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(54) **Process for the ventilation of road tunnel**

(57) A process for the ventilation of the road tunnels is performed so that the tunnel is partitioned with horizontal barriers 1 in the form of declined ceiling, longitudinal at the high of 4.5 to 4.7 meters from the roadway, and with two vertical barriers 2 forming thus three longitudinal channels. The channels are provided with electro-motoric fireproof jalousies 4 incorporated in horizontal barrier 1. In the case that the fire occurs in the tunnel, by the switching operation regime from automatic to manual, and by the controlling of the fan operation for exhausting or supplying the air into side channels 3 and middle channel 7, and by the controlling of the closing and opening of the jalousies 4, it is achieved that:

- there is no propagation of the smoke and fire out of controlled area (distance between two jalousies of about 50 to about 100 meters);
- efficacious acting of stable system for the extinguishing is obtained, because there is no along air

streaming and new air supplying to the fire place, thus self-extinguishing occurs because of reduced amount of oxygen;

- quick and safe evacuation of the people from the tunnel is provided, and undisturbed arrival of the saviours next to the fire place is ensured;
- there is no need for the building of special shelters in the tunnel for the people;
- we have very elastic system functioning for fans and jalousies regulation;
- maintenance of the equipment is possible during the traffic in the tunnel;
- the fans are accommodated outside of the tunnel in the engine-room next to the transformer station;
- damages on the equipment in the tunnel arise only in the area of fire emergence; and
- damages on the ventilation equipment, after fire was extinguished, are only on the jalousies (jalousies drive) of nearest place to the fire.

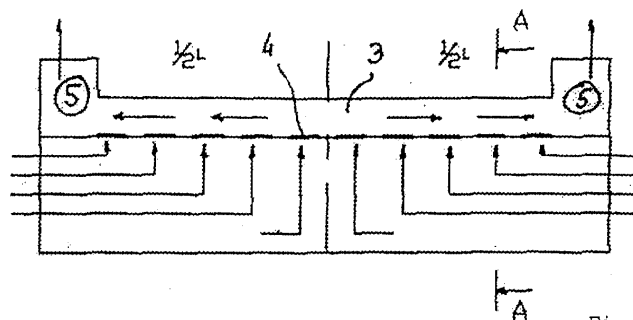


Fig. 1

## Description

**[0001]** Invention claimed for patent protection according to the International patent classification is classified into the group A 62 C 39/00 embracing the processes, equipment and accessories for fire extinguishing, which are not predicted in the other groups.

**[0002]** Road tunnels in normal use have to be provided with a possibility of the ventilation by means of natural or forced means, as to make possible air exchange in a tunnel and the maintenance of the purity parameters (contamination) in permissible limits. Because of that, the ventilation systems (for example axial fans) supporting an air circulation through the tunnel are incorporated into the tunnels.

**[0003]** By means of the contamination testing and reaching the upper permissible limit, a ventilation system forcing the circulation throws a fresh outside air into the tunnel and reduces the contamination of the air in the tunnel is switched on.

**[0004]** Such or similar ventilation system functions are satisfactory until the moment when the fire occurs in the tunnel. In this moment, because of combustible materials amount on the place of fire occurrence (vehicles, fuels, cargo and others), appears the rapidly propagation of the fire, causing rapidly temperature increasing and very strong air streaming in the tunnel, what renders difficult people saving and localization of the fire. Because of complicated vehicle evacuation (returning and going out of the tunnel) and, today also, because of the tunnels length, as well the big traffic in the tunnels, the arrival of the saviors to the place of fire occurrence and its localization is very difficult. Because of that, the fires cause enormous material damages, long time is needed for repairing the tunnel for the use, traffic is difficult in the area where the tunnel is out of the use and large is the number of human victims.

