



(51) International Patent Classification:
F01N 13/18 (2010.01)

(21) International Application Number:
PCT/FI2014/050205

(22) International Filing Date:
20 March 2014 (20.03.2014)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: WÄRTSILÄ FINLAND OY [FI/FI]; Tarhaajantie 2, FI-65380 Vaasa (FI).

(72) Inventors: HYTÖNEN, Jari; c/o Wärtsilä Finland Oy, Järvikatu 2-4, FI-65100 Vaasa (FI). SANDBERG, Juhon; c/o Wärtsilä Finland Oy, Järvikatu 2-4, FI-VAASA 65100 (FI).

(74) Agent: BERGGREN OY AB; P.O. Box 16, (Antinkatu 3 C), FI-00101 Helsinki (FI).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: EXHAUST DUCT ARRANGEMENT

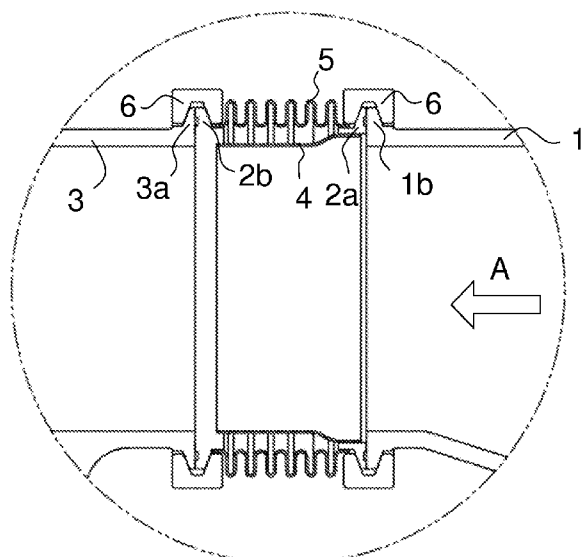


FIG. 3

(57) Abstract: The exhaust duct arrangement comprises a first exhaust duct part (1) having a flange (1b) for connecting a second end of the part (1) to an adjacent exhaust duct part (2), and a second exhaust duct part (2) having a first flange (2a) at a first end and a second flange (2b) at a second end, each of the flanges (2a, 2b) being arrangeable against a flange (1b, 3a) of an adjacent exhaust duct part (1, 3). The flanges (1b, 2a, 2b) of the exhaust duct parts (1, 2) are configured so that when the first end of the second exhaust duct part (2) is arranged against the flange (1b) of the first exhaust duct part (1), the joint that is formed has a different cross-sectional profile than a joint that is formed by arranging the second end (2b) of the second exhaust duct part (2) against the flange (1b) of the first exhaust duct part (1).

Exhaust duct arrangement

Technical field of the invention

The present invention relates to an exhaust duct arrangement in accordance with the preamble of claim 1.

5

Background of the invention

An exhaust duct of a large piston engine, such as a ship or power plant engine, is typically made of several exhaust duct parts that are connected to each other. Each exhaust duct part is provided with a flange at its each end for facilitating connecting of the part to the adjacent parts of the exhaust duct. In some cases, two rigid exhaust duct parts are connected to each other via a connecting piece comprising a rigid inner pipe, often called as a flame tube, and a flexible bellows-type tube arranged around the flame tube. Each end of the connecting piece is provided with a flange for connecting the connecting piece to the adjacent exhaust duct parts. The flexible outer tube is connected to the flanges of the connecting piece at both ends, but only one end of the flame tube is connected to a flange of the connecting piece. The rigid flame tube is thus rigidly connected only to one of the adjacent exhaust duct parts, and a flexible connection is thus formed between the rigid exhaust duct parts. The flexible connection allows heat expansion of the parts and prevents vibrations from being transmitted from one exhaust duct part to another part. To allow bending of the connecting piece, the outer diameter of the flame tube has to be slightly smaller than the inner diameter of the flange of the connecting piece at the free end of the flame tube. Therefore, it is important that the connecting piece is mounted in a correct orientation. The free end of the flame tube should point to the flow direction of the exhaust gas. If the free end of the flame tube points to the wrong direction, the exhaust gas flows at a high speed into the space between the flame tube and the flexible outer tube. The exhaust gas flow and the thermal loading of hot exhaust gases can damage the flame tube and the bellows, and in the worst case the flame tube cracks and pieces of the flame tube are carried to a turbine of the turbocharger destroying the turbocharger. In addition, the hot exhaust gases cause wear of the outer tube, which can lead to leaks into the engine room, damage the insulation of the exhaust

system, increase surface temperatures of the engine and consequently increase the risk of fire and compromise human safety.

