March 22, 1960 W. A. RAY 2,929,330

GEAR PUMP OPERATED HYDRAULIC MOTOR

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Fig. 1

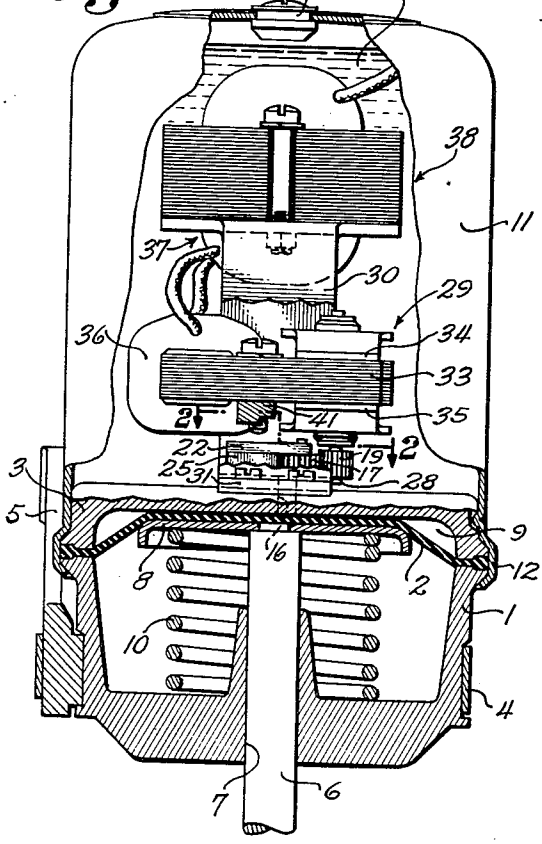


Fig. 2

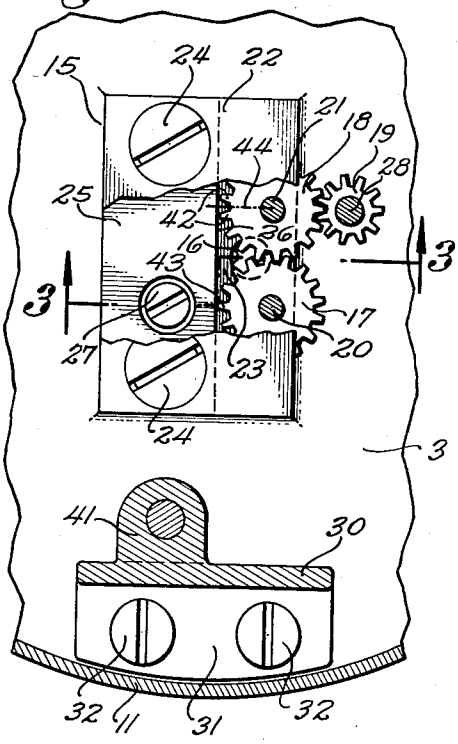


Fig. 3

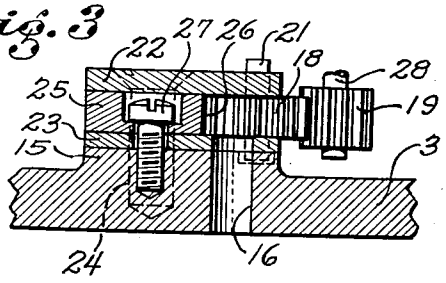
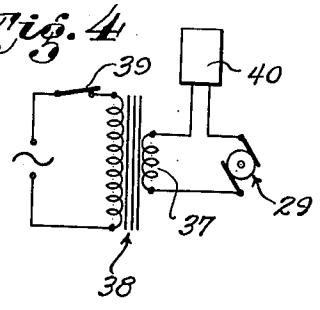


Fig. 4



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GEAR PUMP OPERATED HYDRAULIC MOTOR

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3 Claims. (Cl. 103—126)

This invention relates to hydraulic motors adapted to operate a load by movement of an actuator.

Motors of this type are well-known. In one form, oil under pressure serves to depress a movable wall carrying the actuator, and against the force of a spring. When the oil pressure is relieved, the spring moves the wall and its associated actuator in an opposite direction.

It has been common to utilize such a device for operating such loads as a valve or a damper in heating apparatus, and in response to a condition, such as temperature variations beyond limits. In such prior motors, it is customary to provide an electric motor operated pump to supply the requisite liquid under pressure to the movable wall; and when the actuator reaches a limiting position, the motor driving the pump is deenergized. The actuator is held at this limiting position until a valve is opened that permits the pressure to be relieved.

