US012385427B2

(12) **United States Patent**
Salvadori et al.

(10) **Patent No.: US 12,385,427 B2**
(45) **Date of Patent: Aug. 12, 2025**

(54) **VEHICLE EXHAUST SYSTEMS**

(71) Applicant: **AGCO International GmbH**, Neuhausen (CH)

(72) Inventors: **David Salvadori**, Beauvais (FR); **Einstein Huayanay**, Beauvais (FR); **David Briand**, Beauvais (FR)

(73) Assignee: **AGCO International GmbH**, Neuhausen (CH)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/716,622**

(22) PCT Filed: **Nov. 15, 2022**

(86) PCT No.: **PCT/IB2022/060962**
§ 371 (c)(1),
(2) Date: **Jun. 5, 2024**

(87) PCT Pub. No.: **WO2023/119000**
PCT Pub. Date: **Jun. 29, 2023**

(65) **Prior Publication Data**

US 2025/0027436 A1 Jan. 23, 2025

(30) **Foreign Application Priority Data**

Dec. 21, 2021 (GB) 2118593

(51) **Int. Cl.**
F01N 13/14 (2010.01)
F01N 13/18 (2010.01)

(52) **U.S. Cl.**
CPC ***F01N 13/141*** (2013.01); ***F01N 13/1855*** (2013.01); *F01N 2260/20* (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC F01N 13/141; F01N 13/1855; F01N 2260/20; F01N 2450/16; F01N 2450/24; F01N 2510/02
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,998,597 A 3/1991 Bainbridge et al.
5,966,933 A * 10/1999 Ishihara F01N 13/08 285/330
(Continued)

FOREIGN PATENT DOCUMENTS

CN 213743623 U * 7/2021
JP S509821 U 1/1975
KR 100783866 B1 * 12/2007

OTHER PUBLICATIONS

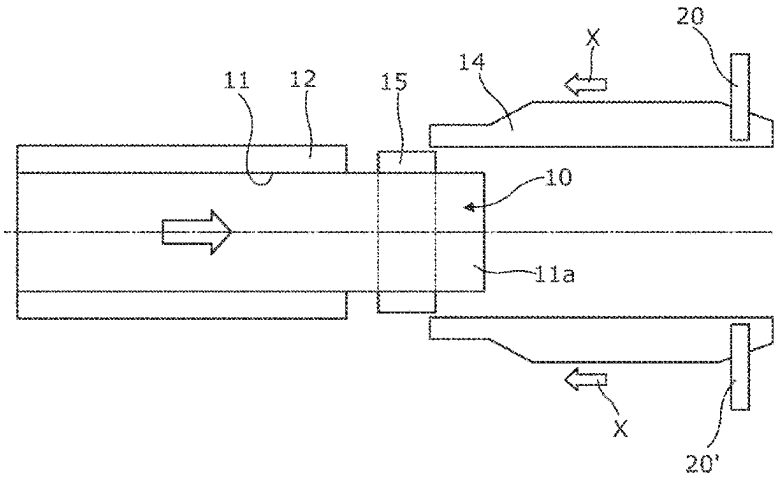
European Patent Office, International Search Report related to International Patent Application No. PCT/IB2022/060962, mail date Feb. 9, 2023, 11 pages.
(Continued)

Primary Examiner — Jorge L Leon, Jr.

(57) **ABSTRACT**

A heat shield arrangement (**14**) for shielding the environment surrounding the junction between two sections (**10**, **13**) of insulated vehicle exhaust from heat emanating from uninsulated end portions of the junction of the exhaust sections. The heat shield (**14**) is of tubular form and mounted on the insulation surrounding one section (**10**) of the exhaust and is slidingly movable between a first position (**14'**) in which the junction between the two sections is exposed to allow access to work on fastening means (**15**) for holding the two sections together and a second position (**14"**) in which the shield surrounds the junction and overlaps the ends of the insulation on both sections of the exhaust to insulate the surrounding environment.

12 Claims, 5 Drawing Sheets



(52) **U.S. Cl.**
CPC *F01N 2450/16* (2013.01); *F01N 2450/24* (2013.01); *F01N 2510/02* (2013.01)

(58) **Field of Classification Search**
USPC 60/323
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

10,927,744	B2	2/2021	Willats et al.	
2019/0135201	A1*	5/2019	Herzig	F01N 13/1811

OTHER PUBLICATIONS

UK Intellectual Property Office, Search Report for related UK Application No. GB2118593.9, dated May 25, 2022, 3 pages.