The cross-sectional profiles of the flanges of the connecting piece are usually substantially identical. Typically, when a flange of the connecting piece is arranged against a flange of an adjacent rigid exhaust duct part, the cross-sectional profile of the formed joint is substantially V-shaped and tapers towards the outer perimeter of the joint. The shape of each flange is thus a half-V. The joint is secured by arranging a clamp ring around the flanges. Because the flanges are substantially identical, the connecting piece can be mounted in any of the two possible longitudinal orientations. The correct mounting of the connecting piece is ensured by markings indicating the flow direction of the exhaust gas. However, the mechanic assembling the exhaust duct may forget to check the correct orientation of the connecting piece or may even be unknowing of the flow direction. Therefore, there is a substantial risk of incorrect mounting of the connecting piece, significant damages of a turbocharger and hot exhaust gas leakage into the surroundings.

Summary of the invention

An object of the present invention is to provide an improved exhaust duct arrangement. The characterizing features of the exhaust duct arrangement according to the invention are given in the characterizing part of claim 1.

The exhaust duct arrangement comprises a first exhaust duct part having a first end and a second end, the second end being provided with a flange for connecting the second end to an adjacent exhaust duct part, and a second exhaust duct part having a first end provided with a first flange for connecting the first end to an adjacent exhaust duct part, and a second end provided with a second flange for connecting the second end to an adjacent exhaust duct part, each of the flanges being arrangeable against a flange of an adjacent exhaust duct part. The flanges of the exhaust duct parts are configured so that when the first end of the second exhaust duct part is arranged against the flange of the first exhaust duct part, the joint that is formed has a different cross-sectional profile than a joint that is formed by arranging the second end of the second exhaust duct part against said flange of the first exhaust duct part.

The different cross-sectional profile of the joint that results when a wrong end of the second exhaust duct part is arranged against the end of the first exhaust duct part thus functions as a clear indicator of wrong mounting.

5 The different cross-sectional profile can mean, for instance, a different thickness of the joint.

According to an embodiment of the invention, the arrangement further comprises a clamp ring which is arrangeable around a joint that is formed by arranging a flange of the second exhaust duct part against the flange at the second end of the first exhaust duct part, the clamp ring being configured so that
10 it can be tightened around the joint only if the first flange of the second exhaust duct part is arranged against the flange at the second end of the first exhaust duct part.

Since the clamp ring can be tightened only in the case the second exhaust duct part is correctly orientated, wrong mounting of the second exhaust duct
15 part is even more effectively prevented.

Brief description of the drawings

Embodiments of the invention are described below in more detail with reference to the accompanying drawings, in which

20 Fig. 1 shows a perspective view of an exhaust duct assembly,

Fig. 2 shows a cross-sectional view of a prior art joint between adjacent exhaust duct parts,

Fig. 3 shows a cross-sectional view of two joints joining adjacent exhaust duct parts together,

25 Fig. 4 shows an enlarged cross-sectional view of a joint between two correctly mounted exhaust duct parts, and

Fig. 5 and 6 shows cross-sectional views of joints between wrongly mounted exhaust duct parts.

Description of embodiments of the invention

In figure 1 is shown as an example of an exhaust duct arrangement an exhaust gas receiver of a large internal combustion engine. The engine is a large piston engine, such as a main or an auxiliary engine of a ship, an engine that is used at a power plant for producing electricity, or an engine that is used for pumping or compressing fluids in different applications. The exhaust gas receiver comprises several exhaust duct parts 1, 2, 3 that are connected to each other. Arrow A indicates the flow direction of the exhaust gas in the exhaust gas receiver. The exhaust gas receiver comprises rigid exhaust duct parts 1, 3 that are connected to each other via flexible exhaust duct parts 2. Hereinafter the rigid exhaust duct parts 1, 3 are referred to as a first exhaust duct part 1 and a third exhaust duct part 3, where the expressions "first" and "third" refer to the order of the exhaust duct parts in the flow direction of the exhaust gas. The first and the third exhaust duct parts 1, 3 can be either identical or different parts. The flexible exhaust duct part 2 is referred to as a second exhaust duct part 2. The expressions "first end" and "second end" used in the following description refer to the intended flow direction inside the part, "first" meaning the upstream end and "second" meaning the downstream end. Each of the first and the third exhaust duct parts 1, 3 is provided with a branch 12 for connecting the part 1, 3 to a cylinder head of the engine.

