

Aug. 27, 1940.

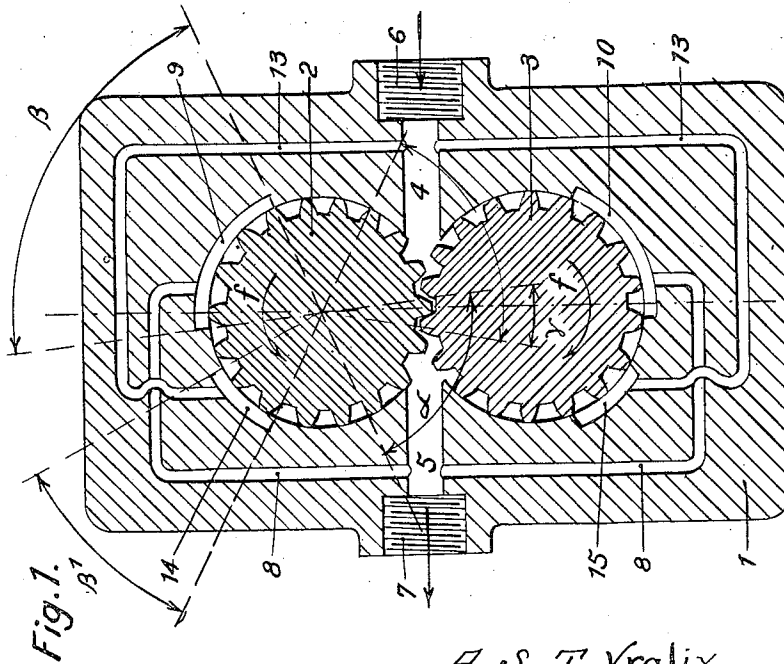
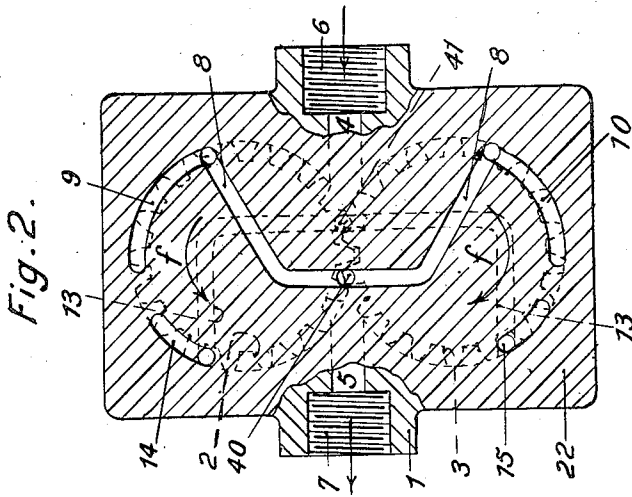
A. S. T. VROLIX

2,212,994

BALANCED GEAR PUMP

Filed Jan. 21, 1938

5 Sheets-Sheet 1



A. S. T. Vrolix
inventor

by *Glascock Downing & Seebold*
Attys.

Aug. 27, 1940.

A. S. T. VROLIX

2,212,994

BALANCED GEAR PUMP

Filed Jan. 21, 1938

5 Sheets-Sheet 2

Fig. 4.

