**Title:** AIR DEFLECTOR FOR CONTROLLING AIRFLOW AROUND A TRACTOR VEHICLE

**Abstract:** The invention relates to an adjustable air deflector (12, 21) for controlling airflow along a tractor vehicle (10), the air deflector (12, 21) comprising an outer wall (13) with a front edge (14), a rear edge (15) and side portions (16). The outer wall (13) is associated with an airflow passage (20) extending between the front edge (14) and the rear edge (15), for conducting airflow through the air deflector. An airflow control valve (24) is adapted to enable regulation of airflow through the passage (20).
AIR DEFLECTOR FOR CONTROLLING AIRFLOW AROUND A TRACTOR VEHICLE

TECHNICAL FIELD

The invention relates to an air deflector for controlling airflow around a tractor vehicle. The invention also relates to a vehicle comprising the air deflector, and methods for actively controlling the air deflector on the vehicle.

BACKGROUND OF THE INVENTION

Commercial vehicles such as trucks are often configured as trailer pulling tractors. The tractor vehicle is provided with a so called "fifth wheel" for coupling to trailers. Often tractor vehicle are utilized for moving different trailers between logistic centres.

Tractor vehicles are normally provided with roof air deflectors and side air deflectors at the rear end of the truck cab for guiding airflow to bridge the gap between the rear end of the truck cab and the front end of the trailer. The height of trailers is not standardized. Thus, roof air deflectors are normally adjustable in angle between a low position suitable for driving without a trailer and a top position adapted to the trailer height.

It will have a negative impact on fuel efficiency and air pollution if the air deflector is not properly adjusted when a tractor truck is switched between trailers of different height or the trailer is uncoupled from the truck so that it is driven without a trailer.

UK patent application GB 2089303 describes an adjustable roof air deflector assembly with automatically adjustable, sensor controlled deflector inclination. However, these systems are expensive involving adjustment mechanisms that need to be robust enough to accommodate for forces induced by both side and head wind.

The weight of this mechanism at the top of a truck roof has a negative influence on both road handling and driver comfort.

Tractor vehicles not intended for long haul service are usually equipped with a driver's cab of medium height. When such a tractor vehicle is used for pulling a high
trailer, the roof air deflector needs to be adjusted accordingly. In this extreme angle of adjustment the air deflector is more exposed to forces induced by wind, or by vibration caused by bad roads.

Side air deflectors may also need to be adjusted when shifting between trailers. Especially, when a truck will be used without a trailer, the side air deflectors should be adjusted to reduce fuel consumption. Similar remote controlled adjustment mechanisms as described here above for roof air deflectors can also be used for side air deflectors. Similar to roof air deflectors, side air deflectors need to be robust, preferably adding a minimum of weight and cost, which is difficult to accomplish.

The actuators and hinges for adjustable air deflectors need maintenance to function properly which adds to the vehicle service cost. When the deflectors do not function properly, fuel consumption usually increases. Bad road conditions may damage air deflectors due to vibrations.

An object of the invention is to provide an improved air deflector arrangement that solves or minimizes the above problems.

INVENTION

The above described problems have been reduced by an air deflector arrangement as claimed in the appended claims.

According to a preferred embodiment, the invention relates to an adjustable air deflector for controlling airflow along a tractor vehicle, the air deflector comprising an outer wall with a front edge, a rear edge and side portions. The outer wall is associated with an airflow passage extending between the front edge and the rear edge, for conducting airflow through the air deflector. An airflow control valve is adapted to enable regulation of airflow through the passage. The arrangement according to the invention with an airflow passage and a control valve for regulation of airflow through the passage makes it possible to have a smaller roof deflector with only a small adjustable part being able to handle trailers of various heights, thus reducing size and weight to minimize dynamic forces on the air deflector.
The air deflector may comprise an inner wall with a front edge, a rear edge and a curved profile section for guiding airflow through the airflow passage 20 at an angle past the rear edge of the outer wall.

Preferably, the rear edge of the inner wall is extended to a point past the rear edge of the outer wall. The front edge of the outer wall can be extended to a point past the front edge of the inner wall.

According to a further example, the airflow control valve is adapted to control the flux area of the airflow passage.

When the air deflector is mounted at the roof of a draft vehicle cab it can be mounted in a fixed position. This simplifies attachment of air deflectors on tractor vehicles as aftermarket equipment.

Preferably, the air deflector is adapted to be mounted in a position in which the front edge of the outer wall extends to a point forward of the cab in the manner of a sun visor, extending at least across an upper portion of the front of the cab. When mounted in this way, the front part of the air deflector can advantageously function as a sun visor.

