

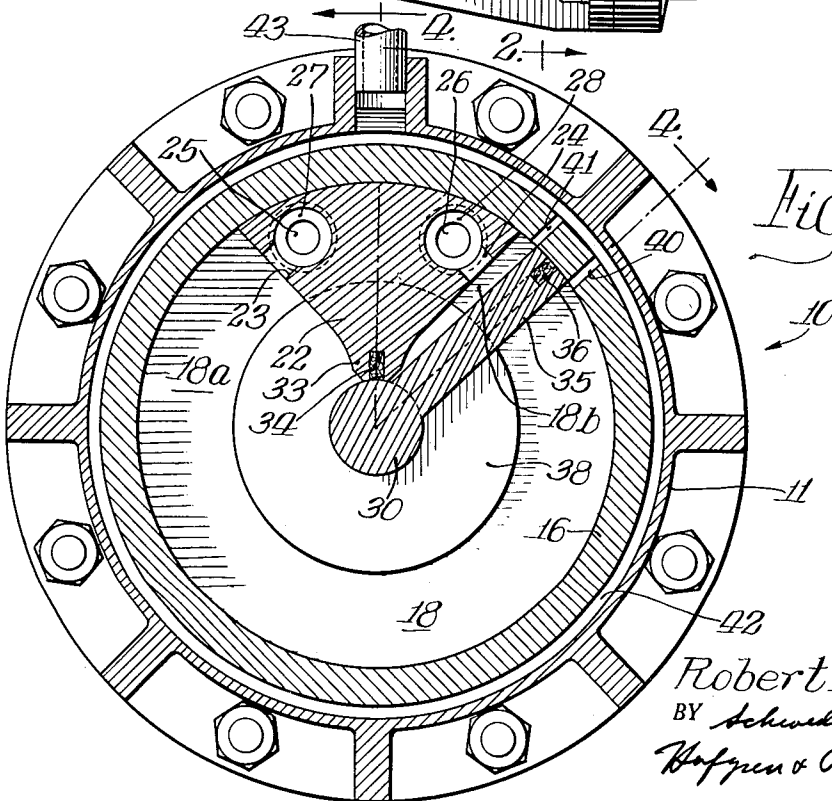
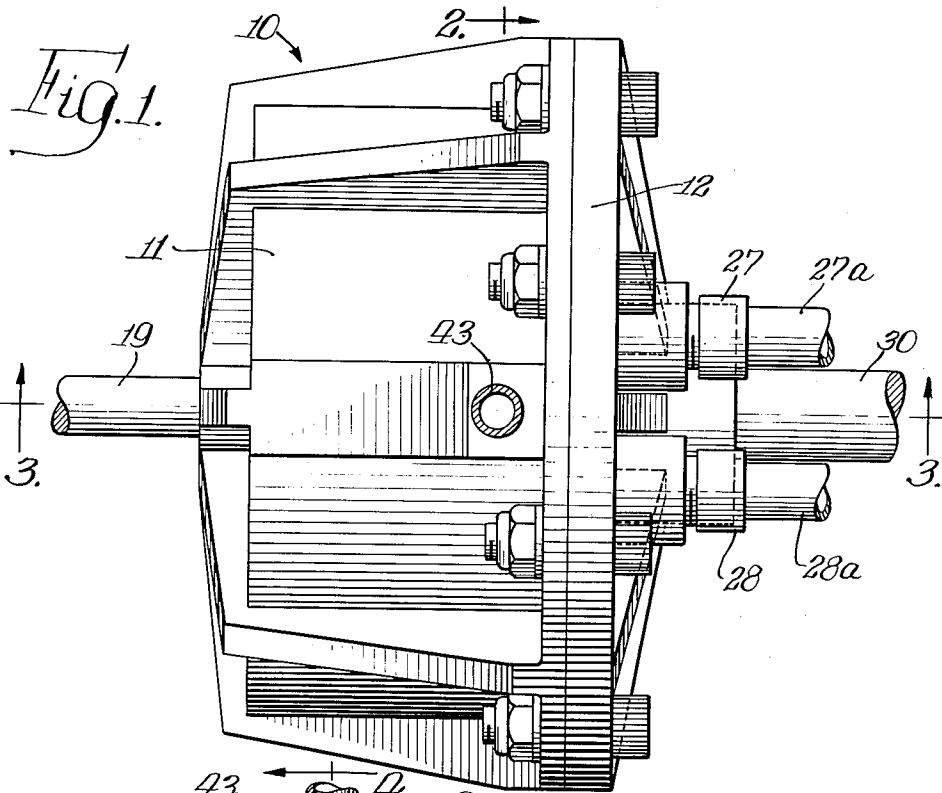
Feb. 21, 1956

