Nov. 9, 1965 E. SOEDING ETAL 3,216,768

PUMP CONSTRUCTION

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Fig.2

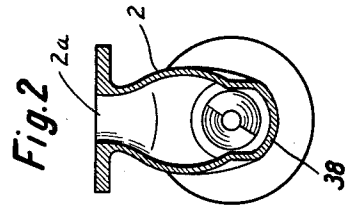
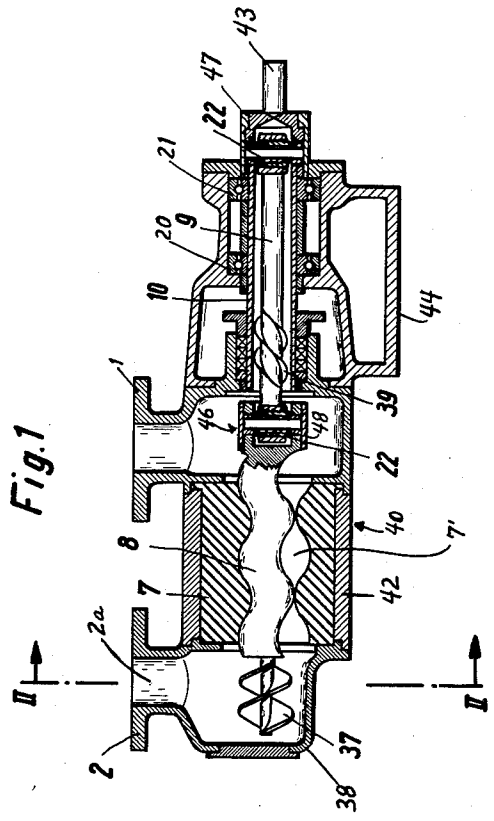


