March 10, 1970 F. SEEBERGER ET AL 3,499,389

WORM PUMP

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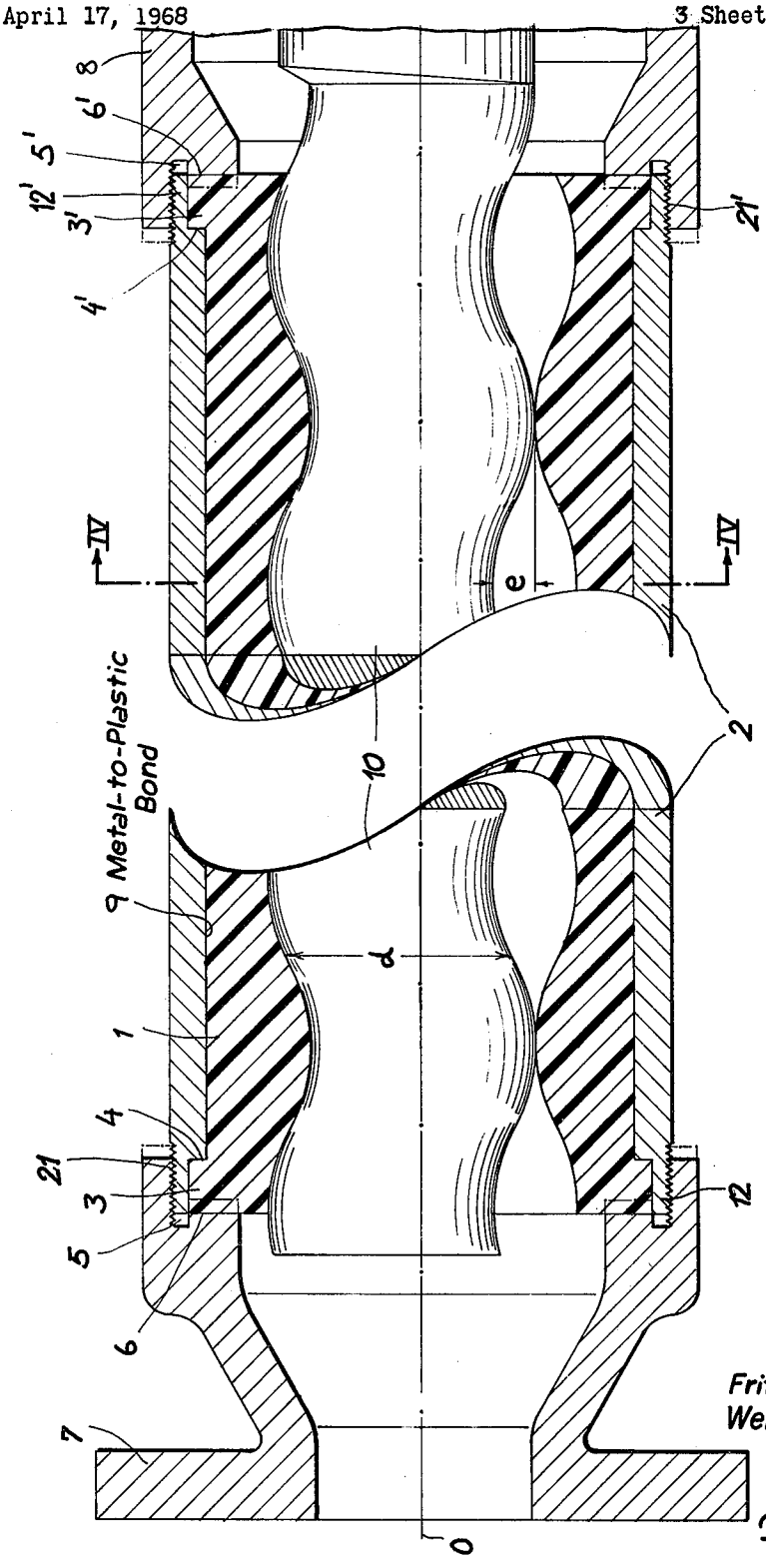


