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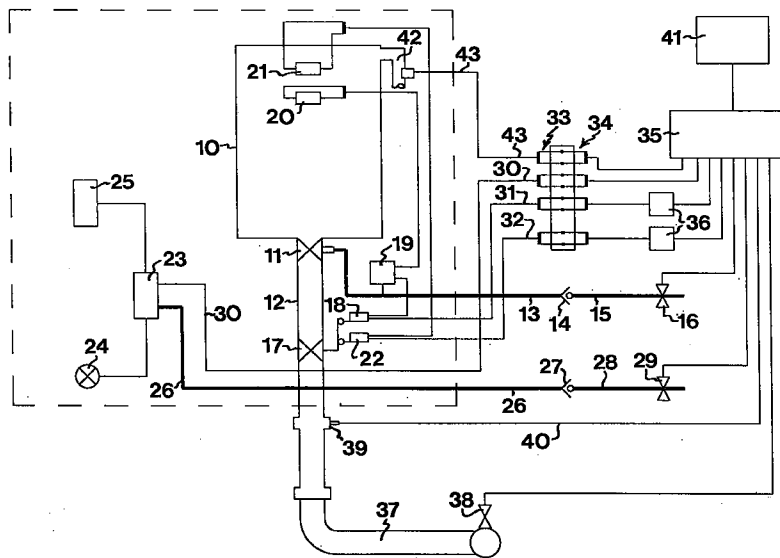
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(54) Safety system for tank lorries

(57) A safety system for loading tank lorries comprises two level indicators (20, 21) arranged at different levels in the individual compartment (10). The lowermost level indicator (20) is connected to a control device (35, 41) included in the safety system by being connected in series on the one hand with a pressure gauge (19), which senses the pressure in a compressed-air conduit (13) to the bottom valve (11) of the compartment and, on the other hand, with a limit transducer (18)

of a manual or automatic operating valve (17), which is arranged in the branch conduit (12) of the tank lorry. Moreover, the safety system comprises a safety circuit (23), which is connected to the control device (35, 41) and is adapted to check that the engine of the lorry is not running and to prevent starting of the engine of the lorry when unloading is to take place.



## Description

When unloading explosive liquid loads, for instance oil and petrol, to tank lorries, there is a great risk of malfunction involving risks of damage. A common error is that overcharging of a compartment or filling of the incorrect compartment in the tank lorry takes place. Originally, the tank lorry drivers have applied completely visual methods, i.e. they used a key-operated switch and, optionally, a product selector for the starting of pumps and valves. The filled quantity was then checked by the driver placing himself on top of the tank lorry with the manhole covers open. When the individual compartment was almost full, the driver had to climb down to the ground and stop the filling operation. This system is complicated and may cause accidents caused by, for example, slipping, explosion etc.

In order to reduce the risk of overcharging, the various compartments of the tank lorries have then been equipped with an overcharging protection means in the form of a so-called thermistor, a resistor sensitive to temperature. This was connected to the depot by means of a plug. At the depot there was an amplifier that converted the signal from the thermistor to a relay signal for closing a solenoid valve at the depot. This system functions if all components included are new and correctly adjusted. Problems may, however, arise after some time, e.g. a mechanical fault in the solenoid valve at the depot. As a consequence, the product continues to flow into the tank lorry although the electric signal to the solenoid valve has disappeared. This risk was later eliminated by the installation of a further thermistor in each compartment, and an amplifier on the tank lorry. The control signal emitted by the thermistor was amplified in the amplifier in order to control a solenoid valve, which was used to open, by means of the compressed-air system of the lorry, a bottom valve in compartment such that the product could flow into the compartment. When the product level has reached this additional thermistor and this is cooled, the solenoid valve is closed. This system afforded additional safety against overcharging if the protecting means of the depot should not be functioning. This safety system on the tank lorry is, in fact, functioning on its own and completely independent of the depot. In spite of this double safety, overflowing could take place if both systems ceased to function at the same time.

