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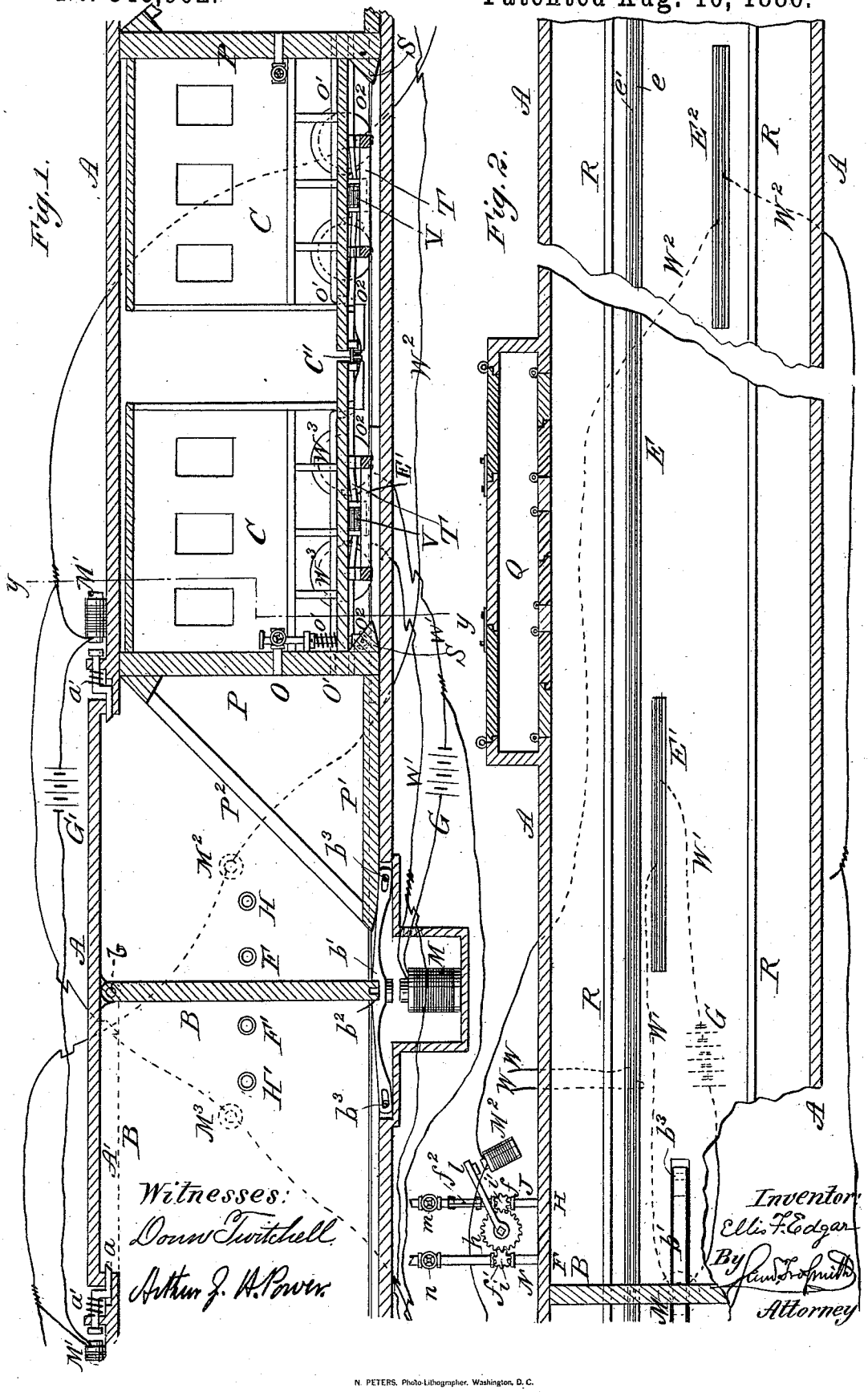
E. F. EDGAR.

PNEUMATIC AND ELECTRIC RAILWAY.

No. 346,902. Patented Aug. 10, 1886.



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PNEUMATIC AND ELECTRIC RAILWAY.

No. 346,902. Patented Aug. 10, 1886.

Fig. 3.

