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(54) Title: AN ARRANGEMENT FOR DIRECT SUPPLY OF PUMPED MEDIUM TO A TWIN-SCREW PUMP

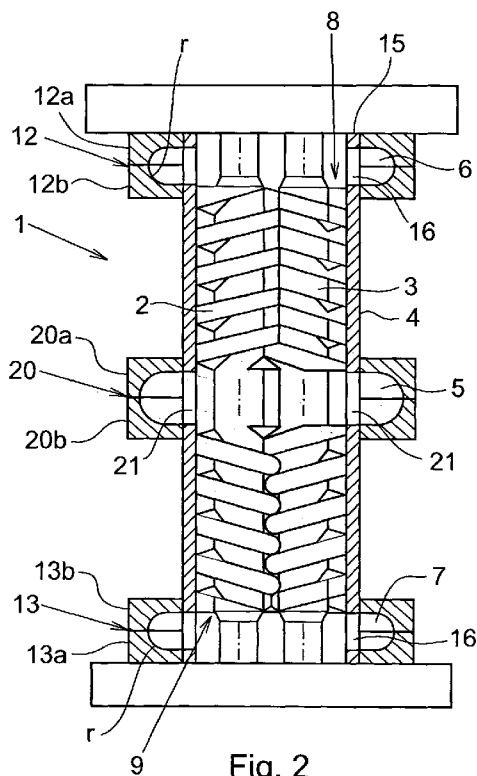


Fig. 2

(57) Abstract: An arrangement for a twin-screw pump (1) is disclosed, the pump comprising a pair of rotors (2, 3) having opposite pairs of intermeshing helical gears which are journaled and driven in rotation in a pump chamber defined by a rotor liner (4) provided with upper and lower feeding openings (8, 9) to the pump rotors, wherein upper and lower fluid supply chambers (6, 7) are each respectively provided as a fluid passage (6, 7) that opens laterally in the inner periphery of a centrally open ring-shaped flange (12, 13), the flange being connectable by its inner periphery to the rotor liner in position to establish direct flow communication between the fluid passage (6, 7) and the upper or lower feeding openings (8, 9), as the case may be, to the pump chamber.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, **Published:**
ML, MR, NE, SN, TD, TG).

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An arrangement for direct supply of pumped medium to a twin-screw pump

TECHNICAL FIELD OF THE INVENTION

The present invention refers to twin-screw pumps and arrangements for the supply and discharge of pumped medium in a twin-screw pump. More specifically, the invention refers to a twin-screw pump arrangement which is configured for a direct supply of pumped medium to a pump chamber, and optionally also configured for a direct discharge of pumped medium from the pump chamber.

BACKGROUND AND PRIOR ART

A vertically operated twin-screw pump 1, see Fig. 1 of the drawings, typically includes a pair of rotors 2, 3 comprising opposite pairs of intermeshing helical gears which are journaled and driven in rotation in a pump chamber defined by a rotor liner 4 which is coaxially provided inside a pump housing. A centre section of the pump chamber communicates through an opening in the rotor liner with a discharge chamber 5 in the pump housing from where the medium is discharged downstream. The end sections of the pump housing include an upper and lower supply chamber 6 and 7 communicating respectively with upper and lower feeding openings 8 and 9 to the pump rotors. Pumped medium is supplied from upstream via fluid inlets to the upper and lower supply chambers, respectively. The upper and lower supply chambers, as well as the discharge chamber, are each respectively formed as annular compartments defined between the pump housing and the rotor liner. A twin-screw pump having this general and typical structure is illustrated in Fig. 1 of the accompanying drawings.

The internal geometry of supply and discharge chambers in twin-screw pumps typically has regions of stagnant flow wherein accumulation of solids and gas can take place if a multiphase fluid, e.g., is delivered by the pump as is often the case in hydrocarbon production at sea or at land. This in turn may lead to corrosion and wear and may additionally cause dry running if the pump is supplied liquid at insufficient amounts for lubrication of the rotor screws.

SUMMARY OF THE INVENTION

In order to obviate this problem the present invention provides a twin-screw pump arrangement which is configured for a direct supply of pumped medium to the pump chamber. The pump arrangement may optionally be similarly configured for a direct discharge of pumped medium from the pump chamber.

