

**Oct. 22, 1968**

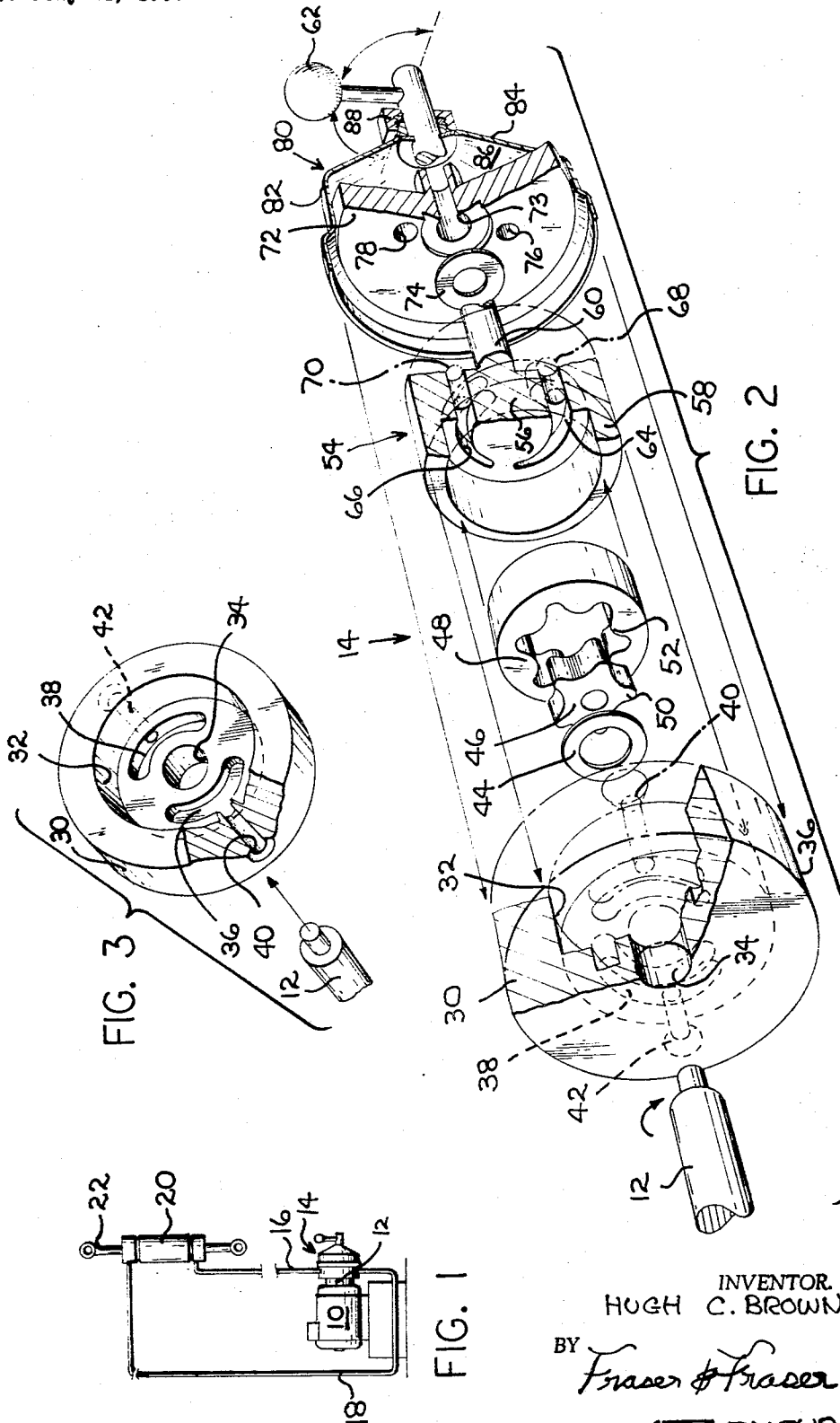
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**3,406,631**