R. E. BRITTON
PRESSURE FLUID VANE TYPE MOTOR FOR
STEERING MECHANISMS AND THE LIKE

2,735,406

Filed June 17, 1952

2 Sheets-Sheet 1



INVENTOR.
Robert E. Britton,
BY *Schweder, Merriam,*
Hoffman & Brady
Attys.

Feb. 21, 1956

R. E. BRITTON
PRESSURE FLUID VANE TYPE MOTOR FOR
STEERING MECHANISMS AND THE LIKE

2,735,406

Filed June 17, 1952

2 Sheets-Sheet 2

Fig. 3.

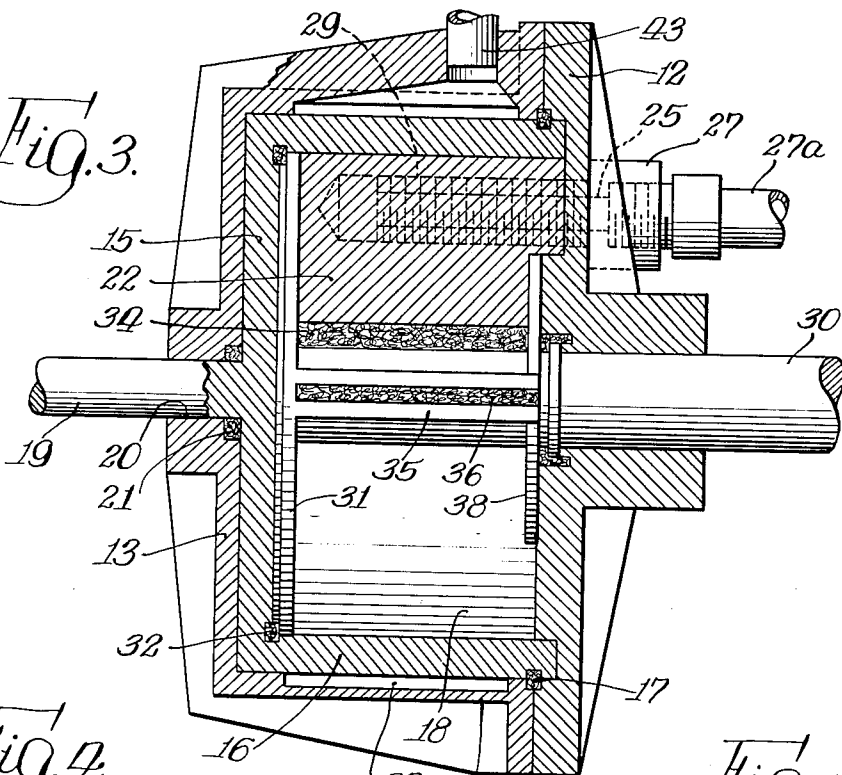


Fig. 4.

