T. H. JOHNSON.

APPARATUS FOR VENTILATING TUNNELS.

APPLICATION FILED JULY 25, 1910.

975,248.

Patented Nov. 8, 1910.

2 SHEETS—SHEET 1.

FIG. 1

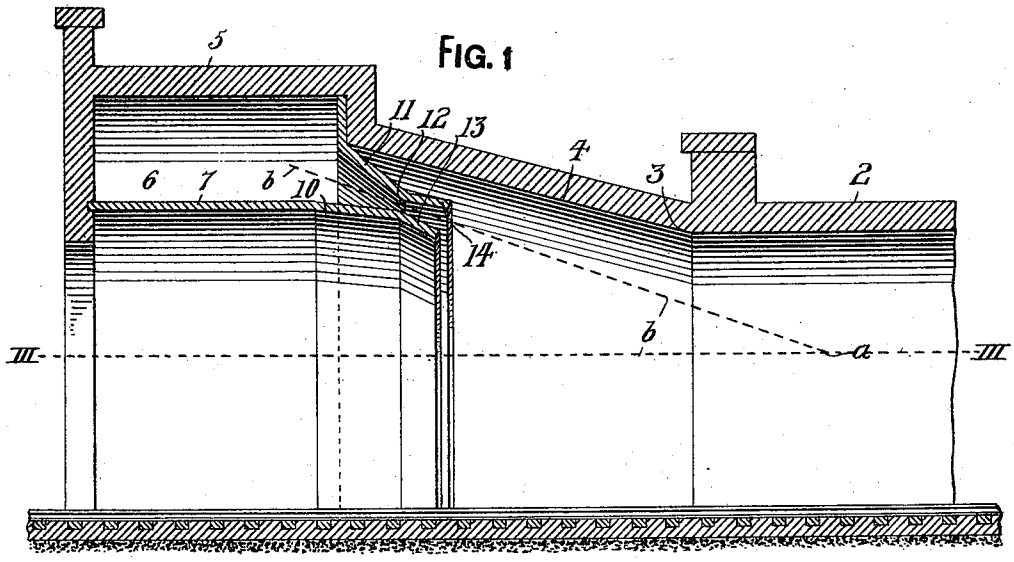
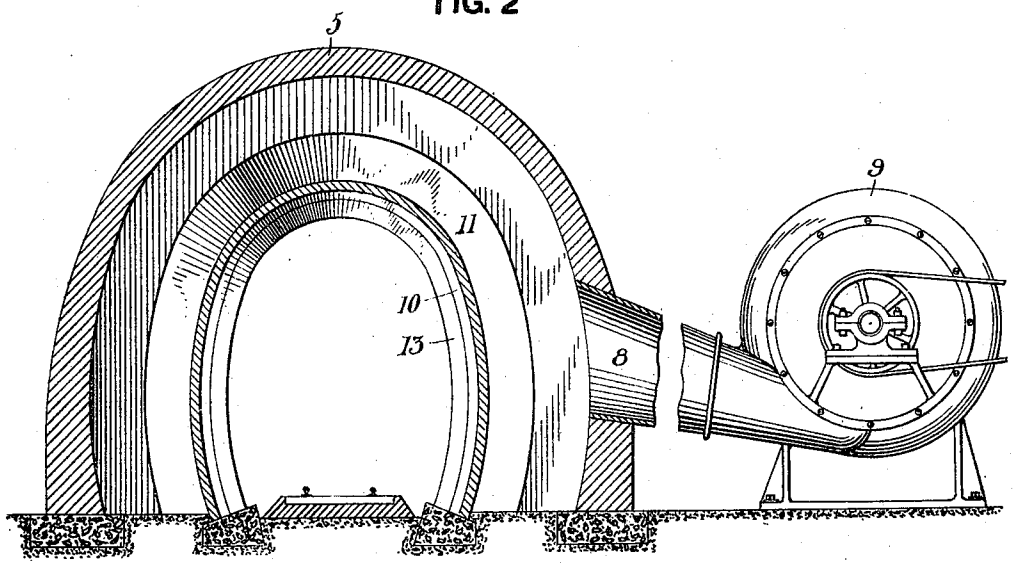


FIG. 2



WITNESSES

J. P. Appleman,

Henry Bens.