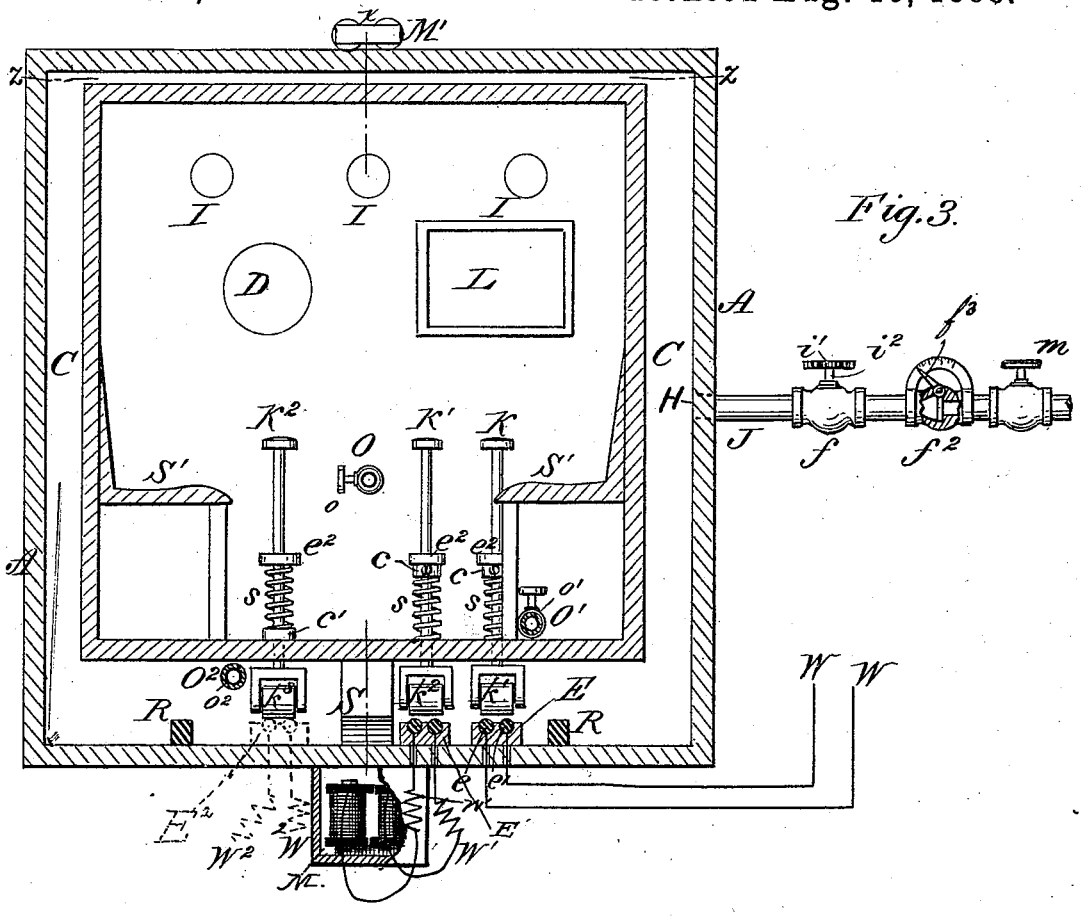
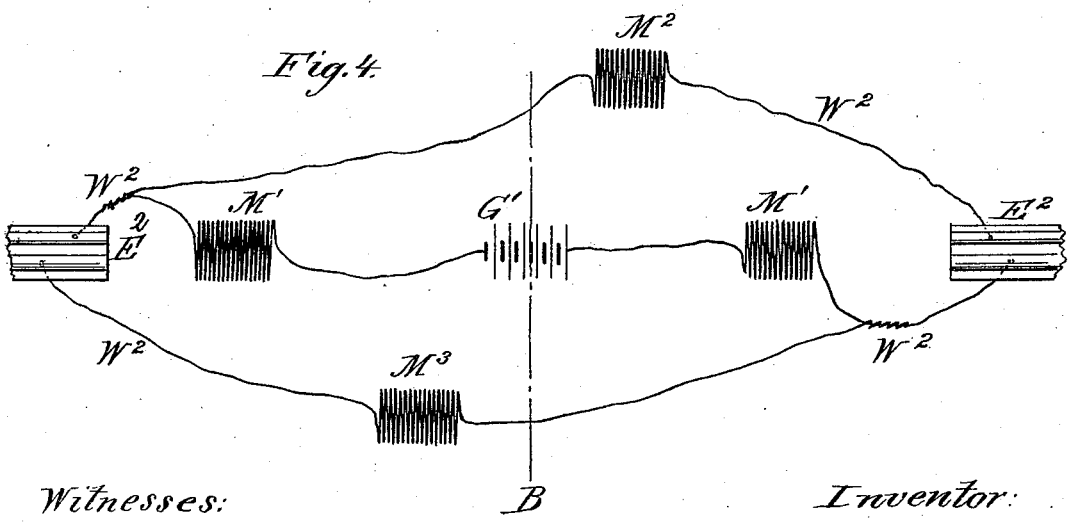


Fig. 4.



