

ARTICULATED TRANSFER ARM FOR TRANSFERRING FLUID
PRODUCTS WITH U-SHAPED SPRING BALANCING

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10 The invention relates to the transfer of fluid, liquid or gaseous products,
between a base and a mobile reservoir, for example a tank loaded on a lorry
or on a railway wagon.

These fluid products can be of very varied types, for example but not
limitatively petroleum products, such as gasoline or liquefied petroleum gas
15 (LPG) in particular, or chemical products, acids or solvents in particular.

In practice, these fluid products are mainly liquid, but are generally in
equilibrium with a gaseous phase, so that, rather than speaking of liquid
products, it is more correct to speak of fluid products; it may be necessary to
transfer these two liquid and gaseous phases separately.

20 There are in practice various types of tank adapted suitable to be
loaded onto various types of support (lorry or wagon). In addition, the tanks
are provided with connection flanges, designed to be connected to liquid
product transfer pipes, which can be situated in very diverse ways on the
body of these tanks. Finally, in practice it proves to be impossible to
25 guarantee that a mobile support, such as a lorry or wagon, carrying a tank,
can always be brought exactly into the same configuration relative to a base,
when a transfer operation is necessary.

This is why the connection between the base on the one hand and the
connection flange on the mobile reservoir on the other can be effected only by
30 means of a device having a certain deformation capability. Fluid product
transfer devices, often called transfer arms or loading/unloading arms, are
thus of two possible types: either they comprise a flexible part, which poses
possible problems of resistance to ageing, or they are constituted by a
succession of at least two tubular sections articulated to each other.

Fluid product transfer arms must therefore in practice be brought into a suitable configuration when a transfer operation is being prepared, so as to bring a free end of this arm (the other end generally being connected permanently to the base) opposite the connection flange of the tank concerned. This operation is generally carried out by an operator, and it is desirable for the latter not to be obliged to deploy excessive forces. It should be stated here that a motorized control of a liquid product transfer arm, which avoids any effort for the operators, is however difficult to implement, having regard to the difficulty in bringing the free end of the arm, in an automated fashion, precisely opposite the connection flange; this assumes a high degree of control of the automated equipment controlling the configuration of the arm, and therefore a possibly long and expensive training of the operator. In any event, such a motorized control entails high costs.

To avoid an operator having to deploy major forces during the manual manoeuvring of a liquid product transfer arm, various types of balancing device have already been proposed, intended to compensate at least partly for the variations in torque about the articulation axes (essentially about the horizontal axes) generated by the movements of the masses during variations in configuration of the tubular sections of the arm about the axes.

A first category of balancing device uses one or more counterweights which are fixed opposite the part of the arm to be balanced. This solution, entirely effective, nevertheless proves bulky in practice.

Another category of balancing device uses springs, for example steel torsion springs, most often in a cylindrical helix, attached to the rotating joint or inside it; they may also be steel torsion springs in an Archimedes spiral or in a hyperbolic spiral.

Another category of balancing device uses a steel compression spring often situated along the part of the arm to be balanced or in an appliance known as a balancing box or spring box, fixed to the arm part to be balanced.

Yet another category of balancing device uses steel draw springs also often situated along the arm.

Another configuration of balancing device uses jacks, for example nitrogen, pneumatic, hydraulic or electric.

Naturally, these various types of balancing are not mutually exclusive and it has already been proposed to combine several types of balancing on the same transfer arm.

These various solutions have their own advantages and disadvantages. It can however be stated, in summary, that at the present time no balancing device exists which is at one and the same time effective, compact, reliable and inexpensive. Thus, for example, the presence of counterweights (see above) provides an effective balancing, in a wide variety of possible positions, but at the cost of considerable bulkiness; with regard to the other solutions, the quality of the balancing is generally entirely approximate, in particular when the transfer arm in question is intended to allow a range of movement on each side of a median idle configuration (there is not always symmetry of behaviour of the balancing device for configurations of the transfer arm which are disposed on each side of the median configuration) and often turns out to lead to risks of faulty operation, having regard to moving parts.

The aim of the invention is to overcome the aforementioned drawbacks.

