Sept. 29, 1953 W. SCHUBERT 2,653,581

HYDRAULIC POWER DEVICE

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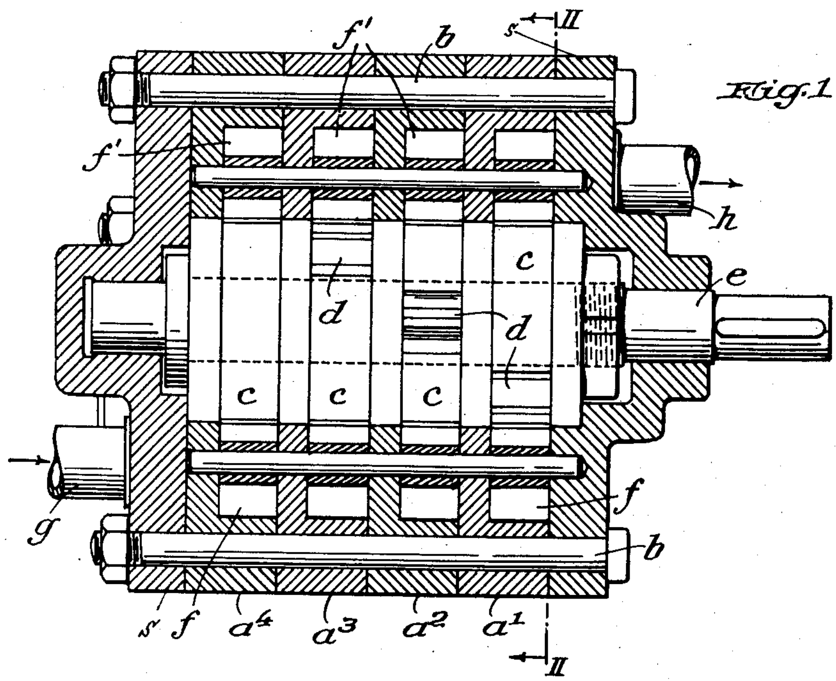

Fig. 1

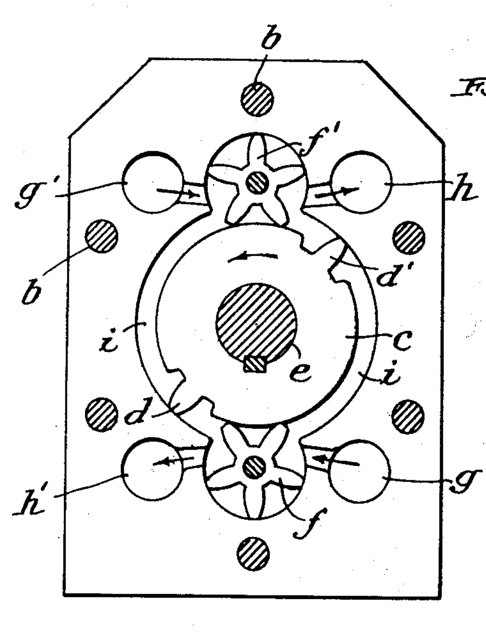

Fig. 2

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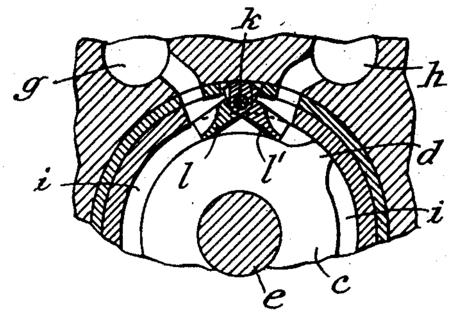

Fig. 3

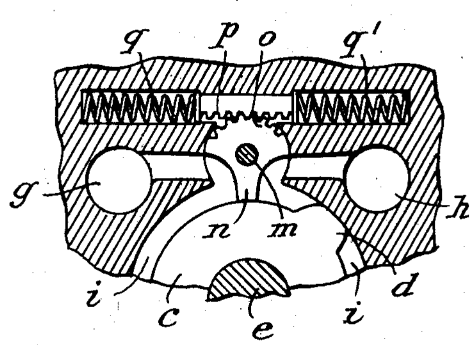

Fig. 4

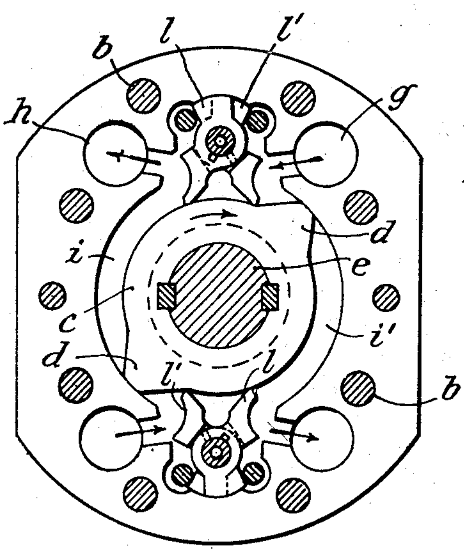

Fig. 6.