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(No Model.) 4 Sheets—Sheet 3.

E. F. EDGAR.

PNEUMATIC AND ELECTRIC RAILWAY.

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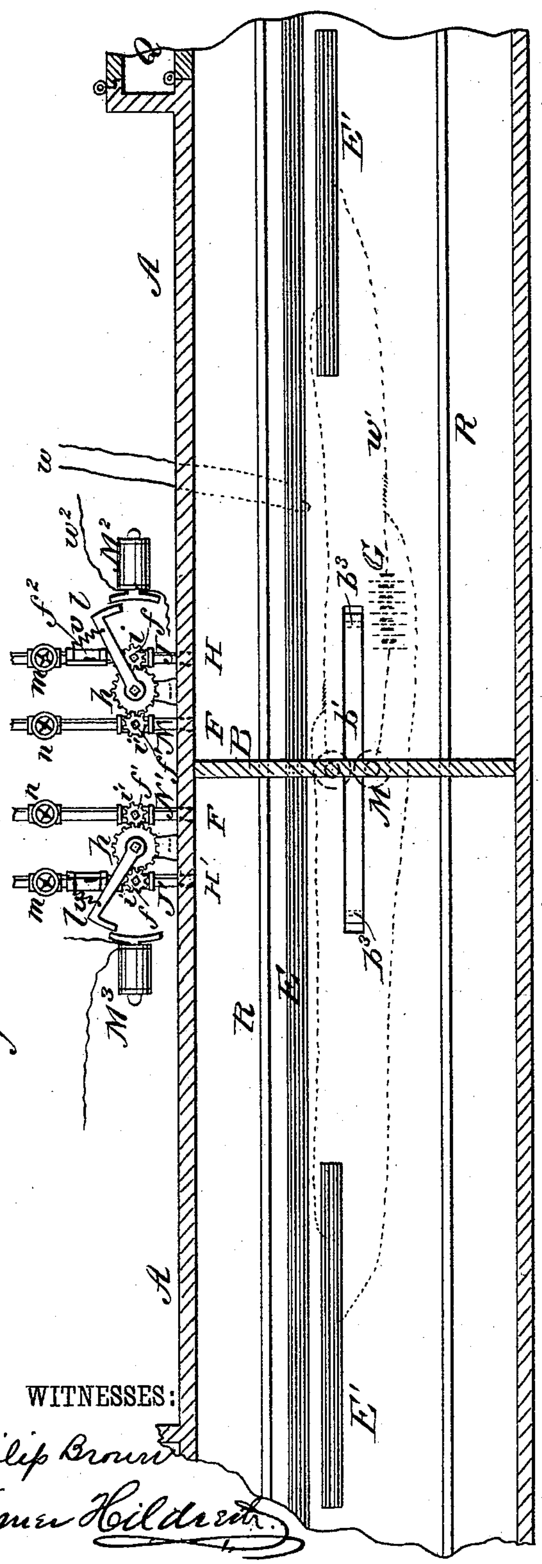

Fig. 5

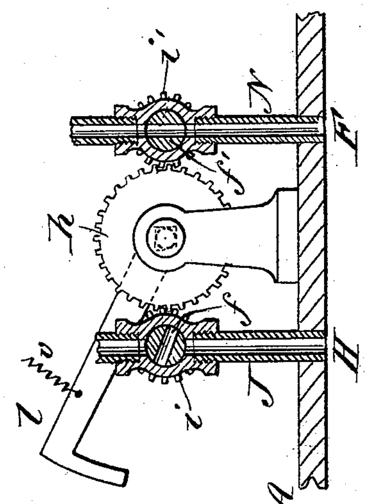

Fig. 6

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(No Model.) 4 Sheets—Sheet 4.

E. F. EDGAR.

PNEUMATIC AND ELECTRIC RAILWAY.