In a further development of this system use has besides been made of an unloading computer at the depot. This computer has a database with information on compartment volumes in each tank lorry. When the driver arrives at the depot, he enters a lorry code to give the unloading computer information on which lorry is involved. Thus the unloading computer obtains an identification. The driver then selects the product and indicates which compartment he wants to load. In this context, a thermistor plug connected to the computer must be connected to the selected compartment. This increased system confers the advantage that the

unloaded quantity to the individual compartment cannot exceed the space of the compartment if the database is correct. When the loading of the first compartment begins, the unloading system loads the desired volume. The system has a time delay which enables filling of the next compartment only after a certain time of waiting, thereby achieving a certain amount of safety that the driver has moved the thermistor plug to the next compartment and opened this.

This system has been used to a great extent and has afforded great safety. However, it still happens that overflowing and spillage take place owing to various kinds of carelessness.

An object of the present invention therefore is to further increase the safety and reduce the risk of malfunction and overflowing when unloading liquids to different types of lorries.

The invention is based on the knowledge that additional measures of precaution are necessary to counteract certain types of malfunction or wrong operation on the part of the staff or owing to deficiencies in the unloading computer or its database.

The invention is based on a known safety system, which comprises a control device at the depot for controlling the loading procedure and the opening and closing of a product valve in a connection conduit from the depot to an inlet conduit included in the tank lorry; a liquid-sensing transducer connected to said control device and arranged at the top in the individual load compartment of the tank lorry for interrupting the liquid supply to the individual load compartment for preventing overflow, when liquid is detected; a liquid level transducer connected to the control device of the depot at a lower level in the individual load compartment for interrupting the liquid supply when filling of this compartment to a predetermined maximum level therein has taken place; an inlet valve of the individual compartment, said inlet valve being connected to the control device of the depot and being activatable by said control device; an operating valve included in the inlet conduit; and a connection transducer connected to the control device of the depot and adapted to check whether the connection conduit is connected to the inlet conduit before the operating valve thereof, or not.

In order to further reduce the risk of overcharging and spillage of liquid, this known safety system is to be supplemented, according to the invention, with a sensor included in the connection of the control device to the inlet valve and adapted to sense the setting position of the inlet valve; a further sensor connected in series with said sensor and adapted to sense the setting position of the operating valve included in the inlet conduit; a control circuit included in the control device of the depot and adapted to prevent opening of the product valve or to close the same if one or both sensors indicate the closed position of the associated valve; a safety circuit which is included in the electric system of the tank lorry and is connected to the control device and is adapted to check that the engine of the lorry is switched off and to

prevent starting of the engine of the lorry when loading is to take place.

The invention thus is based on the knowledge that an increase of the safety is required by sensing not only of both the setting position of the inlet valve included in the inlet conduit and the setting position of the operating valve included in the inlet conduit, but also of the fact that the engine of the tank lorry is switched off and cannot be started by means of its starting motor. This information is then used in the control device of the unloading depot, thereby preventing a product valve from being opened if either of or both of these monitored valves is/are in closed condition or if the engine is running or if electric connection could be established between the ignition key switch and the starting motor. This prevents the unloading to the tank lorry if the individual compartments of the tank lorry are not prepared to receive a load or if the engine of the tank lorry is running or if there is a possibility of starting the engine.

In a further development of the invention, the safety system has besides been increased with an identification device, which comprises an identification circuit on the tank lorry and a sensing circuit in the unloading device of the depot. This further development also eliminates the risk that the tank lorry driver by mistake indicates a lorry code which is incorrect in relation to the vehicle he is driving.

An embodiment of the invention will now be described in more detail with reference to the accompanying drawing, which schematically shows an individual compartment of a plurality of compartments in a tank lorry and the associated safety equipment.