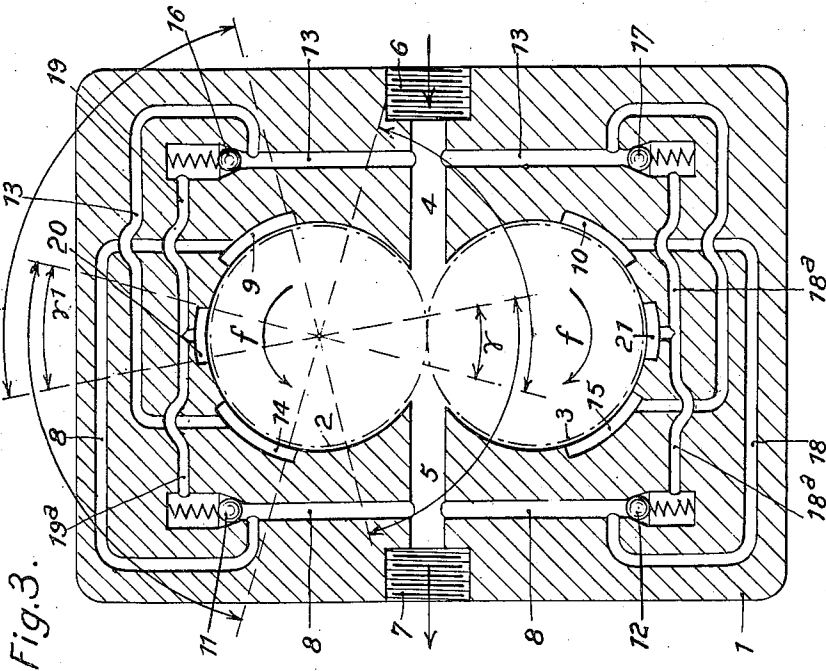
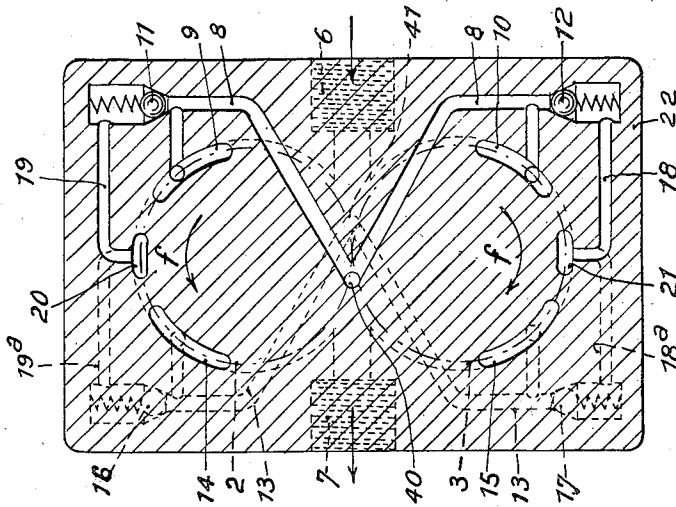


Fig. 3.

A. S. T. Vrolix
INVENTOR

By: Glascock Downing & Seabolt
ATTYS.

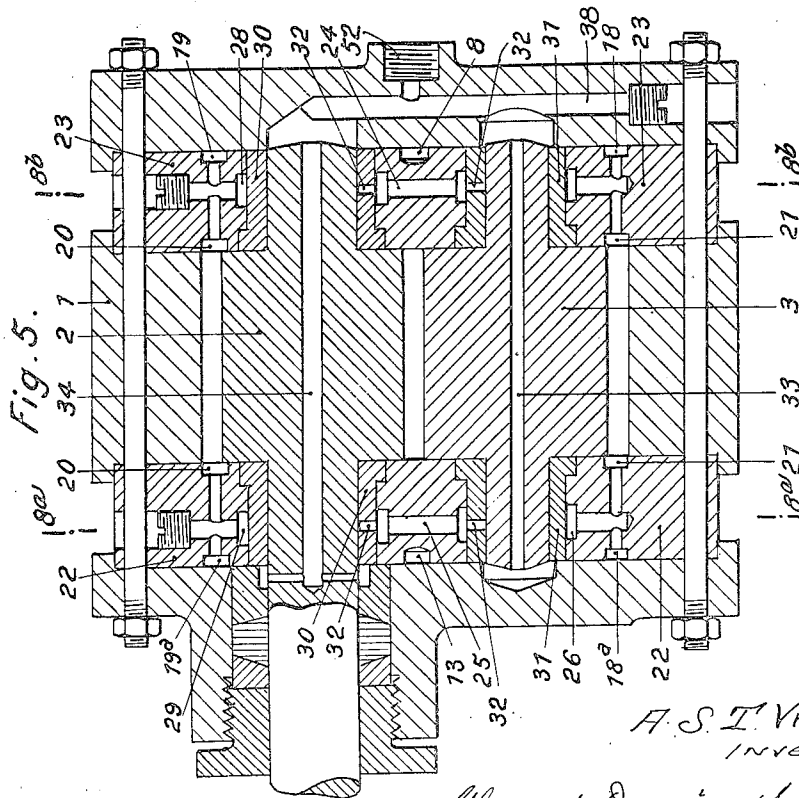
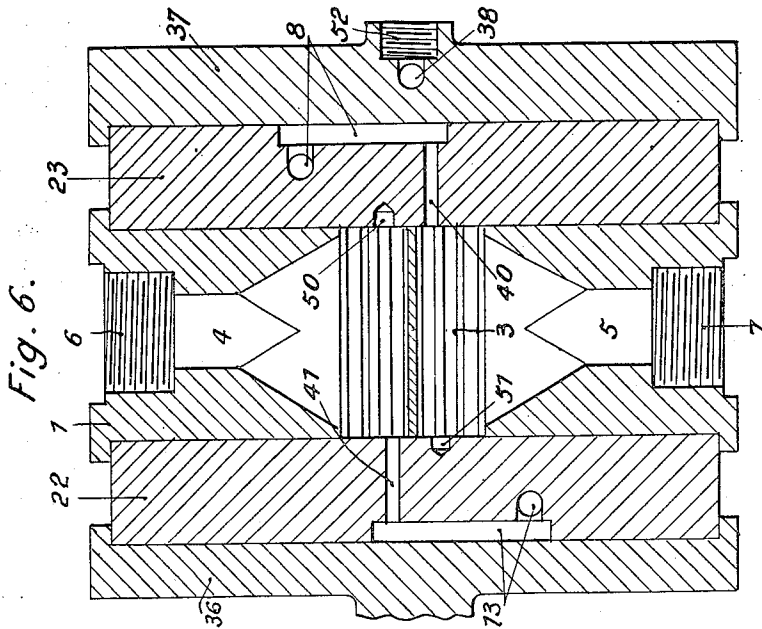
Aug. 27, 1940.