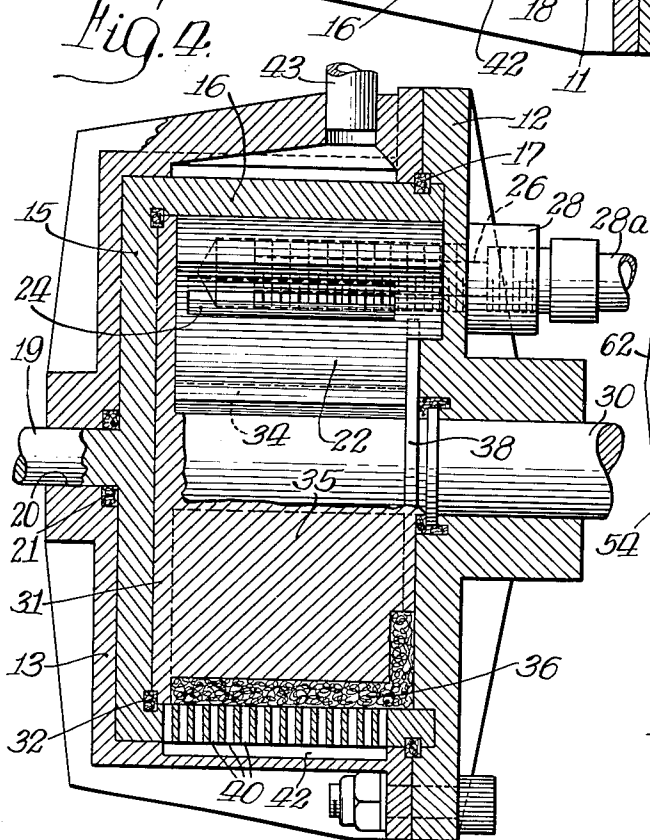
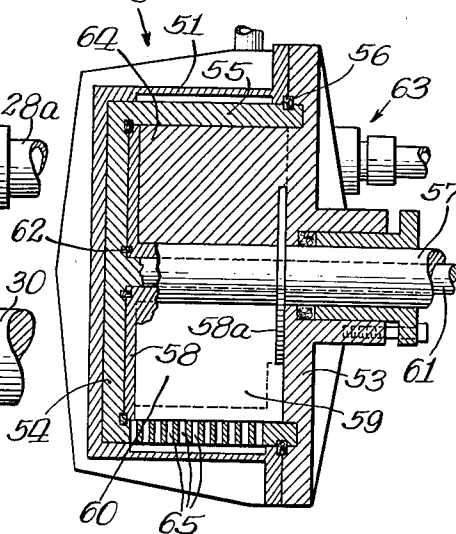


Fig. 5.



INVENTOR.
Robert E. Britton
BY *Schroeder, Meniam,*
Hofmann & Brady Attys.

1

2

2,735,406

PRESSURE FLUID VANE TYPE MOTOR FOR STEERING MECHANISMS AND THE LIKE

Robert E. Britton, Holland, Mich., assignor of one-half to Francis G. Filippi

Application June 17, 1952, Serial No. 294,035

9 Claims. (Cl. 121—41)

This invention relates to a fluid control device and more particularly to a control device operable in a follow-up manner.

It is the general object of this invention to produce a new and improved fluid control mechanism of the type described.

One of the principal features of this invention is the provision of a fluid control system for transmitting power to a movable member to move the same, with the extent of movement of the movable member being correlated with the extent of movement of a control member.

A further feature of the invention is the provision of a fluid control mechanism of the type just described in which fluid power is used to move the movable member in a follow-up manner with the control member, with the apparatus being so constructed and arranged that very little force is required to move the control member while any desired or necessary degree of force can be applied to the movable member to cause the movement of the same.

A further feature of the invention is to provide a fluid control mechanism which includes a chamber divided by a movable member into two sections with means being provided for introducing fluid, preferably a liquid such as oil, under pressure into both sections of the chamber together with drain ports for draining fluid from both sections of the chamber, with at least one of the drain ports being carried by the control member and being movable with movement of the control member to a position where it is at least partially throttled by the movable member to cause an increase in pressure in the section with which such throttled port communicates, thereby to cause movement of the movable member in a follow-up manner.

Yet another feature of the invention is the provision of a fluid follow-up mechanism which includes an annular chamber defined in part by an annular wall which carries a pair of drain ports together with a vane movably mounted in the chamber, with the chamber being provided with means which, with the vane, divides the same into two sections, one on either side of the vane, with the drain ports being adapted to be throttled by the vane as the wall is moved relative thereto, thereby to cause an increase in fluid pressure in the section to which the throttled port is connected to rotate the vane in the same direction as the wall in a follow-up manner.

