

April 15, 1958

W. F. ERICKSON ET AL

2,830,542

FLUID PUMP

Filed June 22, 1953

3 Sheets-Sheet 1

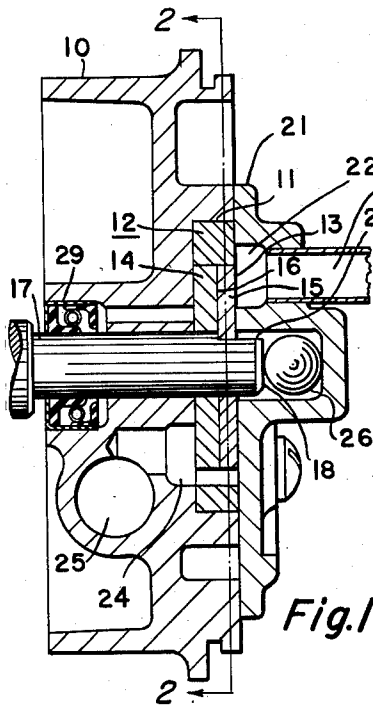


Fig. 1

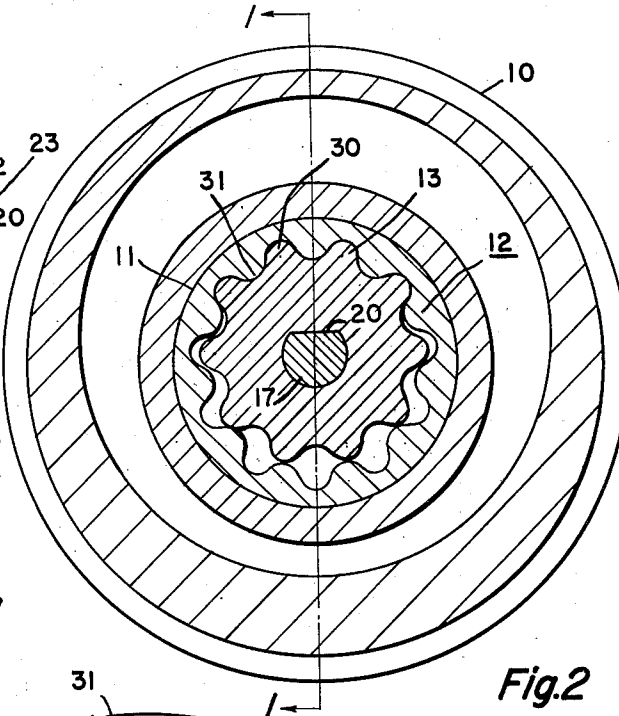


Fig. 2

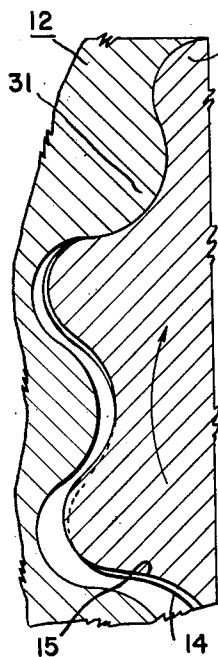


