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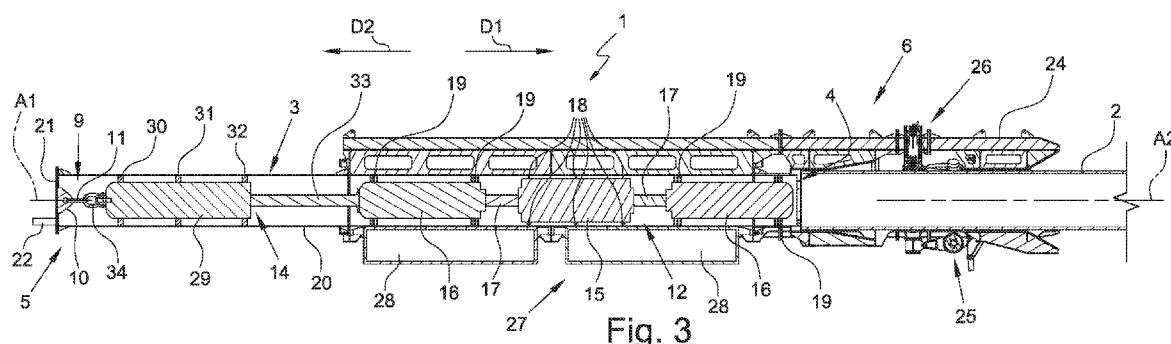
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(54) Title: LAUNCHING SYSTEM AND METHOD FOR INSERTING A VEHICLE IN A PIPELINE IN A BODY OF WATER



(57) Abstract: A launching system (1) for inserting a vehicle (12) in a pipeline (2) in a body of water has: - a cylinder (3), which has an open end (4) and is configured for housing the vehicle (12) to be inserted in the pipeline (2); - an aligning structure (6), which is connected to the cylinder (3) and is configured to be clamped to the pipeline (2) so as to align the cylinder (3) with the pipeline (2) and transfer the vehicle (12) from the cylinder (3) to the pipeline (2); and - a piston (14), which is housed in the cylinder (3), is selectively releasably connected to the vehicle (12), and is configured to push the vehicle (12) into the pipeline (2) in a given direction (D1).

"LAUNCHING SYSTEM AND METHOD FOR INSERTING A VEHICLE IN A PIPELINE IN A BODY OF WATER"

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PRIORITY CLAIM

This application claims priority from Italian Patent Application No. 102017000019527 filed on February 21, 2017 the disclosure of which is incorporated by reference

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TECHNICAL FIELD

The present invention relates to a launching system for inserting a vehicle in a pipeline in a body of water.

In general, the term "vehicle" within the scope of the present disclosure refers to any device configured to be
15 advanced into the pipeline to convey tools, such as scrapers for cleaning the inner surface of the pipeline and/or selectively expandable gaskets which allow the pipeline to be temporarily blocked and/or dynamic gaskets which allow the vehicle to drain the water from the pipe.
20 Moreover, the term "vehicle" within the scope of the present disclosure refers to a single module equipped with at least one of the aforesaid tools or with a plurality of modules connected to each other. In the "oil & gas" industry, each module is defined with the term "pig".

25

STATE OF THE ART

The well-known systems generally comprise a cylinder, which has an open end and is configured to house a vehicle to be inserted into the pipeline; and an aligning structure, which is configured to be clamped to the pipeline so as to align the cylinder with the pipeline and to tightly couple the cylinder onto the outside of the pipeline after removal of any coating on the outside of said pipeline. Pumping a pressurized fluid into the cylinder causes transfer of the vehicle from the cylinder to the pipeline, and subsequently, the advancement thereof along the pipeline.

Launching systems of the type identified above are described in documents US 2002/0059687, US 6,533,032, and US 6,022,421. Launching operations are generally performed in a body of water and involve the use of ROVs.

One of the major problems of the above-mentioned launching systems is achieving a tight coupling between the cylinder and the pipeline. In some cases, the pipeline is provided with an outer coating and it is necessary to remove the outer coating along the end section and to finish off the end section so as to provide an effective tight coupling with the cylinder.

OBJECT OF THE INVENTION

The object of the present invention is to provide a launching system for inserting a vehicle in a pipeline in a body of water, which is capable of obviating the drawbacks

of the prior art.

In accordance with the present invention, there is provided a launching system for inserting a vehicle in a pipeline in a body of water, the launching system
5 comprising:

- a cylinder, which extends along a first axis, has an open end, and is configured for housing a vehicle to be inserted in the pipeline;

- an aligning structure, which is connected to the
10 cylinder and is configured to be clamped to the pipeline so as to align the cylinder with the pipeline; and

- a piston, which is housed in the cylinder, and is configured to push the vehicle into the pipeline in a first direction.

15 Thanks to the present invention, the transfer can be accomplished without the need to provide a tight coupling between the cylinder and the pipeline in which the cylinder is clamped to the outside of the pipeline.

In particular, the cylinder comprises a pipe; a blind
20 flange; and at least one connector, through which a pressurized fluid can be fed into the cylinder.

The fluid used is normally water, which is brought to a higher pressure than the pressure in the body of water in the areas surrounding the pipeline and the launching
25 system.

