Sept. 9, 1947. O. SINGSTAD ET AL 2,427,075

TRAFFIC TUNNEL AND METHOD OF TUNNEL VENTILATION

Filed July 11, 1944

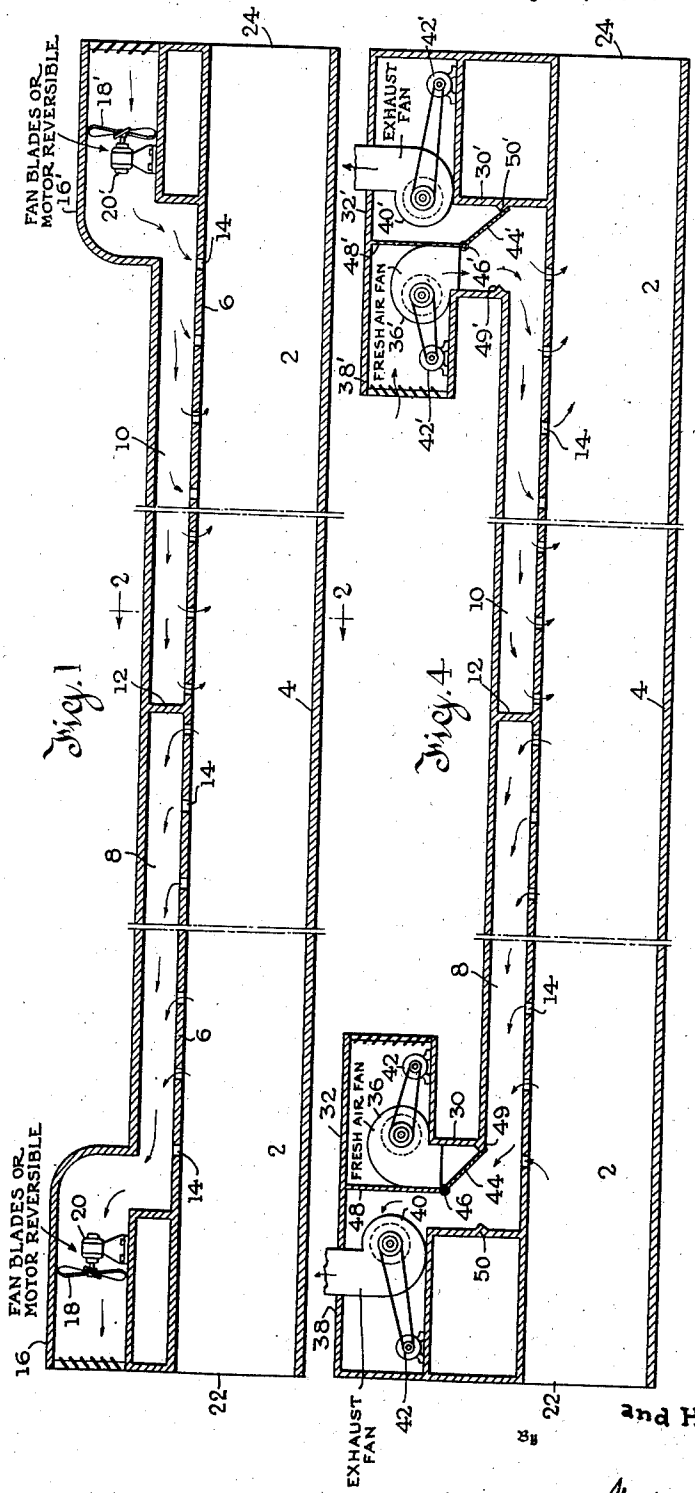


Fig. 1

Fig. 4

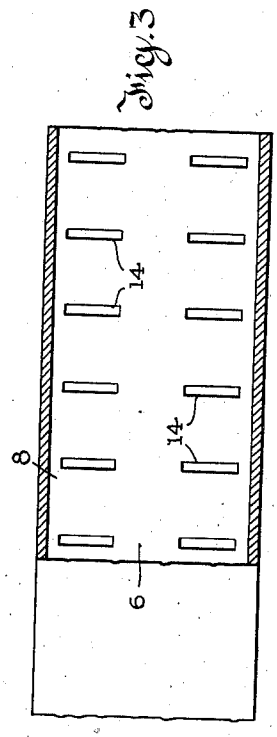


Fig. 3

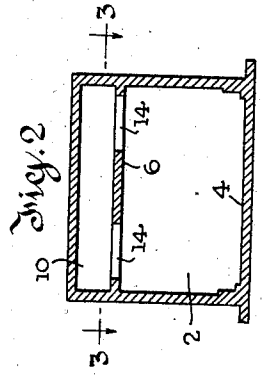


Fig. 2

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Patented Sept. 9, 1947

2,427,075

UNITED STATES PATENT OFFICE

2,427,075

TRAFFIC TUNNEL AND METHOD OF TUNNEL VENTILATION

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Application July 11, 1944, Serial No. 544,430

7 Claims. (Cl. 98—49)

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This invention is for an improved method or system for ventilating traffic tunnels, and also for a novel and improved type of tunnel construction.

In traffic tunnels, which are used almost exclusively by motor cars propelled by engines of the internal combustion type, it is of the utmost importance that a suitable amount of fresh air be supplied at all times to the various parts of the tunnel and that the smoke and combustion gases from the vehicles (containing poisonous carbon monoxide) be exhausted as quickly as possible.

In cylindrical, subaqueous tunnels, such, for example, as the Holland Tunnel in New York city, it is the accepted practice to make use of the top and bottom portions of the cylinder to provide two ducts, one beneath the roadway for supplying fresh air and the other in the roof over the ceiling of the roadway for exhausting said smoke and combustion gases.

However, the cost of excavating a cylindrical tunnel or other type of two-duct tunnel through a hill or mountain would be high as compared with the cost of constructing a tunnel having a flat floor or roadway, because of the additional amount of rock and earth required to be removed for the construction of a duct beneath the roadway corresponding to the lower duct of a cylindrical tunnel. According to the present invention, it is possible to achieve adequate ventilation of a tunnel by the provision of dual purpose ventilating