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Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

[Continued on next page]

(54) **Title**: ENGINE AIRFLOW SHIELD

(57) **Abstract**: A cooling system (10) for a vehicle (14) includes a radiator (18) disposed on the vehicle and configured to receive airflow (F) through the radiator. A fan (24) is disposed on the vehicle (14) downstream of the radiator (18) with respect to the direction of airflow (F). An engine (12) is disposed on the vehicle (14) downstream of the fan (24), and an engine shield (26) is disposed on the vehicle downstream of the fan and upstream of the engine.

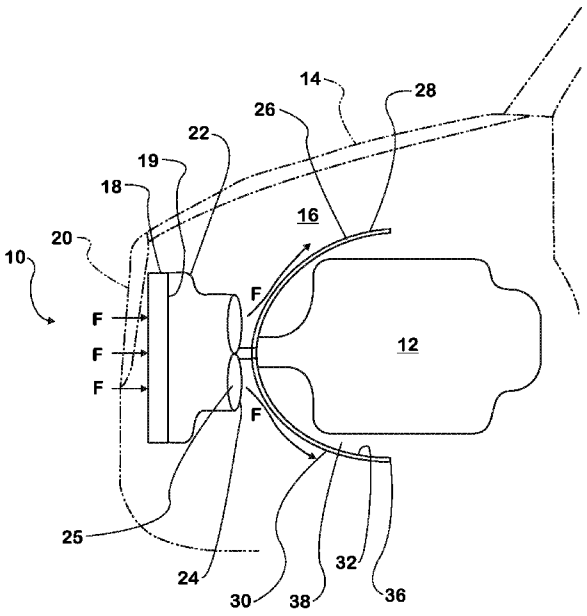

FIG. 1

WO 2012/128767 A1

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *with amended claims (Art. 19(1))*

Published:

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

ENGINE AIRFLOW SHIELD

BACKGROUND

[0001] Embodiments described herein relate generally to engine cooling systems for vehicles, and more particularly, to components related to airflow through a radiator and into an engine compartment.

[0002] In conventional engine cooling systems, a coolant is circulated through the engine to transport heat away from the engine. The coolant is typically water. Cooler water is transported through channels formed in the engine, and the water is heated within the channels by the engine. The heated water exits the engine and is circulated through a radiator at the front of the vehicle. In the radiator, the water is cooled convectively, typically with tubes and fins, and then the cooled water is returned to the engine.

[0003] Airflow through the radiator increases the convective heat transfer away from the coolant. Typically, a fan is provided on the radiator. The fan is attached to a fan shroud, and the fan shroud is attached to the downstream side of the radiator (in the direction of airflow through the radiator). The fan increases the airflow through the radiator by drawing air through the radiator, particularly when the vehicle is stationary.

[0004] When the air is drawn through the radiator, the air is directed at the engine compartment. Typically, the airflow is directed at the engine block, which is immediately downstream of the fan. The shape of the engine block obstructs the flow path of the airflow. When the airflow hits the engine block, the airflow is deflected outwardly in many directions, and a high pressure region is created directly behind the

fan. This backpressure restriction causes the fan to operate inefficiently with reduced airflow being drawn through the fan, which in turn, reduces the airflow being drawn through the radiator. With reduced airflow through the radiator, the capability of the radiator to convectively cool the coolant being circulated through the radiator is reduced. The issue of backpressure restriction has typically been addressed by changing the placement of the engine fan and the fan shroud, or by changing the design of the engine fan and the fan shroud.

SUMMARY

[0005] A cooling system for a vehicle includes a radiator disposed on the vehicle and configured to receive airflow through the radiator. A fan is disposed on the vehicle downstream of the radiator with respect to the direction of airflow. An engine is disposed on the vehicle downstream of the fan, and an engine shield is disposed on the vehicle downstream of the fan and upstream of the engine.

[0006] An engine shield for a cooling system is disposed downstream from a radiator and a fan, and upstream of an engine. The engine shield includes a body having an exterior surface, an interior surface opposite from the exterior surface, a nose and a rear edge opposite from the nose. The engine shield includes an interior compartment that is at least partially defined by the interior surface. The body is configured to receive at least a portion of the engine within the interior compartment.

[0007] A method of reducing backpressure downstream of a fan in a cooling system for an engine of a vehicle, the cooling system having a radiator, includes attaching an engine shield to the vehicle upstream of the engine. The method also includes drawing airflow through the radiator with a fan disposed on the vehicle downstream of the radiator and disposed upstream of the engine shield. The method

includes directing the airflow downstream of the fan and around the engine shield, where the engine shield is disposed on the vehicle downstream of the fan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a schematic diagram of an engine compartment of a vehicle showing a radiator, a fan shroud, a fan, an engine block, and an engine shield.