A. S. T. VROLIX
BALANCED GEAR PUMP

2,212,994

Filed Jan. 21, 1938

5 Sheets-Sheet 3



A. S. T. Vrolix
Inventor

By: *Glascow Downing & Seebold*
Attys

Aug. 27, 1940.

A. S. T. VROLIX

2,212,994

BALANCED GEAR PUMP

Filed Jan. 21, 1938

5 Sheets-Sheet 4

Fig. 7.

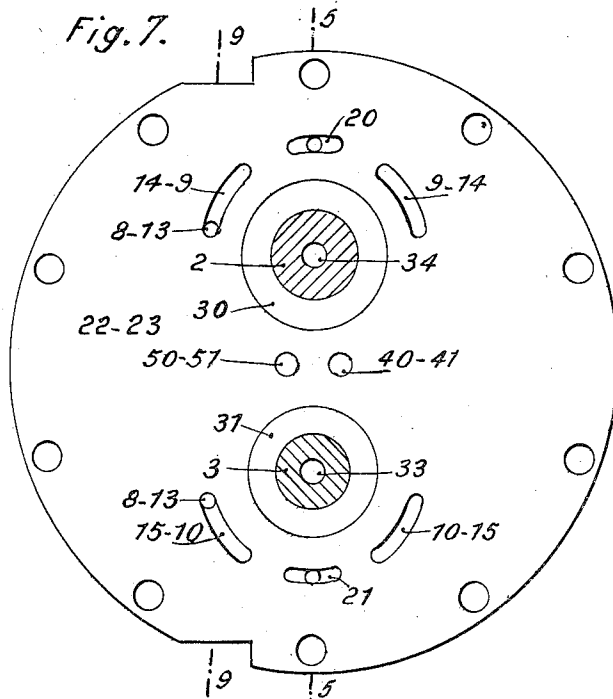


Fig. 8.

