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(54) **Tunnel dust collecting system**

System zum Auffangen von Staub im Tunnel

Système de collecteur pour la poussière dans des tunnels

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(56) References cited:
DE-A- 2 509 279 **FR-A- 2 253 877**

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Description

BACKGROUND OF THE INVENTION

(Field of the Invention)

[0001] This invention relates to a tunnel dust collecting system according to the preamble of the claim. In such a system, an electrical dust collector is used to remove dust and smoke from the contaminated air in a tunnel thereby to use the air again. The tunnel dust collecting system is installed on the ceiling of a tunnel which is provided mainly for automobiles.

(Prior Art)

[0002] A tunnel dust collecting system according to the preamble of claim 1 is known from JP-A-63-319072.

[0003] There are available a variety of tunnel dust collecting systems. Typical ones of the systems, are a tunnel dust collecting system of bypass tunnel type as shown in Fig. 2 (A), and a tunnel dust collecting system of ceiling installation type as shown in Fig. 2(B) and Figs. 3(A) and 3(B). Figs. 3(A) and 3(B) are a plan view and a sectional view of the tunnel dust collecting system shown in Fig. 2(B).

[0004] In the tunnel dust collecting system of bypass tunnel type as shown in Fig. 2(A), a bypass tunnel is connected, as a dust collecting chamber 2, to the main tunnel 1 provided for automobiles, so that the air contaminated in the tunnel 1 is led into the dust collecting chamber at one end opened in the side wall of the main tunnel 1, where it is decontaminated with an electrical dust collector 3 (hereinafter referred to merely as "a dust collector 3", when applicable). The air thus processed is supplied into the main tunnel 1 with an air blower 4 through the other end of the dust collecting chamber 2.

[0005] On the other hand, in the tunnel dust collecting system of ceiling installation type, a ceiling board 5 is installed in such a manner as to form a dust collecting chamber 2 in the upper portion of a tunnel. The dust collecting chamber 2 has one end 2a which is used to suck air from the tunnel (hereinafter referred to as "an air sucking end 2a", when applicable), and the other end 2b which is used to supply decontaminated air into the tunnel (hereinafter referred to as "an air supplying end 2b", when applicable). The contaminated air sucked into the dust collecting chamber 2 through the air sucking end 2a is decontaminated with dust collectors 3, and the air thus decontaminated is supplied into the tunnel with air blowers 4 provided near the air supplying end 2b. When compared with the tunnel dust collecting system of bypass tunnel type, the tunnel dust collecting system of ceiling installation type is advantageous in that its installation cost is lower because it is unnecessary to form the bypass tunnel.

[0006] In the tunnel dust collecting system of ceiling installation type, as shown in Fig. 3, two dust collectors 3 are provided in the dust collecting chamber 2 in such a manner that they are separated from each other with a partition board 6. More specifically, the dust collecting chamber is divided by the partition board 6 into two parts,in which the two dust collectors are provided, respectively. Two axial flow type air blowers 4 with cylindrical casings 4b are provided at the air supplying end 2b of the dust collecting chamber 2, and air sucking inlets 7 are provided at the air sucking end of the dust collecting chamber 2. The air in the upper portion of the tunnel is sucked through the air sucking inlets 7 linearly along the central axis of the tunnel into the dust collecting chamber and decontaminated with the dust collectors 3, and the air thus decontaminated is linearly supplied into the tunnel with the air blowers 4 through air supplying outlets 4a.

[0007] The ceiling board 5 serves as a base board which supports the dust collectors 3 etc. Generally, the ceiling board 5 is extended to the air supplying outlets 4a of the air blowers 4, being utilized as means for making access to the air blowers for inspection or maintenance.

[0008] In the case of Fig. 3, only two dust collectors 3 are provided. However, in the case where more than two dust collectors are employed, they are arranged staggered in the dust collecting chambers from the air sucking end 2a towards the air supplying end 2b.

[0009] The above-described conventional tunnel dust collecting system of ceiling installation type is disadvantageous in the following points lowering its dust collection efficiency. I n the conventional tunnel dust collecting system, as shown in Fig. 3, the air decontaminated by the dust collectors 3 is blown along the central axis of the tunnel 1 into the upper portion of the latter as it is. Therefore, when compared with the tunnel dust collecting system of bypass tunnel type, the decontaminated air is difficult to mix with the contaminated air in the driveway space la of the tunnel 1. In general, in order to completely mix the decontaminated air with the contaminated air, there must be a distance of about 100 m. That is, the interval of installation of the dust collecting systems is limited. Therefore, the conventional system cannot decontaminate air sufficiently in the area where the engine load of an automobile is increased to increase the contamination of air as in an up- grade driveway of an undersea tunnel. The interval of installation of dust collecting systems is determined with the distance taken into consideration with which decontaminated air is completely mixed with contaminated air.