Fig. 4

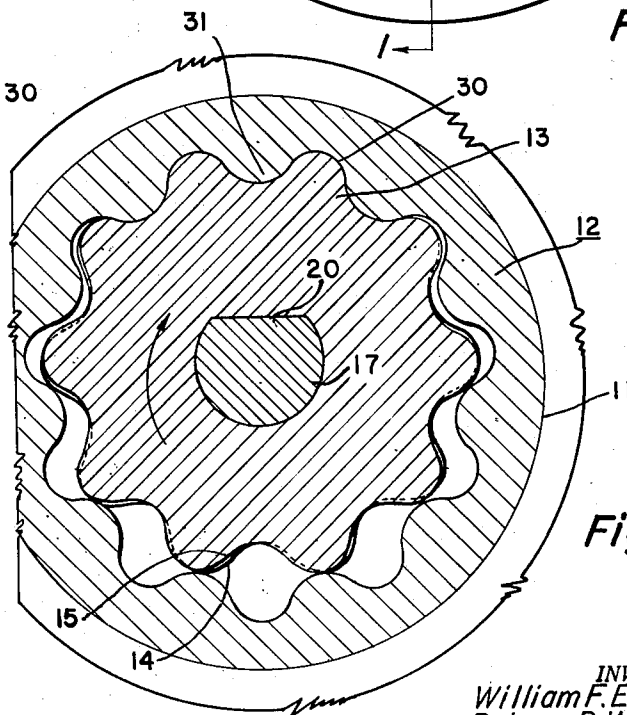


Fig. 3

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Fig. 5

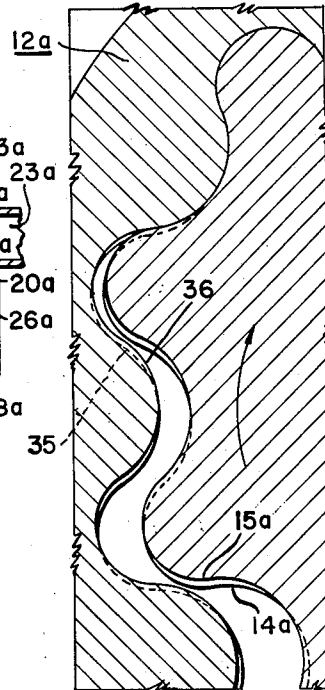
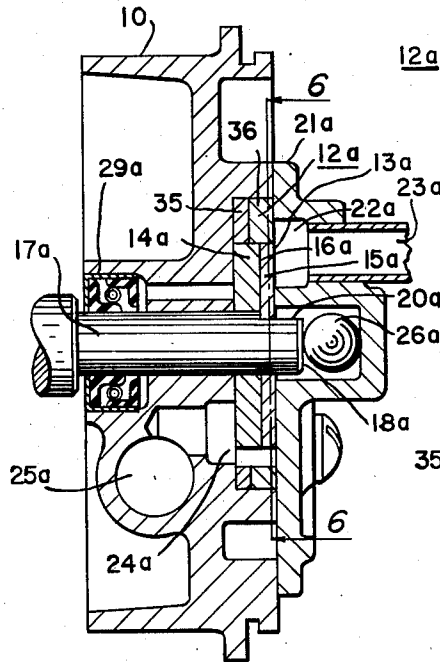
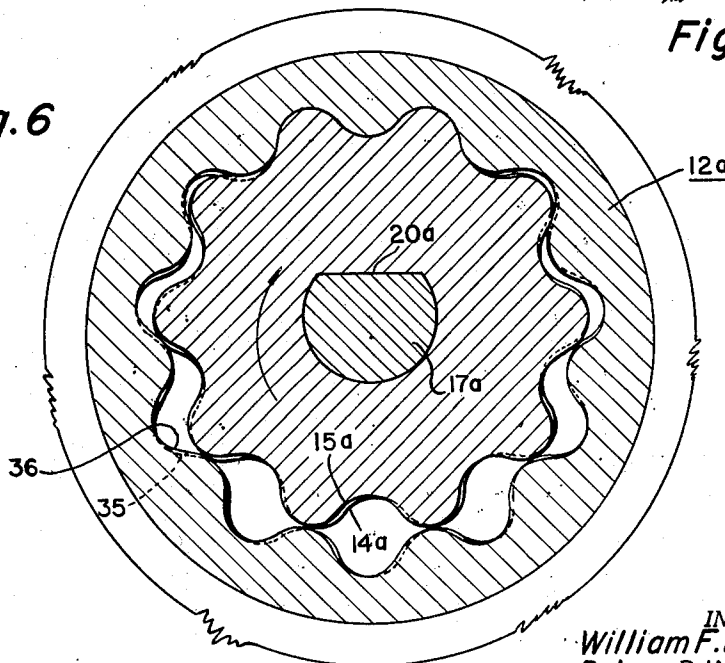


