(No Model.) 2 Sheets—Sheet 1.

B. S. HENNING.

UNDERGROUND RAILWAY.

No. 432,615. Patented July 22, 1890.

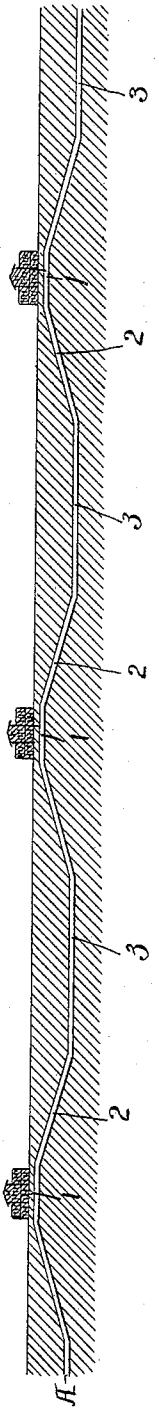


Fig. 1.

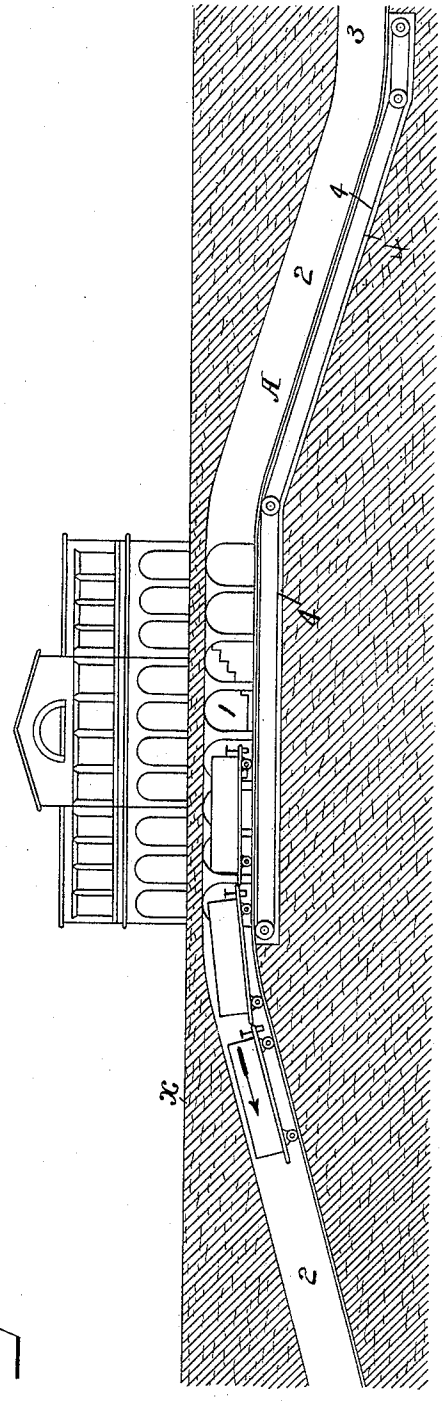


Fig. 2.

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Fig. 3.

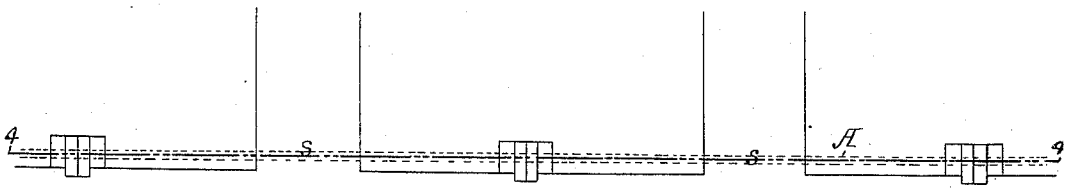


Fig. 4.

