No. 612,402. Patented Oct. 18, 1898.

C. COMSTOCK.

ATMOSPHERIC RAILWAY SYSTEM.

(Application filed July 28, 1897.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

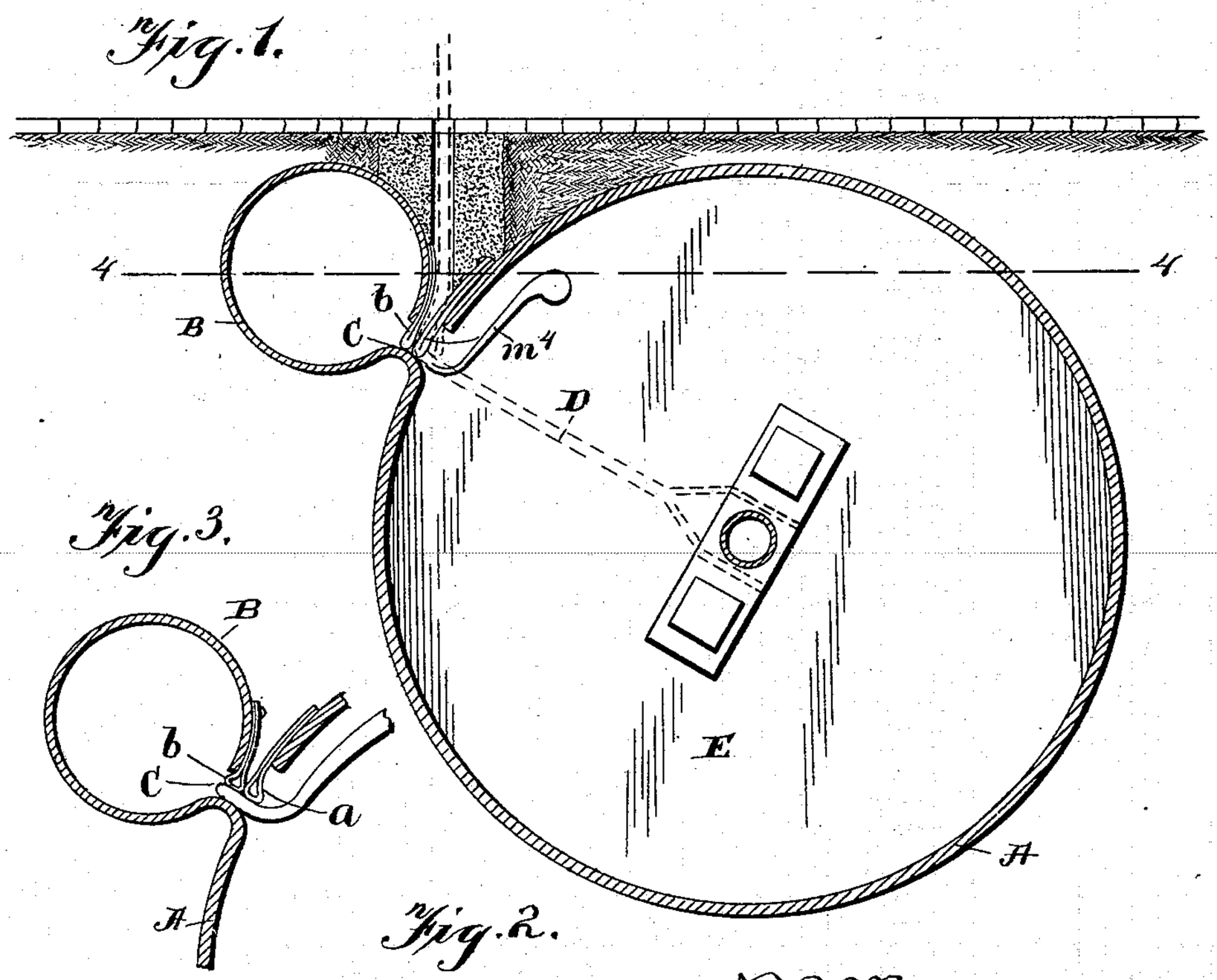
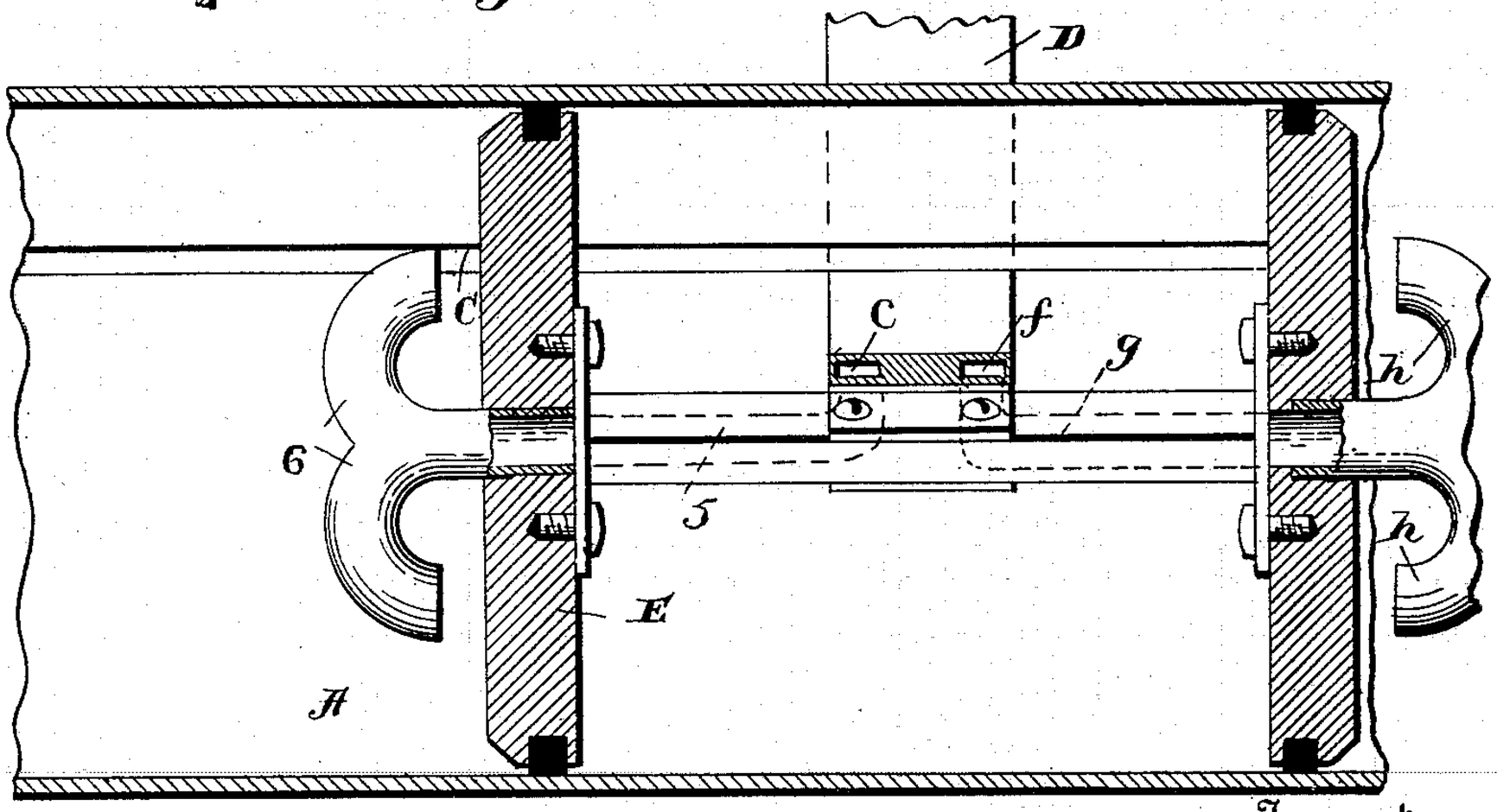