When a side air deflector is mounted at the side of a tractor vehicle cab it can be mounted in a fixed position. This further simplifies attachment of air deflectors on tractor vehicles as aftermarket equipment.

According to the invention, a tractor vehicle for trailer pulling includes a cab mounted air deflector with an airflow control valve. Airflow control valve adjustment can be controlled by an actuator with input from a sensor for detecting trailer presence and/or trailer height. Also, airflow control valve adjustment can be controlled by an actuator with input from a sensor for detecting a vehicle braking mode.

According to a further example, airflow control valve adjustment can be controlled by an actuator with input from a sensor for detecting ambient air pressure in the vicinity of the vehicle.

A method according to the invention, for adjusting airflow along a tractor vehicle designed for pulling a trailer, wherein the cab of the tractor vehicle is provided with an
adjustable roof air deflector comprising an airflow passage with an airflow control valve, comprises the steps of reducing airflow through the airflow passage if the tractor vehicle is travelling without a trailer, reducing airflow through the airflow passage if the tractor vehicle is pulling with a trailer with a low to medium height, and increasing the airflow through the airflow passage when the vehicle is pulling a trailer with a medium to high height.

According to a further example, a method for adjusting airflow along a tractor vehicle designed for pulling a trailer, wherein the cab of the tractor vehicle is provided with an adjustable side air deflector comprising an airflow passage with an airflow control valve, comprises the steps of reducing airflow through the airflow passage if the tractor vehicle is travelling without a trailer, and increasing the airflow through the airflow passage when the vehicle is pulling a trailer.

The invention as described above is intended for commercial vehicles such as trucks, especially tractor-trailer combinations.

FIGURES

In the following text, the invention will be described in detail with reference to the attached drawings. These schematic drawings are used for illustration only and do not in any way limit the scope of the invention. In the drawings:

Figure 1 shows a schematically indicated perspective view of a commercial vehicle with a roof air deflector arrangement according to the invention;

Figure 2 shows a schematically indicated plan view of a tractor-trailer combination vehicle with a side air deflector arrangement according to the invention;

Figure 3 shows a schematically indicated side view of a tractor-trailer combination vehicle with a roof air deflector arrangement according to the invention show in a first mode of operation;

Figure 4 shows a schematically indicated side view of a tractor-trailer combination vehicle with a roof air deflector arrangement according to the invention show in a second mode of operation;

Figure 5 shows in a similar view as Figure 3, an alternative embodiment of the roof air deflector; and
Figures 6-8 show alternative airflow valve means for controlling airflow through a roof air deflector according to the invention.

DETAILED DESCRIPTION

Figure 1 shows a schematically indicated perspective view of the front end of a commercial, trailer pulling vehicle 10 with a driver's cab 11 on which is mounted a roof air deflector 12 according to the invention. The roof air deflector 12 comprises an outer wall 13 with a front edge 14, a rear edge 15 and side portions 16. The roof air deflector 12 also comprises an inner wall 17 with a front edge 18, a rear edge 19 and a curved profile section. An airflow passage 20 is formed between the outer wall 13 and the inner wall 17, in conjunction with the side portions 16, essentially so that it extends along the entire front of the driver's cab.

The roof air deflector 12 is mounted at the roof of the driver's cab 11 so that the front edge 18 of the curved profile inner wall 17 is positioned substantially at the joint between the cab front and the cab roof. The front edge 14 of the outer wall 13 extends to a point in front of the inner wall front end in the manner of a sun visor. The rear edge 19 of the inner wall 17 extends to a point past the rear edge 15 of the outer wall 13. Thus, the roof air deflector 12 provides an airflow passage extending from an inlet at the front of the cab 11 to an outlet at the rear of the cab. In accordance with the invention, airflow through the passage will be controlled by means of an airflow control valve, which is not shown in Figure 1 but will be described in more detail in the following.

The cab 11 is also provided with a set of side air deflectors 21 extending between the vehicle chassis 22 and the side portions of the roof air deflector 12. Figure 2 schematically indicates a tractor vehicle 10 with a trailer 23 and with side air deflectors 21 shown in section and positioned at each side of the gap between the cab 11 and the trailer 23. In principle, the side air deflectors 21 are similar to the roof air deflector 12, each with outer and inner walls 13, 17 respectively, and with an airflow passage which is controlled by an airflow control valve 24.