* cited by examiner

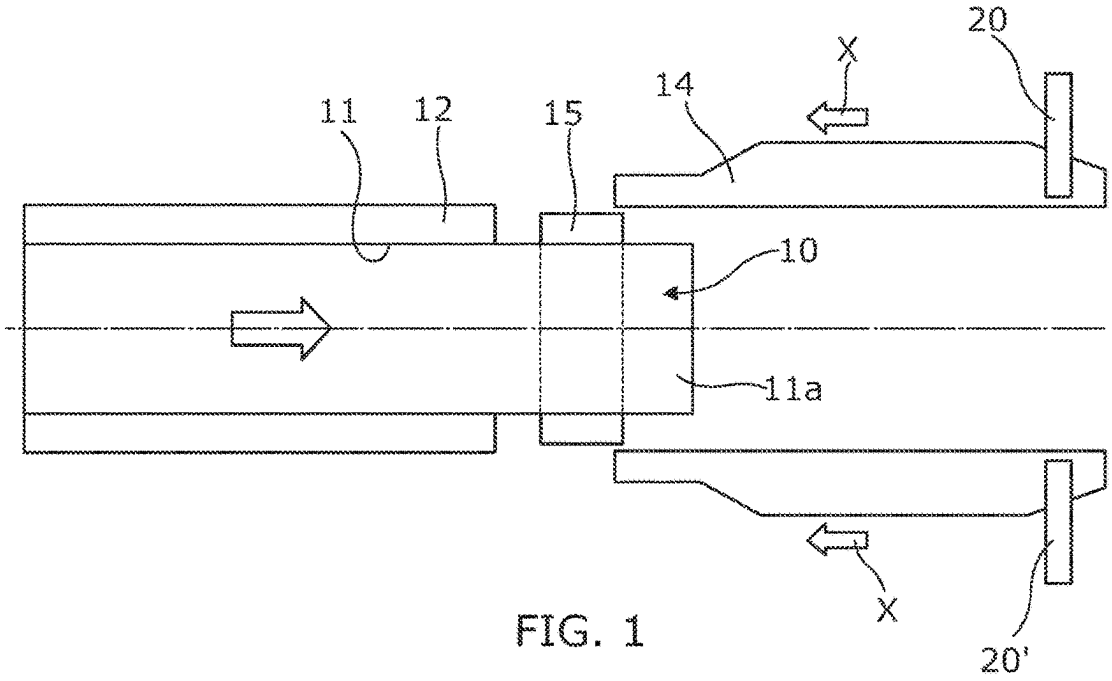


FIG. 1

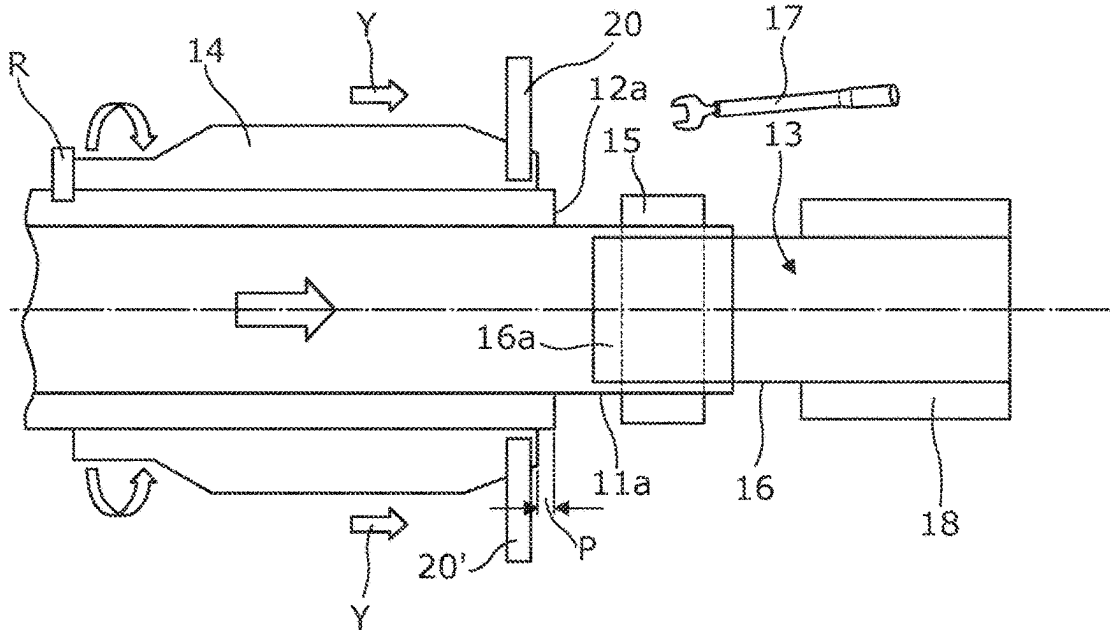


FIG. 2

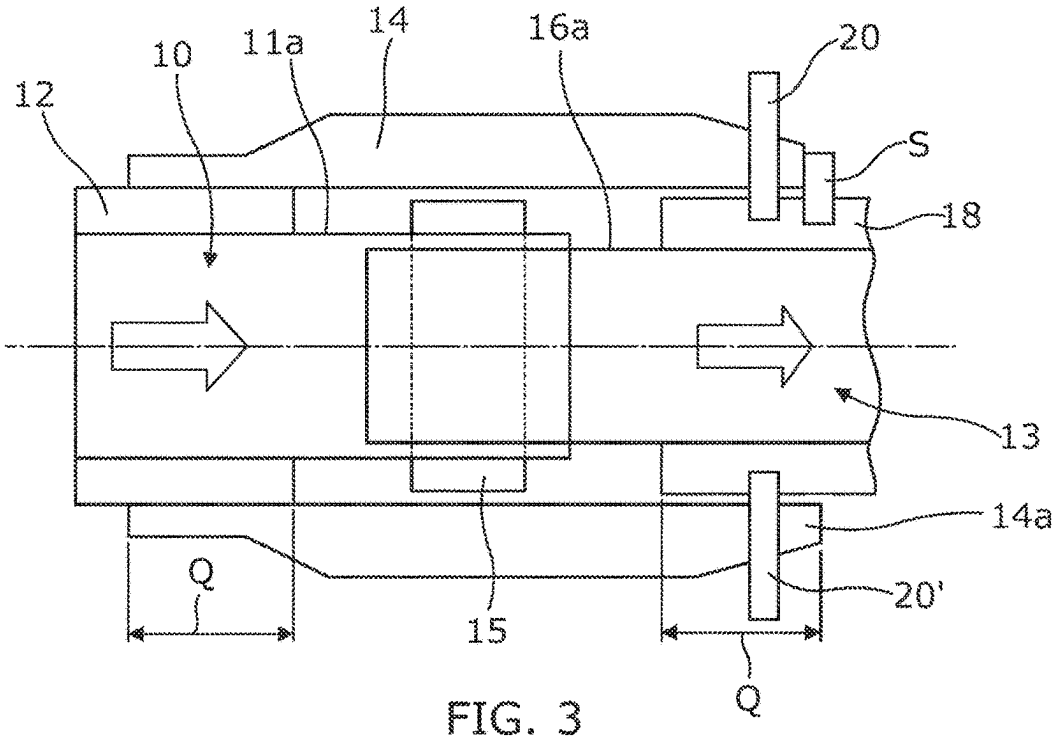


FIG. 3

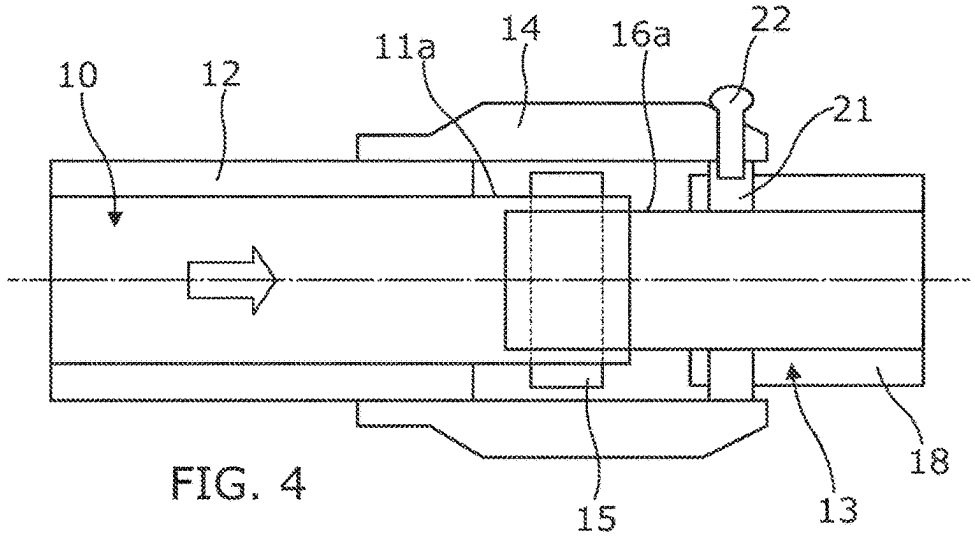


FIG. 4

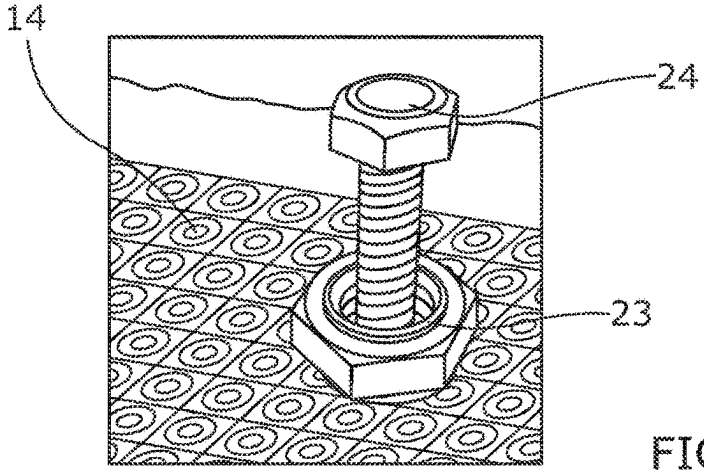


FIG. 5

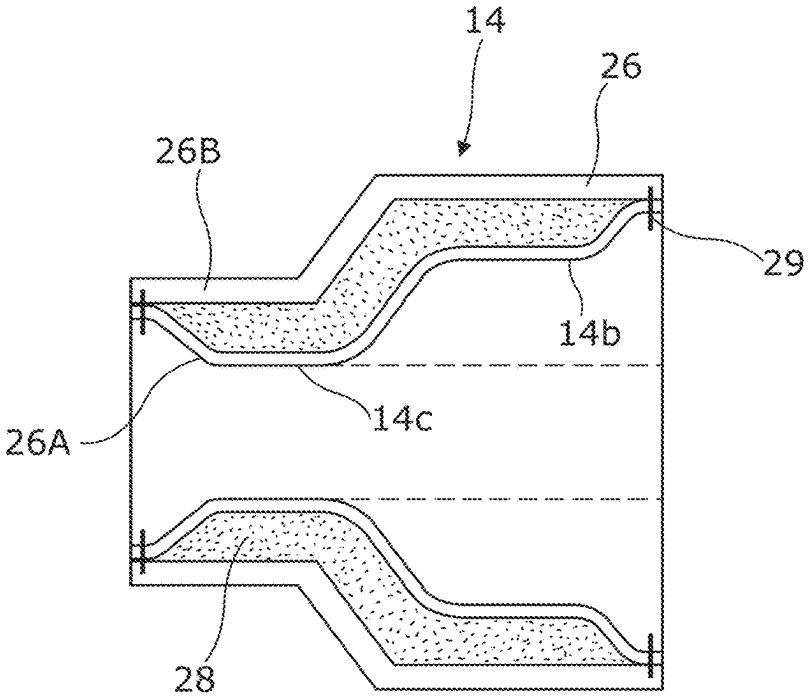


FIG. 6

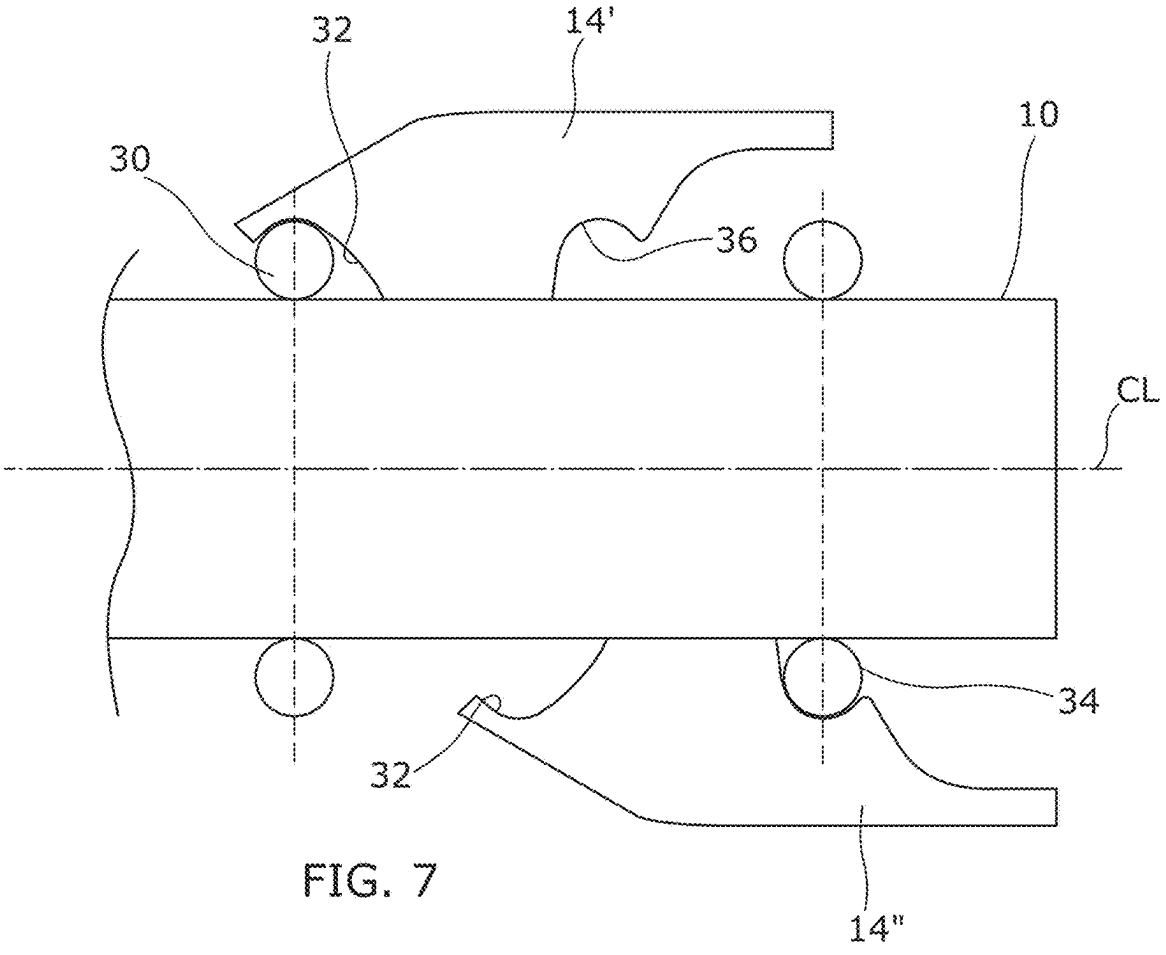


FIG. 7

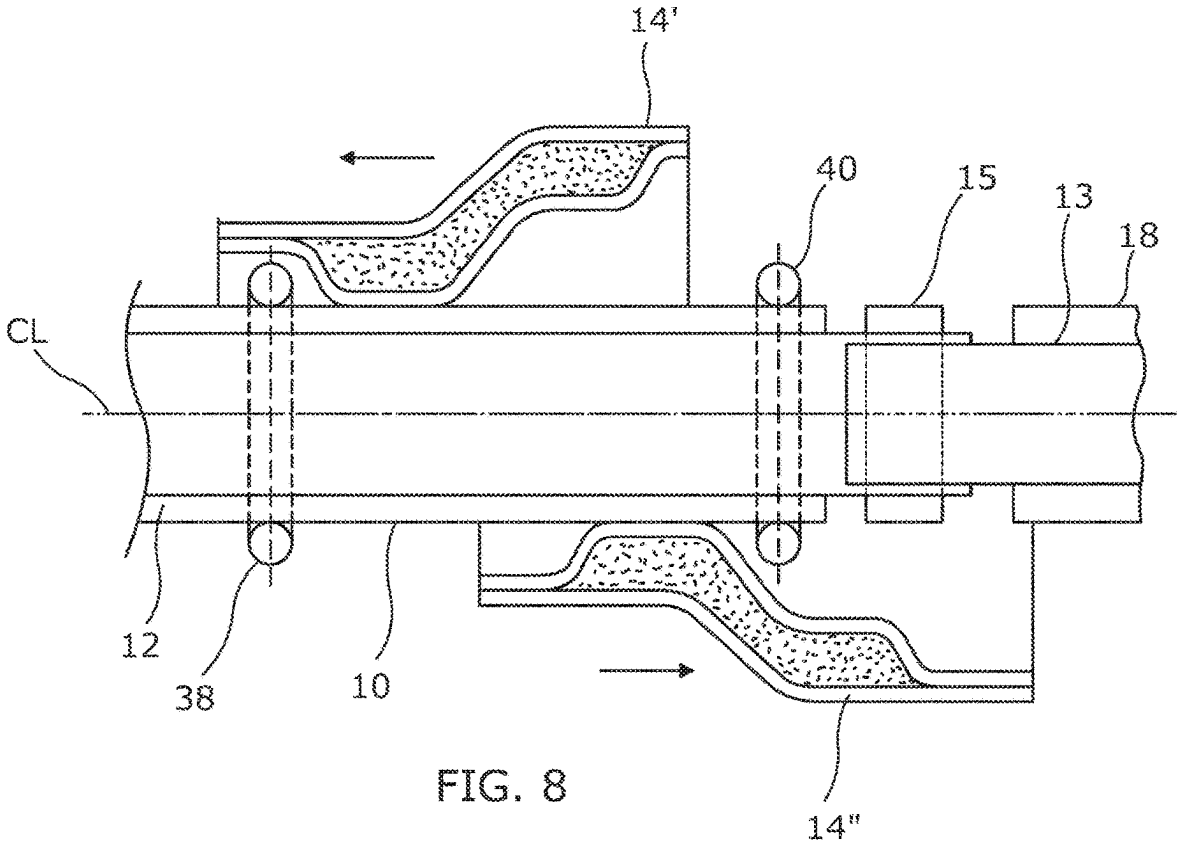


FIG. 8

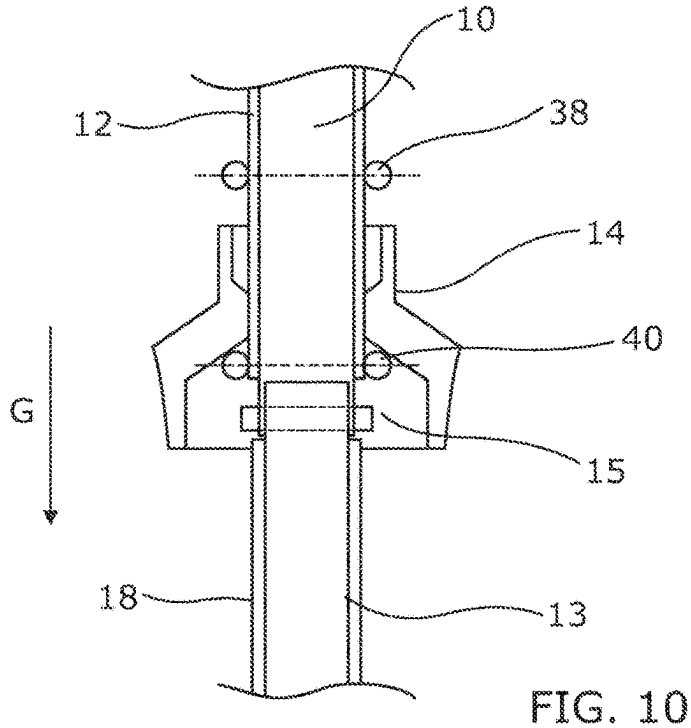


FIG. 10

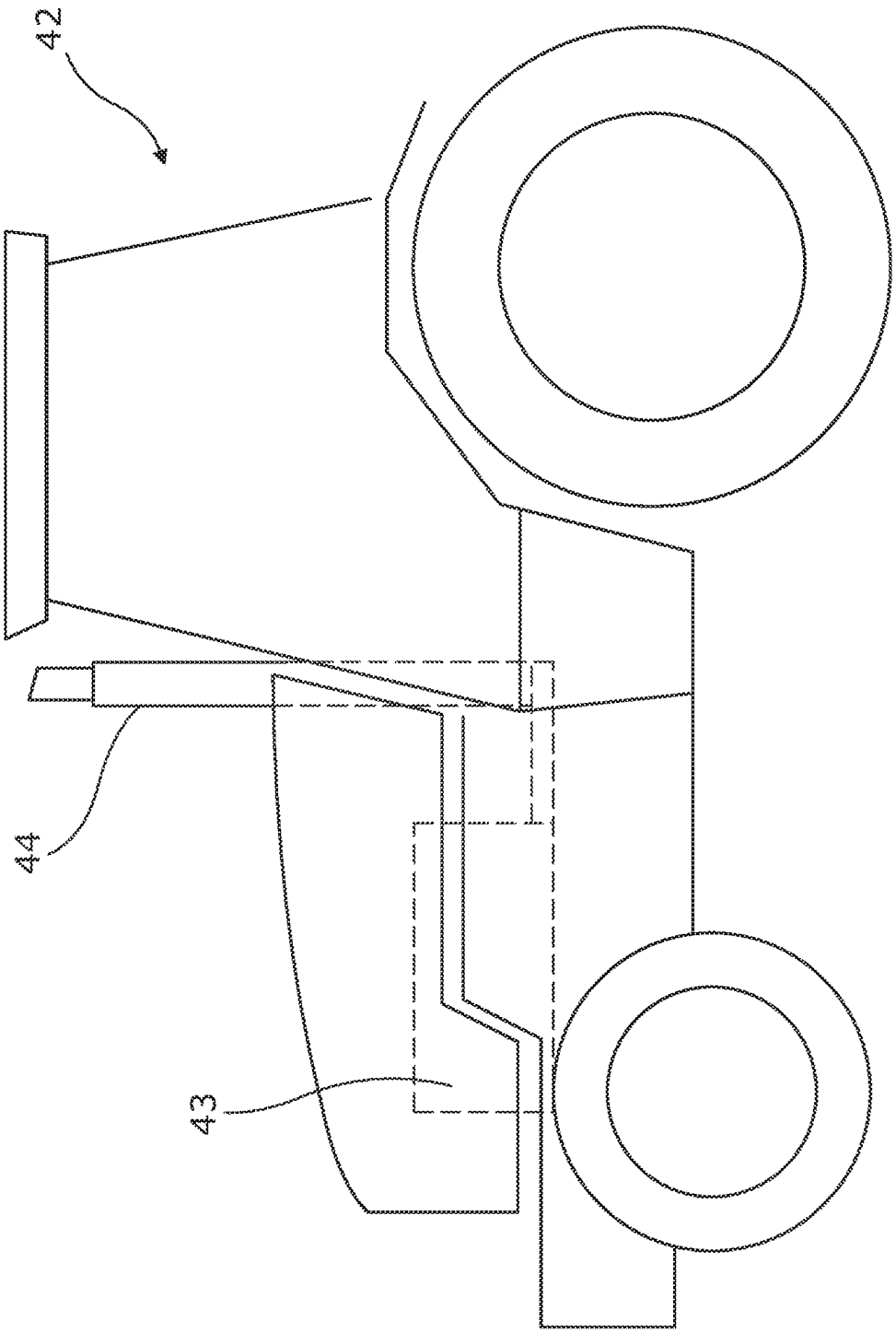


FIG. 9

VEHICLE EXHAUST SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a national phase entry under 35 U.S.C. § 371 of International Patent Application PCT/IB2022/060962, filed Nov. 15, 2022, designating the United States of America and published in English as International Patent Publication WO 2023/119000 A1 on Jun. 29, 2023, which claims the benefit of the filing date of U. K. Patent Application 2118593.9 "Vehicle Exhaust System," filed Dec. 21, 2021, the entire disclosure of which is incorporated herein by reference.

FIELD

This disclosure relates to vehicle exhaust systems and in particular to heat shield arrangements for shielding the environment surrounding the junction between two sections of insulated vehicle exhaust from heat emanating from the uninsulated end portions of the junction of the exhaust sections.

BACKGROUND