Fig. 3.

Fig. 2.



Witnesses
Geo. E. Frech,
B. E. Seitz.

Inventor
Charles Comstock,
by Pattison & Neblett,
Attorney's

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 612,402. Patented Oct. 18, 1898.

C. COMSTOCK.

ATMOSPHERIC RAILWAY SYSTEM.

(Application filed July 28, 1897.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 4.

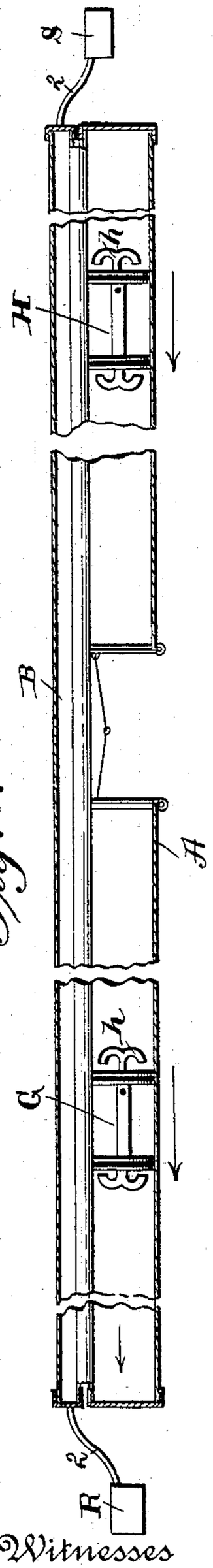


Fig. 6.

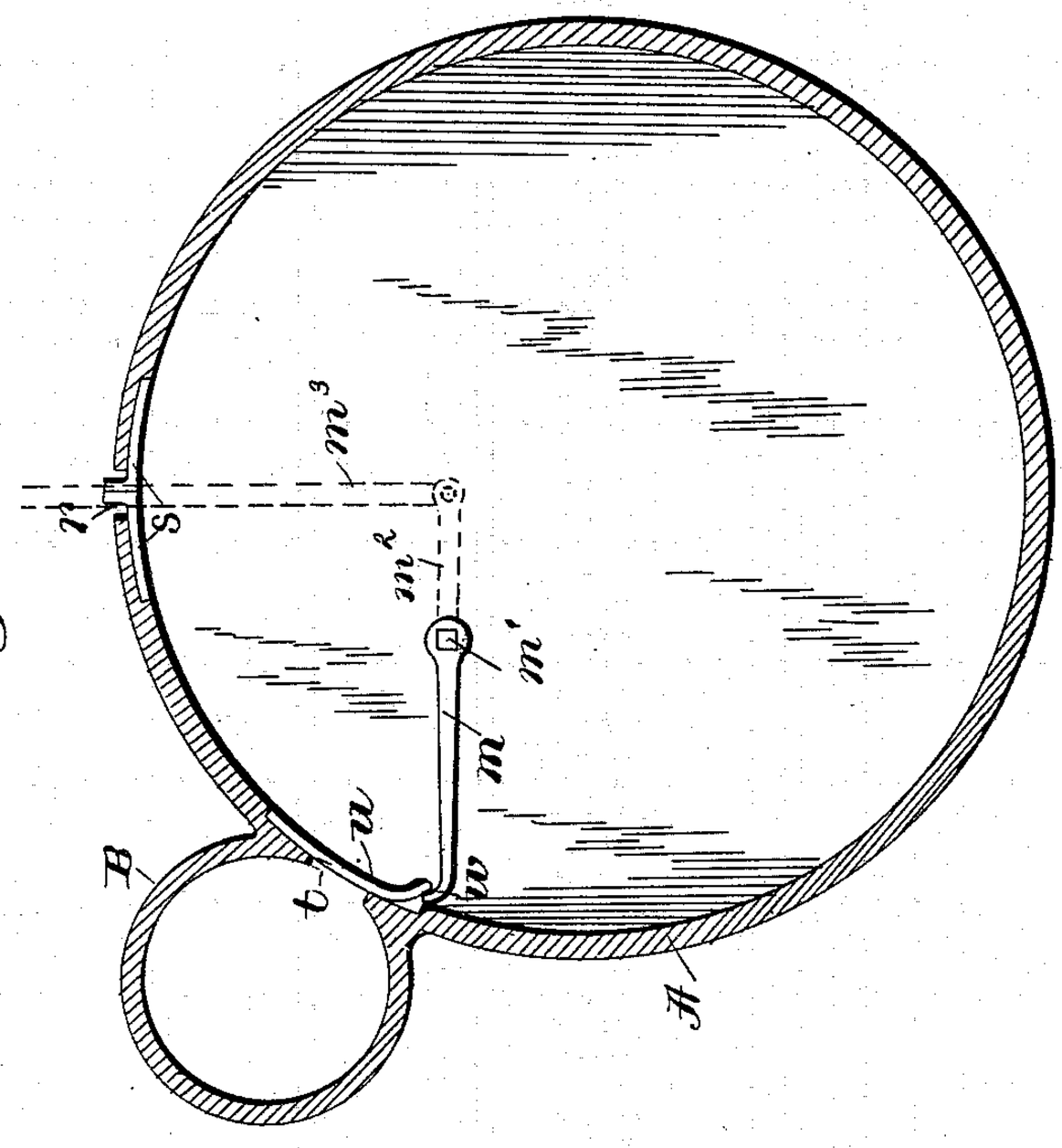
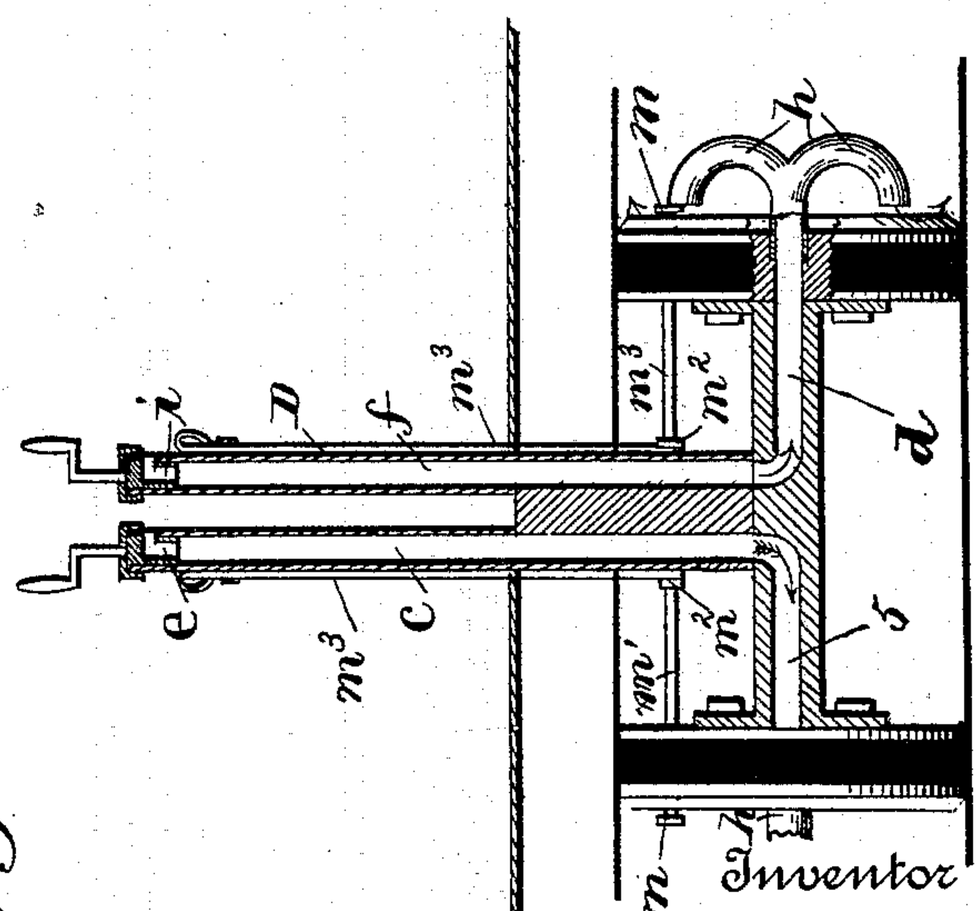