For the sake of clarity, the Figure illustrates only one compartment 10 in a tank lorry. The components belonging to the individual compartment are therefore multiplied by the number of compartments in the tank lorry involved. At the top the compartment has a man-hole cover (not shown) and a venting tube. At the lower end of the compartment there is an inlet valve 11 at the end of an inlet pipe 12. The inlet pipe is part of a branch conduit, the various branches of which are connected to different compartments in the tank lorry. The inlet valve 11 is pressure-controlled, in the case shown by compressed air via a conduit 13. The conduit 13 is connectible, with the aid of connecting means 14 at the end of a supply conduit 15, to an external compressed-air source at the tank depot. A control valve 16 is arranged in the conduit 15 for controlling the supply of compressed air.

At the inlet end of the inlet pipe or branch conduit 12, an operating valve 17 is arranged, which in the shown embodiment is manual but which could also be compressed-air operated. On the control means of the valve, a limit transducer 18 is arranged to sense whether the valve is closed or open. According to the invention, this limit transducer is connected in series on the one hand with a pressure gauge 19 sensing the pressure in the conduit 13 and, on the other hand, a lowermost level indicator 20 which is in the form of a

thermistor or capacitive transducer and is arranged in the upper part of the compartment 10.

In the uppermost part of the compartment there is a further level indicator 21, which also is in the form of a thermistor or capacitive transducer. The latter level indicator 21 is connected in series with a further limit transducer 22 arranged on the operating valve 17.

As shown, a safety circuit 23 is included in the tank lorry. This device comprises a pressure-controlled switch, which is connected to the electric system of the tank lorry to prevent starting of the engine by means of the ignition key switch 24 of the tank lorry and its starting motor 25 and for preventing the loading operation from being begun if the motor should be running. The pressure-controlled switch included in the safety circuit 23 is therefore, via a compressed-air conduit 26, a connecting means 27, a supply conduit 28 and a control valve 29 connected to an external compressed-air source at the depot. The safety circuit 23 also includes transducers, which are connected to a signal line 30 and which are arranged to indicate whether the engine of the lorry is switched off and also indicate that the pressure-controlled switch has opened the electric circuit between the ignition key switch 24 and the starting motor 25.

The signal line 30 and signal lines 31 and 32 from the limit transducers 18, 22 are each connected to a pole in a contact means 33. This is in turn connectible to corresponding contact means 34 at the unloading position of the depot, such that the various signals can be conducted to a control device or circuit 35 which is arranged at the depot and is in the form of a PLC. If necessary, amplifiers 36 may have been arranged in the connection lines between the transducers 18 and 22 and the control circuit 35.

With a view to checking that a supply pipe or depot pipe 37 between the main valve 38 of the depot and the operating valve 17 of the tank lorry is connected, an inductive transducer 39 or some other type of transducer is arranged in prior-art manner. This transducer is connected to the control circuit 35 via a signal line 40. The control circuit 35 is in turn connected to a master computer 41.

The components that are arranged on the individual tank lorry have been framed by the dashed line A in the drawing.

According to the invention, a prior-art tank lorry has thus been modified by the lowermost thermistor 20 in the compartment 10 being connected in series with on the one hand a pressure gauge 19, which senses the pressure exerted on the pressure conduit 13 to the bottom valve 11 of the compartment and, on the other hand, with a limit transducer 18 of a manual or automatic valve 17, which is arranged on the manifolds or branch conduit 12 of the tank lorry. This arrangement results in a feed-back coupling, such that the loading operation can begin only if the correct bottom valve 11 is pressurised and the correct operating valve 17 is open. Moreover, loading cannot begin until it has been

checked that the engine of the tank lorry is not running and the pressure switch included in the safety circuit 23 has opened the necessary electric circuits for the starting motor and the engine, such that the engine certainly cannot be started during loading.