It is one of the objects of this invention substantially to simply such hydraulic motors; for example, to make it unnecessary to use a relief valve, to simplify the pump construction, and to provide for a limiting position of the actuator without using any circuit controlling devices.

In order to accomplish these results, the device incorporating the invention utilizes a gear pump driven by a small electric motor. Since such gear pumps do not entirely block reverse flow of liquid when there is a pressure sufficiently great to overcome the pressure delivered by the pump, this makes it unnecessary to provide a relief valve; furthermore, the gear pump may be so arranged that the forces due to pump operation do not deleteriously affect the alignment of the motor shaft. This shaft can thus be made quite small.

It is accordingly another object of this invention to provide a gear pump structure in a hydraulic motor, having these advantages.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming a part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a view, mainly in longitudinal section, of a hydraulic motor incorporating the invention;

Fig. 2 is an enlarged fragmentary sectional view, taken along a plane corresponding to line 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional view, taken along a plane corresponding to line 3—3 of Fig. 2; and

Fig. 4 is a wiring diagram of a system utilizing the invention.

In common with well-known types of hydraulic motors, the device shown herein has a hollow body 1 provided

with a movable wall, such as a flexible diaphragm 2. This flexible diaphragm is clamped at its edge to the upper edge of the body 1 by the aid of a cover 3. The cover 3 and the body 1 may be appropriately made from castings. The device may be supported, as by a strap 4, upon a bracket 5.

An actuator 6 extends through a bore 7 formed in the body 1. This actuator is in the form of a bar or rod joined at its upper end to a metal cupped member 8 engaging the lower surface of the diaphragm 2.

The space 9 between the upper surface of the diaphragm 2 and the cover 3 may be supplied with liquid under pressure to depress the diaphragm 2 against the action of a compression spring 10, located within the body 1.

The mechanism for controlling the passage of liquid under pressure into the chamber 9, is accommodated above the cover 3 and within a casing member 11. This casing member 11 has a lower flange 12 closely encompassing the adjacent edges of the cover member 3, the diaphragm 2 and the body 1. It provides a substantially liquid-tight enclosure above the cover member 3 for accommodating the liquid 13, which may conveniently be oil or the like. A filler plug 14 of yieldable material, such as rubber or the like, is removably located within an aperture in the upper wall of the casing member 11.

The upper surface of the cover 3 is provided with a boss 15 through which a port 16 extends. This port serves to pass liquid into and out of the chamber 9.

In order to create a pressure for the pumping of the liquid through the port 16, use is made of a gear pump operated by an electric motor. The gear pump includes intermeshing gears 17 and 18. These gears intermesh adjacent the port 16, as shown most clearly in Fig. 2. Gear 18 operates in a counterclockwise direction and the gear 17 in a clockwise direction. Furthermore, the gear 18 is driven as by the aid of a pinion 19. The port 16 opens into a pump outlet space defined by the gears 17, 18 and an edge surface 26.

Portions of the gears 17 and 18 are disposed in liquid body 13. Accordingly, liquid is urged from the body of liquid into the outlet space toward port 16.

Both of the gears 17 and 18 are respectively provided with shafts 20 and 21 parallel to the axis of port 16 and disposed on opposite sides thereof. The shafts 20 and 21 for the gears 17 and 18 are journaled at their upper ends in a cover plate 22, and the lower end within a bottom plate 23. This bottom plate 23 rests upon the boss 15, as shown most clearly in Fig. 3. The plate 22 is attached to the boss 15 as by the aid of machine screws 24. Interposed between the upper and lower plates 22 and 23 is a spacer 25 having a right-hand edge 26 disposed adjacent and tangent to the teeth of the gear wheels 17 and 18. A cap screw 27 is utilized for holding the plate 25 in place and permits adjustment of the plate 25.

Edge 26 and gears 17 and 18 define a substantially triangular outlet chamber for the pump.

