(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 933 596 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
14.06.2017 Bulletin 2017/24

(51) Int Cl.:
F28F 9/00 *(2006.01)* ***F28F 9/013*** *(2006.01)*
F28D 7/16 *(2006.01)*

(21) Application number: **15157913.3**

(22) Date of filing: **06.03.2015**

(54) **RETENTION DEVICE FOR A HEAT EXCHANGER**

RÜCKHALTEVORRICHTUNG FÜR EINEN WÄRMETAUSCHER

DISPOSITIF DE RETENUE POUR UN ÉCHANGEUR DE CHALEUR

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **17.03.2014 US 201414215740**

(43) Date of publication of application:
21.10.2015 Bulletin 2015/43

(73) Proprietor: **BorgWarner, Inc.**
Auburn Hills, MI 48326-2872 (US)

(72) Inventors:
- **Busato, Murray F.**
Clinton Township, MI Michigan 48035 (US)
- **Adhvaryu, Ketan**
Sterling Heights, MI Michigan 48313 (US)
- **Weissinger, Pete**
Sterling Heights, MI Michigan 48312 (US)

(74) Representative: **Hoefer & Partner Patentanwälte mbB**
Pilgersheimer Straße 20
81543 München (DE)

(56) References cited:
EP-A1- 2 522 943
US-A- 1 338 479
US-A1- 2008 006 398

EP 2 933 596 B1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States Application Serial No. 14/215,740 filed March 17, 2014.

TECHNICAL FIELD

[0002] The field to which the disclosure generally relates to includes retention device.

BACKGROUND

[0003] Retention devices may be used in a variety of applications.
Document EP 2 522 941 A1, which is considered as the closest prior art, discloses a device for reducing vibrations of a tube core of a heat exchanger inside a shell. The device allows a secure and quick insertion after the core has been manufactured and yields that high temperatures - to which the core is subjected for the attachment by means of brazing - do not affect the properties of the device, particularly the elasticity achieved by means of tempering.
It is an object underlying the present invention to provide products with a retention device having an improved retention reliability and easy handling.

SUMMARY OF ILLUSTRATIVE VARIATIONS

[0004] The object underlying the present invention is achieved by a product according to independent claim1 and alternatively by a product according to independent claim 7. Preferred embodiments are defined in the respective dependent claims.
A number of variations may include a product comprising a retention device comprising a plurality of members, including an arch member and a spring member defining multiple contact points.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Select examples of variations within the scope of the invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

Figure 1 is a schematic illustration of an EGR system in which a number of variations may be utilized.
Figure 2 illustrates a heat heater in which a number of variations may be utilized.
Figure 3 is an illustration of the heat exchange of Figure 2 with the housing removed.
Figure 3A is an enlarged view of a portion of Figure 3.
Figure 4 is a perspective sectional view of the heat exchange in Figure 2.
Figure 5 illustrates a baffle which may be utilized in a number of variations.
Figure 6 illustrate a product including a heat exchange bundle of tube having a retention device thereon according to a number of variations.
Figure 7 is a section illustration of retention device according to a number of variations.
Figure 8 is a perspective view of a product including a heat exchange bundle of tube having a retention device thereon according to a number of variations.
Figure 9 is a perspective view of a product including a heat exchange bundle of tube having two retention devices thereon according to a number of variations.
Figure 10 is a partial perspective view of a first retention device and second retention device have mating fastening and guide features in a connected arrangement according to a number of variations.
Figure 11 is a partial perspective view of a first retention device and second retention device have mating fastening and guide features in an unconnected arrangement according to a number of variations.
Figure 12 is a perspective sectional view of a heat exchanger having a first retention device and second retention device thereon according to a number of variations.
Figure 13 is an enlarged view of a portion of Figure 12.
Figure 14 is an enlarged view of a portion of Figure 13.
Figure 15 is a perspective view of a heat exchanger having a first retention device and second retention device in unconnected positions and ready for assembly with the heat exchanger according to a number of variations.
Figure 16 is a perspective view of a heat exchanger having a first retention device and second retention device in a connected relationship and assembled to the heat exchanger according to a number of variations.
Figure 17 is a perspective view of a retention device according to a number of variations.
Figure 18 is a perspective view of a first retention device and a first retention device which may have mating locking and/or guide feature and illustrating the direction of movement of the retention devices for assembly according to a number of variations.
Figure 19 is a perspective view of a first retention device and a first retention device which may have mating locking and/or guide feature and which may be connected together according to a number of variations.

DETAILED DESCRIPTION OF ILLUSTRATIVE VARIATIONS

[0006] Control of vehicle exhaust emissions and meeting fuel economy standards are mandatory requirements

in most countries. Oxides of Nitrogen (NOx) and particulate matter are two components of the engine exhaust emissions that must be controlled.

[0007] Formation of NOx will occur at higher engine combustion temperatures and particulates will form at lower combustion temperatures. A system, referred to as the exhaust gas recirculation (EGR) system, has been developed to control combustion temperatures and control NOx and particulate emissions.

[0008] A schematic of an EGR system is shown in Figure 1. The engine 1 may have an intake manifold 2 and an exhaust Manifold 3. The EGR system may include an exhaust gas recirculation (EGR) valve 4 that controls the flow of exhaust gas to intake manifold 2. The heat exchanger 5 may be used to reduce the temperature of the exhaust gas. Conduits 6, 7, 8, 9 and 10 may provide the interconnection between the exhaust manifold 3, heat exchanger 5, EGR Valve 4, and Intake manifold 2. The system shown may use an electrically controlled EGR valve. An electronic control unit (ECU) 11 may provide a signal that will control the opening/closing of the valve. As the EGR valve opens and closes it will increase or decrease the flow rate of exhaust gas to the intake manifold. A throttle valve 12 may be provided to control airflow into the intake manifold.

[0009] A portion of the exhaust gas may be recirculated back to the intake manifold where it will be combined with incoming air and fuel. The exhaust gas portion of the mixture does not support combustion and when this mixture is compressed and ignited in the cylinder, the inert exhaust gas will control the combustion temperature and limit the formation of NOx and particulate in the exhaust.

[0010] The temperature of the recirculated exhaust gas may be a factor that determines the effectiveness of the NOx and particulate reduction. It is common for an EGR system to include a heat exchanger to remove heat from the exhaust gas and provide an optimize exhaust gas temperature for controlling emissions.

[0011] One type of heat exchanger 13 is shown in Figures 2, 3, and 4. It may include a number of tubes 15 in a rectangular array 16. Tube 15 may have an inner surface 29, wall 30, and outer surface 25, as shown in Figures 3, 3A View A and 4. This rectangular array 16 may also be referred to as the core and exchanger 13 may include one or more cores. The tubes 15 may be made of a metal such as stainless steel, aluminum or other suitable material. The core 16 may include metal headers 17 and 18 located at either end of the tubes 15. The headers 17 and 18 may also be made of a metal such as stainless steel, aluminum or other suitable material. The tubes 15 may be secured and sealed to metal headers 17 and 18 by brazing, soldering, or other suitable means.

[0012] The core 16 may be placed in a housing 14 and may be sealed into the housing by a gasket 19, O-ring 20 or other suitable means. At one end, header 18 may be attached to a cone 21 to transition to the O-ring seal 20. Housing 14, core 16, cone 21, gasket 19, and O-ring 20 may define a sealed space 22 within the housing 14. Sealed space 22 may be suitable for introducing a cooling fluid 24 that may contact tubes 15 in the rectangular array 16. Header 17 and gasket 19 may have a first opening 23 to allow a cooling fluid 24 to flow into sealed space 22. Cooling fluid 24 may contact the outer surface 25 of tubes 15. Header 17 and gasket 19 may also have a second opening 26 that may allow cooling fluid 24 to exit sealed space 22.

[0013] The heat exchanger shown in Figures 2, 3, 3A and 4 may function in the following manner. A fluid or gas 27 may enter tubes 15 from a first end 28. For this example, the fluid or gas 27 may be exhaust gas from an internal combustion engine. The exhaust gas 27 may be at a first temperature, for example 600°C. Exhaust gas 27 may flow through tubes 15 and may exit at a second end 29. Cooling fluid 24 may enter sealed space 22 and may contact the outer surface 25 of tubes 15 as shown in Figure 3. Cooling fluid 24 may be at a lower temperature than exhaust gas 27, for example 100°C.

[0014] As the exhaust gas 27 flows through tubes 15 it may transfer some of its heat to the inner surface 29, wall 30, and outer surface 25 of tubes 15. The transfer of heat may continue as the gas flows along the length of tubes 15 and the exhaust gas 27 may become progressively cooler. A portion of the heat transferred to inner surface 29, wall 30, and outer surface 25, of tubes 15, may then transfer to cooling fluid 24, contacting the outer wall 25 of tubes 15, in sealed space 22. Transferring heat from exhaust gas 27, to tubes 15, and to fluid 24, in sealed space 22, may have two effects as described in the following paragraphs.

