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(54) **Diaphragm pump.**

(57) In a diaphragm pump, a central portion of the diaphragm is clamped between a plate (36) and a ring (37) which are held together by a number of screws (41). The plate (36) is held by a further screw (48) on an end of a connecting rod (14) and the screws (41) are accessible only from a chamber to which actuating fluid is admitted.

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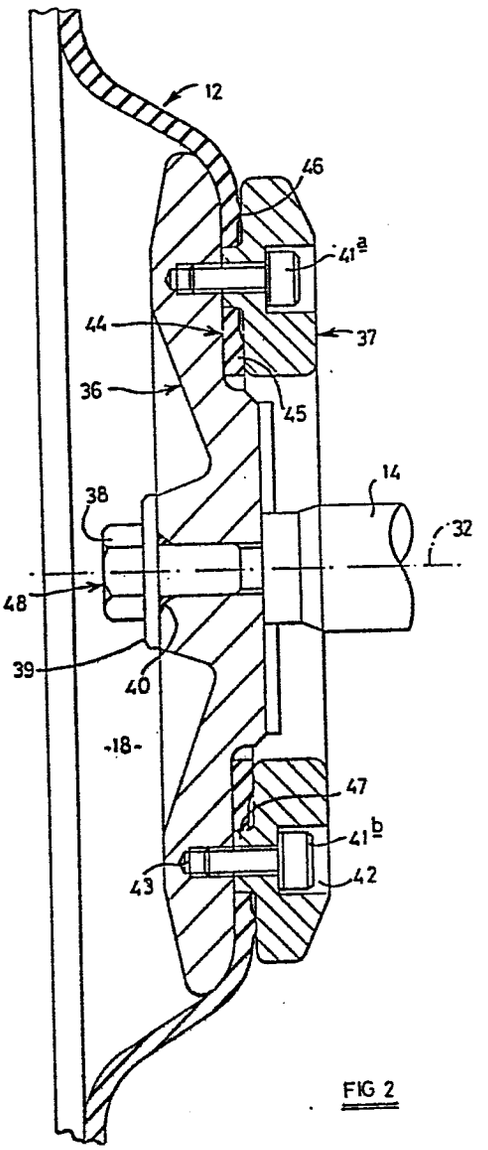

FIG 2

Title: "Diaphragm Pump"

This invention relates to a pump comprising a hollow body, a diaphragm which is flexible relative to the body and guide means for guiding a central portion of the diaphragm for movement along a rectilinear path relative to the body, wherein the diaphragm is mounted in the body by a peripheral portion of the diaphragm remote from the central portion, the central portion of the diaphragm is attached to the guide means, the diaphragm and the guide means collectively separate first and second chambers within the body and the second chamber communicates with control means adapted to admit a driving fluid under pressure to the second chamber intermittently to displace the central portion of the diaphragm.

According to the present invention, the guide means of a pump of the kind described comprises first and second clamping elements between which the central portion of the diaphragm is received and the clamping elements are engaged by each of a plurality of releasable fasteners accessible at or from a face of one of the clamping elements which forms a boundary of the second chamber but not accessible at or from a face of the other clamping element which forms a boundary of the first chamber.

In a pump in accordance with the invention, the releasable fasteners which are engaged with the clamping elements are shielded from the pumped medium which passes through the first chamber. Accordingly, the fasteners are not affected by an abrasive or corrosive action of the pumped medium.

The releasable fasteners are preferably screws which are screwed into threaded bores formed in the first clamping element adjacent to the first chamber and having respective heads engaged with the second clamping element. With this arrangement, the second clamping element can be a plastics moulding. The shape of the second clamping element may be selected to reduce the unswept volume of the second chamber, as compared with the unswept volume which would be available if the second clamping element was in the form of a flat, metal plate.

The bores in the first clamping element which receive the releasable fasteners are preferably blind bores. This avoids the risk of leakage of the operating fluid to the first chamber from the second chamber through open-ended bores in the clamping elements.

Respective parts of the clamping elements are preferably in mutually abutting relation, thereby limiting mutual approach of further parts of the clamping elements between which the central portion of the diaphragm is trapped. The abutting parts may be annular and each abutting part of the second clamping element may surround a respective one of the releasable fasteners. This arrangement avoids tightening of the fasteners imposing a bending load on the second clamping element.