[0009] FIG. 2 is a perspective view of the engine shield having optional vanes.

DETAILED DESCRIPTION

[0010] Referring to FIGs. 1-2, a cooling system is indicated generally at 10 and is associated with an engine 12 of a vehicle 14. The vehicle 14 is shown in dashed lines and may be a truck, car, van or any other vehicle. The engine 12 is mounted inside of an engine compartment 16 of the vehicle 14. A radiator 18 is disposed near a front end 20 (shown in dashed) of the vehicle 14 for receiving coolant from the engine 12. The coolant is delivered with hoses (not shown) to the radiator 18, where the coolant is cooled via convection of airflow F through the radiator and in the direction indicated. The cooled coolant is returned to the engine 12 with hoses (not shown).

[0011] A fan shroud 22 is attached to a rear face 19 of the radiator 18, and a fan 24 is disposed at the downstream side of the fan shroud (in the direction of airflow). The fan 24 includes at least one blade 25 that is driven by the engine 12 to draw airflow F through the radiator 18 and in the direction indicated. The forward movement of the vehicle 14 increases the airflow F through the radiator 18. The fan 24 increases the airflow F through the radiator 18, particularly when the vehicle 14 is stationary.

[0012] When the airflow F passes through the radiator 18 and the fan 24, the airflow is conventionally directed at the engine 12, which has a generally obtuse, irregular and non-aerodynamic shape. The airflow F is deflected and diverted in many directions outwardly around the engine 12, creating a backpressure restriction downstream of the fan. The backpressure decreases the airflow F through the fan 24, which decreases the airflow through the radiator 18, which decreases the capability of the radiator to cool the coolant.

[0013] In the engine cooling system 10, upon exiting the fan 24, the airflow F is directed at an engine shield 26, which is located downstream of the fan and upstream of the engine 12. The engine shield 26 may be attached to the engine 12 with brackets or supports, or may be attached to other vehicle surfaces surrounding the engine, or in the engine compartment 16, for ease of manufacturing or use.

[0014] The engine shield 26 has a body 28 with a generally aerodynamic shape. The body 28 may be a generally rounded parabolic shape, a generally elliptical shape, a generally hemispherical shape, a generally cone or blunt-cone shape, a generally power-series shape, or a generally ogival shape, however other shapes are possible. The body 28 may be a solid of revolution about an axis A, having a length L, a width W, having a constant or varying thickness T, and may have a varying shape along the axis A. Additionally, the body 28 may have an irregular shape. Further, the body 28 may not be symmetric about an axis A. The shape of the body 28 may be any shape that reduces the backpressure downstream of the fan 24 by providing a lower resistance path of airflow F around the generally smooth body 28 than is provided around the engine 12. The shape may be discontinuous with holes or openings in the

surface to allow the passage of pipes or hoses routed to the engine 12 or to surrounding components. The shape may also have fins or turning vanes as shown in FIG. 2.

[0015] The body 28 has an exterior surface 30, an interior surface 32 opposite from the exterior surface, a nose 34 and a rear edge 36 opposite from the nose. The nose 34 may be pointed or round, may be the most upstream-located portion of the body 28, and may also be an edge. The rear edge 36 may be the most downstream-located portion of the body 28.

[0016] An interior compartment 38 is at least partially defined by the interior surface 32. The body 28 is configured to receive at least a portion of the engine 12 within the interior compartment 38, and the body 28 may encompass the entire engine 12. Alternately, the body 28 may be spaced upstream from the engine 12 such that the engine is not received at the interior compartment 38. The interior compartment 38 may be open at the rear edge 36 or may be enclosed, and the interior compartment may be open at other locations besides the rear edge.

[0017] The exterior surface 30 may be generally smooth and the body 28 may be formed of suitable materials such as steel, aluminum, or other metal alloy. Optional vanes 40 may be disposed on the exterior surface 30, and may be fluted or curved outwardly to direct and channel the airflow F rearward of the fan 24 and at specific areas of the engine compartment 16 that reduce flow inefficiencies or that reduce flow recirculation through the radiator 18. The vanes 40 may have the same or different lengths, and may be integrally formed or attached to the exterior surface 30. It is possible that one or more vanes 40 are disposed on the exterior surface 30.

[0018] The engine shield 26 reduces the backpressure restriction downstream of the fan 24, causing the fan to operate with increased efficiency to increase airflow F being drawn through the fan. The increased airflow F increases the efficiency of the radiator 18 to convectively cool the coolant.