[0015] The first effect may be the exhaust gas 27 exiting tubes 15 at second end 29 may be at a lower temperature than the exhaust gas 27 entering tubes 15 at the first end 28. For example exhaust gas 27 entering tubes 15, at first end 28, may be at 600°C and the exhaust gas 27 exiting tubes 15, at second end 29, may be at 200°C. The reduction in temperature may, in part, be due to the transfer of heat from exhaust gas 27, to tubes 15, and to cooling fluid 24 in sealed space 22.

[0016] The second effect may be the cooling fluid 24 exiting sealed space 22 at second opening 26 may be at a higher temperature than the cooling fluid 24 entering sealed space 22 at the first opening 23. For example the cooling fluid 24 exiting sealed space 22, at second opening 26, may be at 110°C and the cooling fluid 24 entering sealed space 22, at first opening 23 may be at 100°C. The increase in temperature may, in part, be due to the transfer of heat from exhaust gas 27, to tubes 15, and to cooling fluid 24 in sealed space 22.

[0017] Both first and second effects may be influenced in-part by parameters such as; the temperature of exhaust gas 27 entering tubes 15, the flow rate of exhaust gas 27, the materials of tubes 15, the wall thickness of tube 15, the length of tube 15, the surface area of tube 15, the fluid properties of the cooling fluid 24 in sealed space 22, the flow rate of the cooling fluid 24 in sealed

space 22, or other parameters.

[0018] As the cooling requirements for the heat exchanger increase, it may be necessary to increase the number of tubes 15 or increase the length of the tubes 15. The longer tubes may require additional support. A baffle 31 shown in figures 4 and 5 may be located along the length of tubes15. The baffle 31 may be a metal plate with multiple openings 32 that will receive and support tubes 15. Baffle 31 may add support but it may not be sufficient with high levels of vibration that may cause movement of the tubes 15 and the potential for fatigue of the tubes, the brazing joints, or other components.

[0019] The addition of a retention device may help to prevent the potential for movement and damage. Figure 6 shows a partial assembly of heat exchanger 13 with a retention device 33 installed on core 16. Retention device 33 includes at least one spring member 34. Figure 7 shows a portion of retention device 33 and spring member 34 viewed in the direction of arrow 44. Retention device 33 includes a first arch member 35 and a second member 36 extending from a first end 37 of first arch member 35. There may be a radius 38 at the transition between first arch member 35 and second member 36 that may define a first contact point 39. There may be a third member 40 extending from a second end 41 of first arch member 35. There may also be a radius 42 at the transition between first arch member 35 and third member 40 that may define a second contact point 43. Spring member 34 may extend from third member 40 and may define a third contact point 45 along the length of spring member 34. Spring member 34 may include a curved section 46 which may include the third contact point 45 as shown in Figure 7.

[0020] Referring to Figure 7, retention device 33 may function in the following manner. When the first contact point 39 and second contact point 43 are in contact with a substantially rigid surface 47 and a force, represented as arrow 48, is applied to third contact point 45, spring member 34 may deflect in direction 49 and transmit a force to the substantially rigid surface at first contact point 39 and second contact point 43. While force 48 is applied, first arch member 35 will remain substantially in the form of the arch and only the first contact point 39 and second contact point 43 will substantially contact rigid surface 47. The arch form of first arch member 35 and the minimum contact with rigid surface 47 may allow a less impeded movement of the retention device 33 along substantially rigid surface 47. The deflection of spring member 34, in direction 49, is shown as dashed line form 34A, in figure 7.

[0021] Referring to Figure 8, spring member 34, may extend along an axis 50 for a length 51. The length 51 may be 5mm, 10mm, or other suitable length to achieve the desired retention requirements. There may be an interrupted length 52 along axis 50 followed by a second spring member 34B having a length 53 along axis 50. Second spring member 34B may have the same length as first spring member 34 or it may have another length to achieve the desired retention requirements. The spring retention device 33 may be manufactured in many shapes to fit the shape of a core. For example it may be manufactured in rectangular shape to fit a rectangular core, a circular shape to fit a circular core, or other shape to suitably fit a core.

[0022] Figure 9 shows retention device 33 installed on rectangular core 16 of heat exchanger 13. Retention device 33 has been formed in a rectangular shape to fit the shape of core 16. The retention device 33 may be attached and retained to core 16 by interconnecting features 54 which may include a receptacle 55 and an engagement member 56 as seen in Figure 10 View B and Figure 11. When engagement member 56 engages receptacle 55, retention device 33 will define a closed form or loop and may be retained to core 16 as shown in Figure 9.

[0023] Figure 12, Figure 13 View C, and Figure 14 view D show retention device 33 installed on core 16. Retention device 33 may be assembled to core 16 prior to installing core 16 into housing 14. Core 16 along with retention devices 33 may be slid into housing 14 until core 16 comes into sealing contact with housing 14. Retention device 33 may engage housing 14 within space 22. A distance 57, between tubes 15 and an inside wall 58 of housing 14 may be less than a distance 59 between contact points 39, 43, and 45 on spring member 34 of retention device 33. It may be noted that distance 57 may be similar for each of the four inside walls of housing 14 that confront tubes 15 of core 16. Since dimension 57 may be less than dimension 59, there may be an interference dimension 60 that that is substantially the difference between dimension 59 and dimension 57. For example, in one variation the interference dimension 60 may be substantially 1 mm when dimension 59 is 7mm and dimension 57 is 6mm. Dimension 60 may vary with the tolerance of the components.

[0024] In a number of variations, interference dimension 60 may be 1 mm, 2mm, or other dimension that will provide the desired level of retention. The selection of interference dimension 60 may in-part be based upon the level of vibration, level of mechanical shock, or other relevant parameter.

[0025] Referring to Figure 14 view D, as core 16 is slid into housing 14, the contact with inside wall 58 and interference 60 may provide a force 73 on third contact point 45 and deflect spring member 34 in direction 62. Force 73 may cause first contact point 39 and second contact point 43, of retention device 33, to contact tubes 15 and transmit a force to the tubes. Tubes 15 may form a substantially rigid surface, for first contact point 39 and second contact point 43. When force 73 is applied to the third contact point 45 and spring member 34 deflects in direction 62, first arch member 35 will substantially remain in the form of the arch and only the first contact point 39 and second contact point 43 may substantially contact tubes 15. The deflected position 34A of spring member 34, in direction 62, is shown as a solid line in

figures 14 View D. The initial position of spring member 34 is shown as dashed lines. The arched form of first arch member 35 and the minimum contact with the rigid surface of tubes 15, may allow a less impeded movement of retention device 33 along the surface of tubes 15. It may also be possible that only one of the first or second contact points, 39 or 43, may contact the rigid surface of tubes 15. This may be in-part result from dimensional differences of components, assembly variation, or other factors.

[0026] Retention device 33 may extend along the four sides of the rectangular core 16 and may include additional portions of spring member 34. Retention device 33 may contact four inside surfaces of rectangular housing 14. Additional portions of spring member 34 may provide a force on tubes 15 at each location that may tend to prevent movement of the tubes 15 and core 16 when a force is applied to the heat exchanger 13. The force may be applied in any direction to heat exchanger 13 and may result from an impact, vibration, or other force. Preventing or limiting movement of tubes 15 and core 16 may lessen the potential for fatigue and failure of tube 15, brazing joints, or other component.

[0027] Referring again to Figures 9, 10 View B, and 11, in a number of variations it may be advantageous to include a guide feature 61 to guide interconnecting features 54 and aid with the assembly of retention device 33 to core 16. In a number of variations guide feature 61 may include two guide members 62 and 63 formed in retention device 33. Guide feature 61 may be designed to receive a guide portion 64 of retention device 33 that may include receptacle 55 or engagement feature 56. For example, guide portion 64 may include receptacle 55 as shown in Figures 10 View B and 11. Guide feature 61, including guide members 62 and 63, may align guide portion 64, receptacle 55, engagement feature 56, and facilitate engagement thereof as shown in Figures 9 and 10 View B.

[0028] As previously stated, guide feature 61 may include a first guide members 62 and second guide member 63 that may retain guide portion 64 and may prevent disengagement. An existing portion of retention device 33 may be used as a guide member. For example, guide member 63 may be a portion of the first arch member 35, second member 40, or spring member 34 as shown in figure 11. A guide member may also be formed as a separate portion of retention device 33 such as guide member 62 also shown in Figures 10 View B and 11.

[0029] Installing a one-piece retention device may require deformation to assemble it to the core. In a number of variations, to efficiently install the retention device it may be made in two pieces as shown in Figure 15. The 2-piece design may include a first retention device 33A and second retention device 33B. The 2-piece design will allow installation after assembly of core 16, including tubes 15, header 17, header 18, and baffle 31. The retention devices are shown assembled to core 16 in Figure 16.

