July 26, 1938. R. SYKORA 2,124,800

HYDRAULIC DEVICE

Filed Jan. 4, 1938 2 Sheets-Sheet 1

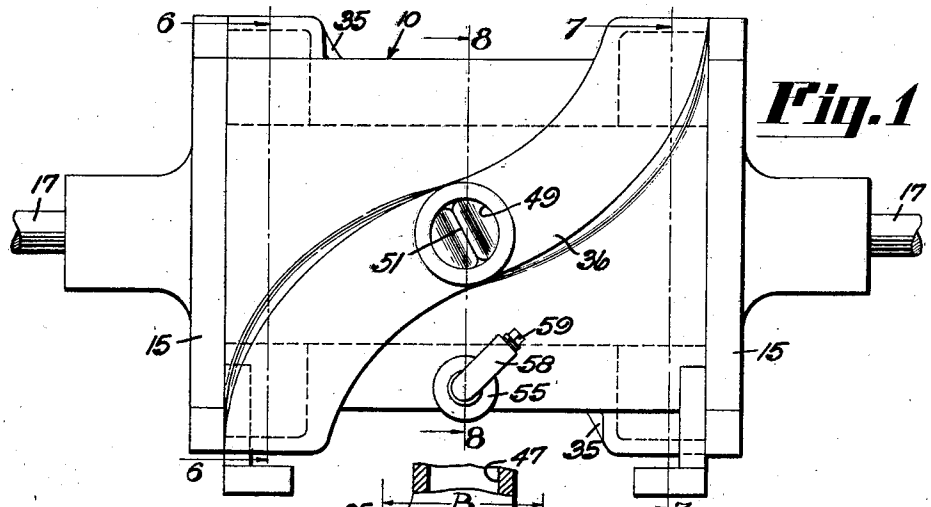


Fig. 1

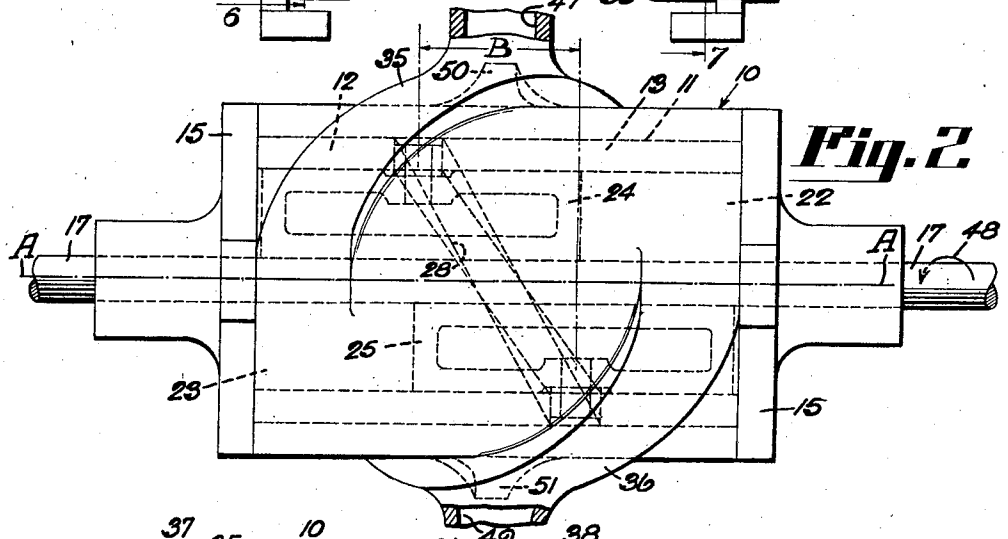


Fig. 2

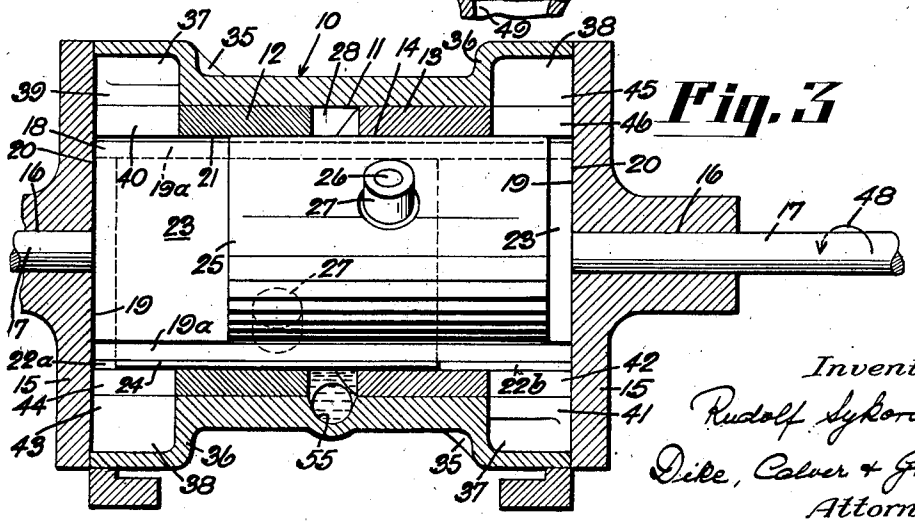


Fig. 3

Inventor:
Rudolf Sykora
Dike, Calver & Gray
Attorneys.

