

(19)



(11)

EP 1 560 749 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
01.12.2010 Bulletin 2010/48

(51) Int Cl.:
B63H 5/08 ^(2006.01) **B63H 5/125** ^(2006.01)
B63H 20/12 ^(2006.01)

(21) Application number: **03810725.6**

(86) International application number:
PCT/SE2003/001482

(22) Date of filing: **24.09.2003**

(87) International publication number:
WO 2004/041635 (21.05.2004 Gazette 2004/21)

(54) **HYDRAULIC SYSTEM ARRANGED BETWEEN A FIRST AND A SECOND MARINE PROPULSION
DEVICE**

ZWISCHEN EINER ERSTEN UND EINER ZWEITEN SCHIFFSANTRIEBSVORRICHTUNG
ANGEORDNETES HYDRAULISCHES SYSTEM

SYSTEME HYDRAULIQUE DISPOSE ENTRE DES PREMIER ET SECOND DISPOSITIFS DE
PROPULSION MARINS

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**

(30) Priority: **06.11.2002 SE 0203280**

(43) Date of publication of application:
10.08.2005 Bulletin 2005/32

(73) Proprietor: **AB VOLVO PENTA
405 08 Göteborg (SE)**

(72) Inventors:
• **HEDLUND, Benny**
S-430 91 Hönö (SE)
• **ASBERG, Mikael**
S-423 41 Torslanda (SE)

(74) Representative: **Fröhling, Werner Otto**
Volvo Technology Corporation
Corporate Patents 06820, M1.7
405 08 Göteborg (SE)

(56) References cited:
US-A- 2 968 192 US-A- 4 778 418

EP 1 560 749 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

Background of the invention

[0001] The present invention relates to a hydraulic system which is arranged between a first and a second marine propulsion device, which are each arranged so that they can rotate about a respective axis at a distance from one another, comprising a first hydraulic piston-cylinder device having a cylinder chamber on each side of said piston, arranged between said first propulsion device and an element fixed in relation to said axis, and a second hydraulic piston-cylinder device having a cylinder chamber on each side of said piston, arranged between said second propulsion device and an element fixed in relation to said axis, according to the preamble to claim 1.

Description of the prior art

[0002] One example of marine propulsion devices of the aforementioned type is a propeller rig in a boat propeller drive. The boat propeller drive in this case comprises a shield bolted to the stern of the boat and in which the propeller rig is pivotally suspended in order to allow the propeller rig to be rotated firstly about a vertical axis for steering said boat and secondly about a horizontal axis for trimming and tilting of the propeller rig. In order to achieve said rotation, two hydraulic cylinders are usually arranged between the shield and the propeller rig, more specifically one on each side of the propeller rig.

[0003] Marine propulsion devices may also be designed with a propeller rig that extends through the bottom of a boat, preferably in the stern part of the boat, the propeller rig being suspended so that it can rotate about a vertical axis for steering the boat.

[0004] In the case of twin marine propulsion devices as described above, a tie bar is generally used between the propulsion devices in order to ensure that the angle of the devices relative to one another is kept within a desired interval under varying operating conditions, such as running with a variously laden boat, running in high seas etc., which gives rise to varying hydrodynamic forces. Said tie bar is in this case arranged either between the propulsion devices, outside the hull, or inside the hull between lever arms connected to each propulsion device. One disadvantage with the aforementioned solution is that the tie bar does not allow for just one propeller rig to be raised, for example after grounding in which the rig has been damaged, leaving the other undamaged propeller rig in operation. A further disadvantage with the tie bar between the propeller rigs is that it is relatively exposed to being damaged by external objects when for example docking in a harbor. A further disadvantage of the latter solution is that the tie bar with associated lever arms takes up space in the boat's engine compartment where space is usually very limited.

[0005] A further particular disadvantage that arises in boats of the multiple hull type, such as catamarans, is

that the tie bar is relatively long and unprotected and therefore even more exposed to being damaged by external objects. Moreover, the relative movements between the hulls that usually occur on boats of this type results in that the angle of the propulsion devices relative to one another varies to an unacceptable degree.

[0006] Closest prior art US 4,778,418 discloses a tie bar arrangement between two boat propeller drives suspended from the stern of a boat. The said drives comprise a propeller rig which is pivotally suspended in order to allow the propeller rig to be rotated firstly about a vertical axis for steering said boat and secondly about a horizontal axis for trimming and tilting of the propeller rig. Trimming or tilting is achieved by means of two hydraulic cylinders between the stern of the boat and the propeller rig, more specifically one on each side of the propeller rig. The tie bar arrangement comprises a piston-cylinder device arranged between the propeller rigs and designed to connect the propeller rigs rigidly together under normal operating conditions and to be capable of extension when tilting one of the propeller rigs in order thereby to allow the boat to be powered by just one propeller rig/motor. For this purpose the piston-cylinder device is designed, when rigid connection is required, to assume a limit position by pneumatic or hydraulic means or with the aid of a helical coil spring.

