

PRE-ASSEMBLY OF PARTS

The present invention concerns the field of mechanical assemblies and more particularly those comprising a shaft, such as a smooth or threaded rod (stud), on which a plurality
5 of parts come to be mounted. These parts are pierced by a hole, with a section substantially corresponding to the section of the shaft, so as to receive said shaft. These parts may be chosen from: washer, spacer, seal, spring, nut, etc. During assembly each of the parts of the plurality is engaged on the
10 shaft. For critical applications the type, orientation and number of each part must be respected. This can be difficult if assembly is carried out under conditions of poor lighting, lack of room, difficulty in positioning, difficulty of access or of mobility (vehicle, floating platform, etc.). Such
15 conditions can be encountered in numerous industrial fields, in particular the automotive industry, construction and shipbuilding.

An idea on which the invention is based is to propose a pre-assembly comprising some or all of the parts intended to
20 be mounted on a shaft, by type, orientation and number matched to the requirements of the assembly, secured as a single object, in order to facilitate their manipulation.

The invention concerns a pre-assembly of parts capable of being mounted on a shaft, such as washers, comprising a stack
25 comprising at least two parts arranged in an assembly configuration and a flexible securing sheet capable of securing said at least two parts of the stack by totally or partially enclosing a lateral surface of said stack.

According to another feature, the flexible securing sheet
30 comprises a plastic film.

According to another feature, the flexible securing sheet comprises a heat-shrunk sleeve.

According to another feature, the flexible securing sheet is pierced or weakened at the level of the passage of the
35 shaft.

According to another feature, the flexible securing sheet comprises at least one peripheral strip completely surrounding

the lateral surface of the stack.

According to another feature, the flexible securing sheet comprises at least one axial strip extending in an axial direction of the stack over a portion of the lateral surface
5 of the stack.

According to another feature, the flexible securing sheet comprises an adhesive to adhere to the parts and/or to itself.

According to another feature, the flexible securing sheet is precut to facilitate its removal after assembly.

10 According to another feature, the stack comprises spring washers, preferably disposed head-to-tail, and more preferably an odd number thereof.

According to another feature, the pre-assembly, preferably the flexible securing sheet, comprises a marking so as to
15 indicate an axial orientation of the stack. This marking therefore enables a poka yoke to be created.

The invention further concerns a method of fabricating a pre-assembly of parts capable of being mounted on a shaft, such as washers, characterized in that it comprises the
20 following steps: producing a stack comprising at least two parts disposed in an assembly configuration, applying a flexible securing sheet capable of securing said at least two parts of the stack by totally or partially enclosing a lateral surface of said stack.

25 According to another feature, the method further comprises, after the production step, a step of checking the stack produced by measuring the dimension of the stack in the direction of the shaft.

The invention further concerns an insulating wall, in
30 particular for tanks for storing a cryogenic fluid, that includes a retaining member including at least one such pre-assembly, said retaining member engaging at least one insulating block to retain the insulating block on a support surface.

35 An insulating wall of this kind may form part of a fluid-tight and thermally insulating tank installed in a terrestrial storage installation, for example to store LNG, or installed

in a floating, coastal or deep water structure, in particular a methane tanker ship, a floating storage and regassification unit (FSRU), a floating production and offloading (FPSO) unit, etc.

5 According to one embodiment, a ship for transporting a fluid product, in particular a cold liquid, includes a double hull and a tank as referred to above disposed in the double hull.

 According to one embodiment, the invention also provides
10 a method of loading and offloading such a ship, in which a fluid is fed through insulated pipes from or to a floating or terrestrial storage installation to or from the tank of the ship.

 According to one embodiment, invention also provides a
15 transfer system for a fluid product, in particular a cold liquid, the system including the aforementioned ship, insulated pipes adapted to connect the tank installed in the hull of the ship to a floating or terrestrial storage installation and a pump for driving a flow of fluid product
20 through the insulated pipes from or to the floating or terrestrial storage installation to or from the tank of the ship.