ducts located over or alongside the roadway. It is an important feature of our invention, therefore, not only to provide dual purpose, ventilating ducts without excavating beneath the roadway, but also to provide means for using these ducts separately or together for forcing air into the tunnel or for exhausting the gas and smoke from the tunnel, as conditions require and as hereinafter described.

In the tunnel of the present invention, gases are exhausted from one section of the tunnel roadway through a duct, fresh air entering the roadway at one end of the tunnel; the second or remaining section of the tunnel has fresh air supplied thereto by its ventilating duct, the gases being exhausted through the roadway at the other end of the tunnel. However, the air flow in either duct may be reversed, and this feature is especially important in the case of fire. If a fire should occur in the tunnel, especially in that section where fresh air is coming into the tunnel from the duct, such incoming air would spread the smoke all through the tunnel driveway; accordingly, the air flow should be immediately reversed in such a section and the smoke and gases from the fire would then be carried out of the

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tunnel through the adjacent ventilating duct, used as an exhaust duct.

More specifically, the tunnel of the present invention is ventilated by a ventilating duct extending for the length of the tunnel; however, this duct is divided into two parts, and each part may be used to exhaust gases from its section of the tunnel, or to supply fresh air to its section of the tunnel, as may be necessary or desirabe, suitable means being provided for reversing the air flow in the ducts, as will be described. In that section of the tunnel subjected to exhaust, fresh air enters the tunnel roadway at the adjacent mouth of the tunnel; in that section of the tunnel where fresh air is supplied by means of the duct, the exhaust gases pass out of the tunnel roadway at the other mouth thereof.