Fig. 5.



Witnesses
Geo. E. Fuchs.
B. E. Seitz

Inventor
Charles Comstock,
by Pattison & Neslit
Attorney's

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 612,402. Patented Oct. 18, 1898.

C. COMSTOCK.

ATMOSPHERIC RAILWAY SYSTEM.

(Application filed July 28, 1897.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 7.

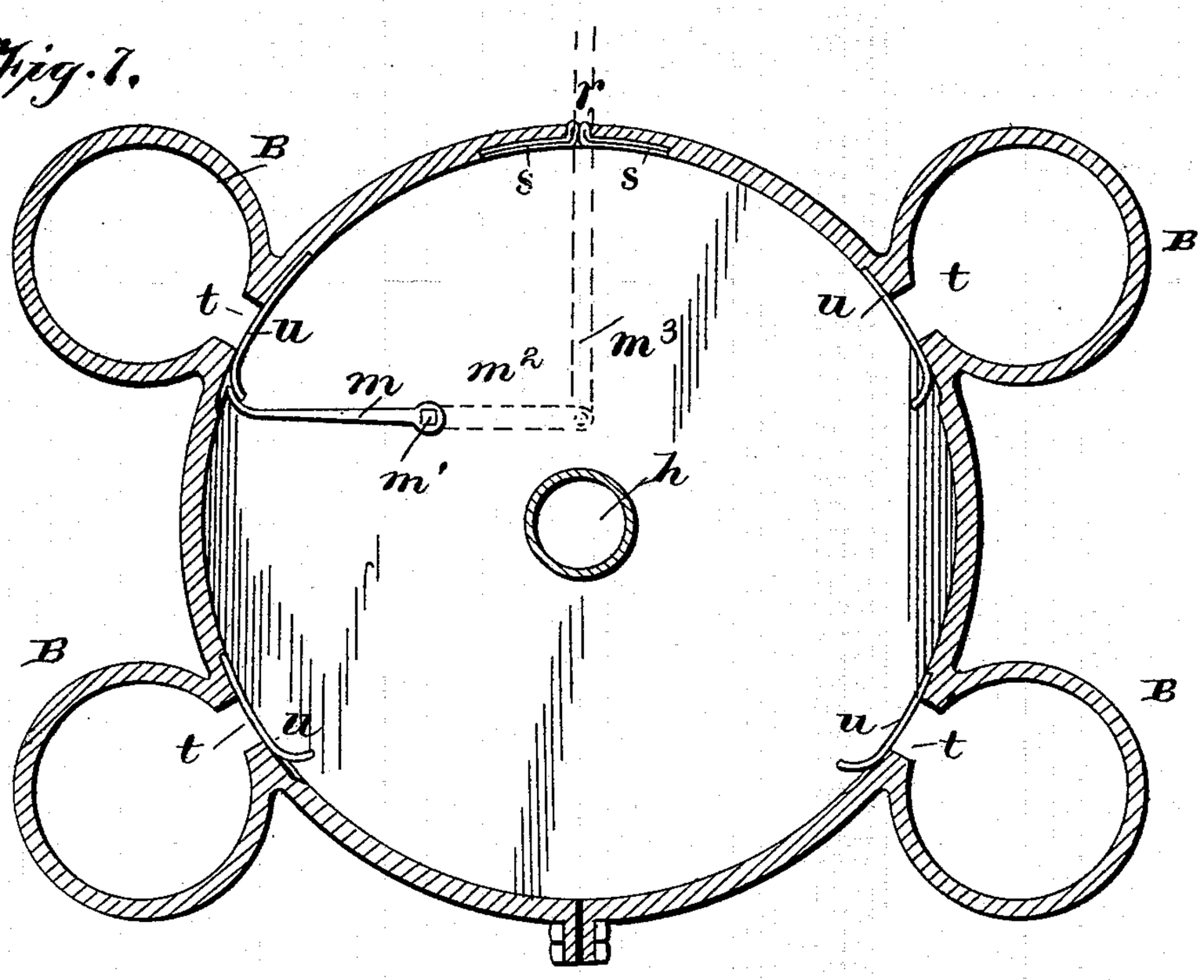


Fig. 8.

