

A Barge Transport System

This invention relates to a barge transport system of the kind comprising at least one barge and at least one powered pushing vessel connectable to the or each barge for the transport thereof by pushing, the pushing
5 vessel as well as the or each barge being provided with means for connecting the pushing vessel rigidly to the or any selected barge.

Several different barge transport systems are known including a pushing vessel connectable to the stern
10 portion of a number of barges. The connection between the pushing vessel and the barge gives rise to problems, firstly, because the floating level of the barge varies according to its load and secondly because open sea conditions require an extremely rigid connection.

15 Attempts to solve these problems have been made based on the use of different vertically adjustable connection devices. In particular friction and mechanical clutch means devices have been used to provide locking between the pushing vessel and the barge. Furthermore
20 longitudinal slide members and cable or chain attachments have also been used. However friction locking is generally not seaworthy and connection means comprising long slide surfaces are difficult or impossible to connect or disconnect in rough water. Other known connection
25 means are so complicated or bulky, that their use is impractical.

The aim of the present invention is to solve the problems of connecting firmly a pushing vessel to a barge in a simple manner applicable, and also reliable,
30 in open sea conditions.

According to one aspect of the present invention

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there is provided a sea-going barge transport system comprising at least one barge having a notch extending through a stern portion thereof, at least one powered pushing vessel receivable in said notch of the or each barge for propelling the barge by pushing and connecting means for rigidly connecting said pushing vessel to the or any one of the barge(s) at any one of a number of different relative vertical positions of the pushing vessel within the notch of the barge, said connecting means comprising first engaging means in a fixed position at a front portion of said pushing vessel, second engaging means in a fixed position at a front portion of the notch of the or each barge interengageable with said first engaging means, third engaging means in the stern portion of, and at opposite respective sides of, the pushing vessel, fourth engaging means of the or each barge interengageable with each of said third engaging means and moving means operable to move the third engaging means or the fourth engaging means transversely of said pushing vessel to enable a mechanically positively locking inter-engagement and disengagement between the third and fourth engaging means, the said interengaging means being formed so that, on operation of the moving means to interengage the third and fourth engaging means of the or one of the barges, a wedging engagement between each third engaging means and its respective fourth engaging means transversely locks the pushing vessel to the barge and urges the pushing vessel forwardly into the notch to provide a wedging engagement between the third and fourth engaging means thereby minimising any movement inducing connection clearance between said pushing vessel and the barge.

In this specification the expression "stern portion" when applied to the pushing vessel means a portion of the pushing vessel being at a distance from the fore end of the pushing vessel of at least one half, preferably

at least $\frac{3}{4}$, of the length of the pushing vessel. The expression "mechanically positively locking" means mechanical locking by means of distinct support surfaces, not pure friction locking.

5 In a barge transport system in accordance with the invention the pushing vessel can be completely firmly connected to the or a selected barge by using connection means both in the front and in the stern portion of the pushing vessel, thereby forming a mechanically positively
10 locking connection having a tightening wedge-effect and including adjustment possibilities to meet changes in the floating level of the barge. On interengagement of said third and fourth engaging means, the wedging effect produced both mechanically locks the pushing vessel
15 transversely relative to the barge and urges the pushing vessel forwards relative to the barge in the longitudinal direction of the pushing vessel. This relative forward movement of the pushing vessel into the notch provides a wedging engagement of the first and second engaging means and is conveniently achieved by providing the third
20 engaging means as transversely movable wedge-formed connection members with a greater wedge angle at their rear side than at their front side.

In a preferred embodiment of the invention, the
25 barge comprises a number of wedge-formed depressions or protrusions at different height levels to which corresponding connection members of the pushing vessel can be connected or engaged for locking the pushing vessel firmly to the barge. The pushing vessel may have, at
30 each connection position, a single connection protrusion and the or each barge may be provided with corresponding connection depressions so arranged in vertical rows, that the pushing vessel can be connected to the barge at a desired level.

35 Special care has to be taken regarding the strength and the operational reliability in open sea of the movable

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connection elements used in the pushing vessel. Connection elements movable by means of slide surfaces are usually not wholly reliable in practice. It is preferred to use rotatably journalled connection members since shaft bearings are easier to protect against moisture and dirt than slide surfaces.

Since the realisation of a connection system which is infinitely variable in the vertical direction and at the same time is mechanically very firm, is complicated, it is recommended to use a connection system having a plurality of fixed vertical connection positions arranged stepwise with a given pitch. In order to be able to always obtain, in spite of the pitch, a quick and reliable connection, it is practical to provide the pushing vessel with a trim arrangement, by means of which the draught and the trim of the pushing vessel can be adjusted as known per se. Thereby, the necessary fine adjustment of the vertical position of the pushing vessel relative to the barge is easy to carry out.