## PUMP ASSEMBLY

Filed July 21, 1966

2 Sheets-Sheet 1



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PUMP ASSEMBLY

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2 Sheets-Sheet 2

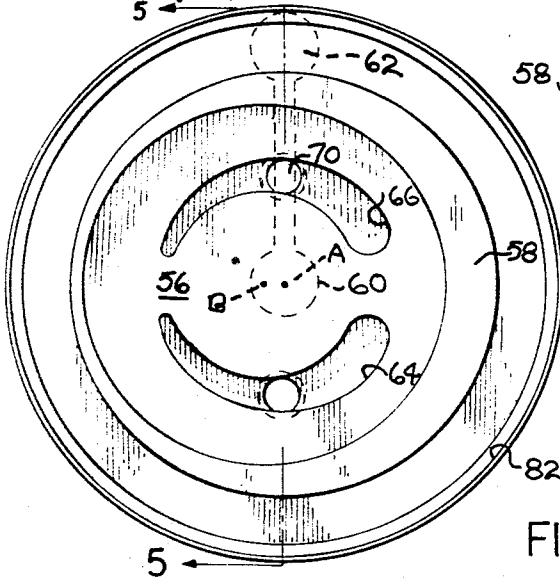


FIG. 4

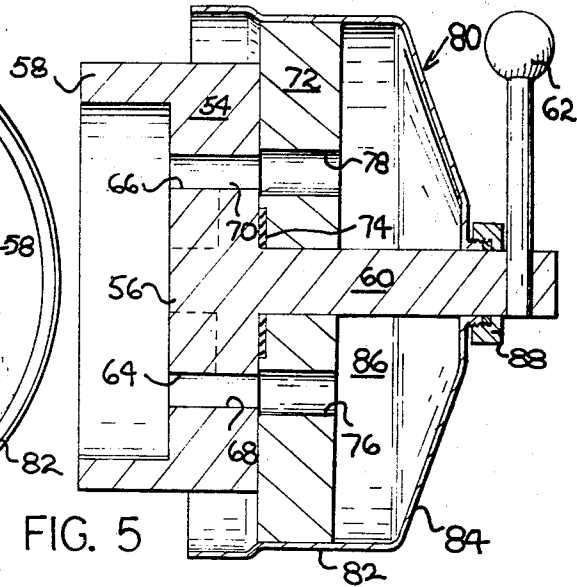


FIG. 5

FIG. 6

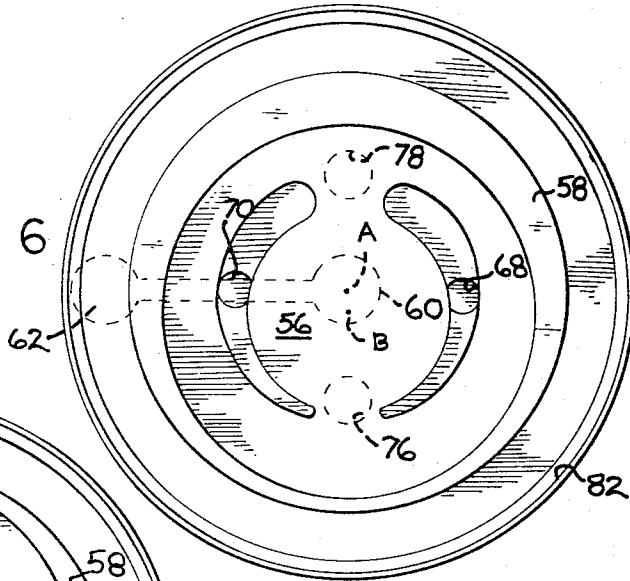
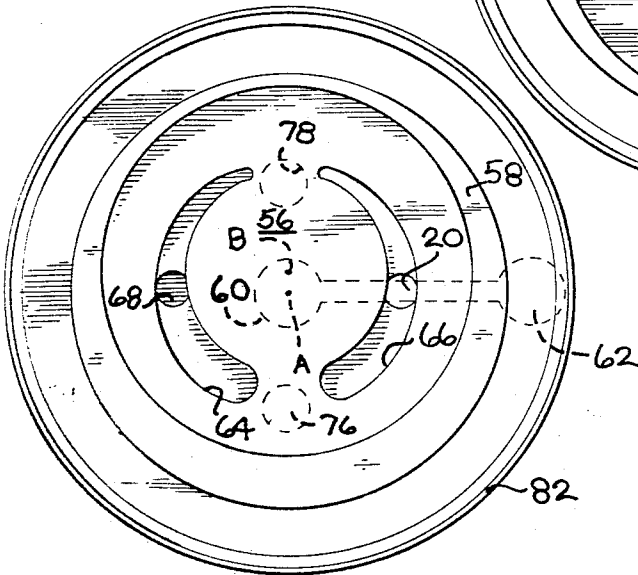