INVENTOR

Thomas H. Johnson

by C. M. Clark

his attorney.

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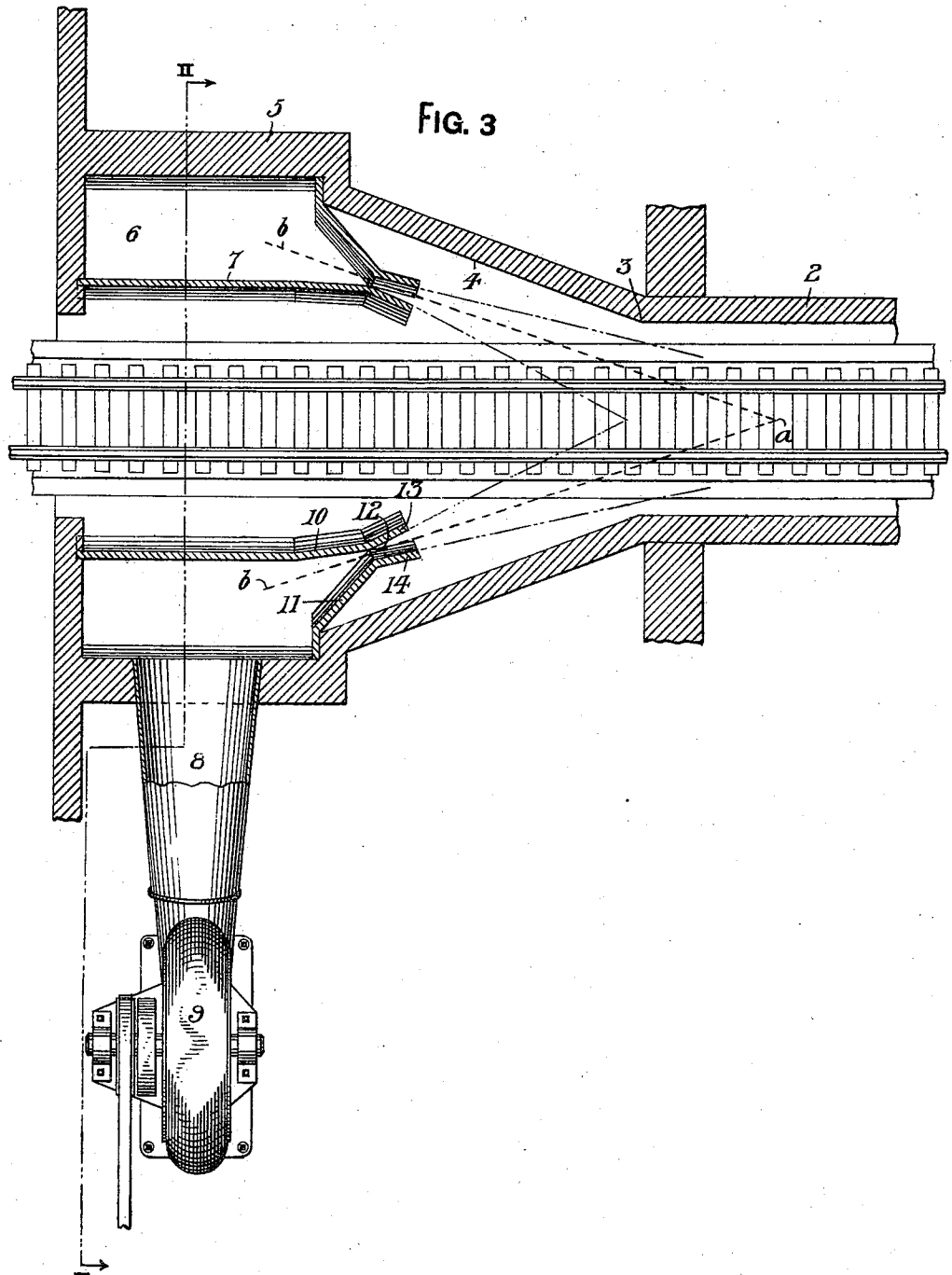
FIG. 3



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his attorney

UNITED STATES PATENT OFFICE.

