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HELICAL MULTIPLE PUMP

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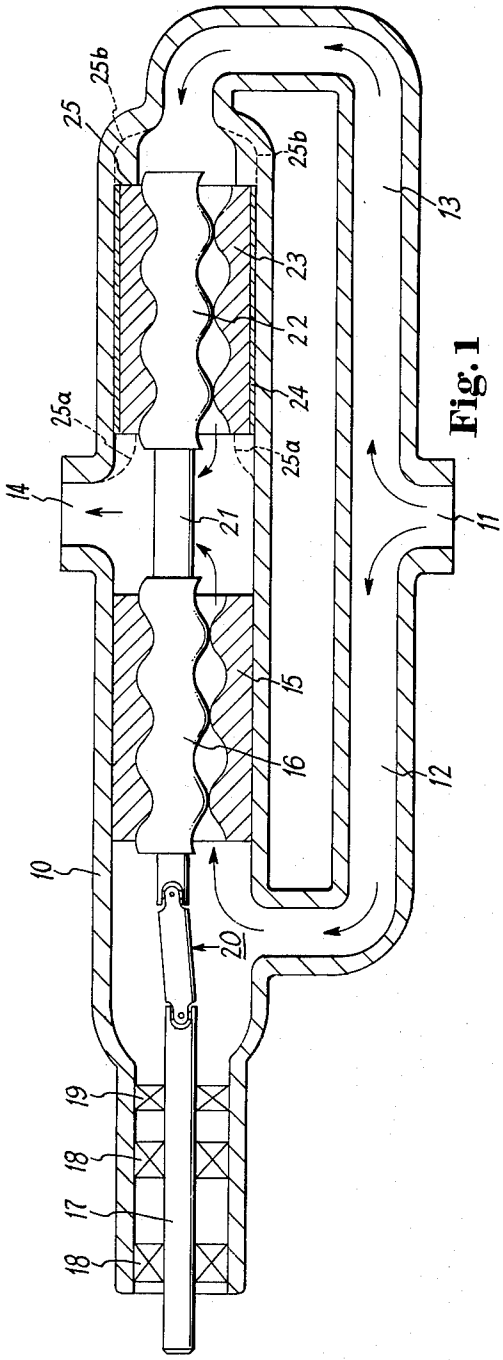

Fig. 1

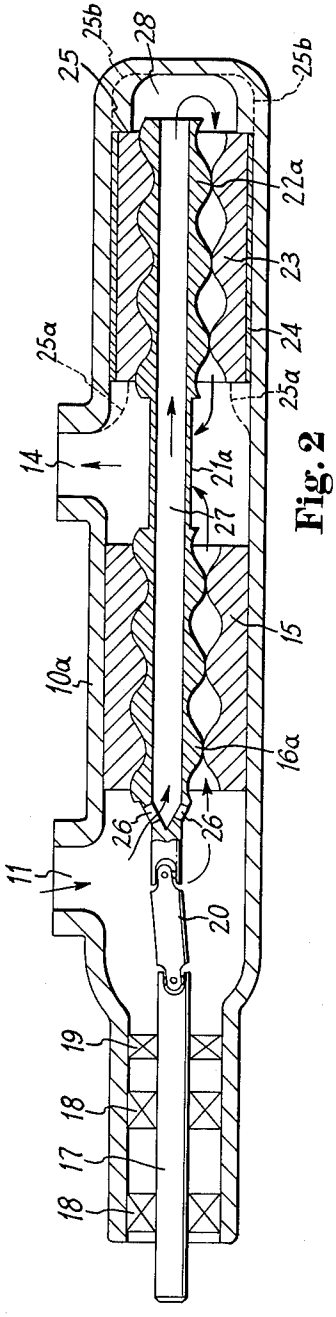

Fig. 2

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HELICAL MULTIPLE PUMP

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This invention relates to a helical multiple pump and more particularly to a multiple pump such as is disclosed in the Moineau Patent No. 2,483,370. The individual pumping elements of such a pump are disclosed in the Moineau Patent No. 1,892,217.

According to the earlier of said patents, a pair of helically threaded members in engagement one with the other, the outer elements having one more thread than the inner element, cooperate to produce a series of pumping pockets which travel from end to end through the pump. Generally, the outer pumping element is fixed or stationary and the inner element is rotated. The configuration of the cooperating threads enforce upon the axis of the rotor an orbital path in a circle.