The edge 26 of plate 25 is disposed tangential to the circular envelope of the teeth of the gear wheels 17 and 18. A slight clearance exists between this tangential surface 26 and the teeth of the gears, especially when the teeth in succession reach the position of teeth 42 in gear 18. In that position, the edge 26 is out of contact with the teeth. In this way, leakage for the pumping action is provided. Furthermore, when the pump stops, the liquid is forced outwardly along the edge 26 by the action of the spring 10 which urges the diaphragm 2 upwardly. This upward movement of the diaphragm

places the liquid in space 9 above the diaphragm under sufficient pressure to cause this leakage to take place.

The driving gear 19 is mounted on a motor shaft 28. This shaft is freed of any lateral stress that would tend to flex it. The motor thus does not drive through either gear 17 or 18. Since the shaft 28 is freed of any lateral thrust, its alignment in its bearings is readily maintained, and the motor shaft can be provided with end play, assisting in lubrication.

The motor structure 29 shown in Fig. 1 is supported by the aid of a boss 41 attached to a bracket 30 having feet 31 (Fig. 2). These feet 31 are attached to the cover 3 by the aid of screws 32.

A stack of laminations 33 for the motor is clamped between the arms 34 and 35 of the bracket 30. A field coil structure 36 is disposed around one leg of the stack 33. It is connected to the low voltage secondary winding 37 (Fig. 4) of a transformer 38. This transformer 38 is supplied with alternating current by the aid of a circuit controller 39.

As shown most clearly in Fig. 4, the circuit energizing the motor 29 includes a condition-responsive device 40. For example, it may be a thermostat responsive to temperature variation in a space or room. The actuator 6 may be connected to a valve arrangement for adjusting the degree of heat supplied by a heating device.

In operation, when the thermostat is energized, the gear pump 17—18 is operated and liquid under pressure is forced into the chamber 9. The actuator 6 is thus urged downwardly until the maximum stroke is reached. After the maximum stroke is reached, the pump continues to operate, but its output leaks past the space between the edge 26 and the teeth of gears 17 and 18, thus by-passing port 16.

Now when the temperature condition is remedied, the motor 29 is deenergized by the thermostat 40. There is no longer any pressure existing upon the liquid urging the diaphragm 2 inwardly. Instead the spring 10 slowly returns the diaphragm to the position shown in Fig. 2. In this process, the liquid is urged outwardly into the casing 11, past the clearance between the edge 26 and the teeth of gears 17 and 18. The gear teeth are furthermore purposely so arranged that when one tooth, such as tooth 43 of gear 17, is closest to the edge 26, there are two teeth 42 on gear 18 that are symmetrically disposed on either side of a radius 44 normal to the edge 26. It is thus ensured that a leakage path past one or the other gear 17 or 18 is provided for the discharge of the pump, as well as a path for the exit of liquid from chamber 9.

The inventor claims:

1. In a gear pump: a pump body including a wall; a pair of pump elements having interengaging teeth and supported for rotation, said elements being located so that the wall extends with slight clearance substantially in tangent relationship to the elements, the wall and the elements defining an outlet space; the wall diverging from the elements on opposite sides of said outlet space whereby leakage paths are established when the pump elements are stopped; and means forming a reservoir space in communicaton with the wall at both of said diverging portions.

2. In a gear pump: the actuator in one direction; a pump body including a wall; a pair of pump elements having interengaging teeth and supported for rotation, said elements being located so that the wall extends with slight clearance substantially in tangent relationship to the elements, the wall and the elements defining an outlet space; the teeth of the elements being so arranged that when a tooth of either element extends substantially normal to the wall, there are two teeth of the other element disposed symmetrically with respect to a radius of the other element that is normal to the wall; the wall diverging from the elements on opposite sides of said outlet space whereby leakage paths are established when the pump elements are stopped; and means forming a reservoir space in communication with the wall at both of said diverging portions.

3. In a gear pump: a pair of juxtaposed plates; a spacer between the plates and having a wall terminating within corresponding sides of the plates whereby a space is formed between the plates and bounded on one side of said wall, the other side of the space being open; a pair of intermeshing gear members each journalled to the plates, and each having a circular envelope; said wall extending substantially tangent to the circular envelopes of the gear members at spaced portions of the wall; means forming a lubricant reservoir in connection with the wall beyond both of said tangent portions; and a motor operated pinion in engagement with one of said gear members; the teeth of the members being so arranged that when a tooth of one element extends substantially normal to the wall, there are two teeth of the other member disposed symmetrically with respect to a radius of said other member that is normal to the wall, whereby leakage paths are established when the members are stopped, the combined area of which paths is substantially unaffected by the angular position of the members.

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