FIG. 7



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1

3,406,631

## PUMP ASSEMBLY

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1 Claim. (Cl. 103—3)

### ABSTRACT OF THE DISCLOSURE

A pump assembly wherein the fluid flow can be reversed without reversing the direction of rotation of the driving motor and while the motor is in operation. The pump assembly comprises a main body member having an inner pumping chamber and a center bore, the chamber having diametrically opposed crescent shaped cavities from which passages extend respectively to the outside. A uni-directional drive shaft extends through the central bore of the pumping chamber, to which is fixed an inner pump rotor disposed within an outer pump rotor which has a series of inward teeth adapted to engage outward teeth on the inner rotor. The inner rotor has one less tooth than the outer rotor. A cup-shaped member has a base portion and a skirt-like portion which rotatably fits the pumping chamber and surrounds the outer rotor for shifting the latter in one direction or the other. The outer and inner peripheral walls of the skirt-like portion are eccentric to each other and a control shaft is secured concentrically to the base portion and extends outwardly therefrom to receive a control handle. In the inner surface of the base portion is a pair of diametrically opposed lobe-shaped cavities from each of which extends a port passing through the base portion. A partition wall abuts the outer face of the base portion and is centrally apertured to receive the control shaft and has a pair of diametrically opposed ports which extend therethrough and are adapted to align with the ports leading from the lobe-shaped cavities. A cover through which the control shaft extends, has a cylindrical skirt portion which sealingly engages a peripheral outer wall of the main body member and encloses the partition wall and has an outwardly spaced rear wall, which provides a reservoir chamber.

Many kinds of reversible rotary pumps are known and employed in connection with apparatus such as fluid actuated motors, and the like. In such applications, the direction or rotation of the prime mover of the pump is typically reversed to suitably effect a reversal of the flow of the pump fluid and accordingly a reversal in the movement of the associated fluid actuated motor. However, such pumps are limited to being driven by prime movers which are readily reversible; or alternatively must utilize a gear transmission to effect the desired reversal of the direction of fluid flow.

The present invention contemplates a pump structure which can readily reverse the direction of the flow of the pumped fluid without reversing the direction of rotation of the prime mover.

The pump of the present invention is particularly concerned with the type of pump including a pair of toothed rotors, one within and eccentric to the other and has one less tooth than the other, the teeth having diametrically opposite full mesh and open mesh positions and preferably remaining in substantially contacting relationship with respect to each other between such positions. Typically the inner or center one of the rotors is driven by a prime mover thus causing the other rotor to be driven through the interengagement of their respective teeth. As the engaging teeth of the rotors move away from the full mesh position, in the direction of rotation, pumping chambers are established therebetween which continue to increase in

2

volume to the full open position and then decrease in volume to the full mesh position in the direction of rotation.

