(No Model.)

2 Sheets—Sheet 1.

J. M. THOMPSON & F. JONES.

PROPULSION OF CARS BY COMPRESSED AIR.

No. 352,985. Patented Nov. 23, 1886.

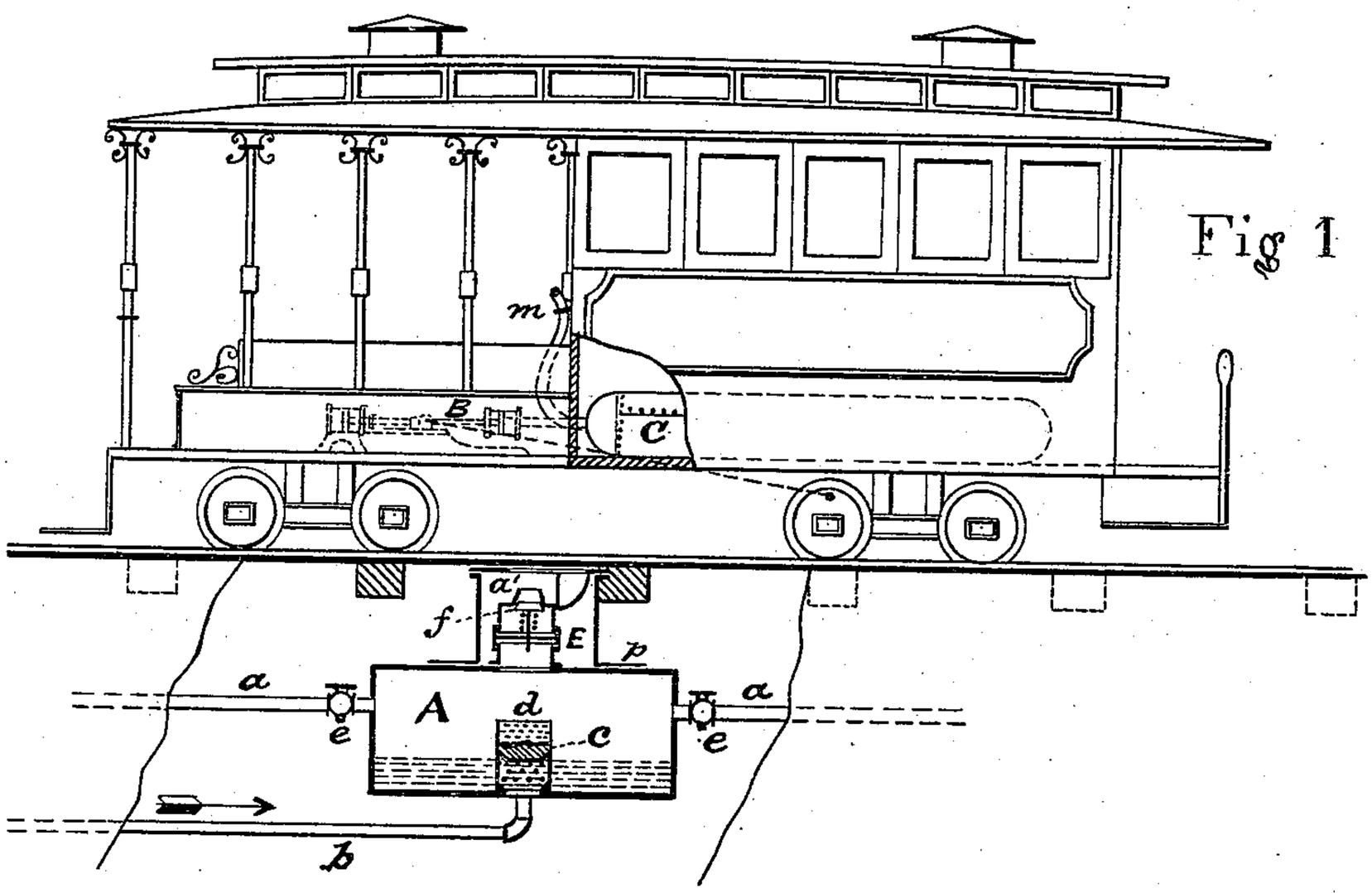

