# United States Patent [19]

**Tuckey**

[11] **Patent Number: 4,500,270**

[45] **Date of Patent: Feb. 19, 1985**


[54] **GEAR ROTOR FUEL PUMP**


[75] Inventor: **Charles H. Tuckey**, Cass City, Mich.

[73] Assignee: **Walbro Corporation**, Cass City, Mich.



[21] Appl. No.: **403,097**

[22] Filed: **Jul. 29, 1982**

[51] **Int. Cl.**[3] ..... **F04B 23/14**; F04B 17/00

[52] **U.S. Cl.** ..... **418/133**; 418/135; 418/108; 418/166; 418/171

[58] **Field of Search** ..... 417/205; 418/133, 135, 418/166, 171, 108, 133



[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 1,584,207 | 5/1926 | Bell | 418/108 |
| 1,722,616 | 7/1929 | Williams | 418/108 |
| 2,380,783 | 7/1945 | Painter . | |
| 2,383,153 | 8/1945 | Parsons . | |
| 2,460,047 | 1/1949 | Von Wangenheim | 418/108 |
| 2,650,544 | 9/1953 | Parsons | 418/133 |
| 2,787,963 | 4/1957 | Dolan et al. | 418/133 |
| 2,792,788 | 5/1957 | Eames | 418/108 |
| 3,299,824 | 1/1967 | Gauthier | 418/133 |
| 4,295,797 | 10/1981 | Ruhl et al. | 417/205 |

FOREIGN PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 134056 | 2/1933 | Austria | 418/108 |



*Primary Examiner*—William R. Cline
*Assistant Examiner*—Jack McGlew
*Attorney, Agent, or Firm*—Barnes, Kisselle, Raisch, Choate, Whittemore & Hulbert



[57] **ABSTRACT**

A positive displacement fuel pump utilizing an in-line pump and armature with a flexible drive connection and spring-pressed backing plate for the pump and short cantilever mount shaft for the pump rotor.


**3 Claims, 12 Drawing Figures**

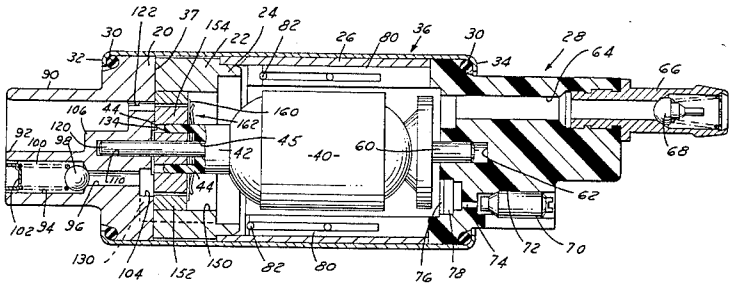
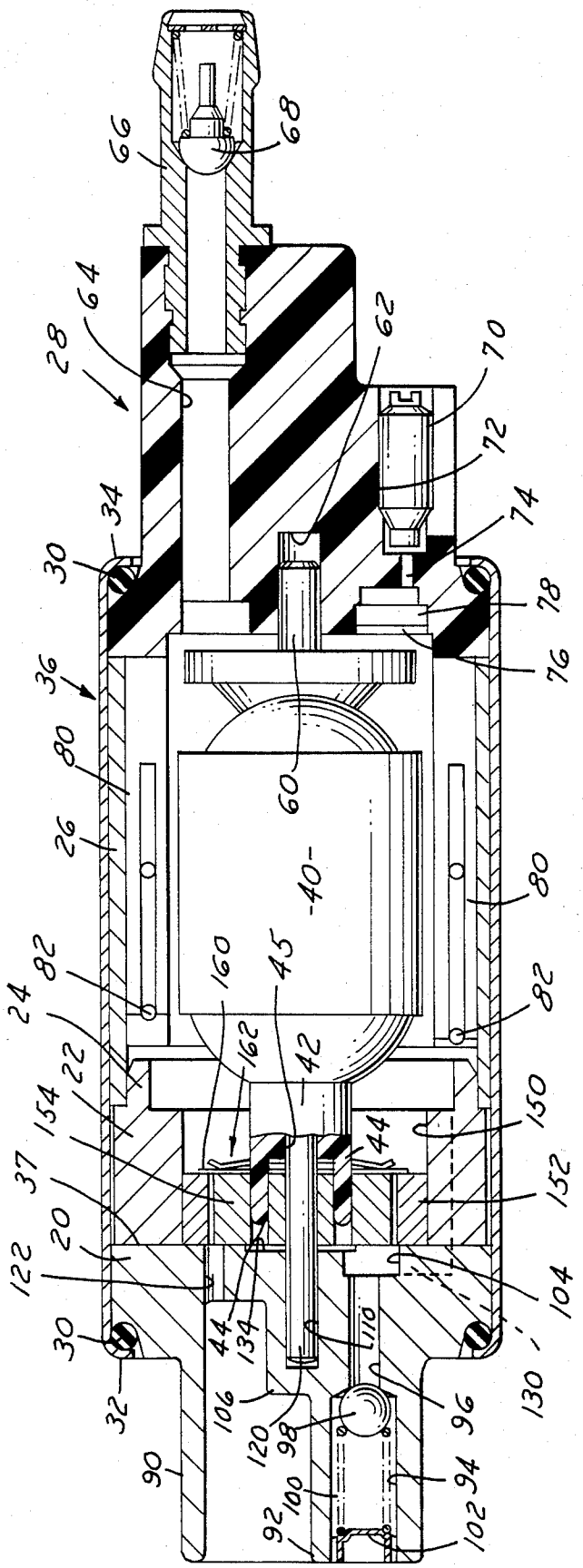