THOMAS H. JOHNSON, OF PITTSBURG, PENNSYLVANIA.

APPARATUS FOR VENTILATING TUNNELS.

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To all whom it may concern:

Be it known that I, THOMAS H. JOHNSON, a citizen of the United States, residing at No. 619 South Negley avenue, Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Ventilating Tunnels, of which the following is a specification.

My invention consists in an improvement in apparatus for ventilating tunnels.

It has for its object the providing of means by which a scavenging blast of air is introduced into and through the tunnel in such a manner as to impinge on the air in the tunnel interior to drive it forwardly therethrough and thereby to avoid the formation of eddies, whirls or re-actionary currents.

In the use of ventilating means wherein currents of air are introduced to the tunnel through tapering conduits, it has been found in practice that due to the re-acting effect of adjacent walls against which the blast of air impinges, there has been a tendency to form eddies, cross currents, etc., which prevent the full efficiency of the blast and induce conflicting currents and resulting retardation to the travel of the inclosed air, gases, etc.

Apparatus of the same general type as above indicated has previously been used with partial success, and I am aware of the prior U. S. patents to Churchhill and Wentworth Nos. 671264 and 689039, also of the British patents of Saccardo, Nos. 14829 of 1891 and 2026 of 1898. In such prior constructions the outer wall of the current inducing nozzle is continuous with the inner wall of the tunnel and the inner wall of the nozzle terminates in a free end. As a result of this arrangement, the jet of air issuing from the nozzle comes into direct contact with the tunnel wall, the friction of which retards the flow of air, while also preventing expansion of the jet on that side, resulting in whirls and eddies on the free side of the jet with corresponding waste of energy and loss of efficiency.

The object of my improvement is to secure the desired result of perfect scavenging and removal of the inclosed gases with an avoidance of the loss of friction just referred to, and to generally increase the efficiency of the apparatus.

With these and other objects in view, my improvement consists in so constructing the air blast chamber and its annular nozzle with relation to the surrounding tunnel wall extension that by suitably enlarging the tunnel wall extension, which is beyond the tunnel proper, the air blast structure is given ample clearance room for the blast to avoid the objections noted, while itself being of ample size to avoid any effective contraction of the normal tunnel area.

Generally stated, the invention consists in providing at either end of the tunnel or at any intermediate point therein an encircling casing or chamber having an outlet opening at its inner portion directed generally inward and toward the center of the tunnel opening, composed of concentric inner and outer walls converging toward each other and then diverging and forming an annular emission nozzle of diverging cross section, constructed and adapted to operate in the manner hereinafter more fully described.

In the drawings:—Figure 1 is a longitudinal vertical section through a portion of a tunnel provided with my improvement. Fig. 2 is a horizontal sectional view therethrough indicated by the line II. II. of Fig. 3. Fig. 3 is a horizontal sectional view on the line III. III. of Fig. 1.

In the drawings, 2 represents the tunnel wall of ordinary form in cross section and usually of continuous uniform diameter and height. The air chamber, in the arrangement shown, is located at one end of the tunnel, although as stated, it may be at any point between its ends. In order to provide ample clearance, the walls 2 are sloped backwardly and outwardly from the point 3, providing diverging surfaces 4 and affording corresponding clearance for the air jets and for the air chamber structure. Beyond the thus enlarged cavity of the tunnel and in a suitable surrounding space within the wall extension 5, is located the air chamber 6. Said air chamber completely surrounds the tunnel cavity above the ground as clearly shown in Fig. 3. The air chamber is composed of any suitable material as concrete,

planking, metal, etc., to provide, with the wall extension 5, an interior wall 7.

8 is an air supply duct introduced at any suitable point into the air chamber whereby a supply of air from fan 9 or other suitable means is furnished thereto. The fan may be located as shown, laterally of the tunnel structure in any convenient position and may be driven in the ordinary manner by suitable power connections.