FIG. 1

INVENTORS
Fritz Seeberger
Werner Wehling

Karl F. Ross
Attorney

March 10, 1970 F. SEEBERGER ET AL 3,499,389

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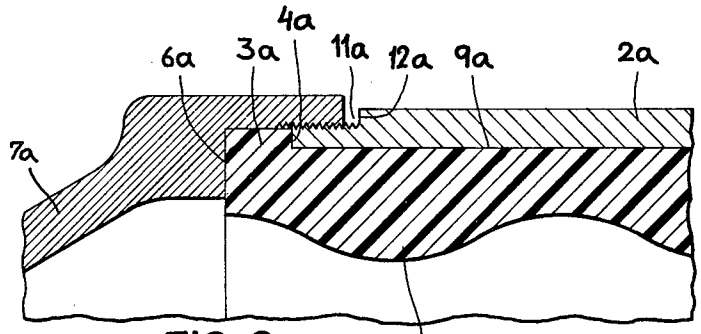


FIG. 2

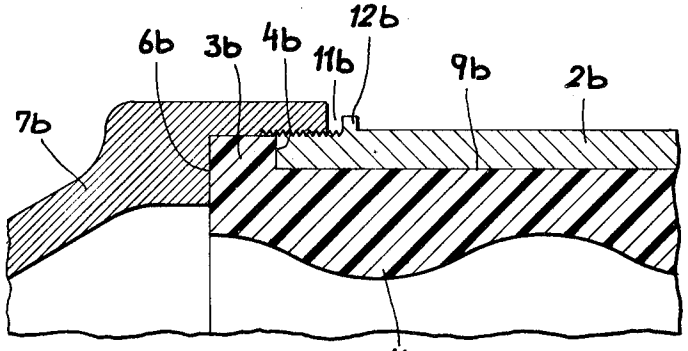


FIG. 3

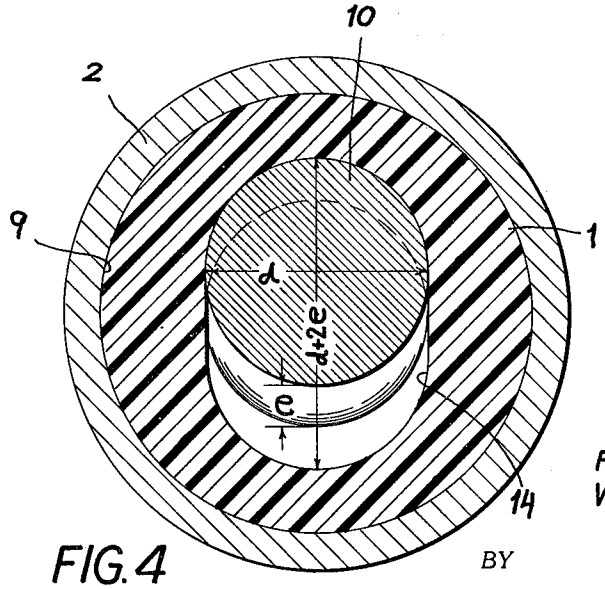


FIG. 4

INVENTORS
Fritz Seeberger
Werner Wehling

BY

Karl F. Ross
Attorney

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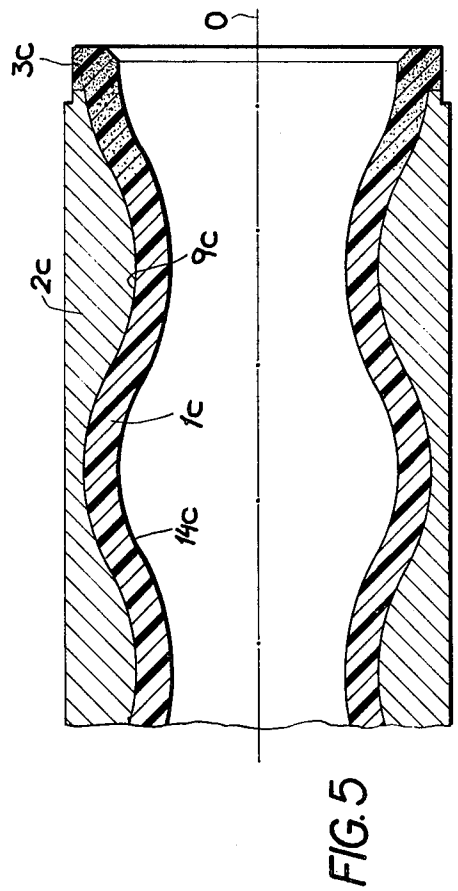


