

“Petal control valve for separable connection units for flexible hoses”.

* * * *

The present invention relates to a petal control valve for separable connection units for hoses for transferring fluid products, in particular petroleum products.

It is known that sea transfer of petroleum products from petrochemical installation, from platform, from tanker to tanker, from tanker to land installation and vice versa is carried out through flexible hoses and hose connection units which consist of two separable parts, each provided with a respective control valve which automatically closes upon separation to limit the spillage of product into the sea, with consequent less pollution of the latter. These connection units are placed on the part of the flexible hose positioned in the sea and have the primary objective of protecting the hose, and more in general the connection line, in case of abnormal situations which cause excessive pulling on the hose or excessive pressure on the line. Such abnormal situations may be: breaking away and drifting off of tankers or more in general petroleum installations (FPSO) thus stretching the flexible hose, rough sea causing traction on the hose beyond the limits, boat knocking into the hose and dragging it away thus creating excessive loads thereon, quick closing of the valve downstream of the flow or any other reason causing excessive axial load and/or pressure increase.

The currently available connection units are made so that the control valves are automatically closed after the separation of the two parts of the connection unit, i.e. without control by an operator in the aforesaid situations.

Fluid control valves of the petal type are also known, i.e. consisting of a plurality of rotatable segments or sectors, which are rotated between an opening position, in which the petals are substantially parallel to the flow direction of the petroleum product, and a closing position in which the petals converge transversally to the axis of the unit to block the product flow. The

movement from the opening position to the closing position occurs under the bias of elastic means when the retaining action exerted, for example, by an axially removable inner sleeve ceases due to the axial traction stress imposed on the connection unit. Fluid dynamic brakes appropriately slow down the closing speed of the upstream valve to avoid excessive pressure, called water hammer, determined by the combined action of the elastic means and of the pressurized fluid, which may have destructive effects on the control valve and on the connection unit itself. A petal control valve is described for example in patent applications MI2010A002247 and MI2010A002248, filed on 6 December 2010.

The problem of pivoting the petals exists in the valves of the aforesaid type, because the pivoting movement must be accurate, reliable and externally accessible from the connection unit for adjusting and possibly replacing the pins used.

Therefore, it is an object of the present invention to provide a petal control valve for separable connection units for hoses for transferring fluid products, which have an effective pivoting system of the rotational petals.

In accordance with the invention, such an object is achieved by means of the use of spherical pins interposed between laterally adjacent petals and provided with a threaded positioning neck inserted and screwed into a respective radial hole of the body of the connection unit.

A locking cap screwed in turn into said radial hole and tightly abutting against said neck of the spherical pin for keeping the spherical pin in a suitable position to enable a correct and precise pivoting between the two adjacent petals and to prevent the pin from rotating and displacing from the set position.

The features of the present invention will become further apparent from the following detailed description of an embodiment thereof, shown by way of non-limitative example in the accompanying drawings, in which:

figures 1 and 2 respectively show a side view and an axial section

view, taken along line II-II in figure 1, of the connection unit for flexible hoses with petal control valves according to the present invention;

figure 3 shows an axial section view of the same connection unit during a two-parts separating process with the control valves already closed;

5 figure 4 shows a section view of the connection unit taken along line IV-IV in figure 3;

figure 5 shows by way of example a perspective view of one of the petals of smaller size of the control valve which is upstream in the flow direction of the fluid product;

10 figure 6 shows a plan view of the same petal;

figure 7 shows a section view of the same petal taken along line VII-VII in figure 6;

figure 8 shows a side view of the same petal;

15 figure 9 shows by way of example a perspective view of one of the petals of larger size of the control valve which is upstream in the flow direction of the petroleum product;

figure 10 shows a plan view of the same petal in figure 9;

figure 11 shows a side view of the same petal in figure 9;

20 figures 12 and 13 show a partially sectioned view of the housing seats of the spherical pins with which the petals in figures 5-8 and 9-11 are provided;

figure 14 shows how a petal of smaller size overlaps a petal of larger size in the closing position of the valve to which said petals belong;

25 figure 15 shows a cross-section view of the connection unit through the pivoting points of the petals according to line XV-XV in figure 1;

figure 16 shows an enlarged detail of one of the pivoting points shown in figure 15.