July 26, 1938. R. SYKORA 2,124,800

HYDRAULIC DEVICE

Filed Jan. 4, 1938 2 Sheets-Sheet 2

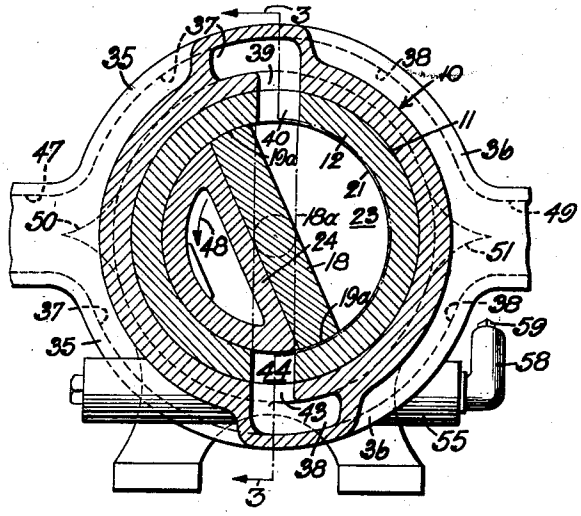


Fig. 6

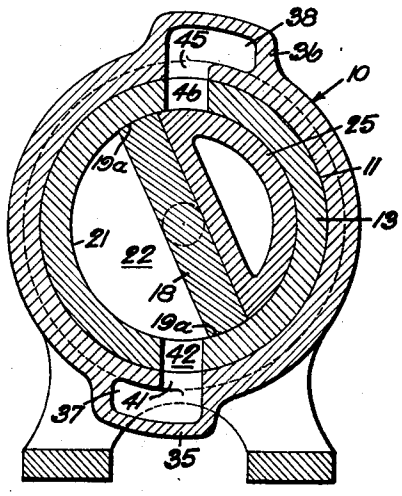


Fig. 7

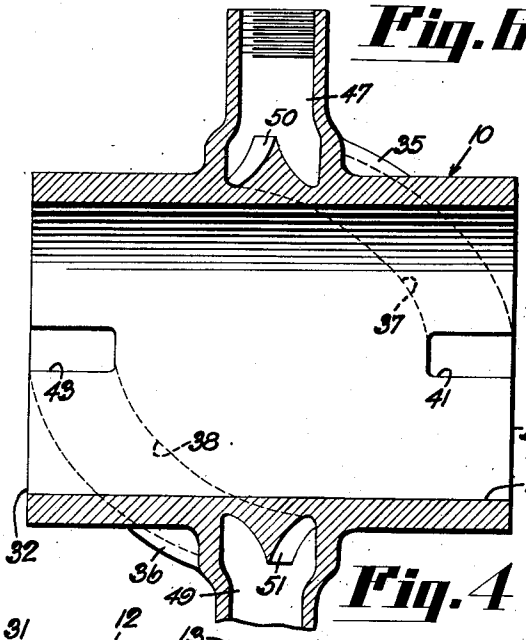


Fig. 4

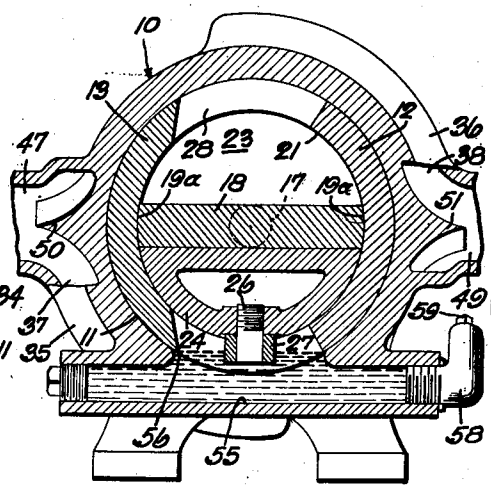


Fig. 8

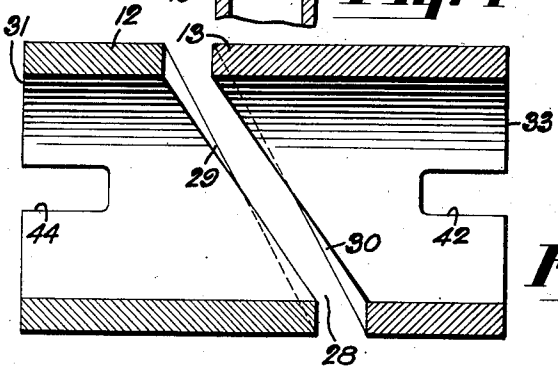


Fig. 5

Inventor:
Rudolf Sykora
Dike, Calver & Gray
Attorneys.

Patented July 26, 1938 2,124,800

UNITED STATES PATENT OFFICE

2,124,800

HYDRAULIC DEVICE

Rudolf Sykora, Boston, Mass., assignor of one-half to C. Wesley Hale, Springfield, Mass.

Application January 4, 1938, Serial No. 183,299

8 Claims. (Cl. 103—157)

This invention relates to hydraulic devices and more particularly to certain improvements in the hydraulic device disclosed in my prior Patent No. 1,430,602, dated October 3, 1922.

It is the primary aim and object of the present invention to simplify the construction of the above patented device and to increase the efficiency thereof.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

In the drawings:

Fig. 1 is a side elevation of a rotary device which embodies the present invention.

Fig. 2 is a plan view of the device, partly fragmentary.

Fig. 3 is a section taken substantially on the line 3—3 of Fig. 6.

Fig. 4 is a longitudinal section through the casing of the device.

Fig. 5 is a longitudinal section through certain detail structure of the device.

Figs. 6, 7 and 8 are cross-sections taken substantially on the lines 6—6, 7—7 and 8—8, respectively, of Fig. 1.

Referring to the drawings, the reference numeral 10 designates a preferably cast casing (Fig. 4) which is cylindrically bored at 11 to receive sleeve portions 12 and 13 (Fig. 5). The sleeve portions 12 and 13 define a cylinder chamber 14 (Fig. 3) which is closed at both ends by end covers 15, secured in any suitable manner to the casing 10. Journalled in suitable bearings 16, provided by the end covers 15, is a shaft 17 which is provided with a transverse rib or wing 18 that is of the same thickness as the diameter of the shaft 17. More particularly, the end faces 19 of the wing 18 slidably engage the adjacent machined surfaces 20 of the end covers 15, while the curved side faces 19a of said wing slidably engage the cylindrical wall 21 of the cylinder chamber 14 (Figs. 3 and 8). Hence, the wing 18 divides the cylinder chamber 14 into two equal piston chambers 22 and 23, each of which is substantially semi-circular in cross-section (Figs. 6 and 7). Moreover, the wing 18 effectively seals the piston chambers 22 and 23 against leakage of fluid from one chamber to the other chamber.

