A system for delivering cooling air to an engine of an automotive vehicle comprises a 21 housing defining a passage 25 for directing air towards the engine and an adapter 30, 40, formed separately to the housing. The adapter extends outwardly from the housing 21 and is configured to form a seal with a panel assembly 4, for example to seal the passage 25 with respect to the panel assembly 4 around an opening 10, 11, 12 provided in the panel assembly 4.
AIR FLOW SYSTEM FOR ENGINE COOLING

TECHNICAL FIELD

The present disclosure relates to an air flow system for engine cooling. Aspects of the invention relate to an air flow system, to a vehicle comprising an air flow system, to a method of assembling a plurality of air flow systems, and to a method of designing a plurality of air flow systems.

BACKGROUND

A vehicle engine may be cooled using air that is allowed to enter the engine compartment via one or more openings in a panel assembly, for example a bumper or other leading edge assembly. In order to improve cooling efficiency and reduce the aerodynamic drag caused by the openings, and in some cases in order to meet regulatory requirements, it is often necessary or at least desirable to direct air from an opening in a panel assembly towards the radiator via a passage that is sealed with respect to the opening. However, the need to provide a seal between a passage for directing air towards a radiator and a panel assembly places additional design constraints on the air delivery system. In addition, it may from time to time become necessary to replace the seal between the passage and the panel assembly, which may require replacement of the entire component that provides the passage.

It is an aim of the present invention to address disadvantages associated with the prior art.

SUMMARY OF THE INVENTION

According to an aspect of the present invention there is provided an adapter for an air flow system comprising a housing defining a passage for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle. The adapter may be formed separately to the housing, may be configured to extend outwardly from the housing, and may be configured to provide a seal between the housing and the vehicle panel assembly.
By providing a separate adapter for providing a seal with the vehicle panel assembly the invention allows the design of the housing to be simplified, and allows the seal between the housing and the vehicle panel assembly to be replaced if necessary without replacing the entire housing. In addition, the use of a separate adapter allows a common design of housing to be used in combination with a plurality of different vehicle panel assembly designs. It is therefore possible to use the same housing component across a plurality of vehicle models having different panel assembly designs, for example different variations (including updates) of the same vehicle line and/or vehicles from entirely different lines.

It will be appreciated that the term panel assembly refers to an assembly comprising one or more external bodywork panels of or for a vehicle, and that the or each panel of the panel assembly may be formed either as a single integrally formed part or as an assembly of parts, for example including an inner skin and an outer skin. It will further be appreciated that the housing may be formed either as a single integrally formed part or as an assembly of parts. It will further be appreciated that the phrase “towards an engine” may mean towards a radiator of an engine, whether or not the radiator is mounted directly to the engine.

The adapter may be configured to at least substantially seal the passage with respect to the vehicle panel assembly around the opening or a portion of the opening.

A distal edge of the adapter (that is the edge furthest from the housing) may have a profile that at least substantially matches the shape of the vehicle panel assembly. In particular, the distal edge of the adapter may have a profile that at least substantially matches the shape of an inside surface of the vehicle panel assembly around the opening or the portion of the opening. The distal edge of the housing may be configured to form a seal with the vehicle panel assembly extending continuously around the opening or the portion of the opening.

The adapter may have a shape that substantially corresponds to the shape of the passage when viewed from in front of the housing. The adapter may be configured to extend around the passage. The adapter may have a width (as viewed from in front of
the housing) that is greater than its height. The adapter may have a length (in a
direction extending away from the housing) that is less than its width.

The adapter may comprise attachment means for attaching the adapter to the housing.

The attachment means may comprise at least one clip and/or at least one locking
formation that is configured to receive a clip. For example, the adapter may comprise a
plurality of clip formations that are configured to be received by a corresponding
plurality of locking formations (for example apertures) provided on the housing.

The adapter may comprise a first portion that is configured to engage the housing and
a second portion that is configured to engage the vehicle panel assembly. The first
portion may be formed of a first material and the second portion may be formed of a
second material different to the first material. The first material is preferably harder
than the second material, and the second material is preferably more elastic than the
first material. The first portion may provide a main body of the adapter and the second
portion may provide a flexible seal for forming a seal with the vehicle panel assembly.

The first material may be a plastic material.

The second material may be a rubber material. The second material is preferably an
elastic material.

The first portion and the second portion may be integrally moulded together. The first
portion and the second portion may, for example, be integrally moulded together using
a 2K or "double shot" injection moulding process, or alternatively by overmoulding.