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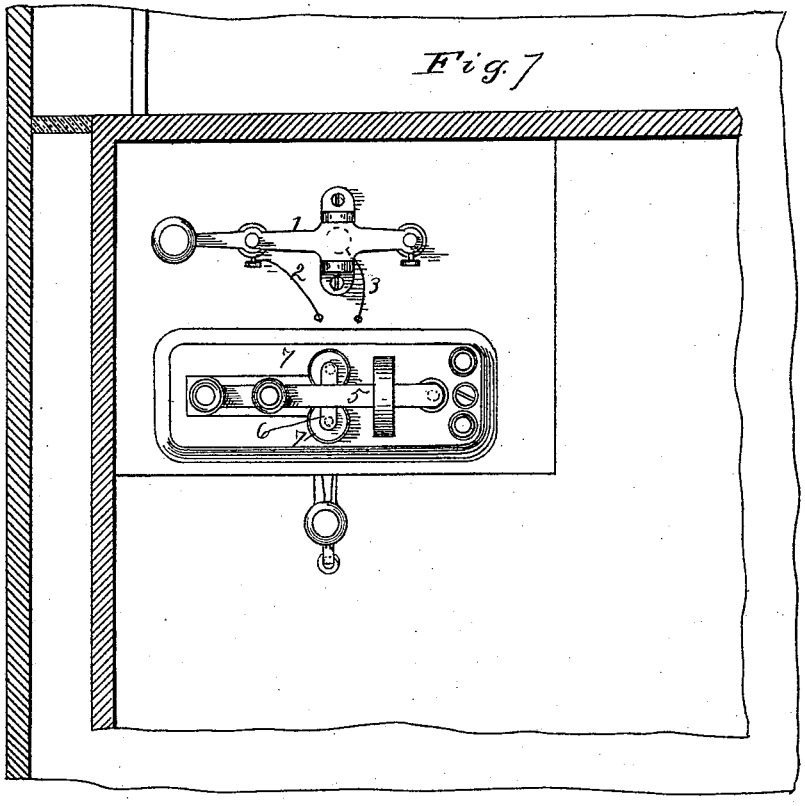
Fig. 7



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UNITED STATES PATENT OFFICE.

ELLIS F. EDGAR, OF WOODBRIDGE, NEW JERSEY.

PNEUMATIC AND ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 346,902, dated August 10, 1886.

Application filed January 7, 1882. Serial No. 49,573. (No model.)

To all whom it may concern:

Be is known that I, ELLIS F. EDGAR, of the town of Woodbridge, county of Middlesex, in the State of New Jersey, have invented a new and useful Pneumatic and Electric Railway, of which the following is a specification.

My invention relates to that class of railways in which the carriages are projected in an air-tight passage or tunnel; and the object of the invention is to transmit cars with freight or passengers from one station to another with the greatest possible degree of speed and safety by the combined use of a vacuum, compressed air, and electrical currents. I attain those objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a side view of the tunnel in which the cars are projected, with two piston-cars standing at the station, shown in section at line *x x* in Fig. 3 with the valve-door, which separates two adjacent sections of the railway, closed; showing also the electrical generators, magnets, and electrical connections, and the fastenings of the valve-door; also, the vacuum and compressed-air tubes where they enter through the openings in the tunnel. Fig. 2 is a plan view of the same tunnel shown on section at the line *z z* of Fig. 3, showing the sides of the tunnel, the valve door, and the station-platform in section, with a full view of the rails, the electrical tracks, generators, magnets, and electrical connections, the stopping electrical tracks, and the air-tubes and apparatus for regulating the flow of air to and from the tunnel. Fig. 3 represents a cross-section of the tunnel and piston-car taken at the line *y y* in Fig. 1, showing the sides, top, and bottom of the tunnel, the piston-car, the seats in the piston-car, the rails, the continuous and starting electrical tracks, and the compressed-air tubes in section, with a full view of the inner face of piston, the keys, and rollers for making the electrical connections, the tubes for supplying air to the car, for applying compressed air to the car-brakes, and for relieving the piston from the pressure of compressed air when approaching the station, part of the inclined shoe, with the head-lights, lookouts and indicators, and the tube for supplying compressed air, with its valve and indicator, the electrical tracks, with the conducting-wires, and the magnet for operating the valve-door, with the stopping electrical track indicated by dotted lines. Fig. 4 is a diagram showing the electrical connection between the electrical generator and the stopping electrical tracks, with the several magnets connected therewith, the dotted lines representing the location of the valve-door. Fig. 5 is a horizontal sectional view of the tunnel, showing the valve-door B, railway-tracks, electrical tracks, magnet M, generator G, spring *b'*, and their electrical connections, tubes J and N, J' and N', magnets M^2 M^3, stop-cocks *f f'*, cogged wheels *h*, and pinions *i i'*, levers *l*, and springs *v*, with their mechanical and electrical connections, and hand stop-cocks *m n*. Fig. 6 is an enlarged view of the stop-cocks *f f'*, with the tubes J and N, and tunnel and stop-cocks *f f'* in section, showing one stop-cock open and the other closed, in connection with the cogged wheel *h* and lever *l*. Fig. 7 is a detached view enlarged, showing in plan an electric key and sounder to be used by the engineer for signaling.