Not only is a strong connection between the pushing vessel and the barge important, but the connection must also be accomplished quickly and securely under difficult conditions. Since the connection is based on mechanical locking, and not on frictional locking, the shape of a notch or opening in the barge arranged to receive the pushing vessel can be made to diverge over its total length, or at least substantially its total length, in the backwards direction of the barge. Such a shape is considerably more difficult to use in known constructions having parallel slide surfaces in the barge. However a diverging shape of the barge notch or opening is advantageous since the connection of the pushing vessel to the barge is facilitated. The hull of the pushing vessel is preferably shaped to correspond to the shape of the barge notch. Further, it is preferred that the length of the notch is at least 80% of the length of the pushing vessel.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which

Figure 1 is a side view of an embodiment of a pushing vessel of a barge transport system according to the invention,

Figure 2 is a longitudinal section of a pushing vessel receiving recess at the stern end of a barge for receiving the pushing vessel shown in Figure 1,

Figure 3 shows alternative connection means for connecting the bow of a pushing vessel to a barge, in a barge transport system according to the invention,

Figure 4 is a schematical top view of the pushing vessel shown in Figure 1 connected to the barge shown in Figure 2,

Figure 5 is a rear view of a pushing vessel connected to a barge, and

Figure 6 shows schematically another embodiment of a vertically adjustable connection device of a barge transport system according to the invention.

In Figure 1 there is shown a pushing vessel 1 having at its bow a wedge-formed connection protrusion 3. The stern portion of the pushing vessel is provided, at each of its sides, with wedge-formed connection members 4. The pushing vessel 1 is designed to be received in an opening at the stern of a barge 2 (see Figures 2 and 4), the protrusion 3 fitting into one of a number of corresponding openings or depressions 5 in the barge 2 and each connection member 4 fitting into one of a number of corresponding further openings or depressions 6 in the barge.

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In Figures 1 and 2, the water level is indicated by numeral 7. The position of the water level 7 relative to the barge 2 may vary considerably depending on the weight of the cargo carried by the barge. To cater for this a number of depressions 5 and 6 are provided at different levels, the protrusion 3 interengaging with a suitable depression 5 and the connection members 4 interengaging with suitable depressions 6 for the actual floating level of the barge 2. If protrusion 3 and members 4 do not directly enter into suitable depressions, the connection can be assisted by using a trim system provided in the pushing vessel for adjusting its draught and trim position. Trim systems of this kind are well known and usually comprise water tanks which are filled or emptied for changing the location of the centre of gravity of the vessel and/or the weight of the vessel.

Figure 3 shows an alternative method for the connection at the bow of the pushing vessel 1 to the barge 2. In this embodiment, connection depressions 5a in the barge 2 are arranged in close vertical relationship and correspondingly shaped connection members 3a are provided in the bow of the pushing vessel. A greater number of connection members 3a provides a better connection grip. By means of the pushing vessel's own thrust force or any other longitudinal connection force system provided, connection protrusions 3a are forced to penetrate in a self-adjusting manner into suitable connection depressions 5a, without any need for using a trim system for the pushing vessel. The connection principle shown in Figure 3 can also be applied, but is less favourable, with respect to the connection members in the stern portion of the pushing vessel and the corresponding connection surface of the barge 2.

Figure 4 shows how the connection protrusion 3 in the bow of the pushing vessel 1 provides support

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and a wedge effect in the transverse direction of the vessel 1. The connection members 4 in the stern portion of the pushing vessel 1 are movable in the transverse direction, whereby they exert a wedge effect (by means of the contacting wedging surfaces of the members 4 and depressions 6) locking the pushing vessel 1 to the barge 2 in both a transverse and a longitudinal direction. By this means an extremely firm connection between the pushing vessel 1 and the barge 2 is achieved and both units form together a rigid, seaworthy unit. The connection of the pushing vessel 1 to the barge 2 is facilitated by having a small clearance 8 between them where there are no connection members. Furthermore, the pushing vessel and the corresponding vessel-receiving opening or notch in the stern end of the barge 2 both have a backwards diverging form over the total length of the notch, as shown in Figure 4. It will also be appreciated that the length of the vessel-receiving opening is at least 80% of the length of the pushing vessel 1.

The connection members 4 in the stern portion of pushing vessel 1 are pivotable, their movement being powered by means of hydraulic cylinders 9 (see Figures 4 and 5). Figure 5 shows how the connection members 4 swing on a fixed shaft 10, each connection member 4 being provided with two hydraulic power cylinders 9 (see Figure 4) to obtain a high connection force.

When the pushing vessel 1 is connected to the barge 2, a hydraulic pressure is maintained continuously in the power cylinders 9, thereby continuously eliminating all connection clearances that could otherwise give rise to undesired movement between the pushing vessel 1 and the barge 2. The retracted positions of the connection members 4 are shown in dashed lines in Figure 5.