Other and further objects and features of the invention will be readily apparent from the following description and drawings, in which:

Fig. 1 is a side elevational view of an apparatus embody the invention;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along a plane substantially at right angles to the section of Fig. 2 and substantially along line 3—3 of Fig. 1;

Fig. 4 is a sectional view along line 4—4 of Fig. 2; and

Fig. 5 is a view like Fig. 3 of a slightly modified form of the invention.

While this invention is susceptible of embodiments in many different forms, there are shown in the drawings and will herein be described in detail two specific embodiments, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

Although it will be readily apparent to those skilled in the art that the invention hereof is adaptable for many applications, I have found it to be particularly adaptable when applied to a power steering mechanism and thus have chosen to show the invention as embodied in a fluid control device designed for use in such an installation.

Referring now to Figs. 1—4, the transmission includes a casing 10 having a fixed annular wall 11 therein to which is secured a substantially circular cover plate 12. The casing is provided with an exterior wall 13 opposite the cover plate which, with the wall 11 and cover plate, forms within the casing an annular compartment. Rotatably mounted within the compartment of the casing are means forming a fluid chamber which, in the particular embodiment illustrated, comprise a substantially circular flat base plate 15 having an annular side wall 16 upstanding therefrom which is provided with an annular resilient seal 17 sealingly engaging the cover plate 12 to define an annular chamber 18. Secured to the base plate 15 is a master shaft 19 which extends through a suitable opening 20 in the casing and is sealed thereto by the resilient seal 21.

Extending into the chamber 18 is a substantially V-shaped boss 22 provided with fluid inlet ports 23 and 24 on opposite sides thereof, with the ports being in communication with fluid passages 25 and 26, respectively, and formed in the boss for connection to a source of fluid under pressure. The boss 22 is secured to the cover plate 12 and extends entirely across the fluid chamber 18. The fluid passages 25 and 26 are similarly formed in the hollow of screw members 27 and 28, respectively, each of which is threaded into an internally threaded opening, one of which is illustrated at 29, extending into the boss. Connection with the fluid passages is through conduits 27a and 28a, respectively, threaded into the outer ends of the screw members 27 and 28.

Extending outwardly from the cover plate 12 and rotatably supported therein is a slave shaft 30 which extends axially through the chamber 18 and is fixedly connected at its inner end with a flat circular disk 31 rotatably supported on the base plate 15. An annular resilient seal 32 is provided at the juncture of the bottom plate 15 and the annular wall 16 to provide a seal for the disk 31. The slave shaft 30 sealingly engages the inner apex 33 of the boss 22 and for this purpose there is provided a resilient seal 34 mounted in the boss and engaging the shaft.

Secured to the slave shaft is a motor vane 35 which has a shape substantially the same as the cross sectional shape of the chamber 18 and which is provided about two of its outer three sides with a continuous resilient seal 36 having portions engaging the annular wall 16 and the cover plate 12 with the third side being secured to the disk 31. Preferably a second disk 38 is secured to the slave shaft 30 and positioned oppositely of the disk 31 rotatably to engage the cover plate 12 to provide additional bearing surface for the slave shaft and with the disk 38 also being secured to the vane 35 to stiffen and give additional support thereto.

It will be noted from the foregoing that the annular

3

chamber 18 is divided into two sections by the boss and vane. Thus a first section 18a is provided between the side of the boss carrying the port 23 and one side of the vane 35 and a second section 18b is provided between the other side of the vane and the other side of the boss, that is that side of the boss carrying the port 24. The annular wall 16 is provided with two parallel spaced rows of drain ports 40 and 41 which communicate with an annular space 42 provided between the outer surface of the annular wall 16 and the inner surface of the casing portion 11 with the space 42 being connected to a suitable outlet port 43.

