

# PATENT SPECIFICATION

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## (54) THRUST COUPLING FOR TUG AND LIGHTER

(71) We, AKTIEN-GESELLSCHAFT "WESER", a Body Corporate organised and existing under the laws of the Federal Republic of Germany, of Werfstrasse 160, 28 Bremen 21, Germany, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a thrust coupling for tug and lighter.

An arrangement is known wherein a tug and lighter are detachably connected together by an intermediate element anchored with universal mobility to the prow of the tug and with vertical mobility to the stern of the lighter, laterally oriented traction elements being provided to pivot the tug with respect to the lighter. The intermediate element consists of a recumbent pyramid shaped lattice body, the summit of which is connected to the prow of the tug by means of a ball and socket joint and the base of which is connected to the stern of the lighter by means of a vertically movable skid. The skid connection is however only effective during the coupling operation and is afterwards secured to the lighter by a rope train, so that no vertical movement is possible when under way. A rope train extends from a tug winch on both sides of the tug and is made fast to the stern of the lighter at a distance from the longitudinal centre, in order to enable the tug to be pivoted about a vertical axis relative to the lighter by using the winches on the tug, so that the tug generally can act as a rudder device for the tug and lighter combination. The improved manoeuvrability thereby obtained is a considerable advantage compared to other known arrangements wherein the tug runs with its prow into a stern socket of the lighter or into a structure on the lighter stern simulating such a stern

[Price 25p]

socket so that the tug is immovable relative to the lighter. The considerably smaller structural outlay and the avoidance of loss of hold space are further advantages of the previously mentioned arrangement with intermediate element and lateral traction means. It is however a disadvantage that the prow of the tug and the stern of the lighter can only execute vertical movements in common, so that the thrust combination is only seaworthy in comparatively calm water. In heavy seas the tug is carried away by the lighter, which generally has a much larger displacement, with the result that the thrust combination ceases to be manoeuvrable. A further disadvantage is that the rope trains or similar traction elements must be anchored to the lighter, so that it is only possible to establish the thrust combination with the assistance of a crew on the lighter. This crew must in many cases be placed on board as a first step in coupling the tug and lighter together because lighters frequently have no crew. The establishment of a thrust combination with lighters in the open seas is therefore virtually impossible.

According to the present invention there is provided a thrust coupling between a tug and a lighter including an intermediate thrust member connected to the prow of the tug and to the stern of the lighter, the intermediate member being adapted to permit pivotal movement of the tug about a vertical axis relative to the lighter and to permit vertical movement of the prow of the tug relative to the stern of the lighter when the tug and lighter are under way, means being provided for pivoting the tug about the said vertical axis.

The means for pivoting the tug may comprise traction elements connected between the tug on the one hand and the lighter or the intermediate member on the other hand on both sides of the centre lines of both vessels. It is advantageous that the

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articulations of the traction means to the stern of the lighter or the intermediate member move vertically approximately synchronously with the prow of the tug. As  
 5 intermediate member, a rail extending approximately horizontally is advantageously used, the freely vertically movable connection of which to the stern of the lighter  
 10 comprises a truck guide system, and to the ends of which the traction means are articulated. This arrangement permits unobstructed vertical movements between the  
 15 position of the tug is not influenced by movements of the lighter. Thus the manoeuvrability of the tug cannot be impaired by movements of the lighter. Furthermore, the major parts of the thrust coupling  
 20 may thus be permanently attached to the tug, because only vertical guideways are necessary on the stern of the lighter. Consequently the thrust coupling can be established solely from the tug, without the  
 25 assistance of a crew on the lighter being necessary. The thrust coupling is particularly suitable for picking up lighters which are plying unmanned in the open sea. The arrangement of a rail makes possible a  
 30 robust construction and stable guide means for connecting the rail to the stern of the lighter.