The same letters and figures refer to similar parts throughout the drawings.

I construct my railway as follows: I make a rectangular air-tight casing or tunnel, A, of iron, about seven feet in width and eight feet in height, the inner surface being made smooth and true. This tunnel I divide into sections at the several stations by means of a valve-door, B, which is suspended in a depression, A', at the top of the casing on pivots *b*, and held in position at the bottom by a spring, *b'*, having a notch, b^2, into which the door fits, the spring being secured in place by pins b^3 passing through slotted holes, and fixed in a depression in the bottom of the tunnel-casing, into which it may be forced by pressure or by the action of the magnet M until the top of the spring is on a level with the casing. The valve-door, when raised, rests in the depression A', with its surface flush with the inner surface of the casing, and is held in that position by means of the bolts *a* and the springs *a'*, which surround them.

I do not confine myself to the use of valve-doors hung from the top of the tunnel; but, if desired, folding-doors hung at the sides may be used, and closed by springs or otherwise when released from their fastenings by the operation of the magnet M'.

I provide an electrical generator, G, for the

purpose of withdrawing the spring b' and an electrical generator, G', for the purpose of withdrawing the bolts a and operating the lever l, which is geared with the stop-cocks f and f' by means of the cogged wheel h, and when moved in one direction closes the vacuum-tube N and opens the compressed-air tube J, and when moved in the opposite direction closes the compressed-air tube J and opens the vacuum-tube N.

On the bottom of the tunnel, in the proper position, I place the rails R, made of rectangular bars of iron or steel, with flat sides and top, for the car-track.

I provide piston-cars C, resting on trucks T, the wheels of which are adapted to fit the rail R, in the ordinary manner of adjusting railway-wheels. The front end of the piston-car C consists of a rectangular plate or piston, P, which is firmly fixed to the car and made to fit the inner surface of the tunnel with a close joint, which will prevent the passage of air.

The piston-cars C are made short and coupled together in the ordinary manner of coupling cars, and with their faces or piston ends outward in opposite directions, and can be separated for the purpose of placing freight or passenger cars between them, in the ordinary way of making up a train.

In front of the piston P, at the bottom, I attach an iron bar, P', extending out about eight feet and inclined upward at the point like a shoe. From this point to the upper end of the piston P, I affix another bar, P^2, making a strong bridge, in cow-catcher form, at an angle of about forty-five degrees. To the back of the piston, at the bottom, I affix a shoe, S, inclining upward the same as the point of the bar P'.

On the bottom of the tunnel, parallel with the rails R, I provide a continuous electrical track, E, extending the entire length of the tunnel, constructed of gutta-percha or other non-conducting material, having embedded in it side by side, but insulated from each other, two electrical conductors, e e', which are full flush with the surface of the electrical track E, which is also full flush with the surface of the bottom of the tunnel.

At each station at the point where the piston-car C stands when the train is not in motion, parallel with the rail R, I place a short starting electrical track, E', a little distance from the continuous electrical track E, made of the same material and in the same manner, flush with the bottom of the tunnel. At a greater distance from the continuous electrical track, parallel with the rail R, and about half a mile from the station, I place a short stopping electrical track, E^2, of the same material as the continuous electrical track, constructed and placed in the same manner.

