Sept. 22, 1970 M. J. HUBER 3,529,617

FLUID FLOW PROPORTIONER

Filed July 19, 1968 2 Sheets-Sheet 1

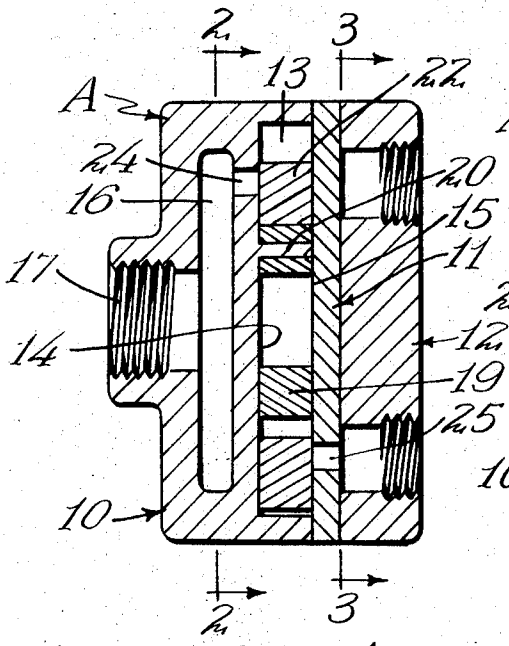


FIG. 1

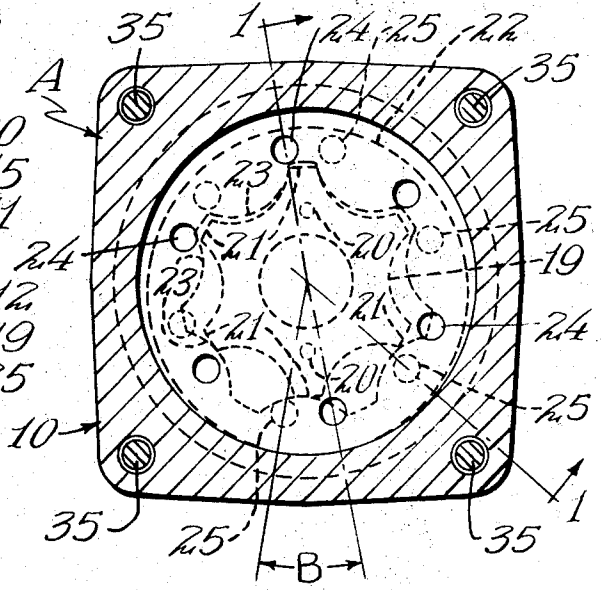


FIG. 2

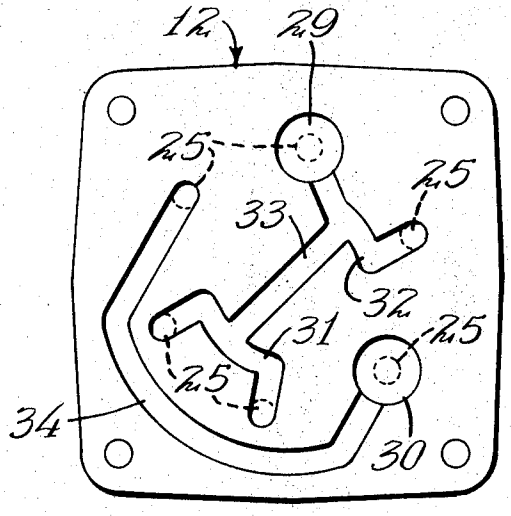


FIG. 3

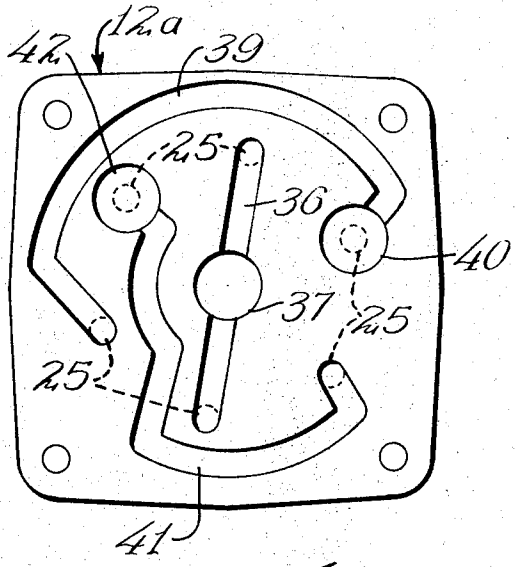


FIG. 4

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FLUID FLOW PROPORTIONER

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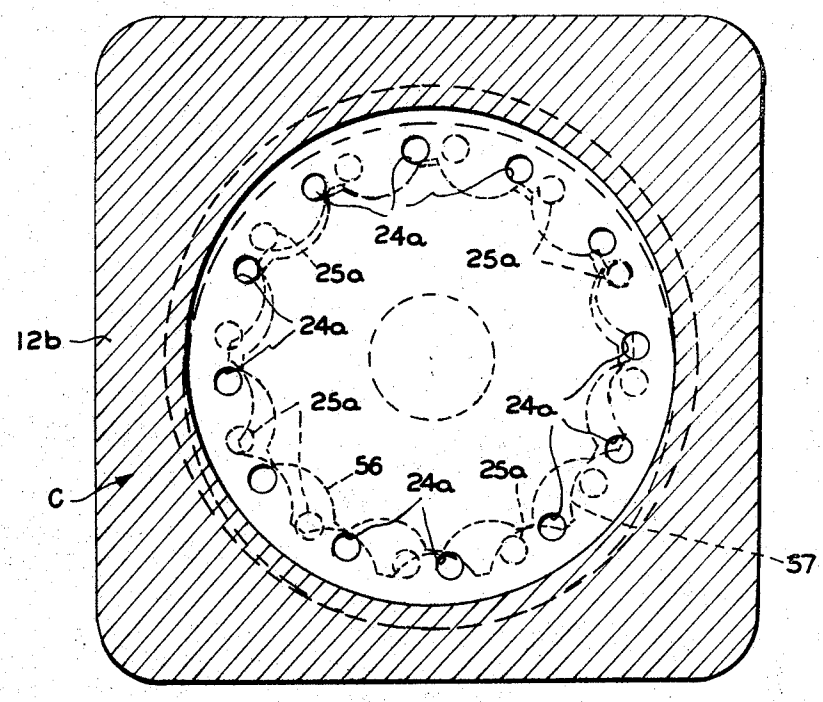


FIG.5

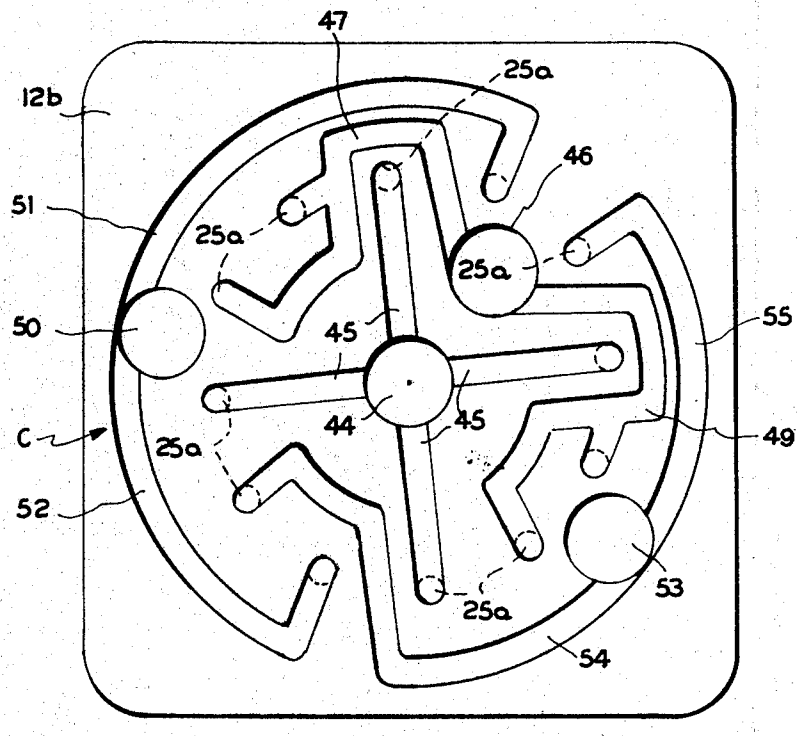


FIG. 6

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FLUID FLOW PROPORTIONER

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ABSTRACT OF THE DISCLOSURE

The flow proportioner comprises a gerotor device. A housing is provided having an inlet, an inlet manifold, a gerotor cavity, a porting plate, a discharge manifold and a plurality of outlet ports. An externally lobed center member is fixed in the gerotor cavity and an internally lobed gerotor rotates in an orbital path about the center member. Inlet valving holes communicate with the inlet manifold and are sequentially opened and closed by the gerotor during its rotation. The porting plate includes discharge valving holes which are also sequentially opened and closed by the gerotor during its movement. The discharge valving holes are connected to a plurality of discharge manifolds each connected to an outlet port. The fluid flowing through each outlet depends upon the number of discharge valving holes to which it is connected, as compared to the total number of discharge valving holes.