The tunnel of the present invention will handle one-way traffic or two-way traffic. Where the tunnel is handling one-way traffic, the entrance section would be subject to exhaust, and fresh air would enter with the traffic; the second or exit section would be supplied with fresh air by means of the duct and the gases would leave the roadway at the other end of the tunnel. The direction of air flow would be in the same general direction as the flow of traffic in both parts of the tunnel.

This same system would also handle two-way traffic. However, with two-way traffic, both ventilating ducts could be used as exhaust conduits, in which case fresh air would enter the tunnel at both ends and flow toward the mid-portion of the tunnel, the exhaust gases being carried away by the exhaust ducts; or one duct could be used as an exhaust conduit and the other as a blower, air entering at one end of the tunnel driveway being exhausted at the other end thereof.

The invention will now be further described in more detail in connection with the accompanying drawings illustrating, more or less diagrammatically, how the invention may be practiced.

In these drawings:

Fig. 1 is a vertical longitudinal section of the tunnel of the present invention, diagrammatically illustrating its main features;

Fig. 2 is a transverse cross section of the tunnel, on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary plan view, on line 3—3 of Fig. 2; and

Fig. 4 is a vertical longitudinal section of the tunnel, showing another way of carrying out the invention.

Referring now to these drawings, the traffic tunnel 2 comprises a roadway 4 and a roof or ceiling 6. Extending lengthwise of the tunnel, conveniently in the roof thereof, is a ventilat-

ing duct 8 and a second ventilating duct 10, the two ducts being defined by the partition or bulkhead 12 and being preferably coaxial. The roof or ceiling 6 of the tunnel is provided with openings 14 connecting the tunnel with the ventilating ducts 8 and 10. While the ventilating ducts are shown in the roof, it should be understood that any other suitable location could be used.

Ventilating duct 8 communicates with any suitable means for exhausting air from the duct or for supplying fresh air to the duct, as may be desired. For example, duct 8 may communicate with a fan housing 16 provided with a propeller type of fan 18 driven by a motor 20. As shown in Fig. 1, this fan is operating as an exhaust fan, exhausting air from that section of the tunnel between one end 22 of the tunnel, and the partition 12. In order to reverse the air flow and cause the fan 18 to supply fresh air to this same section of the tunnel, the fan blades may be reversed, the direction of rotation of the motor 20 may be reversed, or a reversing gear could be used between the motor and the fan, as will readily be understood by one skilled in the art.

A similar fan assembly is installed near the other end 24 of the tunnel, corresponding parts being indicated by primed reference characters. However, in the right hand section of the tunnel, the fan 18' is shown as operating as a blower or pressure fan for supplying fresh air to duct 10 and thence to the tunnel in that section between partition 12 and the other end 24 of the tunnel.

Assuming that cars are entering the left hand end 22 of the tunnel, the combustion gases given off by the cars will be drawn off through the exhaust duct 8 and out of the fan housing 16. This exhausting of the air through the roof of the tunnel will draw in fresh air at the entrance 22 of the tunnel, and this fresh air will move along in the same general direction as the traffic. That section of the tunnel from the partition 12 to the other end 24 is supplied with fresh air from the fan 18' through the duct 10 and the openings 14 in the roof of the tunnel, this fresh air moving along with the cars in the general direction of the traffic, the gases being delivered to the atmosphere through the right hand end 24 of the tunnel.

The tunnel just described could be used for either one-way or two-way traffic. If used for one-way traffic, the general direction of flow of the fresh air coming in at the left hand end, through the mouth of the tunnel, and the general direction of flow of the fresh air coming in through the roof of the tunnel, in the right hand end, are both in the general direction of the flow of traffic.

If the tunnel is handling two-way traffic, one lane would be travelling with the incoming fresh air, while the other lane would be going against the incoming fresh air, but in each case fresh air is being supplied and the combustion gases are being carried out of the tunnel, so that the harmful gases never exceed safe limits. Similarly, in the right hand section of the tunnel, one lane of traffic would be travelling with the fresh air that has come in from the duct 10 and is moving out toward the mouth 24, while the other lane of traffic would be travelling more or less against this air, but in any case the cars would be supplied with the proper amount of fresh air and the combustion gases would be carried out of the end 24. If desired, both ducts 8 and 10 could be used as exhaust conduits, by operating the fans in the proper direction, in which case fresh air would enter the tunnel at each end and flow inwardly, the exhaust gases being carried out the roof through the ducts 8 and 10.