In particular, the launching system comprises a restoring device associated with the cylinder and connected to the piston for pulling the piston in a second direction opposite to the first direction.

5 In this way, the piston is returned to the initial position and is ready to insert a new vehicle.

In particular, the aligning structure comprises a frame, which is mounted on the cylinder and defines a housing space for housing the pipeline; at least three
10 guiding devices; and a plurality of clamping devices.

In practice, the aligning structure is rigidly connected to the cylinder and can be clamped to the pipeline so that the cylinder is rigidly connected to the pipeline.

15 In particular, the launching system comprises at least one floating device for reducing its weight and facilitating its installation. The floating device is preferably tubular in shape, is arranged around the cylinder and supported by the aligning structure.

20 The floating device provides greater manoeuvrability, in the body of water, of the assembly formed by the cylinder, the aligning structure, the piston, and the vehicle to be fitted on the end section of the pipeline.

In particular, the piston comprises a module; and an
25 annular gasket mounted on the module and configured to seal

the space between the module and the cylinder.

The annular gasket allows the piston to be moved in the first direction.

In particular, the piston comprises a further annular
5 gasket mounted on the module and configured to seal the space between the module and the cylinder and/or the pipeline.

The additional gasket increases the effectiveness of the seal between the piston and the cylinder.

10 Alternatively, and according to one embodiment of the present invention, the additional annular gasket serves the purpose of sealing the space between the module and the pipeline, whereas the other annular gasket is arranged between the module and the cylinder.

15 In accordance with this embodiment, the piston is positioned partly inside the cylinder and partly inside the pipeline. The piston also comprises a conduit, which is configured for fluidically connecting the space upstream of the piston to the space downstream of the piston; and a
20 remotely controlled valve for selectively opening and closing the conduit.

In this way, the piston practically seals the connection between the cylinder and the pipeline and allows the pressurized fluid to directly push the vehicle into the
25 pipeline.

In particular, the piston comprises a spacer for pushing the vehicle. The spacer allows the vehicle to be fully inserted in the pipeline while keeping the piston completely inside the cylinder.

5 In particular, the piston comprises a connecting member for connecting the piston to a restoring device so as to return the piston to the initial position.

The present invention also relates to a launching method for inserting a vehicle in a pipeline, which is free
10 from the drawbacks of the prior art.

In accordance with the present invention, there is provided a launching method for inserting a vehicle in a pipeline in a body of water, the method comprising the steps of:

- 15 - housing a vehicle in a cylinder, which extends along a first axis and has an open end;
- aligning the cylinder with a pipeline, which extends along a second axis and has a respective open end;
- arranging the open end of the cylinder so that it
20 faces the open end of the pipeline; and
- pushing a piston housed in the cylinder in a first direction for transferring the vehicle from the cylinder to the pipeline.

Thanks to the present method, it is not necessary to
25 provide a tight coupling between the cylinder and the

pipeline, whose free ends can also be arranged at a given distance one from the other.

In greater detail, the method comprises feeding a pressurized fluid into the cylinder for pushing the piston
5 in the first direction. In practice, sea water is pumped into the cylinder, which operates like a real single-acting hydraulic cylinder.

In particular, the method comprises pulling the piston in a second direction opposite to the first direction. In
10 this case, the movement of the piston in the second direction is obtained by means of mechanical devices.

In particular, the launching method comprises guiding the aligning structure along an end section of the pipeline; and clamping the aligning structure around the
15 end section of the pipeline. The guiding step allows the cylinder to be aligned with the pipeline, whereas the clamping step prevents relative movements between the cylinder and the pipeline during the step of transferring the vehicle.

20 In particular, the method comprises supporting the cylinder and the aligning structure at least partly by means of a floating device, which in particular is tubular in shape and arranged about the cylinder, to allow a greater manoeuvrability of the assembly comprising the
25 cylinder, the aligning structure, the piston and the

vehicle.

In accordance with one embodiment, the method comprises arranging the piston partly in the cylinder and partly in the pipeline, and sealing the space between the
5 piston and the pipeline and between the piston and the cylinder.

In other words, the piston is capable of tightly connecting the cylinder to the pipeline.

In accordance with this embodiment, the method
10 comprises opening a conduit, which extends through the piston for fluidically connecting the space upstream of the piston to the space downstream of the piston, and advancing the vehicle into the pipeline, while the piston remains stationary to ensure the seal between the cylinder and the
15 pipeline.

BRIEF DESCRIPTION OF THE FIGURES

Further features and advantages of the present invention will be apparent from the following description of a non-limiting embodiment thereof, with reference to the
20 figures of the accompanying drawings, wherein:

- Figure 1 is a perspective view, with parts removed for clarity, of a launching system coupled to a pipeline and constructed in accordance with the present invention;

- Figure 2 is a perspective view, with parts removed
25 for clarity and in enlarged scale, of a detail of the

launching system in Figure 1;

- Figures 3 and 4 are sectional views, with parts removed for clarity, of the launching system of Figure 1 in different steps of the method object of the present invention; and

- Figures 5 to 6 are sectional views, with parts removed for clarity and in enlarged scale, of the launching system of Figures 3 and 4 in further operating steps of a different embodiment of the present invention.