In the piston-car I place three operating keys, K K' K^2, consisting of metallic rods having a button at the top, and at the lower end a pivoted metallic roller, k' k^2 k^3, electrically insulated from the rod, and of sufficient width to cross both of the conducting-wires in the electrical tracks. These keys are placed, respectively, over the three electrical tracks and secured in place by passing through eyes e^2, which are fixed to the piston P' by screwing into it, or in any other usual manner, and pass down through holes in the bottom of the car. The keys K and K' are provided with collars c, which are adjustable by means of set-screws, and the key K^2 is provided with a collar, c', which may be used to detain the key above the track, when desired, and all of the keys are provided with helical springs, by which they are kept in position and regulated. The piston P is also provided with an opening, O, through which air may be admitted into the piston-car C, and which is adjustable by means of the thumb-screw o; also, an adjustable opening, O', with a tube, o', through which compressed air may be passed from the front of the piston P to the rear of the train; also, an opening, O^2, with a tube, o^2, attached, through which compressed air may be carried to air-brake mechanism V, of any desired construction, supported upon the trucks of the car. I also provide a bull's-eye, D, for lighting the track ahead, a lookout, L, of heavy plate-glass, and indicators I, to register the speed of the train and the density of the air.

The car is provided with seats S', under which is left a space for the wheels W^3 of the trucks.

The conducting-wires w w are electrically connected with the electrical tracks E, and with an electrical generator outside of the tunnel in the office at the station, by means of which electrical communication can be had by closing the circuit with the key K. The conducting-wires w' w' are electrically connected with the electrical track E', and with the electrical generator G and magnet M. The conducting-wires w^2 w^2 are electrically connected with the electrical track E^2, and with the electrical generator G' and the magnets M', M^2, and M^3.

I do not confine myself to any specific position of the electrical generators and magnets, or any particular method of the electrical connections, as any known position or method in public use which will accomplish the object may be adopted; neither do I confine myself to any particular order in which the electrical tracks shall be placed with regard to the rails, as the order may be varied to suit the taste of the constructor; nor do I confine myself to any special form of truck or car, as any desired form may be used which can be adapted to the necessary form, size, and curves of the tunnel.

On the outside of the tunnel A, at each side of the valve-door B, I make two openings, F F' H H', into which are fixed the ends of the air-tubes J and J' and M and N', the tubes M and N' being connected at their other end to a vacuum-pump, and the tubes J and J' to a compressed-air reservoir, which are not shown in the drawings, and may be located at any convenient place, and be of any of the ordinary constructions having sufficient capacity to do

the work required to operate the road. These tubes N and J and the tubes N′ and J′ are placed near each other, and are provided with stop-cocks f' and f, which are operated by means of the magnets M^2 M^3, respectively, the cogged wheels h meshing in the pinions i i', with levers l attached, which are provided with springs v, which serve to draw them away from the magnets M^2 M^3 when such magnets are not charged, but which are not strong enough to overcome the attraction of said magnets when charged.

To the stop-cocks f f' the pinions i i' are rigidly fixed, and so meshed with the gear-wheels h that when the levers l are in contact with the charged magnets M^2 M^3 the valves of the stop-cocks f are open and the valves of the stop-cocks f' are closed, and the air-tubes J J′ open and the air-tubes N N′ closed; but when the electrical circuit is broken and the magnets M^2 M^3 release their hold the levers l are forced away from the magnets by the springs v, thus turning the gear-wheels h, which by their cogged connection with the pinions i i' change the position of the stop-cocks and close the valves of the stop-cocks f, while they open the valves of the stop-cocks f', thus closing the air-tubes J J′ and opening the air-tubes N N′. (See Fig. 6.) I also provide valves f^2, which are worked automatically by the currents of air passing through the tubes J J′, and have index-fingers f^3 rigidly fixed, which indicate when they are open and closed. (See Fig. 3.) The tubes J J′ are also provided with stop-cocks i^2, which are operated automatically by the magnets M^2 M^3 and the mechanism connected with them. Hand stop-cocks m are also provided by which the flow of compressed air may be regulated when desired, as indicated by the index-finger f^3, and hand stop-cocks n are also provided in the same manner and for the same purpose in the tubes N N′.

At each station a platform, Q, with sufficient doors is provided, which can be opened for the convenient ingress and egress of passengers and for removing freight and baggage. All the doors, openings, valves, and joints are made close, so as to prevent the passage of air when closed, and care must be taken to properly insulate all the conductors, and if a river is to be crossed when a draw is necessary the portion removed by the draw must be so arranged by any known method that when closed again the casings, tubes, and every part of the structure shall be joined so closely as to prevent the passage of air.

The electrical generators used may be any of the magneto or dynamo electrical machines in use, or the current of electricity may be supplied by any other known method.