An important feature of this invention lies in the provision of means whereby the air flow in either ventilating duct may be quickly reversed. This feature is of particular value in case of fire, as already stated, and as experience with tunnel ventilation has demonstrated. If, for example, a fire should occur in the right hand section of the tunnel below the duct 10, the air flow in duct 10 could be quickly reversed and the smoke and flames thereby exhausted through the roof of the tunnel and out through fan housing 16'. If, on the other hand, a fire should occur in that section of the tunnel below the duct 8, the normal exhaust through the roof would take care of the smoke and flames in that section; and, finally, if the fire were to occur near the partition 12, it would be possible quickly to reverse the air flow in duct 10 and thus carry away any smoke and flames that reach over into that section of the tunnel. In short, our improved method of ventilation is completely flexible and capable of meeting all contingencies successfully.

Another advantage of being able to reverse the flow in the ducts 8 and 10 is this: If the tunnel shown in Fig. 1 is for one-way traffic from left to right, the air flow would be as indicated, 8 acting as an exhaust duct and 10 as a fresh air duct, and the air flow would be in the same general direction as the traffic flow; however, if it should be necessary or advisable to have this tunnel carry one-way traffic in the opposite direction—that is, from right to left—the air flow in the two ducts would be reversed, 10 becoming an exhaust duct and 8 a pressure duct, in which case the general direction of air flow in both sections of the tunnel would still be in the same direction as the traffic flow.

In actual practice, it is proposed to use both an exhaust fan and a fresh air fan for each section of the tunnel, as shown in Fig. 4, the reversing of the air flow being accomplished by shutting off one fan and operating the other, and by providing suitable dampers for connecting the ventilating ducts with one fan or the other.

Referring now to Fig. 4, conduit 8 connects with a passage 30, communicating either with housing 32 for a pressure fan 36, or with a housing 38 for an exhaust fan 40, these fans being of any desired type and driven by any suitable type of motors or engines 42. A movable damper 44 pivoted at 46 at the lower edge of the partition 48 between the fan housings can assume either of two positions against the stops 49 and 50 for respectively connecting the exhaust fan or the fresh air fan, as the case may be, with the conduit 8. As shown in Fig. 4, the exhaust fan 40 is connected with the conduit 8, and its motor would be running, while the fresh air fan 36 is shut off from conduit 8 and its motor would be stopped. To reverse the air flow, the motor for fan 40 would be stopped, the motor for fan 36 would be started, and the damper shifted to connect fan 36 with conduit 8.

A precisely similar arrangement is shown at the other end of the tunnel, and corresponding parts are indicated by primed reference characters. However, at the right hand end of Fig. 4 the fresh air fan is operating and is in communication

with the duct 10, while the exhaust fan is stopped and is shut off from the conduit by damper 44'. The air flow is reversed by stopping one motor and starting the other and by shifting the damper 44' to the other position.

The air flow in the tunnel is as described in connection with Fig. 1; namely, one section, the section shown at the left, is supplied with fresh air coming in through the mouth 22 of the tunnel, while smoke and combustion gases are drawn off through the roof by conduit 8. In the other section of the tunnel, fresh air comes in through the conduit 10, thence into the tunnel, and the smoke, air and combustion gases leave the tunnel at the end 24. The air flow in either conduit 8 or 10 may be reversed simply by shifting the damper 44 or 44' to the other position and by starting up one fan and shutting down the other.

It will, of course, be understood that in large tunnels or duplicate, side-by-side tunnels, several exhaust fans and several pressure fans may be used at each end of the tunnel, in installations duplicating the installations described herein, as may be required to supply sufficient cubic feet of air per minute, in accordance with the number of cars and trucks that the tunnel is designed to handle.