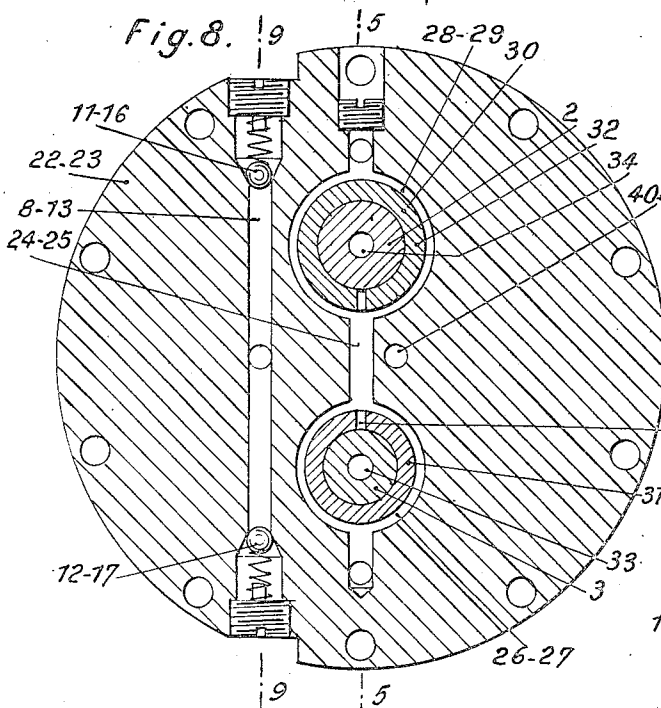
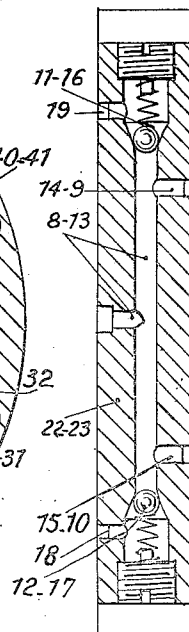


Fig. 9.



A. S. T. Vrolix
INVENTOR

By: *Glascop Downing & Lebold*
ATTORNEYS

Aug. 27, 1940.

A. S. T. VROLIX
BALANCED GEAR PUMP
Filed Jan. 21, 1938

2,212,994

5 Sheets-Sheet 5

Fig. 10.

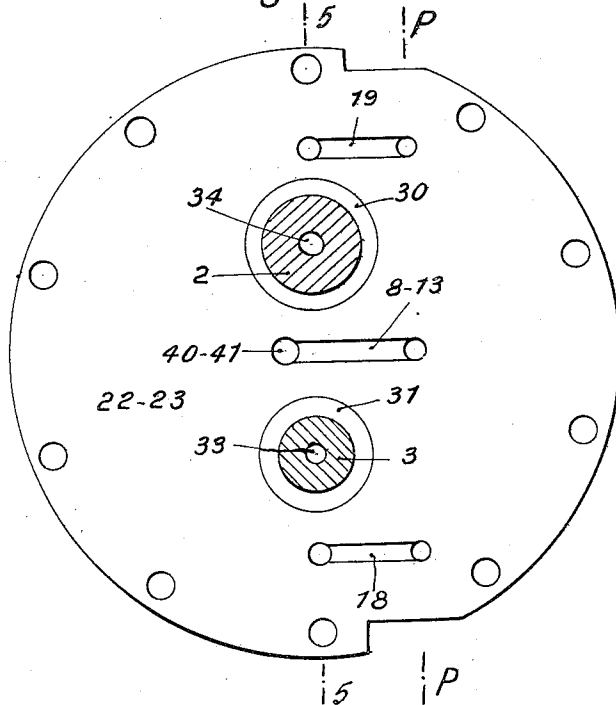
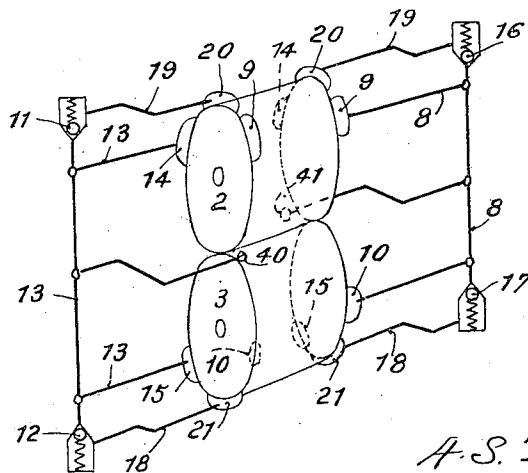


Fig. 11.