It will be clear from the foregoing that rotation of the master shaft 19 serves to rotate the annular wall 16. Such rotation of the wall serves to move one or the other of the rows of drain ports 40 or 41 to a position where such ports are at least partially throttled by the vane 35. Inasmuch as fluid under equal pressures is introduced into the chamber sections 18a and 18b at all times during operation of the device, such throttling of the drain ports causes an increase in pressure to ensue in the chamber section with which such throttled drain ports are connected or are in communication. Such increase in pressure serves to move the vane 35 and hence to rotate the slave shaft 30. Assuming for example that the apparatus thus far described is connected to the steering mechanism of a vehicle with the master shaft 19 being connected to the steering wheel and with the slave shaft 30 being connected to the mechanism for turning the wheels of the vehicle, then, if the steering wheel is rotated so as to rotate the annular wall 16 in a clockwise direction as seen in Fig. 2, the drain ports 41 formed in the wall will be moved to a position at least partially behind the vane 35 so as to be throttled thereby. The drain ports 40 would, under the circumstances described, remain fully open to drain fluid from the chamber section 18a, but the pressure in chamber 18b would increase due to the decreased area of the drain ports 40 and 41. Such increase in pressure serves to move the vane 35 in the same direction as the annular wall 16 moves until the vane is again positioned precisely intermediate the two rows of drain ports. Preferably the two rows of drain ports are spaced apart a distance equal to the thickness of the vane so that the vane will again position itself precisely intermediate the two sets of drain ports. Regardless of the extent of movement of the movable wall 16, the vane will follow such movement in a follow-up manner and again will come to rest at a position intermediate the two rows of drain ports. With the vane at rest so positioned, it will be clear that any forces tending to rotate the slave shaft, and hence the vane, will be resisted and overcome by the fluid pressures within the chambers 18a and 18b and any such forces are not transmitted to the master shaft. Thus, for example, if the apparatus described forms a part of the steering mechanism of a vessel, wave action tending to move the rudder from side to side will be resisted by the fluid pressures; and should such forces be sufficiently strong as to move the rudder and hence the vane so that the vane then covers or throttles one or the other of the rows of drain ports, the ensuing unbalanced fluid pressures would immediately restore the vane to its initial position. All such pressures and resulting movements of the vane create no forces tending to rotate the steering wheel and hence the wheel or tiller can be left in a fixed position with full assurance that the rudder, even though it be moved either way by wave action, will not cause movement of the wheel and will be immediately returned to its initial position.

It will be readily apparent to those skilled in the art that the control device described is one in which an increase in torque can be obtained because of the leverage of the motor vane. The torque produced by the vane is of course a function of the pressure, the area of the vane, and the length of the vane from its outer edge to the center of rotation of the slave shaft which of course produces a moment of rotation. Because of this feature not only is increased efficiency achieved, but also the device is readily

4

adaptable to provide required torques. It will also be apparent that, where the fluid is a liquid, variations in the temperature of the hydraulic liquid will not affect the accuracy of control and that the system is self-purging in that any entrained air bubbles are readily eliminated. Inasmuch as the hydraulic fluid flows at full rate in one direction only, the response to control is substantially instantaneous. The control device is readily adaptable to be used with a variety of fluids which may include either liquids or gases although liquids such as oils are preferred. It will of course be necessary to vary the size and number of the ports within the casing to accommodate fluids of various viscosities and compressibility and, if desired, further fineness of control can be achieved by varying the area and disposition of the drain ports to achieve a modulated effect.

A somewhat modified form of the invention is shown in Fig. 5, the principal difference being that the slave shaft is hollow and encircles the master shaft so that both shafts extend from the same side of the casing. For this purpose the embodiment of Fig. 5 includes a casing 50 having an annular wall 51 therein, a bottom closure 52 and a cover plate 53 which together form a chamber within which an annular chamber is rotatably mounted. The annular chamber includes a base plate 54 and an upstanding annular wall 55 which is sealed to the cover plate 53 by the resilient seal 56. The slave shaft 57 is hollow and secured at one end to a circular disk 58. A vane 59 is secured to the slave shaft, the disk 58 and a second disk 58a, and is rotatable in the annular chamber 60 formed by the members 54, 55 and 53. Extending through the hollow of the slave shaft is the master shaft 61 which is secured to the bottom plate 54. An annular resilient seal 62 is provided at the end of the slave shaft to form a fluid seal therewith. Means generally indicated at 63 are provided for introducing hydraulic fluid under pressure into the chamber 60 by means of a boss 64 similar to the boss 22. Two rows of drain ports, one of which is shown at 65, are provided in the annular wall 55 and function in the same manner as the rows 40 and 41 of drain ports in the previous embodiment. The operation of the species of Fig. 5 is the same as that of the previous species with the exception of the location of the shafts as noted.