An example of a pump embodying the invention will now be described, with reference to the accompanying drawings, wherein:-

FIGURE 1 is a diagrammatic illustration of the pump, and

FIGURE 2 shows a cross-section of certain parts of the pump in a plane containing a longitudinal axis of the pump.

The pump illustrated in the drawings comprises two hollow bodies, 10 and 11, containing respective annular diaphragms 12 and 13. Each diaphragm is mounted in the associated body by an outer peripheral portion of the diaphragm which is clamped between components of the body. A central portion of each diaphragm is clamped by guide means which is common to the two diaphragms and guides the central portions of the diaphragms for reciprocation together along respective rectilinear paths. The guide means includes a connecting rod 14 which slides in bearings provided on the bodies 10 and 11 and which also slides through a control means 15 disposed between the bodies.

The diaphragm 12 and adjacent parts of the guide means collectively separate a first chamber 18 within the body 10 from a second chamber 24 also within that body. Similarly, the diaphragm 13 and adjacent parts of the guide means separates two chambers within the body 11. There communicate with the chamber 18 an inlet and an outlet 19 and 21 respectively, for a pumped medium. One-way valves 20 and 22 are provided in the inlet and outlet respectively. The second chamber 24 is connected by a duct 25 with the control means 15. The control means alternately directs operating fluid under pressure from an inlet 16 along the duct 25 to the chamber 24 and permits the operating fluid to be discharged from the chamber 24. When operating fluid is directed under pressure to the chamber 24 from the inlet, fluid is exhausted from the corresponding chamber in the body 11 and when

the operating fluid is exhausted from the chamber 24, operating fluid is directed from the inlet 16 to the corresponding chamber of the body 11. In this way, the diaphragms 12 and 13 are caused to reciprocate together. The control means 15 may be arranged in a known manner and the overall arrangement of the pump may be as disclosed in the published numbers EP-82303863.3 and EP-82302879.0.

The guide means further comprises a first clamping element 36 and second clamping element 37, both of which are disposed in the body 10. The clamping element 36 is in the form of a disc having a central aperture through which there extends a releasable fastening element 48 which secures the element 36 to an adjacent end portion of the connecting rod 14. It will be noted that the clamping element 36 abuts an end face of the rod but does not engage a laterally facing surface of the rod. The fastening element 48 is in the form of a screw having a head 38 disposed in the chamber 18. Between the head 38 and the element 36, there is provided a metal washer 39 and an 'O' ring 40 of elastomeric material is compressed between the washer 39, the element 36 and a shank of the screw 48. This 'O' ring prevents leakage of fluid between the chambers 18 and 24 through the central opening of the clamping element 36.

The second clamping element 37 is in the form of a ring, having a central opening which is large, as compared with the central opening of the first clamping element 36. The second clamping element is exposed to the interior of the chamber 24 and is mounted on the first clamping element by a number of releasable fasteners 41, two of which are indicated in Figure 2 by the references 41a and 41b. Typically, there may be six fasteners 41 and these are spaced equally from an axis 32 of the screw 38 and are spaced apart equally about that axis. Each of the fasteners 41 is in the form of a screw having a head which engages the second clamping element 37 in a counterbore 42 thereof and a shank which extends through a plain bore in the second clamping element into a blind, screw-threaded bore 43 formed in the first clamping element 36. It will be noted that each fastener 41 is exposed to the contents of the chamber 24 but is shielded from the contents of the chamber 18. Furthermore, each bore 43, being a blind bore, does not provide a path for leakage of fluid between the chambers 18 and 24.

A central portion 44 of the diaphragm 12 is trapped between the clamping elements 36 and 37. The central portion of the diaphragm includes two annular, thickened portions, 45 and 46 respectively. The thickened

portion 45 lies nearer to the axis 32 than do the fasteners 41 and the thickened portion 46 lies further from the axis 32 than do the fasteners 41. When the diaphragm is assembled with the clamping elements shown in figure 2, the thickened portions 45 and 46 are subjected to compression in a direction along the axis 32 and, accordingly, the thickness of the diaphragm at the portions 45 and 46, when in an unstressed condition, is somewhat greater than the thickness illustrated in figure 2. The spacing between those surfaces of the clamping elements which engage the thickened portions of the diaphragm may be reduced to equal the thickness of the diaphragm between the portions 45 and 46. In an alternative arrangement, that part of the diaphragm which is trapped between the clamping elements is of uniform thickness. In this case, one of the clamping elements may be formed with one or more annular ribs which engage the diaphragm to compress an annular portion thereof more severely than the remainder of the diaphragm is compressed.