FIG. 1


66
68
64
28
62
70
72
34
74
30
78
76
36
80
60
26
-40-
80
82
160
45
82
24
162
42
22
154
150
44
37
152
20
122
104
44
134
130
30
110
32
106
120
98
96
90
94
92
100
102

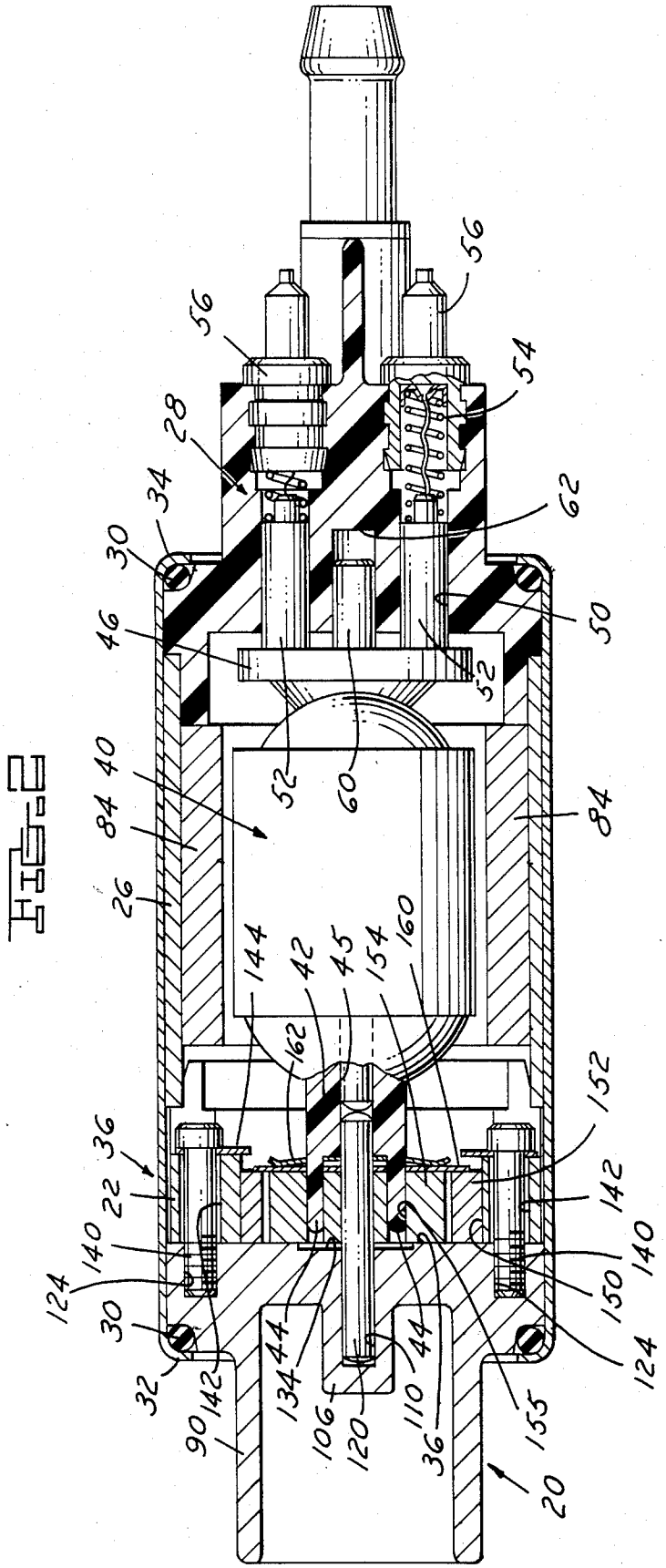

56
56
54
28
34
62
30
50
46
52
52
60
40
84
84
26
144
42
45
154
160
162
152
36
22
142
140
140
124
150
30
44
44
124
32
142
134
106
120
110
36
155
90
20

