

[54] **VALVING MEANS FOR A GEROTOR ASSEMBLY**

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[51] Int. Cl. **F01c 1/02**, F03c 3/00, F04c 1/02

[58] Field of Search 418/60, 61 B, 61 R; 137/625.2

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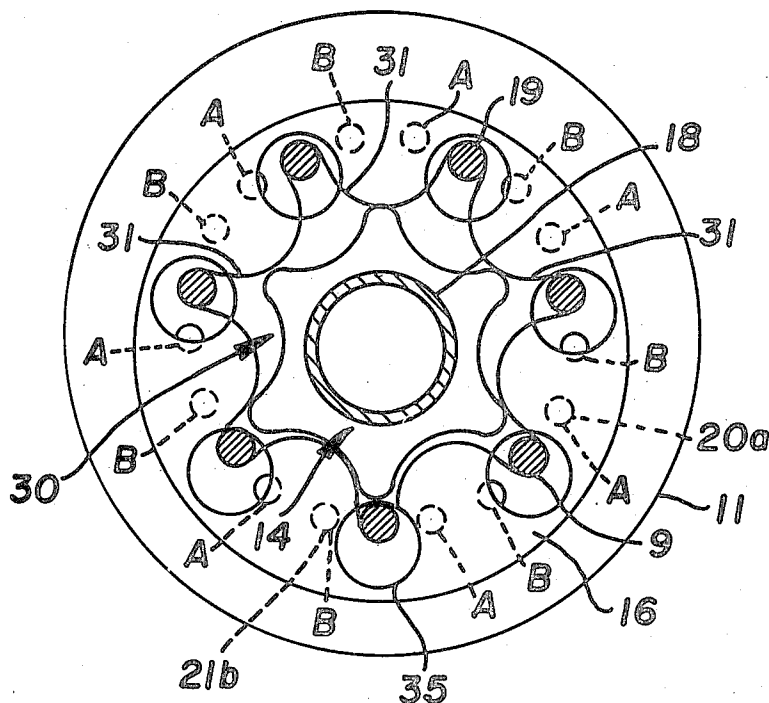
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[57]

ABSTRACT

A valving device for use with a gerotor assembly whether used as a pump or a motor which includes a valving disc placed adjacent to a gerotor face which will control the flow both into and out of the gerotor pockets. The movement of the valving disc is restrained from total rotation but moves in an orbit to open and close in sequential operation, feed and discharge ports such that the rotor will be provided with pressurizing fluid on one side of its extending arms and fluid from the opposite side of the arms will be free to exhaust through the adjacent exhaust port. The rotor is directly connected to an input or output shaft such that the unit may be utilized as a pump or motor and in a modified form of the invention a dual system is illustrated which will utilize a pair of control valving discs.