Fig. 7

Fig. 6



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3 Sheets-Sheet 3

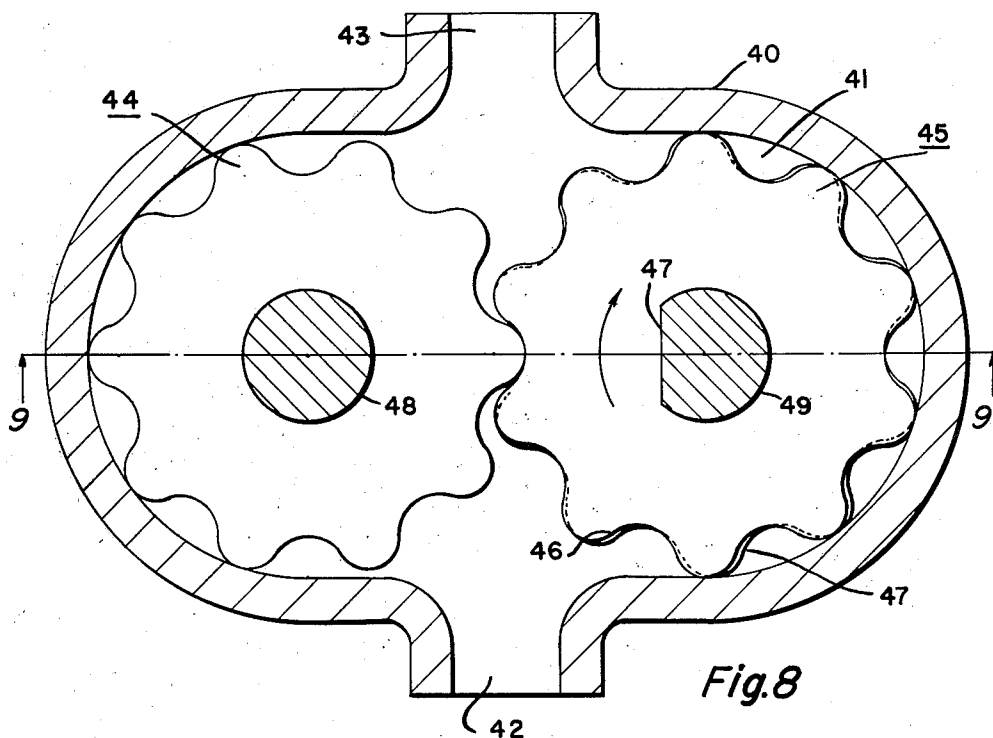


Fig. 8

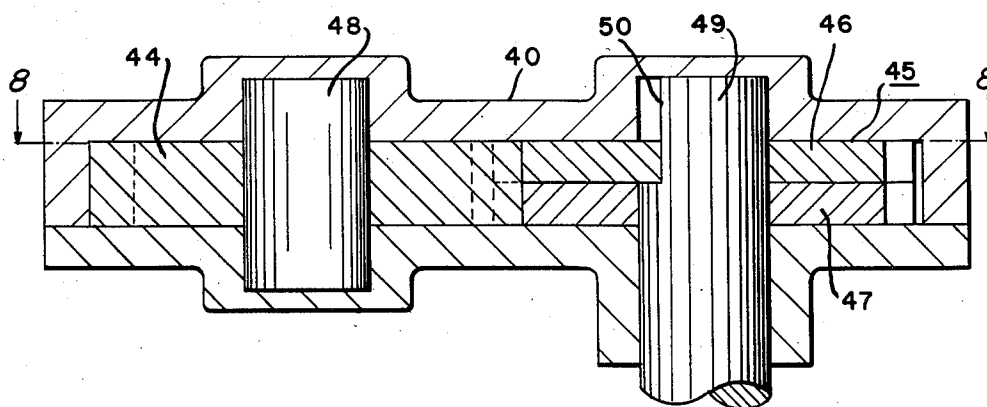


Fig. 9

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16 Claims. (Cl. 103—126)

This invention relates to fluid pumps and particularly to a gear type fluid pump.