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Fig. 5.

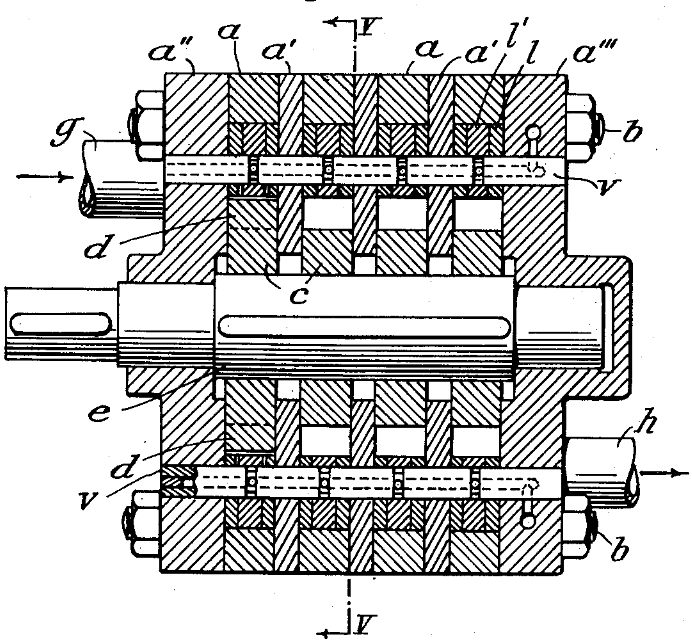


Fig. 7

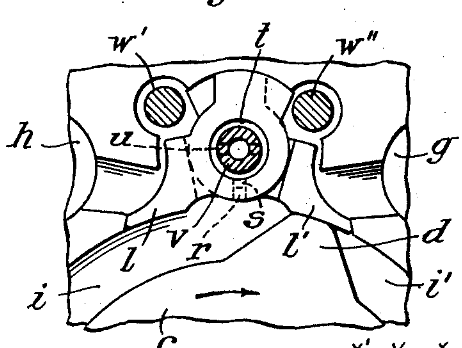


Fig. 8

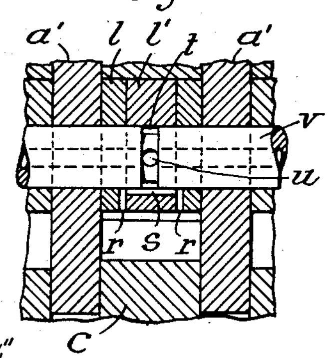
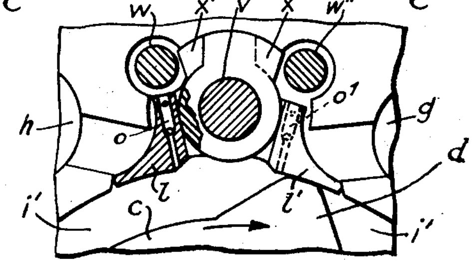


Fig. 9



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Patented Sept. 29, 1953

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UNITED STATES PATENT OFFICE

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HYDRAULIC POWER DEVICE

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Application January 3, 1951, Serial No. 204,174
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2 Claims. (Cl. 121—81)

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This invention relates to hydraulic power devices and particularly to rotary piston motors for hydraulic gears.

The use of hydraulic gears for step-free speed control is generally known. These hydraulic gears are often composed of parts acting as a pump and as a motor. Based on their comparatively simple construction, gears provided with rotary pistons have been used as driving means in cooperation with rotary concentric piston rotors having vanes and movable abutments, which are controlled to provide a free passage for these vanes.

It is the main object of the invention to improve these rotary piston motors and to effect a smooth driving thereof having no perceptible fluctuation periods of the power delivery.

It is a further object of the invention to provide a coaction between the disc rotors and the abutments which will enable a continuous operation at all times regardless of the position of the piston rotors or the abutments.