Fig 1

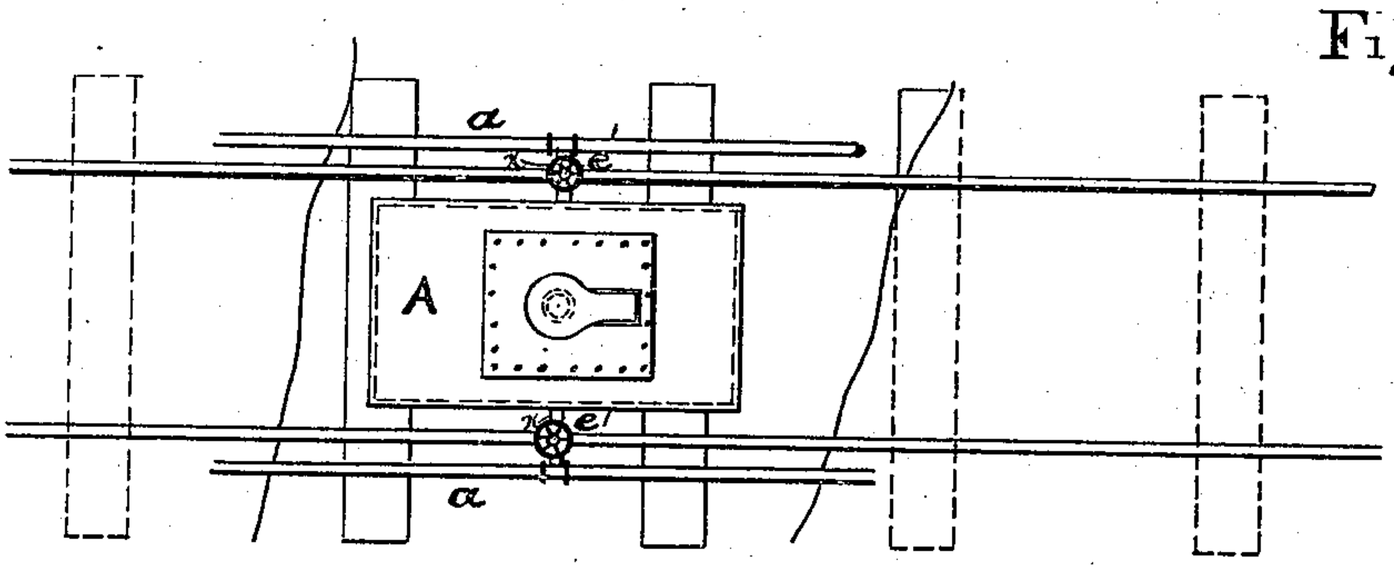

Fig 2.

Witnesses

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(No Model.) 2 Sheets—Sheet 2.