According to a further aspect of the present invention there is provided an adapter for
an air flow system comprising a housing for directing air from an opening in a vehicle
panel assembly towards an engine of an automotive vehicle, wherein the adapter is
formed separately to the housing, is configured to extend outwardly from the housing,
and has a distal edge with a profile that at least substantially matches the shape of the
vehicle panel assembly. In particular, the distal edge of the adapter may have a profile
that at least substantially matches the shape of an inside surface of the vehicle panel assembly around the opening or a portion of the opening.

According to a further aspect of the present invention there is provided an air flow system for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, the air flow system comprising a housing defining a passage for directing air towards the engine and an adapter as described above. The adapter may be attached to the housing, and optionally attached directly to the housing. The adapter may be detachably attached to the housing, thereby facilitating replacement of the adapter. The adapter may extend continuously around the passage.

The housing may be provided with at least one valve element that is selectively movable between an open position in which air flow through the passage is permitted and a closed position in which air flow through the passage is restricted (and optionally at least substantially prevented). The at least one valve element may be configured to at least substantially close the passage when in the closed position to thereby at least substantially prevent air from flowing through the passage towards the engine. The at least one valve element may be located within the housing, for example within the passage. Alternatively the housing may not be provided with any valve elements for opening and closing the passage and may instead simply provide a permanently open passage for delivering air towards the engine.

The housing may be provided with actuation means for selectively controlling the position of the at least one valve element.

The housing may define first and second passages for directing air towards the engine.

The air flow system may comprise first and second adapters formed separately to the housing, wherein each of the first and second adapters is configured to extend outwardly from the housing and to provide a seal between the housing and the vehicle panel assembly. The first adapter may be configured to at least substantially seal the first passage with respect to the vehicle panel assembly around a first opening or a
first portion of an opening, and the second adapter may be configured to at least substantially seal the second passage with respect to the vehicle panel assembly around a second opening or a second portion of an opening. The first and second adapters may be provided as separate components. Alternatively a single adapter may be configured to at least substantially seal both of the first and second passages with respect to the vehicle panel assembly.

The air flow system may further comprise a vehicle panel assembly providing an opening, wherein the passage of the housing is configured to direct air from the opening towards an engine. The adapter may engage the panel assembly, for example an inside surface of the panel assembly, to thereby provide a seal between the housing and the vehicle panel assembly. The seal may extend continuously around the opening or a portion of the opening. The adapter may be configured to at least substantially seal the passage with respect to the panel assembly around the opening or the portion of the opening. The adapter may have a shape that substantially corresponds to the shape of the opening or the portion of the opening when viewed from in front of the housing.

The adapter may be urged against the housing by the panel assembly. This urging may assist with location of the adapter relative to the housing and the panel assembly.

The vehicle panel assembly may be a leading edge panel assembly (that is a panel assembly for forming a front end of a vehicle). In this case the opening may be a main opening of the leading edge panel assembly (that is an opening covered by a main front grille). Alternatively, the opening may be a secondary opening of the leading edge panel assembly (that is an opening other than the opening covered by the main front grille), for example a middle opening or a lower opening located below a main front grille. Where the housing defines first and second passages for directing air towards the engine, the first passage may be for directing air from a middle opening located below a main front grille and the second passage may be for directing air from a lower opening located below the main front grille and the middle opening. It will be appreciated that in some cases the secondary opening(s) may be larger in area than the main opening.
The vehicle panel assembly may comprise a bumper panel.

The opening may be provided by an aperture extending through a panel of the vehicle panel assembly. For example, the opening may extend through a bumper panel.

The opening may be formed between two adjacent panels of the vehicle panel assembly. For example, the opening may be formed between a bumper panel and another panel of the panel assembly such as a second bumper panel, a bonnet panel, or another bodywork panel.

According to a further aspect of the present invention there is provided an automotive vehicle comprising an adapter as described above and/or an air flow system as described above. The vehicle may be a road vehicle or an off-road vehicle, for example a car.

The vehicle may further comprise an engine towards which the passage of the housing is configured to direct air in use. For example, the passage may be configured to direct air directly to (or at least towards) a radiator of the engine.