Heat shield arrangements exist in which a shield of heat-insulating material is fixed in position over the uninsulated end portions at the junction of the exhaust sections, the shield having an aperture therein to give access to clamps or other fixtures which connect the sections of the exhaust. These arrangements are therefore not satisfactory as the access aperture allows escape of significant heat from the junction and also allows debris from the environment to enter under the shield, thus creating a significant fire risk. This is particularly significant if the vehicle is an agricultural tractor in which straw and other highly combustible debris is prevalent.

It is an object of the present disclosure to provide an improved exhaust joint shield arrangement which mitigates the above problems.

BRIEF SUMMARY

Thus according to the present disclosure, there is provided a heat shield arrangement for shielding the environment surrounding the junction between two sections of insulated vehicle exhaust from heat emanating from uninsulated end portions of the two exhaust sections at the junction, the heat shield being of tubular form and mounted on a first section of the exhaust and being movable between a first position in which the junction between the two sections is exposed to allow access to work on fastening means for holding the two sections together and a second position in which the shield surrounds the junction and overlaps the ends of the insulation on both sections of the exhaust to insulate the surrounding environment.

The shield may be mounted to the insulation on the first exhaust section. The shield may slide longitudinally along the first exhaust section between its first and second positions. Spline formations may be provided on the first section of the exhaust and on the shield to facilitate the sliding between the first and second positions.