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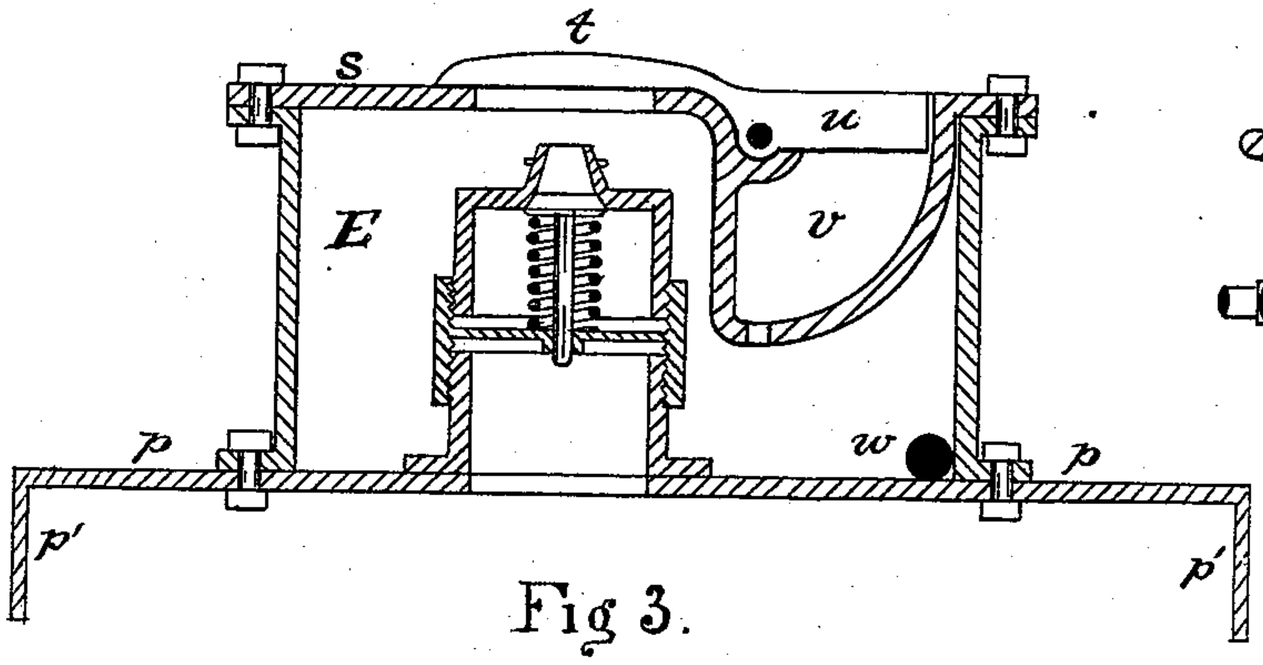


Fig 3.

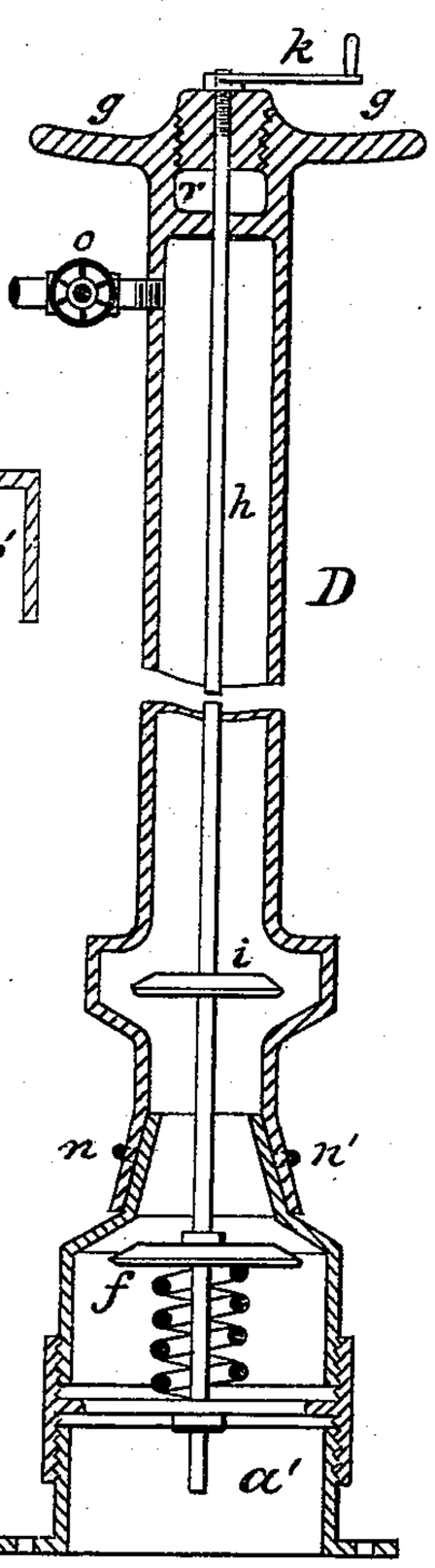


Fig 5.