[0010] In the conventional tunnel dust collecting system, the ceiling board 5 is provided below the air blowers 4. Therefore, as shown in Fig. 3(B), the stream of air blown by the air blowers 4 is not smoothly met with the stream of air around it, thus forming eddies 12. As a result, energy loss is caused, and accordingly it is necessary to use high electric power to supply decontaminated air at a predetermined flow rate.

[0011] On the other hand, the space for installation of

a dust collecting system is limited because of limitations in public engineering works. It is desirable to increase the flow rate of decontaminated air as much as possible with the installation space per station decreased as much as possible.

SUMMARY OF THE INVENTION

[0012] Accordingly, a general object of this invention is to provide a tunnel dust collecting system in which these difficulties are eliminated, thereby to improve the cleanliness of the air in a tunnel. This will be described in more detail.

[0013] In particular, an object of this invention is to provide a tunnel dust collecting system with which the distance required for mixing decontaminated air with contaminated air is decreased, so that the number of dust collecting systems per unitary length of a tunnel is increased, whereby the air decontamination degree in the tunnel is improved.

[0014] The foregoing object of the invention has been achieved by a tunnel dust collecting system comprising the features set out in the claim.

[0015] In the system, generally, two air blowers are used. In this case, it is preferable that the air blowing direction forms an cubical angle of 5 to 12° with the central axis of the tunnel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the accompanying drawings:

Figs. 1(A) and 1(B) are a plan view and a longitudinal sectional view, respectively, showing a tunnel dust collecting system according to a first aspect of this invention;

Fig. 1(C) is a cross sectional view taken along line C-C in Fig. 1(B);

Fig. 2(A) is a perspective view showing a typical example of a conventional tunnel dust collecting system of bypass tunnel type;

Fig. 2(B) is a perspective view showing an example of a conventional tunnel dust collecting system of ceiling installation type; and

Figs. 3(A) and 3(B) is a plan view and a longitudinal sectional view of the tunnel dust collecting system of ceiling installation type shown in Fig. 2(B), respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] In the tunnel dust collecting system according to the invention, the decontaminated air blowing direction of the air blowers are set slightly downwardly outwardly with respect to the central axis of the tunnel so as to form spiral air streams in the tunnel thereby to quickly mix the decontaminated air with the contaminated air in the tunnel.

[0018] An embodiment of the invention, a tunnel dust collecting system, will be described with reference to Figs. 1(A) through 1(C).

[0019] As shown in Fig. 1, a ceiling board 5 having a predetermined length is installed in a tunnel 1 to form a dust collecting chamber 2 in the upper portion of the tunnel. In the figure, the left end of the dust collecting chamber 2 is an air sucking end 2a, and the right end is an air supplying end 2b. Two dust collectors 3 are arranged along the right and left side walls of the dust collecting chamber 2, respectively, in such a manner that they are positioned staggered in the dust collecting chamber 2, or they are arranged as if overlapped as viewed from the air sucking end of the dust collecting chamber. The dust collecting chamber 2 is separated into two right and left air flow chambers with a partition wall 6 extended along the central axis of the dust collecting chamber 2 in such a manner that the right and left air flow chambers have the two dust collectors 3, respectively. Two axial-flow type air blowers 4 are connected to the right and left air flow chambers at the air supplying end. Each of the air blowers 4 comprises a cylindrical casing, and an impeller and a drive motor which are built in the casing. Each of the air blowers 4 has an air supplying outlet 4a with a nozzle 13 for determining its air blowing direction. The nozzles 13 are directed slightly downwardly outwardly with respect to the central axis of the tunnel 1.

[0020] When the tunnel dust collecting system thus constructed is operated, the contaminated air in the driveway space la in the tunnel 1 is led into the dust collecting chamber 2 through the air sucking inlets 7 at the air sucking end 2a. The contaminated air thus led is decontaminated with the dust collectors 3. The air thus decontaminated is supplied into the driveway space la through the nozzles 13 of the air blowers 4. In this operation, since the nozzles are directed downwardly outwardly with respect to the central line of the tunnel 1 as was described before, the decontaminated air blown through the nozzles 13 forms a pair of spiral air streams in the driveway space la as indicated by the broken lines in Fig. 1. As a result, the decontaminated air supplied through the nozzles mixes with the contaminated air in the driveway space la in a short time while winding the latter. It has been confirmed through experiments that the distance required for the decontaminated air to mixed with the contaminated air in the driveway space is shorter about 10% than in the conventional tunnel dust collecting system.