[0030] Figure 17 shows first retention device 33A. Retention device 33A may have a first member 65, second member 66, and third member 67 formed to fit rectangular core 16. Each of the first, second, and third members may have a spring members 34 spaced along each member. Retention device 33A may have interconnecting feature 54 comprising receptacle 55 and engagement member 56 as previously described herein. Receptacle 55 may be located at a first end 68 of retention device 33A and engagement member 56 may be located at second end 70. Retention device 33A may also include guide feature 61 and guide portion 64 also preciously described herein. Guide feature 61 and guide portion 64 may be located at the first or second ends 68 and 70 of retention device 33A. For example, guide feature 61 may be located at the second end 70 and guide portion 64 may be located at the first end 68 as shown in figure 17. Guide portion 64 may also include receptacle 55 also shown in figure 17.

[0031] First retention device 33A and second retention device 33B may be substantially identical in form and may be made from the same manufacturing process. This may reduce cost, reduce tooling requirements, improve assembly, or provide other advantages.

[0032] First retention device 33A and second retention device 33B may be assembled to the core by rotating one of the first or second retention devices 180° about axis 69 and aligning them as shown in figures 18 and 19. Guide feature 61 located at second end 70 of first retention device 33A may align and receive guide portion 64 located at first end 68 of second retention device 33B. Guide feature 61 located at second end 70 of second retention device 33B may align and receive guide portion 64 located at first end 68 of first retention device 33A. The continued engagement of first and second retention devices 33A and 33B in the direction of arrows 71 and 72 may cause engagement feature 56, of first retention device 33A, to engage receptacle 55 of second retention device 33B. Continued engagement may also cause engagement feature 56 of second retention device 33B to engage receptacle 55 of first retention device 33A.

[0033] When engagement members 56 engage receptacles 55, retention devices 33A and 33B will define a closed form or loop as shown in figure 19. The retention devices 33A and 33B may be retained to core 16 as shown in figure 16.

[0034] While the afore written description and figures of the invention show a round tube 15 in a rectangular core 16, it may also be within the scope of the invention to be applied to a core having an oval tube, square tube, or a tube of another suitable shape to achieve the desired cooling requirements. A core having a shape other than a rectangle may also be utilized. For example, the retention device may be applied to a circular core, oval core, or a core of another suitable shape to achieve the desired requirements.

Claims

1. A product (13) comprising at least one retention device (33, 33A, 33B),
the retention device (33, 33A, 33B) comprising:

- a first member (35),
- a second member (36) extending from a first end (37) of the first member (35) and defining a first contact point (39),
- a third member (40) extending from a second end (41) of the first member (35) and defining a second contact point (43), and
- at least one spring member (34, 34B) extending from at least one of the first, second, or third members (35, 36, 40) and defining a third contact point (45),

wherein:

- when the first and second contact points (39, 43) are in contact with a substantially rigid surface (47) and a force (48) is applied to the third contact point (45), a force is transmitted to the substantially rigid surface (47) at one or both of the first or second contact points (39, 43) and **characterised in that**
- the first member (35) is formed as an arch and is configured to substantially remain in the form of the arch and not to contact to the substantially rigid surface (47) when the force (48) is applied to the third contact point (45).

2. A product (13) as set forth in claim 1, wherein:

- the at least one retention device (33, 33A, 33B) comprises at least two spring members (34, 34B) and
- the spring members (34, 34B) are spaced apart from each other on the retention device (33, 33A, 33B).

3. A product (13) as set forth in claim 1, wherein:

- the at least one retention device (33, 33A, 33B) further comprises interconnecting features (54) comprising a receptacle (55) and an engagement member (56) for engaging said receptacle (55),
- the receptacle (55) and engagement member (56) are spaced apart from each other, and
- when the engagement member (56) engages the receptacle (55), the retention device (33, 33A, 33B) defines a closed form or loop for attachment to a product.

4. A product (13) as set forth in claim 1 or 3, wherein:

- the at least one retention device (33, 33A, 33B) further comprises a guide feature (61) and a guide portion (64),
- said guide feature (61) comprises at least one guide member (62, 63),
- said guide portion (64) includes at least one of interconnecting feature (54), and
- the guide member (62, 63) is constructed and arranged to guide the guide portion (64).

5. A product (13) as set forth in any one of claims 1, 3, and 4,

- comprising at least a second retention device (33B; 33, 33A),
- wherein said first and second retention devices (33, 33A; 33B) further comprise:
- a guide feature (61) on the first retention device (33, 33A; 33B) constructed and arranged to guide a guide portion (64) on the second retention device (33B; 33, 33A) and
- a guide feature (61) on the second retention device (33B; 33, 33A) constructed and arranged to guide a guide portion (64) on the first retention device (33, 33A; 33B).

6. A product (13) as set forth in claim 5, wherein the shape of each retention device (33, 33A, 33B) is substantially the same.

7. A product (13),
comprising:

- a core (16) comprising an array of tubes (15),
- a housing (14) for receiving the core (16) and supporting the core (16),
- a clearance between the core (16) and the housing (14), and
- at least one retention device (33, 33A, 33B) positioned between the housing (14) and the core (16),

wherein:

- the at least one retention device (33, 33A, 33B) comprises:

  - a first member (35),
  - a second member (36) extending from a first end (37) of the first member (35) and defining a first contact point (39) along the axis of the tubes (15),
  - a third member (40) extending from a second end (41) of the first member (35) and defining a second contact point (43) along the axis of the tubes (15), and
  - at least one spring member (34, 34B) extending from at least one of the first, second,

or third members (35, 36, 40) and defining a third contact point (45) with the housing (14),

- when the clearance between the housing (14) and the core (16) causes interference with the retention device (33, 33A, 33B) and a force (48) is applied to the third contact point (45) of the at least one spring member (34, 34B), the at least one spring member (34, 34B) is New claims 1 to 11 configured to transmit a force to one or both of the first and second contact points (39, 43) and **characterised in that**
- the first member (35) is formed as an arch and configured to substantially remain in the form of the arch and to not contact along the axis of the tubes (15) when the force (48) is applied to the third contact point (45).

8. A product (13) as set forth in claim 7, wherein:

- the at least one retention device (33, 33A, 33B) comprises at least two spring members (34, 34B) and
- the spring members (34, 34B) are spaced apart from each other on the retention device (33, 33A, 33B).

9. A product (13) as set forth in claim 7, wherein:

- the at least one retention device (33, 33A, 33B) further comprises interconnecting features (54) comprising a receptacle (55) and an engagement member (56) for engaging said receptacle (55),
- the receptacle (55) and the engagement member (56) are spaced apart from each other, and
- when the engagement member (56) engages the receptacle (55), the retention device (33, 33A, 33B) defines a closed form or loop for attachment to a product.

10. A product (13) as set forth in claim 7 or 9, wherein:

- the at least one retention device (33, 33A, 33B) further comprises a guide feature (61) and a guide portion (64),
- said guide feature (61) comprises at least one guide member (62, 63),
- said guide portion (64) includes at least one of said interconnecting features (54), and
- the guide member (62, 63) is constructed and arranged to guide the guide portion (64).

11. A product (13) as set forth in claim 7, comprising at least a second retention device (33B; 33, 33A), wherein said first and second retention devices (33, 33A; 33B) further comprise:

- a guide feature (61) on the first retention device (33, 33A; 33B) constructed and arranged to guide a guide portion (64) on the second retention device (33B; 33, 33A) and
- a guide feature (61) on the second retention device (33B; 33, 33A) constructed and arranged to guide a guide portion (64) on the first retention device (33, 33A; 33B).

Patentansprüche

1. Produkt (13), das mindestens eine Rückhaltevorrichtung (33, 33A, 33B) umfasst, wobei die Rückhaltevorrichtung (33, 33A, 33B) Folgendes umfasst:

- ein erstes Element (35),
- ein zweites Element (36), das sich von einem ersten Ende (37) des ersten Elements (35) aus erstreckt und einen ersten Kontaktpunkt (39) definiert,
- ein drittes Element (40), das sich von einem zweiten Ende (41) des ersten Elements (35) aus erstreckt und einen zweiten Kontaktpunkt (43) definiert, und
- mindestens ein Federelement (34, 34B), das sich von mindestens einem der ersten, zweiten oder dritten Elemente (35, 36, 40) aus erstreckt und einen dritten Kontaktpunkt (45) definiert,

wobei:

- wenn die ersten und zweiten Kontaktpunkte (39, 43) in Kontakt mit einer im Wesentlichen starren Oberfläche (47) stehen und eine Kraft (48) auf den dritten Kontaktpunkt (45) ausgeübt wird, eine Kraft auf die im Wesentlichen starre Oberfläche (47) an einem oder beiden der ersten oder zweiten Kontaktpunkte (39, 43) übertragen wird, und

dadurch gekennzeichnet, dass

- das erste Element (35) als ein Bogen ausgebildet und konfiguriert ist, um im Wesentlichen die Form eines Bogens beizubehalten und nicht in Kontakt mit der im Wesentlichen starren Oberfläche (47) zu kommen, wenn die Kraft (48) auf den dritten Kontaktpunkt (45) ausgeübt wird.

