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HELICAL GEAR PUMP WITH STATOR COMPRESSION

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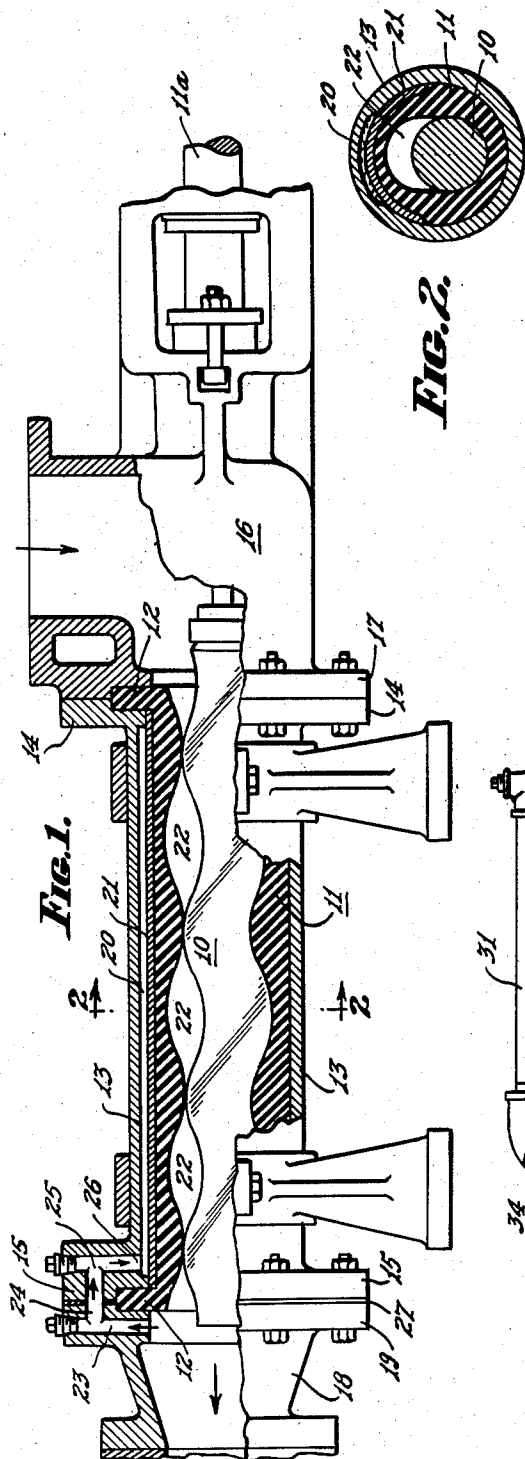


FIG. 1.

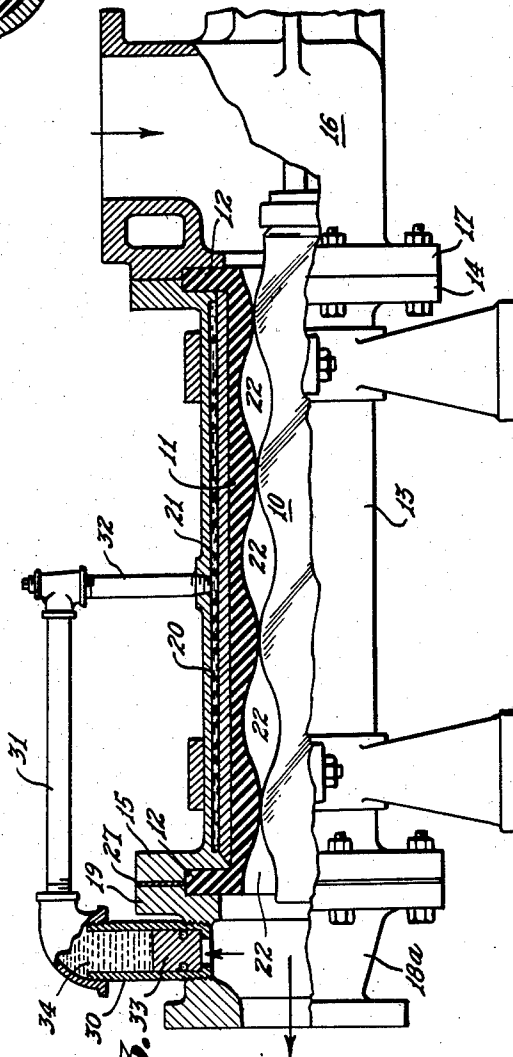
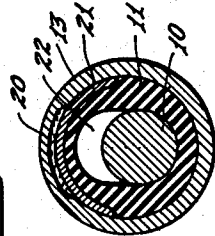


FIG. 3.