Figure 2 shows a cross-sectional view of a joint between two prior art exhaust duct parts 1, 2. The intended flow direction in figure 2 is from right to left. The joint connects a first exhaust duct part 1 to a second exhaust duct part 2. The construction of the second exhaust duct part 2 can be better seen in figure 3, which shows an exhaust duct according to the invention. Apart from the flanges 2a, 2b of the second exhaust duct part 2, the construction of the second exhaust duct part 2 in figure 3 is identical with the construction of the second exhaust duct part 2 in figure 2. The second exhaust duct part 2 comprises two flanges 2a, 2b. A first flange 2a is arranged at the first end of the second exhaust duct part 2 and a second flange 2b is arranged at the second end of the second exhaust duct part 2. The second exhaust duct part 2 comprises a flexible outer part 5, which is in the embodiments of the figures a bellows-type tube. The outer part 5 is made of a flexible material that is corrugated. The flexible outer part 5 is attached to both the first flange 2a and to the second flange 2b of the second exhaust duct part 2. The second exhaust duct part 2 allows heat expansion of the parts of the exhaust duct and prevents transmis-

sion of vibrations from one part of the exhaust duct to another part. The second exhaust duct part 2 further comprises a rigid inner tube 4, i.e. a flame tube. The inner tube 4 protects the outer part 5 from the hot exhaust gas. The inner tube 4 is connected only to the first flange 2a of the second exhaust duct part 2. The second end of the inner tube 4 is free. The outer diameter of the inner tube 4 at the free end of the inner tube 4 is slightly smaller than the inner diameter of the second flange 2b, and the inner tube 4 thus allows bending of the outer part 5 to a certain extent and also allows varying of the length of the outer part 5 and thus the length of the whole second exhaust duct part 2.

- 10 The first flange 2a of the second exhaust duct part 2 is provided with a groove 9 for accommodating a seal, but otherwise the first flange 2a of the second exhaust duct part 2 is identical to the flange 1b at the second end of the first exhaust duct part 1. Consequently, in the joint that is formed by arranging the first flange 2a of the second exhaust duct part 2 against the flange 1b at the second end of the first exhaust duct part 1, the plane of symmetry 7 coincides with the split plane 8 of the joint. The cross-sectional profile of the joint is V-shaped. The second flange 2b of the second exhaust duct part 2 is identical to the first flange 2a of the second exhaust duct part 2. The third exhaust duct part 3 connected to the second end of the second exhaust duct part 2 is not shown, but the third exhaust duct part 3 is provided with a flange that is identical to the flange 1b of the first exhaust duct part 1. Each joint between two adjacent exhaust duct parts 1, 2, 3 is secured by arranging a clamp ring 6 around the flanges 1b, 2a that are arranged against each other. The clamp ring 6 is provided with a V-shaped groove 11, which contacts inclined surfaces of the flanges 1b, 2a and presses the flanges 1b, 2a together. All the joints of the exhaust duct are identical, and the same type of clamp ring 6 can be used in all the joints. Because the flanges at the ends of the second exhaust duct part 2 are identical with each other and the flange of the first exhaust duct part 1 is identical with the flange 3a of the third exhaust duct part 3, either the first end or the second end of the second exhaust duct part 2 can be arranged against the second end of the first exhaust duct part 1.

In figure 2, the second exhaust duct part 2 is correctly mounted. The fixed end of the inner tube 4 is thus at the upstream side end of the second exhaust duct part 2, i.e. at the first end. The inner tube 4 thus prevents exhaust gas from flowing at high speed into the space between the inner tube 4 and the outer part 5 of the second exhaust duct part 2. However, because of the construction

of the flanges of the first, second and third exhaust duct parts 1, 2, 3, nothing prevents from mounting the second exhaust duct part 2 in a wrong longitudinal orientation between the first exhaust duct part 1 and the third exhaust duct part 3. The second exhaust duct part 2 could thus be mounted by accident so that the free end of the inner tube 4 points towards the first exhaust duct part 1, i.e. towards the upstream side of the exhaust gas flow. Wrong mounting of the second exhaust duct part 2 allows the exhaust gas to flow into the space between the outer part 5 and the inner tube 4 of the second exhaust duct part 2, which can damage both the inner tube 4 and the outer part 5. If the inner tube 4 cracks, parts of the inner tube 4 can hit the turbine blades of a turbocharger and destroy the turbocharger. Damaging of the outer part 5 can cause exhaust gas leakage into the engine room.

Wrong mounting of the second exhaust duct part 2 can be prevented by an arrangement according to the invention. Figure 3 shows joints between a first exhaust duct part 1 and a second exhaust duct part 2 and between the second exhaust duct part 2 and a third exhaust duct part 3. Arrow A indicates the flow direction in the exhaust duct. Figure 4 shows a cross-sectional view of the joint between the first exhaust duct part 1 and the second exhaust duct part 2 when the second exhaust duct part 2 is correctly mounted. In figure 4, the flow direction of the exhaust gas is from right to left. The second end of the first exhaust duct part 1 is provided with a flange 1b. The flange 1b is similar to the flange shown in figure 2. The flange 1b has thus a shape that is similar to a half-V. The inner perimeter of the flange 1b is thicker than the outer perimeter and the flange 1b tapers towards the outer perimeter of the flange 1b. The outer edge of the flange 1b is thus thinner than the inner edge. Also the flange 2a at the first end of the second exhaust duct part 2 is similar to the flange 2a shown in figure 2. However, the flange 2a is not identical with the flange 1b of the first exhaust duct part 1, but has a smaller thickness. Therefore, in the joint between the flange 1b of the first exhaust duct part 1 and the first flange 2a of the second exhaust duct part 2, the plane of symmetry 7 does not coincide with the split plane 8 between the flanges 1b, 2a, but is shifted slightly towards the first exhaust duct part 1. The cross-sectional profile of the joint is substantially V-shaped. When the flanges 1b, 2a of the first exhaust duct part 1 and the second exhaust duct part 2 are correctly mounted against each other, a clamp ring 6 fits around the joint and can be tightened to secure the joint. The clamp ring 6 comprises a V-shaped groove 11, which contacts the inclined surfaces