According to a further aspect of the present invention there is provided a method of assembling a plurality of air flow systems for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, the method comprising: providing first and second housings each providing a passage for directing air from an opening in a vehicle panel assembly towards a vehicle engine; providing first and second adapters each configured to extend outwardly from a housing and to provide a seal between the housing and a vehicle panel assembly; and attaching the first adapter to the first housing to thereby provide a first air flow system and attaching the second adapter to the second housing to thereby provide a second air flow system; wherein the first and second housings are manufactured to the same design; and wherein the first and second adapters are manufactured to different designs, the first adapter having a distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a first design and the second adapter having a differently shaped distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a second design different to the first design. The method may further
comprise incorporating each of the first and second air flow systems into respective first and second vehicles having different vehicle panel assembly designs.

According to a further aspect of the present invention there is provided a method of designing a plurality of air flow systems for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, the method comprising: designing a common housing providing a passage for directing air from an opening in a vehicle panel assembly towards a vehicle engine for use in a plurality of different vehicles having different vehicle panel assembly designs; designing a first adapter for use in combination with the common housing, the first adapter having a distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a first design; and designing a second adapter for use in combination with the common housing, the second adapter having a distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a second design different to the first design.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a vehicle comprising an air flow system according to one possible embodiment of the present invention;

Figures 2 to 4 illustrate the air flow system;
Figures 5 and 6 illustrate first and second adapters of the airflow system in isolation; and

Figures 7a to 7c illustrate a housing forming part of the airflow system.

DETAILED DESCRIPTION

Figure 1 illustrates a vehicle 1 comprising an engine 2 including a radiator 3 that is located behind a leading edge panel assembly 4 (hereafter referred to as “the panel assembly”) that forms the front of the vehicle. The panel assembly 4 includes a front edge of a bonnet panel 5, a main front grille 6, a main bumper panel 7, and a lower bumper panel 8.

The panel assembly 4 provides a plurality of openings through which air may enter the engine compartment in use of the vehicle in order to cool the engine. The openings include an upper opening or main opening 10 that is defined between the main bumper panel 7 and the bonnet panel 5 and that is covered by a main grille. The openings also include a pair of secondary openings located below the upper opening. The secondary openings include a middle opening 11 that is defined between the main bumper panel 7 and the lower bumper panel 8, and a lower opening 12 that is provided by an aperture extending through the lower bumper panel 8. The middle and lower openings 11, 12 are each elongate and extend across a large portion of the width of the panel assembly 4 and the width of the vehicle 1.

The middle opening 11 is split into a plurality of sections by a plurality of columns that are integrally formed with the lower bumper panel 8 and that extend across the middle opening 11 from the lower bumper panel 8 to the main bumper panel 7, as illustrated in Figure 2. The outer-most columns of the middle opening 11 define the edges of a central portion 11a of the middle opening 11. The lower opening 12 is similarly split into a plurality of sections by a plurality of columns that are integrally formed with the lower bumper panel 8 and that extend across the lower opening 12, with the outer-most columns of the lower opening 12 defining the edges of a central portion 12a of the lower opening 12.
The vehicle is provided with an air flow system 20, illustrated in Figure 2 to 4, for directing air from the middle and lower openings 11, 12 towards the radiator 3 in accordance with one possible embodiment of the present invention. The air flow system 20 comprises an active vane housing 21 that is located behind (that is inboard of) the panel assembly 4 between the panel assembly 4 and the radiator 3. The active vane housing 21 comprises a generally upright body portion 22 that is mounted to a structural beam of the vehicle (as illustrated in Figure 3), and first and second duct portions 23, 24. The first duct portion 23 is integrally formed with the body portion 22 at an upper edge thereof and defines a first (upper) passage 25 extending through the active vane housing 21 for directing air from the middle opening 11 of the panel assembly 4 towards the radiator 3. The second duct portion 24 is integrally formed with the body portion 22 at a lower edge thereof and defines a second (lower) passage 26 extending through the active vane housing 21 for directing air from the lower opening 12 of the panel assembly 4 towards the radiator 3. The first and second passages 25, 26 each extend substantially across the width of the active vane housing 21.