A. S. T. Vrolix
INVENTOR

By: Glascock Downing & Hubold
ATTYS.

UNITED STATES PATENT OFFICE

2,212,994

BALANCED GEAR PUMP

Albert Sylvain Toussaint Vrolix, Paris, France, assignor of one-half to Société Anonyme L'Outilage R. B. V., Paris, France

Application January 21, 1938, Serial No. 186,197
In France May 22, 1937

3 Claims. (Cl. 103—126)

The present invention has for its object to improve the efficiency of so-called gear pumps, which are also capable of operating as motors.

It is known that in these devices, the gears are subjected, under the effect of the pressure of the fluid which passes through them, to considerable reactions which cause an excessive friction of the gears against the walls of their housings.

In order to compensate these detrimental reactions, various devices have already been proposed or applied: some of said devices make use of perforations provided between the teeth of the gears themselves; others include balancing chambers lodged in the pump body and diametrically opposite the suction and delivery chambers.

In these latter devices, however, it is observed that the reaction produced by the thrust of the fluid in the zone of mesh of each gear is not compensated. Now the pressure of the fluid in this zone actually becomes very high since the fluid which is imprisoned between the teeth of the gears is taken from the delivery chamber, that is to say at an already very high pressure, in most cases. Furthermore, said pressure is pulsating, and not continuous, a fact which makes the drawbacks thereof more serious.

In other devices, in order to reduce the amount of fluid imprisoned on the pitch-arc, recesses are provided as close together as possible on the end walls facing the gears. However, the result of these artifices is to decrease the distance between the suction chamber and the delivery chamber, so that they frequently cause leaks. They cannot therefore be efficient at the high pressures which are now required from such machines.

According to the present invention, the balancing of these gear devices which are capable of operating as pumps or as motors is effected, without any perforations between the teeth, by the co-operation, for each gear, of two balancing chambers each embracing a different portion of the periphery of the gear and extending over arcs of unequal size, the simple or multiple chamber of greatest length being arranged diametrically opposite the gear arc which is subjected to the pressure produced or received (pump or motor) and the pitch-arc, the length of said chamber being approximately equal to the sum of said two arcs—with which it communicates—whereas the chamber of smallest length is diametrically opposite the gear arc which is subjected to the suction (pump) or to the exhaust (motor), and communicates with said arc.

Said balancing chambers and the conduits which open therein are provided, either in the pump body itself in which the gears rotate, or again partially or totally in the walls which face the sides of said gears.

For the purpose of ensuring the balancing of the pump or motor gear system in both directions of operation, by eliminating any possibility of unbalancing at the instant when said directions are reversed, the invention also includes embodiments in which, to each gear there is made to correspond, on the one hand two equal balancing notches or chambers which are respectively diametrically opposite the arcs subjected to the pressure and the suction and communicate with said arcs, and on the other hand a third chamber extending over an arc which is opposite and approximately equal to the pitch-arc, the action of said third chamber being automatically added, by means of a set of valves or equivalent devices, to that of the balancing chamber which is under pressure, according to the direction of rotation of the gears.

As in the simplified embodiment, the balancing chambers and the conduits which supply them may be provided either in the pump body, or in the end walls.

Branch conduits may be taken off the conduits which supply the balancing chambers for the purpose of using a part of the fluid under pressure for lubricating the bearings.

The principle of the invention is illustrated by means of various embodiments, in the accompanying drawings in which:

Fig. 1 shows a diagrammatical view of a balancing device for a single direction of rotation; said device is lodged in the body of the bores receiving the gears of the pump or motor (the gears are shown in transverse section).

Fig. 2 is a view in transverse section of a similar device lodged in the end walls.

Fig. 3 shows diagrammatically, in transverse section, a balancing device which is operative for both directions of rotation of the group of gears and is lodged in the body of the bores.

Fig. 4 is a diagrammatical view corresponding to the previous one, but in which the balancing device is lodged in the end walls.

Fig. 5 is a view in axial sectional elevation, of an embodiment of the arrangement according to Fig. 4 and having forced lubrication bearings of the gears. This view corresponds to a section along the plane projected at 5—5 in Figs. 7, 8 and 10.