6 Claims, 13 Drawing Figures



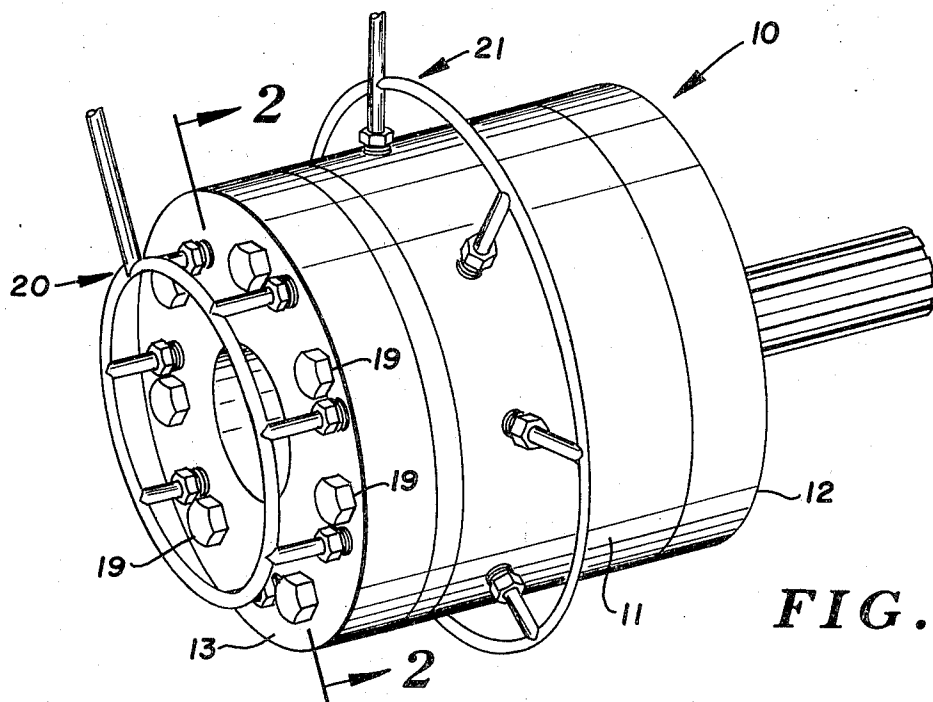


FIG. 1

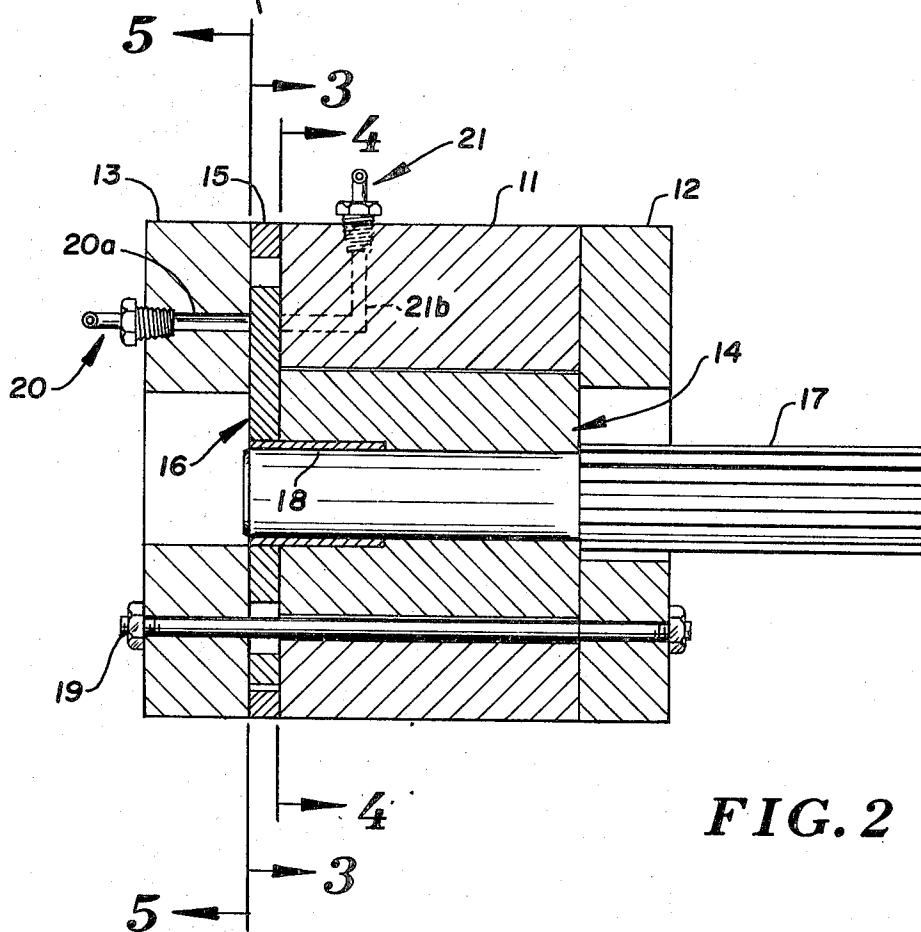


FIG. 2

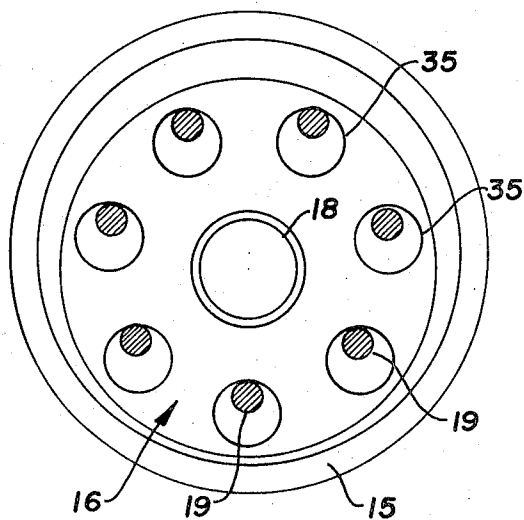


FIG. 3

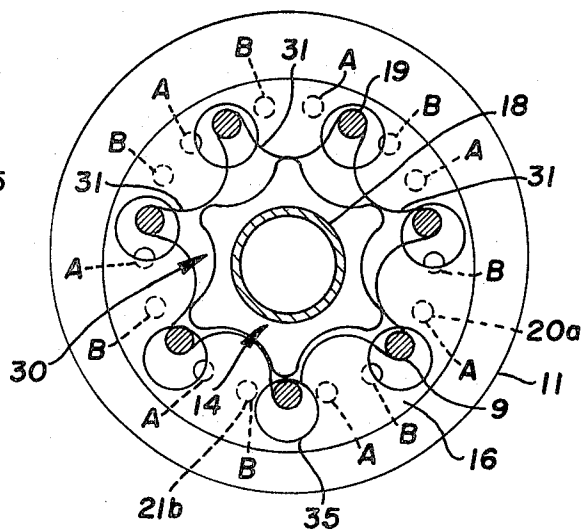


FIG. 4

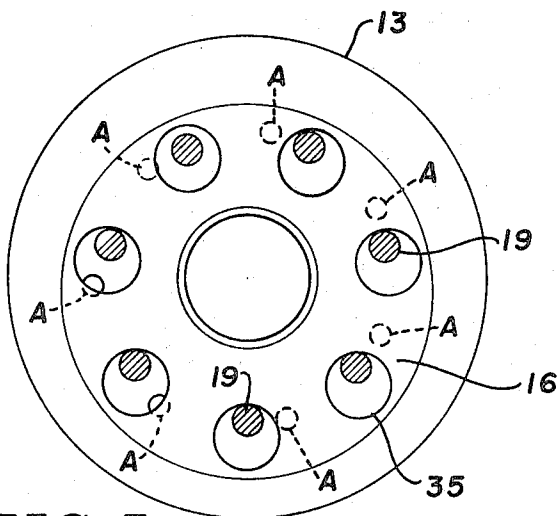


FIG. 5

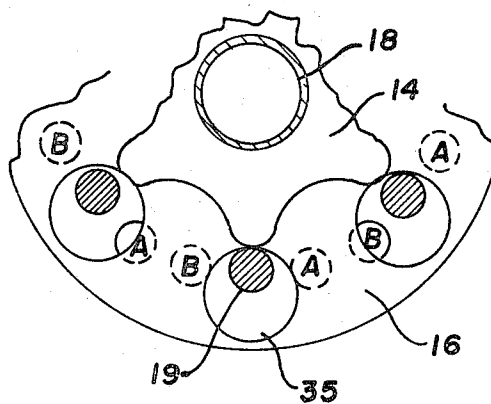


FIG. 6