The flow of air through the first passage 25 is controlled by a first set of valve elements or active vanes 27a that are located within the first passage 25 and mounted together on a first common shaft that extends across the width of the first passage, as illustrated in Figures 7a to 7c. The first set of vanes 27a is controlled by an actuator 28 that is located on a side edge of the active vane housing 21. The actuator 28 is operable to rotate the common shaft upon which the first set of vanes 27a is mounted to thereby selectively move the first set of vanes between an open position in which air flow through the first passage 25 is permitted and a closed position in which the valve elements seal the first passage to prevent air flow through the first passage 25. Similarly, the flow of air through the second passage 26 is controlled by a second set of valve elements or active vanes 27b that are located within the second passage 26 and mounted together on a second common shaft that extends across the width of the second passage. The second common shaft is coupled to the first common shaft by a rigid link arm 29 (or alternatively another linking system such as a Bowden cable) located on the opposite side of the active vane housing 21 to the actuator 28. The link arm 29 is configured to operate the second set of vanes 27b in phase with the first set
of vanes 27a to thereby selectively open and close the second passage 26 at the same time as the first passage 25.

The air flow system 20 further comprises first and second adapters 30, 40 that are configured respectively to seal the first passage 25 of the active vane housing 21 with respect to the central portion 11a of the middle opening 11 of the panel assembly 4 (that is the region defined between the outer-most columns of the middle opening) and to seal the second passage 26 of the active vane housing 21 with respect to the central portion 12b of the lower opening 12 of the panel assembly 4 (that is the region defined between the outer-most columns of the lower opening). The first and second adapters 30, 40 are illustrated in isolation from the active vane housing in Figures 5 and 6.

The first adapter 30 has a shape that substantially corresponds to the shape of the central portion 11a of the middle opening 11 and to the shape of the first passage 25 of the active vane housing 21 when viewed from in front of the active vane housing 21. The first adapter 30 extends around the first passage 25 and sealingly engages the active vane housing 21 around the first passage 25 around a proximal edge 31 thereof (that is the edge facing towards the active vane housing). It will be appreciated that the first adapter 30 may form a seal with the active vane housing 21 around either the inside surface or the end surface or the outside surface of the first duct portion 23. The first adapter 30 is attached to the active vane housing 21 by a plurality of clips 32 that are integrally formed with the first adapter 30 and which are received within a corresponding plurality of apertures provided on the active vane housing 21.

The first adapter 30 extends outwardly from the active vane housing 21 and has a profiled distal edge 33 (that is the edge facing away from the active vane housing) that substantially corresponds to and matches the shape of the inside surface of the panel assembly 4 around the central portion 11a of the middle opening 11. The distal edge 33 of the first adapter 30 sealingly engages the inside surface of the panel assembly 4 around the central portion 11a of the middle opening 11 to thereby seal the first passage 25 of the active vane housing 21 with respect to the central portion 11a of the middle opening 11. In particular, the distal edge 33 of the first adapter 30 forms a seal with the inwardly facing surfaces of the main bumper panel 7 and the lower bumper.
panel 8 on either side of the first opening 11 between the outer-most columns, and with the inwardly facing surfaces of the outer-most columns to thereby provide the seal. The first adapter 30 is slightly compressed between the active vane housing 21 and the panel assembly 4 in order to ensure a good seal with the active vane housing 21 and with the panel assembly 4, and to assist with location of the first adapter 30 relative to the active vane housing 21 and the panel assembly 4.

The second adapter 40 similarly has a shape that substantially corresponds to the shape of the central portion 12a of the lower opening 12 and to the shape of the second passage 26 of the active vane housing 21 when viewed from in front of the active vane housing 21, and has a profiled distal edge 43 that substantially corresponds to and matches the shape of the inside surface of the panel assembly 4 around the central portion 12a of the lower opening 12. The second adapter 40 is similarly configured to sealingly engage the inside surface of the panel assembly 4 around the central portion 12a of the lower opening 12 to thereby seal the second passage 26 of the active vane housing 21 with respect to the central portion 12a of the lower opening 12. In particular, the distal edge 43 of the second adapter 40 forms a seal with the inwardly facing surface of the lower bumper panel 8 both above and below the lower opening 12 between the outer-most columns of the lower opening, and with the inwardly facing surfaces of the outer-most columns of the lower opening to thereby provide the seal. As with the first adapter 30, the second adapter 40 is also attached to the active vane housing 21 by a plurality of clips 42, and is slightly compressed between the active vane housing 21 and the panel assembly 4.