To this end it proposes an articulated arm for transferring fluid, liquid or gaseous products, comprising two tubular sections connected to each other by a rotating joint with a horizontal axis, and a balancing device linked to each of the tubular sections to compensate for variations in torque about the axis of the rotating joint during a relative rotation between the sections, characterized in that this balancing device comprises a U-shaped spring, having two legs the ends of which are each connected to a respective section.

It will be seen, in particular, that this U-shaped spring can act both when these legs are approaching or moving away from each other, so that this spring has a substantially symmetrical behaviour when the tubular sections move relative to each other each side of an idle configuration.

According to preferred provisions of the invention, possibly combined:

- each of the ends of the U-shaped spring is articulated on its respective section, about an axis parallel to the axis of the rotating joint;

- at least one of the ends of the U-shaped spring comprises a plurality of housings for the reception of an organ for its connection to the respective tubular section;

5 - each of the ends of the legs of the U-shaped spring comprises a plurality of housings for the reception of an organ for its connection to the respective tubular section;

10 - the two tubular sections are respectively fitted, each side of the rotating joint, with attachment brackets formed in such a way that the two legs of the U-shaped spring are disposed substantially in the same plane perpendicular to the axis of the rotating joint;

- the U-shaped spring is made of composite material;

- the U-shaped spring is covered with a silicone sheath.

15 Subjects, characteristics and advantages of the invention emerge from the following description, given by way of non-limitative example, with reference to the attached drawings in which:

- figure 1 is an elevation view of a portion of articulated liquid product transfer arm according to the invention;

- figure 2 is a top view of this articulated liquid product transfer arm;

- figure 3 is a side view of this articulated transfer arm; and

20 - figure 4 is a side view of the U-shaped spring which the articulated arm of figures 1 to 3 comprises.

25 Figures 1 to 3 represent in part an arm for transferring fluid, liquid or gaseous products, comprising a first tubular section 1, a second tubular section 2, a rotating joint 3 with a horizontal axis, and a balancing device 4 connected to each of the tubular sections to compensate for variations in torque (due to gravity) about the axis of the rotating joint during a relative rotation between the sections about this horizontal axis.

30 In the example shown, the first tubular section 1 is horizontal and has a 90° bend numbered 5, connected to a second rotating joint 6 with a vertical axis. This second rotating joint 6 is in turn connected to the rotating joint 3 with a horizontal axis by a second right-angled bend 7.

For its part, the second tubular section 2 is, in the configuration shown in the figures, horizontal, parallel to the first tubular section 1. This second

tubular section 2 ends at its left end in a third 90° bend numbered 8 which is connected to the rotating joint 3.

Thus, according to the angular positions of each of the rotating joints 6 and 3, the second tubular section 2 can adopt any angular orientation (within a given range of movement, of course), both azimuthal and elevational, relative to the first tubular section 1.

In fact, it can be seen that the bend 7 which is connected to each of the rotating joints 3 and 6 in itself constitutes a tubular section, which is connected to the second tubular section 2 by a rotating joint with a horizontal axis.

The balancing device 4 is connected to each of these tubular sections 2 and 7. It is thus indirectly that this balancing device is connected to the tubular section 1, but, inasmuch as the rotating joint 6 has a vertical axis, no balancing force is necessary to take account of the variations in angular position during a rotation of this rotating joint.

This balancing device essentially consists of a U-shaped spring 10, having two legs 11 and 12, in practice parallel to each other in the idle configuration of the spring, of which the ends 11A and 12A are each connected, respectively, to one of the sections 2 and 7.

In an advantageous manner, each of these ends of the U-shaped spring is articulated on its respective section, about an axis parallel to the axis of the rotating joint. However, as a variant, if the elasticity of the material constituting the spring allows, provision can be made for the ends of this spring to be connected to the section without freedom of rotation, but only by deformation of these ends.

This mounting by articulation of the ends of the spring on the respective sections is realized here by means of a pin 13 or 14, passing through housings worked in these ends of the legs of the spring 10.

In an advantageous manner, with a view for example to permitting control of the elastic return realized by a given spring, as required, at least one of the ends of the legs of the U-shaped spring comprises a plurality of housings for the reception of an organ intended for its connection to the respective tubular section, for example the aforementioned pin 13 or 14.