[0007] As with the aforementioned tie bar, one disadvantage with the said tie bar arrangement between the propeller rigs is that the arrangement is relatively exposed to being damaged by external objects when for example docking in a harbor. Another disadvantage is that the arrangement is only capable of assuming a predefined rigid position and a free position and thus does not permit angular adjustment of the boat propeller drives relative to one another while the boat is running.

Summary of the invention

[0008] The object of the present invention is to provide a hydraulic system having a tie bar function between a first and a second marine propulsion device, which are each arranged so that they can rotate about a respective axis at a distance from one another, which is both relatively unsusceptible of being damaged by external objects and which takes up little, if any, space inside the hull of a boat.

[0009] This object is achieved by the invention as described in claim 1. Preferred embodiments of the invention are described in the succeeding claims.

[0010] The invention relates to a hydraulic system arranged between a first and a second marine propulsion device, which are each arranged so that they can rotate about a respective axis at a distance from one another. The hydraulic system comprises a first hydraulic piston-cylinder device having a cylinder chamber on each side of said piston, arranged between said first propulsion device and an element fixed in relation to said axis, and a second hydraulic piston-cylinder device having a cylinder

chamber on each side of said piston, arranged between said second propulsion device and an element fixed in relation to said axis. Connecting the cylinder chambers in the first piston-cylinder device to the cylinder chambers in the second piston-cylinder device via a first and a second hydraulic circuit leads to that rotating of one propulsion device results in rotation of the other propulsion device. This provides a tie bar function which takes up little, if any, space inside the hull of a boat and at the same time requires no external arrangement between the propulsion devices which is relatively exposed to being damaged by external objects, in order to obtain said function.

[0011] Connecting the cylinder chambers in the first piston-cylinder device to the cylinder chambers in the second piston-cylinder device, so that an increase in pressure occurs in one of said hydraulic circuits when rotating the one propulsion device, causes the system to become rigid whilst avoiding the risk of gas formation, due to a fall in pressure, in the hydraulic oil enclosed in the system.

[0012] According to a preferred embodiment at least one of said hydraulic circuits is connected to a hydraulic accumulator in order to permit preloading of the system. Depending on the selected pressure level in the accumulator, a very rigid system with simultaneous elimination of any risk of gas formation in the hydraulic oil can be achieved, or alternatively a system with a built in elasticity.

[0013] According to a further preferred embodiment a hydraulic pump is connected to the first and the second hydraulic circuit in order to allow hydraulic oil to be pumped from one circuit to the other. This allows one propulsion device to be rotated in relation to the other, even while the boat is running, with a view not only to adjusting their precise angular position relative to one another, depending on for example the current speed of the boat, but also in certain types of operation, to rotating one propulsion device more than the other, for example when turning at high speed.

[0014] According to an especially preferred embodiment said first and second piston-cylinder devices are arranged on opposite sides of each propulsion device, so that rotating one propulsion device in one direction results in compression of the first piston-cylinder device and simultaneous expansion of the other piston-cylinder device, thereby rotating the other propulsion device in the same direction.

Description of the drawings

[0015] The invention will be described below with reference to preferred examples of embodiment and to the drawings attached, in which:

Fig. 1 shows a schematic representation of a hydraulic system having a tie bar function on two boat propeller drives,

Fig. 2 shows a schematic and partially cross-section-

Fig. 3

al representation of two boat propeller drives pivotally suspended on the stern of a boat, and shows a schematic and partially cross-sectional representation of said hydraulic system on two boat propeller drives designed with a propeller rig that extends through the bottom of a boat.

Description of the preferred embodiments

[0016] Fig. 1 shows a schematic representation of a hydraulic system 1 arranged between a first marine propulsion device 2 and a second marine propulsion device 3 of the propeller rig type in a boat propeller drive, which are each arranged on the stern 5 of a boat 4 so that they can each rotate about a respective axis 6, 7 at a distance from one another. The hydraulic system 1 comprises a first hydraulic piston-cylinder device 8, having a cylinder chamber 9, 10 on each side of said piston 11, arranged between said first propulsion device 2 and an element 12 fixed in relation to said axis 6 and stern 5, and a second hydraulic piston-cylinder device 13 having a cylinder chamber 14, 15 on each side of said piston 16, arranged between said second propulsion device 3 and an element 17 fixed in relation to said axis 7 and stern 5. Connecting the cylinder chambers 9, 10 in the first piston-cylinder device 8 to the cylinder chambers 14, 15 in the second piston-cylinder device 13 via a first hydraulic circuit 18 and a second hydraulic circuit 19 leads to that rotating of one propulsion device 2 results in rotation of the other propulsion device 3.