As illustrated in Figure 2, opening or closing the valves 24 will have a great effect on the overall aerodynamics of the vehicle combination. At the left side of the vehicle, the airflow control valve 24 of the side air deflector is in a closed position. In this

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position, the airflow along the left side of the cab 11, as indicated by the arrow 25, flows along the outer surface of the outer wall 13, hitting the front of the trailer 23. At the right side of the vehicle, the airflow control valve 24 of the side air deflector is in an open position. In this position, the airflow along the right side of the cab 11, as indicated by the arrow 26, is allowed to pass through the airflow passage. The curvature of the inner wall 17 redirects the airflow to pass without hitting the front of the trailer 23.

When the tractor vehicle 10 is travelling without a trailer, the side air deflectors can be adjusted to close the airflow control valves 24, to reduce air resistance (arrow 25). When this vehicle needs to reduce speed, the side air deflectors can be adjusted to open the airflow control valves 24 to alter the airflow with the effect of presenting a less efficient aerodynamic profile (arrow 26).

Normally though, when the vehicle is travelling with a trailer the airflow control valves 24 should be open to direct the airflow past the front of the trailer (arrow 26). When this tractor-trailer combination needs to reduce speed, the side air deflectors can be adjusted to close the airflow control valves 24 to redirect the airflow to the front of the trailer (arrow 25). In this manner, the adjustable side air deflectors can supplement other brake systems of the tractor-trailer combination to reduce wear on said brake systems, for example when travelling downhill.

Figure 3 and 4 illustrates how the roof air deflector 12 of a tractor vehicle can be adjusted to compensate for trailers of different height. In Figure 3, the tractor vehicle is combined with a trailer 23 of medium height. For this combination, the airflow control valve 24 is normally set in a closed mode, allowing the airflow to flow along the outer surface of the outer wall 13 to pass over the top of the trailer 23 according to arrows 27 and 28. When this vehicle combination needs to reduce speed, the roof air deflector 12 can be adjusted to open the airflow control valve 24 to alter the airflow with the effect of presenting a less efficient aerodynamic profile.

When this tractor vehicle travels without a trailer, the airflow control valve 24 is normally set in a closed mode, allowing the airflow to flow along the outer surface of the outer wall 13. When this vehicle needs to reduce speed, the roof air deflector 12
can be adjusted to open the airflow control valve 24 to alter the airflow with the effect of presenting a less efficient aerodynamic profile.

In Figure 4, the tractor vehicle of Figure 3 is combined with another trailer 23 of more than medium height. For this combination, the airflow control valve 24 is normally set in an open mode, allowing the airflow to flow through the airflow passage 20 (arrow 27), as well as along the outer surface of the outer wall 13 (arrow 28) to pass over the top of the trailer 23. When this vehicle combination needs to reduce speed, the roof air deflector 12 can be adjusted to close the airflow control valve 24 to alter the airflow allowing it to hit the front of the trailer 23.

Figure 4 also illustrates how the curvature near the rear edge 19 of the inner wall 17 guides airflow through the airflow passage 20 at an angle past the rear edge 15 of the outer wall 13, making airflow along the outside of the outer wall 13 deviate upwards. It is clear from this illustration that the airflow control valve 24, if continuously adjustable, will be able to adapt the roof air deflector 12 continuously to trailers of any height between medium and high.

The airflow control valve 24 can be controlled manually by the operator of the vehicle from inside the cab via an electrically controlled actuator (not shown in the drawings). When the operator knows the height of the trailer and the gap distance between the cab and the trailer, the appropriate setting can be drawn from a database. Several different methods for automatically detecting trailer presence and trailer height are well known in the field of the invention, for example air pressure detecting sensors, radar, or digital imaging processing systems can be used for this purpose and need no detailed explanation.

For the side air deflectors 21 of Figure 2, sensors can be used for detecting the amount of side wind that the vehicle experiences and for adjusting the airflow control valves 24 on the cab side air deflectors 21 in order to decrease air drag.

In Figures 2-4, the airflow control valves 24 have been shown to be positioned near the front end of the airflow passage 20. Figure 5 shows an alternative position of the airflow control valve 24 near the rear end of the airflow passage 20. In fact, the airflow control valve can be positioned anywhere along the length of the airflow passage 20.
In Figures 6-8, three different types of airflow control valves 24 are shown. In Figure 6, the airflow control valve 24 is a flap type valve. In Figure 7, the airflow control valve 24 is a centrally hinged butterfly type valve. In Figure 8, the airflow control valve 24 is a "guillotine" or side gate type valve. Any one of these types of valves can be continuously regulated via a suitable actuator, not shown in the drawings.

