

(19) World Intellectual Property Organization
International Bureau



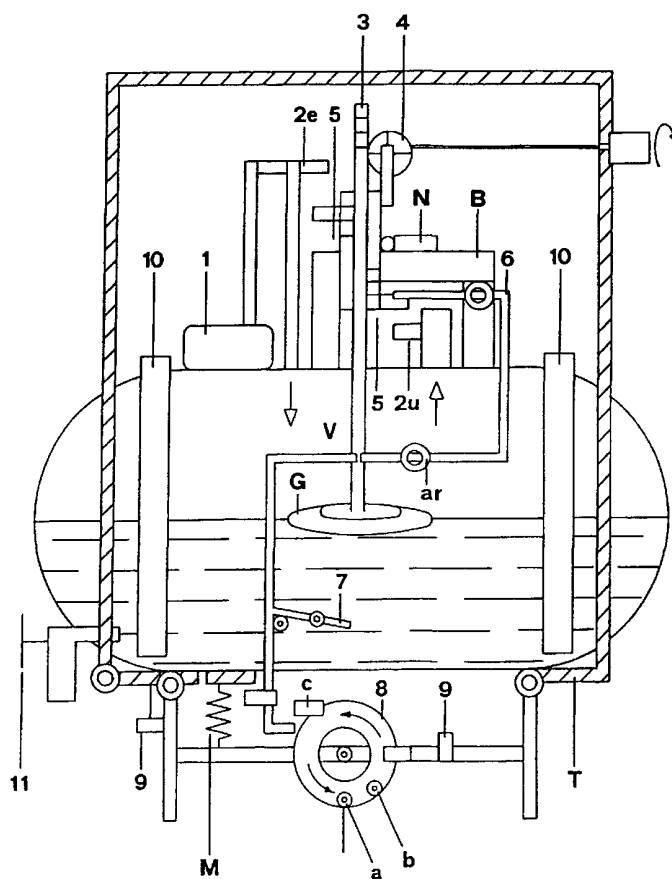
(43) International Publication Date
25 May 2001 (25.05.2001)

PCT

(10) International Publication Number
WO 01/36266 A1

- (51) International Patent Classification⁷: **B63C 7/08** (74) Agent: **MASCIOLI, Alessandro**; Via Leonina, 26, I-00184 Roma (IT).
- (21) International Application Number: **PCT/IT00/00408**
- (22) International Filing Date: 13 October 2000 (13.10.2000) (81) Designated States (*national*): JP, US.
- (25) Filing Language: English (84) Designated States (*regional*): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
- (26) Publication Language: English
- (30) Priority Data: **RM99A000711** 19 November 1999 (19.11.1999) IT Published: — With international search report.
- (71) Applicant and (72) Inventor: **ZINGALE, Giuseppe** [IT/IT]; Via Villini a Mare, 5, I-95126 Catania (IT).
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DEVICE FOR TRANSPORTING LOADS UNDER WATER AND USABLE AS A LIFTING PONTOON



(57) Abstract: The device for the transport of loads under water and that may be used also as a loading bridge, allows to reach great depths under water and comprises a tank (S), two tanks (Sg) and a float (G) in which the pressure automatically remains equal to the external hydrostatic one, due to a valve (V) with four functions that assures the air volume, predetermined in the loading phase, to be constant inside the tank with the variation of the depth.

WO 01/36266 A1

DEVICE FOR TRANSPORTING LOADS UNDER WATER AND USABLE AS A LIFTING PONTOON

5 The present invention concerns a device for the transport of loads under water and that may be used also as a loading bridge.

 The great difficulties are well known that are met when refloating sunk finds and the remains of incidents or wrecks by means of big balloons or inflatable structures that are coupled to
10 the objects on the ground of the sea for lifting them up, even when they are very heavy. Infact, it often happens that those structures come off the string, loose air and it is rather difficult to manage them when the sea is rough or stormy.

 It is the aim of the present invention to realize a means
15 completely different from all existing means in this field, for te transport of loads under water and that ay also be used as a loading bridge.

 The aim set forth is reached by means of the device according to the present invention that allows to reach great
20 depths under water without complicated structures, in which the pressure of the tanks and of a float, forming said device, automatically remains equal to the external hydrostatic one, due to a valve with four functions that assures the air volume predetermined in the loading phase to be constant inside the tank
25 with the variation of the depth.

The present invention will be described more in detail hereinbelow relating to the enclosed drawings in which an embodiment is shown.