It is of course best if each of the ends of the legs of the spring comprises such a plurality of housings.

As can be seen from figure 4, which shows the spring 10 in isolation, each of the ends of the legs of the spring comprises a block 15 or 16 in which
5 is worked a plurality of four cylindrical housings, whose axis is of course perpendicular to the plane of the legs 11 and 12.

These blocks 15 and 16 are, in the example of figure 4, attached to the ends of the legs of the spring 10, more precisely to the inside of these legs. This corresponds to a design of the spring in which the material constituting
10 the legs 11 and 12 and the portion of base which connects them can be different from the material constituting the blocks 15 and 16, which are subjected to stresses different from those acting on the U-section proper, since the U-section is required to have good elastic properties and, in particular, to display long-term resistance to ageing, and where necessary to
15 substantial climatic fluctuations, whereas the material constituting the blocks 15 and 16 must cope with stresses associated in particular with a good resistance to wear, since it is on the internal surface of these housings that all the cases of friction will occur that are associated with the operation of the balancing device as a whole.

20 Naturally, if the nature of the material constituting the U-section proper allows, the housing(s) intended to receive the connection organs such as the pins 13 and 14 can be worked direct in these ends 11A and 12A.

Where appropriate, if this appears useful for the fixing of the blocks 15 and 16 to the ends of the U-shaped piece, additional blocks 17 and 18 can be
25 provided, opposite the blocks 15 and 16 relative to these ends 11A and 12A, in order to be fixed there by bolts, not shown, passing through these ends 11A and 12A. As a variant which is not shown, the blocks 15 and 16 can form part of a monoblock piece surrounding the ends 11A and 12A of the U-shaped piece.

30 One and/or other of the blocks 15 and 16 can be placed outside the U-section.

The two tubular sections 7 and 8+2 connected by the rotating joint with a horizontal axis numbered 3 are each fitted, on each side of this rotating joint, with attachment brackets 20 and 21. These are advantageously formed

in such a way that the two legs 11 and 12 of the U-shaped spring are substantially arranged in the same plane perpendicular to the axis of the rotating joint, that is to say in a plane perpendicular to the plane of figure 2, or in a plane parallel to the plane of figure 1.

5 As can be seen from the figures, these brackets can also be comprised, as far as the bracket 20 is concerned, of an angled wing, optionally provided with reinforcements 20A and 20B (see figure 1), having a bend, visible in figure 3, directed upwards and to the left, in such a way that its end provided with a lug 25 is offset, relative to the (lower) portion of this
10 attachment bracket 20 which is fixed onto the section 8+2 itself, in the direction of the other section, namely the section 7. As far as the other attachment bracket 21 is concerned, it is comprised of two lugs displaced parallel to the horizontal axis of the rotating joint 3, and intended to receive between their ends the end 12A of the U-shaped piece 10.

15 Very varied arrangements can in fact be chosen for the assembly of the U-shaped spring.

In a variant which is not shown, the bracket 20 is fixed direct to the section 2, and not in the immediate vicinity of the rotating joint 3.

The connection organ 14 which serves to link the end 11A of the U-
20 shaped piece to the attachment bracket given the general reference number 20 advantageously comprises a journal 26, suitable for articulation in the end-piece 25, while being able to receive, by screw-fixing, the connection organ such as the pin 14.

25 The fact that the two legs of the U-shaped piece are preferably situated substantially in the same plane perpendicular to the axis of rotation of the rotating joint 3 has the advantage of preventing the appearance, due to the presence of this balancing device, of forces which are not pure torques about the said axis.

30 The U-shaped spring is advantageously made from a composite material. This is for example glass or carbon fibres coated with resin and placed in a forming tool (mould) in order to obtain the final U shape during stoving. After leaving the stoving stage, the spring passes into the finishing phase, comprising deflashing, finishing, drilling, fitting of any final silicone

sheath (or other depending on market availability). All that remains is to bolt on the stainless steel blocks 15, 16, 17, 18.

This U-shaped spring is advantageously covered with a silicone sheath able to effectively protect the material constituting the U-shaped piece from various external forms of attack.