Longitudinally slidable in the piston chambers 22 and 23 are identical pistons 24 and 25, respectively. These pistons 24 and 25 are preferably of the light weight skeleton type illustrated in Figs. 2 and 6 to 8 inclusive, and are provided with a stud 26 and an anti-friction roller 27. The rollers 27 project into a continuous cam groove 28 which is formed by the spaced machined end surfaces 29 and 30 (Fig. 5) of the sleeve portions 12 and 13, respectively, and the cylindrical inner wall 11 of the casing 10. The cam groove 28 is of such design that the pistons 24 and 25 are reciprocated in their chambers 22 and 23 in opposite directions on rotation of the shaft 17 and its wing 18. The shaft 17 may be driven from any suitable prime mover (not shown).

In the above mentioned Patent No. 1,430,602, the cam groove 28 has been directly machined into the cylindrical inner wall 11 of the casing 10. This proved to be a most difficult operation which was totally unsuited for production purposes. The casing had to be chucked at one end so as to admit a machining tool through the other end. The working portion of the tool had to extend a considerable distance from its support, causing undesirable vibrations in the same which effected the quality of the machining operation. Resetting of the tool after sharpening proved to be most difficult and required considerable skill, particularly since the internal cam groove was more or less hidden from the operator's vision. For the same reason, the machining operation was beyond visual inspection by the operator. In contradistinction to the above operation, the present invention provides for cutting the cam groove into a sleeve from the outside thereof until the entire wall thickness has been penetrated by the tool, leaving the sleeve portions 12 and 13 (Fig. 5). This is a simple and rapid operation which does not require very much skill. Moreover, the operator may easily follow the progress of the tool into the sleeve and readily reset the tool after sharpening the same. The chucking of the sleeve is also greatly facilitated, the same being merely placed over a driven arbor and drivingly connected with the same in any suitable, simple manner. The tool moves longitudinally of the sleeve while the latter rotates, and is gradually worked into the sleeve until it is finally parted. The sleeve portions 12 and 13 are then inserted into the cylindrical bore 11 of the casing 10 from opposite ends thereof and secured therein in any suitable manner when their re-

spective end surfaces 31, 32 and 33, 34 (Figs. 4 and 5) are flush. The width of the cam groove 28 is then equal to the one previously machined into the sleeve, because the length of the latter was equal to that of the casing 10. Care has to be taken that the sleeve portions 12 and 13 reassume their proper angular relative positions in the casing in order that the cam groove 28 is of equal width throughout. This, however, offers no difficulty, and may be greatly facilitated by appropriately marking the end surfaces 32, 34 and 31, 33 of the casing and the sleeve, respectively before the latter is parted.

As best shown in Fig. 2, the cam groove 28 lies in a plane which intersects the center of the interior of the casing 10 and is inclined with respect to a vertical plane A—A through the axis of the casing as shown in plan view in Fig. 2. The cam groove 28 is, therefore, in form of an ellipse, with the result that the pistons are moved longitudinally in opposite directions at uniform speed on rotation of the shaft 17 at uniform speed. The rise of the cam groove 28, i. e. the distance B in Fig. 2, is moreover substantially equal to the length of the cylinder chamber 14 (Fig. 3) less the length of one of the pistons, so that the pistons are moved from one end of said cylinder chamber to the other end thereof, and vice versa.