FIG. 5

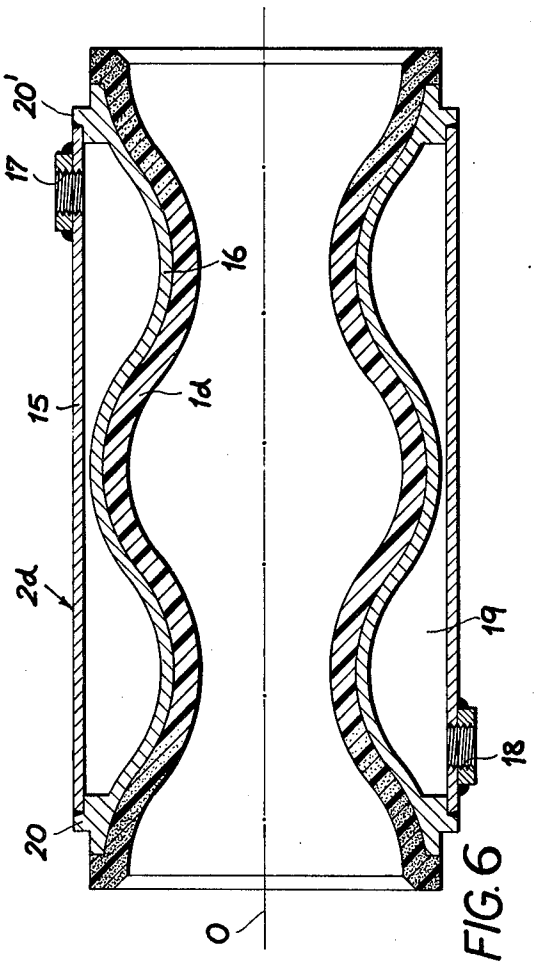


FIG. 6

INVENTORS
Fritz Seeberger
Werner Wehling

BY

Karl F. Ross
Attorney

United States Patent Office

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WORM PUMP

Fritz Seeberger, Kirchhellen, and Werner Wehling, Dorsten, Germany, assignors to Seeberger K.G., Kirchhellen, Germany, a corporation of Germany

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Int. Cl. F04c 5/00, 17/12
U.S. Cl. 103—117 6 Claims

ABSTRACT OF THE DISCLOSURE

The stator of a worm pump, in the form of a generally cylindrical plastic body with a twisted channel and a pair of end flanges, is held in a metallic housing by adhesive bonding and by a pair of annular clamping heads which bear upon the end flanges and upon abutments on the housing that limit their axial displacement toward each other so as to prevent excessive compression of these flanges. The stator body may be of uniform thickness, with the inner housing surface shaped to conform to its channel, and a cooling space may be formed between this peripheral surface and an outer cylindrical jacket.

Our present invention relates to a worm pump of the type wherein a stator is formed with a twisted channel, centered on an axis, and co-operates with a helicoidal rotor adapted to roll about this axis inside the channel. Generally, in such a pump, the rotor is of circular cross-section throughout its length whereas the channel has an elongate cross-section with a minor axis substantially corresponding to the rotor diameter and a major axis equal to the sum of this diameter and twice the eccentricity of the rotor. As a result of the rolling motion of the rotor, a fluid or a mobile mass of solid particles is positively displaced from one end of the stator to the other.