Fig.1



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Fig.3

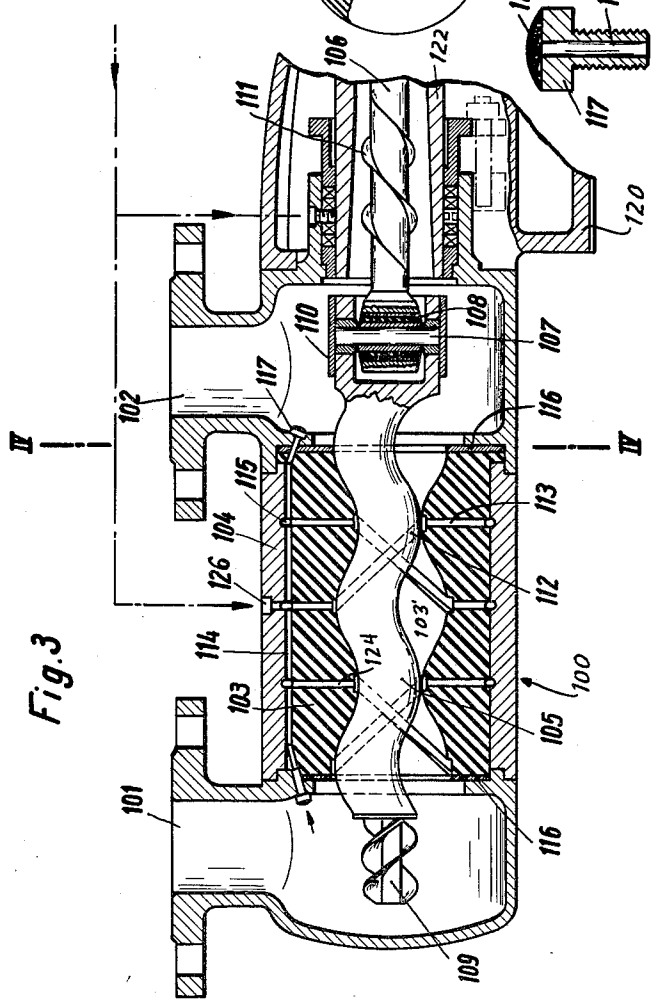


Fig.4

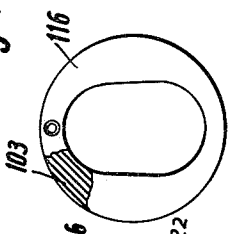


Fig.5

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Fig. 6

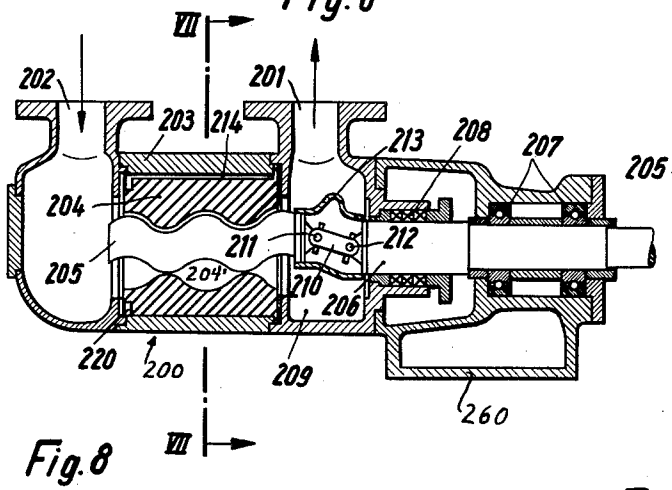


Fig. 7

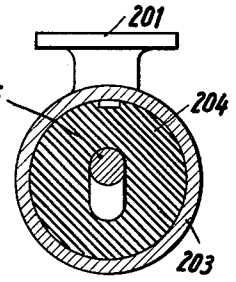


Fig. 8

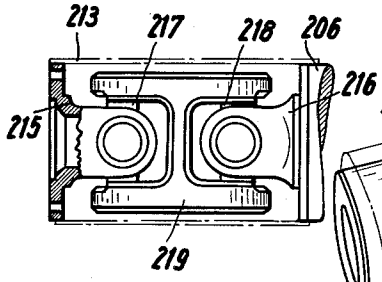


Fig. 9

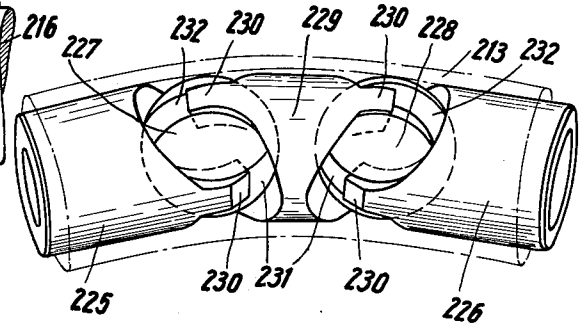


Fig. 10

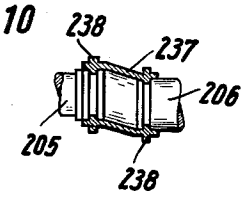


Fig. 11

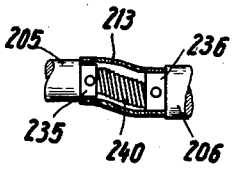
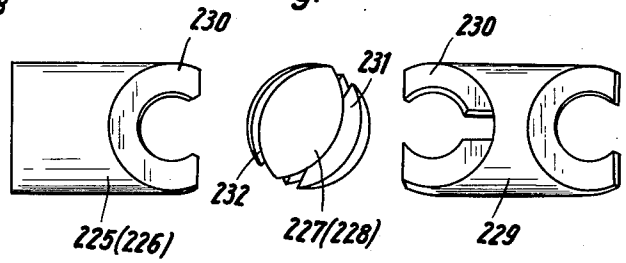


Fig. 12



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3,216,768

PUMP CONSTRUCTION

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Claims priority, application Germany, July 26, 1962, S 80,599
11 Claims. (Cl. 302—14)

This invention relates in general to pump construction, and in particular to a new and useful eccentric worm pump having a helical worm-like rotor arranged inside a stator to form one or more cavities which are advanced from one end to the other of the stator as the rotor is rotated.