[0019] With the airflow F impendent on the engine shield 26, the engine shield may provide additional heat transfer away from the engine 12 and to the engine shield, which is cooled convectively with the airflow. It will be appreciated that the engine shield 26 can be incorporated on new and existing vehicles to form the cooling system 10.

What is claimed is:

1. A cooling system for a vehicle, comprising:

a radiator disposed on the vehicle and configured to receive airflow through the radiator;

a fan disposed on the vehicle downstream of the radiator with respect to the direction of airflow;

an engine disposed on the vehicle downstream of the fan; and

an engine shield disposed on the vehicle downstream of the fan and upstream of the engine.

2. The cooling system of claim 1 wherein the engine shield is one of a generally rounded parabolic shape, a generally elliptical shape, a generally hemispherical shape, a generally cone shape, a generally blunt-cone shape, a generally power-series shape, and a generally ogival shape.

3. The cooling system of claim 1 wherein the engine shield has a body including an exterior surface, an interior surface opposite from the exterior surface, a nose and a rear edge opposite from the nose.

4. The cooling system of claim 3 wherein the interior surface defines an interior compartment.

5. The cooling system of claim 4 wherein the body is configured to receive at least a portion of the engine within the interior compartment.

6. The cooling system of claim 3 further comprising at least one vane disposed on the exterior surface.

7. The cooling system of claim 1 further comprising a fan shroud disposed downstream of the radiator, the fan being disposed on the fan shroud.

8. The cooling system of claim 1 wherein the engine shield decreases the backpressure immediately downstream of the fan.

9. The cooling system of claim 1 wherein the exterior surface of the engine shield is generally smooth.

10. An engine shield for a cooling system, the engine shield disposed downstream from a radiator and a fan, and upstream of an engine, the engine shield comprising:

a body having an exterior surface, an interior surface opposite from the exterior surface, a nose and a rear edge opposite from the nose; and

an interior compartment at least partially defined by the interior surface, wherein the body is configured to receive at least a portion of the engine within the interior compartment.

11. The engine shield of claim 10 wherein the engine shield is one of a generally rounded parabolic shape, a generally elliptical shape, a generally hemispherical shape, a generally cone shape, a generally blunt-cone shape, a generally power-series shape, and a generally ogival shape.

12. The engine shield of claim 10 wherein the exterior surface of the engine shield is generally smooth.

13. The engine shield of claim 10 further comprising at least one vane disposed on the exterior surface.

14. The engine shield of claim 13 wherein the at least one vane is fluted.

15. The engine shield of claim 13 wherein the at least one vane is curved.

16. The engine shield of claim 13 wherein the at least one vane comprises multiple vanes, and wherein the multiple vanes have varying lengths.

17. The engine shield of claim 13 wherein the at least one vane is one of integrally formed and attached to the exterior surface.

18. The engine shield of claim 10 wherein the interior compartment is enclosed except for at the rear edge.

19. A method of reducing backpressure downstream of a fan in a cooling system for an engine of a vehicle, the cooling system having a radiator, the method comprising:

attaching an engine shield to the vehicle upstream of the engine;

drawing airflow through the radiator with the fan disposed on the vehicle downstream of the radiator and disposed upstream of the engine shield; and

directing the airflow downstream of the fan and around the engine shield, wherein the engine shield is disposed on the vehicle downstream of the fan.

20. The method of claim 19 further comprising the step of directing the airflow with at least one vane disposed on the engine shield.

AMENDED CLAIMS
received by the International Bureau on 01 June 2011 (01.06.2011)

1. A cooling system for a vehicle, comprising:

a radiator disposed on the vehicle and configured to receive airflow through the radiator;

a fan disposed on the vehicle downstream of the radiator with respect to the direction of airflow;

an engine disposed on the vehicle downstream of the fan;

an engine shield disposed on the vehicle downstream of the fan and upstream of the engine, wherein the engine shield has a body including an exterior surface, an interior surface opposite from the exterior surface, a nose and a rear edge opposite from the nose; and

at least one vane disposed on the exterior surface.

2. The cooling system of claim 1 wherein the engine shield is one of a generally rounded parabolic shape, a generally elliptical shape, a generally hemispherical shape, a generally cone shape, a generally blunt-cone shape, a generally power-series shape, and a generally ogival shape.

3. The cooling system of claim 1 wherein the interior surface defines an interior compartment.

4. The cooling system of claim 1 wherein the body is configured to receive at least a portion of the engine within the interior compartment.

