CLAIMS

1. A vessel with a retractable thruster assembly, the vessel comprising a hull, a vertical thruster well within the hull, said thruster well having a bottom opening in a bottom plane of the hull,

the vessel further comprising a retractable thruster assembly,

wherein the thruster assembly comprises:

- a thruster head with a propeller,
- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted so as to extend below the casing structure, the casing structure including a watertight compartment, an electric propeller drive motor being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an operative extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

the vessel further comprising a retraction device for vertical displacement of the thruster assembly between an operative extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

wherein an annular gap is present between the lower end of the casing structure and a surrounding lower seal face portion of the thruster well that surrounds the lower end of the casing structure when the thruster assembly is in its extended position,

wherein a first operable sealing device is provided at the lower end of the casing structure of the thruster assembly, said first sealing device comprising one or more operable circumferential sealing members extending around the lower end of the casing structure, said one or more sealing members being adapted to seal the annular gap by sealingly engaging the surrounding lower seal face portion of the thruster well when the thruster assembly is in its extended position,

wherein the lower end portion of the casing structure further includes a circumferential seal face below the one or more sealing members of the first sealing device,

and wherein a second operable sealing device is mounted in the thruster well, spaced a vertical distance above the lower seal face portion of the thruster well, said second sealing device comprising one or more circumferential operable sealing members extending along an inner circumference of the thruster well, said one or more sealing members being adapted to seal the annular gap by sealingly engaging the circumferential seal face portion of the lower end portion of the casing structure when the thruster assembly is in its retracted position, so that

in its retracted position the thruster assembly is raised with its one or more sealing members of the first sealing device above the level of the second sealing device, thereby allowing access to the one or more sealing members of the first sealing device for inspection and/or maintenance, and so that with the thruster assembly in its extended position the one or more sealing members of the second sealing device are accessible for inspection and/or maintenance.

2. Vessel according to claim 1, wherein the one or more sealing members of the first sealing device and/or the second sealing device are expandable sealing members and the sealing device comprises an expansion arrangement that is selectively operable to cause expansion of expandable sealing members.

3. Vessel according to claim 2, wherein the expandable sealing members are inflatable and include one or more internal chambers and wherein the expansion arrangement comprises a source for an inflation fluid, e.g. compressed air.

4. Vessel according to one or more of the preceding claims, wherein the thruster well extends to above the waterline of the vessel, and wherein the second sealing device is arranged below the load waterline of the vessel, and wherein a pump is provided to empty the thruster well above the second sealing device when employed with the thruster assembly in its retracted position.

5. Vessel according to one or more of the preceding claims, wherein – when moving the thruster assembly from its extended to its retracted position – first the thruster well is flooded to the actual waterline level, then the first sealing device is operated to disengage the one or

more sealing members from the surrounding lower seal face of the thruster well, and then the thruster assembly is brought into its retracted position.

6. A vessel with an underwater demountable and retractable thruster assembly, the vessel comprising a hull, a vertical thruster well within the hull, said thruster well having a bottom opening in a bottom plane of the hull,

the vessel further comprising an underwater demountable and retractable thruster assembly,

wherein the thruster assembly comprises:

- a thruster head with a propeller,
- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted with its top end so as to extend below the casing structure, the casing structure including a watertight compartment, a propeller drive motor, preferably electric, being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an operative extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

wherein the thruster assembly has negative buoyancy, and wherein the vessel further includes a thruster assembly hoisting device adapted to lower the thruster assembly downwards fully out of the thruster well as well as lift the thruster assembly from a position fully outside of the hull upward into the thruster well.

7. A vessel according to claim 6, wherein a drive shaft section in the watertight compartment above the top end of the thruster head is removable, and wherein a watertight closure is provided that is mountable to extend over the top end of the thruster head, wherein the thruster assembly hoisting device is adapted to engage directly on the thruster head, and wherein the thruster head is detachable from the casing structure, thereby allowing to lower the thruster head fully below the casing structure as well as lift the thruster head to the casing structure while said casing structure is positioned in the thruster well, preferably in the extended position thereof.