In an alternative arrangement, the shield may be rotated about the first exhaust section when moving between the first and second positions. Complementary screw thread formations may be provided on the first exhaust section

exhaust and on the shield to facilitate the rotation between the first and second positions.

Such arrangements provide a simple but effective way to shield the environment from the heat emanating from the exhaust junction and prevent debris from entering under the shield when the shield is in its second (operative) position. Full access to the joint is also provided with the shield in its first position to allow connecting and disconnecting of the exhaust sections.

A securing arrangement may be provided to hold the shield in its second position during use of the vehicle.

This securing arrangement may conveniently comprise screws, bolts, or other fasteners carried by the movable shield, which engage the insulating material surrounding the other section of the exhaust or with nuts or other fasteners carried by this insulating material.

In such an arrangement, a nut welded or otherwise secured to the shield may carry a bolt or screw which engages the insulating material surrounding the other exhaust section or passes through the insulating material to clamp onto the other exhaust section.

Alternatively, the securing arrangement can comprise a magnetic latch to hold the shield in its second position.

First stop means may be provided for contact by the shield to define the first position of the shield.

Similarly, second stop means may be provided for contact by the shield to define the second position of the shield.

The first stop means and/or the second stop means may comprise a stop ring secured to the first section of the exhaust.

The shield may comprise a metallic outer skin enclosing a volume of insulation material. The insulation material may comprise an insulation wool. The outer skin may comprise stainless steel.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure will now be described, by way of example only, with reference to the accompanying drawings in which:

FIG. **1** shows diagrammatically the mounting of a heat shield in accordance with the disclosure on a first insulated section of a vehicle exhaust;

FIG. **2** shows diagrammatically the connection of a second section of insulated exhaust with the shield in its retracted position;

FIG. **3** shows diagrammatically the shield in its second operational position over the junction between the two exhaust sections;

FIG. **4** shows one form of screw and nut securing means to hold the heat shield in its second operational position;

FIG. **5** shows another form of screw and nut securing means to hold the heat shield in its second operational position,

FIG. **6** is a diagrammatic, longitudinal cross-sectional view through a heat shield in accordance with an embodiment;