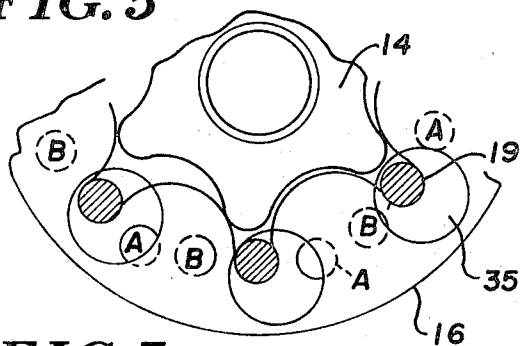


FIG. 7

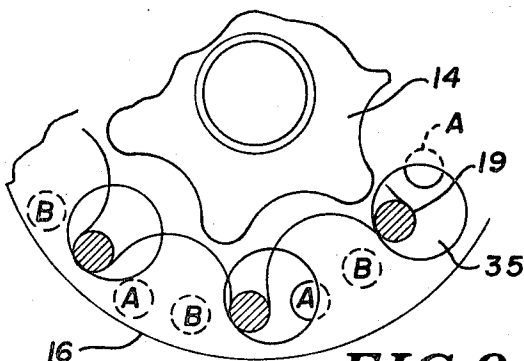


FIG. 8

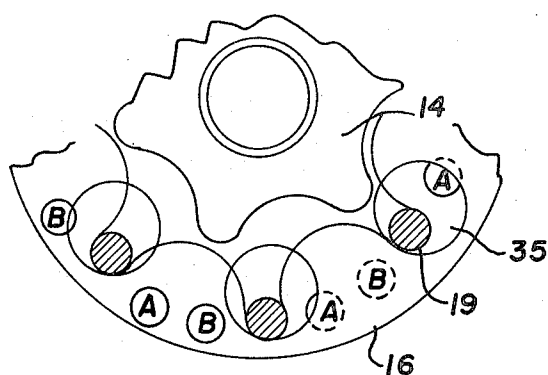


FIG. 9

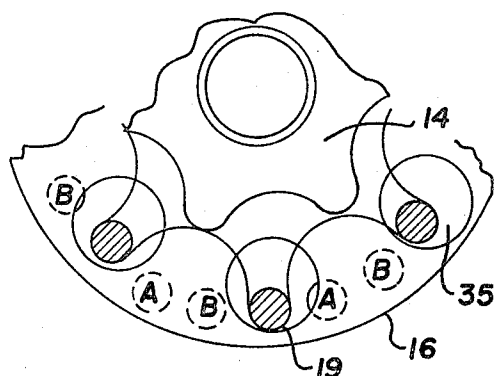


FIG. 10

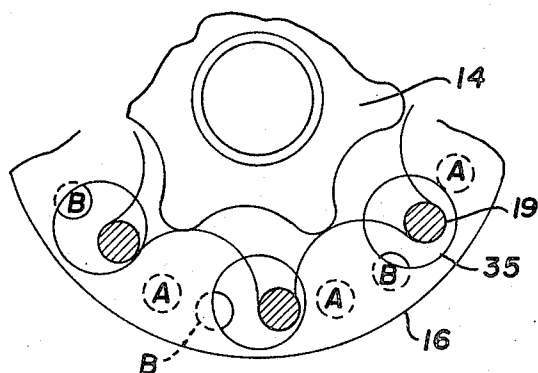


FIG. 11

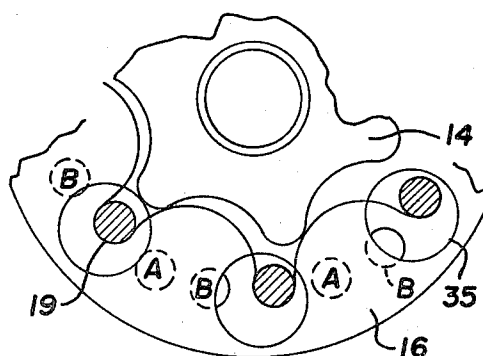


FIG. 12

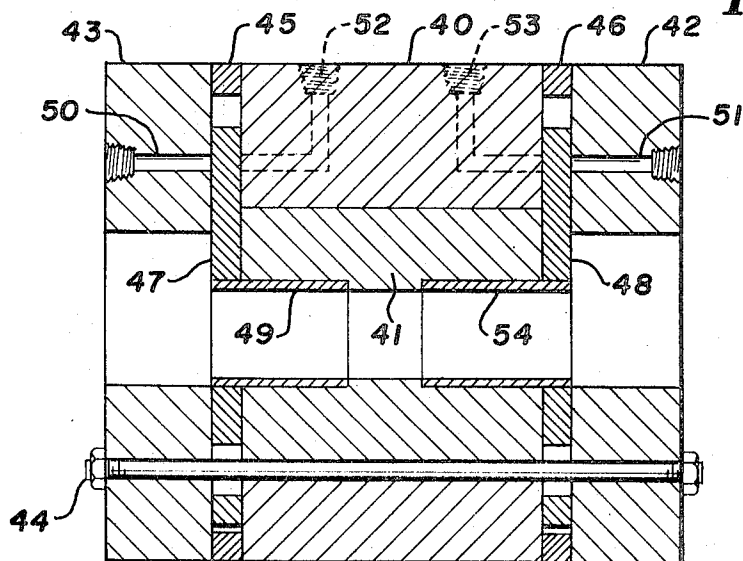


FIG. 13

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VALVING MEANS FOR A GEROTOR ASSEMBLY

With applicant's device a valve for controlling the flow through a gerotor assembly is provided. The valve is driven directly by the rotor and does not depend on any output shaft or any independently controlled driving link for operation thereof.