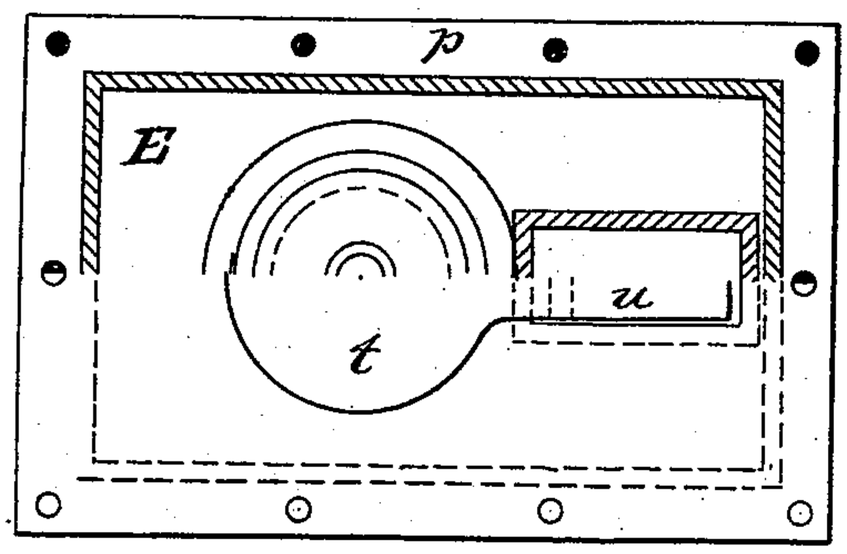
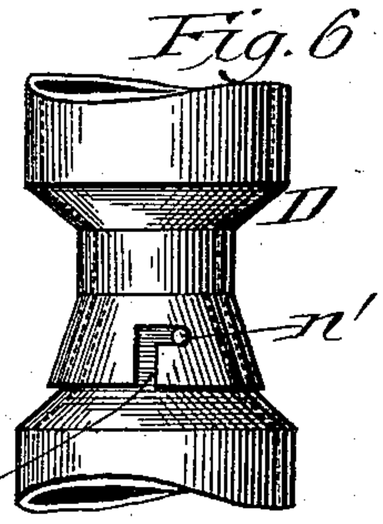


Fig 4.

Fig. 6



Witnesses.

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UNITED STATES PATENT OFFICE.

JAMES M. THOMPSON AND FREDERICK JONES, OF SAN FRANCISCO, CALIFORNIA; SAID JONES ASSIGNOR TO SAID THOMPSON.

PROPULSION OF CARS BY COMPRESSED AIR.

SPECIFICATION forming part of Letters Patent No. 352,985, dated November 23, 1886.

Application filed May 23, 1884. Serial No. 132,609. (No model.)

To all whom it may concern:

Be it known that we, JAMES M. THOMPSON and FREDERICK JONES, citizens of the United States, residing in the city and county of San Francisco, State of California, have invented a new and useful Improvement in the Means for Propelling Railway-Cars by Compressed Air, of which the following is a specification.

Our invention relates to the propulsion of cars on railways, and more especially on street-railways, by compressed-air engines placed on the cars, or on locomotives or "dummies" to which the cars are attached, and the means by which the compressed air is stored and kept at a uniform pressure and furnished to the air-receivers of said engines in an economical and expeditious manner; and the objects of our invention are, first, to provide a simple means for maintaining a regular air-pressure in the supply-pipes and reservoirs without increasing or decreasing the speed of the air-compressors; second, to expedite the passage or delivery of the compressed air into the air-receivers on the cars; third, to insure a constant supply of compressed air at all times; and fourth, to utilize the force of the cars when descending grades to compress air for their propulsion after descending the grades. We attain these objects by the improved appliances illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal view in part section showing a railway and a car in position on it, with its air-reservoir and engine and compressor, and a station air-reservoir with its pipes connecting it with the air-compressor. Fig. 2 is a plan view showing a section of a railway and a station air-reservoir with a double line of air-supply pipes, which connect it with the other station-reservoirs and the air-compressor. Fig. 3, Sheet 2, is a vertical section of the air-pipe with its spring-valve, and through which the compressed air is passed from the station air-reservoir into the car receivers, and also of its inclosed box or casing. Fig. 4, Sheet 2, is a plan view in half-section of the box or casing. Fig. 5, Sheet 2, is a longitudinal section of the "tapping" pipe or tool by means of which the compressed air is passed from the station air-reservoirs into the car receivers; and Fig. 6 is a view of the lower end of the same, showing one of the L-shaped slots in it for holding it in position.