 Other features, details and advantages of the invention
25 will emerge more clearly from the detailed description given hereinafter by way of illustration and with reference to drawings in which:

- figure 1 is a profile view of a prior art pre-assembly, ready to be mounted on a shaft,
- 30 - figure 2 is a profile view of the pre-assembly from figure 1 adapted in accordance with one embodiment of the invention by adding a flexible securing sheet,
- figure 3 shows, in an expanded view, one embodiment of a plastic film intended to form a flexible securing sheet,
- 35 - figure 4 shows in profile view one embodiment of a pre-assembly according to the invention, more particularly adapted to suit an application of fixing an insulating block in a

methane tanker ship tank wall,

- figure 5 shows a cutaway schematic representation of a methane tanker ship tank and a terminal for loading/offloading that tank,

5 - figure 6 is a schematic perspective view of a securing sheet in the form of a peripheral strip having a precut line.

Figure 1 illustrates a frequent situation in mechanical assembly. A smooth or threaded shaft 4 has to receive a stack of parts 2. These parts are pierced by a hole 6 adapted to
10 enable the passage of said shaft 4. They are most often, although not necessarily, circles around the shaft 4. The parts 2 may be washers of any kind, cups, seals, springs, etc. as a function of the requirements of the assembly.

The type of each part 2, the quantity thereof and the order
15 thereof in the stack, as well as the orientation thereof in the case of a non-symmetrical part 2, must most often be respected. Also, under difficult conditions, it may be difficult to produce the stack correctly in situ and to hold the parts 2 together until they are mounted on the shaft 4.

20 Also the invention proposes to pre-assemble the parts 2, in a workshop or in a factory, where it is possible to check the stack, and to secure them by means of a flexible securing sheet 3.

To this end, as shown in figure 2, a stack of parts 2
25 needed for assembly is produced, disposed in an assembly configuration, i.e. by type, number and orientation conforming to the final assembly disposition. The parts in this stack are then held together by a flexible securing sheet 3 functioning by totally or partially enclosing a lateral surface of the
30 parts 2 in the stack.

In accordance with one advantageous embodiment, the flexible securing sheet 3 comprises a plastic film. A small thickness, characteristic of a film, is advantageous in that it does not significantly modify the dimensions of the stack
35 and therefore does not modify the assembly process.

The plastic used here may be of any type. It is advantageously transparent in order to enable checking of the

parts 2 present, their disposition and their condition.

In accordance with one embodiment the flexible securing sheet 3 comprises a heat-shrunk sleeve. A heat-shrinkable sleeve advantageously enables easy production: the sheath is
5 fitted around the parts 2, advantageously along the axis of the shaft 4, after which exposure to hot air shrinks the sheath around the parts 2, holds them together and retains the flexible securing sheet 3 on the parts 2.

Any other embodiment may be envisaged moreover. Thus
10 covering with a filament or tape can enable production of the flexible securing sheet 3 by winding it around the stack.

Alternatively or additionally, the flexible securing sheet may be produced by a varnish or a wax enclosing the stack and deposited by dipping into a bath or with a brush or spraygun.

15 In accordance with another feature, the flexible securing sheet 3 may completely enclose the stack. In this case, during assembly the shaft 4 pierces the flexible securing sheet 3 in line with the hole 6 at the two ends of the stack.

This piercing may be facilitated by weakening the flexible
20 securing sheet 3 at the level of the two passages of the shaft 4.

In order to facilitate assembly, in accordance with another feature, the flexible securing sheet 3 may further be pierced at the level of the passage of the shaft 4. Depending on the
25 embodiment, this piercing is initial or final;

Initial piercing: no material is applied or deposited during the production of the flexible securing sheet 3.

Final piercing: the flexible securing sheet 3 is produced complete and is then pierced with two openings 7 and 8 in line
30 with the hole 6 at the two ends of the stack.