When applied to use, the operation of the railway is as follows: The tunnel being closed so as to exclude the air, and a partial vacuum produced by means of the vacuum-tube N in the section to be entered by the train, the piston-cars being on the track, as represented in drawings, Fig. 1, with the engineer in his place, and a volume of compressed air behind the rear piston, when the signal for starting is given the engineer presses down the key K′, thereby bringing the pivoted roller k^2 in contact with both wires of the starting electrical track, closing the electrical circuit connected with the magnet M, when the magnet withdraws the spring b', releasing the valve-door B from its fastenings. The vacuum in advance of the train causes the air in the rear to rush forward, partly float the valve-door B, and, as the train propelled by the air in the rear of the piston P starts the bar P^2 strikes against the already moving valve-door B and forces it up to its position in the depression A′, where it is held by the bolts a, and speeds on its way toward the next station. After passing the valve-door the roller k^3 impinges on the conducting-wires of the stopping-electrical track E^2, on the other side of the station, closing that electrical circuit, when the magnet M^3 on that side of the valve-door corresponding with the magnet M^2 and the magnet M′ will be charged, the bolts a withdrawn, and the valve-door allowed to fall into place and be secured by the spring b', and the vacuum-tube N having been closed and the compressed-air tube J opened, the compressed air is allowed to enter the tunnel behind the advancing train. As the train approaches the station and reaches the stopping electrical track E^2, the pivoted roller k^3, which is always down in position and works automatically, coming in contact with the conducting-wires w^2 w^2, closes the electrical circuit which operates the magnet M, which, being charged, attracts the lever l, thereby closing the vacuum-tube N, which has been exhausting the air in the tunnel and opening the compressed-air tube J, letting in a flood of compressed air to meet the coming train. As the train approaches the station the compressed air which has entered the tunnel becomes more and more dense by being forced into smaller compass by the piston P until when it reaches the station the resistance of the air and its force as it presses through the tube O^2 against the air-brakes bring it to an easy stop against the air-cushion, which is then allowed to escape to the rear through the tube o', and the train stands in position to be again started through another section. The supply of air for the train is admitted through the opening O, and is regulated by the engineer according to the indicator furnished for the purpose. If from any unforseen cause the magnet M should fail to operate to release the spring, or the magnet M^2 should fail to furnish the compressed air to stop the advancing train, the bar P, by its shoe-like point, would impinge on the spring b' and release the valve-door B, which would be forced up into position and allow the train to pass unharmed without stopping at the station. The vacuum and compressed-air apparatus is to be kept constantly in operation, under the charge of parties who are accessible to the

engineer, by means of the electric circuit with the continuous electric track E, which can be closed at any time by pressing the key down upon the track. By means of this circuit the engineer can give any direction necessary in regard to the management of the vacuum and compressed-air apparatus or any matters connected with the running of the road. Such communication can be made by signals or by regular telegraphic communication. There must always be at least two electrical generators connected with the continuous electrical track, one at each end of the road, so as to avoid the danger of the circuit being broken by the destruction of bridges or damage to the wires at any point on the road, and when a road of any great length is to be operated it would be desirable to have connections with several electrical generators at different points. Supposing the train to be in the position indicated in Fig. 1, and the air is passed through stop-cocks O′ O′ at each end of the train after the train has been brought to a stand, so that the air between the train and the door or partition B, which is shown in the drawings, and also between the train and a corresponding door in rear of the train, and it is desired to move the train forward, the engineer presses down the key K′, thus releasing the latch which locks the bottom of the partition. As the exhaust-pumps are in continuous operation, there will be a partial vacuum in front of the partition, so that when it is released it will swing upward and the car will be drawn forward by reason of the difference in the density of the air in front and in its rear. As the car passes the partition, the inclined bar P^2 will thrust the partition up into a horizontal position, where it will be locked by the bolt *a*, and as the car advances and approaches the next partition the key K^2 will come in contact with the first section of track E^2, and by the operation of the magnets M' M^2 withdraw the bolt *a*, thus permitting the partition to swing into a vertical position, where it will be locked, and at the same time the magnet M^3 will, through its connections, close the stop cock, thereby admitting a flood of compressed air in the rear of the train and between the train and the partition, which has just swung into vertical position and been locked, thereby assisting in propelling the train forward. It will of course be understood that in consequence of the air in the compressor being under a comparatively high pressure per square inch, a relatively large volume will pass through the compressed-air tube during the short space of time occupied by traversing the track E^2, so that although the moment the train has passed over that track and the magnet M^3 ceases to act, and therefore the position of the top cocks is reversed and the exhaust-pump begins to operate, yet the operation of the exhaust-pump is so slow relatively that no such rarefaction in the air will take place between the train and the partition which it has just passed, and is now locked in vertical position, as to materially retard the advance of the train until it shall have reached the second stopping track corresponding to that at the left in Fig. 4. Upon reaching this second section the key K^2 will engage with it and immediately close the exhaust-tube in front of the train and admit a volume of compressed air in such quantity as shall serve to bring the train to a stand before it reaches the partition toward which it is advancing, as has been previously explained. By means of these appliances thus operated the train is advanced from station to station until it is returned to its original starting-point, having made a complete circuit of the tunnel. If, however, it be found desirable to at any time reverse the direction of travel of the train, this can be done by having the stop-cocks properly manipulated by a person outside of the tunnel under the direction of the engineer who can use the continuous electrical track E and the key K for that purpose. In order to permit the train to be moved in an opposite direction from that which it ordinarily pursues when traveling continuously in one direction around the tunnel, the cars at both ends of the train are supplied with inclined bars P^2, for swinging the partitions up into vertical positions; also for shoes for depressing the locking-spring *b′*, the connection of the electrical tracks E^2 E^2 with the generators and magnets is such as to automatically release the devices which lock the partitions, and also to so operate the stop-cocks and to insure air-cushions between the partitions and the advancing train in whichever direction the train be moving.