In gear type fluid pumps there is a difficulty of a rapid pulsation in the delivery of fluid under pressure from the pump. This is occasioned by varying dimensions of the pump gears required by manufacturing tolerances that must be allowed in the manufacture of such gears and due to the fact that gears are not perfect in concentricity nor in spacing of the teeth lobes of the gear. When pumping gears rotate relative to one another in delivering fluid under pressure from a pump chamber, the normal manufacturing tolerances involved in the manufacture of the gears creates different clearance spacings between the gear lobes or teeth that results in volumetric differences in the delivery of fluid from between the several cooperating gear lobes of the pumping gears. These differences in volumetric delivery from the pump create pulsations in the column of fluid delivered from the pump that are transmitted throughout the pumping system, and can become so serious as to develop specific vibration periods on the delivery side of the fluid system and in the device actuated by the fluid delivery from the pump. The variation in volumetric delivery from the pump is also affected by the fact that gears are not perfectly round so that any eccentricity or any out of roundness of the gears causes further variations in the volumetric delivery from the pump which adds to the pulsations from the pump.

It is a current practice to manufacture pump gears from powdered metals by a process wherein powdered metal is compressed in a suitable die to the form of a gear shape. This compressed powdered metal blank is thereafter placed in a high temperature furnace and sintered. Due to the fact that there are variations in the density of the powdered metal in the blank, the sintering process produces uneven strains within the part being sintered that results in some out of roundness of the gear part, but insufficient to normally effect satisfactory operation of the gear as a gear part.

However, when using such gear parts as pump elements the slight out of roundness of the pump gears causes a pulsation in the delivery of fluid under pressure from the gear pump. Even if such gears would be ground or sized after the sintering operation there would still be a certain amount of out of roundness resulting from manufacturing tolerances.

It is therefore an object of this invention to provide a gear pump wherein fluid pulsations on the delivery side of the pump are reduced to a minimum.

It is another object of the invention to provide a gear pump wherein one or more of the gears of the gear pump consists of a plurality of parts, the gear or gears being divided in a plane normal to the axis of the gear, and wherein only one of the gear parts of the divided gear is driven so as to provide a sequence drive to the remaining gear or gear parts. The arrangement is such as to substantially absorb manufacturing tolerances involved between the gear lobes of the gears and thereby reduce the volumetric difference between cooperating intermeshing gear lobes which results in a more uniform non-pulsating delivery from the gear pump.

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Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the invention is clearly shown.

In the drawings:

Figure 1 is a transverse cross sectional view of a gear pump incorporating features of this invention, taken along line 1—1 of Figure 2.

Figure 2 is a transverse cross sectional view of the pump taken along line 2—2 of Figure 1.

Figure 3 is an enlarged view of the pump gears illustrating the manner in which the manufacturing clearances are taken up by the gears.

Figure 4 is a still further enlarged view of a portion of the pump gears to more clearly illustrate the feature of taking up the manufacturing tolerances and out of roundness of the pump gears.

Figure 5 is a cross sectional view of a modified pump structure incorporating features of this invention.

Figure 6 is an enlarged view of the pump gears of the structure of Figure 5.

Figure 7 is a still further enlarged cross sectional view of the pump gears illustrated in Figures 5 and 6.

Figure 8 is a cross sectional view taken along line 8—8 of Figure 9 of a modified arrangement of a gear pump.

Figure 9 is a cross sectional view taken along line 9—9 of Figure 8.

Referring now to Figures 1 through 4 of the drawings the pump of this invention comprises a pump housing 10 having a pumping chamber 11. Within the pumping chamber 11 there is placed an internal gear ring 12 that is rotatable on its own axis within the pumping chamber 11. Internally of the gear ring 12 there is provided a rotor gear element 13 that is also rotatable on its own axis concentric with the axis of the gear ring 12.

The rotor gear 13 is divided into two parts 14 and 15, the division line 16 being normal to the axis of the rotor gear 13.

A drive shaft 17 extends through the pump housing 10 and has the end portion 18 thereof provided with a flat side 20 that engages the rotor gear part 15 for rotatably driving the same on the axis of the drive shaft 17. The rotor gear part 14 is carried on the drive shaft 17 coaxially thereof but is freely rotatable on the shaft 17.