In accordance with one embodiment the flexible securing sheet 3 comprises at least one peripheral strip. One example of a peripheral strip of this kind is shown in figure 3. This strip is termed peripheral in that it is intended to be wound
35 around the periphery of the stack in order to form the flexible securing sheet 3. The markers 5, triangular in figure 3, are, in the final configuration, all disposed on an end surface of

the stack, around the shaft 4 once mounted.

In accordance with another alternative or additional embodiment, the flexible securing sheet 3 comprises at least one axial strip. A strip of this kind is termed axial in that
5 it is deposited on the stack parallel to the axis of the stack and does not cover all of the lateral surface of the stack. In this case the pre-cutting may extend over part or all of a width of the axial strip.

In accordance with another feature, the flexible securing
10 sheet 3 further comprises an adhesive to adhere to the parts 2 and/or to itself 3. The adhesive can thus enable the retention of a filament or tape wound in a coil around the stack, both on the stack and on the filament or tape itself. The adhesive can further enable the retention of a peripheral
15 or axial strip, both on the stack and on the strip itself. Thus the peripheral strip is able to stick to the stack and, by means of an overlength, to itself.

Thanks in particular to its very small overall size, the flexible securing sheet 3 may be left in place, including after
20 assembly. If on the other hand it is wished to remove it once assembly has been carried out, the flexible securing sheet 3 is advantageously precut, for example in the form of a dashed line, in order to facilitate removing the flexible securing sheet 3 after assembly.

25 This precutting may be carried out in different ways. In accordance with one particular embodiment, shown in figure 6, the flexible securing sheet 3 comprises between the openings 7 and 8 a precutting 9 extending over all the length of a lateral surface of the flexible securing sheet 3 facing the
30 lateral surface of the stack. Alternatively, the pre-cutting 9 may extend over only a part of the length of the lateral surface of the flexible securing sheet 3, from one of the openings 7 and 8. The orientation of the pre-cutting 9 may be axial as shown or inclined relative to the axis, for example
35 in the form of a helix. The pre-cutting 9 may be produced by perforating the flexible securing sheet 3 along a dashed line pattern. Alternatively, the pre-cutting 9 may be produced by

passing a cutting means over a part of or all the length of the flexible securing sheet 3 so as to weaken the flexible securing sheet 3 at the level of the pre-cutting.

In particular, the flexible securing sheet 3 may comprise
5 a plurality of pre-cuttings similar to the pre-cutting 9. In use, the pre-cutting 9 may be torn after mounting the pre-assembly 1 on the shaft 4 so as to enable the removal of the flexible securing sheet 3.

In accordance with one particular embodiment, shown in
10 figure 4, the stack comprises spring washers, also known as Belleville type washers. In order to maximize elasticity, the Belleville washers are preferably disposed head-to-tail. In this application the number of washers is advantageously an odd number.

15 Depending on the stack produced, it can happen that the pre-assembly is not symmetrical with regard to mounting it on the shaft 4. Also, although errors in the composition of the stack are prevented by the pre-assembly, it is furthermore necessary to avoid a mounting error where two choices are
20 offered. To this end, in accordance with another feature, it is advantageous to place a marking 5, either visual or tactile, to provide a poka yoke.

To this end the pre-assembly 1 is advantageously marked. This marking may be produced by piercing, by deposition of
25 material, by paint or by varnish directly on one of the parts 2 of the stack, advantageously one of the end parts 2.

In accordance with an embodiment preferred in that it leaves the parts 2 untouched and is easier to implement, said marking 5 is produced by the flexible securing sheet 3. A
30 marking of this kind enables a preferred orientation of the pre-assembly 1 for mounting it on the shaft 4 to be indicated. A marking 5 of this kind may for example be an additional portion of the plastic film, produced in another color. An example of a marking 5 of this kind is shown in figure 3. The
35 peripheral strip of rectangular shape adapted to be wound around the periphery of the stack is completed by protuberances 5 which are advantageously colored. After winding, these

protuberances 5 are all located around the same hole 6 on an end surface of the stack, indicating a preferred orientation of the pre-assembly 1.