Conventionally rotors of such pump assemblies are caused to rotate about fixed respective axes. The pump housing is typically provided with a pair of ports, which at any given instance function as an inlet and an outlet port, respectively. The inlet port communicates with those pumping chambers which are increasing in volume, and the outlet port communicates with those pumping chambers which are decreasing in volume.

In accordance with the present invention, the outer rotor is mounted for rotation about an axis which can be moved or shifted through 360 degrees about the fixed axis of the inner rotor whereby in one sector, the fluid is pumped in one direction and in a like sector 180 degrees displaced therefrom, the fluid is pumped in the opposite direction. Positioning of the outer rotor intermediate the aforementioned sectors, provision is made for pumping the fluid continuously through a reservoir, thereby creating a neutral position for the pumping assembly.

In a broad embodiment, the invention consists of a housing having a chamber therein; pumping means in the chamber including an inner rotor member and an outer eccentric rotor member having interengaging teeth forming at least two pumping chambers therebetween, one of said pumping chambers increasing in volume and the other of said pumping chambers decreasing in volume; means for driving the inner rotor about an axis fixed with respect to the housing; a pair of ports in the housing communicating with respective ones of the pumping chambers; and means for shifting the outer rotor in a plane perpendicular to and about the axis of the inner rotor, whereby the outer rotor may be selectively shifted to cause one of the ports to communicate with the pumping chambers which are increasing in volume and the other of the ports to communicate with the pumping chambers which are decreasing in volume.

The above and other objects and advantages of the invention will become readily apparent from reading the following detailed description of an embodiment of the invention when considered in the light of the accompanying drawings in which:

FIGURE 1 is an elevational view of the pump assembly connected in a typical operating system for actuating a fluid actuated motor;

FIGURE 2 is an exploded view of the pump assembly of the invention;

FIGURE 3 is a perspective view with a portion cut away showing the interior of the main pump body;

FIGURE 4 is a plan view of the interior of the eccentric cup-shaped member for shifting the outer rotor of the pump assembly;

FIGURE 5 is a sectional view of the element illustrated in FIGURE 4 taken along line 5—5 thereof;

FIGURES 6 and 7 show various positions of the pump for reversing the flow of the fluid being pumped and the neutral position thereof.

Referring to FIGURE 1 of the drawings, there is shown an electric motor 10 having an armature shaft 12 for driving the pump assembly of the invention generally indicated by reference numeral 14. The pump 14 is provided with inlet and outlet conduit lines 16 and 18 communicating with a fluid actuated motor 20. The fluid actuated motor 20 is provided with a piston rod 22 integrally connected to a piston housed within the cylinder of the motor 20. It will be appreciated that as fluid is pumped under pressure into and through the line 16 the piston rod 22 may be forced outwardly of the cylinder of the motor 20 and the fluid in the motor cylinder is forced to the pump 14 through the line 18.

If the direction of flow of the pressure fluid is reversed

so as to flow into and through the line 18, the piston rod 22 will be forced inwardly of the cylinder of the motor 20 and fluid is forced to the pump through the line 16.

With particular reference to FIGURES 2, 3, 4 and 5 there is shown the pump assembly 14 which includes a main body member 30 defining an inner pumping chamber 32 having a centrally disposed bore 34 for rotatably receiving the armature shaft 12 of the electric motor 10. The body 30 is provided with diametrically opposed generally crescent-shaped cavities 36 and 38 having diametrically and radially outwardly extending bores 40 and 42, respectively.

A seal ring 44 is fitted on the innermost end of the shaft 12 within the chamber 32 to provide a fluid tight seal between the armature shaft 12 and the pump body 30 to militate against the passage of any fluid therebetween. An inner pump rotor 46 and an outer pump rotor 48 are disposed within the chamber 32. The inner one is shown as having five teeth 50 and the outer rotor 48 is shown as having six teeth 52. It will be understood, however, that satisfactory pumping may be effected by forming the rotor with a different combination of the number of teeth, so long as the outer rotor has one more tooth than the inner rotor. The inner rotor 46 is fixedly secured by a press fit to the shaft 12 which projects through the pump body 30 and into the pumping chamber 32.