**[0005]** Enclosed figures illustrate:

figure 1 represents normal regime in longitudinal cross section through the side exhausting channel of the tunnel,

figure 2 shows cross section on the line A-A of the figure 1,

figure 3 shows a normal regime in longitudinal cross section through the middle pressure channel of the tunnel,

figure 4 shows a cross section on the line B-B of the figure 3,

figure 5 shows a fire regime in longitudinal cross section of the tunnel,

figure 6 shows a cross section on the line C-C of the figure 5,

figure 7 shows a cross section on the line D-D of the figure 5.

**[0006]** In order to avoid aforementioned drawbacks in the case of a fire occurrence in the tunnel, there is provided a process for the ventilation of the road tunnel in such a way that the tunnel is longitudinal provided with declined ceiling, horizontal barrier 1 at the high of 4.5 to 4.7 m above roadway, and the space above ceiling is

partitioned longitudinal by two vertical barriers 2 in tree longitudinal channels. The air is exhausted by means of the side channels 3, electro-motor and fireproofed jalousies 4 incorporated into horizontal barrier 1 of declined ceiling, the gases and smoke from the tunnel are discharged over the front of the tunnel into atmosphere, being purified in the filtering devices, respectively. The jalousies 4 are incorporated on a distances from about 50 to 100 meters, with an exception at the beginning of the tunnel, where the first jalousies are built on about 100 meters from the tunnel beginning. On the both ends of the tunnel, i.e. on the each longitudinal side channel, on the both side of the tunnel, special axial fans 5 are incorporated, built for the operation at elevated temperatures and for contaminated air with increased content of the gases, particles and water drops. The frequent regulators regulate a number of the revolutions of the fan 5, whereby continue regulation of its capacity is provided according to the requirements for the air purity in the tunnel. The exhausting is proceeded through the side channels 3 and that for  $2 \times 50 \% = 100 \%$  of in the ventilation project required amount of the air.

**[0007]** A throwing of the air into the tunnel is achieved as follows:

- 50 % by means of the fans through middle channel 7 into middle part of the tunnel,
- 50 % enters because of the underpressure exhausting fans 5, free through the front openings of the tunnel.

**[0008]** System functions automatic controlled by the computer program. The fans 6, incorporated into middle channel 7, can operate reversible, what means they can operate as exhausting and also as pressuring fans.

**[0009]** During the fire in the tunnel, ventilation has also a second function, different from the above mentioned, and it must ensure:

- discharging the smoke and gases out of the zone of the fire P,
- supplying the fresh air direct to the fire, but so that air hanging is formed preventing the smoke and fire propagation along the tunnel, for the purpose of free access for the saviors to the injured, as well for the evacuation of the people out of this part of the tunnel.

**[0010]** By the limiting of the fire propagation onto relatively small part of the tunnel (this length depends on the incorporated ceiling jalousies 4), it is possible to use the efficacious stabile systems for the fire extinguishing in this part of the tunnel, as well for the extinguishing by means of water haze, water, gas CO<sub>2</sub> and similar. Efficient

canouse alarm system is very important for correct and quick locate of the fire. The following operating process in the tunnel enables to the operator:

- a switching the automatic ventilation system operation to a manual regime, for the adjusting the optimal parameters of smoke and gases exhausting, and for fresh air supplying; 5
- the fans 5 in the side channels 3 are regulated according to the maximum exhausting depend on development of the situation on the fire place; 10
- in the middle channel 7 the fans act as exhausting, pressuring respectively, depending on the place of fire in the tunnel. The fan 6 on the side of tunnel, which is closer from the fire place to the exit, acts as exhausting, and the fan 6 on the side of tunnel, which is more distant from the fire place to the exit, acts as pressuring fan. 15

**[0011]** Thereby is avoided uncontrolled air streaming toward the fire; 20

- in the channels acting as exhausting channels (side channel 3 and middle channel 7), only the jalousies 4 next to the fire place are open, while all others are hermetic closed; 25
- in the channels acting as pressuring channels (middle channel 7), second, third and fourth jalousies 4 from the fire place toward the exit of the tunnel are open, while all others are hermetic closed because of controlled regulation of the air streaming in the tunnel. 30