Figure 1 shows a lateral scheme of a device for the transport of loads under water and that may be used also as a loading bridge, according to the present invention.

Figure 2 shows a safety system of the device according to the present invention, as shown in figure 1.

Figure 3 shows in particular the loading bridge.

The enclosed figures show a device for the transport of loads under water and that may be used also as a loading bridge, in which the pressure in a tank S, in tanks Sg and in the float G always automatically remains equal to the hydrostatic external pressure, due to a valve V that assures the air volume, predetermined in the loading phase, to remain constant inside the tank with the variation of the depth, said valve having the following four functions:

- a metric rod 3 determines the air volume V_{ar} requested for keeping the load P to be transported in a floating condition; if, e.g., $V_{ar} = 1$ cubic metre, the device receives a push upwards of 1,000 kg, coupling a load P equal to 1,000 kg and sinks to the free surface of the water, as it is provided with two floating tanks Sg which have an air volume equal to the weight of the whole structure;
- opening of the valve 2e for the air inlet into tank S, into tanks Sg and into the float G for keeping constant the air volume and the pressure and thus obtaining the stable floating of the

- device; reducing the air volume the device receives a push downwards and the water enters pipes 10, and the pressure increases while the device goes down; inside tank S the water level increases so that the float operates valve 2e until the internal pressure is equal to the external one and consequently the Var is equal to the predetermined one. The compressed air is supplied by a bottle loaded at least at 200 atm, and between the bottle and the valve a pressure reducer is inserted, set at least at 30% more than the depth to be reached;
- 5
- 10 - opening of the valve 2u for the outlet of of the air from tank S, which is necessary for allowing the inlet of water through pipes 10 and for making come down the device: said valve 2u may also be controlled by an emergency device 6 that intervenes in case of a sudden loss of the transported load;
- 15 - acceleration and/or braking of the device according to the present invention in its vertical movements, by means of a system 4 of gear-wheels and hand grip which adjust the position of metric rod 3 and of float G with respect to the oscillating cylinder 5 which, with two adjustable teeth, opens valves 2e and 2u so that, by means of small rotations of hand grip 4, those small air quantities are let in and/or ejected from tank S for lightening or making heavier the device according to the present invention so as to go up or down, while the spring stabilizing pallet N with a screw for adjusting the pressure of cylinder 5, prevents sudden oscillations of valve V when the device performs vertical movements. When the device moves downwards due to the external pressure, the water volume
- 20
- 25

increases, float G rises and valve 2e opens until the predetermined balance of the water level inside tank S is restored; furthermore, as the inlet time of air and water are different, the diameter of pipes 10 is tared onto the air speed -
5 for the inlet and for the outlet -, while cylinder 5 has a plurality of grooves so as to be an obstacle to the sliding of pallet N, the adjusting system whereof is fixed at the base. The crank 7 allows the manual opening of the air.

For what concerns the safety system: in case of accidental
10 unhooking of the transported load, the device receives a sudden upward push and, even if valve V intervenes, the Var remains constant with the consequent need of quickly flooding tank S, which may be obtained as follows:

pulley 8 has a winding spring inside, and rotates around the axis
15 of the central traverse of frame T; when it is in position *a*, it means that the weight has been loaded; when the load gets accidentally unhooked, the return spring brings the pulley in position *b*, the tooth *c* moves the lever system 6 that lowers cylinder 5 and, by means of a lower tooth, keeps valve 2u open:
20 air gets out and water in through pipes 10; if the water inlet through pipes 10 is too slow with respect to the need of stopping the rise of the device according to the present invention in a few metres, an additional quick flooding valve 13 will be operated, placed in the upper part of tank S and shaped for having a great
25 carriage and that will be opened by the depression determined in the tank and by the pressure performed by the water column.

In normal conditions, said valve 13 will be kept closed by the internal pressure and by two small arched steel blades, opportunely tared; it has its central pin in the cap and the ends thereof are resting on the edge of the hole in tank S.

5 Following to the flooding of tank S, the device according to the present invention will become heavier but tanks Sg will remain filled with air and will keep it in a stable floating position making it slowly emerge.

10 If the load to be transported is connected to an emergency rope D, it will be possible to find it. The emergency rope has two functions: it acts as a fishing-line and it slows down the descent of the load and the rising of the device according to the present invention.

15 The cover 9 blocks wheel 8 in position α in two cases: during loading and when the load is transported onto the upper part of the frame. The safety system works with return spring Mn.