The action of such a pump in pumping fluids produces an axial thrust on the rotor and in order to neutralize this axial thrust, Moineau in his Patent 2,483,370 proposed to provide two such sets of pumping elements in axial alignment with the rotors of the two pumps being joined together to provide a common rotor. The two sets of pumping elements, or gears as he called them, were provided with threads of opposite hand and pumping could be achieved, depending upon the rotation of the rotor from the outer ends of the two sets of pumping elements toward the middle and thence to an outlet or from an inlet at the middle of the pump outwardly through the two sets of pumping elements to a manifold leading to the pump outlet.

As Moineau pointed out in his Patent No. 2,483,370, careful orientation of the stator and rotor are necessary and particularly orientation of one of the stators with respect to the common rotor. This requirement for careful phasing or orientation has prevented a multiple pump as proposed by Moineau from becoming commercial.

It should be noted that while the rotor rotates, it is forced to nutate against hydraulic pressure by the stator element. The reaction force of the rotor against the stator causes a deformation of the stator and the alignment or phasing is different for different hydraulic pressures. Thus, even with perfect alignment when the pump is not under operation, the alignment will be imperfect once the desired pressure is built up. This effect is more severe when the stator is made of resilient material, like rubber.

Accordingly, it is the principal object of the present invention to provide a pump of the general type disclosed in the later of the two said Moineau patents, wherein the problem of phasing is solved in a very simple and economical manner.

This and other objects of the invention which will be disclosed in more detail hereinafter or which will become apparent to one skilled in the art upon reading these specifications are accomplished by that certain construction and arrangement of parts of which the following will describe two exemplary embodiments.

Reference is made to the drawings forming a part hereof and in which:

FIG. 1 is a cross-sectional view in more or less diagrammatic form of one embodiment of the invention.

FIG. 2 is a similar diagrammatic cross-sectional view of another embodiment of the invention.

Briefly, in the practice of the invention, advantage is taken of the fact that while the rotor shaft performs an orbital path in a circle, any cross-section of the rotor simply oscillates back and forth along a straight line.

This phenomenon was known to Moineau but its significance in rotor phasing has not heretofore been appreciated. With any cross-section of the rotor oscillating back and forth along a straight line, it is clear that, assuming the orientation of the rotor to be fixed by virtue of its being in a single piece with another rotor in engagement with a fixed stator, the second stator must be oriented in such a way that this straight line oscillation of the rotor can take place. Otherwise the apparatus will bind and the pump cannot be driven.

In accordance with the present invention, the second stator is not fixed but is bonded to a sleeve which is rotatable within the pump casing. As a result of this construction, the second stator is self-aligning or self-orienting during the initial rotation of the rotor and thereafter remains in its oriented position.

Referring now in more detail to the drawings, there is shown in FIG. 1 a pump having a casing **10**. The casing **10** has an inlet or suction port at **11** which communicates by means of ducts **12** and **13** with the intake ends of the two sets of pumping elements as shown. A discharge port **14** is provided between the two sets of pumping elements and the fluid being pumped follows the direction of the arrows.

One set of pumping elements is shown at **15** and **16**, **15** being the stator and being fixed within the housing **10**. In the particular embodiment shown, the stator **15** has two threads while the rotor **16** has a single thread. The pump drive shaft is indicated at **17** and is provided with suitable bearings **18** and a suitable seal **19**. The drive shaft **17** is connected to the rotor **16** by means of the double universal joint indicated generally at **20**. The joint **20** permits rotation of the rotor **16** and also the orbital movement in a circle having a radius *e*, which is known as the eccentricity of the rotor.

The rotor **16** is connected by a shaft or the like **21** to the rotor **22** of the second pair of helical screw elements which cooperates with a stator **23**. It will be understood that the two rotors **16** and **22** are fixed together to rotate and nutate together. Under these circumstances, the orientation or phasing of the stator **23** is of critical importance.

According to the present invention, the stator **23** is not fixed but is bonded to a metallic sleeve **24** which is free to rotate in the pump housing **10**. The pump housing is provided with a shoulder **25** which defines the axial position of the stator **23**.

It will now be understood that if the shaft **17** is rotated by means of a suitable source of power (not shown) the two rotors **16** and **22** will rotate and orbit in a circular path. If the stator **15** were not in position, the rotatable stator **23** would simply rotate with the rotor **22** and no pumping action would result. However, with the stator **15** fixed in position the rotors **16** and **22** are forced to nutate in a direction opposite to the direction of rotation and each cross-section of the rotor **22** oscillates back and forth along a straight line. There is, practically speaking, only one position of orientation of the stator **23** which permits free movement of all the cross-sections of the rotor **22** in a straight line. (The other such position is theoretical only, since the stator would have to move axially in order to rotate 180°.) Therefore, as the pump starts, the rotor **22** rotates the stator **23** slightly until the ideal position is reached, whereupon the straight line oscillation referred to can take place and thereafter the stator **23** remains in its properly aligned or oriented position. As the pumping pressure builds up there is a thrust in a direction opposite to the pumping direction and this thrust pushes the stator **23** against the shoulder **25** in the pump housing **10**. The wear between the stator **23** and shoulder **25** is negligible because as soon as the pump is run-

ning and the stator is oriented, there is no relative motion between the stator **23** and the shoulder **25** and the thrust seals off the suction end of the pumping elements constituted by the rotor **22** and stator **23**.