The clamping elements 36 and 37 have respective abutting parts which limit the degree of compression to which the central portion 44 of the diaphragm can be subjected. The abutting parts of the clamping element 37 are in the form of circular, hollow bosses 47, each of which surrounds a part of the shank of a corresponding one of the fasteners 41. The bosses 47 extend through corresponding apertures formed in the central portion 44 of the diaphragm. As shown in figure 2, each boss 47 abuts an annular part of the first clamping element 36 to maintain a predetermined spacing between those parts of the clamping elements between which the thickened portions 45 and 46 of the diaphragm are nipped. Once the screws 41 have been tightened sufficiently to bring each of the bosses 47 into firm contact with the first clamping element, the application of additional torque to the screws 41 does not significantly affect the degree of compression of the diaphragm.

The first clamping element 36, the shaft 14, the washer 39 and each of the screws 41 are preferably formed of metal. The second clamping element 37 is preferably formed of a plastics material, possibly a reinforced plastics material, by moulding. The diaphragm 12 is formed of an elastomer, preferably a synthetic rubber. The screws 41 are sufficiently close to each other to avoid significant variation in the pressure exerted on the thickened portions 45 and 46 of the diaphragm by the clamping elements at different positiitions around the axis 32. The number of screws 41 is selected in accordance with the diameter and stiffness of the second clamping element 37.

In a case where the second clamping element 37 is formed by moulding a plastics material, the element can readily be formed to a shape which is, in part, complementary to that of the chamber 24, in order to reduce the unswept volume of that chamber to a selected value.

The diaphragm 13 is identical with the diaphragm 12 and is mounted on an opposite end portion of the rod 14 in exactly the same manner as the central portion of the diaphragm 12 is mounted on the rod.

In the event of a large piece of solid material being drawn into the chamber 18 and becoming trapped between the first clamping element 36 and an opposite wall of the chamber 18, the screw 48 will be subjected to a bending load as the first clamping element tends to tilt from its normal perpendicular relation to the axis 32. Even in a case in which the screw 48 becomes bent, it is unlikely that the connecting rod 14 will be damaged, since the clamping element bears only on the end face of the connecting rod.

The features disclosed in the foregoing description, in the following claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

CLAIMS:

1. A pump comprising a hollow body (10), a diaphragm (12) which is flexible relative to the body and guide means (14,36,37) for guiding a central portion of the diaphragm for movement along a rectilinear path relative to the body, wherein the diaphragm is mounted in the body by a peripheral portion of the diaphragm remote from the central portion, the central portion of the diaphragm is attached to the guide means, the diaphragm and the guide means collectively separate first (18) and second (24) chambers within the body, the second chamber communicates with control means adapted to admit a driving fluid under pressure to the second chamber intermittently and wherein the guide means comprises first and second clamping elements (36,37) between which the central portion of the diaphragm is received and the clamping elements are engaged by each of a plurality of releasable fasteners (41) accessible at or from a face of one of the clamping elements which forms a boundary of the second chamber but not accessible at or from a face of the other clamping element which forms a boundary of the first chamber.

2. A pump according to Claim 1 wherein said releasable fasteners are screws (41) which are screwed into threaded bores in the first clamping element (36) adjacent to the first chamber and having respective heads engaged with the second clamping element (37) adjacent to the second chamber.

3. A pump according to Claim 1 or Claim 2 wherein respective parts of the clamping (36,37) elements are in mutually abutting relation, thereby limiting mutual approach of further parts of the clamping elements, between which further parts the central portion of the diaphragm (12) is trapped.

4. A pump according to Claim 3 wherein said abutting parts are annular and each abutting part surrounds a respective one of the fasteners (41).

5. A pump according to any preceding claim wherein the guide means further includes a rod (14) mounted for reciprocation in the body and a screw (48) which passes from the first chamber through respective apertures in the clamping elements and in the diaphragm into a threaded bore in an end

portion of the rod to fasten to the rod the assembly comprising of the clamping elements and diaphragm.

6. A pump according to any preceding claim wherein said fasteners (41) are arranged on a circle concentric with the diaphragm and the central portion of the diaphragm has two annular thickened portions (45,46), one lying nearer to the outer periphery of the diaphragm than do the fasteners and the other lying further from the outer periphery of the diaphragm than do the fasteners and wherein both of the thickened portions are engaged with the clamping elements.