**[0012]** With such process of road tunnel ventilation can be is achieved that: 35

- there is no smoke and fire propagation out of controlled aria (distance between two jalousies from about 50 to about 100 meters);
- efficacious acting of stable system for extinguishing is obtained, because there is no longitudinal air streaming and new air supplying to the fire place, thus self-extinguishing occurs because of reduced amount of oxygen; 40
- quickly and safe evacuation of the people from the tunnel is provided, and undisturbed arrival of the saviours is ensured next to the fire place; 45
- there is no need for the building of special shelters in the tunnel for the people;
- maintenance of the equipment is possible during the traffic in the tunnel; 50
- the fans are accommodated outside of the tunnel in the engine-room next to the transformer station;
- damages on the equipment in the tunnel arise only in the aria of fire emergence; and 55
- damages on the ventilation equipment, after fire was extinguished, are only on the jalousies, on the nearest place to the fire.

## Claims

1. A process for the ventilation of road tunnel, characterized by that the tunnel is partitioned with longitudinal horizontal barrier (1) in the form of declined ceiling at the high of 4.5 to 4.7 m above roadway, and with two vertical barriers (2) so to obtain three channels and that two of them are side channels (2) and one is middle channel (7), while each of three so obtained channels is in horizontal barrier (1) provided with electro-motoric fireproof jalousie (4) at the distance from about 50 to 100 meters, with an exception at the beginning of the tunnel, where the first jalousies are incorporated on about 100 meters from the tunnel beginning, and on each end of the tunnel, i.e. on the each longitudinal side channel (3) on the both sides of the tunnel are special axial fans incorporated, built for the operation at elevated temperatures and for contaminated air with increased content of the gases, particles and water drops, while the middle channel (7) is on both ends provided with special axial fans (6) built for the operation at elevated temperatures and for contaminated air with increased content of the gases, particles and water drops, and the fans (5, 6) are provided with frequent regulators of revolutions number for continue regulation of the capacity, and the fan (6) can operate reversible.
2. A process according to the claim 1, characterized by that the fan (6) capacity is equal to the half of required quantity of the air according to the project, while the capacity of the fan (5) is equal to the whole amount of the air according to the project.
3. A process according to the claim 1 or 2, characterized by that in the case of the fire in the tunnel the operation regime is switched from the automatic on the manual operation.
4. A process according to the claim 1, 2 and 3, characterized by that in the case of the fire in the tunnel on the place (P) the fans (5) in side channels (3) are adjusted to the maximal amount of the exhausting, while the fan (6) at the side which is from the fire place closer to the exit of the tunnel, the fan is adjusted for the operation as exhausting fan, while the fan (6) on the side which is from the fire place in the tunnel more distanced from the exit of the tunnel, the fan is adjusted on the operation as pressure fan, and in this part of channel the jalousies (4) are open only next to the fire, and the other jalousies in this part of the channel are hermetic closed, and on the exhausting acting fans, being from the fire place (P) closer to the exit of the tunnel, (channel 3) and middle channel (7)) are opened the other, third and fourth jalousies (4) looking from the fire place (4) to the exit of the channel, while other jalousies (4) on

this part of the tunnel are hermetic closed.