FIG. **7** illustrates an alternative arrangement for holding the heat shield in retracted and operational positions, the view being split to show the shield in the retracted position above the center line and in the operational position below the center line;

FIG. **8** is a view similar to that of FIG. **7**, but illustrating the use of stop rings to define the retracted and operational position of the shield;

FIG. **9** illustrates schematically a vehicle in the form of an agricultural tractor having an exhaust system in which a heat shield in accordance with the disclosure can be incorporated; and

FIG. **10** illustrates use of the heat shield in a vertically aligned region of an exhaust.

DETAILED DESCRIPTION

Referring to the drawings, a first exhaust section **10** has an inner metal tube **11** which is surrounded by an outer insulating material **12** except at an end portion **11***a*, which is to be joined to a second exhaust section **13** (see FIG. **2**) by a clamp or other fastening means **15** for joining the two sections together at a junction. A tubular heat shield **14** in accordance with the present disclosure made from heat-insulating material is mounted on exhaust section **10** by, for example, sliding or screwing the heat shield **14** along or around the section **10** in the direction of arrows X in FIG. **1**. Splines or screw threads may be provided on the section **10** and the heat shield **14** to facilitate the movement of the shield. Alternatively, the heat shield **14** may simply slide longitudinally on the outer surface of the insulating material **12**.