[0017] Fig. 1 further shows a steering wheel 20 connected to a hydraulic pump 21, which is in turn connected to a hydraulic valve 22, a so-called control valve, which is in addition connected firstly to a pressure pipe (not shown) from a servo pump driven by a drive motor (not shown) and secondly to an oil reservoir (not shown). The hydraulic valve 22 is further connected via hydraulic pipes 23, 24, 25, 26 to the cylinder chambers 27, 28, 29, 30 in two piston-cylinder devices 31, 32, one on each propulsion device 2, 3.

[0018] The function of the hydraulic control system described above, including the tie bar function, is as follows:

[0019] Turning the steering wheel 20 to starboard causes the hydraulic pump 21 to pump oil to the hydraulic valve 22 in which a slide (not shown) is displaced for pumping oil to cylinder chambers 27, 30 of the piston-cylinder devices 31, 32, which causes the piston-cylinder device 31 to be expanded, thereby rotating the first propulsion device 2 about the axis 6, to the right in Fig. 1, whilst the piston-cylinder device 32 is compressed thereby rotating the second propulsion device 3 about the axis 7, to the right in the same figure. If, due to longer hydraulic pipes, for example, the pressure build-up in the piston-cylinder device 32 on the second propulsion device 3 occurs somewhat after the pressure build-up in the piston-cylinder device 31 on the first propulsion device 2, a pressure build-up occurs in the cylinder chamber 9 in the

piston-cylinder device 8, which is transmitted via the second hydraulic circuit 19 to the cylinder chamber 14 in the piston-cylinder device 13, which ensures that both propulsion devices 2, 3 are rotated to the same extent.

[0020] In the embodiment shown in Fig. 1 a hydraulic accumulator 33 is also connected to the second hydraulic circuit 19 to achieve preloading of the hydraulic system 1 which, depending on the selected pressure level in the accumulator 33, provides a tie bar function which is very rigid and in which there is, in principle, no risk of any gas formation in the hydraulic oil, or alternatively a tie bar function with a built in elasticity. In Fig. 1, 34 denotes a monitor device which is arranged in proximity to the steering wheel 20 and is electrically connected to an electronic control unit 35. The control unit 35 is in turn electrically connected to the hydraulic valve 22 and to a hydraulic pump 36, which is designed to pump oil between the first hydraulic circuit 18 and the second hydraulic circuit 19. The control unit 35 is at the same time designed to control the hydraulic valve 22 and the hydraulic pump 36 as a function of an input signal from the monitor device 34, so that the propulsion devices 2, 3 are turned independently of one another, both for adjustment of the precise angle of the propulsion devices relative to one another and for rotating just one propulsion device when maneuvering for example in harbor or at high speed.

[0021] Fig. 2 shows, in more detail and partially in cross-section, the boat propeller drives shown in Fig. 1 fitted to the stern 5 of the boat 4 with inboard engines 37, 38. The boat propeller drives comprise shields 39, 40 which are bolted to the stern 5 and in which the propeller rigs 2, 3 are pivotally suspended in order to allow the rigs 2, 3 to be rotated firstly about vertical axes 6, 7 for steering said boat 4 and secondly about a horizontal axis 41 for trimming and tilting of the propeller rigs 2, 3. Also shown is the one piston-cylinder device 31 for steering the boat 4 and the one piston-cylinder device 13 which forms part of the tie bar function of the hydraulic system 1, the other two piston-cylinder devices 8, 32 being partially hidden behind the propeller rigs 2, 3.

[0022] Fig. 3 shows an alternative embodiment of said marine propulsion device designed with a propeller rig 42, 43 which extends through the bottom 44 of a boat 45, more specifically in the stern part of the boat, the propeller rigs 42, 43 being suspended so that they can rotate about vertical axes 46, 47 for steering the boat 45. The propeller rigs 42, 43 are rotated by means of electric motors (not shown), which are controlled by an electrical control unit 48. The control unit 48 is furthermore designed to control a hydraulic pump 49, in a manner as described above, so that the propulsion devices 42, 43 can be turned independently of one another, both for adjustment of the precise angle of the propulsion devices 42, 43 relative to one another and for rotating just one propulsion device when maneuvering for example in harbor or at high speed.

