

April 3, 1956

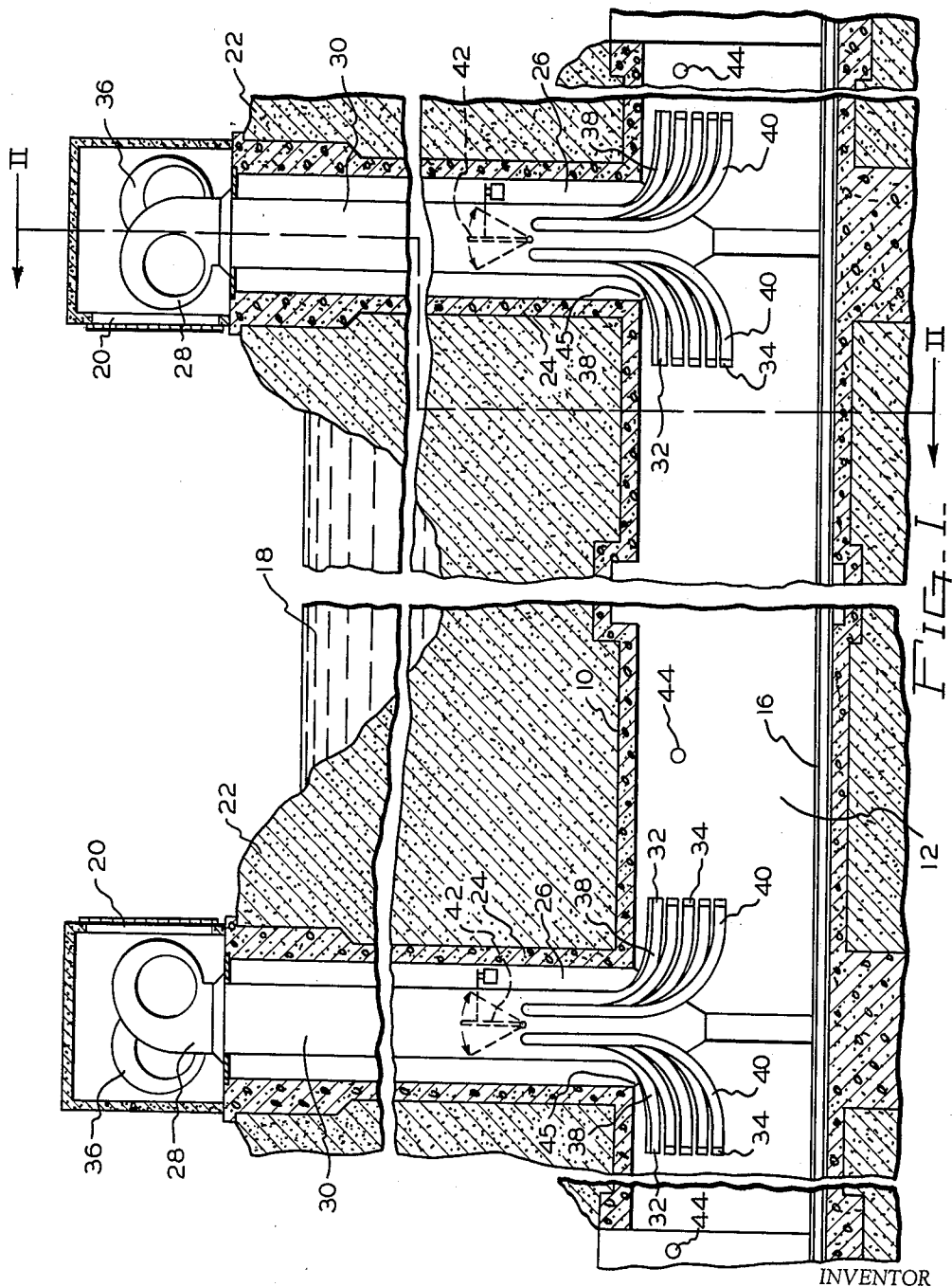
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2,740,347