While in the above mentioned Patent No. 1,430,602 the fluid had to pass through two 90 degree bends when entering the casing and also when leaving the same, thereby meeting with considerable resistance, the present invention contemplates a least obstructed flow of fluid into and from the casing. To this end, the casing 10 is provided with two spiral ribs 35 and 36 in which spiral passages 37 and 38, respectively, have been cored out. The spiral passage 37 is in permanent communication with the cylinder chamber 14 through radial ports 39, 40 and 41, 42 which are provided by the casing 10 and the sleeve portions 12, 13 respectively (see Figs. 3 to 7), and the end covers 15 (Fig. 3). The spiral passage 38 is in permanent communication with the cylinder chamber 14 through radial ports 43, 44 and 45, 46 which are provided in the casing 10 and the sleeve portions 12, 13, respectively (Figs. 3 to 7), and the end covers 15 (Fig. 3). More particularly, all the radial ports 39 and 40, 41 and 42, 43 and 44, and 45, 46 are located in a plane which passes through the axis of shaft 17 and is parallel thereto as appears best from Figs. 3, 6 and 7.

The passage 37 has centrally thereof an outlet 47, assuming thereby that the shaft and the pistons are rotated in the direction of the arrow 48 in Figs. 2, 3 and 6. The passage 38 has centrally thereof an inlet 49.

The cam groove 28 is so correlated with the ports 39 and 40, 41 and 42, 43 and 44, 45 and 46 that the pistons 24, 25 assume the end positions shown in Fig. 2, when the wing 18 assumes the dot-and-dash line position 18a in Fig. 6. On rotating the wing 18 from the dot-and-dash line position 18a in the direction of the arrow 48 (Figs. 2 and 6) and if the present device is used as a pump, the piston 24 is moved to the right as viewed in Figs. 2 or 3, thereby drawing fluid from the inlet 49 into the gradually increasing chamber portion 22a (Fig. 3) by way of the spiral passage 38 and the radial ports 43, 44 (Fig. 6), and simultaneously forcing fluid through the outlet 47 from the gradually decreasing chamber portion 22b (Fig. 3) by way of the radial ports 42, 41 and the spiral passage 37 (Fig. 7). The piston 24 will arrive in its right end position, corresponding to that of piston 25 in Fig. 2, after one-half revolution of the wing 18. On continued rotation of the wing 18, the cam groove 28 will move the piston 24 to the left as viewed in Fig. 2 and return said piston into the illustrated left end position at the end of the next semi-revolution of said wing. During this return movement of the piston 24, the same draws fluid from the inlet 49 into the gradually increasing chamber portion 22b by way of the spiral passage 38 and the radial ports 45, 46 (Fig. 7) which are then in communication with said chamber portion 22b, and simultaneously forces fluid from the gradually decreasing chamber portion 22a and through the outlet 47 by way of the spiral passage 37 and the radial ports 40, 39 (Fig. 6) which are then in communication with said chamber portion 22a.

The piston 25 is reciprocated in exactly the same manner as, and simultaneously with, the piston 24. However, the pistons 24, 25 move always in opposite directions due to their angular displacement of 180 degrees from each other and with respect to the cam groove 28. Hence, both pistons are double-acting and continuously force fluid of the same quantities per time unit through the outlet 47, and draw fluid of the same quantities per time unit through the inlet 49 and into their respective piston chambers. More particularly, the pistons 24, 25 continuously and simultaneously force fluid from the opposite ends of the cylinder chamber 14 through the two opposite branches of the spiral passage 37 and through the centrally located outlet 47, whereby said pistons alternately force fluid through each of said branches during each revolution of the shaft 17. Conversely, the pistons 24, 25 continuously and simultaneously draw fluid from the inlet through the two opposite branches of the spiral passage 38 and into the opposite ends of the cylinder chamber 14, whereby said pistons alternately draw fluid through each of said branches and into each end of said cylinder chamber during each revolution of the shaft 17.