10 PREFERRED EMBODIMENT OF THE INVENTION

Figure 1 depicts a launching system, as a whole, which is constructed in accordance with the present invention and coupled to a pipeline 2.

The launching system 1 comprises a cylinder 3, which extends along an axis A1 and has an open end 4 (Fig.3), and a closed end 5; an aligning structure 6, which is connected to the cylinder 3 and is configured to be clamped to an end section of the pipeline 2 which extends along an axis A2. The aligning structure 6, when clamped to the end section of the pipeline 2, allows the cylinder 3 to be aligned with the pipeline 2, i.e. the axis A1 to be substantially aligned with the axis A2.

The launching system 1 comprises a pumping station 7; and a conduit 8 to connect the pumping station 7 to the cylinder 3 at the closed end 5; and a restoring device 9

which, in the example shown, comprises a winch 10 and a cable 11 guided inside the cylinder 3 (Figure 3).

With reference to Figure 3, the launching device 1 has the function of inserting a vehicle 12 in the pipeline 2. This vehicle 12 is initially housed in the cylinder 3 and must be transferred to the pipeline 2 through the open end 4 of the cylinder 3 and an open end 13 of the pipeline 2 facing the open end 4 of the cylinder 3. For this purpose, the launching system 1 comprises a piston 14, which is housed in the cylinder 3, is connected in a selectively releasable manner to the vehicle 12, and has the function of pushing the vehicle 12 along the cylinder 3 until the vehicle 12 is transferred into the pipeline 2.

In the example shown, the vehicle 12 comprises a central module 15; two end modules 16; and two spacers 17, each of which keeps an end module 16 at a suitable distance from the central module 15 and is hinged to the central module 15 and to the end module 16 to allow curved sections of the pipeline 2 to be travelled. In the example shown, the central module 15 includes rollers 18 configured to roll along the inner surface of the pipeline 2, whereas the end modules 16 are equipped with scrapers 19 for the cleaning of the inner surface of the pipeline 2.

The cylinder 3 comprises a pipe 20; a blind flange 21; and at least one connector 22, through which a pressurized

fluid can be fed into the cylinder 3.

The aligning structure 6 comprises a frame 24, which is mounted on the cylinder 3 and defines a housing space for housing the pipeline 2; at least three guiding devices
5 25; and a plurality of clamping devices 26.

The launching system 1 comprises a floating device 27 which, as a whole, has a tubular shape, is arranged around the cylinder 3, and comprises a plurality of containers 28, for example buoy blocks housed in compartments formed in
10 the aligning structure 6.

With reference to Figure 3, the piston 14 comprises a module 29 having the shape of an elongated body; three annular gaskets 30, 31 and 32 mounted along the module 29 and spaced from one another; a spacer 33 for pushing the
15 vehicle 12; and a connecting element 34 for connecting the piston 14 to the restoring device 9.

In use, inserting the vehicle 12 in the pipeline 2 comprises performing the following operations. The cylinder 3 and the aligning structure 6 are arranged in the body of
20 water, and the aligning structure 6 is fitted on the pipeline 2 section, until reaching the configuration shown in Figure 1. The positioning of the cylinder 3 and of the aligning structure 6 is remotely controlled by means of ROVs (not shown in the accompanying figures) and the weight
25 of the cylinder 3 and of the aligning structure 6 is

lessened by the floating device 27. The aligning structure 6 is fitted on the outside of the pipeline 2 without the need to remove the coating of the pipeline 2 and to carry out machining operations along the outer surface of the pipeline 2. The coupling to the pipeline 2 allows the axes A1 and A2 to be aligned, and the tightening of the clamping devices 26 allows the cylinder 3 to be made integral with the pipeline 2.

With reference to Figure 3, the cylinder 3 is coupled to the pipeline 2 by means of the aligning structure 6, which is clamped to the pipeline 2. In the configuration shown, the open end 4 of the cylinder 3 faces the open end 13 of the pipeline 2 and is slightly spaced from the open end 13. Since it is not necessary to provide a tight coupling, the diameter of the cylinder 3 can also be different from the diameter of the pipeline 2, as is actually illustrated in the attached figures.

Subsequently, the pumping station 7 (Figure 1) feeds pressurized fluid into the cylinder 3 between the piston 14 and the blind flange 21, and the piston 14 starts to move in direction D1 and to push the vehicle 12 in the same direction D1 until the entire vehicle 12 is arranged in the pipeline 2, as shown in Figure 4. At this point, the operation of inserting the vehicle 12 is completed and the piston 14 can be returned to the initial position by means

of the restoring device 9, which, in this case, comprises the winch 10 and the cable 11 for pulling the piston 14 in direction D2 opposite to direction D1.

In accordance with the embodiment illustrated in Figures 5 and 6, the piston 14 comprises a conduit 35, which extends within the module 29 and is configured for fluidically connecting the space upstream of the piston 14 to the space downstream of the piston 14; and a remotely controlled valve 36 for selectively opening and closing the conduit 35.