SYSTEMS FOR VENTILATING TUNNELS AND THE LIKE

Filed April 16, 1951

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

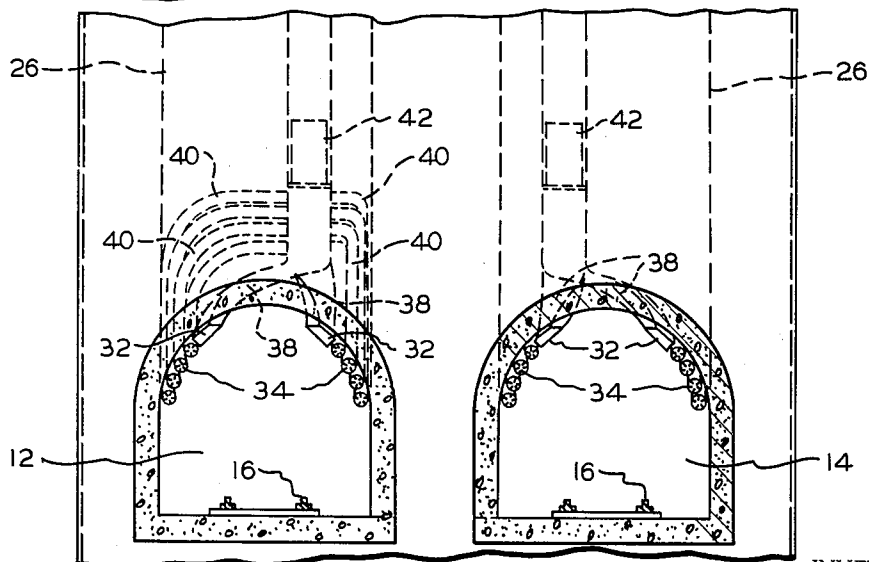
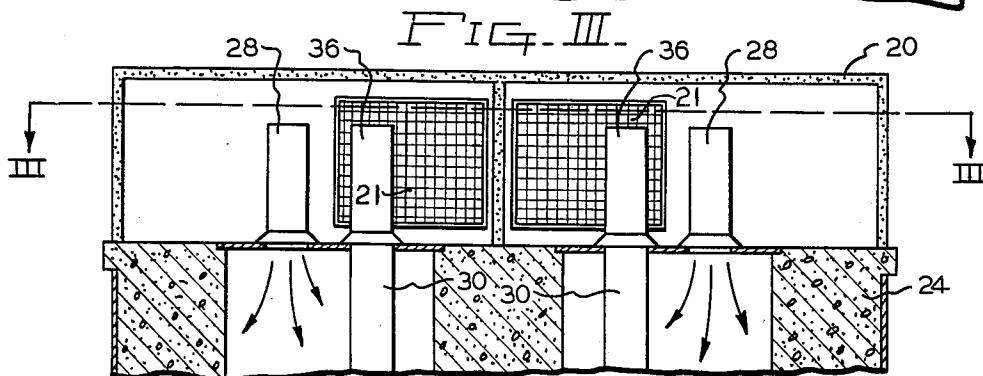
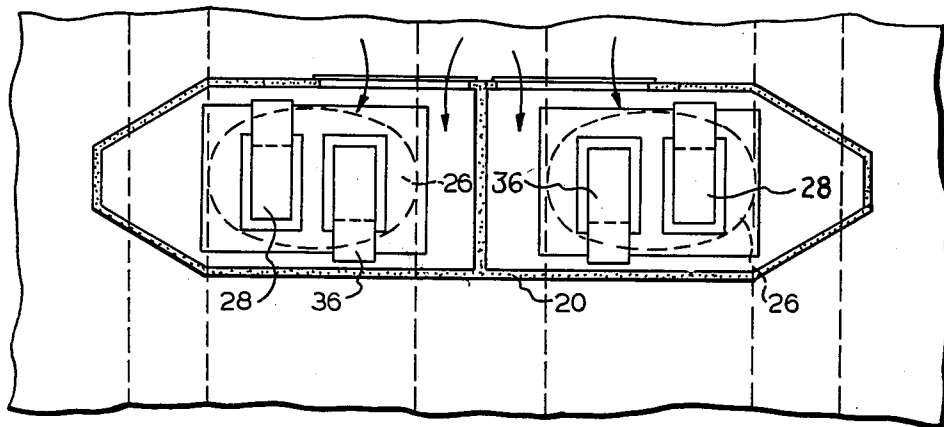


FIG. II.