In one embodiment, the heat shield **14** has an inner metal tubular layer which includes the splines or screw threads. In an alternative construction, no metal inner layer is used, and the splines or screw threads are formed in the insulating material **12** of the heat shield **14**.

With the heat shield **14** in its first retracted position shown in FIG. **2**, the exposed end portion **16***a* of the inner metal tube **16** of second exhaust section **13** of the exhaust is clamped inside the end portion **11***a* of first exhaust section **10** by the clamp or other fastening means **15** using the appropriate spanner or other tool **17**. As can be seen with the heat shield retracted, its outer end is well back a distance P (typically 10 mm or more) from the end **12***a* of insulating material **12** to provide good access to the clamp **15** to facilitate the joining or separation of the exhaust sections **10** and **13**. In an alternative embodiment, the end section **16***a* of the inner metal tube **16** of the second section **13** could be clamped outside the end portion **11***a* of the first exhaust section **10**.

The heat shield **14** is moved to its second operational position shown in FIG. **3** by sliding or rotating the shield around the insulating material **12** of first exhaust section **10** as indicated by arrow Y in FIG. **2** until the end **14***a* of the heat shield **14** surrounds the insulating material **18** of the second exhaust section **13**. Typically, the heat shield **14** will overlap the insulating materials **12** and **18** at Q by 15 mm or more to complete the heat shielding of the joint between the two exhaust sections **10** and **13**.

Stops R and S, shown diagrammatically in FIGS. **2** and **3**, may be provided for contact by the ends of heat shield **14** to define the first and second positions of the heat shield **14**. The stops R and S can be of any suitable shape and could be cylindrical, square, or annular, for example, and they may be differently shaped from one another.

Securing means of any suitable form may be provided to hold the heat shield **14** in its second position during use of the vehicle.

These securing means may, for example, conveniently comprise screws, bolts, or other fasteners **20** carried by the heat shield **14**, which engage the insulating material **18** surrounding the second exhaust section **13** of the exhaust as shown in FIG. **3**. In FIG. **4**, a fastening means in the form of a screw **22** engages a nut or other fastener **21** embedded in insulating material **18**.

In another such arrangement, shown in FIG. **5**, a nut **23** welded or otherwise secured to the heat shield **14** may carry a bolt or screw **24** which engages the insulating material **18** surrounding the second exhaust section **13** or passes through the insulating material **18** to clamp onto the inner metal tube **16** of the second exhaust section **13**.

The heat shield **14** can be made from any suitable material that is both sufficiently heat-insulating in its second position and also sufficiently robust to withstand movement between its first and second positions, and which allows the use of fasteners such as **20**, **20'**, **23**, and **24** when work on the joint between the associated exhaust sections **10** and **13** becomes necessary.

If required, the heat shield **14** may be surrounded by a clamp (not shown) to close the gap between the inner surface of the heat shield **14** and the insulating material **18** of second exhaust section **13**. In an embodiment, a clamp is used in addition to other fasteners **20**, **20'**, and could be located, for example, to the left of the fasteners **20**, **20'** in FIG. **3**. Alternatively, a clamp could be used on its own as a fastener. In a further alternative, the heat shield **14** is welded in position over the joint.

As illustrated in FIG. **6**, the heat shield **14** may have a metallic outer skin **26** surrounding a volume of insulation material **28**. The insulation material **28** may be an insulation wool, which may have a thickness of 10 to 15 mm. The metallic outer skin **26** may be made of any suitable metallic material. In an embodiment, it is made from a stainless steel such as AiSi 430 and may have a thickness of 0.10 to 0.20 mm. The metallic outer skin **26** in one embodiment is formed from a tubular inner skin portion **26**A spot welded **29** to a tubular outer skin portion **26**B about a peripheral region at either end of the heat shield **14**, with the inner and outer skin portions **26**A and **26**B being separated by the insulation material **28** inside the peripheral regions. In this embodiment, over part of its length, the inner skin portion **26**A extends parallel to and is a close sliding fit over the external surface of the insulating material **12** of the first exhaust section **10**. If the heat shield **14** is provided with splines or a screw thread, these may be located in this region.

As indicated above, the heat shield **14** may or may not have a metal inner layer that includes splines or screw threads, and may also include plastic or composite insulating materials as well as or alternative to the insulating materials more commonly used around exhaust systems.

The external shape and cross section of the heat shield **14** may take any appropriate form depending on the proximity of the adjacent items surrounding the heat shield **14** on the associated vehicle. As illustrated in FIG. **6**, the heat shield **14** may have a smaller diameter portion **14***c*, which is a close fit about the insulating material **12** on the first exhaust section **10**, and a larger diameter head portion **14***b*, which locates about the junction between the two exhaust sections **10**, **13** when it is in the second operative position. The larger diameter head portion **14***b* can be dimensioned to accommodate the clamp **15** or other mechanism used to join the two exhaust sections **10**, **13** together.