In accordance with this embodiment, the valve 36 is kept closed until the vehicle 12 is fully inserted in the pipeline 2 and the annular gasket 32 is arranged inside the pipeline 2, as shown in Figure 5, whereas the annular gaskets 30 and 31 are arranged in the area of the cylinder 3 so as to define two sealed chambers downstream and upstream of the piston 14. At this point, the valve 36 is opened and the pressurized fluid flows through the conduit 35 into the chamber located between the piston 14 and the vehicle 12 and pushes the vehicle 12, which advances inside the pipeline 2 and separates from the piston 14.

It is understood that the present invention includes variants that are not explicitly described, without however departing from the scope of protection of the following claims.

CLAIMS

1. A launching system for inserting a vehicle in a pipeline in a body of water, the launching system (1) comprising:

5 - a cylinder (3), which extends along a first axis (A1), has an open end (4), and is configured for housing a vehicle (12) to be inserted in the pipeline (2);

 - an aligning structure (6), which is connected to the cylinder (3) and is configured to be clamped to the
10 pipeline (2) so as to align the cylinder (3) with the pipeline (2); and

 - a piston (14), which is housed in the cylinder (3), and is configured to push the vehicle (12) into the pipeline (2) in a first direction (D1).

15 2. The launching system as claimed in Claim 1, wherein the cylinder (3) comprises a pipe (20); a blind flange (21); and at least one connector (22), through which a pressurized fluid can be fed into the cylinder (3).

 3. The launching system as claimed in Claim 1 or 2,
20 and comprising a restoring device (9) associated with the cylinder (3) and connected to the piston (14) for pulling the piston (14) in a second direction (D2) opposite to the first direction (D1).

 4. The launching system as claimed in any one of the
25 foregoing Claims, wherein the aligning structure (6)

comprises a frame (24), which is mounted on the cylinder (3) and defines a housing space for housing the pipeline (2); at least three guiding devices (25); and a plurality of clamping devices (26).

5 5. The launching system as claimed in any one of the foregoing Claims, and comprising at least one floating device (27), in particular the floating device (27) being tubular in shape, arranged about the cylinder (3) and supported by the aligning structure (6).

10 6. The launching system as claimed in any one of the foregoing Claims, wherein the piston (14) comprises a module (29); and an annular gasket (30) mounted on the module (29) and configured to seal the space between the module (29) and the cylinder (3).

15 7. The launching system as claimed in Claim 6, wherein the piston (14) comprises a further annular gasket (32) mounted on the module (29) and configured to seal the space between the module (29) and the cylinder (3) and/or the pipeline (2).

20 8. The launching system as claimed in any one of the foregoing Claims, wherein the piston (14) comprises a conduit (35), which is configured for fluidically connecting the space upstream of the piston (14) to the space downstream of the piston (14); and a remotely
25 controlled valve (36) for selectively opening and closing

the conduit (35).

9. The launching system as claimed in any one of the foregoing Claims, wherein the piston (14) comprises a spacer (33) for pushing said vehicle (12).

5 10. The launching system as claimed in any one of the foregoing Claims, wherein the piston (14) comprises a connecting member (34) for connecting the piston (14) to a restoring device (9).

10 11. A launching method for inserting a vehicle in a pipeline in a body of water, the method comprising the steps of:

 - housing a vehicle (12) in a cylinder (3), which extends along a first axis (A1), and has an open end (4);

 - aligning the cylinder (3) with a pipeline (2), which
15 extends along a second axis (A), and has a respective open end (13);

 - arranging the open end (4) of the cylinder (3) so that it faces the open end (13) of the pipeline (2) at a given distance from the open end (13) of the pipeline (2);
20 and

 - pushing a piston (14) housed in the cylinder (3) in a first direction (D1) for transferring the vehicle (12) from the cylinder (3) to the pipeline (2).

12. The launching method as claimed in Claim 11, and
25 comprising the step of feeding a pressurized fluid into the

cylinder (3) for pushing the piston (14) in the first direction (D1).

13. The launching method as claimed in Claim 11 or 12, and comprising the step of pulling the piston (14) in a
5 second direction (D2) opposite to the first direction (D1).