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2,740,347

SYSTEMS FOR VENTILATING TUNNELS AND THE LIKE

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Application April 16, 1951, Serial No. 221,233

5 Claims. (Cl. 98—49)

The present invention relates to improvements in tunnel ventilating systems being particularly adapted to tunnels now in existence which do not have sufficient clearance to permit installation of conventional duct type systems.

Ventilation problems in railroad tunnels frequently require the delay and expense of changing from steam and diesel to electric traction power at the entrance to the tunnel. With the general adoption of diesel engines the ventilating problem has been changed from combating smoke to that of carbon monoxide.

According to the present invention a system has been provided for existing tunnels which makes it entirely practical to ventilate long tunnels with such efficiency that both steam and diesel engines may operate with complete safety with the elimination of all discomforts and annoyances to both crew and passengers. This has been accomplished by moving a large volume of air by the aspirator action of high velocity air nozzles assisted by the piston action of the moving vehicle itself. With my improved system all ventilating air is moved in the same direction as the movement of the vehicle in the tunnel and at a sufficiently greater rate to prevent the build-up of obnoxious smokes and gases in the ambient air in which the vehicle is moving. In the case of steam locomotives, to be practical, operation under forced draft should be reduced to a minimum in traversing the tunnel.

Thus, an object of the invention is to provide an improved system of tunnel ventilation in which the air is unidirectional with the vehicle movement.

Another object is to provide an improved system of tunnel ventilation, and the like, in which the air is moved through the tunnel by the aspirator action of high velocity air nozzles.

Another object is to provide an improved system of tunnel ventilation in which the air movement is provided by high velocity jet type directional nozzles.

A further object of the invention is to provide an effective system for ventilating tunnels now in service without material structural alteration.

These and other objects and advantages residing in the combination, construction and steps for carrying out the system herein disclosed will more fully appear from the following specification and the appended claims.

In the drawings,

Fig. I is a longitudinally vertical cross-sectional view of a tunnel structure embodying the system of ventilation of the present invention,

Fig. II is a cross-sectional view taken on line II—II of Fig. I, and

Fig. III is a horizontal section taken on line III—III of Fig. II.

Referring to the illustrated form of the invention, the tunnel structure 10 has tubes or passages 12 and 14 shown provided with railroad tracks 16 for carrying the vehicles through the tunnel structure. It will be understood, however, that the principles of the present invention have

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equal application to all forms of vehicular tunnels of similar structure.

As shown in Fig. I the tunnel structure 10 extends under the river 18 with the ventilating fan housings 20 with air inlets 21 being located on opposite banks 22.

The housings 20 are disposed above the vertical structure shafts 24 which open into the roof of the passages 12 and 14 of the tunnel structure 10 through the air shafts 26 through which a large volume of air is directed by supply fans 28 and moved downwardly at relatively low velocity in view of the large cross-sectional area of the shafts 26 and which enters the tunnel from above with minimum directional effects longitudinally of the tunnel. Also associated with each air shaft 26 is an air shaft 30 in the form of a duct and located within the shaft 26 through which air is delivered at high velocity to the nozzles 32 and 34 by the high pressure fan 36 and which directs the air into the tunnel with positive directional effects. In reference to minimum and maximum directional effects mentioned aforesaid, such terms are intended to describe the phenomena that takes place when a confined stream of air at high velocities causes unidirectional flow of the velocity stream as well as that of the ambient air immediately surrounding the stream. Minimum directional effects result from low velocity discharge of air normal to the axis of the tunnel while the maximum unidirectional effects are experienced when the high velocity stream of air is directed longitudinally of the tunnel.