The invention further concerns a method of fabricating a pre-assembly 1 of parts 2 of this kind capable of being mounted on a shaft 4, such as washers. It comprises the following steps. A first step consists in producing the stack of at least two parts. The stack corresponds to the assembly configuration. In other words, the parts 2 are disposed by type, number and orientation in accordance with the requirements of the mechanical assembly. A second step then consists in applying a flexible securing sheet 3 capable of securing said at least two parts 2 of the stack by totally or partly enclosing a lateral surface.

In accordance with an optional embodiment it is possible to check the stack produced after its production. This can for example be done by measuring the dimension of the stack in the direction of the shaft 4. This measurement of the dimension or height of the stack may be carried out in different ways, for example by a shim system, by laser telemetry or by a vernier calliper. In the case of production in accordance with figure 4, a measurement of this kind enables the correct number and the orientation of the parts 2 to be checked. Indeed, a missing or incorrectly oriented Belleville washer greatly modifies the height of the stack.

A pre-assembly 1 of this kind, including a stack of Belleville washers, may be used in a retaining member for assembling an insulating wall, such as a wall for a tank for storing a cryogenic fluid.

A retaining member or coupler anchoring an insulating block to a support surface, for example a supporting wall of a ship, is shown in figure 2 of the publication FR-A-2798902 and in figure 23 of the publication WO-A-2017103500.

In this case the pre-assembled stack of Belleville washers preferably comprises an odd number of washers disposed in such a manner that the concave end surface faces toward the metal plate exerting a bearing force on the insulating block or

blocks and the convex end surface faces the nut screwed onto the stud on which the stack is engaged.

The nut may also form part of the pre-assembled stack.

Referring to figure 5, a cutaway of a methane tanker ship 5 70 shows a fluid-tight and insulated tank 71 of prismatic general shape mounted in the double hull 72 of the ship. The wall of the tank 71 includes a primary fluid-tight barrier intended to be in contact with the LNG contained in the tank, a secondary fluid-tight barrier arranged between the primary 10 fluid-tight barrier and the double hull 72 of the ship, and two insulating barriers respectively arranged between the primary fluid-tight barrier and the secondary fluid-tight barrier and between the secondary fluid-tight barrier and the double hull 72.

15 In a manner known in itself loading/offloading pipes 73 disposed on the top deck of the ship may be connected by means of appropriate connectors to a maritime or harbor terminal to transfer a cargo of LNG from or to the tank 71.

Figure 5 shows an example of a maritime terminal including 20 a loading and offloading station 75, an underwater pipe 76 and a terrestrial installation 77. The loading and offloading station 75 is a fixed off-shore installation including a mobile arm 74 and a tower 78 that supports the mobile arm 74. The mobile arm 74 carries a bundle of insulated flexible tubes 79 25 that can be connected to the loading/offloading pipes 73. The orientable mobile arm 74 adapts to all methane tanker loading gauges. A connecting pipe that is not shown extends inside the tower 78. The loading and offloading station 75 enables loading and offloading of the methane tanker 70 from or to the 30 terrestrial installation 77. The latter includes liquefied gas tanks 80 and connecting pipes 81 connected via the underwater pipe 76 to the loading or offloading station 75. The underwater pipe 76 enables transfer of the liquefied gas between the loading or offloading station 75 and the terrestrial 35 installation 77 over a great distance, for example 5 km, which enables the methane tanker ship 70 to remain at a great distance from the coast during loading and offloading

operations.

Pumps onboard the ship 70 and/or pumps equipping the terrestrial installation 77 and/or pumps equipping the loading and offloading station 75 are used to generate the pressure
5 necessary to transfer the liquefied gas.

Although the invention has been described in connection with a plurality of particular embodiments, it is obvious that it is in no way limited to them and that it encompasses all technical equivalents and combinations of the means described
10 if the latter are within the scope of the invention.