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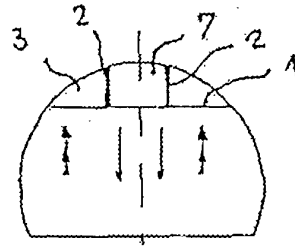
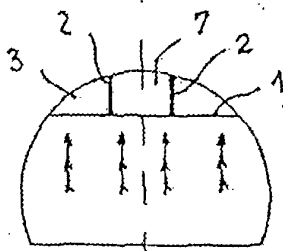
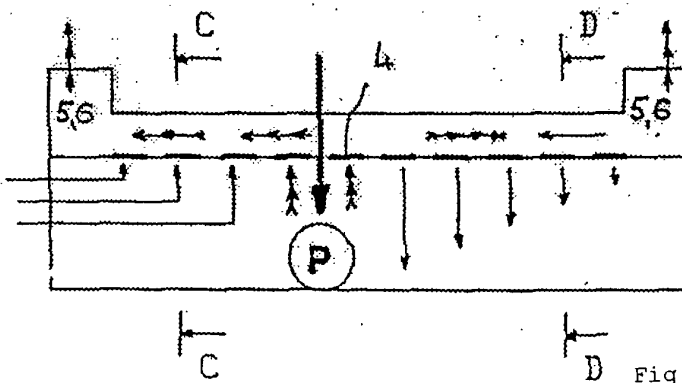
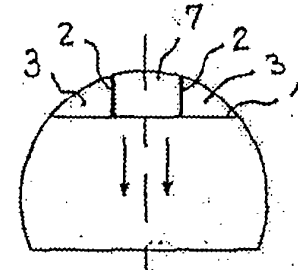
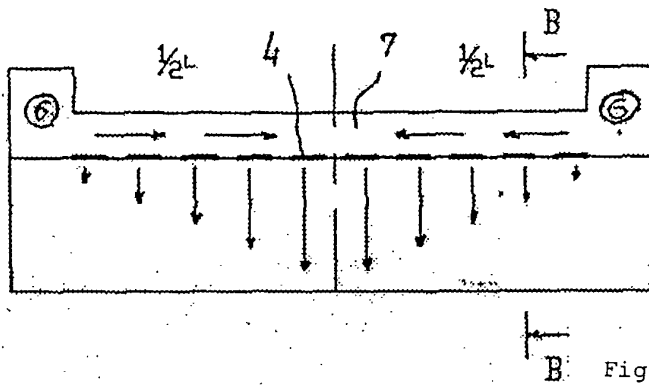
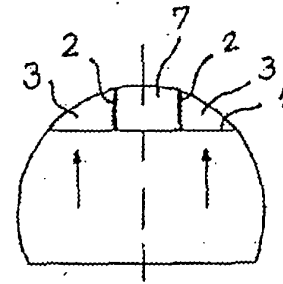
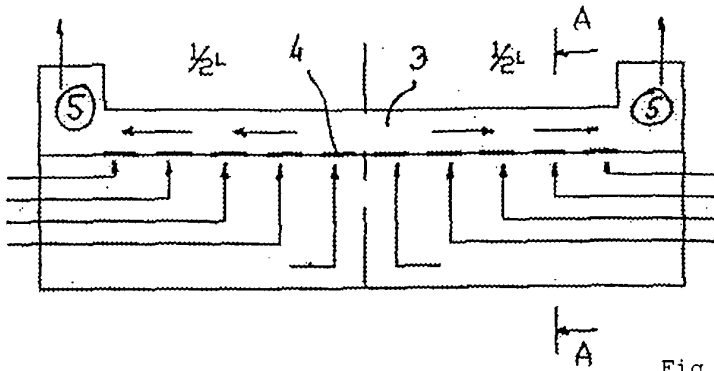
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# EUROPEAN SEARCH REPORT

Application Number  
EP 00 12 7346

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                  |                                  |                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------|
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                  |                                  | A62C<br>E21F                                 |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                  |                                  |                                              |
| Place of search                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                  | Date of completion of the search | Examiner                                     |
| THE HAGUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                  | 22 March 2001                    | Neiller, F                                   |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/> Y : particularly relevant if combined with another document of the same category<br/> A : technological background<br/> O : non-written disclosure<br/> P : intermediate document</p> <p>T : theory or principle underlying the invention<br/> E : earlier patent document, but published on, or after the filing date<br/> D : document cited in the application<br/> L : document cited for other reasons<br/> &amp; : member of the same patent family, corresponding document</p> |                                                                                                  |                                  |                                              |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82