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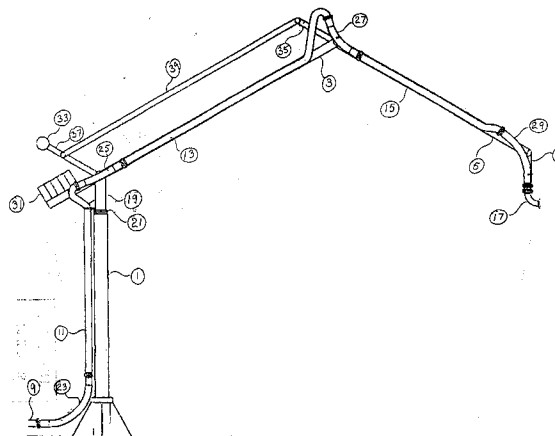
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(54) **Loading arm.**

(57) A loading arm for supplying a fluid, typically oil, to a ship from a quayside, the arm comprising a support link arrangement of limbs (3,5,7) pivoted together to extend from a stanchion (1) on the quay to an inlet pipe on the ship. A pipe extends alongside the link arm the pipe having fixed, rigid sections (11,13,15) alongside the links (1,3,5,7) and flexible sections (25,27,29) past the link joints. The flexible sections (25,27,29) are arranged to extend through the link joint axis when the flexible section is straight in an intermediate position of the link arm. In this design the flexible section is not stretched on flexing.

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This invention relates to a loading arm for use in transferring fluid materials between land based and ship based containers.

A common application of such loading arms is in a marine environment supplying oil from a storage tank to an oil tanker. For this purpose oil is supplied to the dockside in fixed rigid pipes which are connected to a loading arm mounted on the jetty. The loading arm is required to have considerable reach and movement since it has to connect to pipe couplings on ships of various sizes, draught and loading. The necessary adaptability has previously been incorporated by using swivel pipe couplings which combine the hinge with the fluid path. Such interconnections between pipe sections do however require fairly frequent maintenance during which time the loading arm is out of operation. The swivel couplings themselves are, in addition, very expensive, bearing in mind that the pipe diameter is typically 300 millimetres and considerable accuracy of manufacture is required to prevent leakage.

An object of the present invention is therefore to provide a loading arm in which these problems are at least partially alleviated.

According to the present invention a loading arm for transferring a fluid material between land based and ship based containers has at least one floating end and comprises a pipe assembly and a parallel articulated link assembly supporting the pipe assembly, the pipe assembly having an interconnection between rigid pipe sections coinciding with a pivotal connection between links of the link assembly, the interconnected pipe sections being fixed to and supported by the pivotally connected links respectively and the pipe interconnection comprising a flexible pipe section which is of just sufficient length to make the interconnection when the interconnected pipe sections are aligned, the link assembly being counterbalanced to at least partly support the weight of the floating end.

Preferably, each pivotal connection between links has an associated flexible pipe section interconnecting rigid pipe sections.

In a datum position of the link assembly the flexible pipe sections may be substantially straight and the rigid pipe sections shaped to provide substantial alignment at each pipe interconnection in this datum position.

The link assembly preferably includes a primary counterweight mounted on an extension of one link and tending to raise the arm.

There may also be included a secondary counterweight pivotally connected to two successive links in the link assembly and so disposed as to tend to raise the second of the two links relative to the first and to tend to raise the first and second links together.

The secondary counterweight may be mounted on a pantograph linkage including the first link and an extension of the second link.

A loading arm for use in feeding oil to an oil tanker will now be described, by way of example, with reference to the accompanying drawing of a loading arm in a typical operational position.

Referring to the drawing, the loading arm comprises a stanchion 1 which supports the whole arm and is consequently considerably strong and massive. The stanchion may be seen as forming the first link of a link assembly 1, 3 5 and 7 the last link 7 of which forms the floating end of the arm.

In parallel with the link assembly is the oil supply pipe which includes the fixed, rigid pipe 9 from the storage tank and rigid pipe sections 11, 13, 15 and 17. Pipe section 11 extends up the height of the stanchion and is shaped at its upper end into a swan neck form to bring it into alignment with the next section 13 in an intermediate datum position of the link assembly. The upper end of the stanchion has an extension piece 19 which rotates about the stanchion axis on a swivel mounting 21. The rigid pipe section 11 is mounted on the upper part of the swivel joint so that it rotates with the extension piece 19. Movement of the lower end of the pipe 11 around the stanchion is accommodated by a section of flexible pipe 23, which may be arranged to hang in a 'U' shape if a considerable rotation (e.g. 90°) of the arm about the stanchion axis is required.