5. The cooling system of claim 1 further comprising a fan shroud disposed downstream of the radiator, the fan being disposed on the fan shroud.

6. The cooling system of claim 1 wherein the engine shield decreases the backpressure immediately downstream of the fan.

7. The cooling system of claim 1 wherein the exterior surface of the engine shield is generally smooth.

8. An engine shield for a cooling system, the engine shield disposed downstream from a radiator and a fan, and upstream of an engine, the engine shield comprising:

a body having an exterior surface, an interior surface opposite from the exterior surface, a nose and a rear edge opposite from the nose;

an interior compartment at least partially defined by the interior surface, wherein the body is configured to receive at least a portion of the engine within the interior compartment; and

at least one vane disposed on the exterior surface.

9. The engine shield of claim 8 wherein the engine shield is one of a generally rounded parabolic shape, a generally elliptical shape, a generally hemispherical shape, a generally cone shape, a generally blunt-cone shape, a generally power-series shape, and a generally ogival shape.

10. The engine shield of claim 8 wherein the exterior surface of the engine shield is generally smooth.

11. The engine shield of claim 8 wherein the at least one vane is fluted.

12. The engine shield of claim 8 wherein the at least one vane is curved.

13. The engine shield of claim 8 wherein the at least one vane comprises multiple vanes, and wherein the multiple vanes have varying lengths.

14. The engine shield of claim 8 wherein the at least one vane is one of integrally formed and attached to the exterior surface.

15. The engine shield of claim 8 wherein the interior compartment is enclosed except for at the rear edge.

16. A method of reducing backpressure downstream of a fan in a cooling system for an engine of a vehicle, the cooling system having a radiator, the method comprising:

attaching an engine shield to the vehicle upstream of the engine;

drawing airflow through the radiator with the fan disposed on the vehicle downstream of the radiator and disposed upstream of the engine shield;

directing the airflow downstream of the fan and around the engine shield, wherein the engine shield is disposed on the vehicle downstream of the fan and directing the airflow with at least one vane disposed on the engine shield.