At its inner side toward the interior of the tunnel, the inner and outer walls 7 and 5 of the air chamber, which are arranged in annular or concentric form, corresponding generally to the outline of the tunnel, converge toward each other by means of the inwardly tapering wall sections 10, 11, respectively to a point of smallest contraction 12. Beyond such point the walls diverge slightly as indicated at 13, 14, providing a continuous flaring annular emission nozzle 15 as clearly shown in Fig. 3.

It has been found in practice that the efficiency of the annular jet will be at a maximum when the converging portions of the annular nozzle 10, 11, are arranged at an angle of about 30° and the diverging portions 13, 14, at an angle of about 7°, although these proportions may be varied if desired. As indicated, the central line of the blast and of the nozzle at all points projects toward the point *a* centrally of the tunnel, thereby providing a continuous annular jet of air, as indicated by the dotted lines *b*, *b*, in Figs. 1 and 2. It will be observed that with this construction the arrangement of the nozzle terminal of the air chamber is such that the jet of air emitted therefrom passes forwardly well within the surface 4 of the tunnel wall extension. The result of such construction is that the blast is thus prevented from any frictional engagement with or impedance by the face 4 of the wall extension of the tunnel and its operation in the performance of its functions of forcing the gases, smoke, etc. through the tunnel at the other end, is unimpeded, due to the ample clearance provided by the diverging tunnel walls. There is therefore, no impingement of the outer portion of the air blast, against or closely adjacent to the wall surface 4, resulting in a free forward flow of the air through the tunnel.

It will be understood that the contour of the extreme inner corner 13 of the nozzle should be parallel to the contour of the tunnel arch, and may be greater than, equal to, or less in diameter than the contour of the tunnel arch, provided that in the latter case it must not encroach on the proper clearance limits for passage of engines and cars.

It will be understood that the particular arrangement of the air chamber and its terminal, with relation to the tunnel space may be changed or varied to suit local conditions and that the invention is not limited to the specific construction and arrangement shown. The essential features consist in the forming of the annular nozzle whereby the current is forced between the converging walls having the diverging terminals; the location of the air chamber and its nozzle terminal without the area defined by the normal tunnel walls or by the clearance space required by passing trains; and the clearance space beyond the zone of the annular blast, provided by the flaring tunnel wall extensions.

Having described my invention, what I claim is:—

1. In a ventilating system for tunnels, the combination with a tunnel having a flaring extension, of an air chamber located outwardly beyond the clearance space required for the movement of trains and provided with an annularly arranged outlet aperture the general direction of which is inwardly clear of the flaring extension.

2. The combination with the tunnel wall extension, of an annularly arranged air chamber having an annular outlet nozzle formed by inner and outer walls approaching each other to a point and then diverging, the general central direction of said outlet aperture being inwardly away from and at a diverging angle to the inner face of the tunnel wall extension, substantially as set forth.

3. The combination with the tunnel, of an air box having an annular inwardly sloping delivery nozzle formed by inner and outer converging and diverging walls, substantially as set forth.

4. The combination with a tunnel having a laterally enlarged clearance cavity at the desired location; of an annularly arranged air chamber provided with annularly arranged inner and outer walls terminating in diverging terminals, located within said clearance space and laterally beyond the normal tunnel contour, substantially as set forth.

5. The combination with a tunnel having a laterally enlarged clearance cavity at the desired location; of an annularly arranged air chamber provided with annularly arranged inner and outer walls terminating in diverging terminals, located within said clearance space and laterally beyond the clearance space required for the movement of trains.

6. The combination with a tunnel provided with a flaring clearance cavity; of an annular air chamber having an annular nozzle directed inwardly and longitudinally of the tunnel having inner and outer walls

forming a converging-diverging annular nozzle, substantially as set forth.

7. The combination with a tunnel provided with an extension forming a flaring clearance cavity; of an interior annular air chamber having an annular nozzle outwardly clear of the train passage space and directed longitudinally of the tunnel passage and inwardly away from the extension.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

THOMAS H. JOHNSON.

Witnesses:
GEO. B. BLEMING,
C. M. CLARKE.