Each of the first and second adapters 30, 40 is formed as a 2K moulded component in a “one shot” moulding process, and comprises a main body portion 34, 44 which engages the active vane housing 21 and provides the clips 32, 42 for attachment to the active vane housing 21, and a sealing portion 35, 45 that extends around the body portion 34, 44 at the distal edge of the adapter to provide the seal with the inside of the panel assembly 4. The body portions 34, 44 are formed of a hard plastic material (optionally the same material used for the active vane housing), and the sealing portions 35, 45 are formed of a rubber material that is more elastic and less hard than the material of the body portions.
In use of the vehicle 1, as the vehicle travels forwards air is allowed to pass through the upper opening 10, the middle opening 11 and the lower opening 12. Air passing through the central portion 11a of the middle opening 11 is directed towards the radiator 3 by the first passage 25 of the active vane housing 21, and air passing through the central portion 12a of the lower opening 12 is directed towards the radiator 3 by the second passage 26 of the active vane housing 21 in order to assist with cooling of the engine 2. By providing a seal between the first passage 25 and the central portion 11a of the middle opening 11 and between the second passage 26 and the central portion 12b of the lower opening 12, the first and second adapters 30, 40 ensure efficient delivery of cooling air to the radiator 3 via the active vane housing 21 and prevent leakage of air within the engine compartment.

Air passing through upper opening 10 is also directed towards the radiator 3 by a separate air flow system (illustrated in Figure 4) to further assist with cooling of the engine 2. Air passing through the outer portions of the middle and lower openings 11, 12 may be directed by other separate air flow systems (also illustrated in Figure 4) and may be used to cool front brakes of the vehicle and/or other vehicle systems.

If it is desired to close the first and second passages 25, 26 (for example to reduce the level of engine cooling and/or to reduce aerodynamic drag) then the actuator may be controlled to move the vanes into their closed positions, thereby closing the first and second passages 25, 26. In this case, the first and second adaptors 30, 40 ensure that the central portion 11a of the middle opening 11 and the central portion 12a of the lower opening 12 remain sealed and air is not allowed to leak within the engine compartment.

If the seal between the active vane housing 21 and the panel assembly 4 requires replacing after a period of use, for example due to degradation of the sealing portions 35, 45 of the adapters 30, 40, one or both of the first and second adapters 30, 40 may be removed and replaced to renew the seal without removing or replacing the active vane housing 21. The separate, detachable adaptors 30, 40 therefore also increase the ease of maintenance of the air flow system 20.
Because the active vane housing 21 does not directly engage the bumper panel assembly 4 but instead sealingly engages the bumper panel assembly 4 via the first and second adapters 30, 40, it is not necessary for the active vane housing 21 to be specifically shaped and designed to sealingly engage the bumper panel assembly 4. It is therefore possible to reduce the complexity and increase the ease of manufacture of the active vane housing 21. It is also possible to use the same design of active vane housing 21 in multiple different vehicle models having different bumper panel assembly designs. The vehicle models may include different variations (including updates) of the same vehicle line and/or vehicles from entirely different lines. For example, the same design of active vane housing may be used in a first vehicle having a first bumper panel assembly design in combination with first and second adapters that are specifically designed to sealingly engage the bumper panel assembly of the first vehicle, and also in a second vehicle having a second bumper panel assembly design different to the first bumper panel assembly design in combination with differently shaped first and second adapters that are specifically designed to sealingly engage the bumper panel assembly of the second vehicle. In this way the same active vane housing may be used in multiple different vehicle models, with only the adapters, which are smaller, cheaper and simpler to manufacture, being produced to different designs for different models. The adapters used in the first vehicle may have distal edges that are specifically designed to match portions of the inner surface of the bumper panel assembly of the first vehicle to ensure good sealing performance, while the adapters used in the second vehicle may have distal edges that are specifically designed to match portions of the inner surface of the bumper panel assembly of the second vehicle.

Many modifications may be made to the above examples without departing from the scope of the present invention as defined in the accompanying claims. For example, in another embodiment the active vane housing 21 could be modified to also include a further passage for directing air from the upper opening 10 (that is the opening covered by the main grille) towards the radiator 3, in which case a further adapter may also be provided for sealing the further passage with respect to the upper opening. Alternatively, the active vane housing 21 could include only a single passage for directing air from a single opening towards a radiator. In addition, in other embodiments the active vanes may be omitted, and the housing may instead provide
one or more permanently open passages for directing air from one or more openings towards a radiator. Many other modifications are also possible.
CLAIMS

1. An adapter for an air flow system comprising a housing defining a passage for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, wherein the adapter is formed separately from the housing, is configured to extend outwardly from the housing, and is configured to provide a seal between the housing and the vehicle panel assembly.

2. An adapter according to claim 1, wherein the adapter is configured to at least substantially seal the passage with respect to the vehicle panel assembly around the opening or a portion of the opening.