2. Produkt (13) nach Anspruch 1, wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) mindestens zwei Federelemente (34, 34B) umfasst und
- die Federelemente (34, 34B) an der Rückhaltevorrichtung (33, 33A, 33B) voneinander beabstandet sind.

3. Produkt (13) nach Anspruch 1, wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) weiterhin Verbindungsmerkmale (54) umfasst, die eine Aufnahme (55) und ein Eingriffselement (56) umfasst, das in die Aufnahme (55) eingreift,
- die Aufnahme (55) und das Eingriffselement (56) voneinander beabstandet sind, und
- die Rückhaltevorrichtung (33, 33A, 33B), wenn das Eingriffselement (56) in die Aufnahme (55) eingreift, eine geschlossene Form oder Schleife zum Befestigen an einem Produkt definiert.

4. Produkt (13) nach Anspruch 1 oder 3, wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) weiterhin ein Führungsmerkmal (61) und einen Führungsabschnitt (64) umfasst, wobei
- das Führungsmerkmal (61) mindestens ein Führungselement (62, 63) beinhaltet,
- der Führungsabschnitt (64) mindestens eines der Verbindungsmerkmale (54) beinhaltet, und
- das Führungselement (62, 63) konstruiert und angeordnet ist, um den Führungsabschnitt (64) zu führen.

5. Produkt (13) nach einem der Ansprüche 1, 3 und 4, umfassend:

- mindestens eine zweite Rückhaltevorrichtung (33B; 33, 33A),
- wobei die ersten und zweiten Rückhaltevorrichtungen (33, 33A; 33B) weiterhin umfassen:

  - ein Führungsmerkmal (61) an der ersten Rückhaltevorrichtung (33, 33A; 33B), das konstruiert und angeordnet ist, um einen Führungsabschnitt (64) an der zweiten Rückhaltevorrichtung (33B; 33, 33A) zu führen, und
  - ein Führungsmerkmal (61) an der zweiten Rückhaltevorrichtung (33B; 33, 33A), das konstruiert und angeordnet ist, um einen Führungsabschnitt (64) an der ersten Rückhaltevorrichtung (33, 33A; 33B) zu führen.

6. Produkt (13) nach Anspruch 5, wobei die Form einer jeden Rückhaltevorrichtung (33, 33A, 33B) im Wesentlichen die gleiche ist.

7. Produkt (13), umfassend:

- einen Kern (16), der eine Anordnung von Rohren (15) umfasst,
- ein Gehäuse (14) zum Aufnehmen des Kerns (16) und zum Abstützen des Kerns (16),
- einen Abstand zwischen dem Kern (16) und dem Gehäuse (14), und
- mindestens eine Rückhaltevorrichtung (33, 33A, 33B), die zwischen dem Gehäuse (14) und dem Kern (16) positioniert ist,

wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) umfasst:
- ein erstes Element (35),
- ein zweites Element (36), das sich von einem ersten Ende (37) des ersten Elements (35) aus erstreckt und einen ersten Kontaktpunkt (39) entlang der Achse der Rohre (15) definiert,
- ein drittes Element (40), das sich von einem zweiten Ende (41) des ersten Elements (35) aus erstreckt und einen zweiten Kontaktpunkt (43) entlang der Achse der Rohre (15) definiert, und
- mindestens ein Federelement (34, 34B), das sich von mindestens einem der ersten, zweiten oder dritten Elemente (35, 36, 40) aus erstreckt und einen dritten Kontaktpunkt (45) mit dem Gehäuse (14) definiert,
- das mindestens eine Federelement (34, 34B), wenn der Abstand zwischen dem Gehäuse (14) und dem Kern (16) eine Störung mit der Rückhaltevorrichtung (33, 33A, 33B) bewirkt und eine Kraft (48) auf den dritten Kontaktpunkt (45) des mindestens einen Federelements (34, 34B) ausgeübt wird, konfiguriert ist, um eine Kraft auf einen oder beide der ersten und zweiten Kontaktpunkte (39, 43) zu übertragen, und

dadurch gekennzeichnet, dass das erste Element (35) als ein Bogen ausgebildet und konfiguriert ist, um im Wesentlichen die Form des Bogens beizubehalten und keinen Kontakt entlang der Achse der Rohre (15) zuzulassen, wenn die Kraft (48) auf den dritten Kontaktpunkt (45) ausgeübt wird.

8. Produkt (13) nach Anspruch 7, wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) mindestens zwei Federelemente (34, 34B) umfasst, und
- die Federelemente (34, 34B) an der Rückhaltevorrichtung (33, 33A, 33B) voneinander beabstandet sind.

9. Produkt (13) nach Anspruch 7, wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) weiterhin Verbindungsmerkmale (54) umfasst, die eine Aufnahme (55) und ein Eingriffselement (56) umfassen, das in die Aufnahme (55) eingreift, wobei
- die Aufnahme (55) und das Eingriffselement

(56) voneinander beabstandet sind, und
- die Rückhaltevorrichtung (33, 33A, 33B), wenn das Eingriffselement (56) in die Aufnahme (55) eingreift, eine geschlossene Form oder Schleife zum Befestigen an einem Produkt definiert.

10. Produkt (13) nach Anspruch 7 oder 9, wobei:

- die mindestens eine Rückhaltevorrichtung (33, 33A, 33B) weiterhin ein Führungsmerkmal (61) und einen Führungsabschnitt (64) umfasst, wobei
- das Führungsmerkmal (61) mindestens ein Führungselement (62, 63) umfasst,
- der Führungsabschnitt (64) mindestens eines der Verbindungsmerkmale (54) beinhaltet, und
- das Führungselement (62, 63) konstruiert und angeordnet ist, um den Führungsabschnitt (64) zu führen.

11. Produkt (13) nach Anspruch 7, umfassend:

- mindestens eine zweite Rückhaltevorrichtung (33B; 33, 33A), wobei
- die ersten und zweiten Rückhaltevorrichtungen (33, 33A; 33B) weiterhin umfassen:
- ein Führungsmerkmal (61) an der ersten Rückhaltevorrichtung (33, 33A; 33B), das konstruiert und angeordnet ist, um einen Führungsabschnitt (64) an der zweiten Rückhaltevorrichtung (33B; 33, 33A) zu führen, und
- ein Führungsmerkmal (61) an der zweiten Rückhaltevorrichtung (33B; 33, 33A), das konstruiert und angeordnet ist, um einen Führungsabschnitt (64) an der ersten Rückhaltevorrichtung (33, 33A; 33B) zu führen.

Revendications

1. Produit (13) comprenant au moins un dispositif de retenue (33, 33A, 33B), le dispositif de retenue (33, 33A, 33B) comprenant :

- un premier élément (35),
- un deuxième élément (36) s'étendant d'une première extrémité (37) du premier élément (35) et définissant un premier point de contact (39),
- un troisième élément (40) s'étendant de la seconde extrémité (41) du premier élément (35) et définissant un deuxième point de contact (43), et
- au moins un élément de ressort (34, 34B) s'étendant depuis au moins un des premier, deuxième ou troisième éléments (35, 36, 40) et définissant un troisième point de contact (45),

dans lequel, quand les premier et deuxième points de contact (39, 43) sont en contact avec une surface (47) sensiblement rigide et qu'une force (48) est appliquée au troisième point de contact (45), une force est transmise à la surface (47) sensiblement rigide au niveau du premier et/ou du deuxième point de contact (39, 43) et
caractérisé en ce que le premier élément (35) est conformé comme une arche et est configuré pour rester pratiquement sous la forme de l'arche et ne pas entrer en contact avec la surface (47) sensiblement rigide quand la force (48) est appliquée au troisième point de contact (45).

2. Produit (13) selon la revendication 1, dans lequel :

- ledit dispositif de retenue (33, 33A, 33B) comprend au moins deux éléments de ressort (34, 34B) et
- les éléments de ressort (34, 34B) sont espacés l'un de l'autre sur le dispositif de retenue (33, 33A, 33B).

3. Produit (13) selon la revendication 1, dans lequel :

- ledit dispositif de retenue (33, 33A, 33B) comprend en outre des dispositifs de connexion (54) comprenant un logement (55) et un élément d'enclenchement (56) pour entrer en prise avec ledit logement (55),
- le logement (55) et l'élément d'enclenchement (56) sont espacés l'un de l'autre, et
- quand l'élément d'enclenchement (56) entre en prise avec le logement (55), le dispositif de retenue (33, 33A, 33B) définit une forme fermée ou boucle pour se fixer à un produit.

4. Produit (13) selon la revendication 1 ou 3, dans lequel :

- ledit dispositif de retenue (33, 33A, 33B) comprend en outre une caractéristique (61) de guidage et une partie (64) de guide,
- ladite caractéristique (61) de guidage comprend au moins un élément (62, 63) de guidage,
- ladite partie (64) de guide comprend au moins un des dispositifs de connexion (54), et
- l'élément (62, 63) de guidage est structuré et agencé pour guider la partie (64) de guide.