In order to prevent the two separate streams of fluid, which are continuously discharged from the opposite branches of the spiral passage 37 into the outlet 47, from clashing against each other and thus add appreciably to the other minor losses of the pump, such as loss of head due to friction, a guide fin 50 is preferably cast in the outlet 47 which extends transversely to the directions of flow of said streams and diverts the same into substantial parallelism when entering the outlet. Likewise, a guide fin 51 in the inlet 49 gradually diverts the fluid into the opposite branches of the spiral passage 38.

It is obvious from the foregoing description that it is immaterial in which direction the shaft 17 is driven. If the shaft 17 is driven in a direction opposite to the arrow 18 in Figs. 2, 3 and 6, the previously described inlet 49 will become the outlet and the previously described outlet 47 will become the inlet.

The present device also incorporates a very simple, yet highly effective lubricator. To this end, the casing 10 is provided with a lubricant-containing reservoir 55 which is broken through at 56 (Fig. 8) to communicate with the cylindrical bore 11 of said casing. More particularly, the reservoir is located centrally of the length of the casing 10 and in alignment with the nearest portion of the cam groove 28 (Fig. 3) so that the lubricant level in said reservoir may extend into said cam groove. An elbow 58 is

threaded into the reservoir 55 and closed by a plug 59. Refilling of the reservoir with lubricant merely requires removal of the plug 59. As the rollers 27 pass the reservoir 55 and are slightly dipped into the lubricant therein, a small quantity of lubricant is carried by said rollers through the entire cam groove 28, thereby continuously lubricating the same. Some of the lubricant will also seep through the fine clearances between the pistons 24 and 25, the wing 18 and the cylindrical wall 21 of the sleeve portions 12 and 13, and even into the bearings 16, thereby also lubricating the reciprocating pistons 24, 25 and the rotating shaft 17, and effectively sealing the piston chambers 22 and 23 against leakage of fluid from one to the other. The lubricant film on the walls of the piston chambers and on the pistons themselves serves also to protect said chambers and pistons against corrosion by certain fluids, be it liquid or gas, for which the device may be used.

The present lubricator is noteworthy for its simplicity, it merely requiring the reservoir 55 but no special structure for conducting the lubricant from said reservoir to the places of application. The rollers 27, which have already a definite function, namely, to cause reciprocation of the pistons, additionally function as lubricant conveyors.

In view of the foregoing description, the present device has among its main advantages a very simple casing which may be readily cast with the spiral passages 37 and 38 and the inlet and outlet 49, 47. These spiral passages 37 and 38 assure a least obstructed flow of the fluid through the pump. Low frictional resistance to the fluid in the device is, therefore, an important advantage of the present device.

The provision of the spiral passages 37 and 38 in the casing 10 restricts the flow of fluid through the device within the confines of the casing, with the result that the end covers 15 can be made of a very simple construction without any fluid-conducting passages.

The provision of the fluid-diverting fins 50 and 51 in the outlet 47 and inlet 49, respectively, further improve the efficiency of the present device.

The provision of the cam-groove forming sleeve portions 12 and 13 not only permits replacement of these sleeve portions in the casing, but greatly simplifies the machining of the cam groove and, hence, reduces the cost of manufacture of the device considerably.

The lubricator is of a very simple construction and, due to its efficient operation, adds to the life of the device.

By making the thickness of the wing 18 equal to the width of the ports 40, 44 and 46, 42 of the sleeve portions 12 and 13, respectively, the wing 18 will in only one of its angular positions close all of said ports, i. e., when the wing assumes the dot-and-dash line position 18*a* in Fig. 6. By reversing the pistons just when the wing assumes the momentary angular position 18*a*, assurance is given that fluid has always access to the drawing ends of the pistons and may always be displaced from the cylinder chambers when compelled by the piston ends.

Due to the equal longitudinal travel of the pistons in opposite directions, no thrust is imparted to the wing 18 regardless of the internal hydraulic pressure and partial vacuum in the piston chambers. Hence, not only can expensive thrust bearings for the shaft 17 be dispensed with, but the end faces 19 of the wing 18 do not wear on the adjacent cover surfaces 20 and induce leakage of fluid therebetween.