The present invention provides an improvement in pumps of a type mentioned above, particularly in respect to the details of construction thereof which permit the pump to operate efficiently and which provide reduced constructional and installation cost. The present pump construction is particularly applicable for use not only with liquids of all varying types, but also for conveying sludges and thixotropic, non-flowable, highly pasty and highly viscous materials as well as dry materials.

In accordance with one aspect of the invention, the stator is formed between inlet and discharge unions or fittings in a simple manner and is novelly constructed in order to facilitate the movement of the material between the active parts of the pump rotor and stator. The construction is such that coarse or dry pieces of material will not tend to form within the stator along the walls thereof and that such materials will be conducted away from any inactive locations, such as the spaces between joint components of the connecting or driving shaft elements.

In accordance with a further aspect of the invention, the pumping worm-like rotor is advantageously provided with a conveyor screw extension for permitting easy connection to the stator of the pump directly into the materials to be conveyed and for advancing such materials into the vicinity of the working rotor.

The inventive pump advantageously comprises a tubular stator having an interior wall advantageously made of a resilient material which defines cavities along the length of the stator in respect to the worm-like rotor operating therein. The stator is such that it may be easily connected at each end to unions for connecting the pump to an inlet and discharge. The inventive pump construction further includes a housing for supporting a universal or cardan joint connection for driving the worm-like rotor and permitting its rotational and oscillatable movement. The universal joint construction includes a cardan shaft which is rotatable in a sleeve member and includes a conveying screw formation thereon which directs materials which are pumped to the discharge union in a direction away from the joint part and out through the discharge.

Accordingly, it is an object of this invention to provide an improved pump construction.

A further object of the invention is to provide a pump construction which includes a helical or worm-like rotor arranged inside a stator in a manner to form at least one cavity which is displaced axially in a direction of discharge during rotation of the rotor, and wherein the rotor includes conveyor screw means at one or more ends thereon for facilitating the flow of material from the inlet to the discharge.

A further object of the invention is to provide a pump of the character described which includes a drive connection for the rotor of the pump permitting both oscillatable and rotative movement of the rotor and which includes a cardan or universal shaft having conveyor elements thereon for conveying materials delivered to the discharge away from the operating parts of the drive elements.

A further object of the invention is to provide improved joint connections between a driving shaft and a rotor of a helical type pump which permits the rotor to move in rotational and oscillatable movement for the pumping of materials between an inlet union and a discharge union.

A further object of the invention is to provide an improved helical rotor pump and an improved drive joint connection therefor which are simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

In the drawings:

FIG. 1 is a longitudinal section of a helical rotor pump construction in accordance with the invention;

FIG. 2 is a section taken on the line II—II of FIG. 1;

FIG. 3 is a longitudinal section similar to FIG. 1 of another embodiment of the pump;

FIG. 4 is a section taken on the line IV—IV of FIG. 3;

FIG. 5 is an enlarged transverse sectional view of the plug member indicated in FIG. 3;

FIG. 6 is a partial longitudinal sectional view similar to FIG. 1 of another embodiment of the pump;

FIG. 7 is a section taken on the line VII—VII of FIG. 6;

FIG. 8 is an enlarged partial sectional and partial plan view of a drive joint for the pump indicated in FIG. 6;

FIG.9 is a view similar to FIG. 8 of another embodiment of the joint;

FIGS. 10 and 11 are partial elevational and sectional views of other embodiments of the joints; and

FIG. 12 is an enlarged elevational view of the joint elements indicated in FIG. 9.