5. Produit (13) selon l'une quelconque des revendications 1, 3 et 4, comprenant au moins un second dispositif de retenue (33B ; 33, 33A),
dans lequel lesdits premier et second dispositifs de retenue (33, 33A ; 33B) comprennent en outre :

- une caractéristique (61) de guidage sur le premier dispositif de retenue (33, 33A ; 33B) structurée et agencée pour guider une partie (64) de

guide sur le second dispositif de retenue (33B ; 33, 33A) et
- une caractéristique (61) de guidage sur le second dispositif de retenue (33B ; 33, 33A) structurée et agencée pour guider une partie (64) de guide sur le premier dispositif de retenue (33, 33A ; 33B).

6. Produit (13) selon la revendication 5, dans lequel la forme de chaque dispositif de retenue (33, 33A, 33B) est sensiblement la même.

7. Produit (13), comprenant :

- un noyau (16) comprenant une collection de tubes (15),
- un logement (14) pour recevoir le noyau (16) et soutenant le noyau (16),
- un jeu entre le noyau (16) et le logement (14),

et

- au moins un dispositif de retenue (33, 33A, 33B) placé entre le logement (14) et le noyau (16),

dans lequel ledit dispositif de retenue (33, 33A, 33B) comprend :

- un premier élément (35),
- un deuxième élément (36) s'étendant d'une première extrémité (37) du premier élément (35) et définissant un premier point de contact (39) le long de l'axe des tubes (15),
- un troisième élément (40) s'étendant de la seconde extrémité (41) du premier élément (35) et définissant un deuxième point de contact (43) le long de l'axe des tubes (15), et
- au moins un élément de ressort (34, 34B) s'étendant depuis au moins un des premier, deuxième ou troisième éléments (35, 36, 40) et définissant un troisième point de contact (45) avec le logement (14),
- quand le jeu entre le logement (14) et le noyau (16) provoque une interférence avec le dispositif de retenue (33, 33A, 33B) et qu'une force (48) est appliquée au troisième point de contact (45) dudit élément de ressort (34, 34B), ledit élément de ressort (34, 34B) est configuré pour transmettre une force au premier et/ou au deuxième point de contact (39, 43) et

caractérisé en ce que le premier élément (35) est conformé comme une arche et configuré pour rester pratiquement sous la forme de l'arche et ne pas entrer en contact le long de l'axe des tubes (15) quand la force (48) est appliquée au troisième point de contact (45).

8. Produit (13) selon la revendication 7, dans lequel :

- ledit dispositif de retenue (33, 33A, 33B) comprend au moins deux éléments de ressort (34, 34B) et
- les éléments de ressort (34, 34B) sont espacés l'un de l'autre sur le dispositif de retenue (33, 33A, 33B).

9. Produit (13) selon la revendication 7, dans lequel :

- ledit dispositif de retenue (33, 33A, 33B) comprend en outre des dispositifs de connexion (54) comprenant un logement (55) et un élément d'enclenchement (56) pour entrer en prise avec ledit logement (55),
- le logement (55) et l'élément d'enclenchement (56) sont espacés l'un de l'autre, et
- quand l'élément d'enclenchement (56) entre en prise avec le logement (55), le dispositif de retenue (33, 33A, 33B) définit une forme fermée ou boucle pour se fixer à un produit.

10. Produit (13) selon la revendication 7 ou 9, dans lequel :

- ledit dispositif de retenue (33, 33A, 33B) comprend en outre une caractéristique (61) de guidage et une partie (64) de guide,
- ladite caractéristique (61) de guidage comprend au moins un élément (62, 63) de guidage,
- ladite partie (64) de guide comprend au moins un desdits dispositifs de connexion (54), et
- l'élément (62, 63) de guidage est structuré et agencé pour guider la partie (64) de guide.

11. Produit (13) selon la revendication 7, comprenant au moins un second dispositif de retenue (33B ; 33, 33A),
dans lequel lesdits premier et second dispositifs de retenue (33, 33A ; 33B) comprennent en outre :

- une caractéristique (61) de guidage sur le premier dispositif de retenue (33, 33A ; 33B) structurée et agencée pour guider une partie (64) de guide sur le second dispositif de retenue (33B ; 33, 33A) et
- une caractéristique (61) de guidage sur le second dispositif de retenue (33B ; 33, 33A) structurée et agencée pour guider une partie (64) de guide sur le premier dispositif de retenue (33, 33A ; 33B).