FIG-2

FIG. 3

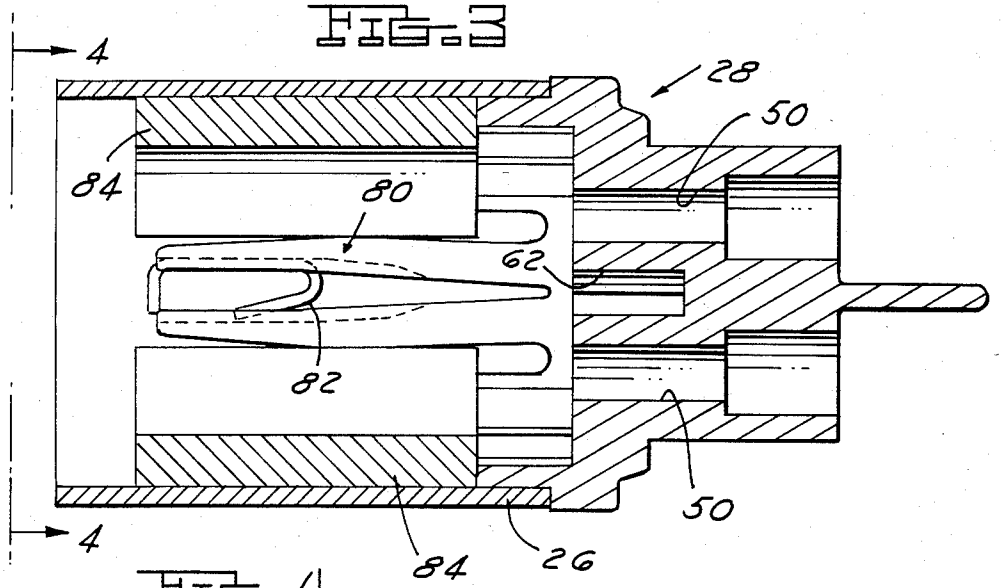



FIG. 4

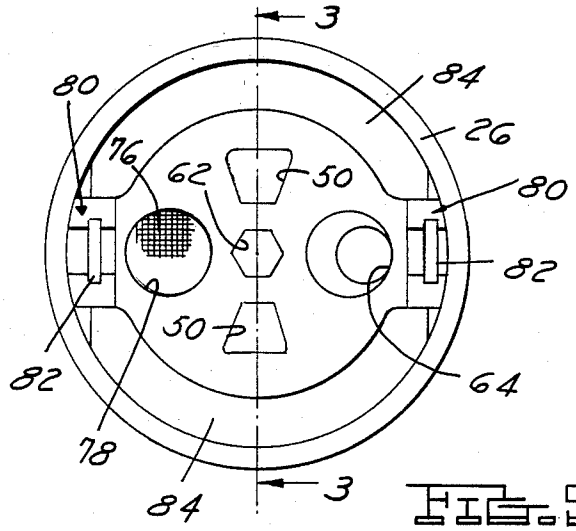



FIG. 6

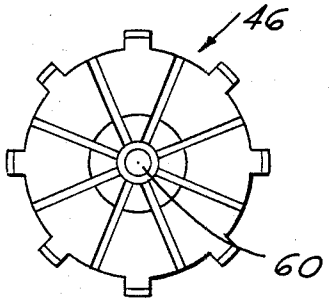



FIG. 5

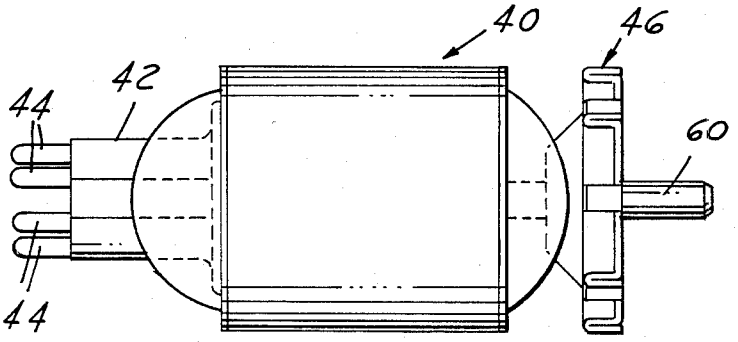


FIG. 7

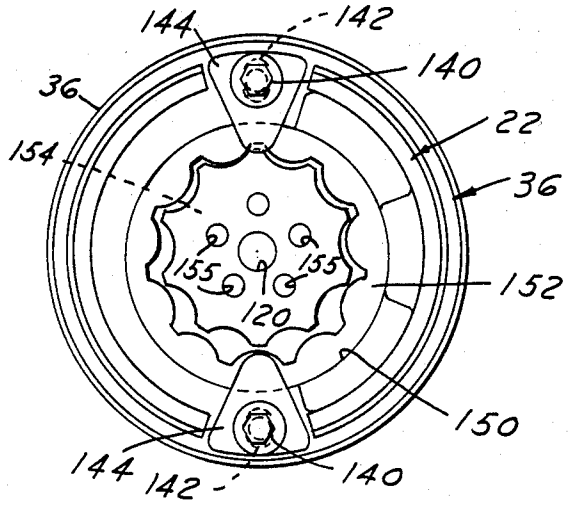



FIG. 8

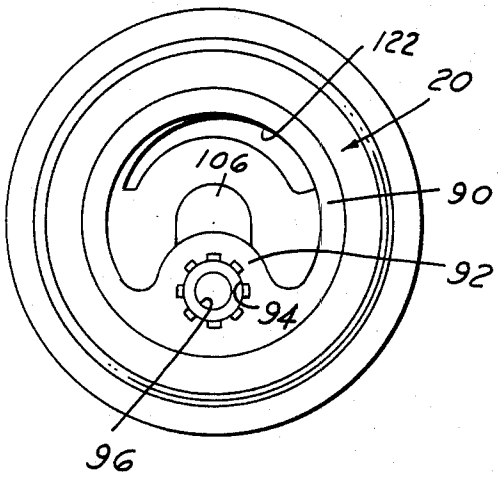



FIG. 9

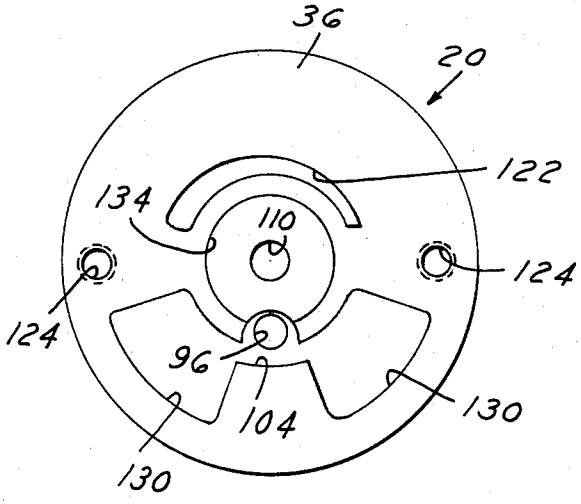



FIG. 10

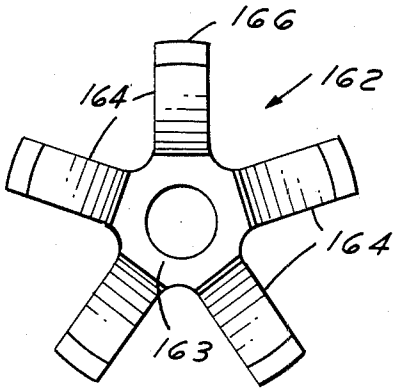



FIG. 11

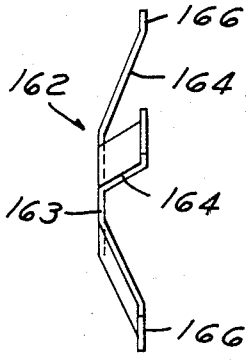
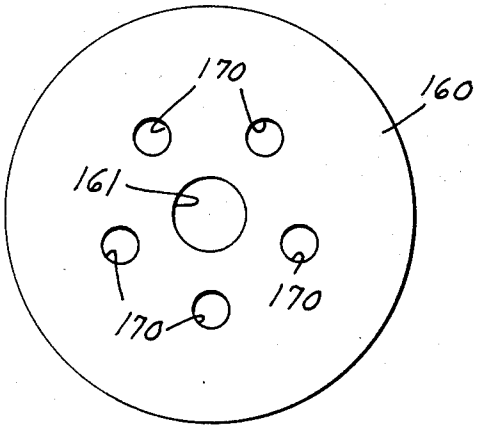



FIG. 12



# GEAR ROTOR FUEL PUMP

## FIELD OF INVENTION

Electric Fuel Pumps utilizing a gear type rotor.

## BACKGROUND AND FEATURES OF THE INVENTION

Many types of fuel pumps are utilized for internal combustion engines to supply fuel to the engine from a remotely positioned fuel tank. Cam-operated diaphragm pumps and positive displacement vane type pumps are in use. The significant objectives of a pump for automotive use are long life without the need for