[0023] In a manner corresponding to that described above, a first hydraulic piston-cylinder device 50, having

a cylinder chamber 51, 52 on each side of said piston 53, is arranged between the first propulsion device 42 and an element 54 fixed in relation to said axis, and a second hydraulic piston-cylinder device 55, having a cylinder chamber 56, 57 on each side of said piston 58, is arranged between said second propulsion device 43 and an element 59 fixed in relation to said axis 47. connecting the cylinder chambers 51, 52 in the first piston-cylinder device 50 to the cylinder chambers 56, 57 in the second piston-cylinder device 55 via a first hydraulic circuit 60 and a second hydraulic circuit 61 leads to that rotating of one propulsion device 42 results in rotation of the other propulsion device 43.

[0024] In one embodiment shown in Fig. 3 a hydraulic accumulator 62 is connected to the second hydraulic circuit 61 in order to provide preloading of the hydraulic system 1 which, depending on the selected pressure level in the accumulator 62, provides a tie bar function which is very rigid and in which there is, in principle, no risk of any gas formation in the hydraulic oil, or alternatively a tie bar function with a built in elasticity.

[0025] The invention is not limited to the example of embodiment described above and shown in the figures but lends itself to variation within the scope of the following patent claims. For example, hydraulic accumulators may be connected to both of the hydraulic circuits.

Claims

1. A hydraulic system (1) arranged between a first marine propulsion device (2, 42) and a second marine propulsion device (3, 43), which are each arranged so that they can rotate about a respective axis (6, 7, 46, 47) at a distance from one another, comprising a first hydraulic piston-cylinder device (8, 50), having a cylinder chamber (9, 10, 51, 52) on each side of said piston (11, 53), arranged between said first propulsion device (2, 42) and an element (12, 54) fixed in relation to said axis (6, 7, 46, 47), and a second hydraulic piston-cylinder device (13, 55) having a cylinder chamber (14, 15, 56, 57) on each side of said piston (16, 58), arranged between said second propulsion device (3, 43) and an element (17, 59) fixed in relation to said axis (6, 7, 46, 47),
characterized in that
a first hydraulic circuit (18, 60) and a second hydraulic circuit (19, 61) are designed to connect the cylinder chambers (9, 10, 51, 52) in said first piston-cylinder device (8, 50) to the cylinder chambers (14, 15, 56, 57) in said second piston-cylinder device (13, 55) in order that rotation of one propulsion device (2, 3, 42, 43) results in rotation of the other propulsion device (2, 3, 42, 43).
2. The hydraulic system (1) as claimed in claim 1,
characterized in that
said first hydraulic circuit (18, 60) and second hy-

draulic circuit (19, 61) are connected to the cylinder chambers (9, 10, 14, 15, 51, 52, 56, 57) so that a pressure increase occurs in at least one of said circuits (18, 19, 60, 61) when rotating the one propulsion device (2, 3, 42, 43).

3. The hydraulic system (1) as claimed in any of the preceding claims,
characterized in that
at least one of said hydraulic circuits (18, 19, 60, 61) contains a hydraulic accumulator (33, 62) for achieving preloading in said first or said second hydraulic piston-cylinder device (8, 13, 50, 55) respectively.
4. The hydraulic system (1) as claimed in any of the preceding claims,
characterized in that
a first hydraulic pump (36, 49) is connected to the first hydraulic circuit (18, 60) and the second hydraulic circuit (19, 61) in order to permit rotating of one propulsion device (2, 3, 42, 43) in relation to the other propulsion device (2, 3, 42, 43).
5. The hydraulic system (1) as claimed in any of the preceding claims,
characterized in that
said first piston-cylinder device (8, 50) and second piston-cylinder device (13, 55) are arranged on opposite sides of each propulsion device (2, 3, 42, 43), so that rotating one propulsion device (2, 3, 42, 43) in one direction results in compression of the first piston-cylinder device (8, 50) and simultaneous expansion of the second piston cylinder device (13, 55), thereby rotating the other propulsion device (2, 3, 42, 43) in the same direction.
6. The hydraulic system (1) as claimed in any of the preceding claims,
characterized in that
at least one further piston-cylinder device (31, 32) is arranged between one propulsion device (2, 3) and an element fixed in relation to said axis (6, 7), the piston-cylinder device (31, 32) being connected to a hydraulic pump (21) driven by a manual drive member (20) for controlling the propulsion device (2, 3).