of the flanges 1b, 2a and presses the flanges 1b, 2a together when tightened. The clamp ring 6 can be identical with the clamp ring 6 of figure 2.

The first flange 2a of the second exhaust duct part 2 is provided with a groove 9 for accommodating a seal. The groove 9 is not an essential feature of the first flange 2a. The sealing can be implemented also without the groove 9 or the groove 9 could be arranged in the flange 1b of the first exhaust duct part 1. In some applications, the joint does not need to be provided with a seal.

Figure 5 shows a joint where the second exhaust duct part 2 is wrongly mounted against the first exhaust duct part 1. The flange 2b at the second end of the second exhaust duct part 2 is arranged against the flange 1b of the first exhaust duct part 1. The shape of the flange 2b at the second end of the second exhaust duct part 2 is similar to the flange 2a at the first end. However, the second flange 2b has a greater thickness than the first flange 2a. The thickness of the second flange 2b equals the thickness of the flange 1b of the first exhaust duct part 1. The plane of symmetry 7 in the joint thus coincides with the split plane 8 between the flanges 1b, 2b. In a wrongly mounted joint, the thickness of the joint in the longitudinal direction of the exhaust duct is different than in a correctly mounted joint. In the case of figure 5, the thickness of the joint is greater than in the correctly mounted joint of figure 4. The groove 11 of the clamp ring 6 contacts the inclined surfaces of the flanges 1b, 2b before it has reached the correct position around the joint. The clamp ring 6 does thus not fit properly around the joint and cannot be tightened. This is a clear indicator to the installer of the exhaust duct that the second exhaust duct part 2 does not have the correct orientation. It is thus not possible to mount the second exhaust duct part 2 in a wrong way, but the second exhaust duct part 2 can be mounted only in one predetermined longitudinal orientation. The second flange 2b of the second exhaust duct part 2 is provided with a groove 9 for accommodating a seal. The groove 9 is not an essential feature of the second flange 2b. The sealing can be implemented also without the groove 9 or the groove 9 could be arranged in the flange 3a of the third exhaust duct part 3. In some applications, the joint does not need to be provided with a seal.

Figure 6 shows a joint where the second exhaust duct part 2 is wrongly connected to the third exhaust duct part 3. The first flange 2a of the second exhaust duct part 2 is arranged against the flange 3a of the third exhaust duct part 3. The shape of the flange 3a of the third exhaust duct part 3 is similar to

the shape of the flange 1b of the first exhaust duct part 1. However, the thickness of the flange 3a of the third exhaust duct part 3 is smaller than the thickness of the flange 1b of the first exhaust duct part 1. The thickness equals the thickness of the first flange 2a of the second exhaust duct part 2. The plane of symmetry 7 in the joint thus coincides with the split plane 8 between the flanges 2a, 3a. In the wrongly mounted joint of figure 6, the thickness of the joint is smaller than in a correctly mounted joint. When a clamp ring 6 is arranged around the joint, the groove 11 of the clamp ring 6 does not come into contact with both of the inclined surfaces of the flanges 2a, 3a, but the inner perimeter of the clamp ring 6 comes into contact with the outer cylindrical surfaces of the second exhaust duct part 2 and/or the third exhaust duct part 3. The clamp ring 6 can thus not be tightened around the joint. This is a clear indicator that the second exhaust duct part 2 is not correctly mounted between the first exhaust duct part 1 and the third exhaust duct part 3. Wrong mounting of the second exhaust duct part 2 is thus prevented.

The first exhaust duct part 1 and the third exhaust duct part 3 can be identical parts, as shown in figure 1. The first end of the first exhaust duct part 1 can thus be provided with a flange that is identical to the flange 3a at the first end of the third exhaust duct part 3 and the second end of the third exhaust duct part 3 can be provided with a flange that is identical to the flange 1b at the second end of the first exhaust duct part 1. Even if the first exhaust duct part 1 and the third exhaust duct part 3 are different parts, both ends of the parts 1, 3 can be provided with flanges that are configured in the way described above to prevent wrong mounting of the second exhaust duct part 2.