A cover member 21 is placed upon the pump housing 10 and retains the gear ring 12 and the rotor gear 13 within the pump housing 11. The cover member 21 has a passage 22 forming an inlet passage for fluid as received from a conduit 23. The pump housing 10 has a discharge chamber 24 and a connecting conduit 25 through which fluid is delivered under pressure from the pump. A ball thrust bearing 26 is provided to engage the end of the drive shaft 17. A shaft seal 29 is provided between the housing 10 and the drive shaft 17.

The rotor gear 13 has a plurality of gear lobes 30 that are less in number than the gear lobes 31 provided on the inner periphery of the gear ring 12 thereby providing an internal gear ring. With the number of gear lobes on the rotor gear 13 being less than the number of gear lobes on the gear ring 12, the rotor 13 and gear ring 12 both rotate concurrently on the axis of the drive shaft 17 with the rotor gear 13 rotating slightly faster than the gear ring 12 because of the difference in number of gear lobes.

With the drive shaft 17 being connected only to the rotor gear part 15, the driving connection to the pump gear parts will be from the rotor gear part 15 to the gear ring 12 and thence back to the rotor gear part 14. The sequence drive thus established causes the rotor gear part 15 to engage the gear ring 12 for positive driving of the same with the rotor gear part 14 being allowed to drop

behind the position of the gear part 15 by the amount of clearance between the gear parts 15, 14, and the gear ring 12. Since the differential position of the gear parts 15 and 16 relative to the gear ring 12 causes the gear parts 14 and 15 to more completely fill the cooperating meshing portion of the gear ring 12 there will be a more uniform delivery of fluid under pressure from between the cooperating gear lobes.

Preferably, to avoid an equal division of the delivery of fluid by the rotor gear parts 14 and 15, the gear parts are made of unequal thickness. This minimizes any periodicity developing in the delivery of the fluid from between consecutive cooperating gear lobe portions which would tend to develop a vibration period in the high pressure delivery side of the pump.

In Figures 5 through 7, the pump illustrated is substantially identical with the pump heretofore described with regard to Figures 1 through 4 with the exception that the gear ring of the pump is also divided normal to the axis of the gear ring into a plurality of parts in the same manner as the rotor gear previously referred to in Figures 1 through 4. Hence the parts of the pump of Figures 5 through 6 that are identical to those illustrated in the pump Figures 1 through 4 are identified by the identical numerals but with the suffix "a".

In Figures 5 and 6 the gear ring 12a comprises two parts 35 and 36. The rotor gear 13a is composed of the two parts 14a and 15a. The rotor parts 14a and 15a are unequal in thickness as are the gear ring parts 35 and 36. The thin rotor gear part 15a meshes with the thick gear ring part 36 while the thin gear ring part 35 meshes with the thick rotor gear part 14a. Also, the thick rotor gear part 14a overlaps the thick gear ring part 36 and meshes with the same.

The drive shaft 17a drivingly connects with only the rotor gear part 15a. Thus the other rotor gear part and the gear ring parts are driven by a sequence drive from the rotor gear part 15a to the gear ring part 36, the gear ring part 36 in turn driving the rotor gear part 14a in the overlapping portions thereof, with the rotor gear part 14a in turn driving the gear ring part 35.

This sequence drive of the several gear parts causes the gear part 14a to lag behind the gear part 15a. With the gear part 14a lagging behind the gear part 15a, as illustrated in Figure 7, the gear part 14a will be driven by the gear ring part 36. The rotor gear part 14a will thus pick up the ring gear part 35 which lags behind the gear ring part 36, as illustrated in Figure 7. The sequence drive thus established reduces to a minimum any volumetric difference created between adjacent and cooperating gear lobes of the rotor gear and the ring gear resulting from either manufacturing tolerances or out of roundness of the elements, and thereby smooths out the fluid delivery from the pump and substantially eliminates pulsations of the fluid discharged from the pump.

In Figures 8 and 9 there is illustrated another form of gear pump incorporating features of this invention. In this modification the gear pump comprises a pump housing 40 having a pump chamber 41 provided with an inlet passage 42 and a discharge passage 43. Cooperating pumping gears 44 and 45 are positioned within the pumping chamber 41.