By the uppermost thermistor 21 in the compartment 10 or its venting tube being connected in series with the limit transducer 22 of the operating valve 17, a feedback coupling is also obtained, such that a signal is received only if the correct operating valve 17 is open. This means that if the driver tries to open the operating valve 17 of the incorrect compartment, or if he tries to open a further operating valve 17, an error signal is received owing to the circuit for the thermistor 21 being balanced. In this context it must be emphasised that the usual amplifier of the tank lorry is automatically disconnected when connecting the lorry to the safety system.

In tank lorries which have no branch conduit or manifolds, the depot tube 37 is connected to each individual compartment, and in this case the lorry is supplemented with a limit transducer on each compartment for sensing whether the depot tube 37 is connected to the correct compartment.

A multipolar electric member 33 is mounted on a cable from the tank lorry for the above-mentioned functions. This member may have more contact pins than those shown, such that by strapping certain contact pins, it is possible to produce an identification code for the lorry involved. A similar identification can be obtained by mounting an ID circuit on the tank lorry and connecting this ID circuit with the control circuit 35 and the computer 41 via the connecting cable from lorry to control circuit 35. Such an arrangement prevents mistakes and mishaps caused by the driver indicating an incorrect lorry code.

In the venting pipe 42 for the compartments, it is also possible to mount a capacity transducer 43 which senses liquid. The transducer 43 is connected to the control circuit 35 of the depot via the multipolar electric member 33 and emits a signal to the control circuit if liquid should escape through the venting pipe. If the above-mentioned safety functions cannot be performed, this signal can therefore be used to activate emergency shut-down etc.

As mentioned above, all controlling of valves takes place by using a pressure medium, especially compressed air, from an external pressure source arranged at the depot. The tank lorry must therefore be rebuilt to permit a multipolar compressed-air means to be connected to the lorry. This compressed-air means comprises the connecting means 27 and also the same number of connecting means 14 as the number of compartments in the individual tank lorry. The usual compressed-air system of the lorry is disconnected by means of a shuttle valve for each bottom valve. This means that compressed air is supplied from the depot only. A compressed-air signal is used in order to disconnect the starting motor 25 of the tank lorry via the pressure switch included in the safety circuit 23. The safety

circuit 23 also checks that the engine of the lorry is switched off. The transducer of this pressure switch is, via the line 30, fed back to the depot. The unloading does not start without a feedback signal.

The carrying out of the invention requires modification of the depot as well. In the unloading position a box is mounted, which contains the compressed-air valves 16 and 29 and the compressed-air connecting means 14, 27 in order to open the bottom valves 17 of the lorry and actuate the pressure switch included in the safety circuit 23 of the lorry.

The control circuit 35 (a PLC) is programmed so as to receive information on the compartment volumes of the lorry from a master computer having a database with information on the tank lorries concerned. When the driver has entered his personal code or pulled his driving licence over a bar-code scanner, the unloading begins by the correct compartment receiving an opening signal. The PLC control circuit 35 checks that all signals from the tank lorry are correct. If this is the case, the product valve 38 opens for filling a preselected quantity. When the preselected quantity has been dosed or the thermistor 20 of the depot has lost the signal, the unloading is interrupted until the driver has opened the operating valve 17 of the next compartment. This sequence is repeated until all preprogrammed compartments have been filled.

By applying the invention, errors owing to the human factor are eliminated. The only thing that is required to begin the unloading operation is that the driver indicates his code or pulls his driving licence over a bar-code scanner, whereupon the computers take over the unloading. When the unloading has begun, the driver's only tasks are to monitor the unloading and open the correct operating valve 17. If he tries to open an incorrect valve or more than one valve, the unloading operation is stopped.