This invention relates to an improvement in fluid flow proportioner and deals particularly with a device for proportioning the flow of fluid from a single source to a plurality of fluid driven devices.

An object of the present invention resides in the provision of a gerotor which is designed to orbit about a stationary member. The stationary member is provided with external lobes, and the gerotor is provided with internal lobes which are of greater number than the external lobes of the fixed member. In other words, there is one more internal lobe on the gerotor so that the gerotor will rotate in an orbital path upon the fixed center. As the gerotor moves about its orbital path, it opens and closes valving holes in sequence. As long as fluid under pressure is provided, the gerotor will continue to rotate.

In order to proportion the fluid flow, groups of discharge valving holes are connected by a manifold to one outlet port, while the remaining discharge valving holes may be connected by another manifold to a second outlet. If desired, the discharge valving holes may be divided into more than two groups, each group being connected to a corresponding manifold having an outlet port. The amount of fluid directed to each outlet port depends upon the number of discharge valving holes in the group connected to that outlet port and the fractional part of the total flow directed to each outlet port will equal the number of holes connected to that port divided by the total number of discharge valving holes. In other words, if half of the discharge valving holes are connected to one outlet port and the remainder connected to a second outlet port, each outlet port will receive one-half of the fluid. As a further illustration, if twelve discharge valving holes are provided, two groups of four discharge valving ports may each be connected to a corresponding outlet port. Two outlet ports may be provided each of which is connected to two of the remaining valving holes. With such an arrangement, one third of the fluid will be directed to each of the first two outlet ports, and one sixth of the fluid will be directed to each of the additional outlet ports.

A feature of the present invention resides in the provision of a device of the type described in which some

pressure boosting may be obtained in subordinate circuits by lowering the pressure requirements of the other circuits.

A further feature of the present invention resides in the provision of a device of the type described which generates a minimum of heat. In a circuit which has several pressure requirements, a conventional flow diverter must "meter" the high pressure oil to control flow in the low pressure circuit. This metering causes a loss of energy and creates heat wasting some of the power. In the present device, the fluid is not metered, but is pumped into the circuit at the required pressure, thus eliminating a substantial portion of the power loss. The only power absorbed by the device is the power necessary to rotate the gerotor about its orbital path.

These and other objects and novel features of the present invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification.

FIG. 1 is a sectional view through the device, the position of the section being indicated by the line **1—1** of FIG. 2.

FIG. 2 is a sectional view through the device, the positions of the section being indicated by the line **2—2** of FIG. 1.

FIG. 3 is a view of the outlet manifold, the position of the section being indicated by the line **3—3** of FIG. 1.

FIG. 4 is a view similar to FIG. 3, showing a modified outlet manifold construction.

FIG. 5 is a view similar to FIG. 2, but showing a gerotor having an increased number of teeth.

FIG. 6 is a view similar to FIGS. 3 and 4, but showing an outlet manifold construction for use with the gerotor of FIG. 5.

The fluid proportioning device is indicated in general by the letter A. In general, the device includes an inlet manifold casting **10**, a porting plate **11**, and a discharge manifold casting **12**. The inlet manifold casting **10** is shown as including a cylindrical cavity **13** closed on one side by a flat sealing surface **14** and closed on its other side by the flat surface **15** of the porting plate **11**.

A manifold cavity **16** is provided within the inlet manifold casing **10** and is provided with an inlet port **17** which is connected to a suitable supply of fluid under pressure. An externally lobed fixed center **19** is centrally positioned relative to the cavity **13**, and is held in fixed relation on the sealing surface **14** by pins **20** or other suitable means. The fixed center **19** is provided with a series of angularly spaced lobes **21**, six such lobes being shown in the particular arrangement illustrated in FIGS. 1 and 2 of the drawings. A gerotor **22** is provided in the cavity **13**, the gerotor having seven internally extending lobes **23**. Six equally spaced inlet valve holes **24** extend through the wall bearing surface **14**, connecting the interior of the cavity **13** to the inlet manifold **16**. Six equally spaced outlet valving holes **25** extend through the porting plate **11** to a suitable manifold arrangement in the discharge manifold casting **12**, as will be described.