8. A vessel with a retractable thruster assembly, the vessel comprising a hull, a vertical thruster well within the hull, said thruster well having a bottom opening in a bottom plane of the hull,

the vessel further comprising a retractable thruster assembly,

wherein the thruster assembly comprises:

- a thruster head with a propeller,
- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted so as to extend below the casing structure, the casing structure including a compartment, preferably watertight, a propeller drive motor, preferably electric, being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an operative extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

the vessel further comprising a retraction device for vertical displacement of the thruster assembly between an operative extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received with the thruster well,

wherein the vessel further includes an operable locking device having one or more mobile locking members, said locking device being adapted to lock the thruster assembly with respect to the thruster well at least in its extended position, at least in vertical direction, preferably the locking device being adapted to lock the thruster assembly also in a horizontal plane with respect to the thruster well,

wherein the vessel further includes an operable positioning device having one or more mobile positioning members that are distinct from the one or more mobile locking members, said positioning device being adapted to bring, or at least assist in bringing, the thruster assembly in a pre-locking position with respect to the thruster well,

and wherein the vessel is adapted to first operate the positioning device and bring the thruster assembly in its pre-locking position and then to operate the locking device and lock the thruster assembly with respect to the thruster well.

9. A vessel according to claim 8, wherein the locking device comprises a set of mobile locking members, e.g. pins, and associated receiving members, the locking members and the associated receiving members being arranged on the casing structure and the well respectively, or vice versa, wherein the mobile locking members are movable between a disengaged position wherein they are free for the receiving members and the thruster assembly is movable vertically within the thruster well, and a locked position, wherein thruster assembly is locked within the thruster well.

10. A vessel according to claim 8 or 9, where the positioning device comprises a set of mobile positioning members and associated receiving members, the mobile positioning members and the associated receiving members being arranged on the casing structure and the well respectively, or vice versa, wherein the mobile positioning members are movable between a disengaged position wherein they are free from the receiving members and the thruster assembly is movable vertically within the thruster well, and an engaged position, wherein they mate with the receiving members.

11. A thruster installation to be mounted in a hull of a vessel comprising a thruster well and a thruster assembly according to one or more of the preceding claims.

12. A thruster assembly according to one or more of the preceding claims.

13. Method of operating a vessel according to one or more of the preceding claims, preferably a method for underwater demounting a thruster assembly of said vessel.

CLAIMS

1. A vessel with a retractable thruster assembly, the vessel comprising a hull, a vertical thruster well within the hull, said thruster well having a bottom opening in a bottom plane of the hull,

the vessel further comprising a retractable thruster assembly,

wherein the thruster assembly comprises:

- a thruster head with a propeller,

- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted such that the thruster head extends below the casing structure, the casing structure including a watertight compartment, a motor being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

the vessel further comprising a retraction device for vertical displacement of the thruster assembly between said extended position and said retracted position,

wherein an annular gap is present between the lower end portion of the casing structure and a surrounding lower seal face portion of the thruster well that surrounds the lower end portion of the casing structure when the thruster assembly is in said extended position,

wherein a first sealing device is provided at the lower end portion of the casing structure of the thruster assembly, said first sealing device comprising one or more circumferential sealing members extending around the lower end portion of the casing structure, said one or more circumferential sealing members of said first sealing device being expandable circumferential sealing members, wherein the first sealing device comprises an expansion arrangement configured to cause expansion of the expandable circumferential sealing members of said first sealing device to seal the annular gap by sealingly engaging the surrounding lower seal face portion of the thruster well when the thruster assembly is in said extended position,

wherein the lower end portion of the casing structure further includes a circumferential seal face below the one or more sealing members of the first sealing device,

and wherein a second sealing device is mounted in the thruster well, spaced a vertical distance above the lower seal face portion of the thruster well, said second sealing device comprising one or more circumferential sealing members extending along an inner

circumference of the thruster well, said one or more circumferential sealing members of said second sealing device being expandable circumferential sealing members, wherein the second sealing device comprises an expansion arrangement configured to cause expansion of the expandable circumferential sealing members of said second sealing device to seal the annular gap by sealingly engaging the circumferential seal face portion of the lower end portion of the casing structure when the thruster assembly is in said retracted position, so that

in said retracted position the thruster assembly is raised with said one or more circumferential sealing members of the first sealing device above the level of the second sealing device, thereby allowing access to the one or more circumferential sealing members of the first sealing device for inspection and maintenance, and so that with the thruster assembly in said extended position the one or more sealing members of the second sealing device are accessible for inspection and maintenance.