7. A pump comprising a hollow body (10), a diaphragm (12) which is flexible relative to the body and guide means for guiding a central portion of the diaphragm for movement along a rectilinear path relative to the body, wherein the diaphragm is mounted in the body by a peripheral portion of the diaphragm remote from the central portion, the central portion of the diaphragm is attached to the guide means, the diaphragm and the guide means collectively separate first (18) and second (24) chambers within the body, the second chamber communicates with control means adapted to admit a driving fluid under pressure to the second chamber intermittently and wherein the guide means (15) comprises first (36) and second (37) clamping elements between which the central portion of the diaphragm is received and the clamping elements are engaged by each of a plurality of releasable fasteners (41) and wherein means (47) other than the diaphragm is provided for limiting mutual approach of the clamping elements to limit the degree of compression to which that part of the diaphragm trapped between the clamping elements can be subjected.

8. Any novel feature or novel combination of features disclosed herein or in the accompanying drawings.

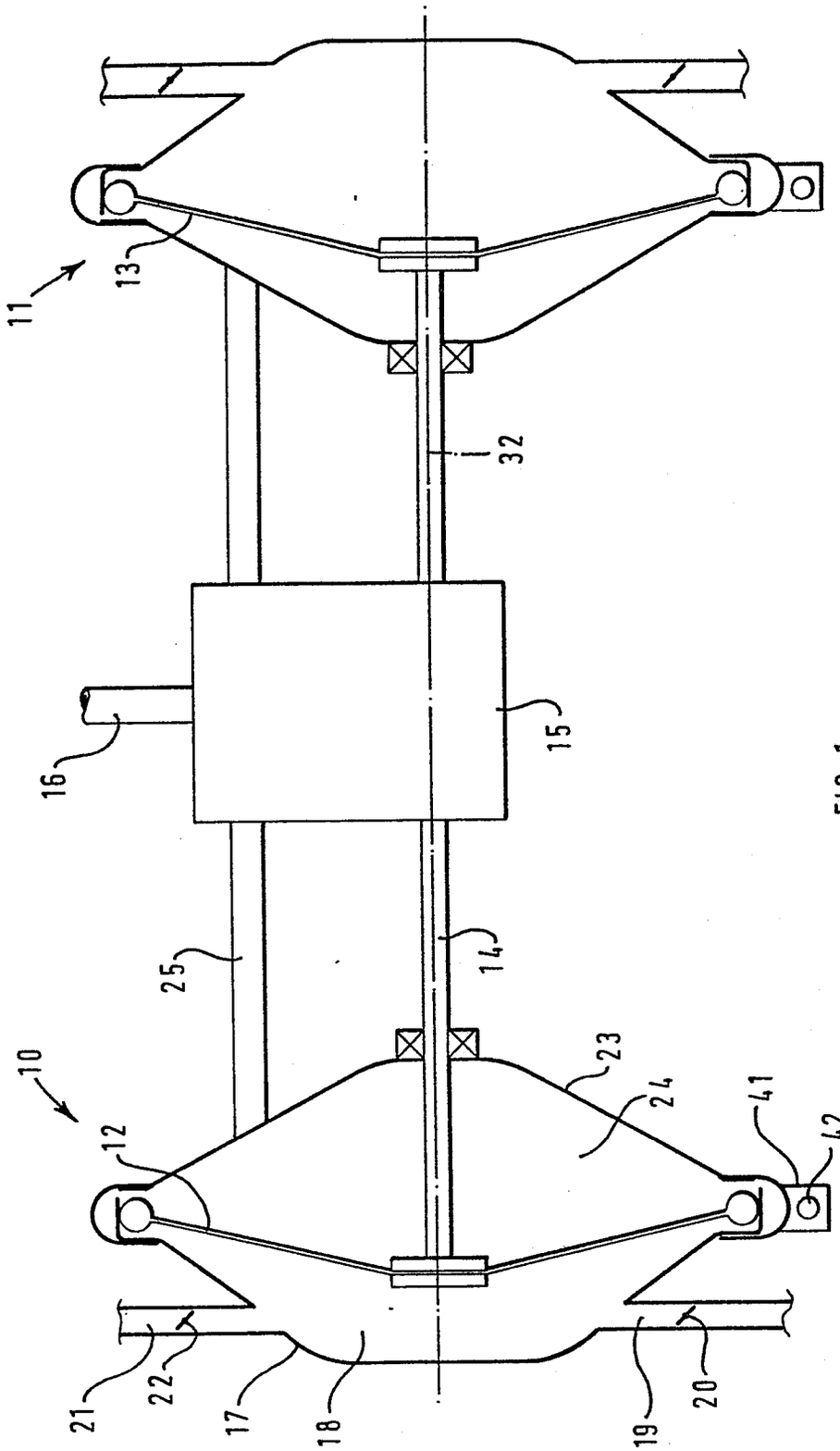

FIG 1

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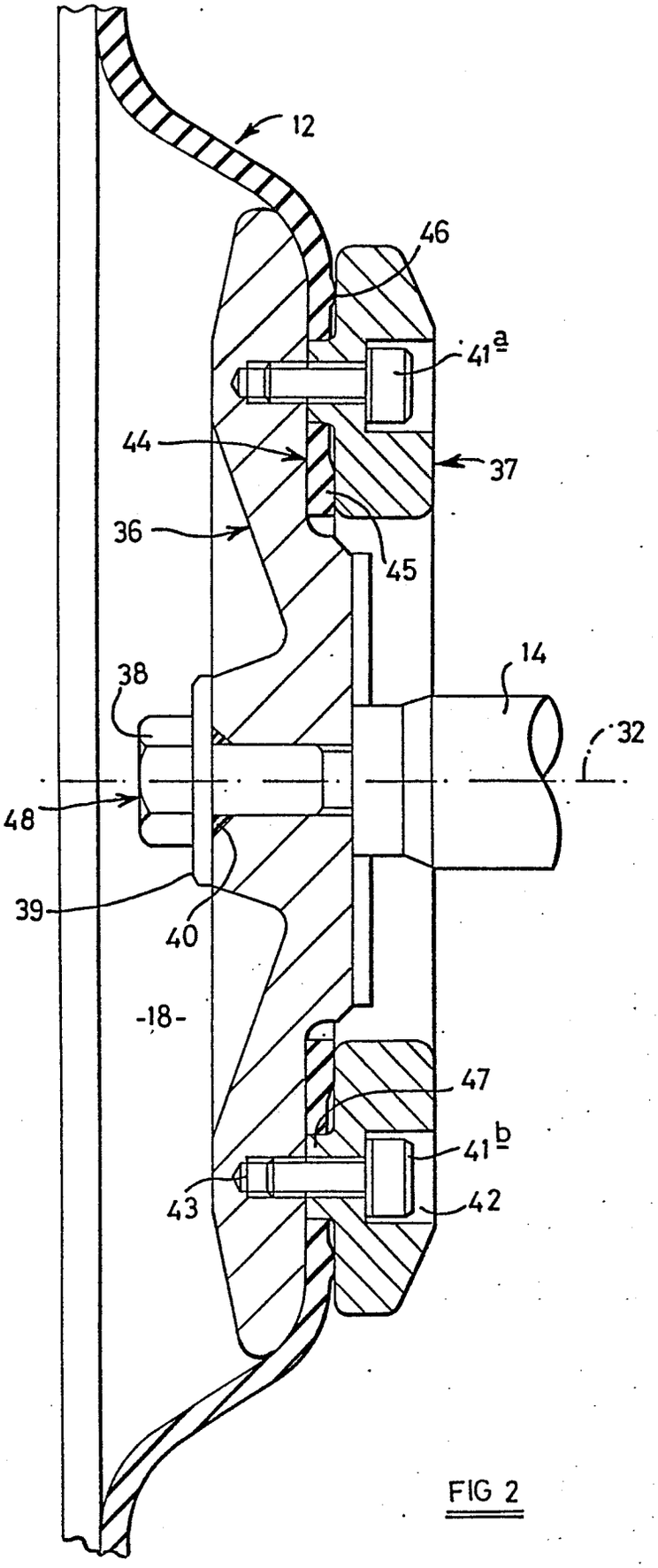

FIG 2

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 84103786.4

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	US - A - 3 338 171 (CONKLIN) * Column 3, lines 15-29; fig. *	1-3,5, 7	F 04 B 43/06
X	US - A - 3 791 768 (WANNER) * Column 2, line 55 - column 3, line 12; fig. 3 *	1,2,5	
A	US - A - 3 164 101 (G. VAN NEDERYNEN) * Column 2, line 67 - column 3, line 21; fig. 1 *	1,2,5, 7	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

F 04 B 43/00
F 04 B 45/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	17-08-1984	WITTMANN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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