Briefly, the object is achieved through a twin-screw pump substantially as outlined above, wherein upper and lower fluid supply chambers are each respectively provided as a fluid passage that opens laterally in the inner periphery of a centrally open ring-shaped flange, the flange being connectable by its inner periphery to the rotor liner in position to establish direct flow communication between the fluid passage and the upper and/or lower feeding openings, as the case may be, to the pump chamber.

The fluid discharge chamber may be similarly provided as a fluid passage that opens laterally in the inner periphery of a centrally open ring-shaped flange which is insertable on the rotor liner for direct flow communication, via the inner periphery of the flange, between the fluid passage and one or more discharge openings into the pump chamber.

This way is achieved an integrated channelling system which can be optimized to provide even fluid flow and velocity distribution. Unlike the supply chambers of prior art, the present solution avoids an inlet geometry that includes areas/regions with high flow speed and associated erosion, as well as areas/regions of low flow speed with associated agglomeration of solids and fluid phase separation.

In other words, the present invention provides a controlled fluid flow cross-sectional area. Obviously, a twin-screw pump equipped as specified is much less likely to erode or to be clogged by sand. In result, maintenance intervals can be extended and costly subsea intervention operations can be avoided, as well as the need for flushing the inlet channels or the need for over-dimensioning in order to have erosion margins.

Preferably the fluid passage is annular and arranged to mouth continuously along the inner periphery of the flange, this way achieving a circumferentially uniform distribution of pumped medium to the pump rotors. The fluid passage may alternatively be annular and arranged to mouth at intervals along the inner periphery of the flange.

The fluid passage is preferably shaped with a rounded cross-sectional profile in order to avoid accumulation of solid matter and to further reduce the risk of erosion.

In order to control the distribution of internal pressure and velocity the internal flow-passage area may be varied in the direction of flow from a fluid inlet into the fluid passage. E.g., the flow-passage area may be successively reducing in both circumferential directions from the fluid inlet to the fluid passage.

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It is preferred that the fluid inlet into the fluid passage opens in the top (or in the bottom respectively) of the fluid passage, i.e. in the axial direction of the pump. This way, a device for splitting a supply fluid stream in two oppositely directed partial flows may be arranged in flow communication with the inlets to the upper and lower supply chambers, in other words arranged between the upper and lower flanges and preferably close to the rotor liner for a compact pump structure.

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In a preferred embodiment the flow splitting device is supported on the mid-positioned flange forming a discharge chamber. The flow splitting device may advantageously be integrated in the flange that provides the discharge chamber.

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The flow splitting device comprises a manifold having an inlet for supply fluid and two outlets in flow communication with the upper and lower fluid supply chambers, and in said manifold a dividing plate arranged to extend in the flow direction from an upstream end facing the manifold inlet to a downstream end that separates the two manifold outlets. In a preferred embodiment the dividing plate runs twisted between its upstream and downstream ends.

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In a process for manufacturing the upper or lower supply chamber, the fluid passage can be formed in a machining process by removing material from top and bottom ring-shaped flange parts that are connectable face to face to produce a fluid passage which is defined by top and bottom surfaces that meet under a radius in the outer periphery of the fluid passage. The flange parts are made of corrosion resistant material, and the fluid passage may additionally be coated internally with a corrosion resistant and low friction material.

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Further advantages and advantageous features will appear from the dependent claims and from the following detailed description of preferred embodiments.

35 SHORT DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be more closely explained below with reference to the accompanying and schematic drawings. In the drawings,

Fig. 1 is cross-sectional view showing a typical prior art twin-screw pump;

Fig. 2 is a longitudinal section I-I through a twin-screw pump configured with upper and lower supply chambers according to the invention;

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Fig. 3 is a longitudinal section II-II through the pump at 90° displacement relative to the section of Fig. 2;

Fig. 4 is a transverse section through the upper supply chamber; and

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Fig. 5 is a transverse section through a fluid discharge chamber and flow-splitting device arranged on the pump.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

15 As used herein, any reference to location in space such as upper, lower, outer, inner, vertical or horizontal etc., shall be understood primarily to describe the spatial relation between elements for the purpose of facilitating description and understanding of the invention, and is not intended to indicate absolute orientation of these elements in space. Albeit being explained in connection with a vertically
20 oriented pump, the invention is not limited to pumps of vertical orientation in use. Also, the accompanying drawings are submitted for purpose of illustration only and are not true to scale or dimensions.