3. An adapter according to claim 1 or claim 2, wherein a distal edge of the adapter has a profile that at least substantially matches the shape of the vehicle panel assembly.

4. An adapter according to any preceding claim, wherein the adapter comprises attachment means for attaching the adapter to the housing.

5. An adapter according to claim 4, wherein the attachment means comprises at least one clip and/or at least one locking formation that is configured to receive a clip.

6. An adapter according to any preceding claim, wherein the adapter comprises a first portion that is configured to engage the housing and a second portion that is configured to engage the vehicle panel assembly, wherein the first portion is formed of a first material and the second portion is formed of a second material different to the first material.

7. An adapter according to claim 6, wherein the first material is a plastic material.

8. An adapter according to claim 6 or claim 7, wherein the second material is a rubber material.
9. An adapter according to any of claims 6 to 8, wherein the first portion and the second portion are integrally moulded together.

10. An adapter for an air flow system comprising a housing defining a passage for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, wherein the adapter is formed separately from the housing, is configured to extend outwardly from the housing, and has a distal edge with a profile that at least substantially matches the shape of the vehicle panel assembly.

11. An air flow system for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, the air flow system comprising a housing defining a passage for directing air towards the engine and an adapter according to any preceding claim.

12. An air flow system according to claim 11, wherein the housing is provided with at least one valve element that is selectively movable between an open position in which air flow through the passage is permitted and a closed position in which air flow through the passage is restricted.

13. An air flow system according to claim 12, wherein the housing is provided with actuation means for selectively controlling the position of the at least one valve element.

14. An air flow system according to any of claims 11 to 13, wherein the housing defines first and second passages for directing air towards the engine.

15. An air flow system according to claim 14, wherein the air flow system comprises first and second adapters formed separately to the housing, wherein each of the first and second adapters is configured to extend outwardly from the housing and to provide a seal between the housing and the vehicle panel assembly.

16. An air flow system according to any of claims 11 to 15, further comprising a vehicle panel assembly providing an opening, wherein the passage of the housing is configured to direct air from the opening towards an engine,
wherein the adapter engages the panel assembly to thereby provide a seal between the housing and the vehicle panel assembly.

17. An air flow system according to claim 16, wherein the vehicle panel assembly is a leading edge panel assembly.

18. An air flow system according to claim 16 or claim 17, wherein the vehicle panel assembly comprises a bumper panel.

19. An air flow system according to any of claims 16 to 18, wherein the opening is provided by an aperture extending through a panel of the vehicle panel assembly.

20. An air flow system according to any of claims 16 to 18, wherein the opening is formed between two adjacent panels of the vehicle panel assembly.

21. An automotive vehicle comprising an adapter according to any of claims 1 to 10 and/or an air flow system according to any of claims 11 to 20.

22. A vehicle according to claim 21, further comprising an engine towards which the passage of the housing is configured to direct air in use.

23. A method of assembling a plurality of air flow systems for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, the method comprising: providing first and second housings each providing a passage for directing air from an opening in a vehicle panel assembly towards a vehicle engine; providing first and second adapters each configured to extend outwardly from a housing and to provide a seal between the housing and a vehicle panel assembly; and attaching the first adapter to the first housing to thereby provide a first air flow system and attaching the second adapter to the second housing to thereby provide a second air flow system; wherein the first and second housings are manufactured to the same design; and wherein the first and second adapters are manufactured to different designs, the first adapter having a distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a first design and the second adapter having a
differently shaped distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a second design different to the first design.

24. A method of designing a plurality of air flow systems for directing air from an opening in a vehicle panel assembly towards an engine of an automotive vehicle, the method comprising: designing a common housing providing a passage for directing air from an opening in a vehicle panel assembly towards a vehicle engine for use in a plurality of different vehicles having different vehicle panel assembly designs; designing a first adapter for use in combination with the common housing, the first adapter having a distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a first design; and designing a second adapter for use in combination with the common housing, the second adapter having a distal edge that is shaped to sealingly engage a vehicle panel assembly manufactured to a second design different to the first design.

25. An adapter, housing, air flow system, vehicle or method substantially as described herein with reference to any of the examples.
Application No: GB1614911.4  Examiner: Vaughan Phillips
Claims searched: 1-24  Date of search: 13 February 2017

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC

Worldwide search of patent documents classified in the following areas of the IPC

The following online and other databases have been used in the preparation of this search report

Online: WPI, EPODOC
## International Classification:

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