While the present device has been described as a pump in the foregoing description, it is to be distinctly understood that the same can also be advantageously used as a fluid motor, wherein fluid under pressure is the driving power and the shaft 17 is the driven element. If the present device is used as a fluid motor, a greater rise of the cam groove 28 than that shown in the patent drawings may be preferred. Instead of a liquid pump the present device may also be advantageously used as a gas compressor.

I claim:

1. In a device of the type described, the combination of means providing a cylinder having a cam groove in its annular wall, and a reservoir in communication with said cam groove and containing lubricant which extends into said cam groove; and a piston in said cylinder having a follower cooperating with said cam groove for reciprocating said piston on rotation of the same, said follower dipping into the lubricant on rotation of the piston, thereby lubricating the cam groove and the cylinder wall.

2. In a device of the type described, the combination of means providing a cylinder having a continuous cam groove in its annular wall, and a reservoir in communication with said cam groove and containing lubricant which extends into said cam groove; means for forming a rotary chamber in said cylinder; and a piston in said chamber having a follower in cooperation with said cam groove for reciprocating said piston on being rotated with its chamber, said follower dipping into the lubricant on each rotation of the piston thereby lubricating the cam groove and said chamber.

3. In a device of the type described, the combination of means providing a cylinder having a continuous cam groove in its annular wall, and a reservoir in communication with said cam groove and containing lubricant which extends into said cam groove; means for forming separate rotary chambers in said cylinder; and pistons in said chambers having followers cooperating with said cam groove for reciprocating said pistons on being rotated with their chambers, said followers dipping into the lubricant on each rotation of the pistons thereby lubricating the cam groove and the chambers and sealing the latter against leakage of fluid from one to the other.

4. In a device of the type described, the combination of a member providing a cylinder and inlet and outlet ports of uniform width in the annular cylinder wall at both ends thereof; a diametrically disposed partition member in the cylinder forming two separate chambers therein and being adjacent said annular wall of a uniform thickness equal to the width of said ports, one of said members being rotatable about the cylinder axis and said ports being so disposed that they are closed by the partition member in one angular position only of the rotatable member; a double-acting piston in each chamber; and means reciprocating said pistons in opposite directions on rotation of the rotatable member.

5. In a device of the type described, the combination of a member providing a cylinder and two spiral passages, said passages being provided with an inlet and outlet, respectively, and each passage surrounding a peripheral half of the cylinder and communicating with the opposite ends of the cylinder through ports of uniform width

in the annular wall thereof; a diametrically disposed partition member in the cylinder forming two separate chambers therein and being adjacent said annular wall of a uniform thickness equal to the width of said ports, one of said members being rotatable about the cylinder axis and said ports being so disposed that they are closed by the partition member in one angular position only of the rotatable member; a double acting piston in each chamber and means reciprocating said pistons in opposite directions on rotation of the rotatable member.

6. The combination set forth in claim 5, wherein the two spiral passages are provided centrally thereof with an inlet and outlet, respectively.

7. The combination set forth in claim 5, wherein the two spiral passages are provided centrally thereof with an inlet duct and outlet duct, respectively, and a fluid-diverting fin in at least one of said passages, said fin extending across said one passage in a plane which intersects the central duct thereof.

8. In a device of the type described, the combination of means providing a cylinder and an inlet and outlet port in the annular cylinder wall at each end thereof, all of said ports lying in a plane parallel to and extending through the cylinder axis; a plane partition of uniform thickness in the cylinder, said partition being rotatable about the cylinder axis for forming two separate rotary chambers in said cylinder, the width of the ports being equal to the thickness of the partition so that the latter closes said ports in only one of its angular positions; a double acting piston in each chamber; and means reciprocating said pistons in opposite directions on rotation of said partition.

RUDOLF SYKORA.