Similar letters refer to like parts throughout the several views.

The station-reservoirs A are located at or near the points where compressed air is required for use, and they are connected by pipes *a a* with an air-compressor or a main reservoir, into which the air is forced or compressed by an air-compressor. These station air-reservoirs A are made with a capacity many times that of the car receivers, so that there will be but little diminution of the air-pressure within them when air is passed from them into the car receivers. Their preferable location is below the street-surface and immediately under the points near the street-crossings where the air is required to be passed from them into the car receivers; but in cases of two or more parallel railways one reservoir of larger capacity can be similarly situated in a position about midway between said points, and to which pipes can lead from said reservoir. In either case the pipes connecting the reservoirs, or leading from the single reservoir to the points where the air is required, must be of large diameter, so as to permit a rapid flow of air from one reservoir to the other and into the car receivers.

The station air-reservoirs A, and also the main reservoir near the air-compressor, and also at the points the most remote, (as hereinafter explained,) from which the compressed air is supplied through the supply-pipes *a a* to the station-reservoirs, can be of the ordinary construction, or constructed in the improved manner shown in Fig. 1, by which a uniform pressure of air is constantly maintained within them, even though nearly all the air should be drawn from them. This improved air-reservoir A has a water-pipe, *b*, at or through its bottom, which connects with a water-supply under pressure equal to the air-pressure required to be maintained in it, through which pipe *b* water will pass into or from the reservoir the instant the quantity of air within it is increased or diminished.

To prevent the passage of air from the reservoir into the pipe *b*, when the air-pressure within the reservoir may at any time exceed

the water-pressure and the reservoir become filled with air, a "float-valve," *c*, is provided and inclosed in a perforated box, *d*. This valvewill float on the surface of the water when there is any in the reservoir and allow it to pass into and from the reservoir; but when the water is forced from it by the air this valve *c* will fall into its seat and prevent any escape of air into the pipe *b*. When the air is passed both into and from the reservoir A through its top, the valve-guide *d* can also be extended to its top, to permit the valve *c* to float to the top when the air reserve is nearly exhausted and close the air-outlet pipe and prevent the passage of water into it. In cases where it is not convenient to have the station-reservoirs A constructed in this improved manner and placed under the surface of the street at or near the points where air is supplied from them to the car-receivers, those of ordinary construction can be used in their stead; or the station-reservoirs could be dispensed with entirely, and reservoirs of this improved construction can be located in a building or basement near and connected with the station-reservoirs, or the points where air is required by pipes, as in that position they would serve the purpose of preventing any diminution of the air-pressure when the air is being passed into the car-receivers nearly or equally as well as if they were in the position of the station-reservoirs.

One or more of the air-reservoirs located at or near the points where the air is required to be passed into the car-receivers can be made of large size and used as "storage-reservoirs," so that a sufficient amount of compressed air will be stored in them to supply that needed during the times when repairs may be needed, either of the compressor or air-supply pipes *a a* on account of the leakages that may occur.

To provide against delays from leakages in the pipe, we provide at or near its end, on each of its ends the most remote from the air-compressor, a large storage-reservoir, from which air will be supplied to those points between it and the point where a leakage may occur and repairs be needed; and to still better insure against delays which would occur from leakages when a single line of air-supply pipe is used we provide a double line of the pipes *a a*, as shown in Fig. 2, and connect them both with the station-reservoirs A, or with each other, through the points where air is needed to be passed into the air-receivers on the cars, and provide the stop-cocks *e e* on each side of said points or reservoirs, and also the stop-cocks *e' e'* on each side of the cross-pipes *x*, which connect them with each other or with the station-reservoirs A, by which either line of pipe *a* can be closed on each side of any "leak" or "break" that may occur in it, and a free air-passage opened around the break through the cross-pipes or reservoirs and the portion or section of the other pipe opposite the break or leakage.