It will be appreciated by a person skilled in the art that the invention is not limited to the embodiments described above, but may vary within the scope of the appended claims. For instance, the exhaust duct parts do not need to form an exhaust gas receiver, but can also be other parts of an exhaust duct. The joints between adjacent exhaust duct parts do not need to have a V-shaped profile, but also other kinds of cross-sectional profiles, such as a half-V are possible. The flanges could be attached to each other by some other means than clamp rings, for instance by bolts. Instead of using different thicknesses of the flanges, wrong mounting of the parts could be prevented in some other way, for instance by providing the flanges with suitable protrusions and/or holes or grooves that allow mounting of the parts only in a certain orientation.

Claims

1. An exhaust duct arrangement comprising
- a first exhaust duct part (1) having a first end and a second end, the second end being provided with a flange (1b) for connecting the second end to an adjacent exhaust duct part (2), and
 - a second exhaust duct part (2) having a first end provided with a first flange (2a) for connecting the first end to an adjacent exhaust duct part (1), and a second end provided with a second flange (2b) for connecting the second end to an adjacent exhaust duct part (3), each of the flanges (2a, 2b) being arrangeable against a flange (1b, 3a) of an adjacent exhaust duct part (1, 3),

characterized in that

the flanges (1b, 2a, 2b) of the exhaust duct parts (1, 2) are configured so that when the first end of the second exhaust duct part (2) is arranged against the flange (1b) of the first exhaust duct part (1), the joint that is formed has a different cross-sectional profile than a joint that is formed by arranging the second end of the second exhaust duct part (2) against said flange (1b) of the first exhaust duct part (1).

2. An arrangement according to claim 1, **characterized** in that the flanges (1b, 2a, 2b) of the exhaust duct parts (1, 2) are configured so that when the first end of the second exhaust duct part (2) is arranged against the flange (1b) of the first exhaust duct part (1), the joint that is formed has a different thickness in the longitudinal direction of the second exhaust duct part (2) than a joint that is formed by arranging the second end of the second exhaust duct part (2) against the flange (1b) of the first exhaust duct part (1).

3. An arrangement according to claim 1 or 2, **characterized** in that the arrangement further comprises a clamp ring (6) which is arrangeable around a joint that is formed by arranging a flange (2a, 2b) of the second exhaust duct part (2) against the flange (1b) at the second end of the first exhaust duct part (1), the clamp ring (6) being configured so that it can be tightened around the joint only if the first flange (2a) of the second exhaust duct part (2) is arranged against the flange (1b) at the second end of the first exhaust duct part (1).

4. An arrangement according to any of claims 1 to 3, **characterized** in that the flanges (1b, 2a, 2b) of the exhaust duct parts (1, 2) are configured so that

when the first end of the second exhaust duct part (2) is connected to the second end of the first exhaust duct part (1), the plane of symmetry (7) in the joint is located in the longitudinal direction of the second exhaust duct part (2) at a distance from the split plane (8) of the joint.

- 5 5. An arrangement according to any of claims 1 to 4, **characterized** in that the flanges (1b, 2a, 2b) of the exhaust duct parts (1, 2) are configured so that when the second end of the second exhaust duct part (2) is connected to the second end of the first exhaust duct part (1), the plane of symmetry (7) in the joint coincides with the split plane (8) of the joint.
- 10 6. An arrangement according to any of the preceding claims, **characterized** in that the flanges (2a, 2b) of the second exhaust duct part (2) taper towards the outer perimeter of the flanges (2a, 2b).
7. An arrangement according to any of the preceding claims, **characterized** in that the flange (1b) arranged at the second end of the first exhaust duct part
15 (1) tapers towards the outer perimeter of the flange (1b).
8. An arrangement according to any of the preceding claims, **characterized** in that the arrangement comprises a third exhaust duct part (3) having a first end and a second end, the first end being provided with a flange (3a) for connecting the first end to an adjacent exhaust duct part (2), and the flanges 2a,
20 2b, 3a) of the second exhaust duct part (2) and the third exhaust duct part (3) are configured so that when the first flange (2a) of the second exhaust duct part (2) is arranged against the flange (3a) of the third exhaust duct part (3), the joint that is formed has a different cross-sectional profile than a joint that is formed by arranging the second flange (2b) of the second exhaust duct part (2)
25 against said flange (3a) of the third exhaust duct part (3).
9. An arrangement according to claim 8, **characterized** in that the flanges (2a, 2b, 3a) of the second exhaust duct part (2) and the third exhaust duct part (3) are configured so that when the first flange (2a) of the second exhaust duct part (2) is arranged against the flange (3a) of the third exhaust duct part (3),
30 the joint that is formed has a different thickness than a joint that is formed by arranging the second flange (2b) of the second exhaust duct part (2) against the flange (3a) of the third exhaust duct part (3).