The connection devices in the stern portion of pushing vessel 1 are symmetrically arranged on both



sides of the vessel 1. Since the downwards extension of the back portion of the barge 2 is relatively small (as can be seen in Figure 2) at the position of the connection openings or depressions 6, it is of advantage to have the corresponding connection members of the pushing vessel at a relatively high level. For this reason the connection head of each connection member 4 is at a higher level than the fixed shaft 10 of the connection member.

It is also possible to replace the connection members 4 by connection means at the stern portion of the pushing vessel 1 which are vertically adjustable. In this case there is no need to provide a plurality of connection depressions 6 in the barge, only one depression at each side of the barge being sufficient. Figure 6 shows schematically how such a vertically adjustable connection device could be constructed (only the principle of the construction is shown, the dimensions of the parts not being drawn to the proper scale). As in Figure 5, swingable or pivotable connection members 4 are journaled on a shaft 10 and are actuated by hydraulic first power cylinders 9. The shafts 10 and the cylinders 9 are attached to the ends of support beams 11, the opposite ends of which are pivotally journaled at a fixed point 12 of the pushing vessel 1. Second power cylinders 13 are connected to raise and lower the movable ends of the support beams 11, whereby the connection level of connection members 4 is adjusted.

In other embodiments of the invention (not shown) it is possible for different interengaging connection means to be provided on the pushing vessel and the barge.

For example, the protrusion(s) 3 at the front of the pushing vessel 1, could be replaced by one or more openings or depressions interengageable with projections in the barge. Alternatively it is not essential, although it is preferred, for the "front engaging means" of the

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pushing vessel to be situated right at the front of the pushing vessel. For instance front engaging means (pivotal, for example, in a similar manner to the connection members in the stern portion of the pushing vessel) could be provided on either side of the pushing vessel anywhere in the front portion (i.e. the front half) of the pushing vessel.

Finally it will be appreciated that although the invention has described the preferred embodiment of having transversely movable (e.g. pivotal) connection members in the stern portion of the pushing vessel, it is possible for such transversely movable connection members to be provided in the or each barge to interengage with openings or depressions formed in the stern portion of the pushing vessel.

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CLAIMS

1. A sea-going barge transport system comprising at least one barge having a notch extending through a stern portion thereof, at least one powered pushing vessel receivable in said notch of the or each barge for propelling the barge by pushing and connecting means for rigidly connecting said pushing vessel to the or any one of the barge(s) at any one of a number of different relative vertical positions of the pushing vessel within the notch of the barge, said connecting means comprising first engaging means in a fixed position at a front portion of said pushing vessel, second engaging means in a fixed position at a front portion of the notch of the or each barge interengageable with said first engaging means, third engaging means in the stern portion of, and at opposite respective sides of, the pushing vessel, fourth engaging means of the or each barge interengageable with each of said third engaging means and moving means operable to move the third engaging means or the fourth engaging means transversely of said pushing vessel to enable a mechanically positively locking interengagement and disengagement between the third and fourth engaging means, the said interengaging means being formed so that, on operation of the moving means to interengage the third and fourth engaging means of the or one of the barges, a wedging engagement between each third engaging means and its respective fourth engaging means transversely locks the pushing vessel to the barge and urges the pushing vessel forwardly into the notch to provide a wedging engagement between the third and fourth engaging means thereby minimising any movement inducing connection clearance between said pushing vessel and the barge.

2. A barge transport system according to claim 1, characterised in that the second and fourth engaging means are constituted by a number of wedge-formed depressions or protrusions formed at different height levels of the or each barge.



3. A barge transport system according to claim 1 or 2, characterised in that the third engaging means are movable by said moving means in the transverse direction of the pushing vessel.

5 4. A barge transport system according to claim 3, characterised in that the third engaging means have a greater wedge angle at their rear side than at their front side.

10 5. A barge transport system according to any of the preceding claims, characterised in that the third engaging means are pivotally journalled on a supporting shaft.

15 6. A barge transport system according to any of the preceding claims, wherein said moving means comprises power cylinder means for urging the transversely movable ones of said third and fourth engaging means into and out of interengagement with each other.

20 7. A barge transport system according to claim 6, wherein said power cylinder means comprise hydraulically actuated power cylinders for providing a continuous firm contact pressure between said third and fourth engaging means when the latter are interengaged.

25 8. A barge transport system according to any of the preceding claims, characterised in that said pushing vessel comprises a trim system for adjustment of the draught and trim of said pushing vessel, thereby facilitating the connection of said pushing vessel to the or each barge.

30 9. A barge transport system according to any of the preceding claims, wherein the notch in the stern portion of the or each barge diverges towards the stern



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of the barge over at least substantially its entire length.

10. A barge transport system according to any of the preceding claims, the length of the notch of the or each barge is at least 80% of the length of said pushing vessel.

11. A barge transport system constructed and arranged substantially as herein described with reference to and as illustrated in Figures 1, 2, 4 and 5 or Figures 1, 2, 4 and 5 as modified by Figure 3 and/or Figure 6.