The pump gear 45 is composed of two parts 46 and 47, as illustrated in Figure 9, the gear 45 being divided into two parts along a plane normal to the axis of the pump gear 45.

The pump gear 45 receives a drive shaft 49 that has a flattened portion 50 on one end thereof for drivingly connecting with the pump gear part 46 to drive the same. The pump gear part 47 is freely rotatable on the drive shaft 49.

The pump gear 44 is a single unit and is freely rotatable on its supporting shaft 48.

It will be apparent that a sequence drive is provided from the pump gear part 46 to the pump gear 44 and

then to the pump gear part 47 in exactly the same manner as established in the pump illustrated in Figures 1 through 4 inclusive. The sequence drive arrangement provided in the pump illustrated in Figures 8 and 9 reduces to a minimum the volumetric difference between cooperating gear lobes of the pump gear 44 and 45 in exactly the same manner as heretofore described in the pump illustrated in Figures 1 through 4.

Also it will be understood that the pump gear 44 can be divided into two parts normal to the axis of the gear with the pump gear parts of different thickness in the same manner as described with reference to the pump structure illustrated in Figures 5 through 7 inclusive, with the resulting reduction in the volumetric difference between the cooperating gear lobes.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a gear pump having one gear element meshing with a second gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing one only of the gear elements as a split gear divided normal to the axis of the gear element with one of the parts of the split gear being driven and the other rotatable relative to the one part.

2. In a gear pump having one gear element meshing with a second gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing one only of the gear elements as a split gear divided normal to the axis of the gear element and means driving the gear elements through driving engagement with only one of the split gear parts.

3. In a gear pump having one gear element meshing with a second gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing each of the gear elements as a split gear divided normal to the axis of the gear element and means driving the gear elements by sequential contact rotatively through driving engagement with only one of the split gear parts.

4. In a gear pump having one gear element meshing with a second gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing one only of the gear elements as a split gear divided normal to the axis of the gear element with each part of the split gear having a different thickness and means driving the gear elements through driving engagement with only one of the split gear parts.

5. In a gear pump having one gear element meshing with a second gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing each of the gear elements as a split gear divided normal to the axis of the gear element with each part of the split gear elements having a different thickness, the respective parts of the split gear elements being positioned relative to each other with a thick gear part meshing with a thin gear part and overlapping disposition of the thick gear parts, and means driving the gear parts through driving engagement with only one of the parts.

6. In a gear pump having a rotor gear element meshing with an internal ring gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing one only of the elements as a split element divided normal to the axis of the element and means driving only one part of the divided element.

7. In a gear pump having a rotor gear element meshing with an internal ring gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing the rotor gear element only as a split element divided normal to the axis of the element and means driving only one part of the divided element.

8. In a gear pump having a rotor gear element meshing with an internal ring gear element and operative therewith for placing fluid under pressure, the improvement comprising, providing the rotor gear element and the internal ring gear element as split elements divided normal to the axis of the respective elements with the parts of the respective elements having different thickness and disposing the parts of the elements relative to each other with a thick part in meshing engagement with a thin part and the thick parts in overlapping relationship, and means drivingly engaging only one of the parts of the divided elements.

9. In a gear pump having an axially rotating rotor gear element meshing with an axially rotating internal gear element having a greater number of gear lobes thereon than the rotor gear element with the gear elements being cooperative for placing fluid under pressure, the improvement comprising, providing one only of the elements as a split element divided normal to the axis of the element with one of the parts of the split gear freely rotatable relative to the other part and means driving the said other part.

10. In a gear pump having an axially rotating rotor gear element meshing with an axially rotating internal gear element having a greater number of gear lobes thereon than the rotor gear element with the gear elements being cooperative for placing fluid under pressure, the improvement comprising, providing the rotor gear element only as a split element divided normal to the axis of the element and means drivingly engaging only one part of the divided element.