Such a stator can be most conveniently produced from moldable plastic material and, in order to withstand the shear and torsional stresses developing during use, is generally encased in a metallic outer housing of more or less cylindrical configuration. Difficulties have arisen in the past, however, in the establishment of a firm connection between the metallic housing and its plastic liner containing the channel. Thus, there exists in conventional constructions the danger of detachment of the liner from the housing, with possible creation of undesirable bypass paths for the medium to be pumped and with deformation of the channel walls resulting in increased frictional resistance, intense heating and consequent further deformation.

It is, therefore, the general object of our present invention to provide improved means in such a worm pump for securely joining the channeled plastic body thereof to its metallic housing, with elimination of any risk of dislocation or detachment.

It is also an object of our invention to provide an improved stator construction for such pumps wherein the plastic liner of insert is of reduced thickness, compared with the metallic housing, to lower the cost of manufacture and to minimize the possibility of deformation.

A further object is to provide means in such pump for effectively cooling the region of its rotor channel.

In accordance with a feature of our present invention, a generally cylindrical plastic body—representing the aforedescribed channeled insert—is adhesively bonded to the inner periphery of a surrounding metallic housing and is provided with a pair of end flanges which overlie respective annular end faces of the housing and are sandwiched between these faces and a pair of clamping heads bearing axially thereon. Advantageously, pursuant to a more specific feature of our invention, these clamping heads are in contact with annular shoulders or other abutments on the housing which limit the compression of the stator flanges. The term "plastic" as herein used, and as employed in the appended claims, includes both synthetic and natural polymers (e.g. rubber) capable of shaping by compression or injection molding.

According to another feature of our invention, the inner periphery surface of the metallic housing is given an undulating shape similar to that of the twisted channel whereby the thickness of the plastic body may be made uniform over substantially its entire length (except for the end flanges) and may even be reduced to less than the wall thickness of the housing. This configuration of the inner housing wall further contributes to the shear resistance of the stator assembly and can also be utilized to provide space within the housing for the circulation of a cooling fluid.

The above and other features of our invention will become more fully apparent from the following detailed description of certain embodiments, given with reference to the accompanying drawing in which:

FIG. 1 is an axial sectional view of a worm pump embodying the invention;

FIG. 2 is a fragmentary view, in axial section, showing a modification of the construction of FIG. 1;

FIG. 3 is a view similar to FIG. 2, illustrating another modification;

FIG. 4 is a cross-sectional view taken on the line IV—IV of FIG. 1; and

FIGS. 5 and 6 are two views similar to FIG. 1, showing additional embodiments.

The pump illustrated in FIGS. 1 and 4 comprises a stator **1** of plastic material received in a cylindrical metal housing **2** and secured thereto by adhesive bonding along their contact surface **9**. Two end flanges **3**, **3'** rest against annular end faces **4**, **4'** of housing **2** and are engaged by annular shoulders **6**, **6'** of a pair of clamping heads **7** and **8** which are threadedly connected at **21**, **21'** with the outer housing surface so as to be axially displaceable toward each other. To limit the extent of this displacement, a projecting ring flange **12**, **12'** at each end of housing **2** confronts a relatively shallow annular recess **5**, **5'** in the corresponding head **7** or **8**; the terminal position of these heads has been indicated by dot-dash lines. These heads may be part of a larger structure, such as a supply duct for a medium to be force-fed by the pump.

The plastic insert **1** has a twisted channel **14**, centered on the housing axis O, partly occupied by a helicoidal rotor **10** of diameter d which corresponds to the minor axis of the channel section as seen in FIG. 4. The major axis of that section is equal to $d+2e$ where e is the eccentricity of the rotor **10**. It will be understood that the channel profile seen in FIG. 4 remains constant throughout the length of the stator but that the orientation of its major and minor axes progressively deviates in both directions, from the position shown in FIG. 4, on opposite sides of the section line IV—IV of FIG. 1.

The plastic body **1**, with its end flanges **3** and **3'**, may be cast in situ within the housing **2**. Alternatively (as indicated diagrammatically in FIGS. 5 and 6 discussed below) the flange portions may be molded separately and subsequently bonded to the main body by thermal fusion. Rotor **10** is driven from its right-hand end (as viewed in FIG. 1), by conventional means not shown, so as to roll about the axis O inside channel **14**. Depending on the direction of rotation, the working medium will be displaced either from head **7** toward head **8** or vice versa.