Referring to the drawings in particular, the invention embodied therein, as indicated in FIG. 1, comprises a pump generally designated **40** having a tubular casing **42** forming a stator which is formed at each end for easy connection to a pressure or discharge union or fitting **1** at one end and a suction or inlet union or fitting **2** defining an inlet chamber at its opposite end. A stator element or sleeve member **7** is fitted within the casing **42** and is provided with a helically extending bore **7'** which, together with a rotor **8**, forms one or more cavities or material trapping areas which advance axially during rotation of the rotor **8**.

In the embodiment illustrated in FIG. 1, the union or fitting **2** at the suction side is made of a size to accommodate a multi-thread Archimedean worm (equal pressure worm) or thread conveyor **37** which is coaxial with and connected to the rotor **8** for rotation therewith. The worm **37** has a pitch which is greater than that of the rotor **8** and conveys material, from the region in which it is delivered through an opening **2***a* of the inlet union **2** or from a region in which it is disposed in a freely heaped form, axially in a direction toward the rotor **8** for delivery between the rotor and the stator **7**. The worm **37** runs in a worm housing portion **38** of the union **2**, or it can be arranged, in those instances where

a union 2 is not employed, directly in a container filled with the material to be conveyed. In the embodiment illustrated, the worm housing 38 is made as a part of the suction union or pipe 2, and the union 2 is suitably dimensioned to provide for the oscillating movement of the worm along with the rotor 8.

In some instances the rotor 8 is connected through coupling means or drive means to effect its rotation through the suction side, and this can be readily provided for in the embodiment illustrated by having the coupling drive connection arranged concentrically in respect to the worm 37.

In the embodiment of FIGS. 1 and 2 the drive connection is made to rotor 8 at its discharge end through a drive shaft 43. For this purpose an auxiliary cardan shaft housing 44 is fitted directly to the discharge union 1 and the housing supports a sleeve or hollow shaft element 10. A cardan or universal shaft element 9 is arranged within the hollow shaft 10. (Shaft 9 is also known as an oscillating shaft.) A single thread or multi-thread worm or conveying screw 39 having a pitch greater than the pitch of the rotor 8, is formed adjacent one end of the cardan shaft 9 and is shaped to convey material in a direction toward the rotor 8 so as to prevent the hollow shaft 10 from becoming filled in an undesirable manner with the material being conveyed. The cardan shaft 9 is connected to the rotor 8 at its one end and the shaft 43 at its opposite end through universal couplings 46 and 47 which include rubber bushes 22. The bushes 22 are capable of resiliently absorbing the universal deflection due to the oscillation of the rotor 8. A covering 48 is provided around the universal joint 46 and there is no need for lubrication or for additional protective elements to prevent penetration of material or other foreign bodies or dirt. The arrangement insures steady power transmission from the cardan shaft 9 to the rotor 8. By metal rubber bushes is meant bushes consisting of rubber which is vulcanized onto the metal sleeves.

In FIG. 3 there is indicated an alternate embodiment of worm pump which includes an exterior casing 100 which is connected at its opposite ends to an inlet union or fitting 101 and an outlet union or fitting 102, respectively. A stator member 103 is positioned within the casing 104 and is provided with a helical bore 103' in which is rotatable a rotor 105. As indicated in the other embodiment, at the inlet of the rotor 105 there is provided an Archimedean worm or conveyor screw 109 which rotates with the rotor 105 in the inlet fitting 101. The opposite end of the rotor 105 is connected to a cardan shaft 106 by means of a universal or cardan joint 107. As in the other embodiment, the mounting of the cardan journal is formed by a metal rubber bushing 108.

The discharge fitting 102 is connected at its outer end to a housing 120 having a sleeve portion 122 in which the cardan shaft 106 is rotatable. The cardan shaft 106 is also provided with blade portions 111 forming a screw or thread conveyor for insuring that material is delivered out of the tubular shaft 122 and in a direction toward rotor 105 and through the discharge fitting 102.