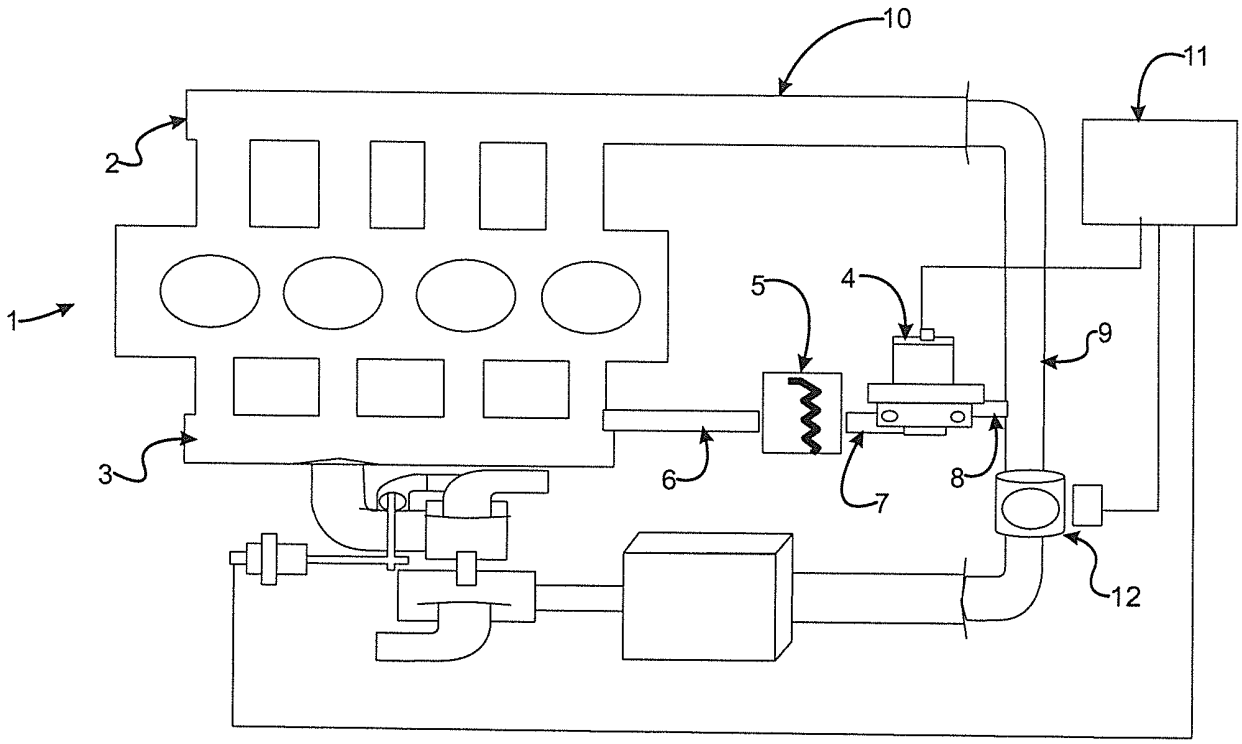

Fig.1

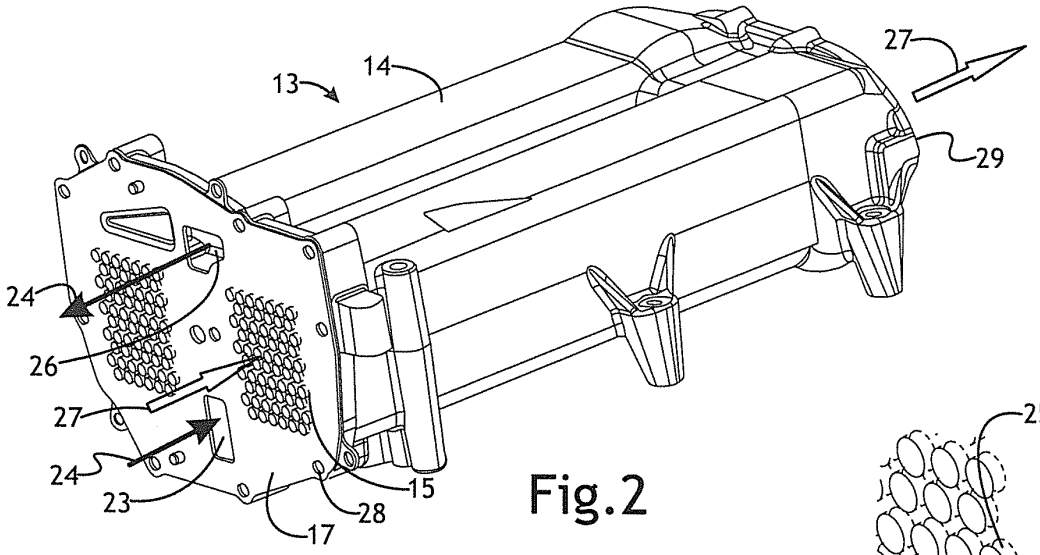

Fig.2

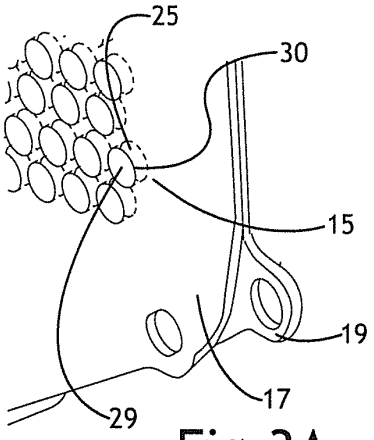

Fig.3A

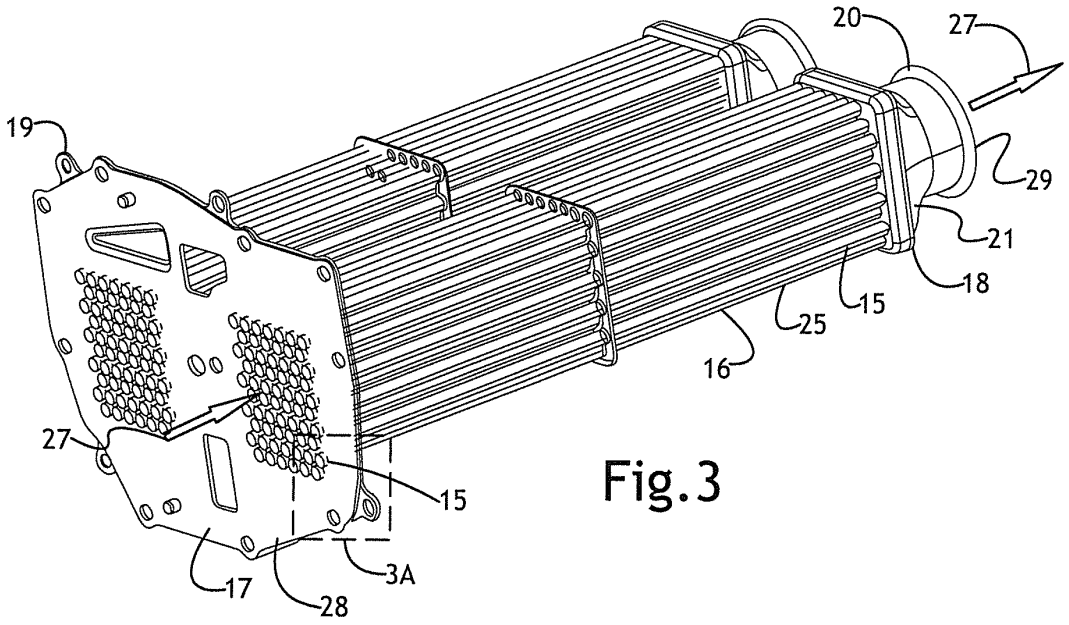

Fig.3

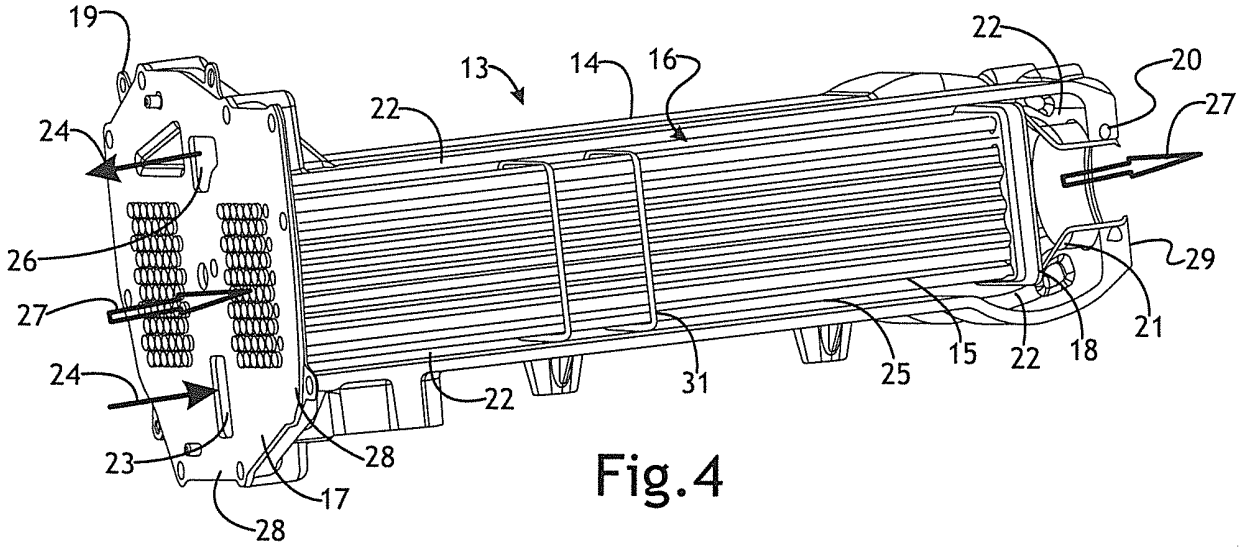
19
13
14
16
22
22
20
27
24
26
27
29
21
24
22
31
25
15
22
18
23
28
17
28