On railways where there are grades we provide each car, locomotive, or "dummy" with a small air pump or compressor, B, which connects with the air-receiver C, and can be at any time instantly connected or disconnected with the piston of the air-engine, so that when the car is descending a "grade" the compressor can be operated by the force of the moving car, forcing air into the air-receiver C, which is afterward used in the propulsion of the car, while its downward force is lessened, so that there is less strain and wear on its "breaks."

To avoid as much as possible the lessening of the air-pressure by friction in the pipe or "main" *a*, and consequent loss of power, or to save the expense of erection and operation of two air compressors or engines, (when employed at each end of a railway,) we provide one, and locate it midway, or as nearly so as practicable, between the ends of the railway, and connect it with the air pipe or "main" *a*, which extends in both directions from it to each end of the track. By this arrangement two or more railways can also be operated in some cases with one air compressor or engine by locating it at a point as equidistant as practicable from all their ends and connecting it with all the mains of said railways.

The tapping pipe or tool D, for opening the spring-valves *f* in the supply-pipes and connecting the car-receivers C with the station-reservoirs A, so that air can be passed from the latter into the former, is shown in Fig. 5 secured in position on the upright supply-pipe or outlet-pipe *a'* from a station-reservoir. It consists of a tube or pipe of sufficient length for its upper end to extend a convenient distance up through a slot or opening in the bottom of the car or dummy when its lower end is secured to the upright supply-pipe *a'*. Its lower end is open and slightly enlarged, (so as to fit closely around the upright tapering ends of the supply or outlet pipes *a'*,) and has one or more L-shaped slots, *n*, formed in it, as shown, which serve the purpose, in combination with the projections *n'* on the pipe *a'*, when the tapping-tool is turned on the pipe *a'*, of tightening and holding the tapping-pipe firmly to it during the passage of air from the reservoirs A into the car-receivers C. Its upper end is provided with the cross arms or handles *g*, and is closed, with the exception of a round hole, through which the valve or "push" rod or arm *h*, having secured to it the valve *i*, is passed. This push-rod *h* has a crank or handle, *k*, at its upper end, and a screw-thread formed on it, which engages a female screw-thread formed in the upper part of the opening in the upper end of the tapping-pipe, and is made of proper length for its lower end to reach to or near the spring-valve *f* in the outlet or reservoir pipe *a'*, when the tapping-pipe is secured to it and the valves *f* and *i* are both closed.

A flexible pipe or hose, *m*, is connected with the tapping-pipe D at or near its upper end, and its other end is connected with the car-receiver C, so that when the tapping-pipe D is

connected and secured to the reservoir-pipe a', and the valves f and i are opened by forcing or "screwing" down the push-rod h, the air passes freely from the reservoirs A into the car-receivers C. Stop-cocks o are also provided in the tapping-pipe and car-receivers where the flexible pipe m is attached, to prevent the escape of air after the car-receiver is "charged" with air. A stuffing-box, r, is formed in the top of the tapping-pipe around the push-rod h, to prevent any escape of air in that direction.

To cover and protect the reservoir-pipe a', we provide an iron box, E. (Shown in Figs. 3 and 4.) When the air or station reservoirs are placed immediately under the points where the air is required to be passed into the car-receivers, the bottom of the box E can be so shaped as to fit and rest on the top of the reservoir, as shown in Fig. 1; or it can rest on the ground. In either case it is provided with broad flanges p at its bottom, so as to give it secure foundation to support the weight of the "street" travel over it. When it is not secured to the top of the reservoir, it can be provided with flanges p' p', depending from its bottom flanges, to the better insure against any lateral displacement.