[0021] As is apparent from the above description, the tunnel dust collecting system of the invention has the following effects or merits:

[0022] According to the invention, the nozzle is connected to the air outlet of each of the air blowers in such a manner that the decontaminated air is blown downwardly outwardly with respect to the central axis of the tunnel. As a result, the distance is reduced which is required for the decontaminated air supplied from the dust

collector to mix the contaminated air in the tunnel, and accordingly the number of dust collecting systems per unitary length of a tunnel can be increased as much. Thus, with the tunnel dust collecting system of the invention, even a tunnel high in air contamination can be sufficiently ventilated.

Claims

1. A tunnel dust collecting system comprising:

   a dust collecting chamber (2) formed in the upper space of a tunnel (1) with a ceiling board (5) in such a manner that said dust collecting chamber has one end serving as an air sucking end (2a) and the other end serving as an air supplying end (2b);

   electric dust collectors (3) arranged in said dust collecting chamber (2), and air blowers (4) in said dust collecting chamber (2) at the air supplying end (2b); and

   air discharge directing means directing the decontaminated air slightly downwardly and outwardly with respect to the central axis of said tunnel,

   characterized in that

   the said discharge directing means is a nozzle (13) connected to the air outlet (4a) the nozzle (13) being directed slightly downward and outward with respect to the central axis of the said tunnel.

Patentansprüche

1. Ein System zum Aufsammeln von Staub in einem Tunnel mit:

   einer Staubsammelkammer (2), die im oberen Raumbereich eines Tunnels (1) mit einer Dekkentafel (5) so gebildet ist, daß die Staubsammelkammer ein Ende besitzt, das als ein Luftansaugende (2a) dient, und daß das andere Ende als ein Lufteinspeisungsende (2b) dient;

   in der Staubsammelkammer (2) angeordnete elektrischen Staubsammlern (3), und Luftgebläsen (4) in der Staubsammelkammer (2) am Lufteinspeiseende (2b); und

   einer Luftauslaß-Lenkvorrichtung, die die gereinigte Luft leicht nach unten und außen mit Bezug zu der zentralen Achse des Tunnels lenkt,

   dadurch gekennzeichnet, daß

   die Auslaß-Lenkvorrichtung eine Düse (13) ist, die mit einem Luftauslaß (4a) verbunden ist, wobei die Düse (13) bezüglich der zentralen Achse des Tunnels leicht nach unten und außen gerichtet ist.

Revendications

1. Système de collecte de poussière dans un tunnel, comportant :

   une chambre de collecte de poussière (2) formée dans l'espace supérieur d'un tunnel (1) avec une plaque de plafond (5) d'une manière telle que ladite chambre de collecte de poussière a une extrémité qui sert d'extrémité d'aspiration d'air (2a) et l'autre extrémité qui sert d'extrémité d'alimentation en air (2b),
   des collecteurs de poussière électriques (3) disposés dans ladite chambre de collecte de poussière (2), et des ventilateurs d'air (4) dans ladite chambre de collecte de poussière (2) au niveau de l'extrémité d'alimentation en air (2b), et
   des moyens d'orientation d'évacuation d'air qui dirigent l'air décontaminé légèrement vers le bas et vers l'extérieur par rapport à l'axe central dudit tunnel,

   caractérisé en ce que

   lesdits moyens d'orientation d'évacuation d'air sont constitués par une bouche (13) reliée à la sortie d'air (4a), la bouche (13) étant orientée légèrement vers le bas et vers l'extérieur par rapport à l'axe central dudit tunnel.