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HELICAL GEAR PUMP WITH STATOR
COMPRESSION

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This invention relates to helical gear pump of the type invented by R. J. L. Moineau, wherein a helically externally threaded rotor coacts with an internally helically threaded stator, said stator having one more thread than said rotor. Pumps of this general type are now generally built with a metallic rotor which is rigid and a stator which is of flexible or resilient material such as rubber. Pumps of this type are particularly advantageous in the handling of abrasive materials. However, the abrasive materials produce wear and this wear is usually greatest toward the discharge end of the pump.

In my earlier Patent No. 2,796,029, dated June 18, 1957, I disclosed and claimed a pump wherein a metallic semi-cylindrical element was interposed between the stator and the casing in which the stator was disposed and wherein an adjusting screw was provided whereby the stator could be compressed to a desired degree. It was stated to be an object of the invention to provide such adjusting means which would be self-aligning so that the adjustment would compensate for increased wear toward one end of the pump or the other. It was also stated to be an object of the invention to make it possible to increase the capacity of such a pump at higher pressures and to provide a pump where the maximum efficiency would occur at higher pressures.

All of the above mentioned objects are also objects of the present invention. Additionally, it is an object of the present invention to provide an improvement over my said earlier patent whereby the stator is compressed by fluid pressure and to provide a means whereby the stator may be subjected to the discharge pressure of the pump so that as the discharge pressure increases, the stator is more greatly compressed.

These and other objects of the invention which will be pointed out hereinafter or which will be apparent to one skilled in the art upon reading these specifications I accomplish by that certain construction and arrangement of parts of which I shall now describe certain exemplary embodiments.

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

Figure 1 is an elevational view partly in longitudinal cross-section showing one embodiment of the invention. Figure 2 is a cross-sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1 but showing another embodiment of the invention.

Briefly, in the practice of the invention, the external pumping element, i. e. the stator, is disposed within a casing member and is fitted snugly therein. The casing member is relieved over the entire length of the stator and for a substantial width to provide a fluid chamber. The stator is reinforced against collapse at least in the area exposed to the fluid chamber and means are provided for applying fluid pressure to said chamber.

Referring now more particularly to the drawings and to the embodiment of Figure 1, a more or less conventional type of progressing cavity pump is displayed having

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a rotor element 10 driven by means of a shaft 11 from a helical motor (not shown). As is known in the art, the rotor 10 is connected to the shaft 11a by means of a double universal joint to permit the rotor 10 to orbit in a cylindrical path.

The rotor 10 coacts pumpingly with a stator 11 which is made of rubber or other suitable flexible and resilient material. The stator 11 is provided with the end flanges 12 and is seated within a casing element 13 having the end flanges 14 and 15. The intake member of the pump indicated generally at 16 is provided with a flange 17 and the flanges 14 and 17 are rabbeted to receive the flange 12 of the stator which is clamped therebetween as is clearly shown in the drawing. Similarly the exhaust fitting 18 is provided with a flange 19 and the flanges 15 and 19 are rabbeted to receive the other stator flange 12 which is clamped therebetween.

The casing element 13 is relieved at 20 to provide the fluid chamber mentioned above and which, as seen in Figure 1, extends substantially the length of the stator and which, as seen in Figure 2, is of substantial width. The stator 11 at least over the area exposed to the chamber 20 is reinforced as indicated at 21. This reinforcement may consist of any suitable reinforcing material molded into or embedded in the material of the stator or it may comprise a metallic rigid shim permanently bonded to the stator. In the embodiment illustrated in the drawing, a metallic shim is indicated at 21. This shim in the embodiment illustrated is of semi-cylindrical form and is permanently bonded by any suitable means to the stator 11. The purpose of the reinforcement is to prevent collapse of the stator member 11 into the pumping pockets which are indicated at 22 in the various figures. With the reinforcement, when pressure is applied to the chamber 20 the stator is uniformly compressed without the danger of producing a collapse as above described.