Patentansprüche

1. Hydrauliksystem (1), das zwischen einer ersten Marineantriebsvorrichtung (2, 42) und einer zweiten Marineantriebsvorrichtung (3, 43) angeordnet ist, die jeweils so angeordnet sind, dass sie um eine jeweilige Achse (6, 7, 46, 47) im Abstand voneinander drehen können, mit einer ersten Hydraulikkolbenzylindervorrichtung (8, 50) mit einer Zylinderkammer (9, 10, 51, 52) auf jeder Seite des Kolbens (11, 12), die zwischen der ersten Antriebsvorrichtung (2, 42)

und einem bezüglich der Achse (6, 7, 46, 47) festgelegten Element (12, 54) angeordnet ist, und einer zweiten Hydraulikkolbenzylindervorrichtung (13, 55) mit einer Zylinderkammer (14, 15, 56, 57) auf jeder Seite des Kolbens (16, 58), die zwischen der zweiten Antriebsvorrichtung (3, 43) und einem Element (17, 59) angeordnet ist, das bezüglich der Achse (6, 7, 46, 47) festgelegt ist,

dadurch gekennzeichnet, dass

ein erster Hydraulikkreis (18, 60) und ein zweiter Hydraulikkreis (19, 61) so ausgelegt sind, dass sie die Zylinderkammern (9, 10, 51, 52) in der ersten Kolbenzylindervorrichtung (8, 50) mit den Zylinderkammern (14, 15, 56, 57) in der zweiten Kolbenzylindervorrichtung (13, 55) verbinden, damit eine Drehung einer Antriebsvorrichtung (2, 3, 42, 43) in einer Drehung der anderen Antriebsvorrichtung (2, 3, 42, 43) resultiert.

2. Hydrauliksystem (1) nach Anspruch 1,
dadurch gekennzeichnet, dass
der erste Hydraulikkreis (18, 60) und der zweite Hydraulikkreis (19, 61) so mit den Zylinderkammern (9, 10, 14, 15, 51, 52, 56, 57) verbunden sind, dass eine Druckerhöhung in wenigstens einem der Kreise (18, 19, 60, 61) stattfindet, wenn die eine Antriebsvorrichtung (2, 3, 42, 43) gedreht wird.

3. Hydrauliksystem (1) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
wenigstens einer der Hydraulikkreise (18, 19, 60, 61) einen hydraulischen Akkumulator (33, 62) zum Erreichen einer Vorbelastung in der ersten bzw. zweiten Hydraulikkolbenzylindervorrichtung (8, 13, 50, 55) umfasst.

4. Hydrauliksystem (1) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die erste hydraulische Pumpe (36, 49) mit dem ersten Hydraulikkreis (18, 60) und dem zweiten Hydraulikkreis (19, 61) verbunden ist, um eine Drehung der einen Antriebsvorrichtung (2, 3, 42, 43) bezüglich der anderen Antriebsvorrichtung (2, 3, 42, 43) zu ermöglichen.

5. Hydrauliksystem (1) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
die erste Kolbenzylindervorrichtung (8, 50) und die zweite Kolbenzylindervorrichtung (13, 55) an entgegengesetzten Seiten jeder Antriebsvorrichtung (2, 3, 42, 43) angeordnet sind, so dass eine Drehung einer Antriebsvorrichtung (2, 3, 42, 43) in einer Richtung in einer Kompression der ersten Kolbenzylindervorrichtung (8, 50) und einer gleichzeitigen Expansion der zweiten Kolbenzylindervorrichtung (13, 55) re-

sultiert, wodurch die andere Antriebsvorrichtung (2, 3, 42, 43) in der gleichen Richtung gedreht wird.

6. Hydrauliksystem (1) nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet, dass
 wenigstens eine weitere Kolbenzylindervorrichtung (31, 32) zwischen einer Antriebsvorrichtung (2, 3) und einem bezüglich der Achse (6, 7) festgelegten Element angeordnet ist, wobei die Kolbenzylindervorrichtung (31, 32) mit einer Hydraulikpumpe (21) verbunden ist, die von einem manuellen Antriebs-
 element (20) zur Steuerung der Antriebsvorrichtung (2, 3) angetrieben wird.

Revendications

1. Système hydraulique (1) agencé entre un premier dispositif de propulsion marine (2, 42) et un second dispositif de propulsion marine (3, 43), qui sont respectivement agencés de manière à pouvoir tourner autour d'un axe respectif (6, 7, 46, 47) à une distance l'un de l'autre, comprenant un premier dispositif hydraulique piston-cylindre (8, 50), possédant une chambre de cylindre (9, 10, 51, 52) sur chaque côté dudit piston (11, 53), agencée entre ledit premier dispositif de propulsion (2, 42) et un élément (12, 54) fixe par rapport audit axe (6, 7, 46, 47), et un second dispositif hydraulique piston-cylindre (13, 55) possédant une chambre de cylindre (14, 15, 56, 57) sur chaque côté dudit piston (16, 58), agencée entre ledit second dispositif de propulsion (3, 43) et un élément (17, 59) fixe par rapport audit axe (6, 7, 46, 47),
caractérisé en ce que
 un premier circuit hydraulique (18, 60) et un second circuit hydraulique (19, 61) sont conçus pour coupler les chambres de cylindre (9, 10, 51, 52) dudit premier dispositif piston-cylindre (8, 50) aux chambres de cylindre (14, 15, 56, 57) dudit second dispositif piston-cylindre (13, 55) de manière à ce qu'une rotation d'un dispositif de propulsion (2, 3, 42, 43) ait pour conséquence une rotation de l'autre dispositif de propulsion (2, 3, 42, 43).