10. An arrangement according to claim 8 or 9, **characterized** in that the arrangement further comprises a clamp ring (6) which is arrangeable around a joint that is formed by arranging a flange (2a, 2b) of the second exhaust duct part (2) against the flange (1b) at the first end of the third exhaust duct part (3),
5 the clamp ring (6) being configured so that it can be tightened around the joint only if the second flange (2b) of the second exhaust duct part (2) is arranged against the flange (3a) at the first end of the third exhaust duct part (3).

11. An arrangement according to any of claims 8 to 10, **characterized** in that the flanges (2a, 2b, 3a) of the second and the third exhaust duct parts (2, 3)
10 are configured so that when the second end of the second exhaust duct part (2) is connected to the first end of the third exhaust duct part (3), the plane of symmetry (7) in the joint is located in the longitudinal direction of the second exhaust duct part (2) at a distance from the split plane (8) of the joint.

12. An arrangement according to any of claims 8 to 11, **characterized** in that
15 the flanges (2a, 2b, 3a) of the second and the third exhaust duct parts (2, 3) are configured so that when the first end of the second exhaust duct part (2) is connected to the first end of the third exhaust duct part (3), the plane of symmetry (7) in the joint coincides with the split plane (8) of the joint.

13. An arrangement according to any of claims 8 to 12, **characterized** in that
20 the flange (3a) arranged at the first end of the third exhaust duct part (3) tapers towards the outer perimeter of the flange.

14. An arrangement according to any of the preceding claims, **characterized** in that the second exhaust duct part (2) is a connecting piece for flexibly connecting other exhaust duct parts (1, 3) together.

25 15. An arrangement according to claim 14, **characterized** in that the second exhaust duct part (2) comprises a rigid inner tube (4) that is connected only to the first flange (2a) of the second exhaust duct part (2) and a flexible outer part (5) that is connected to the first flange (2a) and to the second flange (2b) of the second exhaust duct part (2) and surrounds the inner tube (4).