replacement parts or repair, adequate pressure and gallon per hour (gph) output, ability to run on a 12-volt electrical source, and a quiet operation will not be disturbing to passengers in vehicles in which the pump is used.

Pumps utilizing a gear type rotor are known. The present invention has the objectives of meeting the above requirements in a construction in which manufacturing cost is minimized and performance is optimized. It is a further object to provide a construction which compensates for misalignment in assembly without affecting pump operation. Another object is the provision of a construction which avoids expensive machining and critical assembly dimensions.

Objects and features of the present invention will be apparent in the following description and claims in which the the invention is described, together with a disclosure directed to persons skilled in the art to enable the making and using of the invention, all in connection with the best mode presently contemplated for the practice of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

Drawings accompany the disclosure and the various views thereof may be briefly described as:

FIG. **1**, a first longitudinal section of a pump assembly.

FIG. **2**, a second longitudinal section of a pump assembly taken at 90° to the first longitudinal section.

FIG. **3**, a sectional view of an outlet cover and motor housings taken on line **3**—**3** of FIG. **4**.

FIG. **4**, an end view of the motor housing taken at line **4**—**4** of FIG. **3**.

FIG. **5**, an elevation of an armature assembly.

FIG. **6**, a view of the commutator end of the armature.

FIG. **7**, an interior view of the inlet end of the pump and the pump assembly.

FIG. **8**, a view of the pump inlet end from the outside.

FIG. **9**, a view of the pump inlet end from the inside without the pump elements.

FIG. **10**, an elevation of a spring.

FIG. **11**, a side view of the spring retainer.

