A pump/motor includes a stator (10) having an interior profile surface and a rotor having an exterior profile surface. The stator tube is formed from the sheet metal spiral wound to generate an interior profile, with an adjacent edge of the spiral wound sheet being secured together. Substantially uniform thickness elastomeric layer (20) form down interior surface of the stator tube. A rotor (30) is rotatable within the stator tube and the elastomeric layer of an operation of pump/motor.
MOTOR/PUMP WITH SPIRAL WOUND STATOR TUBE

CROSS-REFERENCE TO RELATED APPLICATION

0001 This application claims the priority of U.S. Provisional Application No. 61/239,537 filed on Sep. 4, 2009, the disclosure of which is incorporated herein by reference for all purposes.

FIELD OF THE INVENTION

0002 The present invention relates to motors and pumps of the type which include a stator and a rotor which rotates within the stator to either pump fluid or to generate mechanical forces from fluid pumped through the motor, e.g., to rotate a downhole bit. More particularly, the present invention relates to a relatively low cost stator tube formed by welding a spiral sheet to form the stator tube, with an elastomeric layer having a substantially uniform thickness on the interior of the stator tube.

BACKGROUND OF THE INVENTION

0003 Various types of downhole progressing cavity or Moinneau-style pumps and motors have been devised for downhole use in hydrocarbon recovery operations. In one embodiment, the equipment acts as to pump downhole fluid to the surface, typically by rotating a sucker rod at the surface to rotate the downhole rotor. Also, the pump could be configured to run with an electric submersible motor, which is not driven from the surface using sucker rods. In other embodiments, the equipment serves as a motor to receive downhole fluids pumped from the surface, and uses hydraulic forces to rotate the rotor and thereby rotate a bit below the motor. Various embodiments of downhole motors and pumps are disclosed in U.S. Pat. Nos. 4,386,654, 4,519,712, 4,591,322, 4,773,834, 4,592,427, and 4,991,292. A stator for a positive displacement pump is disclosed in U.S. Pat. No. 5,145,342, and U.S. Pat. No. 5,474,432 discloses a pump or motor construction.

0004 A progressing cavity pump is disclosed in U.S. Pat. No. 6,120,267. U.S. Pat. Nos. 6,716,008, 6,464,467, 6,398,522, 6,308,549, 6,220,837, and 6,126,032 disclose other embodiments of downhole motor pumps. U.S. Pat. No. 6,729,391 discloses a progressing cavity pump which is inserted in a tubing string. An internally profiled stator tube is disclosed in U.S. Pat. No. 6,309,195, and a method of producing elastomeric stators is disclosed in U.S. Pat. No. 6,158,988.


0006 The disadvantages of the prior art are overcome by the present invention, and an improved progressing cavity pump/motor and in particular a stator for a progressing cavity pump/motor is hereinafter disclosed.

SUMMARY OF THE INVENTION

0007 A progressing cavity pump/motor has a stator with substantially the same shape as the interior wall of the stator, so that an even rubber thickness on the stator may cooperate with the rotor profile to generate a pumping action or generate mechanical torque from fluid transmitted to the motor. The stator is formed from one or more strips of metal which are rolled and formed into the desired shape, and welded along the strip seam to produce the desired configuration.

0008 These and further features and advantages of the present invention will become apparent from the following detailed description, wherein reference is made to the figures in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

0009 FIG. 1 illustrates a portion of a suitable stator tube according to the present invention.

0010 FIG. 2 is a detailed view of a portion of the stator tube shown in FIG. 1.

0011 FIG. 3 illustrates a side view of a portion of the stator and rotor within the stator.

0012 FIG. 4 illustrates a side view of another embodiment of a stator tube with a spiraling strip around the seam.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

0013 FIG. 1 illustrates a spiral shaped stator tube 10 which has an interior profile intended to generally match the interior profile of the elastomeric layer subsequently molded into the stator. The spiral shaped stator tube 10 as shown in Fig. 1 thus provides a significant advantage of enabling a substantially even thickness of rubber around the profile of the stator, thereby eliminating problems associated with a thick rubber section retaining heat within the stator and lowering the pressure capability of the pump/motor. While other pump/motor stators have this general configuration, the present invention substantially reduces the costs of manufacturing the stator.

0014 By utilizing a stator tube that has the same shape but is slightly larger than the interior profile of the rubber within the stator, the stator may be manufactured with an even rubber thickness around its inner profile. At the stator minor diameter, the rubber is thus thinner than for a conventional cylindrical stator with a varying rubber thickness, thereby resulting in the advantages of improved heat transfer capability and high pressure capability.

0015 Stators with substantially even rubber thicknesses have been formed by various techniques, including casting, electrode discharge machining, and rotary swaging. Each of these techniques forms a suitable stator tube, but the cost of stator manufacturing is a significant disadvantage to the acceptance of such pump/motors.

0016 As shown in FIGS. 1 and 2, the stator may be manufactured from metal strips 12 which are easily rolled and formed into the desired shape, then welded at 14 along the seam of the strips. While each strip may have a desired configuration to achieve the end results, it is preferable that the seam and thus the weld 14 are made at the radially outward portion of each stator lobe profile, as shown in FIG. 1, so that the seam is easily accessible to a welding operation. The seam
and thus the weld alternatively could be provided in the “valley” or the radially inward portion of each stator profile. The axial spacing between a full revolution of the stator spiral thus coincides with the axial spacing between a full spiral of the weld. Two spiraling strips welded together at this seam thus forms the completed stator housing. The seam may alternatively be made between the “hill” and the “valley” of the spiral wound stator tube.