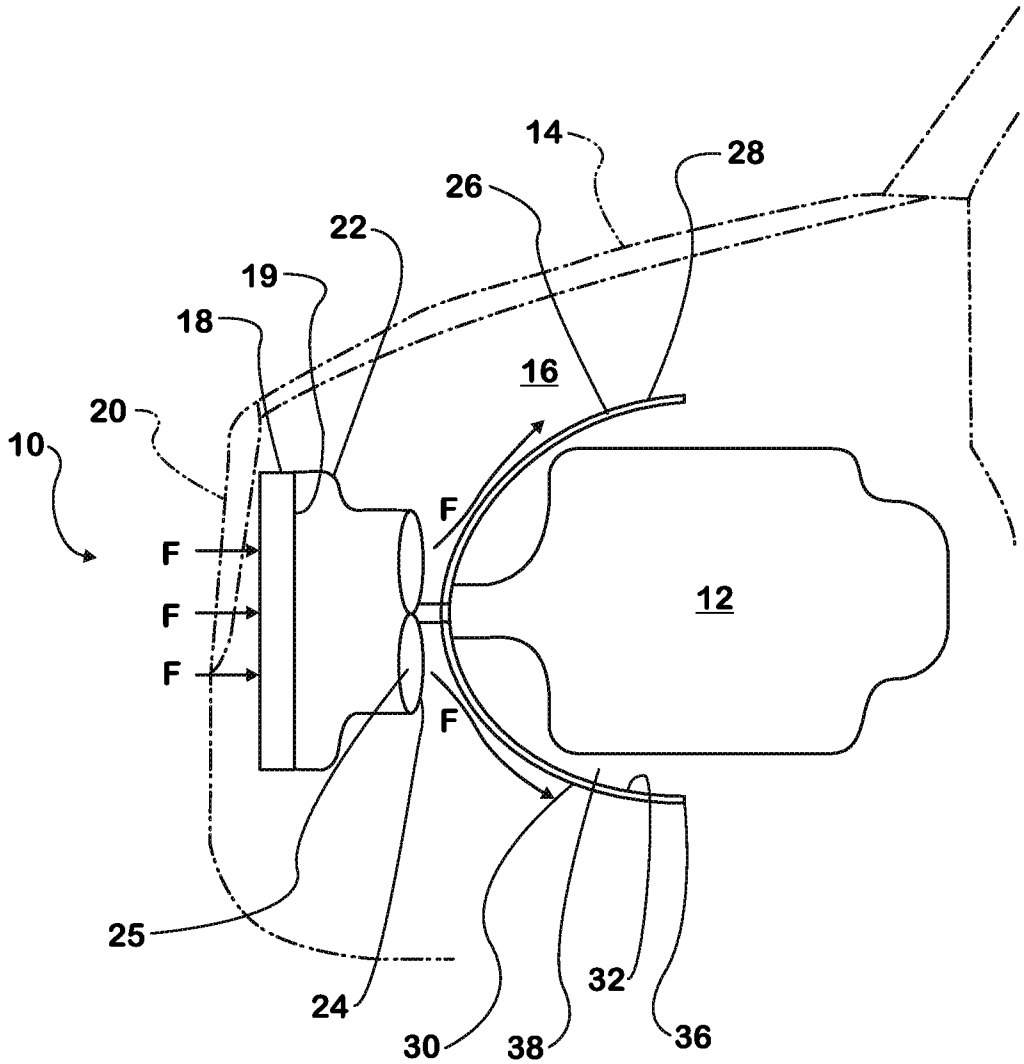

FIG. 1

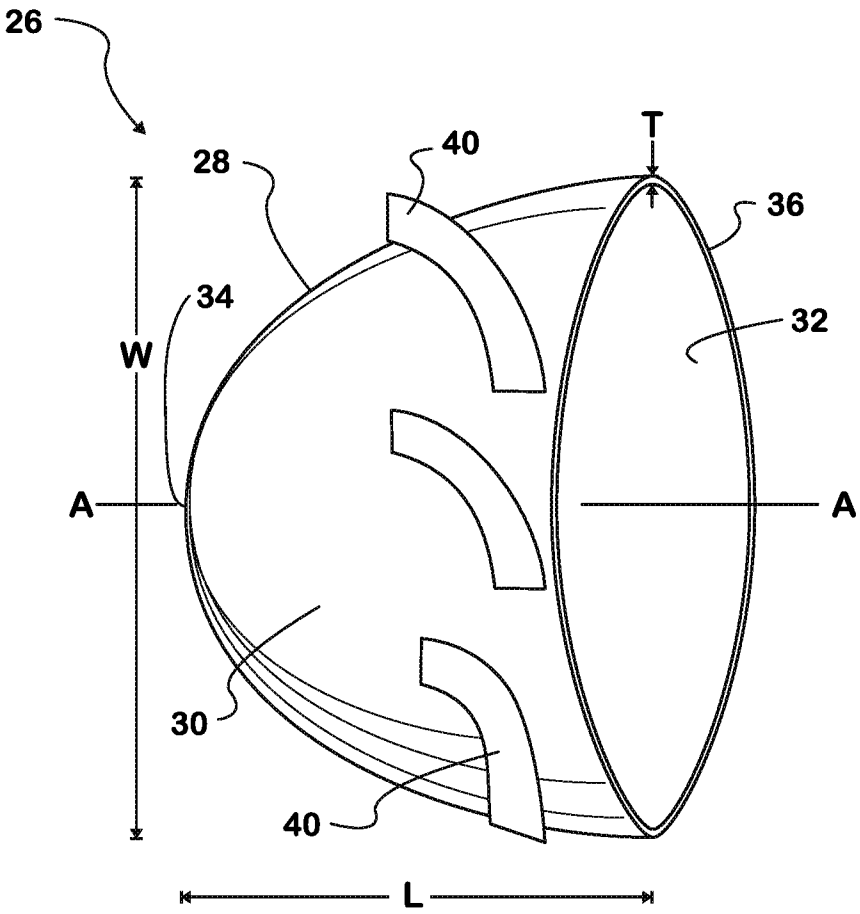

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/029718

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F01P 5/06 (2011.01)
USPC - 123/41.7
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - F01P 5/06, 11/10 (2011.01)
USPC - 123/41.62, 41.7

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 27 22 089 A1 (EGGER) 30 November 1978 (30.11.1978) entire document	1-5, 7-12, 18, 19
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Y		6, 13-17, 20
Y	US 3,727,593 A (ENKE) 17 April 1973 (17.04.1973) entire document	6, 13-17, 20
Y	US 2006/0051209 A1 (LEE et al) 09 March 2006 (09.03.2006) entire document	14
A	US 1,783,085 A (HALFORD) 25 November 1930 (25.11.1930) entire document	1-20
A	DE 679,935 A (SCHILLING) 18 August 1939 (18.08.1939) entire document	1-20
A	EP 0 084 868 A1 (BUDDENHAGEN et al) 03 August 1983 (03.08.1983) entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 May 2011	20 MAY 2011

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774