FIG. **12**, an elevation view of the gear pump seal plate.

## DETAILED DESCRIPTION OF THE INVENTION AND THE MANNER AND PROCESS OF USING IT

With reference first to FIG. **1**, the general assembly of the rear rotor pump is shown in longitudinal section. An inlet end shell or housing **20**, which can be a die casting or molded part, butts against a cam ring **22** which has a reduced flange **24** telescoping into one end of a flux ring **26**. At the other end of the flux ring is an outlet end part **28**. The inlet end and the outlet end each have opposed shoulders against which sealing rings **30** are disposed, held in place by spun-in ends **32**, **34** of an outer metallic shell **36**. The inlet housing **20** has a flat inner surface **37** which serves as one wall of a pump rotor housing.



In FIG. **5**, an armature assembly **40** is illustrated having a cylindrical drive projection **42** at one end with slender projecting fingers **44** circumferentially spaced around projection **42**. At the other end of assembly **40** is a commutator disc **46**. In FIG. **2**, brush recesses **50** contain brushes **52** backed by springs **54** seated in brush connector nipples **56** projecting from the outlet end housing.

The armature shaft **60** at the commutator end is received in a central recess **62** in the end housing. Reverting to FIG. **1**, the outlet end housing **28** has an axially extending passage **64** which serves as a pump outlet in conjunction with a brass outlet fitting **66** carrying a one-way, spring-pressed outlet valve **68**. This fitting is molded into the outlet housing **28** formed of a glass reinforced plastic which has a high degree of resistance to hydrocarbons, as do the other plastic parts of the assembly. A screw outlet bleed adjustment plug **70** is threaded into recess **72** in end housing **28** to control a passage **74** leading to the interior of the pump assembly. A filter disc **76** is positioned in a port **78** connecting to passage **74**.

The end housing **28** has axially extending split fingers **80** carrying spreading springs **82**. See FIGS. **1** and **3**. These fingers hold semi-circular permanent magnets **84** which surround the armature outside of air gap and form the motor field. See FIG. **4**.

The inlet end **20** of the pump at the left end of FIGS. **1** and **2** has a cylindrical entrance collar **90**. Viewed from the outer end, as in FIG. **8**, this collar has an internal bulge **92** toward the center. The bulge has an axial recess **94** splined on its inner surface and leads to a passage **96** ensmalled to form a valve seat for a ball valve **98** backed by a spring **100** retained by a press-fit button **102**. Passage **96** communicates with a pump outlet passage **104** so that the ball valve may serve as a relief valve.

Inwardly of the collar **90**, and rising from bulge **92**, is a further bulge **106** integral with the end housing which has a central recess **110** to receive a pump rotor mount in the form of a stub shaft **120**. A view of the inside of the inlet end **20** is found in FIG. **9**. Outside the pin recess **110** is an arcuate inlet port **122** open, as shown in FIG. **1**, to the interior of inlet collar **90**. Two diametrically opposed threaded holes **124** are formed on the inner face of housing **20**. On the opposite side of center from the arcuate inlet opening are two outlet ports **130** connected by previously referenced short passage **104**. Relief valve passage **96** described in connection with FIG. **1** shows also in FIG. **9**. A shallow circular recess **134** surrounds pin shaft recess **110**.

Cam ring **22**, previously identified in FIGS. **1** and **2**, has partial ring portions **24** which interfit with flux ring **26**. This cam ring also has openings for headed retainer screws **140**. These screw openings **142** are preferably larger than the screws to allow diametrical adjustment of the cam ring relative to the axis of the assembly. FIG. **7** shows cam ring **22**. Triangular washer plates **144** underlie the heads of bolts **140** to apply retention pressure on the cam ring and hold it securely against the end

housing **20**. These plates also retain the outer gear rotor during assembly.

The cam ring **22** has a large circular opening **150** which is positioned off center from the basic axis of rotation and this opening receives the outer gear rotor **152** of a gear rotor pump. This particular outer gear rotor has, as an example, eleven tooth recesses. The inner gear **154** of the gear rotor assembly is mounted on stub shaft **120** and has ten gear teeth formed thereon. The gear **154** has axial holes **155** spaced around the center shaft pin **120** to receive the finger projections **44** on drive projection **42**. Some small clearance is provided between the finger projections **44** and the holes **155** in rotor **154** to provide for slight misalignment.