2. The vessel according to claim 1, wherein the expandable circumferential sealing members of the first and second sealing devices are inflatable and each include one or more internal chambers and wherein the expansion arrangement of each of the first and second sealing devices comprises a source for an inflation fluid.

3. The vessel according to claim 1, wherein the thruster well extends to above a load waterline of the vessel, and wherein the second sealing device is arranged below the load waterline of the vessel, and wherein a pump is provided to empty the thruster well above the second sealing device when employed with the thruster assembly in said retracted position.

4. A method for moving a thruster assembly from said extended position to said retracted position in a vessel according to claim 1, wherein, when moving the thruster assembly from said extended to said retracted position, first the thruster well is flooded to the actual waterline level, then the first sealing device is operated to disengage the one or more circumferential sealing members of the first sealing device from the surrounding lower seal face of the thruster well, and then the thruster assembly is brought into said retracted position.

5. A thruster installation to be mounted in a hull of a vessel comprising a vertical thruster well and a retractable thruster assembly, said thruster well having a bottom opening adapted to extend in a bottom plane of the hull,

wherein the thruster assembly comprises:

- a thruster head with a propeller,

- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted such that the thruster head extends below the casing structure, the casing structure including a watertight compartment, a motor being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an extended position, in which the thruster head projects downward beyond the bottom opening, and a retracted

position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

the installation further comprising a retraction device for vertical displacement of the thruster assembly between said extended position and said retracted position,

wherein an annular gap is present between the lower end portion of the casing structure and a surrounding lower seal face portion of the thruster well that surrounds the lower end portion of the casing structure when the thruster assembly is in said extended position,

wherein a first sealing device is provided at the lower end portion of the casing structure of the thruster assembly, said first sealing device comprising one or more circumferential sealing members extending around the lower end portion of the casing structure, said one or more circumferential sealing members of said first sealing device being expandable circumferential sealing members, wherein the first sealing device comprises an expansion arrangement configured to cause expansion of the expandable circumferential sealing members of said first sealing device to seal the annular gap by sealingly engaging the surrounding lower seal face portion of the thruster well when the thruster assembly is in said extended position,

wherein the lower end portion of the casing structure further includes a circumferential seal face below the one or more circumferential sealing members of the first sealing device,

and wherein a second sealing device is mounted in the thruster well, spaced a vertical distance above the lower seal face portion of the thruster well, said second sealing device comprising one or more circumferential sealing members extending along an inner circumference of the thruster well, said one or more circumferential sealing members of said second sealing device being expandable circumferential sealing members, wherein the second sealing device comprises an expansion arrangement configured to cause expansion of the expandable circumferential sealing members of said second sealing device to seal the annular gap by sealingly engaging the circumferential seal face portion of the lower end portion of the casing structure when the thruster assembly is in said retracted position, so that

in said retracted position the thruster assembly is raised with said one or more circumferential sealing members of the first sealing device above the level of the second sealing device, thereby allowing access to the one or more circumferential sealing members of the first sealing device for inspection and maintenance, and so that with the thruster assembly in said extended position the one or more circumferential sealing members of the second sealing device are accessible for inspection and maintenance.

6. A vessel with an underwater demountable and retractable thruster assembly, the vessel comprising a hull, a vertical thruster well within the hull, said thruster well having a bottom opening in a bottom plane of the hull,

the vessel further comprising an underwater demountable and retractable thruster assembly,

wherein the thruster assembly comprises:

a thruster head with a propeller,

a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted with said top end such that the thruster head extends below the casing structure, the casing structure including a watertight compartment, a motor being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

wherein the thruster assembly has negative buoyancy, and wherein the vessel further includes a thruster assembly hoisting device adapted to lower the thruster assembly downwards fully out of the thruster well as well as lift the thruster assembly from a position fully outside of the hull upward into the thruster well.