In FIG. 2, where elements corresponding to those of

FIG. 1 have been identified by the same reference numerals with the suffix *a*, and abutment **12***a* is formed as a step in the outer surface of housing **2***a*, this step confronting an edge of head **7***a* across an annular gap **11***a*. According to FIG. 3, where the suffix *b* is used in lieu of *a*, the abutment **12***b* is formed as an annular rib on the housing **2***b*.

FIG. 5 shows as modified housing **2***c* with an inner peripheral surface **9***c* of undulating shape parallel to the walls of the associated rotor channel **14***c*, this surface thus forming a twisted passage similar to but larger than the channel **14** shown in FIGS. 1 and 4. By virtue of this construction, stator body **1***c* may be made of uniform thickness throughout its length, apart from the end flanges; only one such flange **3***c* has been illustrated in FIG. 5.

As noted before, and as schematically indicated by stippling, this end flange may have been joined to the remainder of body **3***c* by thermal fusion; the flange could also be produced by deformation of a heated axial extension of body **1***c*.

As shown in FIG. 6, a housing **2***d*, otherwise similar to housing **2***c* of FIG. 5, may be formed from two parts, i.e. a cylindrical outer jacket **15** and an undulating inner shell **16** defining a fluid space **19** between them; shell **16** has a pair of annular shoulders **20**, **20'** holding the jacket **15** in position.

Ports **17** and **18** serve for the introduction and withdrawal of a circulating fluid, especially a coolant. The jacket **15** may be positioned on the shell **16** by conventional techniques, e.g. by shrinkage, or one of the shoulders **20**, **20'** may be replaced by a press-fitted or threaded ring.

Apart from the provision of a separate outer jacket, as illustrated in FIG. 6, the stator housing according to our invention can be made in a single piece, the same being true of the channeled plastic body.

The heads **7**, **8** need not be directly screwed onto the housing **2** but may be held in position by an external clamping mechanism, not shown, which urges them toward each other into their limiting position indicated in dot-dash lines in FIG. 1.

We claim:

1. A worm pump comprising a stationary metallic housing with annular end faces centered on an axis; a generally cylindrical plastic stator body with a twisted channel and a pair of end flanges overlying said annular end faces, said body being adhesively secured to the inner periphery of said housing; a pair of clamping heads

bearing axially upon said end flanges with freedom of at least limited axial displacement toward each other to impart further clamping pressure to said end flanges; and a helicoidal rotor disposed in said channel for rolling motion about said axis.

2. A worm pump as defined in claim **1** wherein said housing is provided with abutments spaced from said clamping heads but engageable thereby in a terminal position for limiting the compression of said end flanges between said heads and said end faces.

3. A worm pump as defined in claim **1** wherein said inner periphery has a twisted shape substantially paralleling said channel, said body being of substantially constant thickness.

4. A worm pump as defined in claim **3** wherein said housing comprises a rigid inner shell forming said periphery and an outer jacket defining a cooling space with said shell, said housing being provided with conduit means for the circulation of cooling fluid through said space.

5. A worm pump as defined in claim **3** wherein the thickness of said body is less than the maximum wall thickness of said housing.

6. A worm pump comprising a stationary metallic housing of generally cylindrical shape with threaded extremities forming a pair of annular end faces centered on an axis; a generally cylindrical plastic stator body with a twisted channel and a pair of end flanges overlying said annular end faces, said body being adhesively secured to the inner periphery of said housing; a pair of clamping heads screwed onto said threaded end faces and bearing axially upon said end flanges with freedom of at least limited axial displacement toward each other to impart further clamping pressure to said end flanges; and a helicoidal rotor disposed in said channel for rolling motion about said axis.

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DONLEY J. STOCKING, Primary Examiner

W. J. GOODLIN, Assistant Examiner