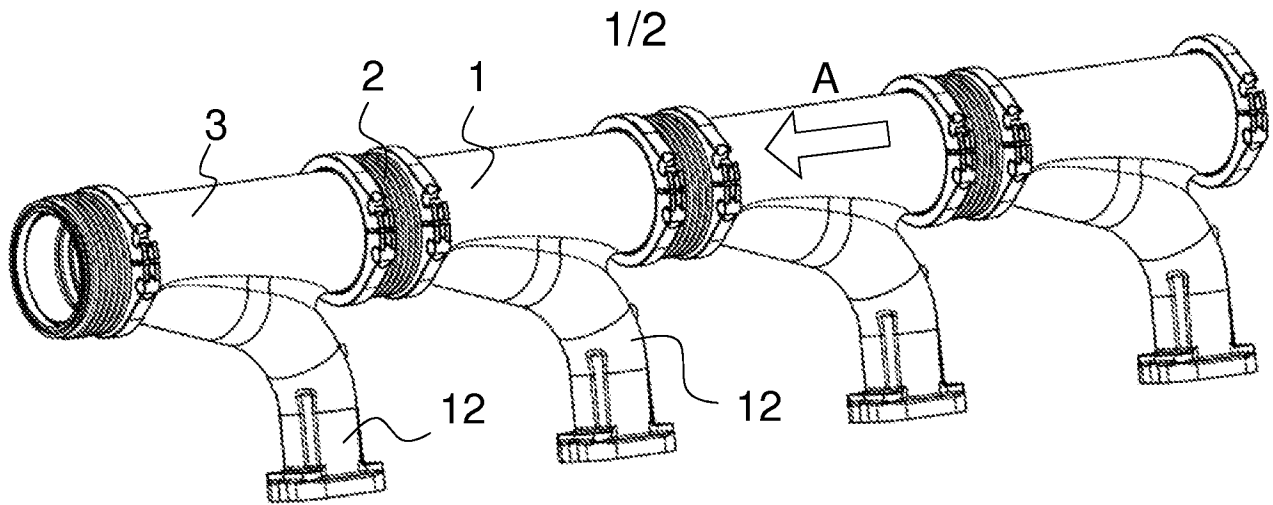


FIG. 1

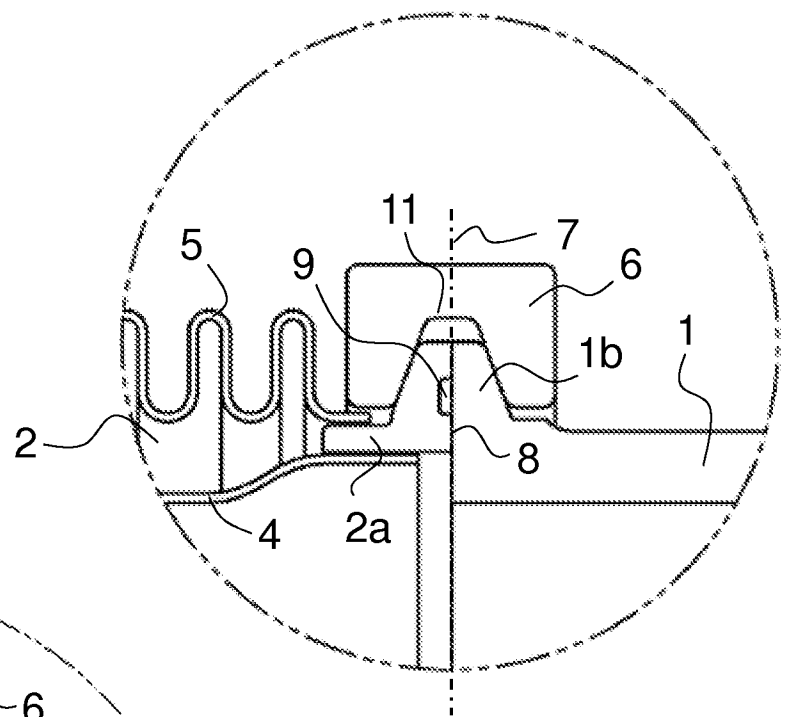


FIG. 2

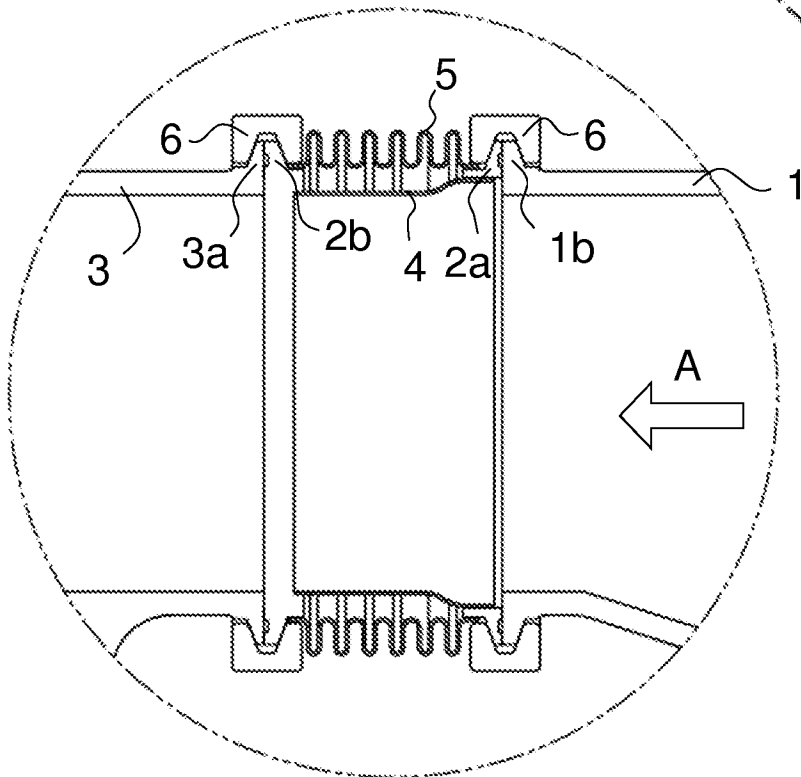


FIG. 3

2/2

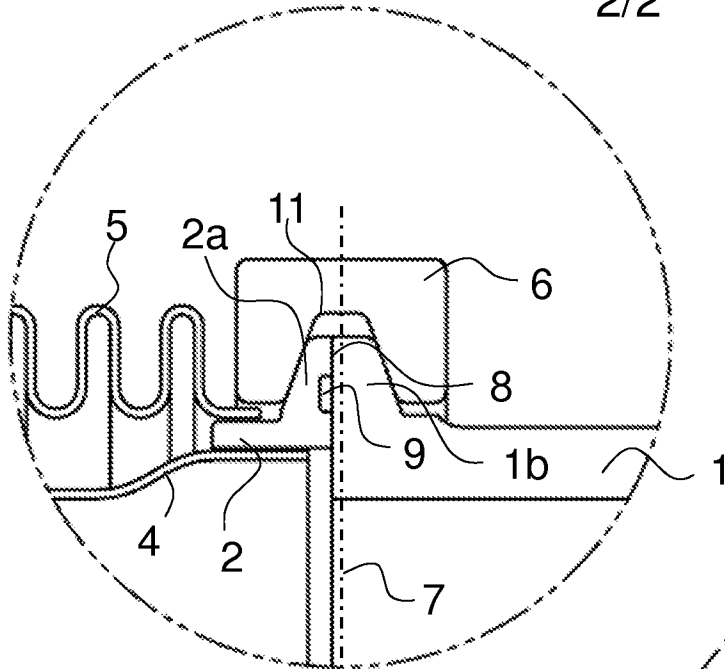


FIG. 4

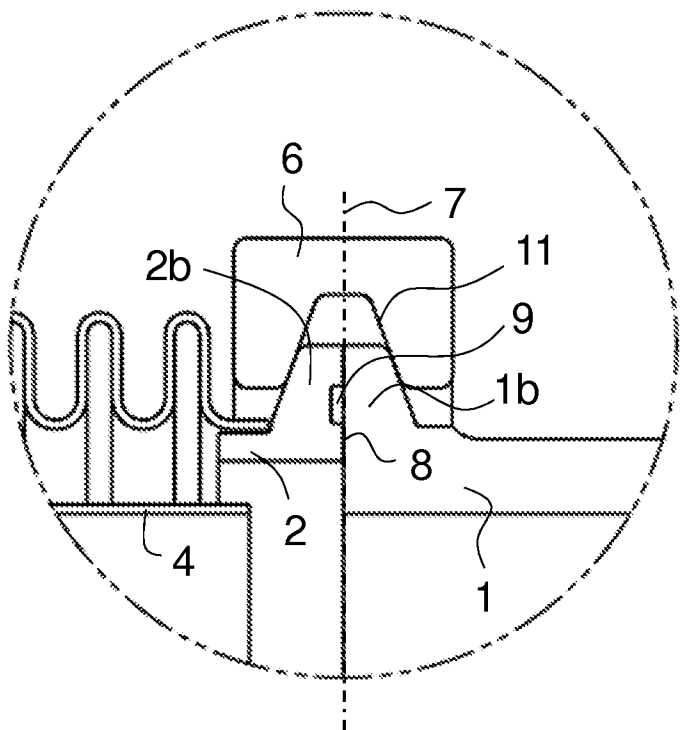


FIG. 5

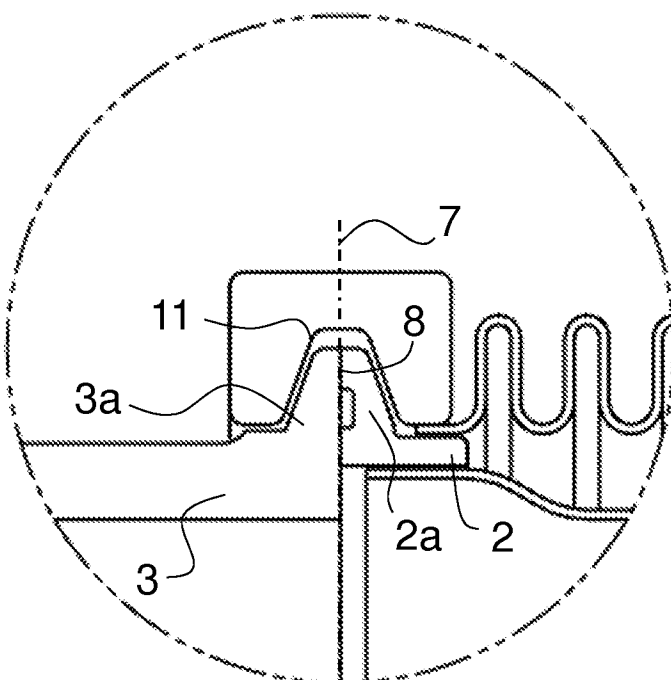


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2014/050205

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01N13/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01N F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/029199 A1 (DONALDSON CO INC [US]; BELISLE JOHN I [US]; HANSMANN JOHN T [US]) 16 March 2006 (2006-03-16)	1-13
Y	paragraph [0034] - paragraph [0037]; figures 1,2 abstract	14,15
Y	----- EP 0 664 416 A1 (WAERTSILAE DIESEL INT [FI]) 26 July 1995 (1995-07-26) column 2, line 29 - column 3, line 50; figures 1,2 abstract	14,15
A	----- FR 2 953 580 A1 (MOTORISATIONS AERONAUTIQUES SOC D [FR]) 10 June 2011 (2011-06-10) abstract; figure 4 ----- -/--	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

8 July 2014

Date of mailing of the international search report

15/07/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Hermens, Sjoerd

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2014/050205

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2014/001624 A1 (WAERTSILAE FINLAND OY [FI]) 3 January 2014 (2014-01-03) the whole document -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/FI2014/050205

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006029199 A1	16-03-2006	EP 1797295 A1	20-06-2007
		US 2006053779 A1	16-03-2006
		WO 2006029199 A1	16-03-2006

EP 0664416 A1	26-07-1995	EP 0664416 A1	26-07-1995
		FI 940164 A	14-07-1995
		JP H07269339 A	17-10-1995

FR 2953580 A1	10-06-2011	NONE	

WO 2014001624 A1	03-01-2014	NONE	