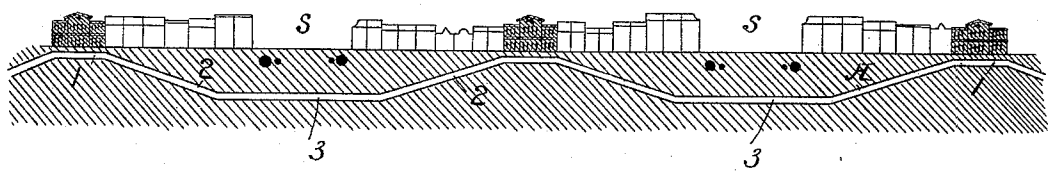
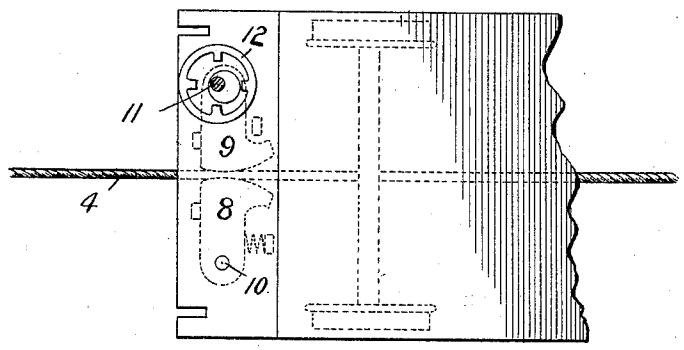


Fig. 5.



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UNITED STATES PATENT OFFICE.

BENJAMIN S. HENNING, OF NEW YORK, N. Y.

UNDERGROUND RAILWAY.

SPECIFICATION forming part of Letters Patent No. 432,615, dated July 22, 1890.

Application filed May 20, 1890. Serial No. 352,521. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN S. HENNING, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Underground Railways, of which the following is a specification.

The plans of rapid transit in cities heretofore carried into effect are open to many serious objections, among which are noise, dust, and smoke, the obstruction and defacement of thoroughfares, and obstruction incident to exposure to storms. The use of underground ways obviates some of these objections; but heretofore it has been necessary to arrange such ways near the surface, rendering it necessary to cross lines of sewers, pipes, &c., arranging the systems of such pipes at many points. It has been proposed to avoid these objections by lowering the level of the tunnels; but this is attended with the disadvantage of the employment of elevating apparatus at the different stations for raising passengers from the underground to the street-level. In order to obviate these objections to an underground system, as well as objections incident to the use of a separate motor for each train, I make use of the construction and means hereinafter described, and illustrated in the accompanying drawings, in which—

Figure 1 is a sectional view of part of an underground system embodying my invention. Fig. 2 is an enlarged sectional view at one of the sections; Fig. 3, a diagrammatic plan showing the arrangement of way and stations in a city; Fig. 4, a sectional elevation on the line 4 4, Fig. 3. Fig. 5 is a part plan of one of the cars.

The underground tunnel A extends continuously below the surface *x* of the ground, the tunnel being either parallel with a street or running in a direct line between terminal points, as may be desirable; but instead of being in proximity to the surface of the ground, as heretofore has been the practice, or instead of being throughout its length at a distance from said surface upon a continuous level with elevators or stairways leading upward at the stations, the said tunnel consists of a series of inclines in reverse directions and a series of high levels at the stations, but below the surface of the ground, and a series of low levels between said stations. Thus that portion 1 of the underground way A which is nearest to each station is level for such a distance as may be necessary to support a train of the greatest length, and while it may be at the surface of the ground in some instances is preferably below the same, but so near to the surface that passengers can reach the surface by ordinary stairways without objectionable efforts.

From the upper level 1 the track descends in opposite directions upon as steep an incline as is practicable or desirable toward the adjacent station, such inclined portion 2 being of any desired length and finally joining the lower level 3, which extends for any desired distance to the foot of the incline leading to the next station.

By this arrangement of upper and lower levels and intermediate inclines the greater portion of the underground track is at such a depth below the surface that the tunnel will in no way interfere with the pipe or sewer system of the city, while by arranging upper levels and inclining the track to and from the latter at the stations the passengers are carried by the vehicles to such a point at each station in proximity to the surface that they can reach the latter without material effort, thereby obviating the expense and loss of time connected with the use of elevators at the stations or the objections incident to long stairways.