Pressed against the gear rotor assembly is a circular flat plate **160** preferably formed of flexible material. This plate is most effective if it is flexible. A thickness range of 0.005 to 0.010", depending upon material used, has proved satisfactory. The material from which the plate **160** is formed is preferably metal and more particularly stainless steel but some dense plastics may perform successfully. The circular plate is held firmly against and rotates with the rotor assembly, thereby forming a good seal and eliminating any axial clearance and at the same time causing very little friction. Behind this plate **160** is a multi-legged spider spring **162** (FIGS. **10** and **11**) having five legs **164** bent, as shown in FIG. **11**, in an axial direction from a center ring portion **163**. The ends of the legs **164** are bent into a plane substantially parallel to the body portion **163** to form pressure pads **166**. As shown in FIGS. **1** and **2**, the legs of the star or spider spring **162** interfit with the projections **44** and are pressed against the plate **160** when the parts are brought into assembly. There is a slight clearance between the diameter of the stub shaft pin and the inside diameter of the plastic drive sleeve **42** to allow some angularity to exist between the armature shaft and stationary rotor pin to prevent binding if there is slight misalignment.

The shaft pin **120** is placed in recess **110** perpendicular to the surface **37** of the end housing against which the outer gear rotor **152** and the inner gear rotor **154** are pressed by the spider spring **162**. Thus, in essence, there is a cantilever mount on shaft **120** for the inner gear rotor **154**. The outer gear rotor **152** is supported by and rotatable in the cam ring **22**.

The cylindrical drive projection **42**, previously referenced as mounted on the armature assembly, has a central bore **45** which receives and is supported on the distal end of the stub shaft **120**. There is some diametrical clearance between the bore **45** and the shaft **120** so that the drive projection **42** is rotatably piloted on the shaft but allows some play. This, coupled with the clearance between drive pins **44** and drive holes in rotor **154**, compensate for any misaligment of the armature assembly relative to the stub shaft. As previously indicated, some clearance is provided between the drive fingers **44** and the holes **155** to allow for any slight misalignment. The seal plate **160**, which may be made of a thin non-corrosive metal or a dense plastic, is sufficiently flexible that it will provide an adequate seal on the parts and this avoids the necessity for a very accurately machined and positioned housing plate at this side of the rotor. It also eliminates difficult tolerances on the cam ring **22** and gear rotors. The operating clearance needed between rigid parts is also eliminated and this reduces leakage and cost of manufacturing.

The seal plate **160** is illustrated in elevation in FIG. **12**. This plate has a central opening **161** to accommodate the shaft **120** surrounded by openings **170** to accommodate the finger projections **44**.

In operation, fluid supply through collar **90** enters the inlet port **122** and moves into gear recesses between the inner and outer gear rotors **152** and **154**. As gear rotor parts **152** and **154** rotate, driven by the armature **40**, the drive element **42**, and fingers **44**, liquid is placed under a pressure as the teeth of the rotor **154** move into the gear recesses of the gear rotor **152**. Fluid, such as gasoline, is forced into the outlet ports **130** (FIGS. **1** and **9**) and passes around the outer gear rotor **152** into the armature chamber and to the outlet housing port **64**.

There is some outside clearance between cam ring **22** and shell **36** so the ring can be shifted relative to the headed screws **140** before they are tightened. There must be some clearance between the teeth of the inner rotor gear and those of the outer rotor gear at a point directly across from the area where the teeth are in mesh. This clearance would normally be in a range of 0.0005 to 0.003. The clearance can be adjusted by movement of the cam ring which pilots the outer rotor gear. The object is to keep the teeth tip clearance to a minimum to prevent pressurized fluid from leaking across from the pressure side to the inlet side of the pumping unit. Once this is established, the screws **140** are tightened and the parts will maintain the proper relationship.