The inlet valving holes **24** are angularly spaced from the corresponding outlet valving holes **25** in angular distance B. The center of the angle B extends through the center of the lobes **21** of the fixed center **19**. As the gerotor **22** rotates about its orbital path, the inlet valve holes **24** are sequentially opened to admit fluid under pressure into the areas between the lobes of the fixed center and the lobes of the gerotor until the area is maximum. Further movement of the gerotor closes the inlet valving holes **24** and opens the outlet valving holes **25** which remain open until all of the fluid has been forced from the space between the gerotor lobes and the lobes of the fixed center **19**. Thus the gerotor operates in the conventional manner, sequentially opening and closing the

inlet valving holes and sequentially opening and closing the discharge valving holes, the opening of the discharge holes being timed to lag the opening of the inlet valve holes 24 by the angle B.

An important advantage of the present device lies in the simple manner in which the fluid flow may be proportioned. FIG. 3 of the drawings shows the manner in which the discharge manifold casting 12 may be formed so as to direct two-thirds of the fluid to one discharge port 29 and to direct one-third of the fluid to a second discharge port 30. While the discharge valving holes 25 would not appear in this view, the position of these valving holes is indicated in dotted outline. It will be noted that a pair of generally U-shaped channels 31 and 32 are connected by a diametrically extending channel 33 and that the U-shaped channel 32 connects with the discharge port 29. It will also be noted that a second channel 34 connects the remaining two diametrically opposed valving holes 25 and communicate with the discharge port 30. Thus the fluid discharging from four of the valving holes 25 will be directed toward the outlet port 29, and the remaining one third of the fluid will be discharged through the port 25.

From the foregoing description, it will be evident that in order to change the proportion of fluid flowing to subordinate circuits, it is only necessary to change the discharge manifold casting 12. The castings and the intermediate porting plate are held together by any suitable means such as by bolts 35 so that the structure may be easily assembled and taken apart. In other words, the subordinate circuits may be supplied with a desired proportion of the fluid by proper design of the discharge manifolds. FIG. 4 shows a different form of manifold system which will divide the liquid into three equal parts.

The discharge manifold casting shown in FIG. 4 is indicated in general by the numeral 12*a*. As in the previous view, the position of the valving holes 25 are shown in dotted outline. Two diametrically opposed valving holes 25 are connected by a diametrically extending groove 36 to a central discharge port 37. A second pair of diametrically opposed valving holes 25 are connected by a groove 39 which leads to a second discharge port 40. The remaining two diametrically opposed valving holes 25 are connected by a groove 41 to a third discharge port 42. As a result, rotation of the gerotor 22 will cause one third of the liquid to be directed to each of the discharge ports 37, 40, and 42.

The design of the discharge manifold casting could obviously be simplified by connecting pairs of adjacent valving holes rather than to connect diametrically opposed valving holes. The arrangement illustrated is preferred because it functions more smoothly. By connecting diametrically opposed valving holes, the intervals at which fluid is delivered to each outlet port is equalized and reduced to a minimum.

FIGS. 5 and 6 of the drawings show a modified form of fluid flow proportioner which is indicated in general by the letter C. The proportioner C is similar to that fluid proportioner A except for the fact that the number of lobes on the fixed center and on the gerotor have been increased in order to increase the smoothness of operation and to provide a greater range of variations. FIG. 5 is sectioned corresponding in position to the line 2—2 of FIG. 1, and the inlet valving holes are indicated by the numeral 24*a*, while the outlet valving holes are indicated by the numeral 25*a*. The outlet valving holes 25*a* are shown in dotted outline in FIG. 6 to show the location of these holes relative to the manifold arrangement. The manifold system of FIG. 6 is designed to supply one-third of the fluid to each of two subordinate circuits, and to supply one sixth of the total amount of fluid to two other subordinate circuits. To accomplish this result, a first discharge port 44 is provided at the center of the discharge manifold casting 12*b* and this discharge port 44 is connected to four equally spaced discharge valving holes 25*a* by four radially extending grooves or passages 45. A second discharge port 46 is connected by grooves 47 and 49 to opposed pairs of valving holes 25*a*. A third discharge port 50 is connected by oppositely extending grooves 51 and 52 to an additional pair of diametrically opposed valving holes 25*a*. A fourth discharge port 53 is connected by oppositely extending grooves or passages 54 or 55 to the remaining pair of diametrically opposed valving holes 25*a*.