With these objects in view, the control of the abutments is directly and coercitively effected by the rotor or its vanes in coaction with the pressure of the fluid. In this manner, a simple robust and stress-resistant construction of the motor results which is well suited for permanent operation and does not require special attendance.

An important element of the invention is the provision of several adjacent equally constructed motor cells for the accommodation of an equal number of vane provided adjacent disc rotors which directly coact with movable abutments. By this coaction of these rotor vanes with their corresponding abutments a constant pressure compensation and equalization is achieved whereby bending and other stresses, otherwise exerted on the rotor and the rotor shaft, as well as the fluid pressures and loads exerted on the bearings, are eliminated.

The abutments may be constructed as blade provided impeller wheels which directly cooperate with rotor vanes, the latter having the shape of gear teeth. The abutments may also consist of pairs of hinged flaps which rotate about bolts. The flaps may be provided with recesses which in the swung-out position of the flaps connect the inner cell spaces with fluid conduits. An opening of the discharge flap due to pressure reduction in the cells is thus excluded.

The invention will now be described in detail and with reference to the accompanying drawings, wherein:

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Fig. 1 is a longitudinal sectional view of a four cell hydraulic gear motor having four vane provided disc rotors and eight abutments;

Fig. 2 is a vertical sectional view on line II to II of Fig. 1;

Figs. 3 and 4 are vertical part sectional views of further modifications of motor cells accommodating a vane provided rotor and abutments;

Fig. 5 is a longitudinal sectional view of a further embodiment of the hydraulic gear motor shown in Fig. 1;

Fig. 6 is a vertical sectional view on line V to V of Fig. 5;

Figs. 7, 8 and 9 are part sectional views similar to Figs. 3 and 4 of further modification of the invention.

The gear motor, shown in Figs. 1 and 2 is composed of four cell elements a^1, a^2, a^3, a^4; these cell elements are accommodated in a housing *s* and secured in the same by tie rods *b*. The individual cells are made exchangeable. The cells accommodate inner chambers *i*; each chamber houses a disc rotor *c*; these rotors are supported on a rotatable center shaft *e* supported in the housing *s*. The rotors are in the present embodiment of the invention provided with two vanes d, d^1 oppositely located at the circumference of the rotor discs. Rotatable abutments f, f^1 are provided in the chambers *i* for direct cooperation with the rotor vanes d, d^1, as later described more in detail.

In order to secure a uniform motor rotation the vanes d and d^1 of the various rotors *c* are staggered or displaced in the individual cells a^1, a^2, a^3, a^4 in such a manner that their displacement angle equals the switching angle of the corresponding abutment. In the shown embodiment of the invention, where four rotors *c* are used having two vanes, this angle is ⅛ of 360° or 45°.

As apparent from Figs. 1 and 2, the abutments f, f^1 are constructed as blade provided impeller wheels and located at the circumference of the rotors *c* at an angle of 180° between them.

The pressure medium is supplied in the chambers *i* between the rotors *c* and the inner wall of housing *s* or between the abutments f, f^1 and the vanes d, d^1 through conduits g, g^1 and discharged through conduits h, h^1. The rotors *c* are sealed in the chambers *i* against the outside by the tight contact of two blades of the abutments f, f^1 with the circumference of the disc rotors *c*. The abutments f, f^1 are rotated by the vanes d, d^1 and shifted during each passage of the same for the distance of two impeller wings.

This rotation of the abutments is furthered by the particular gear teeth shape of the rotor vanes d, d^1.

In conformity with the embodiment of the invention shown in Fig. 3, the abutment forming blade impellers f, f^1 are replaced by pairs of flaps l, l^1 which are rotatable, similarly to a hinge, about pin k; the flaps open and close the fluid inlet and outlet conduits g, h.

The flap l^1 is lifted by the curved ascending flank of the rotating vanes; upon passage of the vanes through the flaps the latter are returned to their previous position.

The flaps may be provided with openings which connect the inner space of the chambers with the outside, if both flaps are in the swung-out position; due to the resulting pressure decrease, the discharge flap may be opened.

In conformity with Fig. 4, the abutment consists of a control slide n which is rotatably supported on a pin m; this control flap is rotated by the rotor vanes d, d^1 and returned to its previous position by return springs q, q^1. The rotatable member is here subjected to stresses in a radial direction only; rotational moments are eliminated and the control position may be maintained without being influenced by the pressure fluid.