It has been determined that excessive wear is encountered on the operative parts when conveying a medium which has an abrasive character or includes a high solid content. This wear is due as a result of too little wetting with liquid of the contacting surfaces of the stator 103 and the rotor 105. In order to overcome this undesirable characteristic, the stator is provided with spiral grooves 112 which form flushing channels. The flushing channels 112 are in communication, through bores 124 of the stator 103, with a flushing system formed by one or more axial cavities 114 located between the outside of the stator 103 and the inside of the housing 104. Peripheral grooves or channels 115 are also provided to provide complete flushing means around the periphery of the stator.

The stator 103 is closed off at both ends by reinforcing plates 116 which abut against the discharge fitting 102

(see FIG. 4). The reinforcing plates 116 include the plug 117 which extends therethrough and connects into the flushing system. This plug 117 is indicated on an enlarged scale in FIG. 5. The plug 117 contains a passage 119 which is closed at its outer end by a filter 118. The flushing system is externally connected through a fitting 126 formed in the exterior of the casing 104. In those instances where the flushing is accomplished by natural flushing, the connection at 126 is sealed off.

In some instances it is desirable to arrange the flushing grooves or channels in a manner differently than that indicated in the drawing so that they do not intersect one another. In addition, when a pump which is operative on two sides is employed, it is possible to dispense with the preliminary worm on the pressure side, that is, where the conveyor portion 111 may be eliminated. If the pump is used for thixotropic liquid, it can then be connected to that side where the preliminary worm is situated. With non-thixotropic media, the other union is used as a suction union.

In the embodiment indicated in FIGS. 6 and 7, a pump 200 is shown which includes a pressure or delivery union 201 and a suction or intake union 202. The pump 200 has a stator housing 203 with a stator 204 affixed therein, and a rotor worm 205 cooperating within the bore 204' of the stator. In this embodiment a housing 260 is connected to the outer end of the pressure union 201 and it provides a rotatable bearing support 207 for a driving shaft 206. The shaft 206 projects through a stuffing box packing 208 in the housing 260 and into a space 209 of the pressure union 201.

In accordance with this embodiment of the invention, the rotor 205 is connected with the driving shaft 206 by means of a double joint generally designated 210 which is covered by a flexible covering 213. A joint of this character requires no maintenance or lubrication. Because each of the stator and the driving shaft projects at one end into the chamber 209 situated between the rotor 205 and the driving shaft 206, it is possible to dispense with the cardan shaft or oscillating shaft as well as the hollow shaft which surrounds it, as was necessary in the other embodiment. The joint 210 obviates the requirement for maintenance or lubrication of the joint and, in addition, provides an arrangement for shortening the length of the pump housing. The double joint 210 includes a pivot point 211 at one end and a pivot point 212 at its opposite end. The joint is enclosed by the protective bellows 213 made of rubber or synthetic plastic which is fixed to the ends of the rotor 205 and driving shaft 206, respectively.

In FIGS. 8 to 12 there are indicated some constructional possibilities for the joint of the same character as the joint 210. In the embodiments illustrated there are preferably two end sections, for example the end sections 215 and 216 of FIG. 8, 225 and 226 of FIGS. 9 and 12, and 235 and 236 of FIG. 11. One of the end sections is connected to the associated driving shaft 206 and the other is connected to the rotor 205. The construction also includes a middle member 219, as indicated in FIG. 8, 229 in FIGS. 9 and 12, and 240 in FIG. 11. At least one of the two parts which slide relatively consist, at least on the sliding surfaces, of a maintenance-free bearing material, more especially polytetrafluorethylene. This polytetrafluorethylene is advantageously in a metal dispersion which requires no lubrication of the support areas.