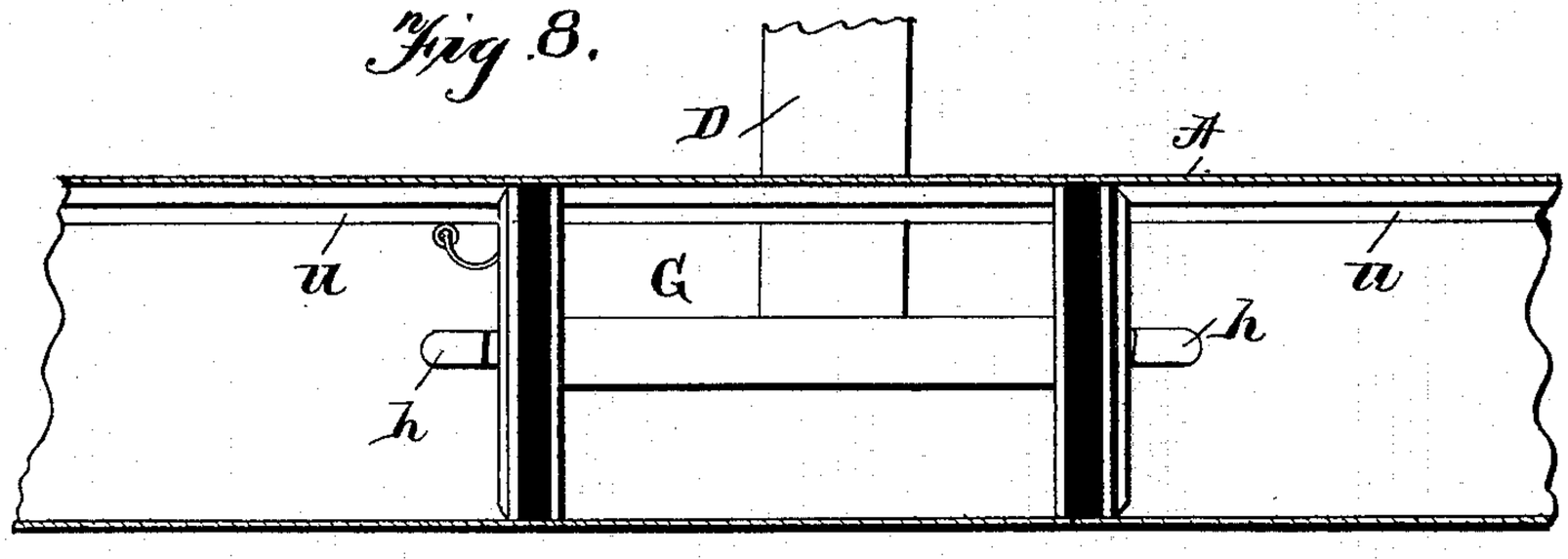
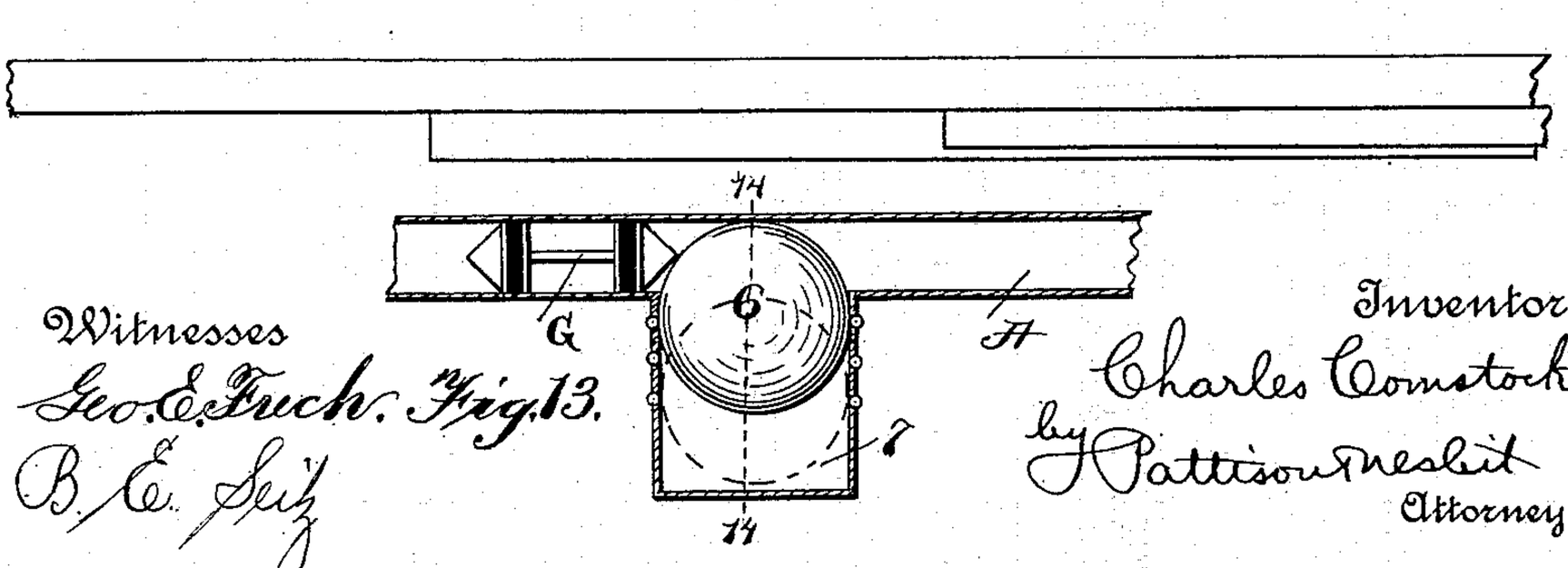


Fig. 9.



Witnesses
Geo. E. Fuch.
B. E. Seiz

Inventor
Charles Comstock
by Pattison & Neslit
Attorney's

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 612,402. Patented Oct. 18, 1898.