The operation of a gerotor assembly is commonly known in the art and this particular type of gerotor operation is widely used on low speed, high torque hydraulic motors where a large volume of hydraulic fluid passes through the gerotor assembly to drive the same which will drive the rotor through six particular orbits for each revolution of the output shaft. This of course is true only for six point rotors. A splined drive link is usually utilized to connect the orbiting rotor to a drive shaft and as such it should be obvious that these units may be utilized as either pumps or motors.

The valving unit in applicant's device is simply a flat disc operating between two surfaces with apertures through the valving disc and in the adjoining surfaces which will provide a control path for the fluid flow to and from the gerotor pockets as the rotor is driven in a circular or orbiting path. The valve disc will orbit with the rotor but is restrained from rotation therewith and thus each passage through the valve disc will sequentially open and close inlet and discharge ports arranged in the two adjacent surfaces.

It is therefore an object of applicant's invention to provide a valve disc or valving member for the control of fluid flow through a gerotor assembly.

It is a further object of applicant's invention to provide a valving disc for the control of the fluid flow through a gerotor assembly when the outer ring or stator of the assembly is held stationary and the rotor is driven in a circular or orbiting motion.

It is a further object of applicant's invention to provide a valve-disc control member for controlling fluid flow through a gerotor assembly wherein the valve disc is directly driven by the rotor and therefore does not depend on shifting thereof through any other linkage members.

It is a further object of applicant's invention to provide a valving disc unit for controlling fluid flow through gerotor assemblies wherein a plurality of rotors may be linked or stacked for driving or being driven by a shaft and which valving discs are driven by the rotor members which eliminates any other controlled linkages thereof.

These and other objects and advantages of applicant's invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a perspective view of a gerotor assembly which would incorporate the concepts of applicant's invention and illustrating thereon a simplified form of fluid flow into and out of the gerotor assembly;

FIG. 2 is a generally longitudinal cross section taken substantially along Line 2—2 of FIG. 1;

FIG. 3 is a transverse cross section taken substantially along Line 3—3 of FIG. 2;

FIG. 4 is a transverse section taken substantially along Line 4—4 of FIG. 2 but illustrating the inlet ports and outlet ports and the valving disc superimposed thereupon for clarity of operation;

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FIG. 5 is a transverse section taken substantially along Line 5—5 of FIG. 2 which illustrates only the valving discs and the inlet ports thereon;

FIG. 6 is the first of a series of superimposed illustrations to illustrate the movement of the rotor and the valving disc for controlling the ports of the unit;

FIGS. 7, 8, 9, 10, 11 and 12 are all sequential illustrations of the same section as illustrated in FIG. 6 to show the complete opening and closing of the inlet and outlet ports as controlled by the valving disc and the relation of the rotor thereto; and,

FIG. 13 is a cross section similar to FIG. 2 while illustrates a compound unit consisting of a dual valving operation.

In accordance with the accompanying drawings, a gerotor assembly is illustrated in FIG. 1 and designated 10. The gerotor assembly includes the main stator 11, a pair of end closure plates 12, 13 an interior rotor designated in its entirety 14, a spacer plate 15, a valving disc 16, an output or input shaft 17 and a bearing member 18 secured to the central access of the rotor for rotation therewith and upon which the valving plate 16 rides. Obviously a splined connection should be provided between the rotor 14 and the input or output shaft 17. In order to hold all these various units in proper alignment, a plurality of tie bolts each designated 19 are provided in spaced relation around the unit and obviously capturing elements must be provided on the ends thereof for securing the units in the proper inline position.

A pair of manifolds designated in their entirety 20, 21 are provided and these are illustrated in their simplest form in FIG. 1 where they simply extend about the periphery and circumference of the stator 11 and end plate 13 to provide fluid into these elements. Obviously this type of plumbing configuration would not be utilized in production situations and rather internal machining or the like would be provided. As illustrated in the various figures, manifold 21 is illustrated as exiting or entering the stator but this should not be considered to be a limiting location as obviously this manifold and passage could extend through the stator to exit from the end plate 12 such that the passage connecting thereto would be straight.

As illustrated in FIG. 2 manifolds 20, 21 connect to passages 20a, 21b which terminate in the surface adjacent the valving plate 16. The particular location of these pass-20a, 21b is not important although their internal relation to one another as will be explained hereinafter and their relation to the valve plate 16 is of particular importance.