In the joint of FIG. 8 there are two cross-pin joint sections 217 and 218 forming four pivot points arranged at right angles to one another and connected to form an element in the shape of a cross. The pivot points or pins are mounted in pairs in each of the forked end sections 215 and 216, and in the H-shaped middle section 219. In each case the parts which slide upon the other include a bearing material such as polytetrafluorethylene in a

metal dispersion, and the end sections and the middle section may comprise metal.

In FIGS. 9 and 10 there are indicated two spherical joint sections **227** and **228** with incisions in planes disposed at right angles to one another. The two end sections **225** and **226** and the middle section **229** are provided, in the ends thereof which are adjacent the balls, with flat projections **30**. The latter are of such a form and of such dimension that they can pass into the incisions or grooves **231** or **232** of the ball joints and can engage therein. In this embodiment the materials are also chosen so that good lubrication properties are obtained without lubricant.

In FIG. 10 there is indicated a constructional form of double joint in which a tube **237** of elastic material such as rubber or synthetic plastic which may also be provided with reinforcing inserts of textile materials, polyamides or metal wire, serves for the torque transmission and for this purpose is fixed with clips or the like at **238** to the ends of the respective rotor **205** and shaft **206**.

In FIG. 12 the joint of FIG. 9 is indicated in an exploded view, and in FIG. 11 there is indicated a joint which includes end sections **235** and **236** which are connected together by an elastic, flexible middle section **240**. A flexible bellows cover **213** as in the embodiment of FIG. 6 is also provided.

In order to compensate for the axial thrust which acts on the stator **204** it is possible to provide a liquid piston formation which is connected to a pressure space **209** by a pipe **214** formed between the stator **204** and the casing **203**. The piston acts in opposition to the direction of thrust of the conveyed medium on the stator **204** and is formed by an edge of the stator **204** which is formed as an inward extension to form a recess **220**.

It is to be noted that in all shown embodiments of the invention the drive is effected from the input drive shaft through the cardan shaft and to the rotor. In the embodiment of FIG. 1 the shaft element **9** is arranged within the hollow shaft element **10** which is provided with ball bearings **20, 21** in such a manner that both shaft elements **9** and **10** are rotating together. Simultaneously the shaft element **9** is carrying out a conical stirring movement within the shaft element **10** so that the single thread or multi-thread worm or conveying screw **39** mounted thereon prevents the hollow shaft **10** from becoming filled in an undesirable manner with the material being conveyed. The shaft **9** pivots in two directions at each of its end connections, and therefore, the rotating movement is transmitted from shaft **43** through shaft **9** to rotor **8** although the right side end (in FIG. 1) of the rotor **8** is carrying out an oscillatory movement simultaneously with its rotating movement.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. An eccentric worm pump comprising a stator having a substantially axially extending helical bore with an inlet adjacent one end and a discharge adjacent the other, a rotor of similar configuration to said bore rotatable in said stator and forming a closed cavity therewith which advances in a direction of pumping movement during movement of said rotor in said stator for conveying the material from the inlet end of said stator to the discharge end thereof, a drive shaft for rotating said rotor and for oscillating said rotor, drive joint means connected between said drive shaft and said rotor for permitting oscillatory movement and rotation thereof, fitting means forming a chamber at each end of said stator, one serving as a suction chamber and one serving as a delivery chamber, and a worm rotatable in said fitting means forming said suction chamber and secured to said rotor for rotative movement therewith for directing materials fed into said inlet fitting in a direction toward said discharge end.

2. An eccentric pump according to claim **1**, wherein said drive connection between said driving shaft and said rotor includes a cardan joint, said screw conveyor being connected to said shaft on the side opposite from said cardan joint.