I claim:

1. A fluid control device comprising a casing having a chamber therein, a motor vane in the chamber and dividing the same into a first section on one side of the vane and a second section on the other side of the vane, a shaft rotatably mounted in the casing and secured to the vane movably to support the same, means for constantly introducing fluid under pressure into both sections of the chamber, a movable member forming at least a portion of one wall of the chamber and provided with a pair of spaced ports for draining fluid from both sections of the chamber, said sections being in communication with said fluid introducing means regardless of the position of the vane relative to said ports, and means for moving the member to move a port therein at least partially behind the vane to throttle such port whereby the ensuing increase in pressure in the section in communication with the last mentioned port will cause the vane to move in the same direction as the member in a follow-up manner.
2. A fluid control device comprising a casing, an annular wall rotatably mounted in the casing and defining therein an annular chamber, a boss extending into the chamber and provided with a fluid inlet port on each side thereof, a shaft rotatably mounted in the casing and extending axially through the center of the chamber, means forming a seal between the shaft and the boss, a motor vane in the chamber and carried by the shaft with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a pair of spaced drain ports in said wall and con-

5

trolled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, means connecting the inlet ports to a source of fluid under pressure, and means for rotating the wall to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

3. A fluid control device comprising a casing, an annular wall rotatably mounted in the casing and defining therein an annular chamber, a boss extending into the chamber and provided with a fluid inlet port on each side thereof, a shaft rotatably mounted in the casing and extending axially through the center of the chamber, means forming a seal between the shaft and the boss, a motor vane in the chamber and carried by the shaft with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a drain port for each of said sections with at least one of the drain ports being formed in said wall and controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, means connecting the inlet ports to a source of fluid under pressure, and means for rotating the wall to move the drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

4. A fluid control device comprising a casing, means forming a rotatable annular chamber in the casing including a circular base plate, an annular wall upstanding from the edge of the base plate and a cover plate, a master shaft rotatably supported in the casing and connected to the base plate for rotating the chamber, a boss extending into the chamber, a slave shaft rotatably mounted in the casing and extending axially through the center of the chamber, means forming a seal between the slave shaft and the boss, a motor vane in the chamber and carried by the slave shaft with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a pair of fluid inlet ports in the boss each opening to a different one of the sections, a pair of spaced drain ports in the chamber forming means and controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, and means connecting the inlet ports to a source of fluid under pressure whereby rotation of the master shaft rotates the chamber to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

5. A fluid control device comprising a casing, means forming a rotatable annular chamber in the casing including a substantially flat circular base plate, an annular wall upstanding from the edge of the base plate, and a substantially flat circular cover plate, a master shaft rotatably supported in the casing and connected to the base plate for rotating the chamber, a boss extending into the chamber, a slave shaft rotatably mounted in the casing and extending axially through the center of the chamber, means forming a seal between the slave shaft and the boss, a substantially rectangular motor vane in the chamber and carried by the slave shaft, a resilient seal on the vane and sealingly engaging the wall and cover plate with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the

6

other side of the boss, a pair of fluid inlet ports in the boss each opening to a different one of the sections, a pair of spaced drain ports in the wall and controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, an annular drain passage in the casing surrounding the wall and in fluid communication with the drain ports, and means constantly connecting the inlet ports to a source of fluid under pressure whereby rotation of the master shaft rotates the chamber to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

6. A fluid control device comprising a casing, means forming a rotatable annular chamber in the casing including a substantially flat circular base plate, an annular wall upstanding from the edge of the base plate, and a substantially flat circular cover plate, a master shaft extending through the cover plate and secured to the base plate for rotating the chamber, a boss extending into the chamber, a hollow slave shaft encircling the master shaft rotatably mounted in the casing and extending axially through the center of the chamber, means forming a seal between the slave shaft and the boss, a substantially rectangular motor vane in the chamber and carried by the slave shaft, a resilient seal on the vane and sealingly engaging the base plate, wall and cover plate with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a pair of fluid inlet ports in the boss each opening to a different one of the sections, a pair of spaced drain ports in the wall and controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, an annular drain passage in the casing surrounding the wall and in fluid communication with the drain ports, and means constantly connecting the inlet ports to a source of fluid under pressure whereby rotation of the master shaft rotates the chamber to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