Fig.4

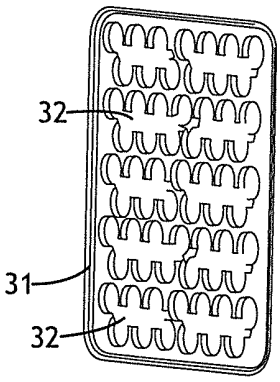
32
31
32

Fig.5

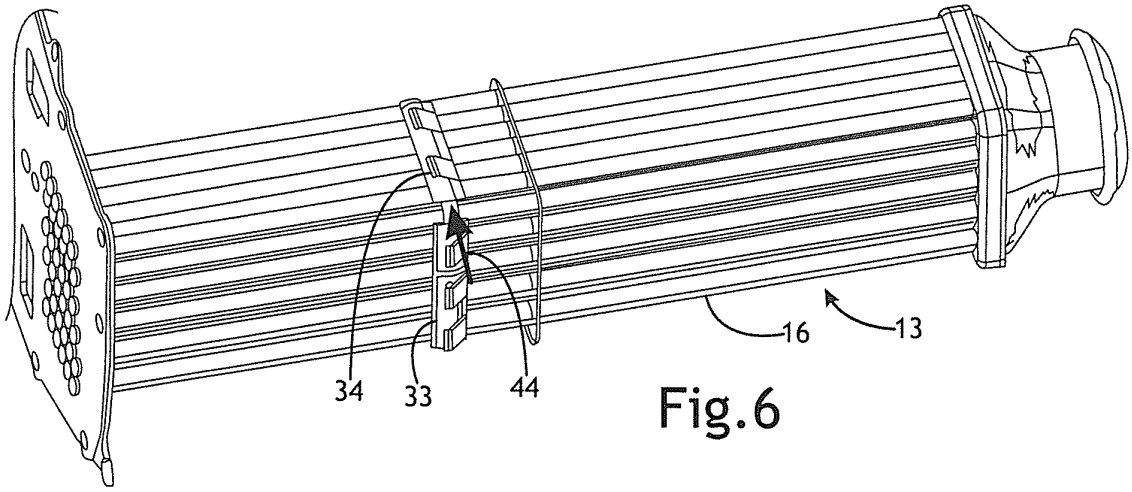

Fig.6

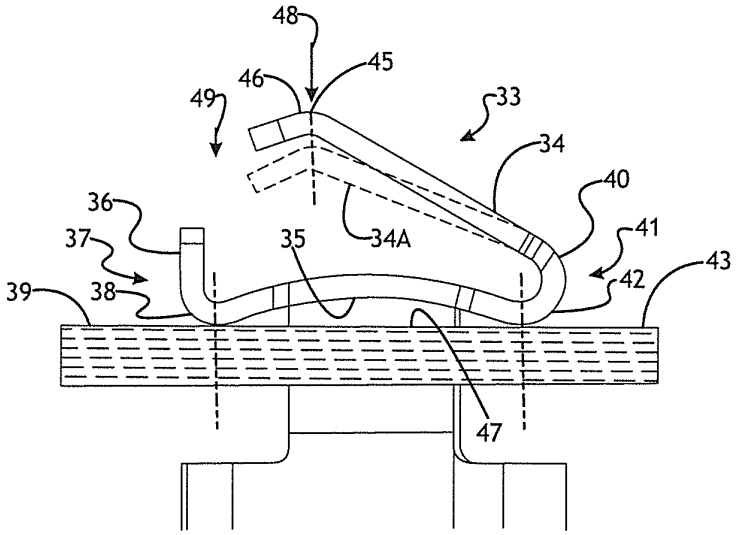

Fig.7

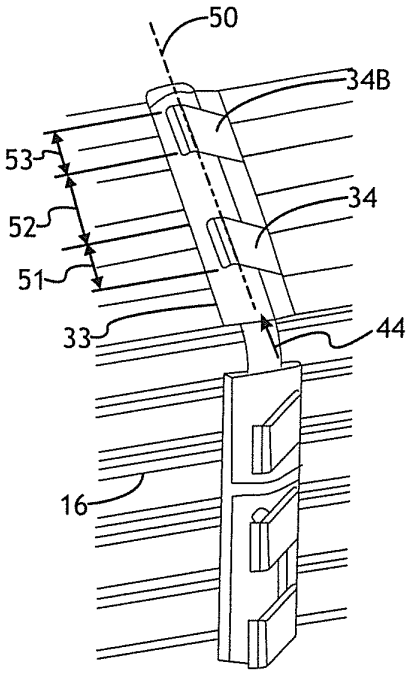

Fig.8

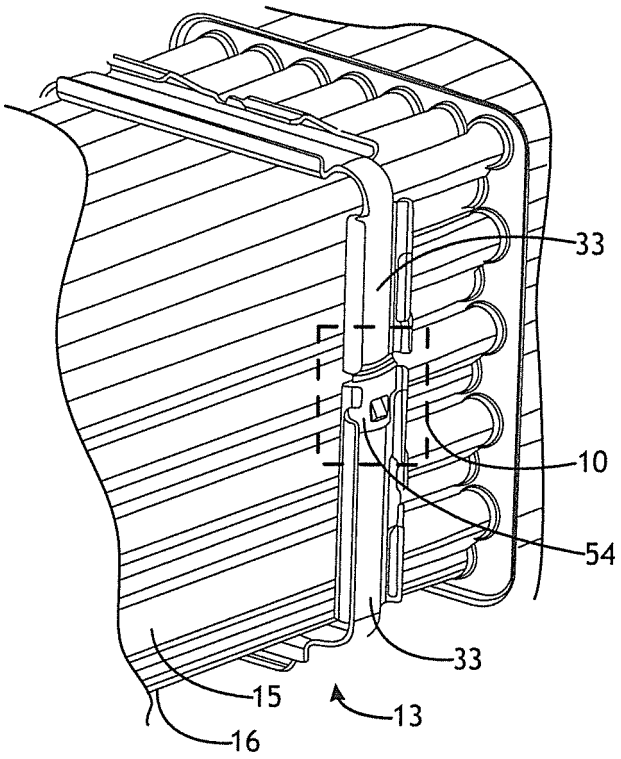

Fig.9

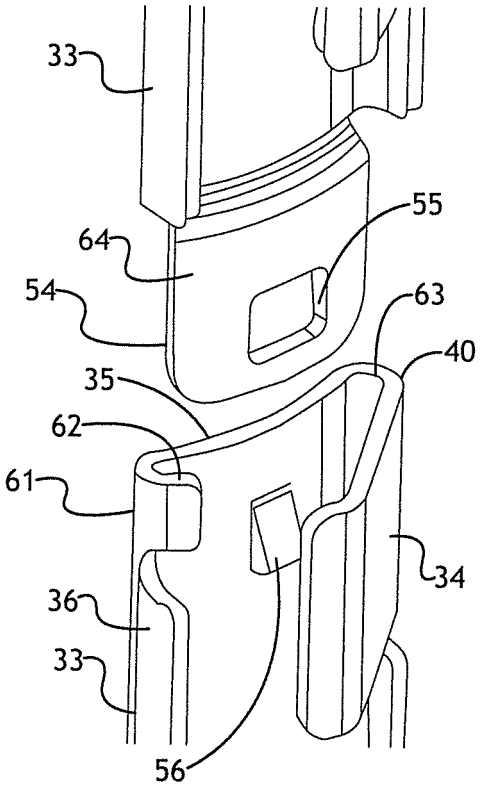

Fig.11

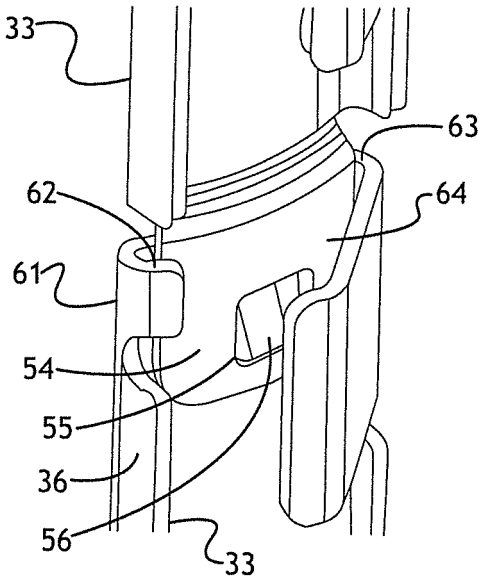

Fig.10

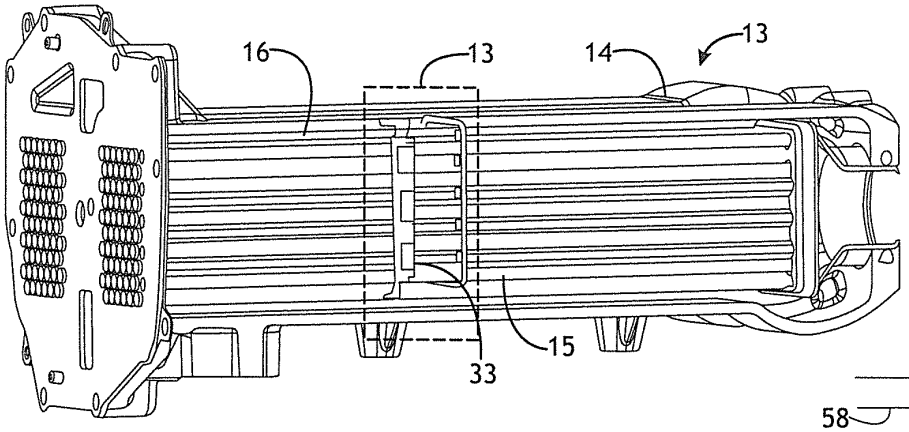

Fig.12