The tunnel construction, and the method of tunnel ventilation, of the present invention, are of general application, and may be used in other types of tunnels, such, for example, as subways and railway tunnels.

Various details of construction and operation, which will be readily understood by those skilled in the art, are not shown in detail in the drawings, which, as has been said, are largely diagrammatic.

While the preferred ways of carrying out the invention have been illustrated, it should be understood that the disclosure is illustrative and not restrictive of the invention, and that it may be carried out in other ways.

We claim as our invention:

1. A traffic tunnel, provided with a pressure duct and an exhaust duct, both located in the upper portion of the tunnel, each duct extending only for a portion of the length of the tunnel and each being in communication with its adjacent portion of the tunnel, the two ducts together extending for substantially the full length of the tunnel, said ducts being independent of each other, whereby air under pressure in the pressure duct cannot flow through into the exhaust duct, means for supplying air under pressure to said pressure duct, and means for exhausting air and gases from said exhaust duct.

2. A traffic tunnel, provided with a pressure duct and an exhaust duct, both located in the upper portion of the tunnel, each duct extending only for a portion of the length of the tunnel and each being in communication with its adjacent portion of the tunnel, the two ducts together extending for substantially the full length of the tunnel, said ducts being independent of each other, whereby air under pressure in the pressure duct cannot flow through into the exhaust duct, means for supplying air under pressure to said pressure duct, means for exhausting air and gases from said exhaust duct, and means for effecting a reversal of gas flow in said pressure duct, whereby, in the event of fire or other necessity, gas and smoke can be exhausted through this duct.

3. In a traffic tunnel which is provided with independent pressure and exhaust ventilating ducts in the upper part thereof, each duct extending only for a portion of the length of the tunnel and each duct being in communication with its adjacent portion of the tunnel, the method of ventilating such a tunnel, comprising exhausting gas and air from one section of the tunnel through the exhaust duct, thereby causing fresh air to flow into this section of the tunnel through the adjacent open end thereof, and supplying fresh air under pressure to the other section of the tunnel through the pressure duct, thereby causing air and gas in said other section to pass out of the tunnel through the other open end thereof.

4. The method as set forth in claim 3, comprising the additional step of reversing the air flow in the pressure duct in the event of fire or other necessity in the adjacent portion of the tunnel.

5. In a traffic tunnel which is provided with independent pressure eand exhaust ventilating ducts in the upper part thereof, each duct extending only for a portion of the length of the tunnel and each duct being in communication with its adjacent portion of the tunnel, the method of ventilating such a tunnel, where the tunnel is handling one way traffic, comprising exhausting air and gas from that section of the tunnel handling entering traffic, through said exhaust ventilating duct, fresh air meanwhile entering the tunnel with such traffic, and supplying fresh air under pressure to the other section of the tunnel, through which traffic leaving the tunnel is passing, the air and exhaust gas meanwhile leaving the tunnel with the traffic leaving the tunnel, the flow of air and gas in both sections of the tunnel being in the same general direction as the flow of traffic in both of said sections of the tunnel.

6. The method as set forth in claim 5, comprising the additional step of reversing the air flow in the pressure duct in the event of fire or other necessity in the adjacent section of the tunnel.

7. A traffic tunnel, comprising independent ventilating ducts, each located in the upper portion of the tunnel and each extending only for a portion of the length of the tunnel and each being in communication with its adjacent portion of the tunnel, said ducts being independent of each other, whereby air under pressure in the pressure duct cannot flow through into the exhaust duct, a pair of fans, one a pressure fan and the other an exhaust fan, positioned near each end of the tunnel, in cooperative relation with the ventilating duct at that end of the tunnel, the fans of a given pair of fans being alternately operable, so that only one fan of each pair is operated at a time, and means including dampers for selectively connecting one of each pair of fans to the adjacent ventilating duct.

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