30 Figure 1 shows a connection unit for flexible hoses, which comprises two separable valve parts or bodies 1 and 2, upstream and downstream in the flow direction of the transported fluid product (from right to left in figure 2),

respectively.

The two parts 1 and 2 are connected by burst screws 3, which break in case of strong traction stress (equal to or higher than the setting load), thus allowing to separate the two parts.

5 A cylindrical sliding sleeve 4 (fig. 2) is arranged within the connection unit, which sleeve is automatically and axially removable from the connection unit when the two parts of the unit are separated.

10 The cylindrical sleeve 4 keeps the normally open position of two rotatable sector valves 5-5' placed upstream and downstream in the flow direction of the petroleum product, respectively.

The functions and operative modes of the sleeve 4 are described, for example, in Italian patent application MI2009A002146 filed on 4 December 2009 by the Applicant.

15 Each valve 5-5' consists of two series of petals or segments 6-7 and 6'-7' of different shape and sizes, which alternate circumferentially and are rotatable about respective axes between the opening position in figure 2 and the closing position in figures 3 and 4.

20 Figures 5-14 show in detail the shape and function of the petals 6 and 7 of the upstream control valve 5, made in accordance with the present invention. The shape of petals 6' and 7' of the downstream valve 5' is similar.

25 A petal 7 of larger size is shown in figures 9-13, where it is seen consisting of an approximately triangular body 51 which is provided with a V-shaped end 31, the sides 32 of which are intended to fluid tightly abut against the corresponding sides of the other adjacent petals 7. Petal 7 has lateral sides 33 with a curved end 34, which include a step 35 on which a side of the petal 6 of smaller size interposed between two petals 7 of larger size rests when valve 5 is closed. Two oblique projections 53 overlap and are integral (or restrained at fixing points 54 and 55) to the upstream surface
30 56 of body 51 which faces the flow of petroleum product when the valve is

closed. Petal 7 also includes partially spherical pivoting points 61 (shown in greater detail in figure 13) and a control heel 62.

5 A petal 6 of smaller size is shown, in turn, in figures 5-8, where it is seen consisting of an approximately triangular body 52 which is provided with a rounded end 36 with step 37 (fig. 8), which tightly engages the curved
ends 34 of two adjacent petals 7 when valve 5 is closed, and with straight
sides 38 which tightly engage the lateral sides 33 of the two adjacent petals 7
when valve 5 is closed. Two fins 59, which laterally protrude from the sides
38 and are provided with curved recesses 60 adapted to house, when the
10 valve is closed, the corresponding projections 53 of the adjacent petals 7 (as shown in greater detail below), overlap and are restrained at fixing points 58 to the upstream surface 57 of the body 52. Petal 6 also includes partially spherical pivoting points 63 (shown in greater detail in figure 12) and a control heel 64.

15 Petals 7 and 6 can rotate about respective axes and pivoted to one another by means of spherical pins 70, shown in figures 14, 15 and 16, which are rotationally housed in the partially spherical seats 61 and 63 of the aforesaid petals. Each spherical pin 70 is provided with a threaded positioning neck 71 (fig. 16) which is inserted and screwed into a respective
20 radial hole 72 of the body of the connection unit. A locking cap 73 is screwed into the same hole 72 and acts on the neck 71 to keep the spherical pin 70 in the correct position. A sealing gasket 75 is interposed between the lateral surfaces of cap 73 and hole 72 to avoid leakages of fluid through the pivoting points.

25 Similar spherical pins 70 with neck 71 and locking cap 73 are provided for the petals of control valve 5', as shown in figures 2 and 3.

Figures 4 and 14 show the closing configuration of the petals 7 and 6 of the control valve 5. The configuration of the petals 7' and 6' of valve 5' is entirely similar.