FIG. 3 illustrates a portion of a stator 10 with a seam 14 as discussed above, and a rotor 30 positioned within the stator.

The metal strips 12 which form the body of the stator tube may thus have a substantially uniform thickness, which may be between 0.040 inches to 0.50 inches. In other embodiments, another thin strip may be welded to the exterior, or possibly the interior, of the formed stator tube on each side of the seam, so that both the weld 14 and the added strip with a weld on each side of seam 14 thus provides additional mechanical strength and fluid pressure integrity. The ends of each stator tube may include an adapter so that the spiral tube can be interconnected by the adapter to tools and tubular with conventional threads.

Referring briefly to FIG. 3, the cross-section of the stator 10 is shown, along with a uniform rubber thickness layer 20 on the interior of the stator 10. FIG. 3 also depicts a portion of a suitable rotor 30 positioned within the stator, such that the rotor rotates within the stator to achieve the desired pumping action or to generate torque from power fluid to rotate a bit.

In one embodiment, an improved downhill motor/pump is provided, the equipment including a stator tube having a substantially uniform thickness metal sheet formed and spiral wound to generate an interior profile for the stator. Adjacent edges of the spiral wound sheet may be secured together by welding. A substantially uniform thickness elastomeric layer may be formed on the interior profile surface of the stator, and a rotor positioned within the stator and the elastomeric layer for cooperating with the elastomeric layer during operation of the pump/motor. In another embodiment, an improved stator is provided suitable for use with a pump/motor, with a stator tube having a substantially uniform thickness metal sheet formed and spiral wound to generate an interior profile, and adjacent edges of the spiral wound sheet secured together.

FIG. 4 illustrates a portion of a stator 11, although in this case the rubber layer 20 is not shown. The seam between spiraling sheets is connected by a spiraling strap 36 which may be positioned over a portion of the external surface of adjacent strips and welded to each strip. As previously noted, the seam may not be provided in the “high portion” of the stator profile, and thus the strips may not enlarge the overall diameter of the stator tube.

Although specific embodiments of the invention have been described herein in some detail, this has been done solely for the purposes of explaining the various aspects of the invention, and is not intended to limit the scope of the invention as defined in the claims which follow. Those skilled in the art will understand that the embodiment shown and described is exemplary, and various other substitutions, alterations and modifications, including but not limited to those design alternatives specifically discussed herein, may be made in the practice of the invention without departing from its scope.

1. A pump/motor including a stator having an interior profiled surface and a rotor having an exterior profiled surface, comprising:

the stator tube including a substantially uniform thickness metal sheet formed and spiral wound to generate an interior profile, adjacent edges of the spiral wound sheet being secured together at a sheet seam with a seam profile substantially corresponding to the interior profile of the stator tube, such that an axial lead of the spiral wound stator tube is substantially an axial lead of the seam of the spiral wound sheet;

a substantially uniform thickness elastomeric layer formed on the interior profiled surface of the stator tube; and

a rotor rotatable within the stator tube and within the elastomeric layer, the rotor cooperating with the elastomeric layer during operation of the pump/motor.

2. A pump/motor as defined in claim 1, wherein the adjacent edges of the spiral wound sheet are secured by a weld.

3. A pump/motor as defined in claim 1, further comprising:

a thin metal strip covering the seam between the spiral wound sheet metal and secured to the sheet metal on each side of the seam.

4. (canceled)

5. A pump/motor including a stator having an interior profiled surface and a rotor having an exterior profiled surface, comprising:

the stator tube including a metal sheet formed and spiral wound to generate an interior profile, adjacent edges of the spiral wound sheet being secured together at a sheet seam with a seam profile substantially corresponding to the interior profile of the stator tube, such that an axial lead of the spiral wound stator tube is substantially an axial lead of the seam of the spiral wound sheet;

a substantially uniform thickness elastomeric layer formed on the interior profiled surface of the stator tube; and

a rotor rotatable within the stator tube and within the elastomeric layer, the rotor cooperating with the elastomeric layer during operation of the pump/motor.

6. A pump/motor as defined in claim 5, wherein the adjacent edges of the spiral wound sheet are secured by a weld.

7. A pump/motor as defined in claim 5, further comprising:

a thin metal strip covering the seam between the spiral wound sheet metal and secured to the sheet metal on each side of the seam.

8. (canceled)

9. A stator for a pump/motor, the stator having an interior profiled surface, comprising:

the stator tube including a metal sheet formed and spiral wound to generate an interior profile, adjacent edges of the spiral wound sheets being secured together at a sheet seam with a seam profile substantially corresponding to the interior profile of the stator tube, such that an axial lead of the spiral wound stator tube is substantially an axial lead of the seam of the spiral wound sheet.

10. A stator as defined in claim 9, further comprising:

a substantially uniform thickness elastomeric layer formed on the interior profiled surface of the stator.
11. A stator as defined in claim 9, wherein the adjacent edges of the spiral wound sheet are secured by a weld.
12. (canceled)
13. A stator as defined in claim 9, wherein the sheet metal has a substantially uniform thickness.

14. A stator as defined in claim 9, wherein side edges of a first metal sheet are each adjacent a respective side edge of a second metal sheet.