As shown, the nozzles 32, because of clearance problems, may conveniently be of a fin type construction and located in the end of the rigid ducts 38 forking off the lower end of each shaft 30. The nozzles 34 are preferably of a jet type with the connection to each shaft 30 being conveniently provided by flexible ducts 40. Each shaft 30, as more clearly shown in Fig. I, is provided with two sets of ducts 38 and 40 for directing the high velocity air in opposite directions longitudinally of the tubes or passages 12 and 14 of the tunnel structure 10. Dampers 42, shown in their neutral position, are located in each shaft 30 to direct the air through one set of nozzles or the other, depending upon the direction of movement of the vehicle through the tunnel structure. Electric eyes 44 may be employed to start the fans 28 and 36 as the vehicle enters the tunnel and to actuate the dampers 42, depending upon the direction of vehicle movement. Upon leaving the tunnel, the fans 28 and 36 may be conveniently turned off through the employment of one of the electric eyes 44.

It will be understood that in tunnels now in service there is very little clearance between the vehicle and the walls of the tunnel passages. This fact accounts for the arrangement of the ducts 38 and 40. Also, the advantage of directing a large portion of ventilating air directly into the passages 12 and 14 through structure of the character of the air shafts 26 should be readily appreciated as all longitudinally extending duct work in the passages 12 and 14 is avoided. The low velocity air flowing down the air shafts 26 through the large openings 45 in the ceiling of the passages 12 and 14 is picked up by the aspirator action of the nozzles 32 and 34 with the result that the total air mass of the passages 12 and 14 moves along the tunnel structure in either direction (depending upon the position of the dampers 42) at a rate in excess of the permitted rate of travel of the vehicle through the tunnel. In this manner there is no possibility of a build-up of objectionable concentration of obnoxious gases and smoke around the vehicle because of the thorough dilution that is taking place within the air being moved forward of the vehicle.

As the movement of the air mass is unidirectional in the passages 12 and 14 with the vehicle, the piston action

of the vehicle assists the aspirator action of the nozzles 32 and 34 upon the air carried by the shafts 26.

I claim:

1. In combination with a tunnel, a first air shaft discharging into said tunnel, air fan structure having a relatively small discharge as compared to the cross-sectional area of said first air shaft for directing a relatively large volume of air into said shaft to produce an air movement therein of relatively low velocity, a second air shaft discharging into said tunnel and having a relatively small cross-sectional area as compared to said first air shaft, fan structure having a discharge conforming in cross-sectional area substantially to the area of said second shaft for directing a relatively large volume of air into said second shaft to produce therein a relatively high velocity air movement, nozzle structure at the tunnel end of said second air shaft and extending into the tunnel for directing air at high velocity into said tunnel longitudinally thereof, said nozzle structure being located in aspirator relationship to the air discharged into said tunnel by said first air shaft.

2. A tunnel ventilating system comprising a passage for the movement of vehicles longitudinally thereof, an air shaft of relatively large cross-sectional area opening into said passage through a wall thereof through which a relatively large volume of air at relatively low velocity may flow into said passage, a high velocity air duct of relatively small cross-sectional area as compared to said air shaft having nozzle structure for directing air at relatively high velocity longitudinally of said passage, means for forcing air with high velocity through said duct and out through said nozzle structure, said nozzle structure being positioned in aspirator relationship with said air shaft where it opens into said passage and being directed along said passage whereby the total air mass of said passage is moved longitudinally thereof at relatively high velocity by air supplied jointly by said air shaft and said air duct.

3. A tunnel ventilating system as defined in claim 2,

means controlling the delivery of high velocity air to said nozzle structure, and means controlling said first means under the regulation of a vehicle traversing said passage to provide the total air mass with movement uni-directional with that of the vehicle.

4. A system of ventilating air delivery and handling for tunnels and the like comprising the delivery of a relatively large volume of air at relatively low velocity and of minimum directional effects into the tunnel, and imparting relatively high velocity and positive directional effects to the entire air mass of the tunnel by the aspirator action of a relatively large volume of relatively high velocity air under the direction of nozzle structure acting longitudinally of the tunnel and located in the stream of said low velocity air.

5. In the combination of claim 1, said nozzles being arranged in two sets disposed in opposite directions of said tunnel, means for regulating the flow of high velocity air through said nozzle sets uni-directional with the movement of a vehicle through said tunnel, said last means including a damper in said second shaft for selectively directing air through either of said sets.

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