While pressure may be applied to the chamber 20 in any desired manner, either hydraulically or pneumatically, by means of a separate pump or compressor, I have found it particularly desirable to obtain the desired compression from the discharge pressure of the pump. Thus, in Figure 1 the exhaust fitting 18 is provided with a passage 23 and a passage 24. The casing element 13 is provided with a passage 25 and a passage 26. The passage 23 communicates between the pump discharge and the passage 24. When the pump is assembled with a suitable gasket 27 the passage 24 is in communication with the passage 25 which in turn communicates with the passage 26, which itself is in communication with the fluid chamber 20. Thus, as indicated by the arrows in Figure 1, when the pump is running, a portion of the discharge passes through the passages 23 to 26 inclusive and into the chamber 20 and the chamber 20 will be thereafter maintained at the discharge pressure of the pump.

The embodiment of Figure 3 does not differ substantially from the embodiment of Figure 1 except that the discharge fitting 18a communicates with a cylinder 30, which cylinder at its other end communicates through the tubing 31, 32 with the chamber 20. A floating piston 33 is provided in the cylinder 30 and the volume above the piston 33 and including the tubing 31, 32 and the chamber 20 is filled with suitable fluid.

In this embodiment, of course, the discharge pressure of the pump operates against the piston 33 which transmits the pressure to the fluid 34 which in turn bears against the shim 21.

While I have shown the direct use of discharge pressure through the medium of the fluid being pumped as well as through the medium of a floating piston, it will be understood that conventional bellows devices or the like may be used with equal success.

I have found that with a device such as shown in the drawings the output of the pump holds up far better under increased discharge pressure. For example, a standard pump without the invention disclosed herein and which will pump 6.9 gallons per minute against zero discharge pressure, the discharge volume drops to about 6.5 gallons per minute at 50 pounds discharge pressure, to 6.1 gallons per minute at 75 pounds discharge pressure, to 5.4 gallons per minute at 100 pounds discharge pressure, to 4.4 gallons per minute at 125 pounds discharge pressure, to 3 gallons per minute at 150 pounds, and to 1.4 gallons per minute at 175 pounds per square inch discharge pressure.

The same basic pump modified as taught herein and delivering 6.9 gallons per minute at zero pressure will deliver 6.7 gallons per minute at 50 pounds, 6.4 gallons per minute at 75 pounds, 6.1 gallons per minute at 100 pounds, 5.6 gallons per minute at 125 pounds, 5.1 gallons per minute at 150 pounds and 4.4 gallons per minute at 175 pounds.

A remarkable change also takes place in the efficiency of the pump. The same standard pump described above operated at 100% of peak efficiency against the discharge pressure of 110 pounds per square inch and with an increase in discharge pressure the efficiency dropped off rapidly and was down to 75% of peak efficiency at 145 pounds discharge pressure, down to 50% of peak efficiency at 165 pounds discharge pressure, and down to 25% of peak efficiency at 180 pounds per square inch discharge pressure.

Modified as herein disclosed, the pump exhibited maximum efficiency at 125 pounds per square inch discharge pressure and maintained substantially peak efficiency up to 150 pounds per square inch discharge pressure and efficiency only dropped to about 85% of peak efficiency at 190 pounds discharge pressure.

It will be clear that various modifications may be made without departing from the spirit of the invention and I therefore do not intend to limit myself except as set forth in the claims which follow.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a helical gear pump having an externally helically threaded rigid rotor, an internally helically threaded stator of resilient material pumpingly coacting therewith, and a rigid casing element within which the said stator is retained; said casing element being relieved internally over substantially its entire length to provide a fluid chamber of substantial angular width external to said stator and extending substantially the entire length of said stator, reinforcing means for said stator extending throughout its length and to an angular width greater than the said chamber in the region exposed to said chamber, and means for applying fluid pressure to said chamber.

2. A pump according to claim 1, wherein said last named means comprises a fluid connection between the discharge of said pump and said chamber, whereby said chamber is at substantially the pump discharge pressure.

3. A pump according to claim 1, wherein said last named means comprises a cylinder, one end of which is in communication with the discharge of said pump, a piston in said cylinder, the other end of said cylinder being in communication with said chamber, and a body of fluid filling the volume between said piston and stator, whereby said chamber is at substantially the pump discharge pressure.

4. A pump according to claim 1, wherein the reinforcement of said stator comprises a substantially semi-cylindrical rigid shim.

5. A pump according to claim 4, wherein said shim is permanently bonded to said stator.

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