2. Système hydraulique (1) selon la revendication 1,
caractérisé en ce que
 lesdits premier circuit hydraulique (10, 60) et second circuit hydraulique (19, 61) sont couplés aux chambres de cylindre (9, 10, 14, 15, 51, 52, 56, 57) de sorte qu'une augmentation de pression se produit dans au moins un desdits circuits (18, 19, 60, 61) lors de la rotation du dispositif de propulsion (2, 3, 42, 43).

3. Système hydraulique (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que

au moins un desdits circuits hydrauliques (18, 19, 60, 61) contient un accumulateur hydraulique (33, 62) pour réaliser une précharge respectivement dudit premier ou dudit second dispositif hydraulique piston-cylindre (8, 13, 50, 55).

4. Système hydraulique (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
 une première pompe hydraulique (36, 49) est couplée au premier circuit hydraulique (18, 60) et au second circuit hydraulique (19, 61) de manière à permettre la rotation de l'un des dispositifs de propulsion (2, 3, 42, 43) par rapport à l'autre dispositif de propulsion (2, 3, 42, 43).

5. Système hydraulique (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
 lesdits premier dispositif piston-cylindre (8, 50) et second dispositif piston-cylindre (13, 55) sont agencés sur des côtés opposés de chaque dispositif de propulsion (2, 3, 42, 43), de sorte que la rotation d'un dispositif de propulsion (2, 3, 42, 43) dans une direction a pour conséquence une compression du premier dispositif piston-cylindre (8, 50) et une expansion simultanée du second dispositif piston-cylindre (13, 55), ce qui provoque la rotation de l'autre dispositif de propulsion (2, 3, 42, 43) dans la même direction.

6. Système hydraulique (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
 au moins un autre dispositif piston-cylindre (31, 32) est agencé entre un dispositif de propulsion (2, 3) et un élément fixe par rapport audit axe (6, 7), le dispositif piston-cylindre (31, 32) étant couplé à une pompe hydraulique (21) entraînée par un élément d'entraînement manuel (20) afin de contrôler le dispositif de propulsion (2, 3).