C. COMSTOCK.

ATMOSPHERIC RAILWAY SYSTEM.

(Application filed July 28, 1897.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 10.

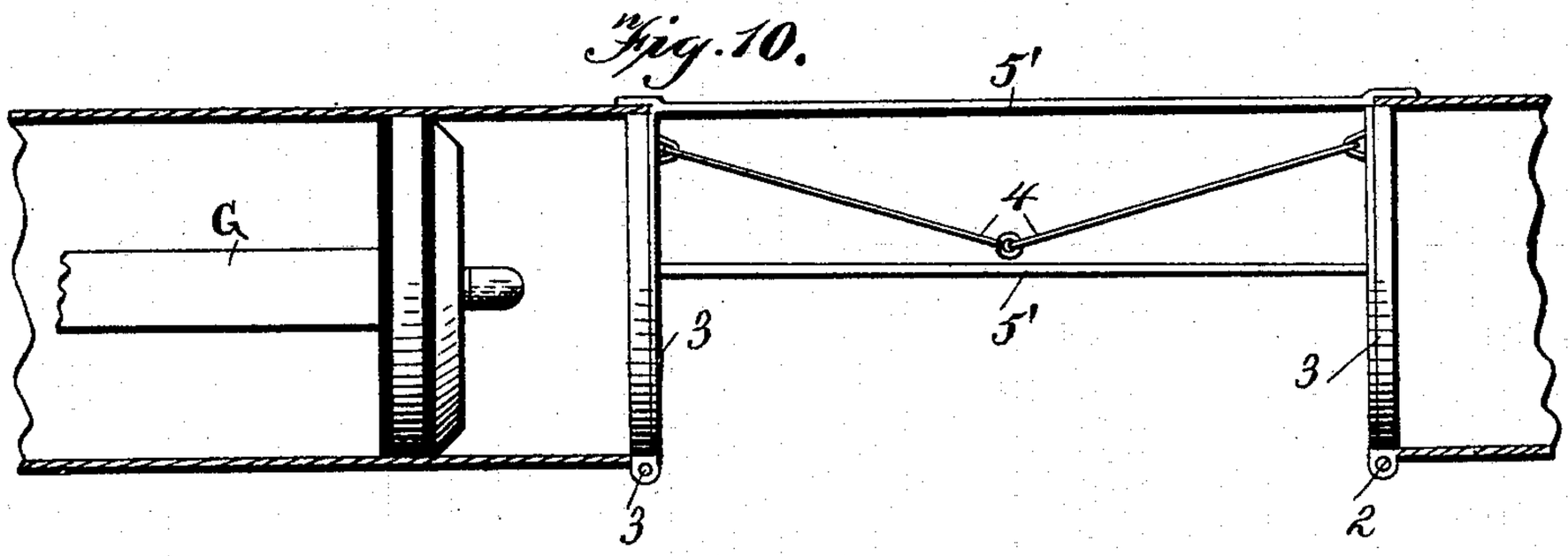


Fig. 11.

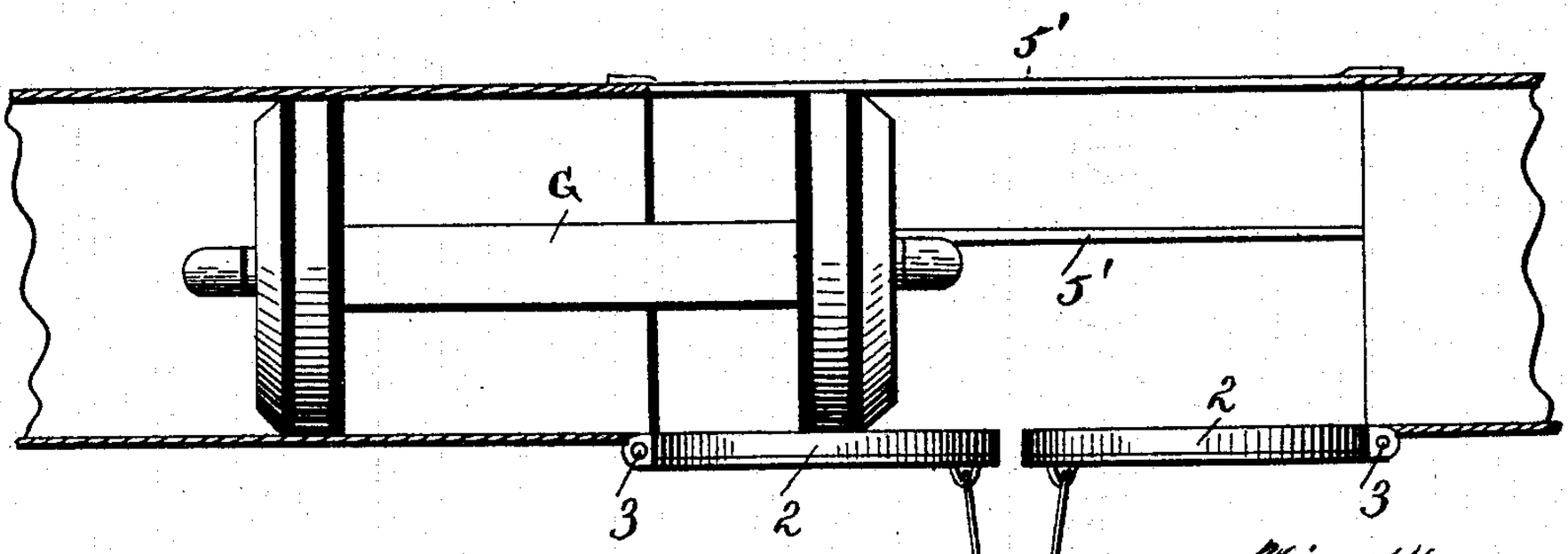


Fig. 14.