The general object of such a gerotor assembly is two fold: it may operate as a motor with the direction of rotation thereof being controlled by providing fluid flow in one direction or fluid flow in the other direction to the manifolds 20, 21 which will cause rotation of the rotor and thus the connected output shaft in the selected direction. Movement of the output shaft 17 will be in an orbit rather than in a simple circular rotation situation and therefore some type of wobble connection must be utilized for proper transmission of purely circular rotation therefrom.

The shape of the gerotor stator and the gerotor rotor is as illustrated in FIG. 4, wherein the stator 11 includes a formed passage 30 therethrough which passage provides in this form, a seven point curvilinear related star relationship to provide pockets each designated 31 at

the seven equ-distant points therearound. These pockets 31 terminate in a smoothly curved section such that the tie rods 19 pass therethrough and are received securely therein. The shape of the rotor 14 is that of a six pointed, curvilinear star arrangement having a bearing 18 secured therein for rotation therewith. The object and design of a gerotor is well known in the art and basically what is produced in such a device is an orbiting effect of rotor 14 such that the rotation thereof is in one direction while the orbiting effect is in the opposite rotation. In other words the various points on the rotor will be shifted from one pocket to another and the rotor is driven through six orbit segments for each rotation of the output shaft as driven by the rotor. FIG. 4 is a composite superimposed view of the rotor, stator, valve plate and controlled apertures at this point a discussion of FIG. 3 should be considered.

In FIG. 3, spacer member 15 is illustrated along with the tie rods 19 and the valving disc 16 is provided along with and showing its mounting to the bearing 18 of the rotor 14. As illustrated, the valving disc 16 includes a plurality of apertures 35 therethrough, the apertures 35 being arranged centrally about the bearing and each of the apertures 35 surrounding one of the tie rods 19. In this manner then it should be obvious that rotation of the valving disc 16 is prohibited but as the rotor 14 orbits, the valving disc 16 is carried by the bearing in the same orbital path but rotation thereof being restrained by the tie rods 19 passing through the apertures 35 will only permit an orbiting effect of the valving disc 16 about the tie rods 19. With this relationship then it is obvious that the rotor 14 directly drives the valving disc 16 and no external drives shifting mechanisms for control disc 16 and thus of fluid flow necessary.

The cross section illustrated in FIG. 5 illustrates the valving plate mechanism 16 with the apertures 35 formed therethrough and as illustrated are in superimposed position over the end cover 13. The purpose of this particular view is to illustrate the position of the inlet ports which in this drawing are designated A. It should be noted that the inlet ports A are arranged in a particular configuration with respect to the apertures 35 such that as the valving disc 16 is orbited about the tie rods 19, the same will be exposed or uncovered at certain positions thereof and will be closed at other positions thereof.

As illustrated in FIG. 4, a superimposed situation is provided wherein the valving disc apertures 35 are illustrated and the inlet apertures, again designated A which are an extension of passages 20a are arranged in relationship about and spaced about the inlet or control apertures 35 and the outlet apertures previously referred to as 21b and again illustrated herein as B are arranged. Shifting of the valving plate 16 will sequentially pass aperture 35 over the apertures A and B to either open or close the same to control flow thereto into the pockets 31 of the stator. Obviously flow of fluid into these pockets will cause movement of or will force the rotor 14 from one pocket into the next adjacent pocket which will result in orbiting and rotating motion of the rotor 14 and thus will cause orbital shifting of the valve plate 16 into its various positions. These various positions and their operation are sequentially illustrated in FIGS. 6 through 12. In these figures, the rotor is again designated 14, the bearing designated 18, the valve plate 16 and the valving apertures 35. In these views the input apertures are designated only as A and the ex-

haust apertures are designated B. The designation of inlet and outlet for these apertures must be regarded as a single directional rotation type arrangement whereas when rotation of the output shaft 17 is provided in the other direction, apertures B would be designated as input apertures and apertures A as exhaust apertures.

In the operation of the unit as illustrated in FIGS. 6 through 12 the distinction must be made between orbiting and rotation of the various elements and this will be understood by those acquainted with the gerotor operation. As the gerotor points move from one pocket to another, as illustrated clockwise, the rotation of the output shaft will be clockwise but the center of the rotor and thus the bearing 18 and the valving disc 16 will be counter clockwise this will then cause the apertures 35 to be moved relative to the tie rods 19 is a counter clockwise direction. For example in the various steps in these figures, the rotor 14 is being moved in a clockwise rotation which is provided by introducing fluid under pressure through apertures A and providing exhaust therefrom through the apertures B. As illustrated therein it should be noted that in FIG. 6 apertures A are being pressurized which will cause clockwise rotation of the rotor 14 but this rotation will move the center of the rotor 14 in a counter clockwise direction. This counterclockwise rotation of the center of the rotor 14 is also the rotational direction of the bearing 18 of the unit and thus the valve plate 16 carried thereby is moved in the same direction as the bearing rotation. As the valve plate 16 is restrained from such rotation it will rather orbit about the tie rods 19 thus exposing either the inlet port A or the exhaust port B or at times combinations of the same.