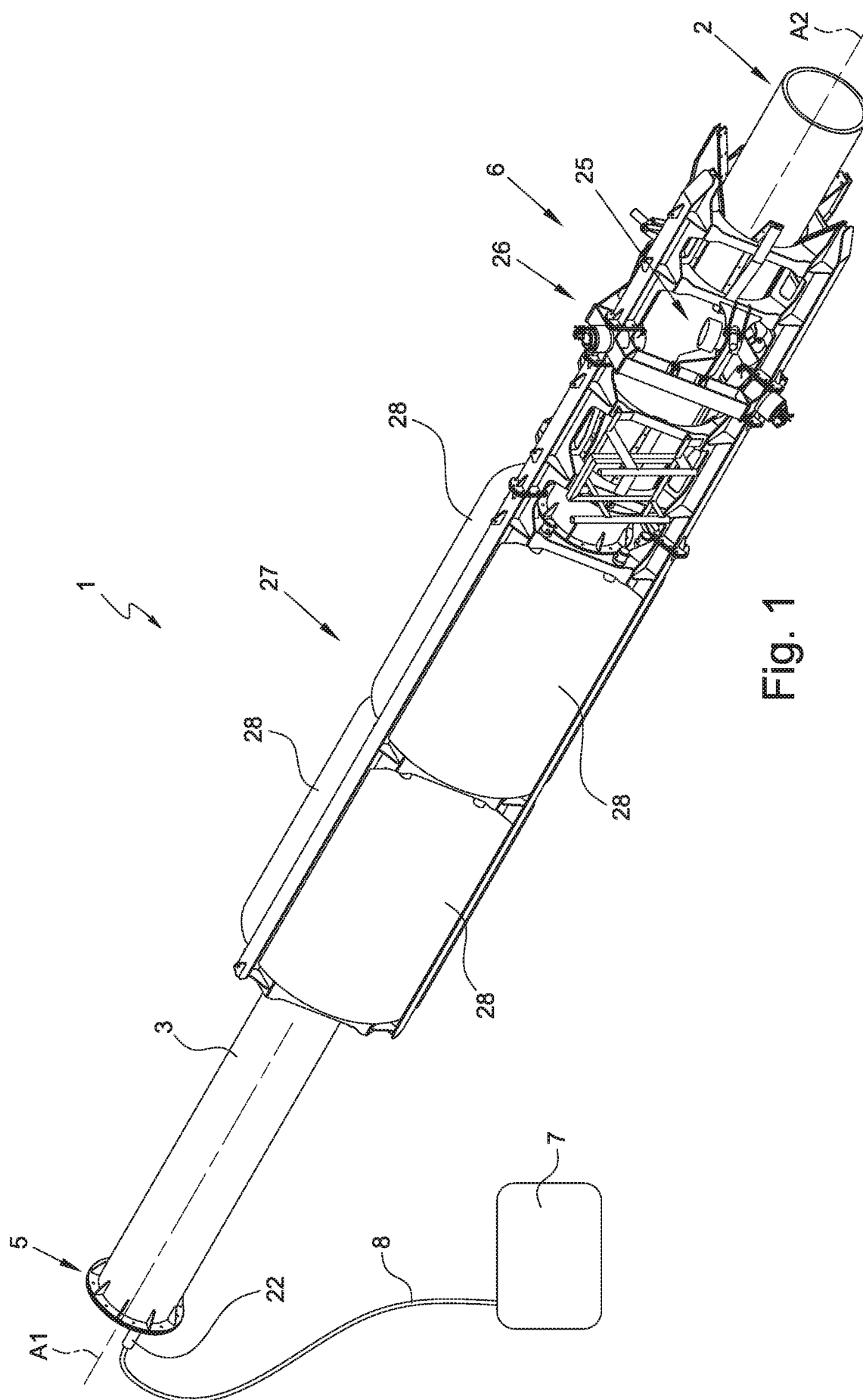
14. The launching method as claimed in any one of Claims 11 to 13, and comprising the step of guiding the aligning structure (6) along an end section of the pipeline (2); and clamping the aligning structure (6) about the end
10 section of the pipeline (2).

15. The launching method as claimed in any one of Claims 11 to 14, and comprising the step of supporting the cylinder (3) and the aligning structure (6), at least partly by means of a floating device (27), which in
15 particular is tubular in shape and arranged about the cylinder (3).

16. The launching method as claimed in any one of Claims 11 to 15, and comprising the steps of arranging the piston (14) partly in the cylinder (3) and partly in the
20 pipeline (2), and sealing the space between the piston (14) and the pipeline (2) and between the piston (14) and the cylinder (3).

17. The launching method as claimed in Claim 16, and comprising the step of opening a conduit (35), which
25 extends through the piston (14) for fluidically connecting

the space upstream of the piston (14) to the space downstream of the piston (14).