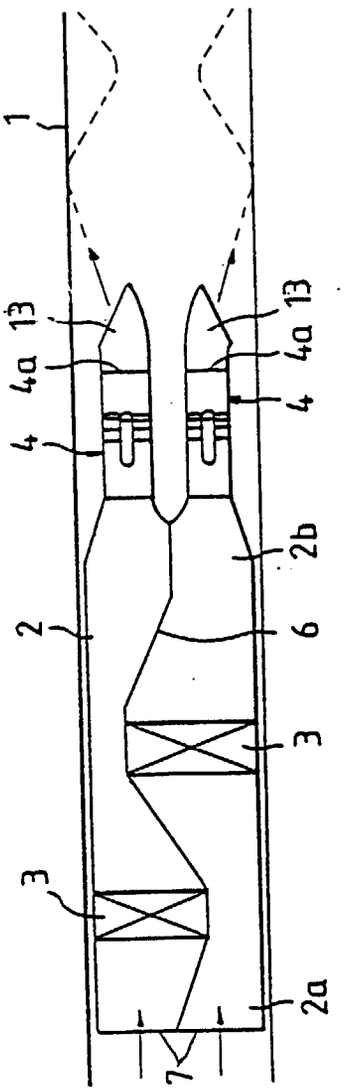

FIG. 1(A)

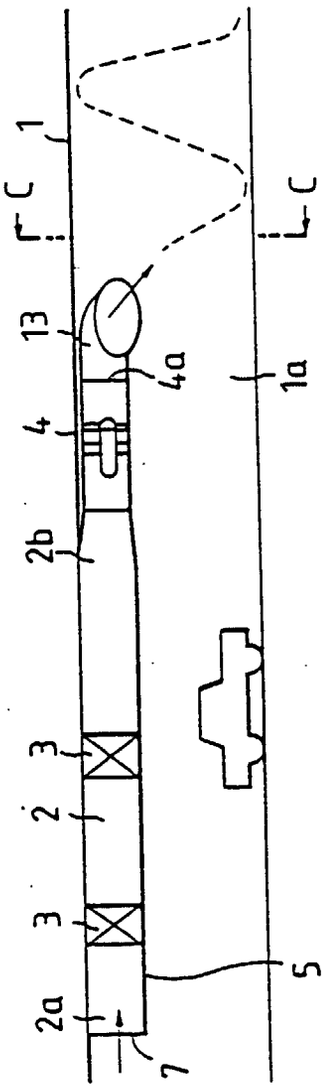

FIG. 1(B)

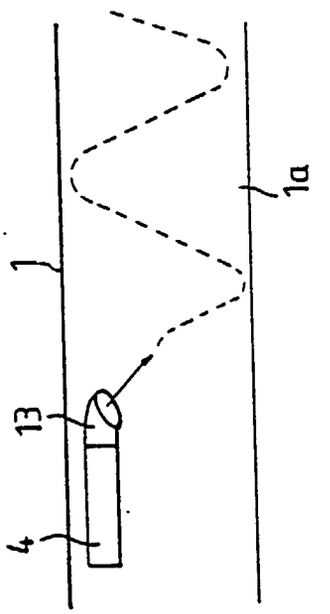

FIG. 2

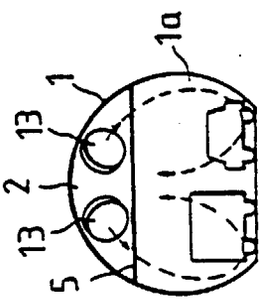

FIG. 1(C)

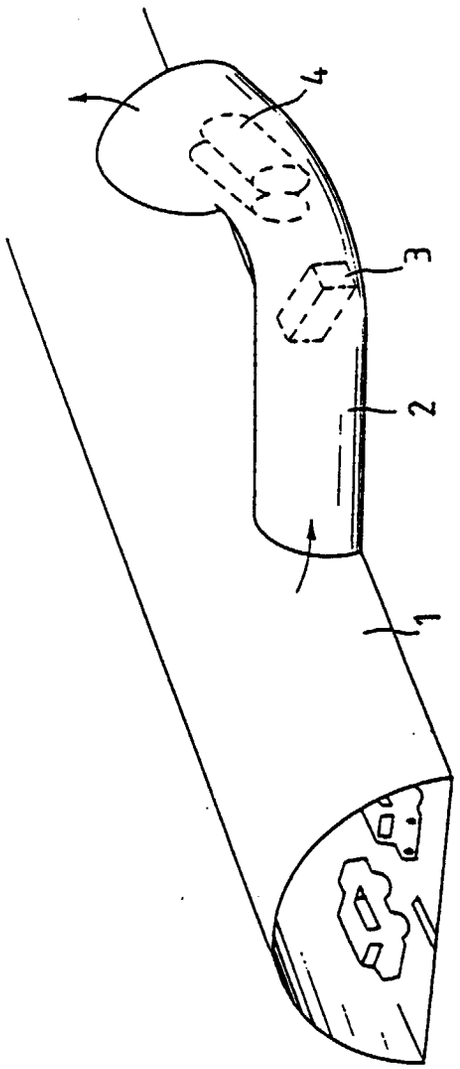

FIG. 2(A)