Fig. 6 is an axial sectional plan view of this same embodiment.

Fig. 7 is a view of one of the end walls, corresponding to Figs. 5 and 6, said end wall being seen from the side facing the inside of the pump. The two end walls are identical and each accommodates a half of the balancing device.

Fig. 8 shows a view of an end wall, in section along the plane projected at 8a—8a or 8b—8b in Fig. 5.

Fig. 9 shows a view of an end wall in transverse section: said section taken along the plane projected at 9—9 in Figs. 7 and 8.

Fig. 10 is a view of one of the end walls, seen from the side of said end wall facing the outside of the pump, said end wall containing half of the balancing device according to the invention.

Fig. 11 shows a perspective diagram of the balancing conduits of Figs. 4 to 10.

Referring to Fig. 1:

The gears 2 and 3 rotate inside bores provided in the pump body 1. If, when the gears rotate in the direction f , the machine operates as a pump, the chambers 4 and 5 are respectively the suction and delivery chambers which are connected by unions 6 and 7 to the suction and delivery conduits.

According to the invention, the gear 2 is balanced by the co-operation of two balancing notches or chambers 9, 14 which are provided in the pump body 1 at the periphery of the gears and extend over arcs of unequal lengths.

The chamber 9 which corresponds to the largest arc, viz. β , is diametrically opposite the angle α corresponding to the part of the gear which is subjected, in the delivery chamber 5, to the pressure produced (operation as a pump), or received (operation as a motor) and to the part of the gear which receives the pressure resulting from the imprisonment of the fluid at the mesh points.

Said chamber 9 communicates, through the conduit 8, with the delivery chamber 5.

The chamber 14, which corresponds to the smallest arc, viz. β^1 , is diametrically opposite the part of the gear which is subjected to the suction (pump) or to the exhaust (motor) and said chamber is connected, through a conduit 13, to the suction chamber 4.

Similarly, for the gear 3, balancing chambers 10 and 15 having conduits, respectively 8 and 13 connecting same to the delivery chamber 5 and the suction chamber 4, are provided, symmetrically with respect to the previous ones, in the pump body 1, at the periphery of the bore in which the gear 3 rotates.

The diagram of Fig. 2 shows an arrangement for balancing the gears which is similar to the previous one, but lodged in the end walls 22, 23 of the pump body and applied against the ends of the gears 2 and 3.

In this figure the same references have been retained for the members which have already been described. The balancing chambers 9, 10 (pressure) and 14, 15 (suction) are provided in each end wall 22 and 23.

In one of the end walls, the end wall 22, are provided the conduits 8, 8 through which the chambers 9 and 10 communicate with the delivery chamber 5.

In the other end wall, are provided the pipes 13, 13 through which the chambers 14, 15 communicate with the suction chamber 4.

The balancing chambers of the same name (pressure or suction), which are provided facing each other on the end walls, communicate freely

with each other through the intermediary of the hollows of the gear teeth.

The devices shown diagrammatically in Figs. 1 and 2 are only capable of balancing the gears in one direction of rotation.

Fig. 3 shows a balancing device according to the invention and which is operative for both directions of rotation of the gears.

For each of the gears 2 and 3 are provided, as previously, balancing chambers 9, 14 and 10, 15 which are in this case lodged in the pump body but which correspond to equal arcs, one set of chambers being diametrically opposite the part of the gears on which the delivery pressure is exerted, the other set being diametrically opposite the part of the gears which is subjected to the suction.

Said balancing chambers 9, 14 and 10, 15 are connected as previously, by conduits 8 and 13, respectively to the delivery chamber 5 and the suction chamber 4.

In combination with said balancing chambers which extend over equal arcs, this embodiment includes, for each gear, a third chamber or notch 20, 21, which is located between the other two chambers for each gear and extends over an arc which is approximately equal and opposite to the pitch-arc of the gears. Said third chamber (20 for the gear 2, 21 for the gear 3) is connected by conduits 19, 19^a (18, 18^a) to the conduits 8, 13, through valves respectively 11 and 16 (12 and 17) either of which lift from their seats, in such a manner that this additional chamber 20, 21 is always in communication with the pressure side of the pump, as can be very clearly seen in Fig. 3.