Fig. 1 shows the prior art twin-screw pump mentioned in the background
25 discussion hereinabove.

With reference to figs. 2 and 3 a twin-screw pump 1 is illustrated having a pair of motor driven rotors 2, 3 comprising opposite pairs of intermeshing helical gears which are journaled and driven in rotation in a pump chamber defined by a rotor
30 liner 4. A centre section of the pump chamber communicates through an opening in the rotor liner with a discharge chamber 5 from where the pumped medium is discharged downstream. At the end regions of the pump chamber, upper and lower fluid supply chambers 6 and 7 are arranged in flow communication with upper and lower feeding openings 8 and 9, respectively, to the pump rotors in the pump
35 chamber. Pumped medium is supplied from upstream via fluid inlets 10 and 11 to the upper and lower supply chambers, respectively.

Each of the upper and lower supply chambers 6 and 7 are provided as fluid passages 6, 7 formed in a ring-shaped flange 12 and 13, respectively. The flanges 12 and 13 are arranged with an open centre providing an inner flange periphery by which the flanges are connectable to a respective end of the rotor liner 4. The fluid passages 6 and 7 run continuously about the inner periphery of the flange and mouth laterally such that when the flange is positioned on the rotor liner, a direct flow connection is established between the fluid passage and the upper or lower feeding opening 8 or 9 to the pump rotors.

Each of the upper and lower flanges 12 and 13 comprises an outer and an inner flange part 12a, 12b, 13a, 13b which are interconnected by a set of bolts insertable in bolt holes 14 (see also Fig. 4). In Fig. 4 the outer flange part 12a, as seen in the longitudinal direction of the pump 1, is lifted away to show the axially inner flange part 12b. The fluid passage 6 is recessed from the surface of flange part 12b, forming in flange part 12b a fluid passage bottom surface 6b. A top surface 6a of fluid passage 6 is preferably similarly recessed from the surface of flange part 12a. In alternative embodiments the entire fluid passage may be recessed from the surface of one of the outer or inner flange parts 12a or 12b. In a radially outer periphery of fluid passage 6, the bottom and top surfaces meet under a radius r when the flange parts 12a, 12b are interconnected. A radially inner periphery of the fluid passage 6 is laterally open towards the centre opening through the flange, thus coinciding with the flange's inner periphery.

The centre opening through flange part 12b is shaped for insertion of the flange part on the rotor liner 4. In inserted position, the bottom surface 6b may be located flush with a rim 15 of the rotor liner, this rim defining the feeding opening 8 into the pump chamber and rotors. In this embodiment (not shown in the drawings), flow communication between the fluid passage and the feeding opening is established continuously along the inner periphery of the flange.

In the illustrated embodiment the rim 15 of rotor liner 4 projects into the fluid passage 6, above the fluid passage bottom surface 6b. Flow communication between the fluid passage 6 and the feeding opening 8 is established via a number of fluid inlets 16 formed as openings or cut outs 16 through the wall of the rotor liner, and distributed about the rim 15 for a uniform feed of fluid to the pump chamber and rotors.

Pumped medium is supplied to the fluid passage 6 via the fluid inlet 10 which opens in the bottom surface 6b of the axially inner and in Fig. 2 lower flange part 12b. The fluid inlet 10 is via a pipe 17 connected to a flow splitting device 18 by which an incoming fluid stream is divided into partial flows supplied via pipes 17 and 19 to the upper and lower fluid passages 6 and 7, respectively, via fluid inlets 10 and 11.

In the embodiment illustrated in Fig. 5, the flow splitting device 18 is seated and supported in a mid-positioned flange 20 providing the discharge chamber 5 via which pumped medium is discharged downstream from the pump chamber. The flange 20 is structured similarly to the upper and lower flanges 12, 13, thus comprising two interconnectable flange parts 20a, 20b together defining a fluid passage which provides the discharge chamber 5. The flange 20 has a centre opening by which the flange 20 is insertable on the rotor liner 4 so as to position the open inner periphery of the discharge chamber 5 in overlapping position with fluid outlets 21 formed through the wall of the rotor liner 4. Pumped medium is discharged downstream via a fluid outlet 22 from the discharge chamber.