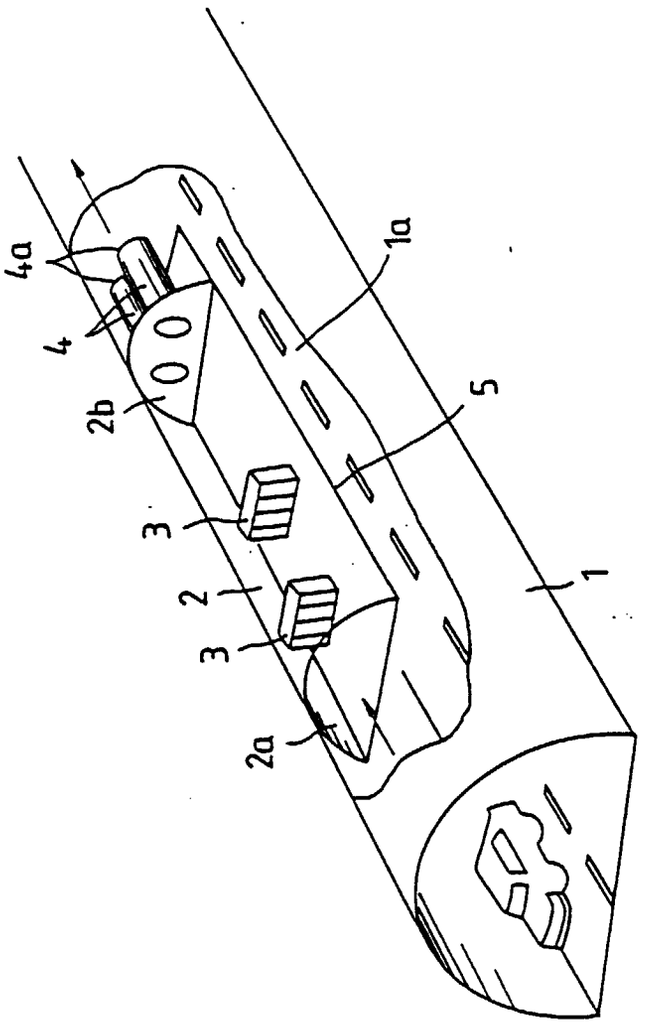

FIG. 2(B)

FIG. 3(A)

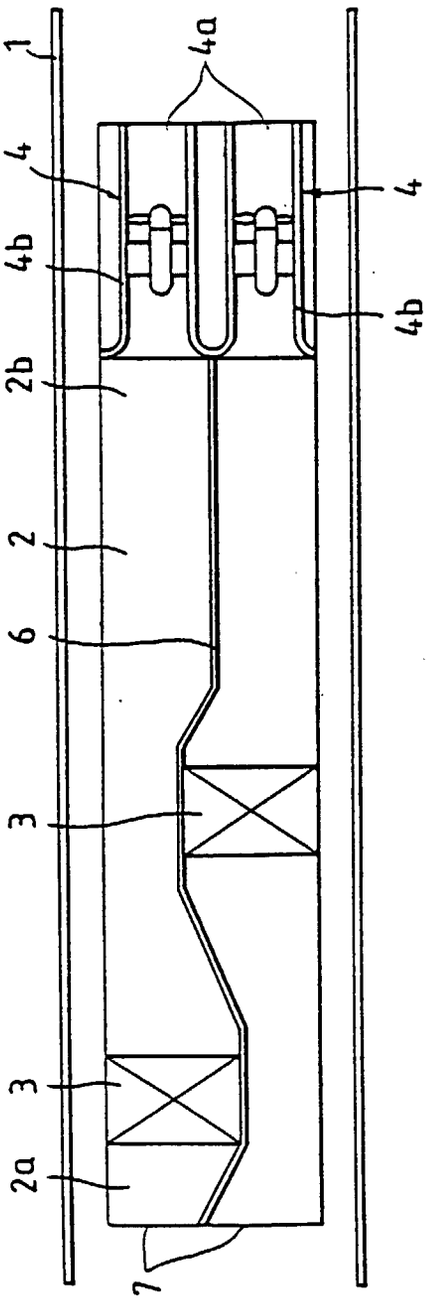

FIG. 3(B)