7. A fluid control device comprising a casing, means forming a rotatable annular chamber in the casing including a substantially flat circular base plate, an annular wall upstanding from the edge of the base plate, and a substantially flat circular cover plate, a master shaft rotatably supported in the casing and connected to the base plate for rotating the chamber, a boss extending into the chamber, a circular disk rotatably seated on the base plate, a slave shaft rotatably mounted in the casing and extending axially through the center of the chamber and secured to said circular disk at the center thereof, means forming a seal between the slave shaft and the boss, a substantially rectangular motor vane in the chamber carried by the slave shaft and secured along one side to the disk, a resilient seal on the vane and sealingly engaging the wall and cover plate with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a pair of fluid inlet ports in the boss each opening to a different one of the sections, a pair of spaced drain ports in the wall and controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, an annular drain passage in the casing surrounding the wall and in fluid communication with the drain ports, and means constantly connecting the inlet ports to a source of fluid under pressure whereby rotation of the master shaft

rotates the chamber to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

8. A fluid control device comprising a casing, means forming a rotatable annular chamber in the casing including a substantially flat circular base plate, an annular wall upstanding from the edge of the base plate, and a substantially flat circular cover plate, a master shaft rotatably supported in the casing and connected to the base plate for rotating the chamber, a boss extending into the chamber, a circular disk rotatably seated on the base plate, a slave shaft rotatably mounted in the casing and extending axially through the center of the chamber and secured to said circular disk at the center thereof, means forming a seal between the slave shaft and the boss, a second disk rotatably seated on the cover plate, a substantially rectangular motor vane in the chamber carried by the slave shaft and secured along one side to the first mentioned disk and along at least a portion of its opposite side to the second disk, a resilient seal on the vane and sealingly engaging the wall and cover plate with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a pair of fluid inlet ports in the boss each opening to a different one of the sections, a pair of spaced drain ports in the wall and controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, an annular drain passage in the casing surrounding the wall and in fluid communication with the drain ports, and means constantly connecting the inlet ports to a source of fluid under pressure whereby rotation of the master shaft rotates the chamber to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

9. A fluid control device comprising a casing, means

forming a rotatable annular chamber in the casing including a substantially flat circular base plate, an annular wall upstanding from the edge of the base plate, and a substantially flat circular cover plate, a master shaft rotatably supported in the casing and connected to the base plate for rotating the chamber, a boss extending into the chamber, a slave shaft rotatably mounted in the casing and extending axially through the center of the chamber, means forming a seal between the slave shaft and the boss, a substantially rectangular motor vane in the chamber and carried by the slave shaft, a resilient seal on the vane and sealingly engaging the wall and cover plate with the vane and the boss dividing the chamber into a first section between the vane and one side of the boss and a second section between the vane and the other side of the boss, a pair of fluid inlet ports in the boss each opening to a different one of the sections, a pair of spaced rows of drain ports formed in said wall with each row being controlled by the vane, said sections being in communication with said inlet ports regardless of the position of the vane relative to said drain ports, an annular drain passage in the casing surrounding the wall and in fluid communication with the drain ports, and means constantly connecting the inlet ports to a source of fluid under pressure whereby rotation of the master shaft rotates the chamber to move a drain port therein to a position wherein it is throttled by the vane whereby the ensuing increase in pressure in the section in communication with the last mentioned port causes rotation of the vane in the same direction as the wall in a follow-up manner.

References Cited in the file of this patent

UNITED STATES PATENTS

1,178,695	Yost	Apr. 11, 1916
1,484,030	Kitchen	Feb. 19, 1924
1,827,117	Staudé	Oct. 13, 1931
1,859,333	Josephs, Jr.	May 24, 1932
1,944,700	Tait, Jr.	Jan. 23, 1934
1,995,588	Secor	Mar. 26, 1935
2,020,847	Mitereff	Nov. 12, 1935
2,481,426	Hull	Sept. 6, 1949