The abutment consists, as stated above, of control slide n which is rotatably supported on pin m. On the opposite side of this flap member n a toothed edge portion o is provided which cooperates with a rack p. Rack p is connected at its ends with springs q, q^1 located in bores of the housing, which hold the flap member n in its median position. The flap member n is swung by the rotor vanes against the pressure of spring q^1; after release from the vane, it is returned in the initial position. In the closing position flap member n is located in front of the inlet opening of supply conduit g, whereas in the opposite position it closes the exit opening of conduit h.

In conformity with the modifications of the invention illustrated in Figs. 5 to 8, the disc rotors c are axially movably supported on shaft e by means of wedges.

Circumferential walls a enclose the rotors; separator walls a^1 are located between the same; they are connected by screw bolts with the outer plates a'', a''', the housing consisting of these three types of walls.

The differential thickness between the rotor discs c and the outer walls a is a few hundredths of a millimeter only; moreover, the abutment flaps l, l^1 are made easily movable by a small play provided between the same and the housing plates a. In consequence thereof, high accuracy need not be maintained with regard to the rotor block and a reliable function of the motor is secured in spite of greatly reduced building costs. If a large number of rotor cells is provided, this building principle should be applied by all means.

As apparent from the drawing, the abutment flaps l, l' are shaped as double arm levers and the lever arms which are located at the outside to the rotor flaps d extend in the manner of a piston into a space connected with the inlets and outlets g, h.

If the motor is to be rotated in both directions, the abutment flaps are provided in pairs. The change of the direction of rotation is effected by a reversal of the flow direction of the fluid. Unless provisions are made to open the discharge flap into a pressure free space, substantial difficulties will arise with regard to the proper control of the abutments.

Fig. 7 shows the position of the abutment flaps l, l' during the passage of a rotor vane d. One flap l has been just lifted by vane d and is, under the influence of the pressure in chamber i. The shorter lever arm of the flap is exposed to the same fluid pressure in the inlet channel g. The vane d has during its meanwhile continued rotation, hermetically closed the inlet flap l', whereby the liquid pressure is maintained in channel i^1.

An additional device is provided whereby the pressure of the liquid in channel i is reduced and the flap is opened by the pressure acting on the opposite shorter flap arm; this takes place during the passage of vane d underneath flap l^1.

The flaps l, l^1 are provided with grooves t at the inside, that is flap l is provided with two radial grooves r and flap l^1 with an axial groove s, Fig. 8. In the position of both flaps shown in the drawing and the two grooves connect space i by means of circular groove t and bores u with an inner more of pin v; the liquid may now be discharged from chamber i through conduit h.

Upon further rotation of vane d flap l' is freed; the latter slides under the influence of the continuously increasing closure pressure along the vane into its operating position, which is established by the pin w''. A pin w' is correspondingly provided for flap l.

The pressure reduction in the channels i, i^1, of Fig. 7 may be obtained by other means, as described above; for instance, return valves o, o^1 may be located in the flaps l, l^1, as shown in Fig. 9, which permit the pressure fluid to flow in one direction, from the interior of the device to the outside thereof.

During the control operation, the rotary force exerted onto the piston rotor is equal to zero or even negative.

To create a uniform rotational moment, the gear motor is subdivided into a plurality of equal adjacent cell elements which accommodate rotors; the latter are staggered relatively to each other, in such a manner, that the stagger angle corresponds to the dead angle, where a cell is without rotative action. This cell construction is an important element of the invention.

Since certain changes may be made in the above article and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

1. In a fluid driven rotary piston motor a housing having side walls, a shaft supported in said side walls, disc-shaped rotors connected with said shaft, partition walls connected with said housing, said partition walls located between two adjacent disc-shaped rotors, a passage space for the driving fluid located between said housing and said rotors, vanes attached to said rotors at opposite parts of its periphery, inlet and outlet conduits in said housing for supply of driving fluid into the same and the discharge thereof, extensions in said housing connected with said inlet and outlet conduits, pairs of hingedly connected flaps rotatably supported in said housing, arms of said flaps being piston-shaped for movement in said enlargements, hollow pins located in said housing parallelly to said shaft and on

both sides thereof to rotatably support said pairs of flaps in operative connection with said vanes, a bifurcated bearing part located on said pins and connected with one flap of each pair of flaps, grooves in the bearing parts of said pair of flaps, said grooves being in operative connection with said hollow pins in the swung-out position of the flaps to connect said space for the driving fluid with said discharge conduits and to return the flap for discharge by the pressure of the driving fluid on its piston-shaped arm upon their displacement by said vanes into its initial position.

2. In a fluid driven rotary piston motor according to claim 1 return valves disposed in the

flaps to permit the driving fluid to flow from the working space to the discharge.

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