20 The present invention also provides for a pressurization of the device that may touch great depths because the internal pressure of tank S is always equal to the outer pressure due to valve V, while float G and tanks Sg must be connected with compressed air behind the outlet of valve 2e so that said tanks and said float will always be filled with air and with a pressure equal to the one of tank S.

25 For obtaining an optimal working of the device according to the present invention, the diameter of pipes 10 must be well dimensioned to the one of valves 2e and 2u for obtaining the movement speed and the intervention time of the emergency

system. During the daily use of the device, also adjusting taps at the inlet of pipes 10 may be useful.

For what concerns the loading system of the device for transporting loads under water, it is necessary to well balance the air volume and the water volume for obtaining the maximum
5 safety in the loading phase.

For this purpose, it is convenient to combine the loading and/or unloading bridge shown in figures 2 and 3 to the device according to the present invention: the frame T has resting rods
10 Ba, which may be adjusted height and the position whereof depends on the weight of the load and on the position of loading and/or unloading of the device.

In the mentioned cases, the device according to the present invention changes its position with respect to the loading bridge.

15 The loading bridge Tc may be laterally coupled to a mole or to a boat.

For making the displacement easier, the device according to the present invention may be provided with propellers and rudders.

20

25

CLAIMS

1. A device for the transport of loads under water and that may be used also as a loading bridge, wherein the pressure in a tank (S), in tanks (Sg) and in the float (G) always automatically remains equal to the hydrostatic external pressure, due to a valve (V) that assures the air volume, predetermined in the loading phase, to remain constant inside the tank with the variation of the depth, *characterized in* the following functions:
- a metric rod (3) determines the air volume (Var) requested for keeping the load (P) to be transported in a floating condition;
 - opening of the valve (2e) for the air inlet into tank (S), into tanks (Sg) and into float (G) for keeping constant the air volume and the pressure and thus obtaining the stable floating of the device; reducing the air volume the device receives a push downwards and the water enters pipes (10), and the pressure increases while the device goes down; inside tank (S) the water level increases so that the float operates valve (2e) until the internal pressure is equal to the external one and consequently the (Var) is equal to the predetermined one;
 - opening of the valve (2u) for the outlet of the air from tank (S), which is necessary for allowing the inlet of water through pipes (10) and for making come down the device: said valve (2u) may also be controlled by an emergency device (6) that intervenes in case of a sudden loss of the transported load;
 - acceleration and/or braking of the device according to the present invention in its vertical movements, by means of a system (4) of gear-wheels and hand grip which adjust the

position of metric rod (3) and of float (G) with respect to the oscillating cylinder (5) which, with two adjustable teeth, opens valves (2e and 2u) so that, by means of small rotations of hand grip (4), those small air quantities are let in and/or ejected from tank (S) for lightening or making heavier the device according to the present invention so as to go up or down, while the spring stabilizing pallet (N) with a screw for adjusting the pressure of cylinder (5), prevents sudden oscillations of valve (V) when the device performs vertical movements; when the device moves downwards due to the external pressure, the water volume increases, float (G) rises and valve (2e) opens until the predetermined balance of the water level inside tank (S) is restored.

2. A device according to claim 1, *characterized in* the dimensioning of the the diameter of pipes (10) with respect to the air speed - for the inlet and for the outlet -, as well as in a plurality of horizontal grooves in cylinder (5) that form an obstacle to the sliding of pallet (N), the adjusting system whereof is fixed at the base.

3. A device according to claim 1, *characterized in* an emergency system consisting of a pulley (8) with a winding spring inside, rotating around the axis of the central traverse of frame (T); when the load gets accidentally unhooked, the return spring brings the pulley in position *b*, the tooth *c* moves the lever system (6) that lowers cylinder (5) and, by means of a lower tooth, keeps valve (2u) open: air gets out and water in through pipes (10).

4. A device according to claim 1, *characterized in* the presence of an additional quick flooding valve (13), placed in the upper part of tank (S) and shaped for having a great carriage and that will be opened by the depression determined in the tank and by the pressure performed by the water column, and that in normal conditions is kept closed by the internal pressure and by two small arched steel blades, opportunely tared, with its central pin in the cap and the ends thereof resting on the edge of the hole in tank (S).
5. A device according to claim 1, *characterized in* the presence of a safety rope (D) connected to the load to be transported, and having two functions: acting as a fishing-line and slowing down the descent of the load and the rising of the device according to the present invention.
6. A device according to claim 1, *characterized in* the presence of a cover (9) for blocking wheel (8) in position *a* in two cases: during loading and when the load is transported to the upper part of the frame.
7. A device according to claim 1, *characterized in* a pressurizing system for touching great depths because the internal pressure of tank (S) is always equal to the outer pressure due to valve (V), while float (G) and tanks (Sg) must be connected with compressed air behind the outlet of valve (2e) so that said tanks and said float will always be filled with air and with a pressure equal to the one of tank (S).
8. A device according to claim 1, *characterized in* a loading system for the transport of loads under water, with a frame (T)

provided with resting rods (Ba) that may be adjuste in height and the position whereof depends on the weight of the load and the position of loading and/or unloading of the device according to the present invention.