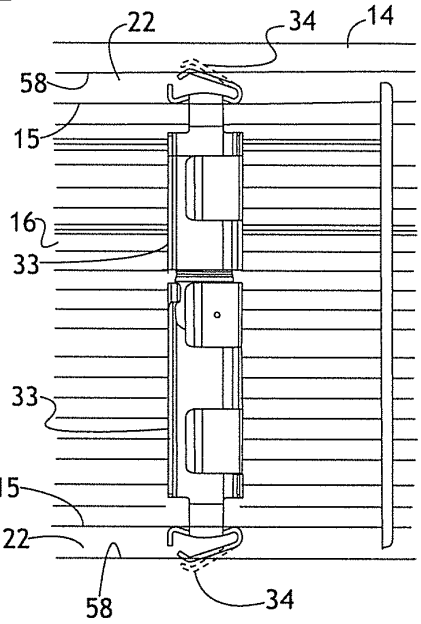

Fig.13

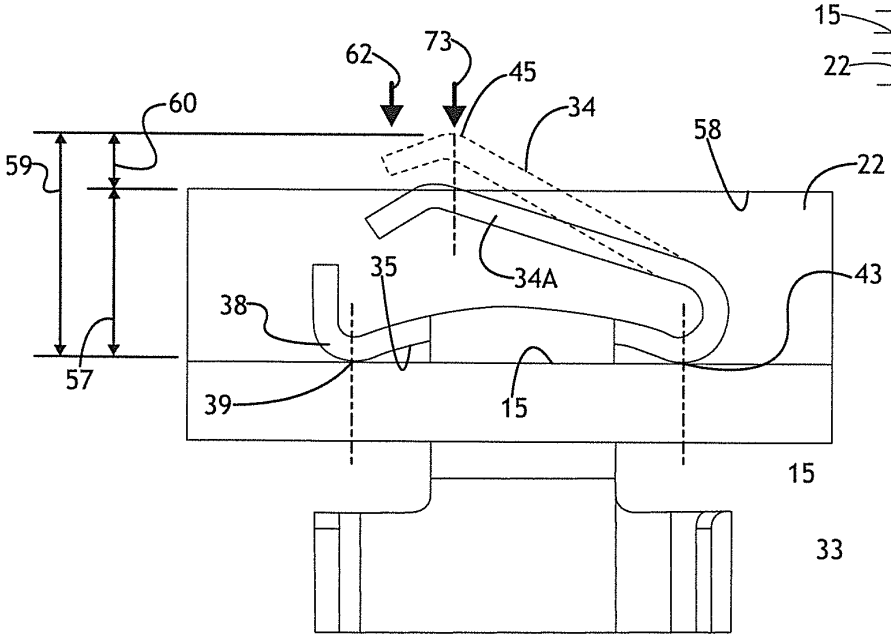

Fig.14

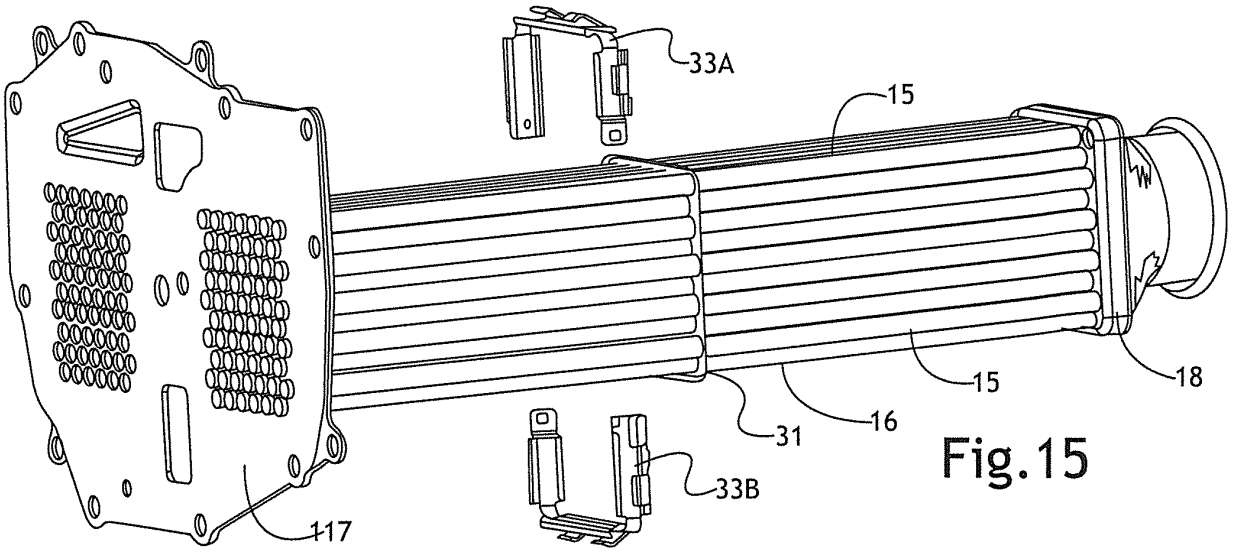

Fig.15

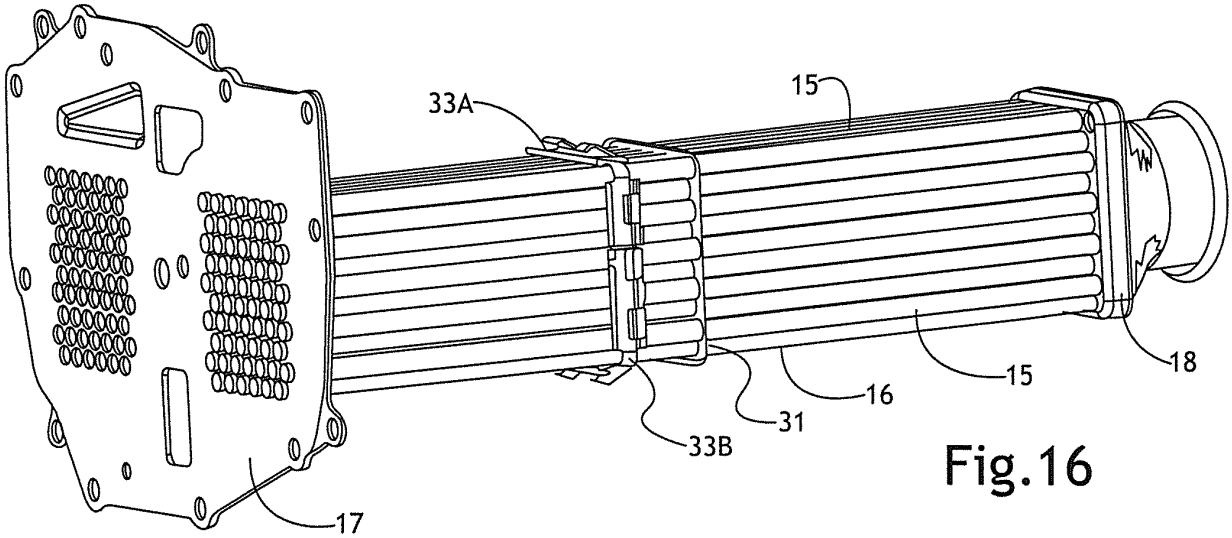

Fig.16

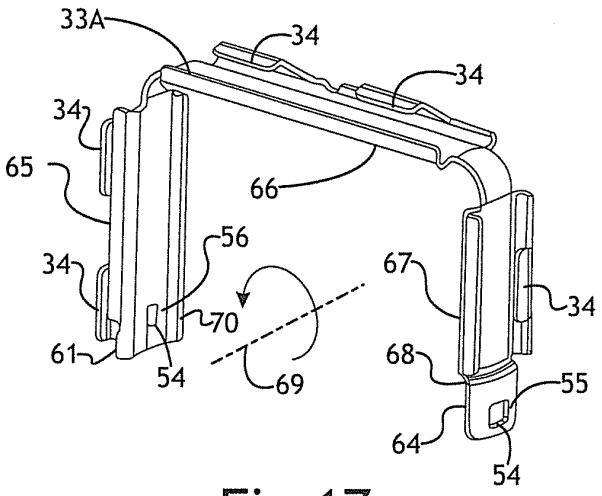

Fig.17

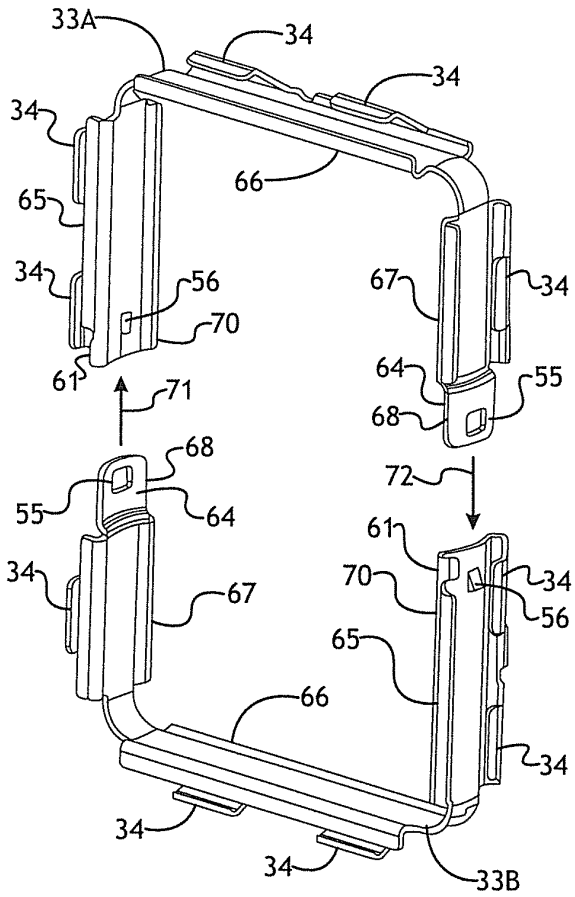

Fig.18

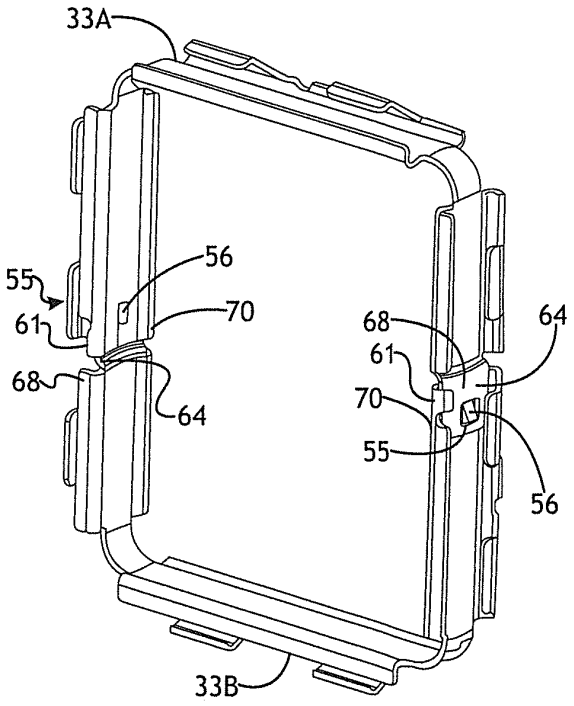

Fig.19

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 14215740 B **[0001]**
- EP 2522941 A1 **[0003]**