It has been found that the use of springs of the aforementioned type, in particular choosing a composite material, permitted the covering of the balancing moments of the liquid product transfer arms to or from lorries or wagons, in a fairly broad range from a few daNn to more than 230 daNn, or even more. The use of a spring according to the invention thus permits a substantial improvement in the ergonomics of the work station of an operator loading or unloading lorries or wagons carrying liquid products. In practice, depending on the requirements and characteristics of the U-shaped springs available in a given range, it is possible to assemble several U-shaped springs in parallel, side by side, using the same articulation axes in practice.

The invention thus leads to a balancing which is indeed more effective than the simple help provided by known devices, but which at the same time is simple, reliable and inexpensive. The balancing achieved is actually very close to the very good-quality balancing provided by counterweights, of which however it was said previously that they led to an awkward bulkiness during manoeuvres.

In the drawings, the balancing device proposed by the invention is shown on a large scale. It must however be noted that, relative to the whole of a liquid product transfer arm, which can comprise several sections, and of which only a part is shown in figures 1 to 3, the invention leads to a less bulky arrangement than in the known solutions.

Through its affixing, the balancing proposed by the invention does not place a further load on the part to be balanced, compared with a spring box.

The balancing achieved by the device proposed by the invention acts in the same way, according on whether the tubular section 2 is directed downwards and upwards at the same angle: there is thus a symmetry of operation.

It has been shown that the balancing device proposed above permits, in a range of movement of 20° above and 20° below the horizontal reference position, a balancing of the arm of less than 5 kg in terms of absolute value.

Above all when a composite material is used to make the spring, the weight of this spring is certainly less than all of the known balancing systems.

From the point of view of safety, this spring cannot break when the arm drops under its own weight, something which was recorded during tests, even when large extra loads are added to the arm: this spring can deteriorate, but not to the point of dropping the load suddenly. Where appropriate, stops can be provided to limit the approach of (even the distance between) the legs of the U-section. As far as the distance between these legs is concerned, a limitation can also be achieved by means of a cable fixed to these legs.

The affixing of the proposed device is simple to implement and does not require any particular tools.

Thanks to the existence of a plurality of housings for the introduction of the pins (or other fixing organs) the balancing is easy to control, so that a fairly small range of springs is enough to ensure the balancing of a wide variety of transfer arms.

The device described above has proved to be not very sensitive to the customary changes in climate temperatures. It is also, thanks to its design (in particular because of the composite nature of the U-shaped piece) not very sensitive to ultraviolet rays. No protective paint is thus necessary.

Thanks to the simplicity of its design, the balancing device of the invention substantially reduces the need for spare parts.

CLAIMS

1. Articulated arm for transferring fluid, liquid or gaseous products, comprising two tubular sections (7, 8+2) connected to each other by a rotating joint (3) with a horizontal axis, and a balancing device (4, 10) linked to each of the tubular sections to compensate for variations in torque about the axis of the rotating joint during a relative rotation between the sections, characterized in that this balancing device comprises a U-shaped spring (10), having two legs (11, 12) the ends (11A, 12A) of which are each linked to a respective section.
2. Arm according to claim 1, characterized in that each of the ends of the U-shaped spring is articulated (13, 14) on its respective section, about an axis parallel to the axis of the rotating joint.
3. Arm according to claim 1 or 2, characterized in that at least one of the ends of the U-shaped spring comprises a plurality of housings (15, 16) for the reception of an organ (13, 14) for its connection to the respective tubular section.
4. Arm according to claim 3, characterized in that each of the ends of the legs of the U-shaped spring comprises a plurality of housings for the reception of an organ for its connection to the respective tubular section.
5. Arm according to any one of claims 1 to 4, characterized in that the two tubular sections are respectively fitted, each side of the rotating joint, with attachment brackets (20, 21) formed in such a way that the two legs (11, 12) of the U-shaped spring are disposed substantially in the same plane perpendicular to the axis of the rotating joint;
6. Arm according to any one of claims 1 to 6, characterized in that the U-shaped spring (10) is made of composite material.
7. Arm according to claim 6, characterized in that the U-shaped spring (10) is covered with a silicone sheath.