A somewhat similar effect can be obtained if the intermediate member is constructed as a pressure element arranged on  
 35 the prow of the tug and acts against a thrust post arranged approximately vertically on the stern of the lighter and at least partly enclosed by the pressure element with a profile matched to the thrust post. As pressure  
 40 element, a roller is suitable which can rotate freely about a horizontal axis and has a peripheral recess merging into lateral bead edges. The thrust post engages in the  
 45 peripheral recess of the roller. The pressure element may also grip behind a vertically extending flange on the thrust post by means of rollers which are mounted for free rotation about horizontal axes. According to a  
 50 further aspect of the invention, vertical relative movements between the prow of the tug and the stern of the lighter are permitted by an arrangement wherein the intermediate element comprises a rocker member  
 55 which is attached to the stern side of the lighter for pivotal movement about a horizontal axis and has a punctiform universally movable connection to the prow of the tug. The traction elements for pivoting the tug  
 60 about the vertical axis of rotation are connected to the rocker member at a lateral distance from the said vertical axis.

Besides simple rope lines, tackles etc., as traction elements, fluid pressure actuated  
 65 piston and cylinder units are also suitable.

Finally, it is recommended to arrange damping devices which counteract the vertical movements of the rail, or respectively of the pressure element, with respect  
 70 to the lighter. These movements can possibly occur freely in a predetermined range so that the damping devices become effective only when the vertical movements  
 75 exceed the range mentioned. A damping device which acts progressively as a function of the length of the movements may be advantageous.

The accompanying drawings illustrate exemplary embodiments of the invention, some details being shown only schematically in order to demonstrate the principle of the invention. In the drawings:

Figure 1 shows in side elevation a tug and the stern of a lighter with a thrust coupling according to the invention; 85

Figure 2 shows in plan the arrangement according to Figure 1;

Figure 3 shows in rear elevation the thrust coupling according to Figures 1 and 2;

Figures 4, 5 and 6 show, on a larger 90 scale compared to Figures 1 to 3, a side elevation, a rear elevation and a plan respectively of the thrust coupling;

Figure 7 shows on the same scale as Figures 1 to 3, the rear elevation of a variant 95 embodiment;

Figure 8 shows a variant embodiment;

Figure 9 shows a variant of the pressure element and of the thrust post compared to Figure 8; 100

Figures 10 and 11 show an exemplary embodiment with an intermediate element constituted by a pivoted rocker member; and

Figure 12 shows an exemplary embodiment with traction elements constituted by piston and cylinder units. 105

The thrust coupling between a port tug 1 of conventional construction and the stern of a lighter 2 illustrated in the exemplary 110 embodiment is substantially constituted, according to the examples of Figures 1 to 7, by a rail 3 extending approximately horizontally and constructed as an intermediate member or element, and by its  
 115 connecting elements to the tug on the one hand and to the lighter on the other hand. The connection to the prow of the tug 1 comprises a combination of three articulated joints with their pivot axes at right  
 120 angles to one another to provide universal mobility. Thus there are one vertical 6 and two intersecting horizontal articulation axes 61 and 62, one of which 61 is oriented in the longitudinal direction of the thrust  
 125 combination and the other 62 at right angles thereto, as shown in detail in Figure 4. From winches mounted aft on the tug 1, rope lines 7 and 8 pass, one of them being  
 130 arranged on each side of the tug. These

rope lines, which may be constructed as simple rope lines or as tackles, are anchored at one end of the tug and at the other end to the ends of the rail 3 at the greatest possible distance from the longitudinal centre of the thrust combination, in order to make possible a pivoting of the tug about the vertical axis 6 of the articulated joint. The coupling of the rail 3 to the stern of the lighter including two guideways 21 and 22 arranged vertically at the middle of the stern of the lighter, and two cooperating roller trucks 23 and 24 mounted on the rail. Each truck has two rollers 25, 26 spaced one above the other which run in their respective guideways so that rollers 25, 26 mounted on the rail can absorb the forces acting at right angles to the horizontal longitudinal centre line. Additionally, further rollers 27 are mounted at the ends of the rail 3 on both sides and engage in an associated vertical guideway 63 on the stern of the lighter. Although in the drawing the rail extends across the total beam of the lighter, this is only one of several possible constructions. Figure 5 also shows a damping device 29 which damps the vertical movements of the rail with respect to the lighter, either linearly or better progressively. At the same time the movements can also occur undamped within a predetermined range.