FIG. **7** illustrates an alternative arrangement for securing the heat shield **14** in the first, retracted position (**14'** illustrated above the center line CL) and the second, operative position (**14"** illustrated below the center line CL). In this embodiment, a first locking ring **30** is secured to the first exhaust section **10** and is resiliently engageable in a first locking formation **32** to hold the heat shield **14** in the first,

retracted position **14'**. Similarly, a second locking ring **34** is secured to the first exhaust section **10** and is resiliently engageable in a second locking formation **36** to hold the heat shield **14** in its second, operative position **14"**. The first and second locking formations **32** and **36** may be recesses defined in an inner surface region of the heat shield **14** in which the locking rings **30** and **34** are resiliently clipped. In an alternative embodiment, there may be only one locking ring **30**, **34** and one locking formation **32**, **36** to hold the heat shield **14** either in the first, retracted position **14'** or in the second, operative position **14"**. In this case, an alternative locking arrangement could be used to hold the heat shield **14** in the second position. For example, one of the alternative locking arrangements could be adopted to hold the heat shield **14** in the second, operative position **14"**. The, or each, locking ring **30**, **34** may be welded or otherwise secured about the insulating material **12** surrounding the first exhaust section **10**. Welding may be appropriate if the insulating material **12** is surrounded by a metallic outer layer.

FIG. **8** illustrates a still further alternative embodiment in which stop rings **38**, **40** are secured (e.g., welded) to the first exhaust section **10** to form first and second stops. The stop rings **38**, **40** are arranged to contact the heat shield **14** to limit movement of the heat shield **14** between the first, retracted position **14'** and the second, operative position **14"**. In this case, the stop rings **38**, **40** serve only as stops similar to the stops R and S described above in relation to FIGS. **2** and **3**. In a modification, at least one of the stops may be a magnetic component that holds the heat shield **14** in abutment with the stop rings **38**, **40** to form a magnetic catch. If the heat shield **14** has an outer casing comprising a magnetic material, such as a magnetic stainless steel, one of the stop rings **38**, **40** may be a magnet or have one or more magnets attached to it to magnetically attract and hold the heat shield **14**. Alternatively, magnetic components may be attached to or incorporated into the heat shield **14**. Other magnetic catch arrangements for magnetically holding the heat shield **14** in either the first, retracted position **14'** and/or the second, operative position **14"** can be used.

A heat shield **14** in accordance with the disclosure may be incorporated into an exhaust system of any suitable vehicle, including agricultural vehicles and machines such as an agricultural tractor **42** illustrated schematically in FIG. **9**. The tractor **42** has an engine **43**, which may be an internal combustion engine, and an exhaust system **44** for directing exhaust gases from the engine to atmosphere. The exhaust system will typically comprise two or more exhaust sections **10**, **13** connected together. The exhaust sections **10**, **13** are insulated but have uninsulated end portions **11***a*, **16***a* that are joined together by means of a clamp **15** or other fixture in the manner described above in relation to FIGS. **1** to **8**. A heat shield **14** in accordance with the disclosure can be used to enclose the joint to provide a heatshield for the uninsulated end portions **11***a*, **16***a*.

As illustrated in FIG. **9**, tractors and other vehicles often have exhaust systems that extend vertically over at least part of their length. In this case in which two sections of exhaust that are clamped together are aligned vertically, a heat shield **14** can conveniently be located about the uppermost of the exhaust sections as illustrated in FIG. **10**. In this case, the heat shield **14** is moved toward the second, operative position **14"** by the force of gravity, as indicated by the arrow G. As illustrated in FIG. **10**, stop rings **38**, **40** similar to those described above in relation to FIG. **8** may be used to limit movement of the heat shield **14**. The heat shield **14** may be held in its second, operative position **14"** by gravity alone. However, additional arrangements for securing the heat shield **14** in the second, operative position **14"** can be used, including any of those described above.

The present disclosure thus provides a simple and effective solution for shielding the environment from heat emanating from exhaust section junctions and which also provides good access for connecting or disconnecting the exhaust sections while also preventing the ingress of debris under the heat shield during use of the vehicle.

The invention claimed is:

1. A heat shield arrangement for shielding surrounding environment of a junction between first and second insulated exhaust sections of a vehicle exhaust, the heat shield arrangement comprising:

a tubular heat shield mounted on the first insulated exhaust section, the heat shield configured to be moved between a first position and a second position;

wherein the junction between the first and second insulated exhaust sections is exposed in the first position to provide access to at least one fastener holding the first and second insulated exhaust sections together;

wherein the heat shield surrounds the junction in the second position and overlaps ends of the first and second insulated exhaust sections to insulate the surrounding environment;

wherein the heat shield is configured to slide longitudinally along the first insulated exhaust section when being moved between the first and second positions; and

wherein corresponding spline formations are formed on the first insulated exhaust section and on the heat shield to facilitate the sliding of the heat shield between the first and second positions.

2. The heat shield arrangement of claim **1**, wherein the spline formations of the heat shield are formed in a metal inner tubular layer of the heat shield.

3. The heat shield arrangement of claim **1**, further comprising a securing arrangement configured to hold the heat shield in the second position.

4. The heat shield arrangement of claim **3**, wherein the securing arrangement comprises first fasteners carried by the heat shield, the first fasteners configured to engage the second insulated exhaust section.

5. The heat shield arrangement of claim **4**, wherein the first fasteners include a nut secured to the heat shield, the nut carrying a bolt of configured to engage the second insulated exhaust section.

6. The heat shield arrangement of claim **5**, wherein the nut is welded to the heat shield.

7. The heat shield arrangement of claim **4**, wherein the first fasteners comprise at least one fastener selected from the group consisting of screws and bolts.

8. The heat shield arrangement of claim **4**, wherein the first fasteners are configured to engage second fasteners carried by the second insulated exhaust section.

9. The heat shield arrangement of claim **8**, wherein the second fasteners include nuts.

10. The heat shield arrangement of claim **3**, wherein the securing arrangement comprises a magnetic or resilient catch.

11. The heat shield arrangement of claim **1**, further comprising a first stop configured to contact the heat shield when the heat shield is in the first position.

12. The heat shield arrangement of claim **1**, further comprising a second stop configured to contact the heat shield when the heat shield is in the second position.

* * * * *