system to be fed, the port 18A is connected to the outlet of said radiator system and the port 18B to the inlet of the boiler.

Water fed in at low pressure through port 18C is carried by the vanes 14 to the port 18D against the pressure existing at the lower end of the riser. By virtue of the shape of the casing 10, and the outward movement of the plungers 15 caused by the shaft 17, the pressure of the hot water is increased to said pressure at the lower end of the riser.

The high pressure water fed in through port 18A from the radiator system enters the spaces behind vanes which have just passed the port 18A and acts on those vanes in such a manner as to tend to turn the rotor 11. As the rotor turns the heads of the plungers co-operate with the flat 17A on the shaft 17, and the plungers 15 are moved radially inwardly by the springs 16. The pressure of the water being returned to the boiler is thus reduced before it passes through the port 18B, and its pressure energy is converted to kinetic energy of the rotor 11.

As the pressure difference existing between ports 18D and 18A is negligible, the seal between the rotor 11 and lobe 10A need not be of a high quality for there is very little tendency for fluid to leak from port 18A to 18D or vice versa. Similar considerations apply as regards ports 18B and 18C.

Turning now to FIGURE 2, the pump and motor combination shown therein includes a stationary casing 19 within which is mounted a rotatable internal gear 20. The gear 20 is rotated by a driven central gear 21 via further gears 22 and 23. The motor for driving gear 21 is not illustrated. A plurality of ports 24 are provided in the gear 20, the ports 24 serving to place the spaces between the teeth of the gear in communication with the outside of the gear.

The casing 19 is provided with four ports 25A, 25B, 25C and 25D which open into recesses 26A, 26B, 26C, 26D formed in the inner surface of the casing 19.

Two fixed crescent-shaped baffles 27 are provided within the gear 20. The outer arcuate surface of each baffle 27 co-operates with the teeth of the gear 20, and the curved end surfaces of the baffles co-operate with the teeth of the gears 22, 23. Bores 28 are provided through the baffles 27.

In use of the pump and motor combination high pressure fluid enters the combination at, for example, 25A (assuming the gears rotate as shown by the arrows) and leaves at 25B. Similarly low pressure fluid enters at 25C and leaves at 25D.

Fluid which enters at, for example, port 25A enters the inter-teeth spaces of the gear 23 and is fed to the space 30. Subsequently this fluid is fed by the gear 22 to the port 25B. Further fluid is trapped in the inter-teeth spaces of the internal gear 20 and is fed in these spaces to the recess 26B and thence to the port 25B.

In a similar manner fluid entering through port 26C is fed by gear 20 to the port 25D and fluid is fed also by gears 22 and 23 to the port 25D via the space 29.

Although the motor and pump combination shown in FIGURE 2 has only one pair of gears 22 and 23, further pairs of such gears may be provided and the baffles 27 are shaped accordingly.

The motor which drives gear 21, or rotor 11 in FIGURE 1, need only be of sufficient power to make up for frictional losses in the circuit, the bulk of the power required to raise fluid being provided by high pressure fluid flowing down the return pipe connected to port 18A (FIGURE 1) or port 25A (FIGURE 2) and which tends to turn rotor 11 and gear 20.

The bores 28 serve to equalise the pressures between the spaces 29 and 30 and the inter-teeth spaces of the gear 20 with which each of these bores 28 communicate.

I claim:

1. A hydraulic motor and pump combination comprising a stationary casing, a high pressure fluid inlet to the casing, a low pressure fluid outlet to the casing, a low pressure fluid inlet to the casing, a high pressure fluid outlet to the casing, and rotatable means comprising an internal gear, a central gear mounted concentrically with said internal gear and at least one pair of gears each meshing with said central gear and said internal gear for forming seals between the low pressure fluid inlet and outlet and between the high pressure fluid inlet and outlet and for conveying fluid from said high pressure fluid inlet to said low pressure fluid outlet and for conveying fluid from said low pressure fluid inlet to said high pressure fluid outlet, parts of said rotatable means projecting from the remainder of said means and presenting surfaces upon which high pressure fluid entering at said high pressure fluid inlets acts and tends to turn said rotatable means.

2. A motor and pump combination according to claim 1, and further comprising two crescent-shaped baffles arranged on diametrically opposed sides of said central gear, each baffle extending from adjacent one of the gears of said pair of gears to adjacent the other gear of said pair of gears, and both baffles having arcuate surfaces co-operating with the teeth of said internal gear and said pair of gears to seal inter-teeth spaces of each of these gears.

3. A hydraulic motor and pump comprising in combi-

nation: a hollow stationary casing having a substantially cylindrical interior surface; said casing including a high pressure fluid inlet port, a low pressure fluid outlet port, a low pressure fluid inlet port and a high pressure fluid outlet port, all of said ports communicating with the interior of said casing; an internal gear means rotatably carried adjacent the cylindrical interior surface of said casing, said internal gear means including a plurality of circumferentially spaced teeth extending radially inward of the cylindrical interior surface of said casing and a plurality of ports communicating the space intermediate the teeth of said internal gear means with the outer surface of said internal gear means; a central gear mounted concentrically with said internal gear; at least one pair of gears, each one of said pair of gears meshing with said central gear and said internal gear means to thereby form a seal between the low pressure inlet and outlet ports and between said high pressure inlet and outlet ports, respectively; and a pair of generally crescent shaped baffles arranged on diametrically opposed sides of said central gear, each of said baffles extending from adjacent one of the gears of said pair of gears to the other gear of said pair, and both of said baffles having arcuate surfaces co-operating with the teeth of said internal gear and said pair of gears to seal the inter-teeth spaces of said internal gears and said pair of gears.

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