## Claims

1. A safety system for tank lorries for reducing the risks when loading the tank lorry from a depot, comprising

a control device (35, 41) at the depot for controlling the loading procedure and the opening and closing of a product valve (38) in a connection conduit (37) from the depot to an inlet conduit (12) included in the tank lorry,

a liquid-sensing transducer (21) connected to said control device (35, 41) and arranged at the top in the individual load compartment (10) of the tank lorry for interrupting the liquid supply to the individual load compartment for preventing overcharging, when liquid is detected,

a liquid level transducer (20) connected to the control device (35, 41) of the depot at a lower level in the individual load compartment (10) for interrupting the liquid supply when filling of this

compartment to a predetermined maximum level therein has taken place,

an inlet valve (11) of the individual compartment (10), said inlet valve being connected to the control device (35, 41) of the depot and being activatable by said control device, an operating valve (17) included in the inlet conduit (12) and a connection transducer (39) connected to the control circuit (35, 41) of the depot and adapted to check whether the connection conduit (37) is connected to the inlet conduit (12) before the operating valve (17) thereof, or not,

**characterised** in that it also comprises a sensor (19) included in the connection of the control device (35, 41) to the inlet valve (11) and adapted to sense the setting position of the inlet valve;

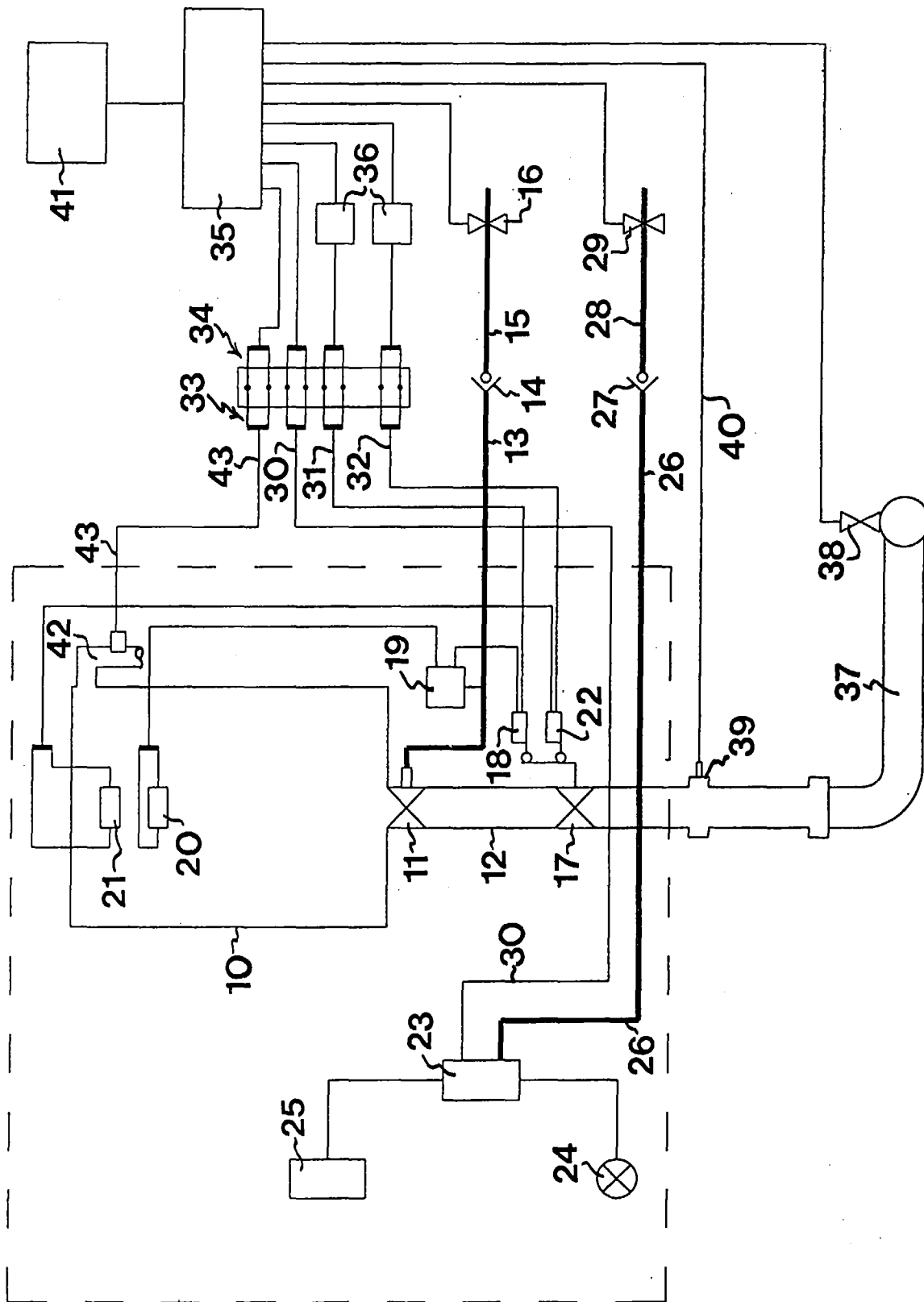
a further sensor (18) connected in series with said sensor (19) and adapted to sense the setting position of the operating valve (17) included in the inlet conduit (12);