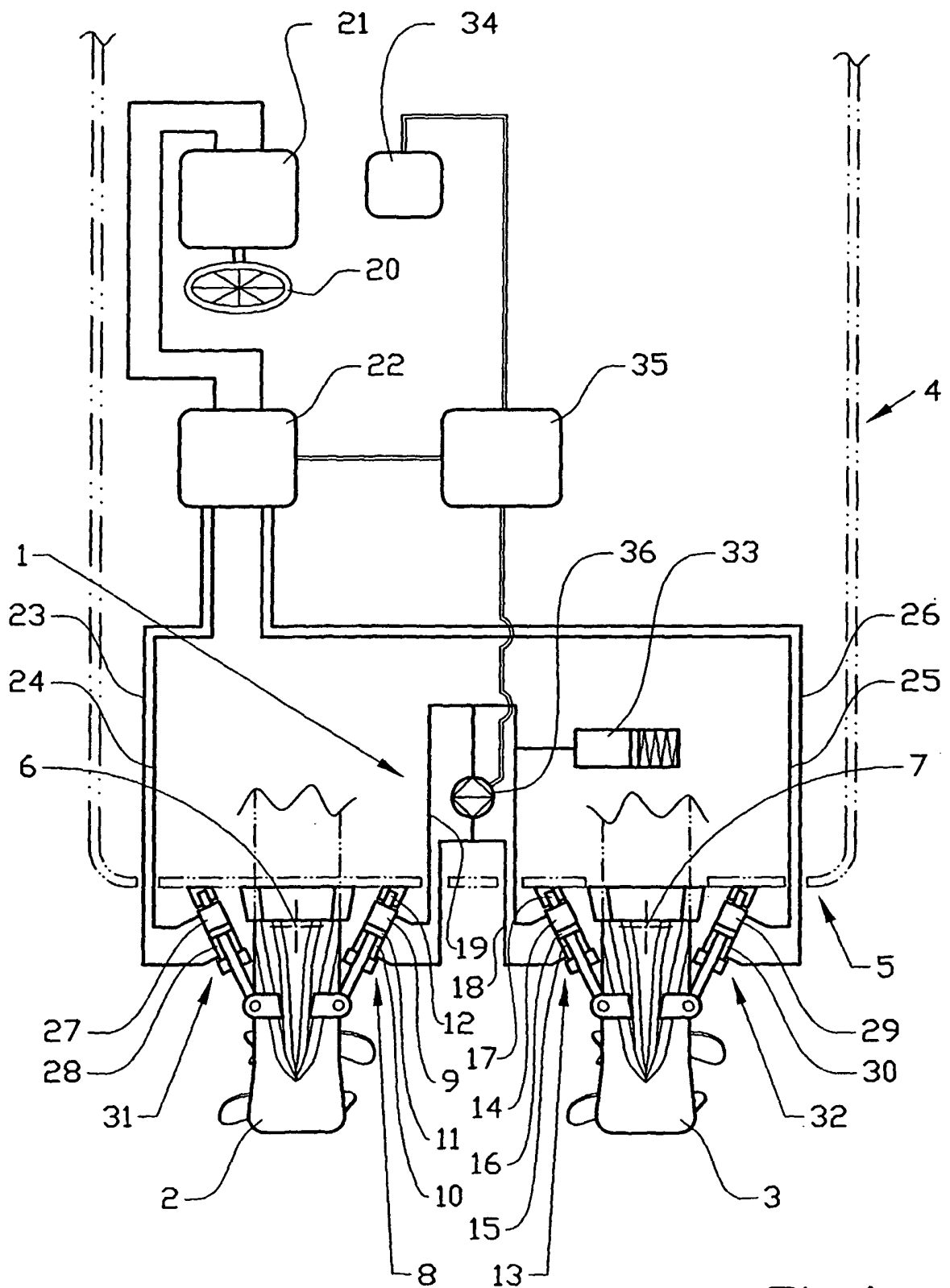


Fig.1

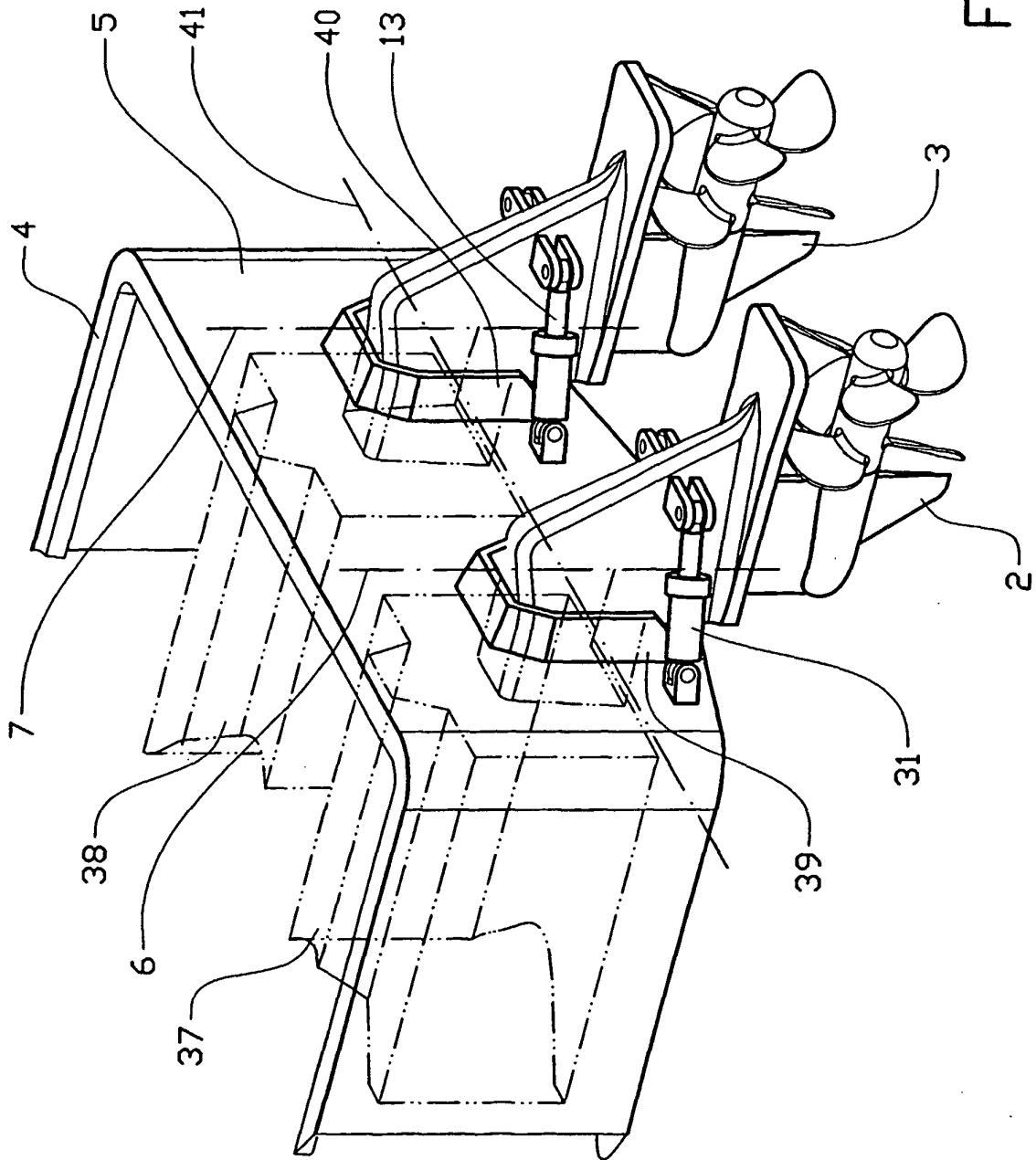


Fig. 2