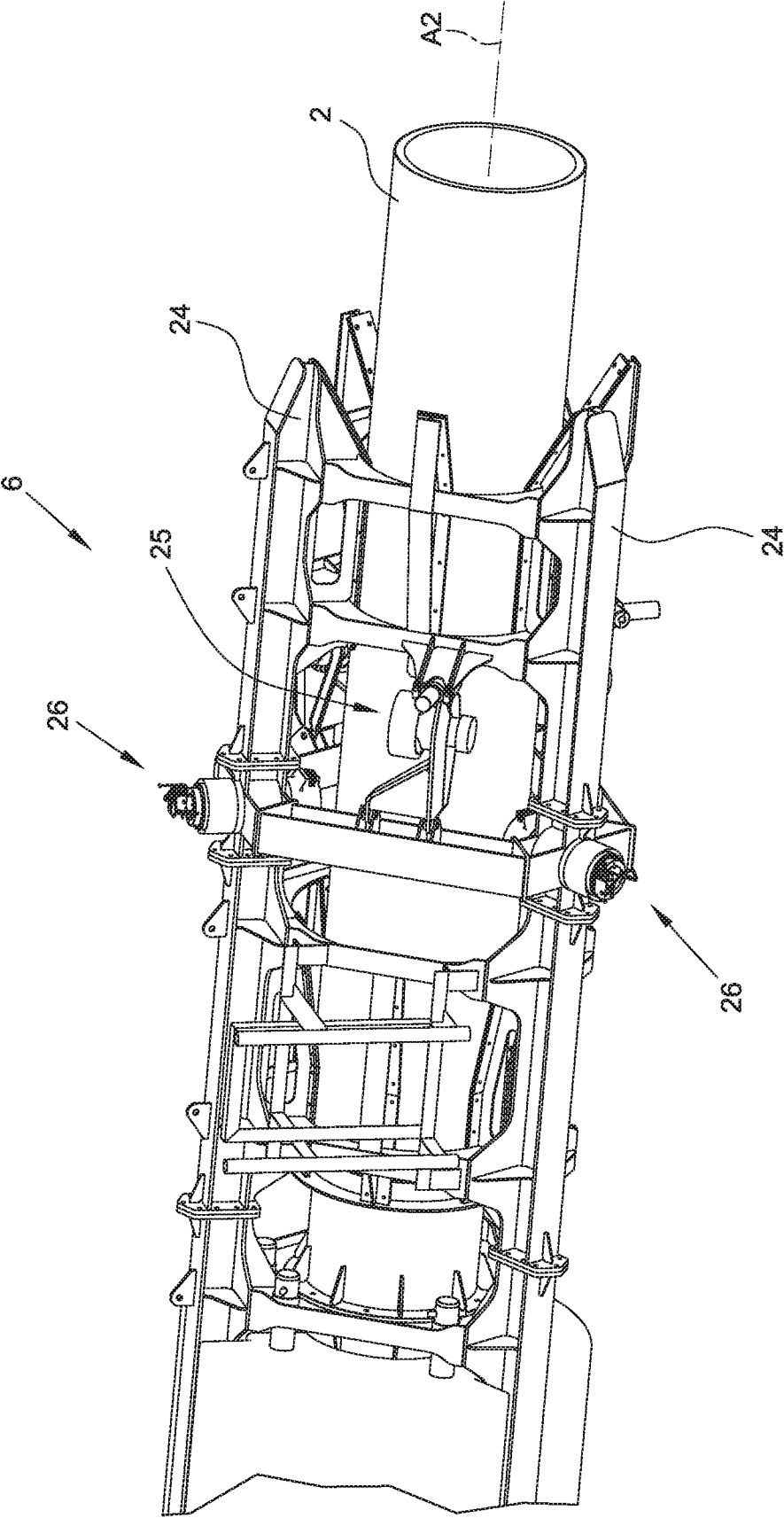
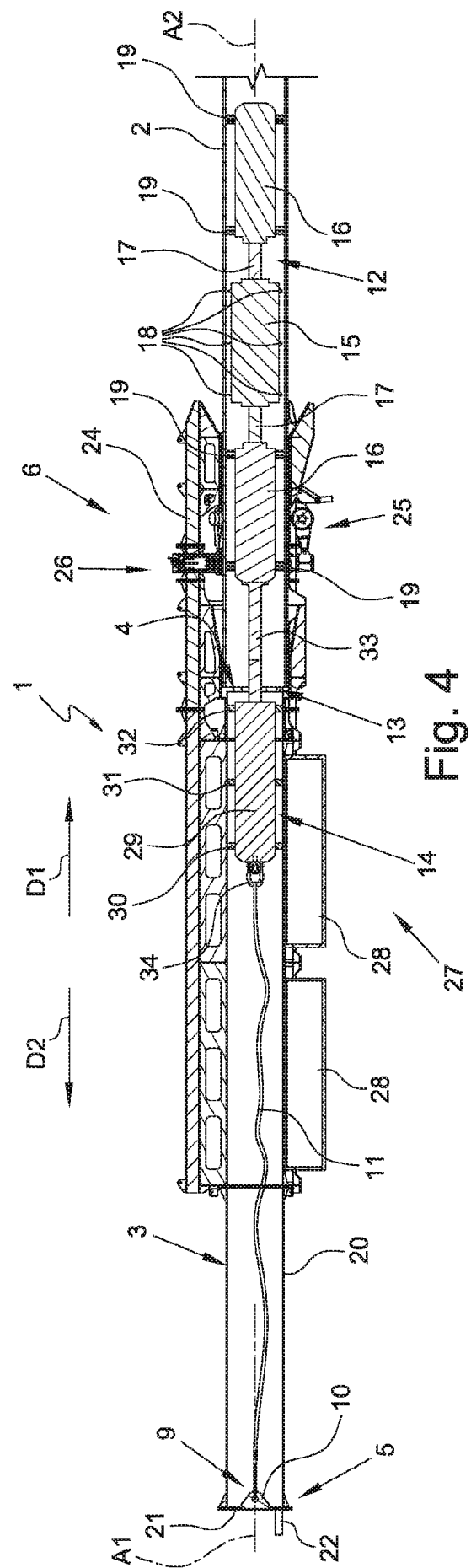
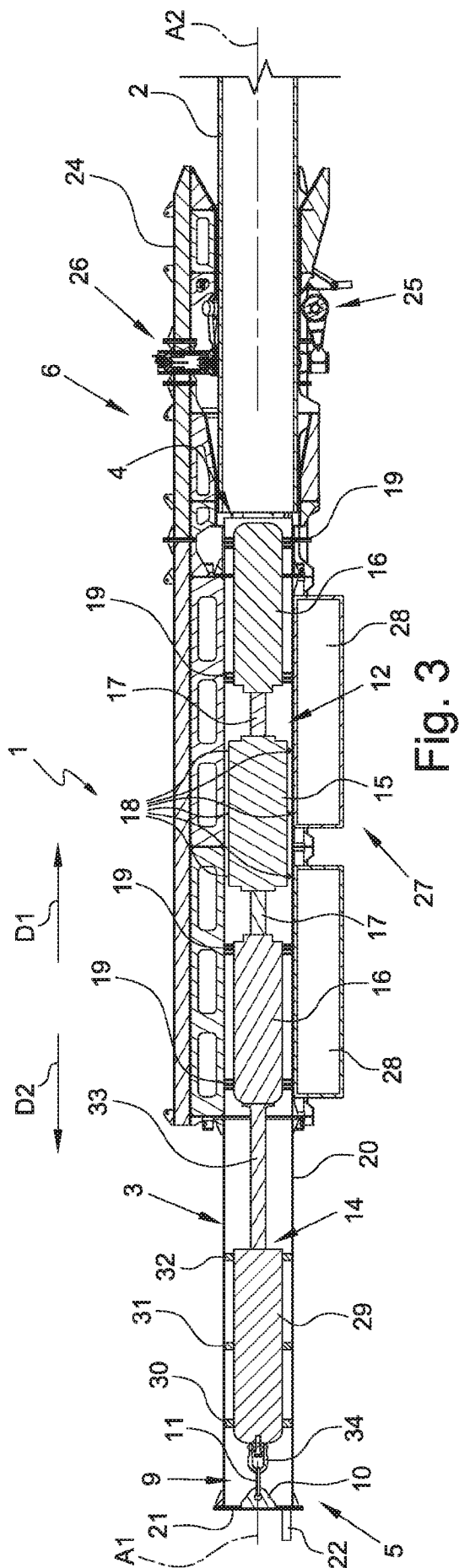