a control circuit (35) included in the control device (35, 41) of the depot and adapted to prevent opening of the product valve (38) or to close the same if one or both sensors (18, 19) indicate the closed position of the associated valve (11, 17),

a safety circuit (23) which is included in the electric system of the tank lorry and is connected to the control device (35, 41) of the depot and is adapted to check that the engine of the lorry is switched off and to prevent starting of the engine of the lorry when loading is to take place.

2. A safety system as claimed in claim 1, **characterised** in that it also comprises an identification device, which comprises an identification circuit on the tank lorry and a sensing circuit in the unloading device of the depot.

3. A safety system as claimed in claim 1 or 2, **characterised** in that a further, liquid-sensing transducer (43) is arranged in the venting pipe (42) of the tank lorry from the compartments (10) and is connected to the control device (35, 41) of the depot for closing the product valve (38) when detecting liquid in the venting pipe.





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EUROPEAN SEARCH REPORT

Application Number  
EP 97 85 0071.8

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.6)
A	DE 4402966 A1 (ALFONS HAAR MASCHINENBAU GMBH & CO.), 3 August 1995 (03.08.95) * column 3, line 58 - column 4, line 3, figure 1, claim 1 *  --	1-3	B67D 5/32 B67D 5/34
A	US 4649968 A (BERRETTINI ET AL), 17 March 1987 (17.03.87) * column 3, line 11 - line 27, figures 1,3 *  --	1-3	
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A	EP 0440299 A1 (SHELL INERNATIONALE RESEARCH MAATSCHAPPIJ B.V.), 7 August 1991 (07.08.91) * figures 1-2, claims 1-4 *  --	1-3	TECHNICAL FIELDS SEARCHED (Int. Cl.6) B67D B65D B60P
A	US 4058148 A (POTTER), 15 November 1977 (15.11.77) * figure 1, abstract *  --	1-3	
The present search report has been drawn up for all claims			
Place of search STOCKHOLM		Date of completion of the search 14 August 1997	Examiner MÅRTEN HULTHÉN
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone                      Y : particularly relevant if combined with another document of the same category                      A : technological background                      O : non-written disclosure                      P : intermediate document</p> <p>T : theory or principle underlying the invention                      E : earlier patent document, but published on, or after the filing date                      D : document cited in the application                      L : document cited for other reasons                      &amp; : member of the same patent family, corresponding document</p>			

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.6)
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A	US 4780705 A (BEANE), 25 October 1988 (25.10.88) * figure 1, claim 1 *  --	1-3	
A	WO 9309997 A1 (MARINE POWER AND CONTROL, INC.), 27 May 1993 (27.05.93) * page 6, figure 1, claims 27,37 *  -----	1-3	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.6)
Place of search STOCKHOLM		Date of completion of the search 14 August 1997	Examiner MÅRTEN HULTHÉN
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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