11. In a gear pump having an axially rotating rotor gear element meshing with an axially rotating internal gear element having a greater number of gear lobes thereon than the rotor gear element with the gear elements being cooperative for placing fluid under pressure, the improvement comprising, providing the rotor gear element and the internal ring gear element as split gear elements divided normal to the axis of the elements with the parts of the respective elements having different thickness, the parts of the elements being positioned relative to each other with a thin part in meshing engagement with a thick part and the thick parts in overlapping meshing relationship, and means drivingly engaging only one of the parts of one of the divided elements.

12. In a gear pump, the combination of, a pump housing having a pumping chamber therein, said housing having fluid inlet and fluid outlet passage means connected with said chamber, cooperating gear elements in said pumping chamber for drawing fluid into the chamber through the fluid inlet passage means and discharging fluid from the chamber under pressure through the fluid outlet passage means, one only of said gear elements being divided normal to the axis of the element into a plurality of parts, and drive means drivingly connected with only one of the parts of the divided gear element to drive the same and therethrough establish sequence drive to the other gear elements and gear element parts whereby to minimize volumetric difference between cooperating intermeshing gear lobes.

13. In a gear pump, the combination of, a pump housing having a pumping chamber therein, said housing having fluid inlet and fluid outlet passage means connected with said chamber, cooperating gear elements in said pumping chamber for drawing fluid into the chamber through the fluid inlet passage means and discharging fluid from the chamber under pressure through the fluid outlet passage means, each of said gear elements being divided normal to the axis of the respective element into a plurality of parts of different thickness, said parts being positioned relative to each other with a thin part meshing with a thick part and with the thick parts in meshing overlapping relationship, and drive means drivingly connected with only one of the parts of the divided gear elements to drive the same and therethrough establish

sequence drive to the other of said parts whereby to minimize volumetric difference between cooperating intermeshing gear lobes.

14. In a gear pump, the combination of, a pump housing having a pumping chamber therein, said housing having fluid inlet and fluid outlet passage means connected with said chamber, an internal ring gear element axially rotatable in said housing, a rotor gear element meshing with said ring gear element and axially rotatable in said housing and having a lesser number of gear lobes than said ring gear element, said elements cooperating for drawing fluid into said chamber through the fluid inlet passage and discharging fluid from the chamber under pressure through the fluid outlet passage, one only of said elements being divided normal to the axis of the element into a plurality of parts, and drive means drivingly connected with one of said plurality of parts providing for sequence drive between the said elements and the said parts thereof.

15. In a gear pump, the combination of, a pump housing having a pumping chamber therein, said housing having fluid inlet and fluid outlet passage means connected with said chamber, an internal ring gear element axially rotatable in said housing, a rotor gear element meshing with said ring gear element and axially rotatable in said housing and having a lesser number of gear lobes than said ring gear element, said elements cooperating for drawing fluid into said chamber through the fluid inlet passage and discharging fluid from the chamber under pressure through the fluid outlet passage, said rotor element only being divided normal to the axis thereof into a plurality of parts, and drive means drivingly connected with only one of the parts of said divided element to drive the said part and by driving the said part establish thereby sequence drive to the gear ring element and thence to the other part of the rotor gear element whereby to minimize volumetric difference between cooperating intermeshing gear lobes.

16. In a gear pump, the combination of, a pump housing having a pumping chamber therein, said housing having fluid inlet and fluid outlet passage means connected with said chamber, an internal ring gear element axially rotatable in said housing, a rotor gear element meshing with said ring gear element and axially rotatable in said housing and having a lesser number of gear lobes than said ring gear element, said elements cooperating for drawing fluid into said chamber through the fluid inlet passage and discharging fluid from the chamber under pressure through the fluid outlet passage, said rotor element and said gear ring element each being divided normal to the axis of the element into a plurality of parts of different thickness, the parts of the said elements being positioned relative to each other such as a thin element meshes with a thick element and the thick elements overlapping one another in meshing relationship, and drive means drivingly connected with only one of the parts of the rotor gear element to drive the said part and establish thereby sequence drive to the ring gear element and thence to the other part of the rotor gear element and back to the second part of the ring gear element whereby to minimize volumetric difference between cooperating intermeshing gear lobes of the said elements.

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