30 The movement of the single petals 7 and 6 from the opening position

to the closing position is controlled by an automatic closing device 9 of the type described in Italian patent application MI2010A002248, filed on 6 December 2010, which acts on the heels 62 and 64 under the bias of helical springs 17 when sleeve 4, according to the modes explained in Italian patent
5 MI2009A002146, is axially pulled out from the interior of valve 5, thus ceasing the retaining action of the rotatable petals 6 and 7 of the valve itself.

The closing movement of the petals 7 and 6 of valve 5 is braked by the controlled leakage of a braking fluid of the viscous type from the housing chambers 18 of the fluid itself to the housing chambers 14 of the springs 17
10 through leakage pipes 19 in which flow speed adjustment cartridges 21 having a helical external groove are inserted.

The leakage speed of the braking fluid is adjusted by means of differently grooved cartridges 21, so as to determine different rotation, and thus closing, speeds of the single petals of valve 5. More specifically, the
15 closing speed of the petals 7 of larger size is set so as to be faster than that of the petals 6 of smaller size, which consequently overlap and partially rest on the edges of the adjacent petals 7, thus achieving the closing configuration in figure 4. This allows to obtain a closure which limits the release of product to the maximum when closing the control valve 5, thus limiting the pressure
20 peak generated by the water hammer of the petroleum product to acceptable levels.

The fins 59 of the petals 6 of smaller size avoid any early closing of the petals 7 of larger size, and when housing the projections 53 of petals 7 in their recesses 60, allow an accurate placement of the petals in the tight
25 closing position, as shown in figure 14.

The petals 6'-7' of the downstream control valve 5' in the flow direction of the fluids are similarly provided with fins and projections similar to the fins 59 and the projections 53 of petals 6-7, and are in turn provided with automatic closing devices, described in patent application
30 MI2010A002248, which by means of appropriate springs act on the heels of

petals 6' and 7' to determine the rotation and thus the automatic closing of petals 6' and 7' when sleeve 4 is pulled out (fig. 3). The braking effect is here determined by the pressurized fluid inside the joining part 2.

5 For units having a one-direction flow, the downstream valve may thus not be provided with a braking system but only with the automatic closing device biased by a spring.

CLAIMS

1. A control valve (5, 5') for connection units for flexible hoses and a connection unit, the control valve (5,5') comprising a plurality of petals (segments or sectors) (6, 7; 6', 7') rotatable between a position of complete opening and a position of complete closing, **characterized in that** said petals (6, 7; 6', 7') are rotatable around pivoting axes defined by spherical pins (70) interposed between laterally adjacent petals and provided with a threaded positioning neck (71) inserted and screwed in a respective radial hole (72) of the body (1, 2) of the connection unit.
2. The control valve according to claim 1, **characterized in that** a locking cap (73) is screwed in said radial hole (72) and tightly abutting against said neck (71) of the spherical pin (70) for keeping said spherical pin (70) in a suitable position to enable a correct and precise pivoting between the two adjacent petals (6, 7; 6', 7').
3. The control valve according to claim 2, **characterized in that** it comprises a sealing gasket (75) inserted between said locking cap (73) and said radial hole (72).
4. The control valve according to claim 2, **characterized in that** said petals (6, 7; 6', 7') are provided with partially spherical seats (61, 63) for housing said spherical pins (70).
5. The control valve according to any one of the preceding claims, **characterized in that** the petals (7, 7') with larger size have a V-shaped end (31), the sides (32) of which are intended to fluid-tightly abut against the corresponding sides of other petals (7, 7') of larger size, and also with lateral sides (33) with a curved end (34) which include a step (35) on which a side of a petal (6, 6') of smaller size interposed between two petals (7, 7') of larger size rests when the valve (5, 5') is closed, and **in that** the petals (6, 6') of smaller size have a rounded end (36) with a step (37), which tightly engages the curved ends (34) of two adjacent petals (79) when the valve (5, 5') is closed, and straight sides (38) on which the step (37) continues, which tightly engage the lateral sides (33) of the two adjacent petals (7, 7') when the valve (5, 5') is closed.