The flow splitting device 18 comprises a manifold of T-shape configuration having a fluid inlet and two oppositely directed fluid outlets. In the manifold, a flow dividing plate 23 is arranged to split an incoming fluid stream into two partial flows which are directed into the pipes 17, 19 and thus towards the upper and lower supply chambers 6 and 7 respectively. In the illustrated embodiment the dividing plate 23 is twisted through 90° to effect diversion of a horizontal supply fluid stream F into two oppositely directed vertical flows f1 and f2.

Since as in the illustrated embodiment the pump's external housing can be omitted, the present invention provides the advantage of a compact, non-complex and lightweight pump design. The flanges 12, 13 and 20 that provide the supply and discharge chambers for the twin-screw pump 1 are preferably made of corrosion resistant metal and may additionally be coated for enhanced resistance against corrosion and against erosion of internal surfaces. Although not illustrated in the schematic drawings, sealing elements will typically be applied at the interfaces between mating flange parts and between the flanges and the rotor liner as required in order to prevent intrusion of sea water, or to prevent escape of pumped medium into the sea. The flanges may be welded to the rotor liner but are preferably arranged dismountable for inspection and maintenance purposes.

The invention is not restricted to the embodiments described above. On the contrary, many possibilities to modifications thereof may appear to a skilled person from the teachings provided herein, without departing from the basic idea of the invention, all such conceivable modifications however included in the scope of the
5 appended claims.

CLAIMS

1. Arrangement for a twin-screw pump (1) comprising a pair of rotors (2, 3) having opposite pairs of intermeshing helical gears which are journaled and driven in rotation in a pump chamber defined by a rotor liner (4) provided with upper and lower feeding openings (8, 9) to the pump rotors, characterized in that upper and lower fluid supply chambers are each respectively provided as a fluid passage (6, 7) that opens laterally in the inner periphery of a centrally open ring-shaped flange (12, 13), the flange being connectable by its inner periphery to the rotor liner (4) in position to establish direct flow communication between the fluid passage (6, 7) and the upper or lower feeding openings (8, 9), as the case may be, to the pump chamber.
2. The arrangement of claim 1, wherein the fluid passage (6, 7) is annular and arranged to mouth continuously about the inner periphery of the flange.
3. The arrangement of claim 1 or 2, wherein the fluid passage (6, 7) is annular and arranged to mouth at intervals about the inner periphery of the flange.
4. The arrangement of any of claims 1 to 3, wherein the fluid passage (6, 7) is shaped with a rounded cross-sectional profile.
5. The arrangement of any previous claim, wherein the internal flow-passage area of the fluid passage (6, 7) is varied in the direction of flow from a fluid inlet (10, 11) into the fluid passage.
6. The arrangement of claim 5, wherein the fluid inlet (10, 11) into the fluid passage opens in the top or in the bottom, respectively, of the fluid passage.
7. The arrangement of claim 6, wherein a device (18) for splitting a supply fluid stream in two oppositely directed flows is arranged in flow communication with the inlets (10, 11) to the upper and lower flanges (12, 13).
8. The arrangement of any previous claim, wherein a fluid discharge chamber is provided as a fluid passage (5) that opens laterally in the inner periphery of a centrally open ring-shaped flange (20) which is insertable on the rotor liner (4) for direct flow communication via the flange's inner periphery between the fluid

passage (5) and one or more discharge openings (21) through the wall of the rotor liner (4).

5 9. The arrangement of claim 8, wherein the flow splitting device (18) is supported on the flange (20) providing said discharge chamber (5).

10. The arrangement of claim 9, wherein the flow splitting device (18) is integrated in the flange (20) providing the discharge chamber (5).

10 11. The arrangement of claim 9 or claim 10, wherein the flow splitting device (18) comprises a manifold having an inlet for supply fluid and two outlets in flow communication with the upper and lower fluid supply chambers (6, 7), and in said manifold a dividing plate (23) arranged to extend in the flow direction from an upstream end facing the manifold inlet to a downstream end that separates the two
15 manifold outlets.

12. The arrangement of claim 11, wherein the dividing plate (23) runs twisted between its upstream and downstream ends.

20 13. The arrangement of any previous claim, wherein the fluid passage (5, 6, 7) is formed through a machining process by removing material from top and bottom ring-shaped flange parts (12a, 12b; 13a, 13b; 20a, 20b) that are connectable face to face to produce a fluid passage which is defined by top and bottom surfaces that meet under a radius (r) in an outer periphery of the fluid passage.