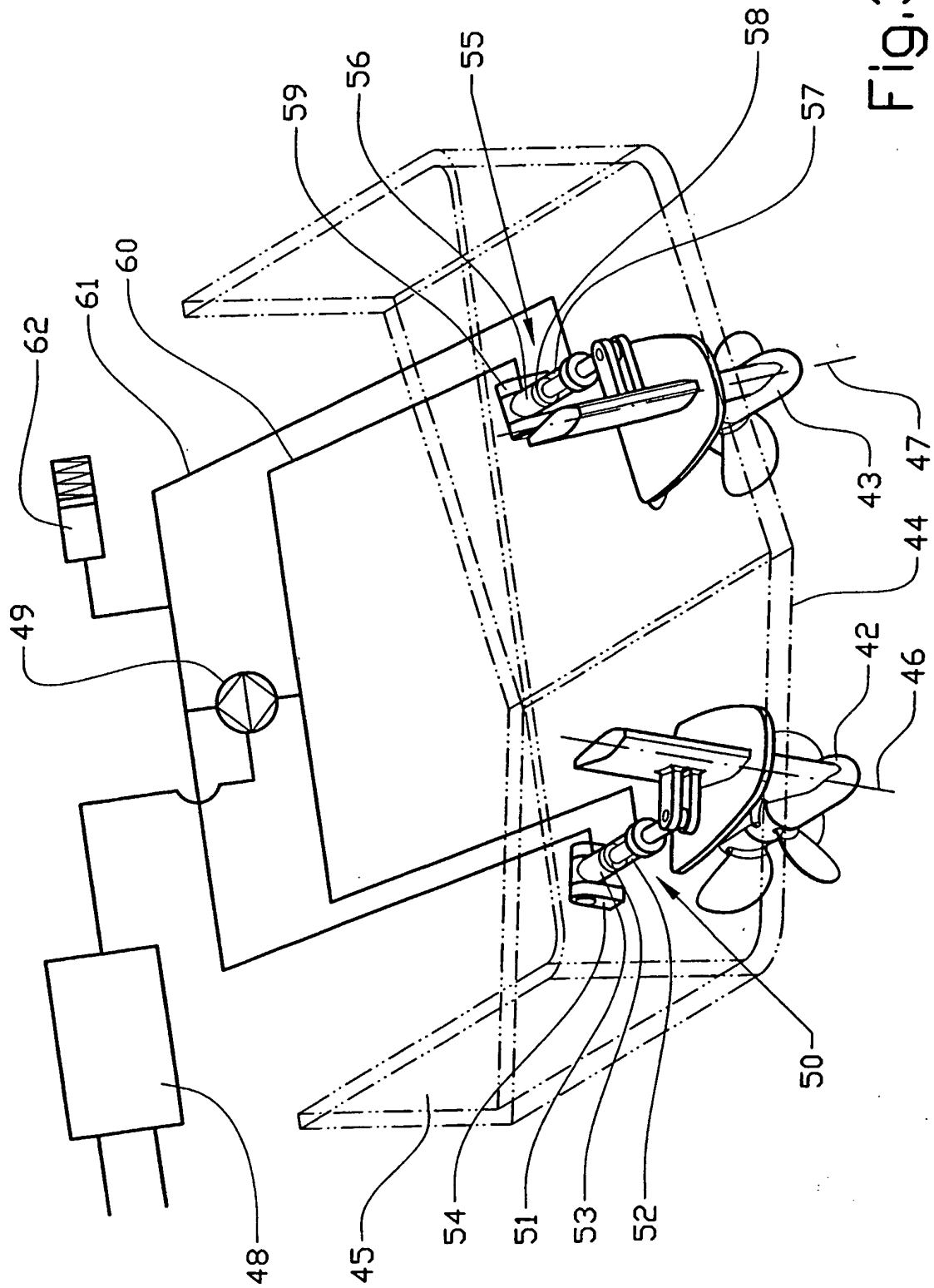


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4778418 A [0006]