The example of Figure 7, shows that the object in view can also be obtained without a rail. The intermediate element, not shown in this Figure, engages by the rollers of its truck guide system 30 in central vertical guideways 21 and 22 on the stern of the lighter. Further truck guide systems 31 and 32 are vertically movable, one in each of two guideways 33 and 34 arranged at a lateral distance from the central guideway. A rope connection 36 running over return pulleys 35 ensures that the vertical movements of the truck guide systems 30, 31 and 32 occur approximately synchronously.

In the exemplary embodiment illustrated in Figure 8, the intermediate element 3 comprises a pressure element with a roller 40 much larger than the rollers 25, 26 and a tubular thrust post 41. The roller 40 is mounted for free rotation about a horizontal axis and has a semi-circular peripheral indentation 42 which merges into bead edges on both sides and has a radius which is greater than the radius of the post 41. Thus the roller partly surrounds the post and the transmission of transverse forces is made possible. Contact between the roller 40 and the thrust post 41 is maintained by the rope lines 7 and 8, which run at one end onto winches on the tug and are attached to the stern of the lighter at 10 and 11 at the other end. Relative movements between the tug and lighter about a horizontal axis occurring in the longitudinal direction are ac-

commodated by a vertically arranged turntable 43, one part of which is firmly attached to the prow-side of the tug 1 and its other part firmly to the bearings of the roller 40. Height differences are accommodated by the roller 40 rolling along the thrust post 41. In the case of pivotal movements of the tug with respect to the lighter in the lateral direction, the roller 40 slides appropriately on the thrust post 41.

In further exemplary embodiment of Figure 9 the coupling includes a thrust post 41 in the form of a double T profile so that a flange undercut on both sides in its horizontal cross-section is formed, which can grip behind a correspondingly shaped pressure element so as to transmit any tensile forces between the tug and lighter which may occur—e.g. in the case of astern travel of a thrust combination. In the exemplary embodiment, the pressure element comprises two arms 45 mounted on the intermediate element 3 with mobility about a vertical axis 44, at the ends of which rollers 46 and 47 can rotate freely about horizontal axes. The rollers 46 and 47 have cylindrical envelope surfaces which are applied against the inner face of the one flange of the double T profile constituting the thrust post in the thrust direction, and against the inner face of the other flange in the traction direction. The pivot arms 45 have a mechanical drive for pivoting in and out when a thrust combination is coupled or uncoupled. A particularly suitable form of drive consists of piston and cylinder units 48 and 49 which are actuated by fluid pressure. In order to permit lateral pivoting movements, in this exemplary embodiment a mounting of the thrust post with mobility about a vertical axis 50 is necessary. For better transmission of major thrust forces, a round or convex conformation of the surface of the thrust post 41 confronting the lighter is convenient, as indicated by the part 51, so that during lateral pivoting movements contact is always retained over the total length between the thrust post 41 and the stern side of the lighter 2. A turntable 53 permits movements about a horizontal axis.

In the exemplary embodiments of Figures 10, 11 and 12, the intermediate element 3 is constructed as a pivoted rocker member which may be formed as a plate, a flat plate shaped lattice structure, or in a similar manner. The said rocker member 3 is anchored on the one hand for pivotal movement about a horizontal axis to the stern side of the lighter, advantageously by pivot eyes 4 and plug bolts 5, so that free movement is possible in the vertical direction about an axis oriented transversely to the longitudinal direction. The connection is however rigid in the direction of the said axis. The opposite side of the rocker

member 3 has a punctiform attachment, universally mobile as far as possible, to the prow of the tug. The traction elements each consist of a rope line 7 and 8, the ropes of which pass on to the drums of winches 9, advantageously automatically controlled. Each rope line extended between the tug and a point on the rocker member 3 at the greatest possible distance from the connection between the tug and the rocker member 3. A special feature of the embodiment according to Figure 11 is that instead of the traction elements being anchored at the outer points on the rocker member, they pass over return pulleys at the points 10 and 11 on the rocker member and are connected to a rapid release hook fitted centrally on the latter, so that the rope lines can be released rapidly in emergencies.