25 14. The arrangement of claim 13, wherein the fluid passage (5, 6, 7) is coated internally with a corrosion resistance and low friction material.

1/3

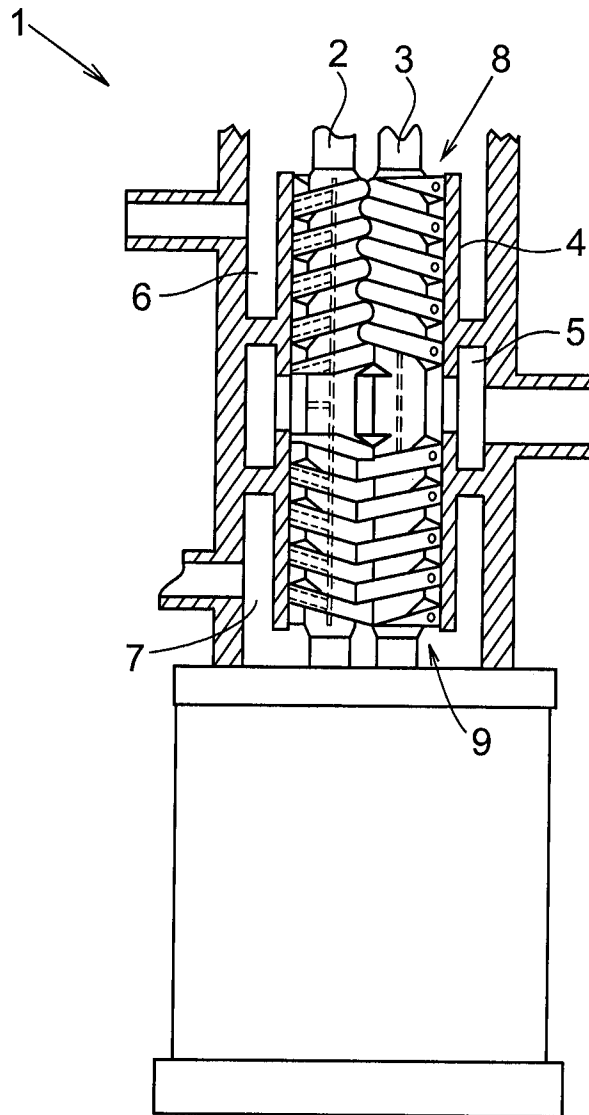


Fig. 1
(Prior art)