The pipe section 13 is fixedly mounted on the link 3 and is coupled to the pipe section 11 by a short section of flexible pipe 25. Similarly the rigid pipe section 15 is fixedly mounted on the link 5 and a short section of flexible pipe 27 connects it to the pipe section 13. The swan neck shaping of the pipe section 11 is repeated with the section 13 again to bring the end of this pipe into alignment with the next section 15 in an intermediate, datum position of the link assembly.

A fourth section of flexible pipe 29 interconnects the pipe section 15 with a final rigid bend 17 which has a coupling flange for coupling to the entry point on the tanker.

The flexible pipe sections 25, 27 and 29, while being satisfactorily flexible under pure bending movements, are liable to be damaged if stretched axially. It is a feature of the invention that the length of the flexible pipe sections is just sufficient to make the interconnection between rigid pipe sections when the latter sections are aligned in the above mentioned datum position of the link assembly. Any movement of the link assembly from this datum condition then causes the flexible pipe sections to flex. However, since the length of the smooth ARC between the rigid pipe ends when these ends are out of alignment is less than the

straight length in the datum condition, the flexible pipe section is not stretched but very slightly compressed when out of the datum condition. The compression is easily accommodated by slight 'bellying out' of the path of the flexible pipe without incurring any damage.

In the datum position referred to above, the shaping of the rigid pipe ends brings the rigid pipe end into line with the associated pivot point. In this condition the flexible pipe has its maximum length, which is its natural unstressed length. The swan neck formation may be 'shared' between the two interconnected pipes so that each is offset to approximately half that of the single swan neck shown. The flexible pipe nevertheless passes through the pivot axis in the datum position.

Flexible piping is expensive and consequently the length is kept to a minimum consonant with the flexing requirements. In the example given, the sections 25 and 27 are of length 2400 millimetres and diameter 300 millimetres and this gives sufficient flexibility for an angular movement of the order of plus or minus 75°.

Pipe section 23 needs to be rather longer to accommodate the movement of the pipe 11 around the stanchion.

It will be appreciated that the weight of the arm overall, the link assembly and the pipes, is very considerable. In order to make movement and attachment of the floating end (17) manageable, the arm is counterbalanced in two ways. First a primary counterweight 31 is mounted on an extension of the arm 3 backwards over the stanchion pivot thus tending to raise the whole arm. Secondly, a secondary counterweight 33 is pivoted to both the link 3 and a backward extension 35 of the link 5. The supporting link 37 is pivoted to the link 3 at such a point that the counterweight 33 is to the left of the stanchion pivot and thus tends to raise the whole arm. In addition, the link 39 causes the link 5 to be raised relative to the link 3.

While the application described relates to an arm having one fixed end and one floating end, it is not essential that one end is fixed.