A cup-shaped member 54 has a base portion 56 and a laterally extending skirt-like portion 58, the outer peripheral wall of which is adapted to fit rotatably within the interior of the pumping chamber 32 to surroundingly contain the rotors 46 and 48. It is preferable that the outer peripheral wall of the cup-shaped member 54 is of only slightly less diameter than the diameter of the inner peripheral wall of the pump body 32 which defines the pumping chamber thereby to provide a satisfactory rotating relation therebetween.

It will be noted from an examination of FIGURES 2, 4, 6 and 7 that the outer and inner peripheral walls of the skirt-portion 58 of the cup-shaped element 54 are eccentric with respect to one another, the outer wall being formed about an axis as indicated at A in FIGURES 4, 6 and 7 and the inner peripheral wall being formed about an axis indicated at B.

A control shaft 60 extends concentrically outwardly from the outer surface of the base 56 and is provided with a control handle 62 at the exterior end thereof. The opposite inner surface of the base 56 is provided with a pair of substantially diametrically opposed lobe-shaped cavities 64 and 66 having ports 68 and 70, respectively, extending completely through the base. The axis A of the outer peripheral wall of the skirt 58 is concentric with the axis of the control shaft 60. As will become more apparent in the further description of the apparatus, the rotation of the cup-shaped member 54 about the axis A effectively shifts or cams the outer rotor 48 to various pumping positions with respect to the inner rotor 46 and the various ports.

A partition wall 72 having a central bore 73 is mounted on the control shaft 60 in such a way as to allow for relative movement therebetween. A bearing element 74 is positioned between the exterior face of the base 56 of the cup-shaped element 54 and the interior face of the partition wall 72. The partition wall 72 is provided with a pair of diametrically opposed ports 76 and 78 which extend completely therethrough and are positioned to enable direct alignment with the corresponding ports 68 and 70 of the member 54.

Finally, there is a cover 80 having a laterally extending cylindrical skirt portion 82 adapted to sealingly engage the marginal peripheral outer wall of the pump body 30 in the assembled form of the pump. The cover 80 encloses the partition wall 72 and is provided with a rearwardly extending and outwardly tapering rear wall 84 which cooperates with the partition wall 72 to define a reservoir chamber 86. A suitable seal 88 is provided to achieve a satisfactory fluid tight connection between the cover 80

and the shaft 60 to prevent the passage of fluid there-through from the reservoir.

In the operation of the pump with the motor shaft 12 and the associated rotors 46 and 48 rotating clockwise, as indicated by the arrow in FIGURE 2, the hydraulic fluid within the system is forced from the pumping chamber 32 to the reservoir 86 entering through the aligned ports 68 and 76, and discharging through the aligned ports 70 and 78. This pumping action occurs with the control handle 62 and the associated cup-shaped element 54 in the position illustrated in FIGURES 2, 4 and 5. More specifically, the pumping chambers established between those teeth 50 and 52 of the inner and outer rotors which are increasing in volume are in communication with the lobe-shaped cavity 64 causing the fluid to be pumped therethrough and into the reservoir 86 through the aligned ports 68 and 76. Simultaneously, fluid is withdrawn from the chamber 86 by the pumping chambers established between those teeth 50 and 52 which are decreasing in volume through the aligned ports 78 and 70 and the lobe-shaped cavity 66.

During the above operation, the crescent-shaped cavities 36 and 38 of the main pumping body 30 are not in perfect alignment with the pumping chambers established between the teeth 50 and 52 to produce sufficient fluid pressure conditions to exist to pump the fluid through the outwardly extending bores 40 and 42 which are in communication with the associated fluid actuated motor 20.