The bottom of the box E is closed, with the exception of an opening to admit the reservoir-pipe a', and the joint around the pipe can be made "water-tight." Its top is provided with a close-fitting water-tight cover, s, in which an opening large enough to admit the lower end of the tapping-pipe D is made, and to which a pivoted cover, t, having its projecting arm u, is secured. The cover s also has formed in it the recess v, into which the arm u projects at all times when the cover is either opened or closed. The end of the recess v next the end of the arm u is made circular and the sides perpendicular, so as to fit around the arm at all times when it is pushed downward to open the cover s, and thus prevent any "dust" from falling into the box. A pipe, w, can connect from the box to a street-sewer or draw-pipe, to carry off any water or dirt that might accumulate in it.

The requisite water-pressure in the air-reservoirs A can in many cases be obtained by connecting the pipe b with the "city" water-supply pipes or "mains," and, even though the water-pressure in them should not be equal to the maximum air-pressure required in the reservoirs, it could not fall below that of the water-pressure, and the float-valve c will prevent the escape of air into the water-pipes when the air-pressure exceeds that of the water.

Having thus described our invention, what we claim is—

1. In a street-railway on which the cars are propelled by compressed-air engines, the station air-reservoirs A, situated below the street surface and track at each of the points where supplies of compressed air are needed for the said air-engines, and connected with each other and with an air pump or compressor by the pipe a, and each having in its top the upright air-outlet pipe a', with its end terminated below the street surface and containing the valve or stop-cock f, constructed and arranged in the manner substantially as and for the purpose described.

2. In a street-railway on which the cars are propelled by compressed-air engines, the combination, with the air-supply pipe or main a, laid along and near the track and below it and the street surface, and connected with an air-compressor, of the station air-reservoirs A, situated below the track and street surface at each of the points where compressed air is needed for said air-engines, and each having its upright air-outlet pipe a', with its end terminated below the street surface and containing the valve or stop-cock f, substantially as and for the purpose described.

3. The combination, with an air-reservoir having an air inlet and outlet pipe and a water inlet and outlet, of a water inlet and outlet pipe, b, connecting with a supply of water under pressure, and through which pipe it is passed into and from the reservoir, substantially as and for the purpose described.

4. In an air-reservoir having a water inlet and outlet pipe, the combination, with the perforated pipe or guide d, of the float-valve c, constructed and arranged substantially as and for the purpose described.

5. In a street-railway on which the cars are propelled by compressed air, the combination, with the air-supply pipe or main a, laid along and near the track and below it and the street surface, and having the upright air-outlet pipes a', with their ends terminated below and near the street surface, and containing the valves or cocks f, of an air pump or compressor connected with said pipe or main at one of its ends, and of a storage air-reservoir connected with it at its other end, substantially as and for the purpose described.

6. The tapping pipe or tool E, enlarged and slotted at its lower end and having the cross-arm or handle g, and outlet-pipe with its stop-cock o at its upper end, and provided with the push-rod h and the valve i, constructed substantially as and for the purposes described.

7. The box E, with its flanges p p' and cover s, having its pivoted cover t and recess v, and drain-pipe w, substantially as and for the purpose described.

8. In a street-railway on which the cars are propelled by compressed air, the box E, placed with its top at the street surface, and connected with a street-sewer by the drain-pipe w, and having an opening in its bottom to admit the upright air-outlet pipe a', and on its top the cover s over the end of said pipe, substantially as and for the purpose described.

9. In a pneumatic street-railway, the combination, with the air-supply pipe or main a, laid along and near the track and below it and the street surface, and having the upright air-outlet pipes a', with their ends terminated below and near the street surface, and con-

taining the valves or stop-cocks *f*, of an air-compressor connected with said pipe or main *a* at a point as midway as practicable between its ends and those of the track, substantially as and for the purpose set forth.

10. In a pneumatic street-railway, the double line of air-pipe *a a*, extending along the track, under the street surface, from and connected with an air-compressor and also with the station-reservoirs A, or with each other, through the points where compressed air is passed from either of them into the air-receivers on the cars by the cross-pipes *x*, which contain the cocks *e e* on each side of said reservoirs or points, and having the cocks *e' e'* on each side of said cross-pipes *x*, substantially as and for the purpose described.

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Witnesses:
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E. E. POWERS.