The use of the verb "to include" or "to comprise" and conjugate forms thereof do not exclude the presence of elements or steps other than those stated in a claim

In the claims, any reference sign between parentheses
15 should not be interpreted as a limitation of the claim.

CLAIMS

1. A pre-assembly (1) of parts (2) capable of being
5 mounted on a shaft (4), such as washers, comprising a stack
comprising at least two parts (2) arranged in an assembly
configuration, **characterized in that** it comprises a flexible
securing sheet (3) capable of securing said at least two parts
10 (2) of the stack by totally or partially enclosing a lateral
surface of the stack, where the flexible securing sheet (3) is
precut to facilitate its removal after assembly.

2. The pre-assembly (1) as claimed in claim 1, in which
the flexible securing sheet (3) comprises a plastic film.
15

3. The pre-assembly (1) as claimed in either one of
claims 1 or 2, in which the flexible securing sheet (3)
comprises a heat-shrunk sleeve.

20 4. The pre-assembly (1) as claimed in any one of claims
1 to 3, in which the flexible securing sheet (3) is pierced or
weakened at the level of the passage of the shaft (4).

5. The pre-assembly (1) as claimed in any one of claims
25 1 to 4, in which the flexible securing sheet (3) comprises at
least one peripheral strip completely surrounding the lateral
surface of the stack.

6. The pre-assembly (1) as claimed in any one of claims
30 1 to 5, in which the flexible securing sheet (3) comprises at
least one axial strip extending in an axial direction of the
stack over a portion of the lateral surface of the stack.

7. The pre-assembly (1) as claimed in any one of claims
35 1 to 6, in which the flexible securing sheet (3) comprises an
adhesive to adhere to the parts (2) and/or to itself (3).

8. The pre-assembly (1) as claimed in any one of claims 1 to 7, in which the stack comprises spring washers, preferably disposed head-to-tail, and more preferably an odd number thereof.

5

9. The pre-assembly (1) as claimed in claim 8, in which the stack further comprises a nut.

10. The pre-assembly (1) as claimed in any one of claims 10 1 to 9, in which the pre-assembly (1), preferably the flexible securing sheet (3), comprises a marking (5) so as to indicate an axial orientation of the stack.

11. A method of fabricating a pre-assembly (1) of parts 15 (2) capable of being mounted on a shaft (4), such as washers, characterized in that it comprises the following steps:

- producing a stack comprising at least two parts (2) disposed in an assembly configuration,
- applying a flexible securing sheet (3) capable of securing 20 said at least two parts (2) of the stack by totally or partially enclosing a lateral surface of the stack, in which the flexible securing sheet (3) is precut to facilitate its removal after assembly.

25 12. The method as claimed in claim 11, further comprising, after the production step, a step of checking the stack produced by measuring the dimension of the stack in the direction of the shaft (4).

30 13. An insulating wall, in particular for tanks for storing a cryogenic fluid, characterized in that it includes a retaining member including at least one pre-assembly (1) as claimed in any one of claims 1 to 10, said retaining member engages at least one insulating block to retain the insulating 35 block on a support surface.

14. A ship (70) for transporting a fluid, the ship including a double hull (72) and a fluid-tight and thermally

insulative tank (71) disposed in the double hull, the fluid-tight and thermally insulating tank including an insulating wall as claimed in claim 13.

5 15. A method of loading or offloading a ship (70) as claimed in claim 14, in which a fluid is fed through insulated pipes (73, 79, 76, 81) from or to a floating or terrestrial storage installation (77) to or from the tank (71) of the ship.

10 16. A transfer system for a fluid, the system including a ship (70) as claimed in claim 14, insulated pipes (73, 79, 76, 81) adapted to connect the tank (71) installed in the hull of the ship to a floating or terrestrial storage installation (77) and a pump for driving a flow of fluid through the
15 insulated pipes from or to the floating or terrestrial storage installation to or from the tank of the ship.