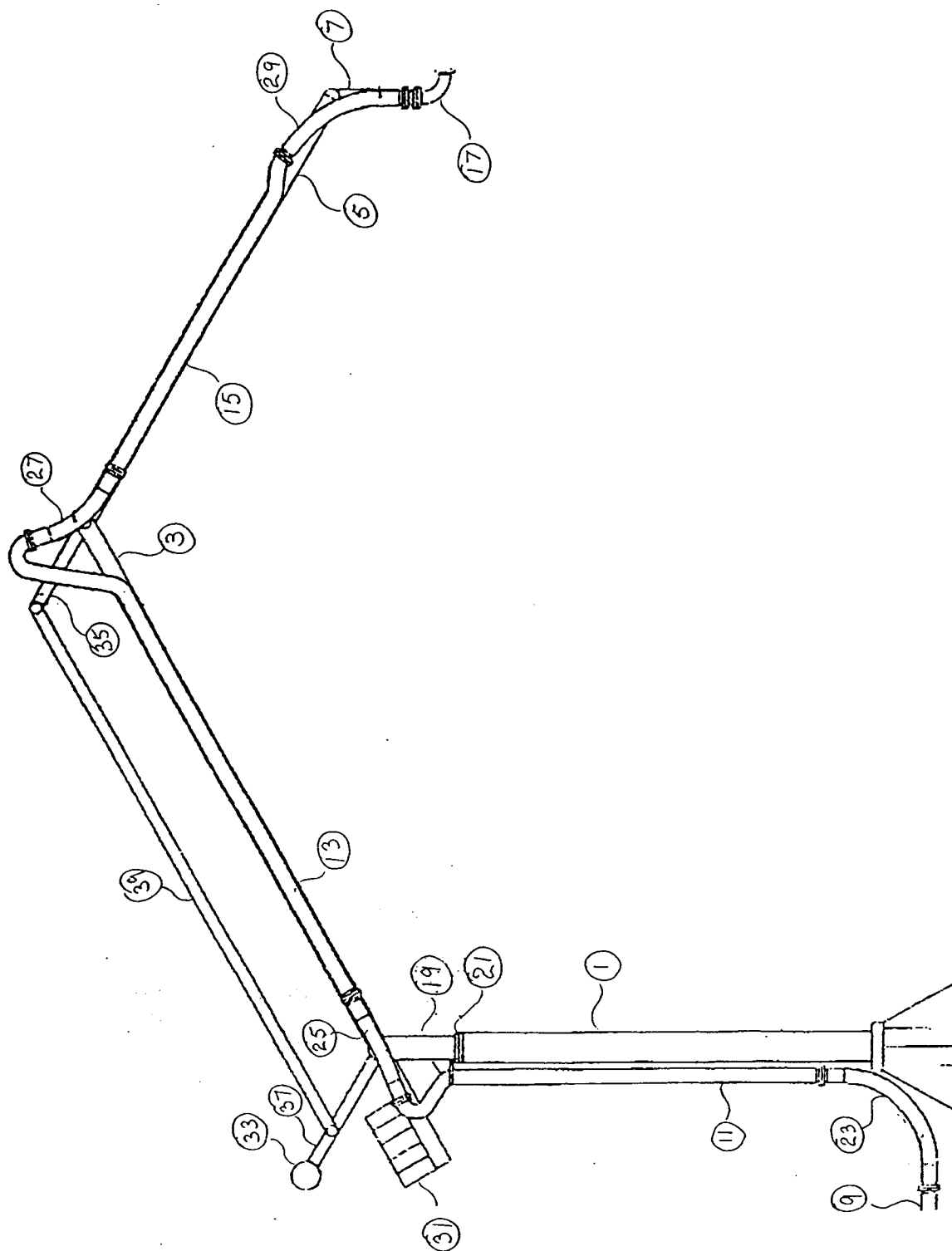
Again, while the transfer of oil to or from oil tankers is the most immediate application, the invention is, of course, not limited to the transfer of oil or even of liquid. A similar arrangement could be used for loading solid particle material, eg grain materials, wheat etc. blown by air, or pulverised coal in a slurry with water.

Claims

1. A loading arm for transferring a fluid material between land based and ship based containers, the loading arm having at least one floating end and comprising a pipe assembly and a

parallel articulated link assembly supporting the pipe assembly, the pipe assembly having an interconnection between rigid pipe sections coinciding with a pivotal connection between links of the link assembly, the interconnected pipe sections being fixed to and supported by the pivotally connected links respectively and the pipe interconnection comprising a flexible pipe section which is of just sufficient length to make the interconnection when the interconnected pipe sections are aligned, the link assembly being counterbalanced to at least partly support the weight of said floating end.

2. A loading arm according to Claim 1, wherein each pivotal connection between links has an associated flexible pipe section interconnecting rigid pipe sections.
3. A loading arm according to Claim 1 or Claim 2, wherein, in a datum position of the link assembly the flexible pipe sections are substantially straight, the rigid pipe sections being shaped to provide substantial alignment at each pipe interconnection in said datum position.
4. A loading arm according to any preceding claim, wherein said link assembly includes a primary counterweight mounted on an extension of one link and tending to raise the arm.
5. A loading arm according to Claim 4 wherein said link assembly includes a secondary counterweight pivotally connected to two successive links in said link assembly and so disposed as to tend to raise the second of the two links relative to the first and to tend to raise the first and second links together.
6. A loading arm according to Claim 5, wherein said secondary counterweight is mounted on a pantograph linkage including said first link and an extension of said second link.
7. A loading arm according to any preceding claim, wherein the first link of the link assembly is a vertical stanchion fixedly mounted.





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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 2100

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)
X	FR-A-2 163 073 (COMPAGNIA ITALIANA TUBI METALLICI FLESSIBILI S.P.A.)	1-4,7	B67D5/70
Y	* page 3, line 3 - page 6, line 16 * * figures 1-6 *	5,6	

Y	GB-A-1 337 726 (EMCO WHEATON UK LTD) * page 4, line 51 - line 96 * * figure 2 *	5,6	

A	US-A-3 085 593 (H. SORENSEN) * column 1, line 53 - column 3, line 9 * * figure 1 *	1,2,4,7	

			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B67D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 2 August 1995	Examiner Smolders, R
CATEGORY OF CITED DOCUMENTS			
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			