In order to permit coupling and uncoupling from the tug without extraneous assistance, a holding tackle 19 may be arranged between the rocker member 3 and a high point on the tug, with its rope running on to a winch (Figure 10). A holding tackle may alternatively be provided on the lighter if the rocker member is intended to remain on the lighter when uncoupled. Remote actuation of the coupling elements between the rocker member on the one hand and the lighter or possibly also the tug on the other hand can be achieved without difficulty using known means, which are therefore not described.

Figure 12 illustrates an exemplary embodiment in which the tug is pivoted about the vertical axis relative to the lighter by piston and cylinder units 15 and 16, which are hydraulically actuated. This variant provides for a double lever 17 to be fixed to the vertical rotary axis of the coupling between the tug and the rocker member with its free ends attached to the traction elements, one of which is placed on each side of the tug. The rocker member 3 is attached to the rotary axis 6 by a further intermediate element 18.

#### WHAT WE CLAIM IS:—

1. A thrust coupling between a tug and a lighter including an intermediate thrust member connected to the prow of the tug and to the stern of the lighter, the intermediate member being adapted to permit pivotal movement of the tug about a vertical axis relative to the lighter and to permit vertical movement of the prow of the tug relative to the stern of the lighter when the tug and lighter are under way, means being provided for pivoting the tug about the said vertical axis.

2. A thrust coupling according to claim 1 in which the means for pivoting the tug comprise traction elements connected be-

tween the tug and the stern of the lighter or the intermediate member on both sides of the centre lines of both vessels.

3. A thrust coupling according to claim 2 in which the traction elements are connected to the stern of the lighter or the intermediate member by means which move vertically approximately synchronously with the prow of the tug.

4. A thrust coupling according to claim 3 in which the intermediate member comprises a rail extending approximately horizontally and transversely of the longitudinal centre line of the lighter the rail being connected to the stern of the lighter by means of a truck guide system which permits vertical movement of the rail relative to the lighter and the traction elements being connected to the ends of the rail.

5. A thrust coupling according to claim 1 in which the means for pivoting the tug comprise fluid pressure actuated piston and cylinder units connected between the tug and the intermediate member.

6. A thrust coupling according to claim 1, 2 or 3 in which the intermediate member is constructed as a pressure element carried by the prow of the tug and acts against a thrust post mounted approximately vertically on the stern of the lighter, which is at least partly surrounded by the pressure element.

7. A thrust coupling according to claim 6 in which the pressure element is constituted by a roller which can rotate freely about a horizontal axis and has a peripheral recess merging into lateral bead edges, and the thrust post engages in the peripheral recess of the roller.

8. A thrust coupling according to claim 6 in which the pressure element has rollers which are mounted for free rotation about horizontal axes and which grip the thrust post behind a vertically oriented flange on the thrust post.

9. A thrust coupling according to claim 8 in which the rollers of the pressure element are mounted on mechanically movable arms pivoted on the intermediate element.

10. A thrust coupling according to claim 2 or 5 in which the intermediate element is constructed as a rocker member which is connected to the stern side of the lighter for pivoting movement about a horizontal axis and has a punctiform universally mobile connection to the prow of the tug, and the traction elements for pivoting the tug about the vertical axis are connected to the rocker member at a lateral distance from the said vertical axis.

11. A thrust coupling according to any one of the preceding claims 1 to 9 characterised in that damping devices are provided which counteract the vertical movements of the intermediate element with respect to the



member 3 has a punctiform attachment, universally mobile as far as possible, to the prow of the tug. The traction elements each consist of a rope line 7 and 8, the ropes of which pass on to the drums of winches 9, advantageously automatically controlled. Each rope line extended between the tug and a point on the rocker member 3 at the greatest possible distance from the connection between the tug and the rocker member 3. A special feature of the embodiment according to Figure 11 is that instead of the traction elements being anchored at the outer points on the rocker member, they pass over return pulleys at the points 10 and 11 on the rocker member and are connected to a rapid release hook fitted centrally on the latter, so that the rope lines can be released rapidly in emergencies.