The invention should not be deemed to be limited to the embodiments described above, but rather a number of further variants and modifications are conceivable within the scope of the following patent claims. For instance, the airflow passage 20 may comprise a plurality of parallel channels for a part of its length or for its entire length. Accordingly, the airflow control valve 20 may comprise a valve arranged in each of said plurality of channels. The plurality of valves can be controlled in unison or individually.

As the air deflector according to the invention is a fixed cab structure, the cab roof can be appropriately designed to compose the inner wall 17 of the roof air deflector 12. Also, the side air deflectors 21 can be designed into the cab structure. Alternatively, the roof or side air deflectors according to the invention can be designed as aftermarket accessories for updating existing vehicles.

In addition to the above described functionality, the air deflector according to the invention can be used for adjusting the airflow to compensate for different distances between the cab and the trailer.
CLAIMS

1. An adjustable air deflector (12, 21) for controlling airflow along a tractor vehicle (10), the air deflector (12, 21) comprising an outer wall (13) with a front edge (14), a rear edge (15) and side portions (16), characterized that the outer wall (13) is associated with an airflow passage (20) extending between the front edge (14) and the rear edge (15), for conducting airflow through the air deflector, and that an airflow control valve (24) is adapted to enable regulation of airflow through the passage (20).

2. An air deflector according to claim 1, characterized in that it comprises an inner wall (17) with a front edge (18), a rear edge (19) and a curved profile section for guiding the airflow through the airflow passage (20) at an angle past the rear edge (15) of the outer wall (13).

3. An air deflector according to claim 2, characterized in that the rear edge (19) of the inner wall (17) is extended to a point past the rear edge (15) of the outer wall (13).

4. An air deflector according to claim 2 or 3, characterized in that the front edge (14) of the outer wall (13) is extended to a point past the front edge (18) of the inner wall (17).

5. An air deflector according to any one of claims 1-4, characterized in that the airflow control valve (24) is adapted to control the flux area of the airflow passage (20).

6. An air deflector according to any one of claims 1-5, characterized in that it is adapted to be mounted in a fixed position at the roof of a tractor vehicle cab (11).

7. An air deflector according to claim 6, characterized in that it is adapted to be mounted in a position in which the front edge (14) of the outer wall (13) extends to a point forward of the cab (11) in the manner of a sun visor, extending at least across an upper portion of the front of the cab.
8. An air deflector according to any one of claims 1-5, characterized in that it is adapted to be mounted in a fixed position at the side of a tractor vehicle cab (11).

9. A tractor vehicle for trailer pulling, characterized in that it includes a cab mounted air deflector with an airflow control valve (24), in accordance to any one of claims 1-8.

10. A tractor vehicle in accordance with claim 9, characterized in that airflow control valve (24) adjustment is controlled by an actuator with input from a sensor for detecting trailer (23) presence and/or trailer height.

11. A tractor vehicle in accordance with claim 9 or 10, characterized in that airflow control valve (24) adjustment is controlled by an actuator with input from a sensor for detecting a vehicle braking mode.

12. A tractor vehicle in accordance with any one of claims 9-11, characterized in that airflow control valve (24) adjustment is controlled by an actuator with input from a sensor for detecting ambient air pressure in the vicinity of the vehicle.

13. A method for adjusting airflow along a tractor vehicle (10) designed for pulling a trailer (23), wherein the cab (11) of the tractor vehicle is provided with an adjustable roof air deflector (12) comprising an airflow passage (20) with an airflow control valve (24), characterized in the steps of reducing airflow through the airflow passage if the tractor vehicle is travelling without a trailer, reducing airflow through the airflow passage (20) if the tractor vehicle (10) is pulling with a trailer (23) with a low to medium height, and increasing the airflow through the airflow passage (20) when the vehicle is pulling a trailer (23) with a medium to high height.

14. A method for adjusting airflow along a tractor vehicle (10) designed for pulling a trailer (23), wherein the cab (11) of the tractor vehicle is provided with an adjustable roof air deflector (12) comprising an airflow passage (20) with an airflow control valve (24), characterized in the steps of reducing airflow through the airflow passage (20) if the tractor vehicle is travelling without a trailer (23), and increasing the airflow through the airflow passage (20) when the vehicle is pulling a trailer (23).
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**IPC:** see extra sheet

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:** B62D

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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

\[I^*\] 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

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Date of the actual completion of the international search: 06-05-2014

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Patent- och registreringssverket

Box 5055

S-1 02 42, STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Goran Carlstrom

Telephone No. +46 8 782 25 00
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