The embodiment of FIG. 2 operates in exactly the same way as that of FIG. 1, except that the casing is of a different configuration and the rotors **16***a* and **22***a* have a bore therethrough which extends also through the connecting portion **21***a*. Openings are provided at **26** to permit access of the fluid being pumped to the passage **27** through the rotors **16***a* and **22***a* and the connecting portion **21***a*. In this embodiment, therefore, fluid being pumped enters the pump at **11** and a portion of the fluid is pumped by the pockets between the elements **15** and **16***a* and a portion of the fluid is drawn through the openings **26** and the passage **27** to the chamber **28** at the entrance end of the pumping elements constituted by the stator **23** and rotor **22***a*. From the chamber **28** the fluid is pumped by the pockets between the members **22***a* and **23** and joins the fluid pumped between the members **15** and **16***a* in passing out through the pump outlet **14**. The arrows in the figure indicate the direction of flow.

It will be understood that details as to the connection of the driving means to the rotors can be varied and that the device could be driven from either end or even from the middle as suggested by Moineau. In order to have a proper motion in both sides of the multiple pump, it is only necessary that the eccentricities of the rotors of the two sections be identical. In order to balance out the thrust on the double universal joint **20**, it is only necessary that the diameters of the two rotors be approximately the same. The pitch of the two sections of the multiple pump need not be the same because the pitch has to do only with the theoretical volume of the pump and in some cases it may be desirable to have one pair of pumping elements pumping a larger volume than the other. The theoretical volume of the pump will be:

$$V=4e(D_1P_1+D_2P_2)$$

wherein e is the eccentricity, D_1 and D_2 are the diameters of the two sections respectively, and P_1 and P_2 are the pitches of the two sections respectively. It will also be understood that it is not necessary that the pumping action be from the outer ends of the multiple pump toward the middle. The pumping could take place in a reverse direction with the portion **14** being the inlet port and the port **11** being the outlet port by simply reversing the rotation of the shaft **17**. If this were done, it will of course be understood that the shoulder **25** would have to be provided at the other end of the stator **23**, as indicated in broken lines at **25***a*, and eliminated at the outboard end of the stator as shown in broken lines at **25***b*.

No limitations not specifically set forth in the claims are intended.

What is claimed is:

1. A multiple pump comprising a casing having an inlet and an outlet and comprising two outer helical screw elements in axially spaced relation, and two inner helical screw elements in engagement therewith respectively, each of said outer elements having one more thread respectively than the inner element engaged therewith, the threads of one engaging set of inner and outer elements being of opposite hand from the threads of the other set of inner and outer elements, said inner elements being fixed together coaxially to constitute a common rotor, one of said outer elements being fixed in said casing, and the other of said outer elements being free to rotate in said casing to the extent permitted by interference with the inner element, whereby it is self-aligning as to phase with respect to the inner element engaged therein and said two sets of inner and outer elements may coact pumpingly without binding.

2. A pump according to claim **1**, wherein said casing is provided with an internal shoulder coacting with the intake end of that outer element which is free to rotate, to fix the position of said last named outer element axially.

3. A pump according to claim **1**, wherein the direction of rotation of said common rotor is such as to produce a pumping action by said two sets of inner and outer elements toward each other, and wherein said outlet is located between said sets.

4. A pump according to claim **3**, wherein said casing is provided with an internal shoulder coacting with the outer end of that outer element which is free to rotate, to fix the position of said last named outer element axially.

5. A pump according to claim **4**, wherein said casing is provided with internal ducts leading from said inlet to the intake ends of the two sets of inner and outer elements.

6. A pump according to claim **4**, wherein said inlet is located near one end of said pump, adjacent the intake end of one set of inner and outer elements, said common rotor having an axial passage therethrough and in communication with said inlet, and providing a duct to the intake end of the other set of pumping elements.

References Cited by the Examiner

UNITED STATES PATENTS

2,329,386	9/43	Brennan	103—117
2,483,370	9/49	Moineau	103—4
2,525,265	10/50	Moineau	103—117

FOREIGN PATENTS

436,843	10/35	Great Britain.

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