In this manner then by introducing fluid under pressure on one side of one of the rotor points it will force the same from the stator pocket and into the next adjacent stator pocket. Obviously when forcing the same into the next adjacent pocket the proper exhaust port must be opened. As this rotation of the rotor 14 occurs the center of the bearing will be orbited in an opposite direction thereto and this opposite orbiting will result in the valve disc 16 being orbited in said opposite direction.

In this form then it should be obvious that the valve disc 16 being carried directly by the rotor 14 performs the opening and closing of the inlet and exhaust ports and this opening and closing is arranged in conjunction with the movement of the rotor member 14. It should be obvious then that no external hook ups are necessary from the output shaft to shift the valving mechanism nor are any exterior valves necessary for proper timing of input and output of fluids.

A modified form of the invention is illustrated in FIG. 13 wherein the stator device is designated 40, the rotor device designated 41 with again end plates 42, 43 thereon which entire unit is held with tie rods 44 extending entirely through the structure and spacer plates 45, 46 are provided to permit valving disc members 47, 48 to be arranged between the stator and the end plate 42, 43. These valving plates 47, 48 again are mounted on bearing members 49, 50 which are fitted internally into the rotor 41. Obviously again an output shaft must be provided for rotation by the rotor 41 for input or output of rotary motion to or from the rotor 41. Again fluid flow passages 50, 51 which may be termed inlet or outlet passages are provided and additional fluid passages 52, 53 are provided such that fluid may be in-

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roduced to or exhausted from the unit. Again the direction of flow through these passages is relatively immaterial to the operation of the unit as the direction of rotation will be determined by the passage in which the fluid is introduced. In the modified form of the invention, as illustrated in this figure, the concept is to provide a plurality of stacked rotor members all of which can be driven through a plurality of stacked valving disc members with a final ultimate input or output shaft being arranged and connected to all the rotors.

This modified form of the invention could be extended to encompass many such individual rotors all tied together through a common shaft with a plurality of stacked valving discs for driving the same. Again, it is immaterial concerning the flow pattern for introducing the fluid into the various valving disc areas as this can be accomplished through many types of porting devices.

It should be obvious that applicant has provided a unique valving disc control unit for a gerotor assembly or the like wherein the valving disc is controlled strictly by the motion of the rotor to sequentially open and close a plurality of inlet and discharge ports without the requirement of external operating linkages or the like.

What I claim is:

1. A gerotor assembly including:

- a. a stationary, internally toothed stator;
- b. an externally toothed rotor having one less tooth than said stator and being received in said stator;
- c. a shaft connected to said rotor;
- d. an end plate on the end of said stator and rotor for sealing the same;
- e. a pair of flow passages including a fluid inlet and a fluid outlet arranged respectively on opposite

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sides of said internal teeth of said stator;

f. a valving disc arranged on said rotor for movement therewith but arranged for rotation relative thereto, said disc having a plurality of apertures therethrough, said apertures being located and having dimension to control flow through said inlets and outlets and into and out of the areas between the internal and external teeth of said stator and rotor; and,

g. means for restraining rotation of said valving disc such that one aperture will control each of said inlet and output pairs including tie rods joining said stator and said end plate and passing respectively through said disc apertures.

2. The structure set forth in claim 1 and said rotor being provided with a bearing member generally centrally thereof, said valving disc being mounted for rotation thereon.

3. The structure set forth in claim 1 and one set of said flow passages being directed through said end plate, the other set of said flow passages being directed in said stator.

4. The structure set forth in claim 1 and one of said tie rods being provided for each of said teeth, each valving disc aperture received respectively about each such rod.

5. The structure set forth in claim 1 and said valving disc being arranged between said end plate and said stator and rotor.

6. The structure set forth in claim 2 and a spacer ring being arranged between said end plate and said stator, said valving disc being arranged for movement within said ring.

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