3. An eccentric worm pump comprising a stator having a substantially axially extending helical bore with an inlet adjacent one end and a discharge adjacent the other, a rotor of similar configuration to said bore rotatable in said stator and forming a closed cavity therewith which advances in a direction of pumping movement during movement of said rotor in said stator for conveying the material from the inlet end of said stator to the discharge end thereof, a drive shaft for rotating said rotor and for oscillating said rotor, drive joint means connected between said drive shaft and said rotor for permitting oscillatory movement and rotation thereof, means forming a chamber at each end of said stator, one serving as a suction chamber and one serving as a delivery chamber, and a screw conveyor secured to said rotor for movement therewith located within the chamber forming the suction chamber, said drive connection between said driving shaft and said rotor including a cardan shaft and a screw conveyor portion formed on said cardan shaft within a housing and arranged to return material, tending to move away from said rotor along said cardan shaft, in a direction toward said rotor.

4. An eccentric worm pump according to claim **1**, wherein said drive shaft connection includes a cardan shaft and a cardan joint connection to said shaft at each end formed by metal rubber bushes.

5. An eccentric worm pump comprising a stator having an axially progressing helical bore with an inlet adjacent one end and a discharge adjacent the opposite end, a helical rotor movable in the bore of said stator, a rotatable drive shaft connected to said rotor for moving said rotor within said stator for pumping material from one end thereof to the other, drive joint means connecting said drive shaft and said rotor permitting rotation and oscillation of said rotor in response to rotation of said drive shaft, a fitting extending outwardly from one end of said stator and defining an inlet chamber in communication with the inlet of said stator, and a thread worm rotatable in said inlet chamber and connected to said drive shaft and providing means for advancing material to said rotor.

6. An eccentric pump according to claim **5**, wherein said thread worm is connected to said rotor on the side thereof opposite from said drive shaft for delivering the material to the inlet end of said stator.

7. An eccentric worm pump according to claim **5**, wherein said drive joint means includes a cardan shaft, housing means adjacent one end of said stator for supporting said cardan shaft, said cardan shaft being connected to said rotor through a universal joint.

8. An eccentric worm pump comprising a stator having an axially progressing helical bore with an inlet adjacent one end and a discharge adjacent the opposite end, a helical rotor movable in the bore of said stator, drive shaft means for moving said rotor within said stator for pumping material from one end thereof to the other, and a threaded worm connected to an end of said rotor providing means for moving material being pumped by said rotor, said threaded worm being connected to said rotor at the end thereof adjacent said drive shaft means.

9. An eccentric worm pump comprising a stator having an axially progressing helical bore, a helical rotor positioned in the bore of said stator and being movable therein for forming a cavity with said stator which advances in an axial direction as said rotor is moved, a discharge fitting connected to one end of said stator for discharging materials pumped by said rotor to said stator, housing means aligned with said stator, a cardan shaft rotatably

supported within said housing means, a universal joint connecting said cardan shaft with said rotor for moving said rotor, and a thread worm rotatable within said housing means in operative running engagement with the walls thereof and connected to said rotor for directing material toward said rotor.

10. An eccentric worm pump comprising a stator housing a tubular stator in said stator housing having an axially progressing helical bore defined therein, a rotor movable within said stator forming at least one cavity therewith which progresses in an axial direction as said rotor is moved, fitting means connected to one end of said stator for discharging material moved by said rotor from said stator, drive means rotatably connected to said rotor for moving said rotor in said stator, means for directing fluid pressure between said tubular stator and said stator housing for absorbing axial thrust, a flushing system formed in said stator including a plurality of bores drilled through said stator connected by longitudinal and circumferential connecting grooves, and a plug member connected into said flushing system from the exterior of said stator, said plug member comprising a passage and a filter in said passage.

11. An eccentric worm pump comprising a stator having an axially progressing helical bore with wall means defining an inlet chamber adjacent one end and a discharge adjacent the opposite end, a helical rotor movable by oscillatory and rotary movement in the bore of said stator, drive shaft means for moving said rotor within said stator for pumping material from one end thereof to the other, said drive shaft means including a threaded worm connected to an end of said rotor and extending into said inlet chamber, said worm providing means for cooperating with the said wall means defining said inlet chamber to break and advance the material to be pumped by said rotor.

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