In Fig. 7 I have shown in plan view a circuit breaking and closing key and a sounder of ordinary construction, by means of which the engineer may signal or hold communication with an operator at any of the stations through the circuit E, as has been hereinbefore described.

Having thus described my invention and its operation, what I claim as new, and seek to secure by Letters Patent, is—

1. In combination with an air-tight pneumatic tunnel having rails for the support and transmission of carriages, a series of electrical tracks having electrical connections for automatically starting and stopping the running of trains, as shown and described.

2. In combination with an air-tight pneumatic tunnel with vacuum and compressed-air connections, having a railway-track and electrical tracks forming electrical connections and circuits, a piston-car, C, provided with keys K, K′, and K^2, having insulated metallic rollers at the lower end, and provided with collars and springs for opening and closing the electrical circuits, as shown and described.

3. In combination with the pneumatic tunnel with vacuum and compressed-air connections, having a railway-track and electrical

tracks, a piston, P, provided with openings O, O′, and O², and tubes *o′* and *o²* for regulating the air-pressure, as shown and described.

4. In combination with vacuum and compressed-air machines, the pneumatic air-tight tunnel A with its valve-door B, rails R R, electrical track E, E′, and E², piston-car C, and tubes N and J, geared lever *l*, electrical generators G and G′, magnets M, M′, and M², and conducting-wires, as shown and described.

5. In a pneumatic railway, the method of checking and stopping a car or train of cars by admitting a volume of compressed air before it automatically by means of a series of electrical connections therewith to act as an air-cushion, as shown and described.

6. In a pneumatic railway, the method of starting, stopping, and regulating the running of the trains, which consists in applying or removing the motive power by means of a series of electrical connections therewith under control of the operator within the car, as shown and described.

7. In a pneumatic railway, the method of accelerating the motion of the train by introducing compressed air in the rear automatically by means of a series of electrical connections therewith.

8. In a pneumatic railway, the combination, with an air-tight pneumatic tunnel, of rails for the support and transmission of carriages, a permanent electrical conductor, a circuit-breaker mounted upon the car, and means for connecting the circuit-breaker with the permanent conductor, substantially as set forth.

9. The combination of the following elements—namely, in a pneumatic railway, an air-tight tunnel, rails for the support and transmission of carriages, a partition transverse to the tunnel, a piston carried by the car and adapted to compress air between the partition and the advancing car, and an air-brake mechanism, V, mounted upon the car and constructed with an opening communicating with the space between the piston and the partition to admit compressed air to the brake, substantially as set forth.

10. In combination with a pneumatic tunnel with vacuum and compressed-air connections, having a railway-track, a piston provided with openings to receive compressed air from in front of the train and conduct it to the rear of the train, substantially as set forth.

11. In combination with an air-tight pneumatic tunnel with vacuum and compressed-air connections, and having a railway-track, a piston-car provided with openings adapted to admit air through the piston into the car, substantially as set forth.

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