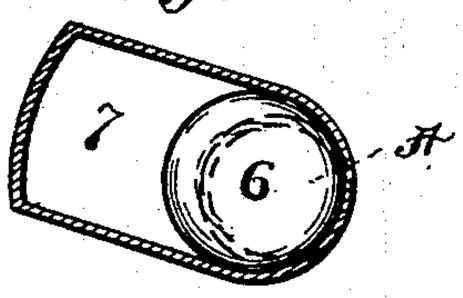
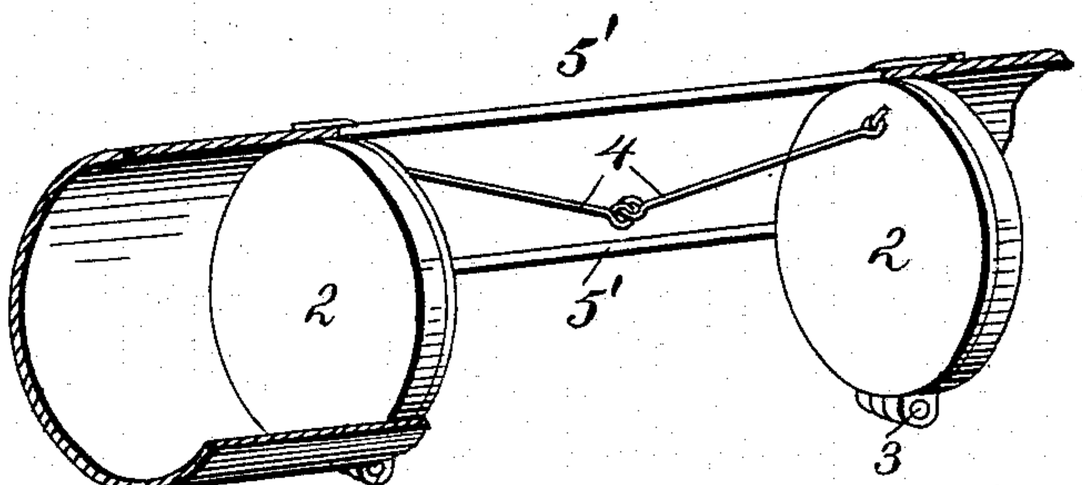


Fig. 12.



Witnesses
Geo. E. Frech.
B. E. Seitz

Inventor
Charles Comstock,
by Pattison & Neslit,
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES COMSTOCK, OF RICHMOND, VIRGINIA.

ATMOSPHERIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 612,402, dated October 18, 1898.

Application filed July 28, 1897. Serial No. 646,238. (No model.)

To all whom it may concern:

Be it known that I, CHARLES COMSTOCK, of Richmond, in the county of Henrico and State of Virginia, have invented certain new and useful Improvements in Atmospheric-Railway Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in atmospheric-railway systems of that type in which an air-tube is used containing a piston connected with the car and atmosphere admitted in rear of the piston, whereby atmospheric pressure is used to propel the car, the system being adapted to propel a number of cars or trains, all of which will be fully described hereinafter.

The object of my invention is to cheapen the construction of this type of atmospheric systems and to greatly simplify and improve the system, whereby the greatest economy in construction and in operation, as well as in maintenance, is secured.

In my present system the propelling-tube is composed of separate sections having closing-caps or ends adapted to be automatically opened and closed as the piston of the car passes along the tube, whereby the pistons of the several cars occupy, respectively, the several sections of the propelling-tube, which enables me to secure a maximum atmospheric power, and I provide one or more auxiliary tubes connected with the propelling-tube, the communication being constructed and adapted to be opened at any point throughout the propelling-tube, either in front or in the rear of the piston, at the will of the operator.

Another object of my invention is to provide means for admitting air at the will of the operator either in front or in the rear of the piston and to provide means for establishing communication between the auxiliary tubes and the propelling-tube either in front or behind the piston, whereby the piston, and consequently the car attached thereto, may be propelled backward or forward at any point throughout the propelling-tube at the will of the operator.

In operation the auxiliary tube or tubes, as the case may be, are the exhausting-tubes, to which the pump is attached, the air being exhausted from the propelling-tube through and by communication with the auxiliary tube at any point throughout the length of the propelling-tube.

Referring now to the drawings, Figure 1 is a vertical cross-sectional view of the propelling and the auxiliary tubes. Fig. 2 is an enlarged vertical longitudinal sectional view of the piston and its appurtenances, the piston being shown in position in the propelling-tube. Fig. 3 is a sectional view transverse the auxiliary tube and a portion of the propelling-tube, showing one form of closing means in a position to establish communication between the auxiliary tube and the propelling-tube. Fig. 4 is a top sectional view of the propelling-tube and its auxiliary tube, the propelling-tube being shown in section and a plurality of pistons therein. Fig. 5 is a separate vertical longitudinal sectional view of the piston and its extension for connecting it to the car and the means for controlling the admission of air, a vertical standard being shown and adapted to be used in connection with the construction of propelling-tube shown in Figs. 6 and 7. Fig. 6 is a vertical transverse sectional view of the propelling-tube and its auxiliary tube, showing a different manner of closing the opening between them and having a separate opening for the piston extension. Fig. 7 is a transverse sectional view of the propelling-tube, showing a plurality of auxiliary tubes. Fig. 8 is a separate view of the piston within the propelling-tube, showing a spring-supported roller for pressing into position the closing means between the two tubes. Fig. 9 is a diagrammatic view showing the propelling-tube and a series of auxiliary tubes of different lengths connected with the sections of the propelling-tube. Fig. 10 is an enlarged sectional view showing the propelling-tube and the gates for closing the adjacent ends thereof, the gates being shown closed. Fig. 11 is a similar view, the gates being shown open. Fig. 12 is a detached perspective view of the gates and the adjacent ends of two sections of the propelling-tube. Fig. 13 is a longitudinal sectional view looking down upon the propelling-tube and

showing a ball for dividing the tube into sections. Fig. 14 is a vertical sectional view on line 14 14 of Fig. 13.

Referring now to the drawings which form a part of this specification, A indicates the propelling or main tube, in which the pistons are placed for propelling the cars or train. As shown in Figs. 1 and 6, (which construction I will first describe,) a single auxiliary tube B extends parallel the propelling-tube A, and C is a longitudinal opening extending from end to end of the tubes, thus forming a communication between them throughout their entire length. The communication C of course is throughout only that portion of the auxiliary tube B which extends along the several sections A of the propelling-tube, there being no opening or communication in the auxiliary tube at the intervening space between the ends of the sections of the propelling-tube. This space C, as shown in Fig. 1, is closed by means of a flap *a*, preferably doubled, as shown, which is secured to the tube A and extends throughout its length, and a second flap *b*, secured to the tube B and extending across its face or opening, the flap *b* being also doubled, as illustrated. These flaps are sufficiently flexible to be forced laterally by the extension D from the car, which passes into the propelling-tube and is attached to the piston E, while at the same time the two flaps together are sufficiently stiff to prevent them being drawn laterally by the vacuum formed in the propelling and auxiliary tubes. However, any other form of movable closing member or members may be provided for this opening without departing from the scope and spirit of my present invention.