What is claimed is:

**1**. In a gear rotor pump having an outer gear rotor with pumping recesses and an inner gear rotor driven within an eccentric opening in a cam ring by a rotating power input unit, that improvement in construction which comprises:

(a) an inlet housing having a liquid inlet at one end and a flat pump housing wall at the other end and a pump inlet and outlet ports circumferentially spaced therein,

(b) a gear assembly mounted for rotation including an inner gear rotor rotatable about a first axis and an outer gear rotor within said cam ring rotatable with said inner gear rotor, each said rotor having equal axial dimensions with one end lying against said flat housing wall,

(c) first flexible plate means rotatable with said assembly radially overlying the other end of said inner and outer gear rotor assembly to close the pumping recesses at said other end and pressing said assembly against said wall, and

(d) second means for rotatably driving said first flexible plate means and said inner gear rotor to cause rotation of said outer gear rotor and a consequent pumping action,

(e) means is provided to mount said gear assembly within said cam ring comprising a non-rotating stub shaft concentric with said first axis and mounted in said inlet housing and projecting perpendicularly from said flat wall rotatably mounting said inner rotor through a central opening in said inner rotor, the stub shaft being independent of and unsupported by said power input unit and said second means,

(f) the second means comprising a rotating means on said power unit rotatable independent of said stub shaft having a body portion exerting axial pressure against said flexible plate means and circumferentially spaced finger projections positioned out-

wardly of said first axis and projecting into receiving recesses in said inner gear rotor.

2. In a gear rotor pump having an outer gear rotor with pumping recesses and an inner gear rotor driven within an eccentric opening in a cam ring by a rotating power input unit, that improvement in construction which comprises:

(a) an inlet housing having a liquid inlet at one end and a flat pump housing wall at the other end and a pump inlet and outlet ports circumferentially spaced therein,

(b) a gear assembly mounted for rotation including an inner gear rotor rotatable about a first axis and an outer gear rotor within said cam ring rotatable with said inner gear rotor, each said rotor having equal axial dimensions with one end lying against said flat housing wall,

(c) first flexible plate means rotatable with said assembly radially overlying the other end of said inner and outer gear rotor assembly to close the pumping recesses at said other end and pressing said assembly against said wall, and

(d) second means for rotatably driving said first flexible plate means and said inner gear rotor to cause rotation of said outer gear rotor and a consequent pumping action,

(e) means is provided to mount said gear assembly within said cam ring comprising a non-rotating stub shaft concentric with said first axis and mounted in said inlet housing and projecting perpendicularly from said flat wall rotatably mounting said inner rotor through a central opening in said inner rotor, the stub shaft being independent of and unsupported by said power input unit and said second means,

(f) the second means comprising a rotating means on said power unit having a body portion with a central bore receiving, supported by, and rotating on the distal end of said stub shaft.

3. In a gear rotor pump having an outer gear rotor with pumping recesses and an inner gear rotor driven within an eccentric opening in a cam ring by a rotating power input unit, that improvement in construction which comprises:

(a) an inlet housing having a liquid inlet at one end and a flat pump housing wall at the other end and a pump inlet and outlet ports circumferentially spaced therein,

(b) a gear assembly mounted for rotation including an inner gear rotor rotatable about a first axis and an outer gear rotor within said cam ring rotatable with said inner gear rotor, each said rotor having equal axial dimensions with one end lying against said flat housing wall,

(c) first flexible plate means rotatable with said assembly radially overlying the other end of said inner and outer gear rotor assembly to close the pumping recesses at said other end and pressing said assembly against said wall, and

(d) second means for rotatably driving said first flexible plate means and said inner gear rotor to cause rotation of said outer gear rotor and a consequent pumping action,

(e) said cam ring having an axially extending annular flange concentric with said first axis, and said rotating power input unit comprising a motor coaxial with said first axis having an encircling flux ring mounted in telescoping relation with said cam ring flange, an armature to rotate on said first axis having an extension portion provided at one end provided with a shaft recess, and means for mounting said gear assembly comprising a stub shaft projecting perpendicularly from said wall and into said shaft recess on said armature.

* * * * *