The pressure angle at the mesh point, γ , which always exists whatever be the direction of rotation, is thus compensated for each of the gears, by an angle γ^1 , of exactly or approximately equal value, in the corresponding notch 20 or 21 the balancing pressure always exists whatever be the direction of operation.

A balancing device is thus obtained which is equivalent to that of Figs. 1 and 2, but which is operative in both directions of rotation of the gears of the pump.

In the case of Fig. 4, the same device is lodged in the end walls 22, 23 which face the flanks of the gears.

As in the embodiment of Fig. 2, the balancing chambers of the same name are provided in each of the end walls and are made therein facing each other. Said chambers communicate freely with each other through the hollows of the teeth.

In this embodiment, one of the end walls, in this case 22, carries the conduits 8, 18, 19 and the valves—in this case 11, 12—which are operative for the balancing under pressure in the direction of rotation f . The other end wall, 23, carries the conduits 13, 18^a, 19^a and the valves 16, 17 which are operative for the balancing under pressure in the opposite direction to f , in such a manner that the chambers 20, 21 are both placed in communication with the pressure side of the pump, whatever be the direction of rotation.

40, 41 respectively designates ports opening into the delivery or the suction chamber for the operation as a pump in the direction f .

Figs. 5 to 11 show, by way of example and without being in any way limitative, an embodiment of a balanced machine corresponding to the diagram of Fig. 4, the same reference numerals designating corresponding members.

In said figures:

22, 23 designate the end walls enclosing the

balancing devices viz.: balancing chambers, conduits and valves;

Optional conduits 24, 25 enable a part of the fluid under pressure in the balancing chambers 20, 21 to be drawn off in order to ensure the lubrication of the bearings of the gears 2 and 3, through annular grooves 26 to 29 which give said fluid access, through openings 32, to the bearing rings 30, 31 which are thus lubricated under pressure. Said rings can, of course, be replaced by any other system of bearing.

Conduits 33, 34, which are connected together by a manifold conduit 38, ensure the axial release of the system of gears 2, 3.

An outlet connection 52 is provided at the end of the manifold conduit 38.

In Fig. 6 blind holes 50, 51 are shown, for balancing the respective ports 40 and 41.

Two outer walls 36, 37 laterally enclose the machine, pump or motor.

It is, of course, understood that the principle of the radial balancing of gear pumps or motors, various applications of which have been described herein, can be embodied in other constructional modifications which are all within the scope of the invention.

I claim:

1. A device for balancing gear pumps which are also capable of operating as motors, comprising in combination with pump gears, two equal balancing chambers respectively located diametrically opposite the arcuate parts of each gear subjected to the pressure and to the suction, said two chambers communicating with said arcuate parts, and a third balancing chamber extending over an arc which is opposite and approximately equal to the pitch-arc of the gears, and means whereby the balancing action of said

third chamber is added automatically to the action of the one of the two first balancing chambers which is connected to the pressure side of the pump according to the direction of rotation of the gears of said pump.

2. A device for balancing gear pumps which are also capable of operating as motors, comprising in combination with pump gears, two equal balancing chambers respectively located diametrically opposite the arcuate parts of each gear subjected to the pressure and to the suction, said chambers communicating with said arcuate parts, and a third balancing chamber extending over an arc which is opposite and approximately equal to the pitch-arc of the gears, and valves operating in such a manner that the action of the third balancing chamber is automatically added to the action of the one of the two first balancing chambers which is connected to the pressure side of the pump according to the direction of rotation of the gears of said pump.

3. A device for balancing gear pumps which are likewise adapted to operate as motors comprising, in combination with each of the gears of these pumps, two systems of balancing chambers, each extending over a different part of the periphery of the corresponding gear and occupying arcs of unequal values, the system of greater area being diametrically opposite and approximately equal to the arc of the gear which is subjected to the pressure produced or received and to the arc of gear intermesh, while the system of smaller extent is diametrically opposite the arc of the gear subjected to the suction or to the exhaust, and means providing communications between said systems and the arcs to which they are respectively opposite.

ALBERT SYLVAIN TOUSSAINT VROLIX.