As shown in Fig. 5, the extension D is provided with two vertical passages, the one *c* in front communicating through the piston-stem opening 5 with the pipes 6 for admitting atmosphere in front of the piston, and the one *f* in the rear communicating through a passage *d* with the pipes *h*, which preferably deliver air directly against the rear head of the piston, while the pipes 6 also preferably deliver air directly against the front head of the piston. The opening *c* is controlled by a valve *e*, and the opening or passage *f* by means of a valve *i*. Through the medium of these valves any desired amount of air can be admitted, either in front of the piston or in the rear thereof, either separately or simultaneously at the will of the driver for the purpose, as will be described hereinafter, of controlling the movements of the piston, and consequently the movements of the car or train attached thereto.

Referring now particularly to Figs. 5 and 6, it will be noted that the means shown in Fig. 6 for closing the opening or communication between the auxiliary tube B and the propelling-tube A consists of a flexible flap *u*, having its outer edge turned outward, as clearly illustrated. Situated at the outer side of each piston-head is an arm *m*, attached to the outer end of a shaft *m'*, the said shaft extending through the head of the piston adjacent to the front and rear sides of the extension D and having connected with an oppositely-extending crank or arm m^2 an operating handle or rod m^3. By depressing either of the operating-rods m^3 the outer end of its arm *m* is forced upward in contact with the outturned edge *w* of the flap *u* and carrying with it, as will be readily understood, the flap *u*, forcing it out of contact with the tubes, thereby establishing communication either in front or in the rear of the piston. This operation controls the movement of the piston, as will be described hereinafter.

In Figs. 1 and 3 an arm m^4 serves the same function as the arm *m* in Figs. 5 and 6 by forcing upward the flaps *a* and *b*, as illustrated in Fig. 3, thus establishing communication between the auxiliary and the propelling tubes.

I prefer the form shown in Fig. 6 for closing the space C or communication between the two tubes by means of the flap *u*, heretofore referred, and in that it permits the passage of the extension D through the top of the propelling-tube instead of through the side and then bent upward, as shown in Figs. 1 and 3. This construction is cheaper than the road-bed in not requiring the building of a conduit between the two tubes, as illustrated in Fig. 1. In Fig. 6 the opening at the top can be closed, and preferably is closed by rubber or leather strips *s*, preferably of a doubled form, the strips adapted to be separated by the extension of the car as it moves along and to close after it. If desired, a roller may be used in the rear of the extension to carry the two strips positively together, though it is deemed not necessary, as the strips themselves normally move together and are aided by the vacuum from the inside of the propelling-tube.

In the several figures I show the auxiliary tube B formed as an integral part of the tube A, and they may be either cast, rolled, or otherwise shaped up from sheet metal. This construction is considered cheaper, and when made of sheet metal will greatly strengthen the propelling-tube and enable the use of thinner material, which is not only cheaper but easier to bring to the proper shape. However, the tubes may be constructed entirely separate and secured together in any desired manner without departing from the spirit of my invention.

Situated at each end of each section of the propelling-tube A is a swinging cap or gate 2, hinged at the end of the section, as shown at 3, and the adjacent head or gates 2 are connected through the medium of the loosely-connected rods 4.

In operation, as the piston moves along in the propelling-tube, the pipes at the front and rear ends of the piston or any other extension will strike one of the gates 2, turn-

ing it upon its pivotal point or hinge, and the gates being connected, as shown in Figs. 10, 11, and 12 by the rod 4, the opening of one gate or head causes the others to open and assume a parallel position, as shown in Fig. 11. The hinges 3 will preferably be strong spring-hinges of any ordinary construction, so that as soon as the piston has passed through the space between the sections of the propelling-tube the gates will automatically close and when closed are held so by the vacuum within the tube, as will be readily understood. This construction is simple and yet effective, whereby the propelling-tube is divided into a plurality of sections to be respectively occupied by the pistons of the cars or train, as is readily understood by those skilled in this art. In order to guide the pistons from one section to the other, parallel bars 5′ will be provided, connecting the ends of the sections, or any other construction may be provided. The heads of the piston will be preferably tapered, as shown at 7, so that guides may be entirely omitted, since the piston is rigidly connected with the car and will practically travel straight from one section to the other.

I will now proceed to describe the operation of my invention. The pistons G and H in Fig. 4, for the purpose of this description, represent cars or trains and they are traveling in the direction indicated by arrow. It will be noted that each piston is in a separate section of the propelling-tube, and in order to move the car forward in the direction indicated by arrow the driver operates the arm *m* in front of the car for establishing communication between the auxiliary tube B and the propelling-tube, which creates a vacuum in the front of the piston. The speed at which the piston moves forward in the propelling-tube will depend upon the amount of normal air admitted in the rear of the piston, and this is regulated through the medium of the valve *i*, as previously described. Pumps R and S are connected with the auxiliary tubes at each end thereof, preferably as shown in Fig. 4, though a single pump may be used, or a number of pumps throughout the length of the tubes, as may be found necessary, according to the requirements of any particular system.

By means of the construction herein described, whereby air may be admitted either in front or behind the piston within the propelling-tube and whereby communication can be established between the auxiliary tube and propelling-tube either in front or behind the pistons, it will be readily understood that the operator has the train entirely under his control either for forward or backward movements in the propelling-tube and at any point thereof. In the operation of the system the car will move across the space between the sections of the propelling-tube, which is only a short space, about equal to the length of the piston, as illustrated in Fig. 11, into the next section, when it is again taken by atmospheric pressure and carried forward at the will of the operator, as just described.

In systems of this character heretofore devised there has been no means whereby the trains can be made to move in opposite directions at the will of the driver from the car, and this is considered a very essential and important part of my invention.

In Fig. 7 I show a series of auxiliary tubes B, showing how a single tube may be used for each car, if desired, or the tubes may be of different lengths, as illustrated in Fig. 9, throughout the length of the system, whereby a single auxiliary tube may act upon one or a number of sections of the line instead of upon all of the sections, whereby the propelling-tube will have a greater exhausting action thereon, as will be readily understood. However, a single auxiliary tube in and ordinary system is considered sufficient to move the trains as rapidly as is desired in practice.

I do not limit myself to the particular construction of the several parts of my invention whereby the results are accomplished, as these may be readily changed and modified by skilled mechanics without departing from the scope and spirit of my invention—as, for instance, the closing means between the auxiliary and the propelling tubes may be varied from that here shown, the means for automatically closing the adjacent ends of the sections of the propelling-tubes may be varied from that shown, the means for admitting air in front and in the rear of the pistons may be modified from that here illustrated and described, and the specific mechanism for effecting communication between the auxiliary and the propelling tubes may also be modified or changed and without varying or departing from the broad idea of my invention.