7. The vessel according to claim 6, wherein a drive shaft section in the watertight compartment above the top end of the thruster head is removable, and wherein a watertight closure is provided that is mountable to extend over the top end of the thruster head, wherein the thruster assembly hoisting device is adapted to engage directly on the thruster head, and wherein the thruster head is detachable from the casing structure, thereby allowing to lower the thruster head fully below the casing structure as well as lift the thruster head to the casing structure while said casing structure is positioned in the thruster well.

8. A vessel with a retractable thruster assembly, the vessel comprising a hull, a vertical thruster well within the hull, said thruster well having a bottom opening in a bottom plane of the hull,

the vessel further comprising a retractable thruster assembly,

wherein the thruster assembly comprises:

- a thruster head with a propeller,
- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted such that the thruster head extends below the casing structure, the casing structure including a compartment, a motor being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an extended position, in which the thruster head projects downward beyond the bottom plane of the hull, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

the vessel further comprising a retraction device for vertical displacement of the thruster assembly between said extended position and said retracted position,

wherein the vessel further includes an locking device having one or more mobile locking members, said locking device being adapted to lock the thruster assembly with respect to the thruster well at least in said extended position, at least in vertical direction,

wherein the vessel further includes an positioning device having one or more mobile positioning members that are distinct from the one or more mobile locking members, said positioning device being adapted to bring, or at least assist in bringing, the thruster assembly in a pre-locking position with respect to the thruster well, wherein in the pre-locking position, the thruster assembly is capable of being locked with respect to the thruster well by the locking device,

and wherein the vessel is adapted to first operate the positioning device and bring the thruster assembly in said pre-locking position and then to operate the locking device and lock the thruster assembly with respect to the thruster well.

9. The vessel according to claim 8, wherein the locking device comprises a set of mobile locking members and associated receiving members, the locking members and the associated receiving members being arranged on the casing structure and the well respectively, or vice versa, wherein the mobile locking members are movable between a disengaged position wherein they are free from the receiving members and the thruster assembly is movable vertically within the thruster well, and a locked position, wherein thruster assembly is locked within the thruster well.

10. The vessel according to claim 8, where the positioning device comprises a set of mobile positioning members and associated receiving members, the mobile positioning members and the associated receiving members being arranged on the casing structure and the well respectively, or vice versa, wherein the mobile positioning members are movable between a disengaged position wherein they are free from the receiving members and the thruster assembly is movable vertically within the thruster well, and an engaged position, wherein they mate with the receiving members.

11. The vessel according to claim 9, where the positioning device comprises a set of mobile positioning members and associated receiving members, the mobile positioning members and the associated receiving members being arranged on the casing structure and the well respectively, or vice versa, wherein the mobile positioning members are movable between a disengaged position wherein they are free from the receiving members and the thruster assembly is movable vertically within the thruster well, and an engaged position, wherein they mate with the receiving members.

12. A thruster installation to be mounted in a hull of a vessel comprising a vertical thruster well and a retractable thruster assembly, said thruster well having a bottom opening adapted to extend in a bottom plane of the hull,

wherein the thruster assembly comprises:

- a thruster head with a propeller,

- a casing structure vertically guided in the thruster well, the casing structure having a lower end portion to which the thruster head is mounted such that the thruster head extends below the casing structure, the casing structure including a compartment, a motor being housed in said compartment,

wherein the thruster assembly is vertically displaceable between an extended position, in which the thruster head projects downward beyond the bottom opening, and a retracted position, in which the thruster assembly is raised and the thruster head is received within the thruster well,

the installation further comprising a retraction device for vertical displacement of the thruster assembly between said extended position and said retracted position,

wherein the installation further includes a locking device having one or more mobile locking members, said locking device being adapted to lock the thruster assembly with respect to the thruster well at least in said extended position, at least in vertical direction,

wherein the installation further includes a positioning device having one or more mobile positioning members that are distinct from the one or more mobile locking members, said positioning device being adapted to bring, or at least assist in bringing, the thruster assembly in a pre-locking position with respect to the thruster well, wherein in the pre-locking position, the thruster assembly is capable of being locked with respect to the thruster well by the locking device,

and wherein the installation is adapted to first operate the positioning device and bring the thruster assembly in said pre-locking position and then to operate the locking device and lock the thruster assembly with respect to the thruster well.