5

10

15

20

25

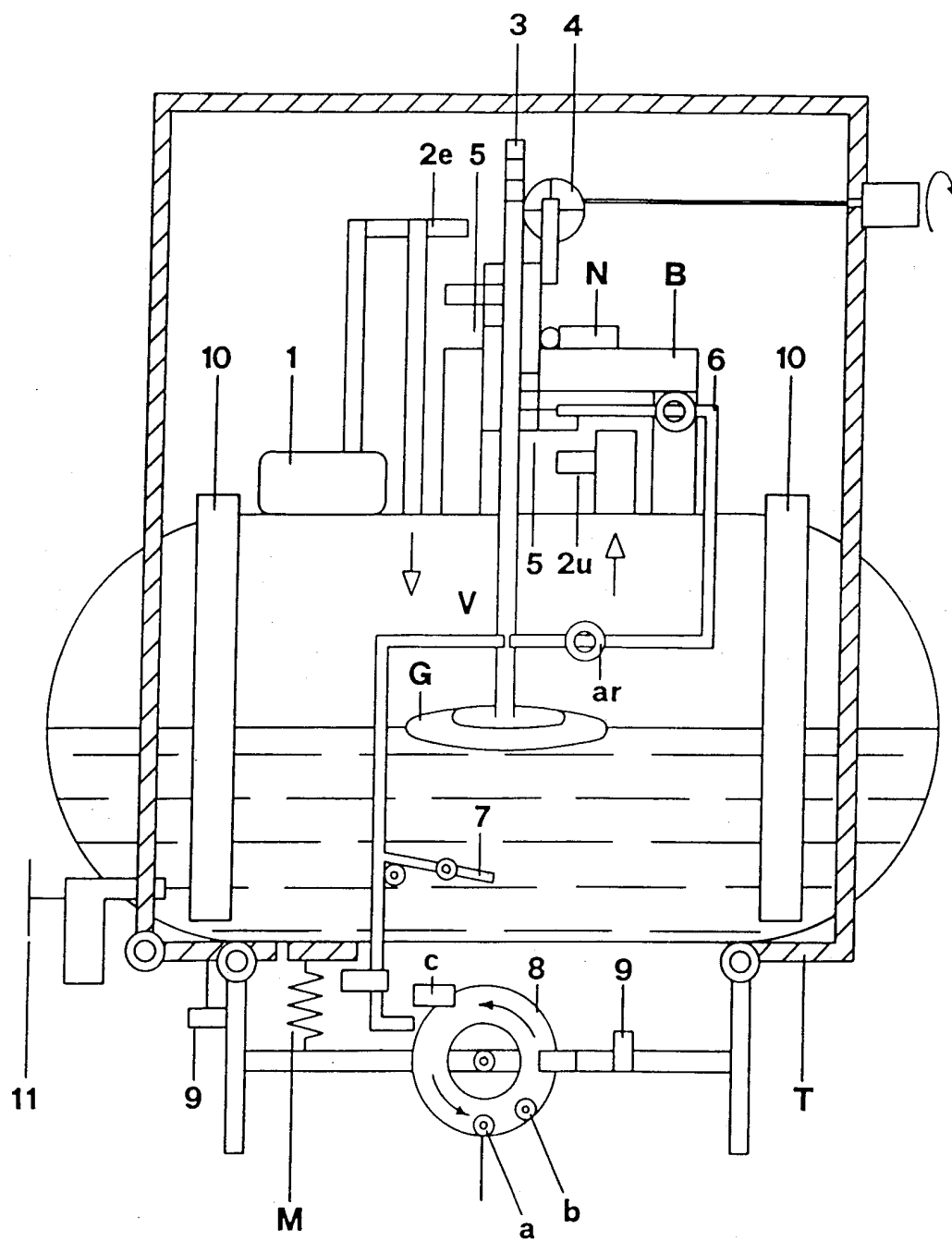


FIG.1

2/3

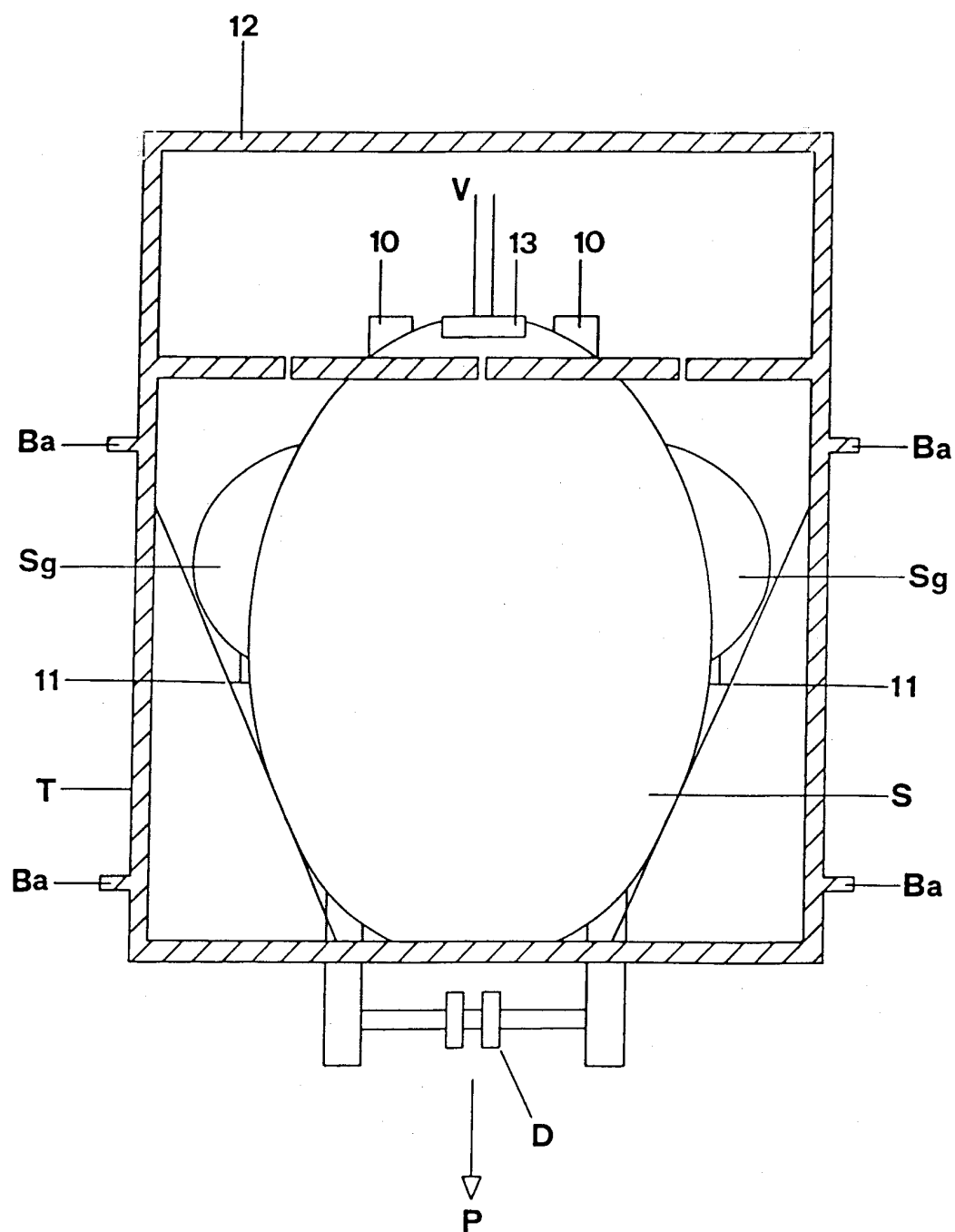


FIG.2

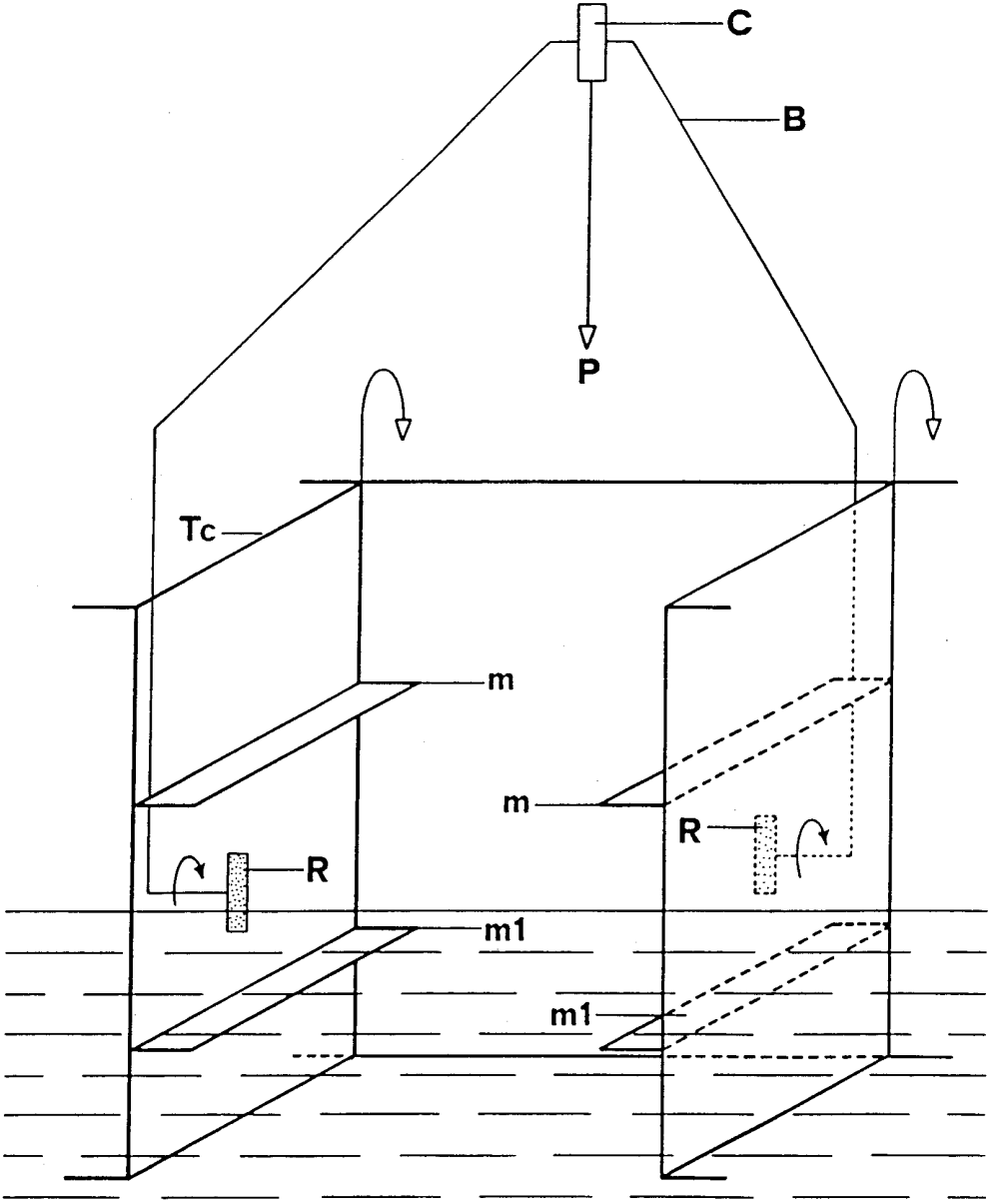


FIG.3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 00/00408

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B63C7/08

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 7 B63C

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 710 746 A (MC DONALD I) 16 January 1973 (1973-01-16) the whole document ----	1-8
A	US 4 677 931 A (BUCKLE BRIAN L) 7 July 1987 (1987-07-07) the whole document ----	1-8
A	GB 1 491 359 A (BVS) 9 November 1977 (1977-11-09) ----	
A	US 5 031 555 A (ALLEN DAVID P) 16 July 1991 (1991-07-16) -----	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

22 February 2001

Date of mailing of the international search report

01/03/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040. Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

De Schepper, H

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IT 00/00408

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3710746 A	16-01-1973	DE 2104411 A FR 2077633 A GB 1338560 A NL 7101298 A	30-09-1971 29-10-1971 28-11-1973 03-08-1971
US 4677931 A	07-07-1987	DK 413985 A EP 0221892 A WO 8503049 A GB 2182892 A,B NO 853550 A	11-09-1985 20-05-1987 18-07-1985 28-05-1987 11-09-1985
GB 1491359 A	09-11-1977	FR 2284512 A NL 7507179 A	09-04-1976 28-01-1976
US 5031555 A	16-07-1991	NONE	