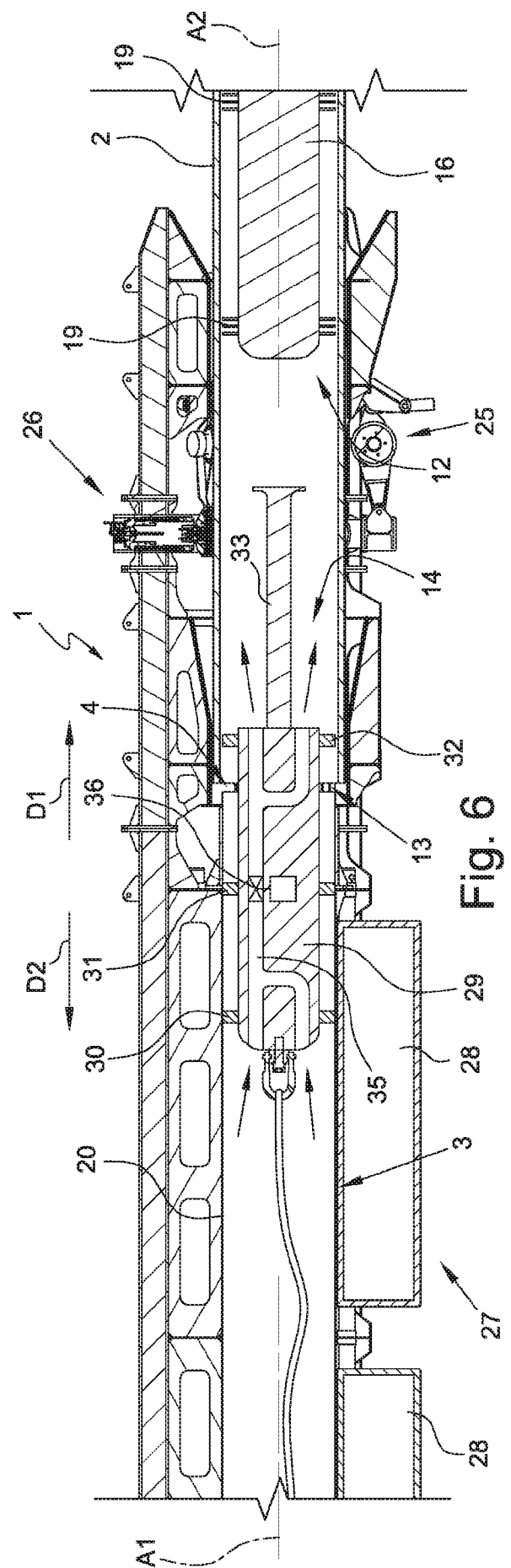
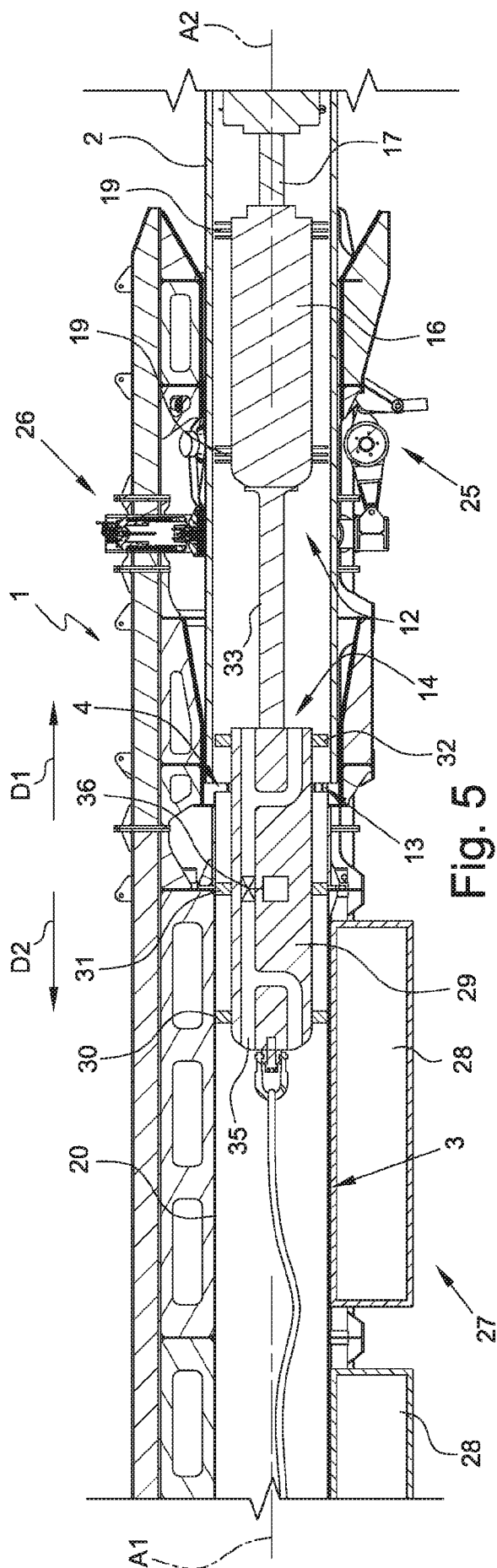