When the control handle 62 is rotated in a counterclockwise position to the position illustrated in FIGURE 6, the cup-shaped member 54 effectively bodily shifts or cams the outer rotor 48 by causing the same to rotate to a position where the pumping chambers between those teeth 50 and 52 which are increasing in volume communicate with the crescent-shaped cavity 38, and the pumping chambers which are decreasing in volume communicate with the crescent-shaped cavity 36 causing the fluid to be drawn into the chamber 32 through the bore 42 and be discharged through the bore 40. In the event the conduit lines 16 were connected to the bore 40, pressure fluid would be introduced into the motor 20 (FIGURE 1) causing the piston rod 22 to be extended from the position illustrated. When the control handle 62 is in the position illustrated in FIGURE 6, the ports 68 and 70 are not in alignment with the ports 76 and 78 thereby blocking-off any communication between the main pumping chamber and the reservoir 86.

When the control handle 62 is rotated through 180 degrees to the position illustrated in FIGURE 7, the cup-shaped member 54 effectively bodily shifts or cams the outer rotor 48 by causing the same to rotate to a position where the pumping chambers between those teeth 50 and 52 which are increasing in volume communicate with the crescent-shaped cavity 36, and the pumping chambers which are decreasing in volume communicate with the crescent-shaped cavity 38 causing the fluid to be drawn into the chamber through the bore 40 and discharged through the bore 42. Under such conditions, the pressure fluid would be introduced into the motor 20 (FIGURE 1) through the conduit line 18 causing the piston rod 20 to be retracted to the position illustrated in FIGURE 1.

When the control handle 62 is in the position illustrated in FIGURE 7, the ports 68 and 70 of the cup-shaped element 54 are not in alignment with the ports 76 and 78 of the partition wall 72, thereby blocking-off any communication between the main pumping chamber 32 and the reservoir 86.

It will be readily appreciated from the above description, a relatively simple pumping device has been developed which is effective to reverse the flow of the pressure fluids being pumped by a simple and efficient means while the prime mover is being rotated in a single direction.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention, and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that within the scope of the ap-

5

pendent claim, the invention may be practiced otherwise than as specifically illustrated and described.

What I claim is:

1. A pump assembly comprising  
main body member having an inner pumping chamber 5  
and central bore,  
diametrically opposed crescent shaped cavities inside  
said body member, diametrically and radially out-  
wardly extending passages from said cavities respec-  
tively and leading to the outside, 10  
a unidirectional drive shaft rotatable in and extending  
through said central bore,  
an inner pump rotor fixed for rotation with said shaft  
and disposed within said pump chamber, an outer  
pump rotor within which said inner rotor is arranged, 15  
said outer rotor having a series of inward teeth and  
said inner rotor having a series of outward teeth one  
less in number than the teeth of the outer rotor,  
a cup-shaped member having a base portion and a skirt-  
like portion rotatably fitting said pumping chamber 20  
and surrounding said outer rotor for shifting same  
rotatively in one direction or the other,  
the outer and inner peripheral walls of said skirt-like  
portion being eccentric to each other,  
a pair of diametrically opposed lobe-shaped cavities in 25  
the inner surface of said base portion, a port for  
each of said cavities extending through said base  
portion,  
a control shaft secured concentrically to said base por-

6

tion and disposed concentrically to the outer pe-  
ripheral wall thereof and extending outwardly there-  
from, a control handle for said shaft,

- a partition wall abutting the outer face of said base  
portion and centrally apertured to receive said con-  
trol shaft for rotation therein, said partition wall hav-  
ing a pair of diametrically opposed ports extending  
therethrough and adapted to align with the ports lead-  
ing from said lobe-shaped cavities, and  
a cover through which said control shaft extends hav-  
ing a cylindrical skirt portion sealingly engaging the  
peripheral outer wall of said main body member and  
enclosing said partition wall, said cover having a rear  
wall spaced from said partition wall to provide a  
reservoir chamber.

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