While I have described spring-hinges for the end caps for closing them after the piston passes, it will be readily understood that weights may be arranged to effect the same purpose should they be deemed more reliable and less likely to get out of order.

One of the many ways in which the ends of the sections of the tube may be closed, in addition to the end caps heretofore described, is by means of a ball 6, adapted to roll across the tube, as illustrated in Fig. 13. The ball is much larger than the diameter of the propelling-tube, as shown, and is placed in a pocket 7, slightly elevated above the tube, so that it will of its own gravity roll into position therein. The end of the piston striking the spherical surface of the ball will force it back into its pocket until the piston has passed, when it will roll back into position, again closing the propelling-tube, as will be readily understood. A suitable packing of any form may be provided around the edges of the propelling-tube to coact with the ball for the purpose of making an air-tight joint. The pocket is also air-tight, so that the ball

extending across the tube will make as near as practicable an air-tight joint therewith.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith and capable of having communication with the propelling-tube throughout the length of the auxiliary tube, a piston within the propelling-tube, and a member moved by the piston and adapted to effect communication between the two tubes in advance of the piston, substantially as described.

2. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, the two tubes having a registering longitudinal opening forming communication between them, and a flexible closing means for said opening, substantially as described.

3. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending longitudinally of the same, the two tubes having registering longitudinal openings, a movable member or members closing the said openings, and the propelling-tube having a longitudinal opening independent of the auxiliary tube for the propelling member, substantially as described.

4. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, the tubes having a longitudinal communication, a movable member or members closing said longitudinal communication, a piston placed in and adapted to travel in said propelling-tube, the piston having a member which engages and moves the closing member in advance of the piston to effect a communication between the tubes, and a pump connected with the auxiliary tube, substantially as described.

5. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, the tubes having longitudinal openings forming communication between them, a movable member closing said openings, a piston within and adapted to travel in said propelling-tube, means in advance of the piston for effecting communication between the two tubes, and a pump connected with said auxiliary tube for exhausting the air therefrom, substantially as described.

6. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending longitudinally thereof, the tubes having a longitudinal opening effecting communication between them, a closing member or members for said openings, a piston adapted to fit and travel within said propelling-tube, a pump connected with the auxiliary tube for withdrawing the air therefrom, means in advance of the piston for effecting communication between the two tubes just in advance of the piston, and a communication between the atmosphere and the propelling-tube in the rear of the piston, substantially as described.

7. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending longitudinally of the propelling-tube, means for closing the said tubes, a piston traveling within said propelling-tube, a member traveling in advance of the piston and effecting communication between the said tubes in advance of the piston, a communication between the atmsophere and the propelling-tube in rear of the piston, and a controlling member for the atmospheric communication, substantially as described.

8. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, a longitudinal opening in said tubes effecting a communication between them, means for closing said opening, a pump connected with the auxiliary tube, a member in advance of and effecting a communication between the auxiliary tube and the propelling-tube in advance of the piston, and a communication between the atmosphere and the propelling-tube in rear of the piston and delivering air directly against the rear end thereof, substantially as described.

9. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel the same, an opening effecting communication between the tubes, a pump connected with the auxiliary tube to exhaust the air therefrom, a piston, means in advance of the piston for effecting a communication between the tubes in advance of said piston, and a communication between the atmosphere and the propelling-tube in the rear of the piston, substantially as described.

10. An atmospheric-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, a longitudinal communication between said tubes, a closing member for said opening, a means in advance of the piston for effecting communication to the tubes in advance of said piston, an atmospheric communication between the atmosphere and the propelling-tube in front of the piston for the purpose described.

11. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel the same, a longitudinal communication between the tubes, a member for closing said opening, a means for effecting communication between the atmosphere and the propelling-tube both ahead of and behind the piston, substantially as described.

12. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, a longitudinal opening for said tube, means for closing said opening, a member in advance of the piston effecting a communication between said tubes, and means for closing the opening before it is reached by the rear end of the piston, substantially as described.

13. A pneumatic-railway system compris-

ing a propelling-tube, an auxiliary tube extending parallel to the same, a longitudinal opening between said tubes, a movable member closing said openings, a means within the tube for effecting a communication between said tubes, and a pump connected with the auxiliary tube, substantially as described.

14. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube having communication therewith, a member for closing the communication, and a movable means carried by the piston for opening the closing means at the will of the driver, substantially as described.

15. A railway system comprising a propelling-tube, an auxiliary tube extending parallel therewith, and having a longitudinal communication in the propelling-tube throughout its length, the piston within the propelling-tube, a movable member closing the communication between the tubes, and movable members situated respectively in front and in the rear of the piston for engaging the closing members and effecting communication between the tubes, and means for operating the movable members for the purpose described.

16. A pneumatic-railway system comprising a propelling-tube, an auxiliary tube, a longitudinal communication between the said tubes, a closing member for the communication, a piston situated within the propelling-tube, a communication at each end of the piston with the atmosphere and means for controlling the said communication, and movable members carried by opposite ends of the piston for acting upon the closing member in front and in rear of the piston, the parts cooperating substantially as and for the purpose described.

17. A pneumatic-railway system comprising a propelling-tube formed into a series of sections, closing members for adjacent ends of the sections, and a piston adapted by contact with the closing members to open them as it moves in the propelling-tube, substantially as described.

18. A pneumatic-railway system comprising a propelling-tube composed of a series of sections, closing members for the adjacent ends of the sections, operating means connecting the closing members whereby when one is opened the other is similarly operated, the piston within the propelling-tube adapted to open the closing members, substantially as described.

19. A pneumatic-railway system comprising a propelling-tube composed of a series of sections, swinging closing members for the adjacent ends of the sections, means connecting the swinging closing members for operating them simultaneously, and a piston within the propelling-tube adapted to cause the closing members to stand open as the piston moves forward.

20. A pneumatic-railway system comprising a propelling-tube, composed of a series of separate sections, closing members for the adjacent ends of the sections, and an auxiliary tube extending the entire length of the propelling-tube and having communication with the separate sections thereof and spanning the space between the sections, substantially as described.

21. A pneumatic-railway system comprising a propelling-tube composed of separate sections, automatically opening and closing members for the adjacent ends of the sections, and an auxiliary tube in communication with the sections of the propelling-tube, substantially as described.

22. A pneumatic-railway system comprising a propelling-tube composed of separate sections, swinging members closing the adjacent ends of the sections, and rods connected at one end to the said swinging members and at their other ends to each other whereby when one member is opened the other is likewise operated, substantially as described.

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

CHAS. COMSTOCK.

Witnesses:
E. R. PHILLIPS,
J. A. LEACH.