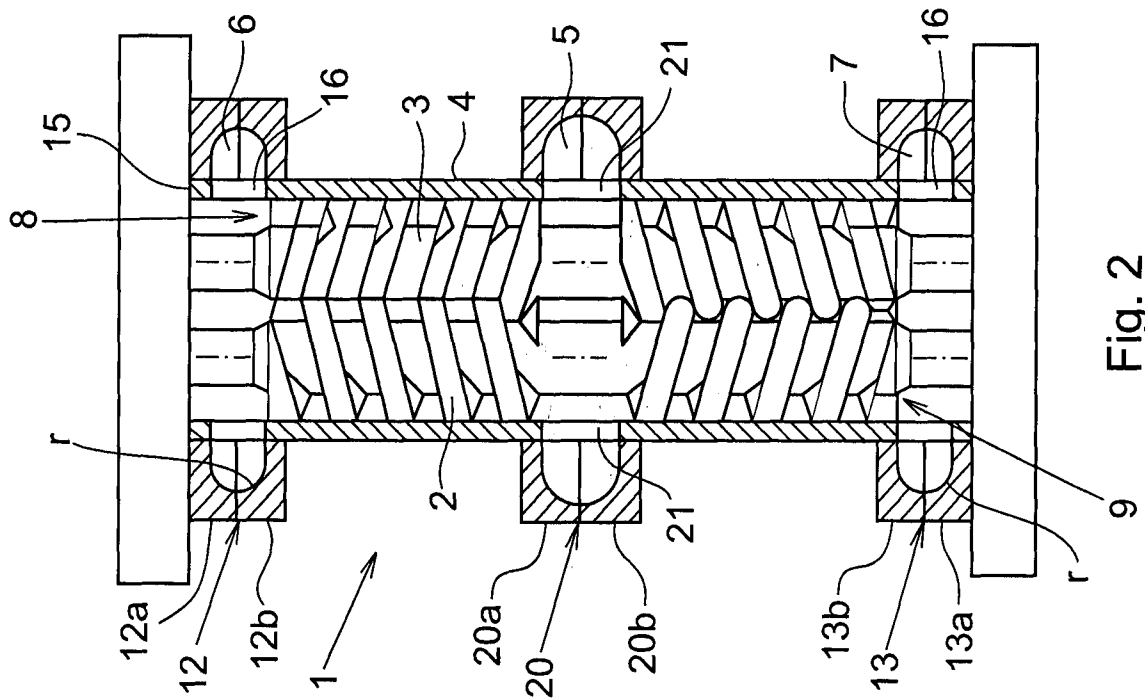


Fig. 2

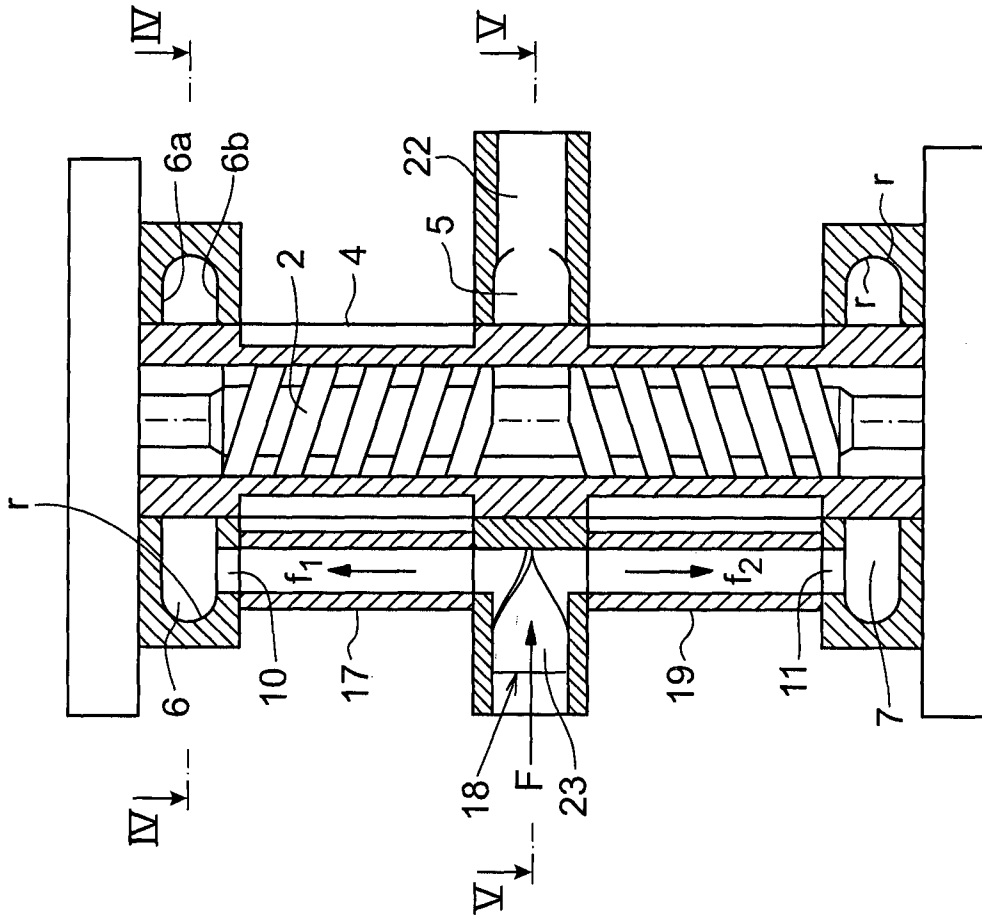
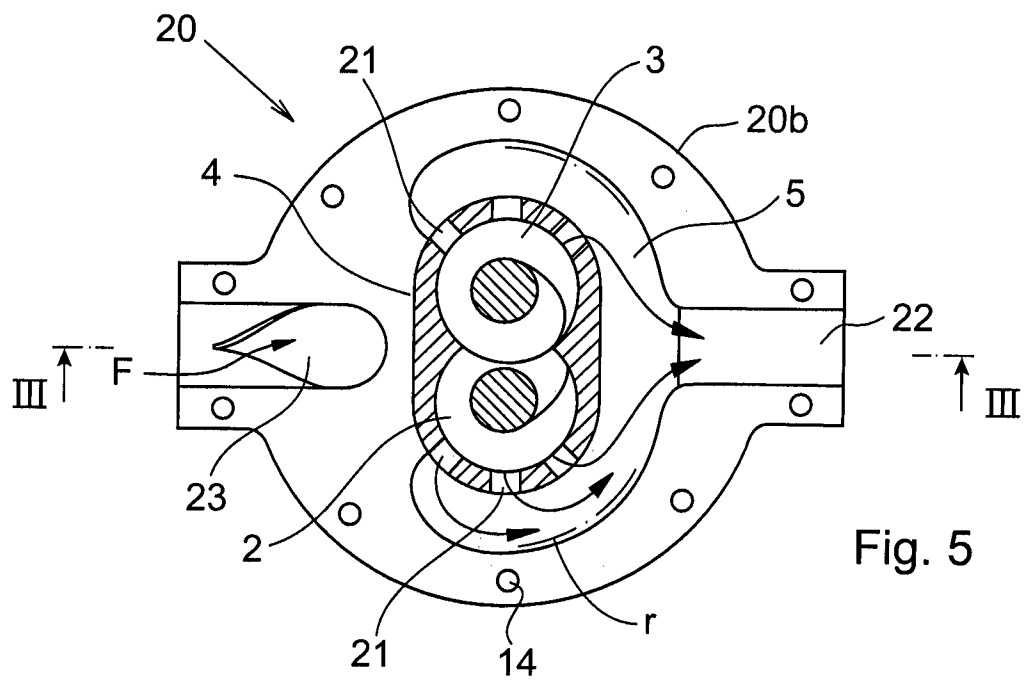
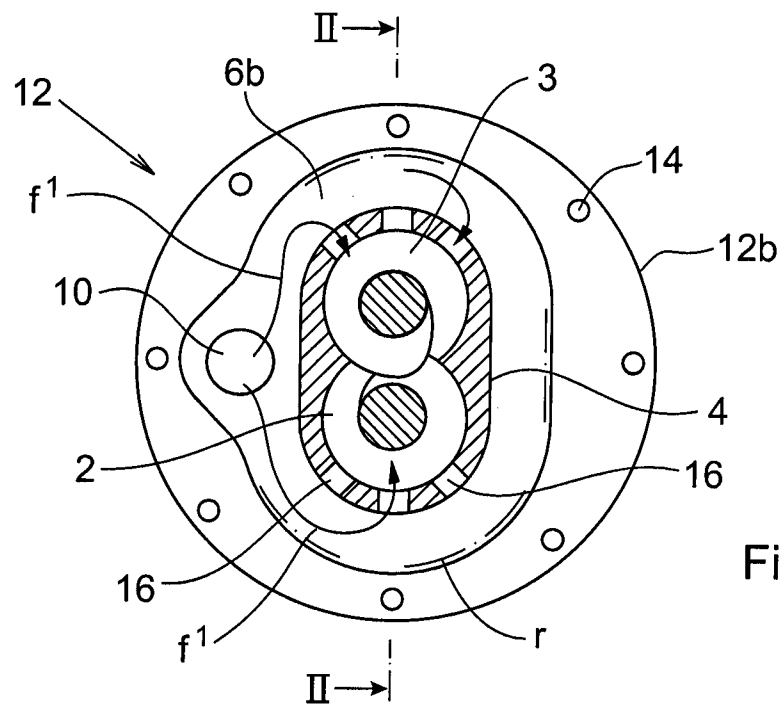


Fig. 3

3/3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/001062

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: E21B, F04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 552562 A (STOTHERT & PITT LTD ET AL), 14 April 1943 (1943-04-14); page 3, line 20 - line 38; figures 1,2 --	1-14
A	US 5738505 A (MEZZEDIMI VASCO ET AL), 14 April 1998 (1998-04-14); column 3, line 36 - line 42; figures 1,2 --	1-14
A	US 2640430 A (SENNET MORGAN B), 2 June 1953 (1953-06-02); abstract; figures 1,2 -- -----	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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Continuation of: second sheet

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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