Fig. 2





INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/051066

A. CLASSIFICATION OF SUBJECT MATTER
INV. B08B9/055 F16L55/46
ADD.

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)
B08B F16L F28G

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/091115 A1 (FRETWELL PETER [GB]) 31 March 2016 (2016-03-31)	1,3-5, 9-11, 13-15
Y	abstract paragraph [0002] paragraph [0063] - paragraph [0064] paragraph [0068] - paragraph [0073] paragraph [0080] - paragraph [0083] claims figures	2,6,7, 12,16
Y	----- FR 2 576 083 A1 (PETROLES CIE FRANCAISE [FR]) 18 July 1986 (1986-07-18)	2,6,7, 12,16
A	abstract page 1, line 1 - line 14 page 3, line 16 - page 4, line 20 claims figures ----- -/-	1,11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search

8 June 2018

Date of mailing of the international search report

15/06/2018

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/051066

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 452 859 A (COTERM CIE TERMINAUX MARINS; SP K BYURO TRANSNEFTEAVTOM) 20 October 1976 (1976-10-20)	1-3,6,7, 9-13,16
Y	page 2, line 126 - page 3, line 79 claims figures	8,17
Y	----- DE 38 24 873 A1 (BERSCH FRIEDRICH [DE]) 25 January 1990 (1990-01-25)	8,17
A	abstract column 2, line 36 - line 62 column 3, line 19 - line 63 claims figures	1-3,6,7, 11-13,16
X	----- US 5 208 937 A (COOPER CLARENCE G [US]) 11 May 1993 (1993-05-11)	1-3,9-14
A	abstract column 3, line 21 - column 5, line 11 claims figures	6,7
X	----- EP 0 646 423 A1 (FUJI OIL CO LTD [JP]) 5 April 1995 (1995-04-05)	1,3, 9-11,13, 14
	abstract column 1, line 5 - line 8 column 6, line 45 - column 7, line 48 column 8, line 19 - line 55 claims figures	
A	----- US 4 068 492 A (RENEAU BOBBY J) 17 January 1978 (1978-01-17)	1,5,11, 15
	abstract column 1, line 62 - column 2, line 24 claims figures	
A	----- WO 2015/159052 A2 (BALLTEC LTD [GB]) 22 October 2015 (2015-10-22)	1,4,11, 14
	abstract page 1, line 2 - line 17 page 5, line 21 - page 12, line 10 claims figures	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016091115	A1	31-03-2016	AU 2015201208 A1 14-04-2016
			AU 2017202938 A1 25-05-2017
			GB 2532185 A 18-05-2016
			US 2016091115 A1 31-03-2016
FR 2576083	A1	18-07-1986	NONE
GB 1452859	A	20-10-1976	NONE
DE 3824873	A1	25-01-1990	NONE
US 5208937	A	11-05-1993	US 5208937 A 11-05-1993
			US 5296039 A 22-03-1994
EP 0646423	A1	05-04-1995	EP 0646423 A1 05-04-1995
			US 5444886 A 29-08-1995
US 4068492	A	17-01-1978	NONE
WO 2015159052	A2	22-10-2015	NONE