Due to the fact that the discharge ports 44 and 46 are each connected to four of the twelve valving holes, one third of the fluid flow will pass through each of these ports to suitable hydraulic circuits. As the discharge ports 50 and 53 are each only connected to a single pair of valving holes, one sixth of the total amount of fluid will be discharged through each of these two ports.

As will be understood, a wide variety of manifolding arrangements are available, and the number of available variations increases as the number of lobes increases. The fixed center 56 of the proportioner C is shown as having twelve lobes while the cooperable gerotor 57 is provided with thirteen. Thus as little as one twelfth of the liquid may be directed to one outlet port while as much as elevent twelfths of the fluid may be proportioned easily and accurately and with the generation of a minimum of heat. The only power required for operation is that necessary to move the gerotor about its orbital path so that the device is economical to operate.

One of the inherent characteristics of the described flow proportioner is its capability of delivering a pressure higher than inlet pressure to a selected outlet or group of outlets. Referring to FIG. 1, assume all of the outlet valving holes 25 except one are disconnected from the devices to which they supply power and are connected instead to a sump. The remaining outlet hole can supply fluid under pressure to its associated power consuming device at a rate equal to one-sixth of the input flow rate and at a pressure equal substantially to six times the inlet pressure. There will be some loss because there always will be some backpressure in the sump-connected discharge holes and because of friction losses. Pressure intensification in the heavily loaded outlet port or ports also is realized if one or more of the other ports is operating against a low load or loads. This pressure intensification is a known characteristic of flow proportioners of the gerotor type (see, for example, Albers Pat. 3,286,645, dated Nov. 22, 1966). Johnson Pat. 2,452,470, dated Oct. 26, 1948, shows another type of positive displacement fluid proportioner in which the same pressure intensification can be achieved.

In accordance with the patent statutes, I have described the principles of construction and operation of my improvement in fluid flow proportioner, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that changes may be made within the scope of the following claims without departing from the spirit of my invention.

What is claimed is:

1. A fluid proportioner comprising

(a) a housing containing a gerotor cavity (13) having plane, parallel end walls;

(b) a fluid pressure operated gerotor assembly in said cavity consisting of

(1) an externally lobed gerotor member (19) fixed to one of said end walls, and

(2) an internally lobed gerotor element (22) meshing with said member, but otherwise free of mechanical torque-transmitting connections, and arranged to rotate and orbit freely about said member, said element and member, together with said end walls, defining variable volume chambers which expand and contract once during each orbit of said element;

(c) a first circular series of uniformly spaced holes (24) in an end wall, coaxial with said member, and

providing a separate hole for each chamber which is uncovered by the gerotor element and thereby connected with the associated chamber when the latter is expanding;

(d) a second circular series of uniformly spaced holes (**25**) in an end wall, coaxial with said member, and providing a separate hole for each chamber which is uncovered by the gerotor element and thereby connected with the associated chamber when the latter is contracting; and

(e) first and second manifold means (**10**, **12**) communicating, respectively, with all of the holes in said first and second series, for leading fluid into and out of the proportioner, one of said manifold means providing separate flow paths for at least two groups of different holes in the associated series.

2. The proportioner defined in claim **1** in which the two series of holes are in opposite end walls.

3. The proportioner defined in claim **1** in which the first manifold means is an inlet for leading fluid into the proportioner, and it provides a single common flow path which communicates with all of the holes in the associated series, whereby the proportioner is a flow divider which splits the inlet flow between said groups in proportion to the ratios of the number of holes in each group to the total number of holes in each series.

4. The proportioner defined in claim **1** in which the holes included in a group are distributed uniformly in the associated series.

References Cited

UNITED STATES PATENTS

2,452,470	10/1948	Johnson	103—162
3,286,645	11/1966	Albers	103—130
2,989,951	6/1961	Charlson	103—130 X
3,106,163	10/1963	Mosbacher	103—130 X
3,178,888	4/1965	Hampton	103—9 X
3,215,043	11/1965	Huber	91—56
3,233,524	2/1966	Charlson	91—56
3,261,235	7/1966	Henkel	91—56 X
3,270,683	9/1966	McDermott	103—130

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U.S. Cl. X.R.

103—130; 137—118, 119, 624.14; 230—145