In order to permit coupling and uncoupling from the tug without extraneous assistance, a holding tackle 19 may be arranged between the rocker member 3 and a high point on the tug, with its rope running on to a winch (Figure 10). A holding tackle may alternatively be provided on the lighter if the rocker member is intended to remain on the lighter when uncoupled. Remote actuation of the coupling elements between the rocker member on the one hand and the lighter or possibly also the tug on the other hand can be achieved without difficulty using known means, which are therefore not described.

Figure 12 illustrates an exemplary embodiment in which the tug is pivoted about the vertical axis relative to the lighter by piston and cylinder units 15 and 16, which are hydraulically actuated. This variant provides for a double lever 17 to be fixed to the vertical rotary axis of the coupling between the tug and the rocker member with its free ends attached to the traction elements, one of which is placed on each side of the tug. The rocker member 3 is attached to the rotary axis 6 by a further intermediate element 18.

#### WHAT WE CLAIM IS:—

1. A thrust coupling between a tug and a lighter including an intermediate thrust member connected to the prow of the tug and to the stern of the lighter, the intermediate member being adapted to permit pivotal movement of the tug about a vertical axis relative to the lighter and to permit vertical movement of the prow of the tug relative to the stern of the lighter when the tug and lighter are under way, means being provided for pivoting the tug about the said vertical axis.

2. A thrust coupling according to claim 1 in which the means for pivoting the tug comprise traction elements connected be-

tween the tug and the stern of the lighter or the intermediate member on both sides of the centre lines of both vessels.

3. A thrust coupling according to claim 2 in which the traction elements are connected to the stern of the lighter or the intermediate member by means which move vertically approximately synchronously with the prow of the tug.

4. A thrust coupling according to claim 3 in which the intermediate member comprises a rail extending approximately horizontally and transversely of the longitudinal centre line of the lighter the rail being connected to the stern of the lighter by means of a truck guide system which permits vertical movement of the rail relative to the lighter and the traction elements being connected to the ends of the rail.

5. A thrust coupling according to claim 1 in which the means for pivoting the tug comprise fluid pressure actuated piston and cylinder units connected between the tug and the intermediate member.

6. A thrust coupling according to claim 1, 2 or 3 in which the intermediate member is constructed as a pressure element carried by the prow of the tug and acts against a thrust post mounted approximately vertically on the stern of the lighter, which is at least partly surrounded by the pressure element.

7. A thrust coupling according to claim 6 in which the pressure element is constituted by a roller which can rotate freely about a horizontal axis and has a peripheral recess merging into lateral bead edges, and the thrust post engages in the peripheral recess of the roller.

8. A thrust coupling according to claim 6 in which the pressure element has rollers which are mounted for free rotation about horizontal axes and which grip the thrust post behind a vertically oriented flange on the thrust post.

9. A thrust coupling according to claim 8 in which the rollers of the pressure element are mounted on mechanically movable arms pivoted on the intermediate element.

10. A thrust coupling according to claim 2 or 5 in which the intermediate element is constructed as a rocker member which is connected to the stern side of the lighter for pivoting movement about a horizontal axis and has a punctiform universally mobile connection to the prow of the tug, and the traction elements for pivoting the tug about the vertical axis are connected to the rocker member at a lateral distance from the said vertical axis.

11. A thrust coupling according to any one of the preceding claims 1 to 9 characterised in that damping devices are provided which counteract the vertical movements of the intermediate element with respect to the

lighter upwards and downwards out of an adjustable range.

12. A thrust coupling substantially as described hereinbefore with reference to 5 Figures 1 to 7 or Figure 8 or Figure 9 or Figures 10 and 11 or Figure 12 of the accompanying drawings.

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