While any desired motive power may be employed in connection with the underground tunnel and way constructed as above described, I prefer to utilize this construction to facilitate transportation. Thus it will be seen that as the cars pass from an upper level 1 onto an incline 2 they will be conducted by the force of gravity along the entire length of said incline and by the force of momentum along the lower level, and I place the stations at such distances apart that the lower level 3 will not exceed in length the distance that the cars will travel at a fair rate of speed under the momentum required in descending the incline, and with the incline upon which the cars must rise to the next level 1, as well as with the latter, I combine any suitable motor, Fig. 2, whereby the cars as their speed

diminishes will be driven at the proper rate of motion up the said incline to the said level, and after stopping thereon to discharge and take on passengers will be started upon said level and conducted to the head of the next incline, down which they will pass by gravity. It will thus be seen that for a major part of the distance the cars will be driven by gravity and momentum alone, so that an artificial motor is required only for a fraction of the distance that the cars have to travel.

Different constructions and arrangements of artificial motors may be employed. For instance, the cars may be provided with secondary batteries and electrical motors, the motor-power being only used and exhausted during the times for which the cars must move after they cease to be effectively carried by momentum, or they may be carried up the inclines and along the upper levels by means of short cable-sections 4, driven from suitable motors, as set forth in my Letters Patent dated August 13, 1889, No. 408,711. In the present instance, however, the cars travel continuously in one direction upon the track, the traveling cable-sections being combined only with the incline upon which the cars must ascend, and also extending along the upper level sufficiently to deliver the cars down the next incline.

To avoid the necessity of carrying the tunnel too far below the surface of the ground, it is preferable to arrange the stations adjacent to the centers of the blocks and as near midway between the streets as possible. This arrangement is illustrated in Figs. 3 and 4, from which it will be seen that by placing the stations midway in the blocks and between the streets *s s* the lowest portions of the tunnel are below the streets where the pipes and sewers are situated, while the higher portions are brought near the surface at the points where they will not materially interfere with such pipes and sewers.

By arranging the higher levels 1 near the surface, but below the surface and without breaking the latter, much valuable space is saved, only sufficient of an area of ground being required at each station to afford a proper outlet and inlet for the movements of passengers to and from the train.

While any suitable gripping appliances may be used for connecting the cars automatically or otherwise with the cable-sections 4, I have shown one arrangement in Fig. 5, consisting of two gripping-jaws 8 9, the jaw 8 swinging on a fixed pivot 10, and the jaw 9 swings on an eccentric secured to a shaft 11, capable of being operated by means of a hand-wheel 12.

While I have referred to lower levels, it will be evident that under some circumstances the opposite inclines might meet at the bottom without an intermediate level portion of any great extent.

Without limiting myself to the special arrangement and details shown, I claim—

1. The within-described system of transit in cities, comprising an underground way having upper and lower levels and intermediate inclines, the upper levels being at or near the surface at the passenger-stations, cars adapted to travel upon said ways, and motors therefor, substantially as set forth.

2. The combination, in a system of transit in cities, of a series of surface stations, an underground way having levels communicating with but below the stations and lower levels and intermediate inclined portions, and cars adapted to travel on said ways, substantially as set forth.

3. The combination, in a transit system, of a way having high and low levels and intermediate inclines, a traveling cable arranged in proximity to the incline traveled by the car in approaching the station and to the level of said station, and cars adapted to engage said cable, substantially as set forth.

4. The combination, with a way having a series of upper levels, a series of lower levels, and intermediate inclines, of traveling cables arranged in proximity to the inclines that are traveled upward by the cars and to the upper levels, and cars provided with means for gripping said cables and releasing the same, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

BENJAMIN S. HENNING.

Witnesses:

ALEX. CURTIS,

EDW. B. HAWKINS.