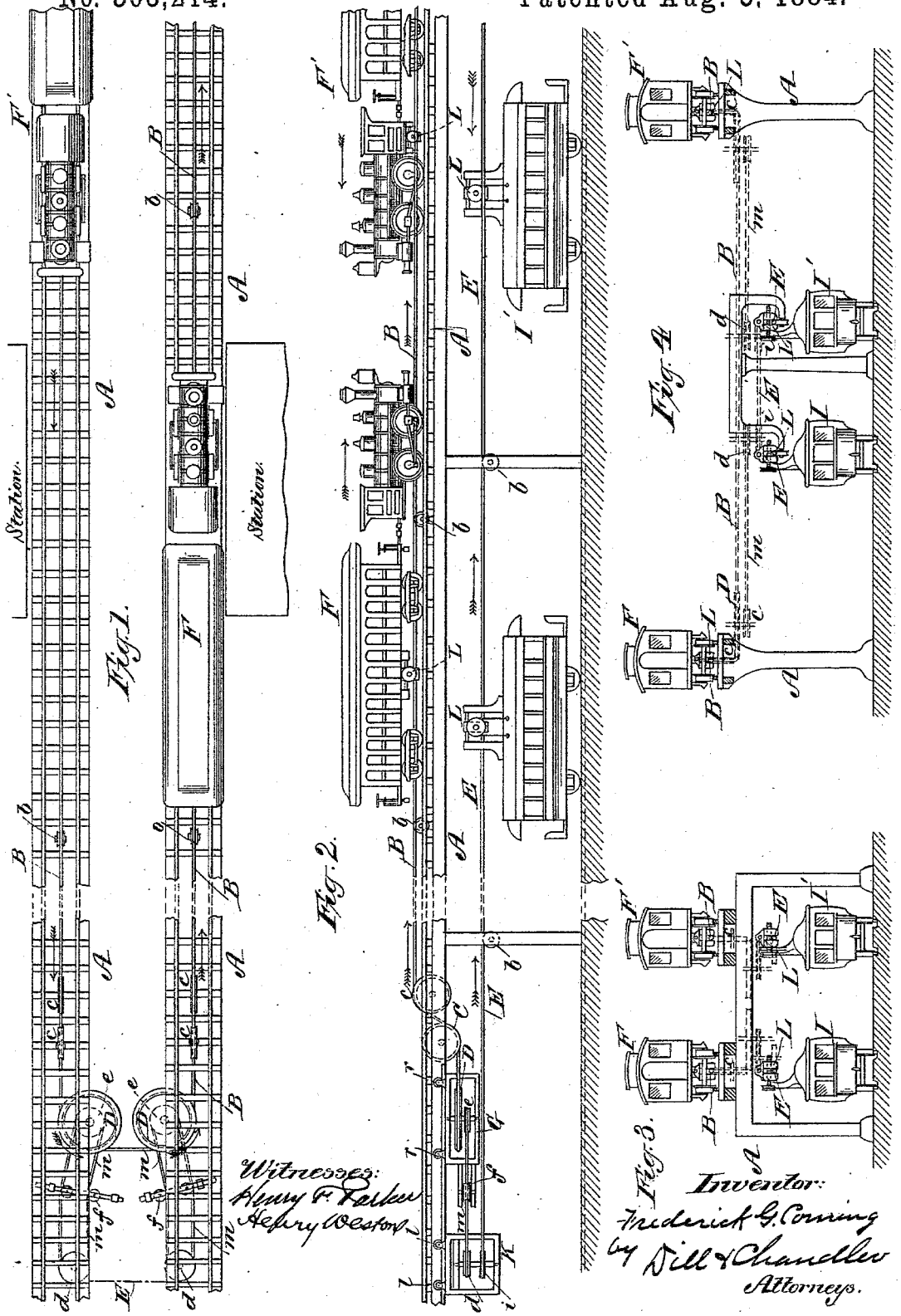
(No Model.) 3 Sheets—Sheet 1.

F. G. CORNING.

MECHANICAL OPERATION OF STREET CARS BY ENDLESS CABLE TRACTION.

No. 303,214. Patented Aug. 5, 1884.



Witnesses:
Henry F. Parker
Henry Weston

Inventor:
Frederick G. Corning
by Dill & Chandler
Attorneys.

(No Model.) 3 Sheets—Sheet 2.

F. G. CORNING.

MECHANICAL OPERATION OF STREET CARS BY ENDLESS CABLE TRACTION.

No. 303,214. Patented Aug. 5, 1884.

Fig. 6.

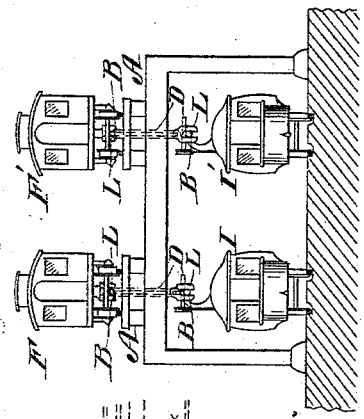


Fig. 8.

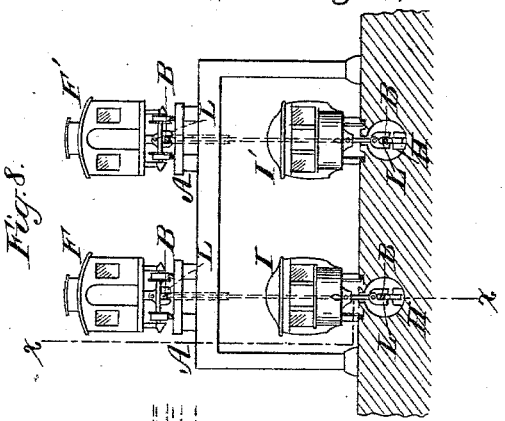


Fig. 5.

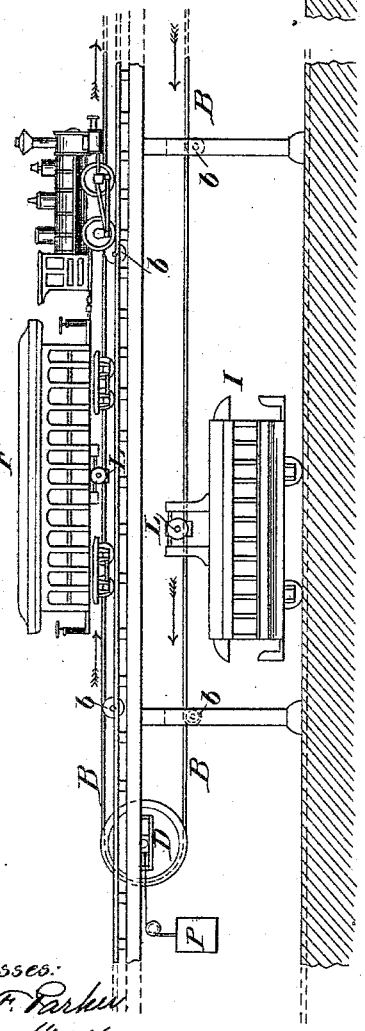
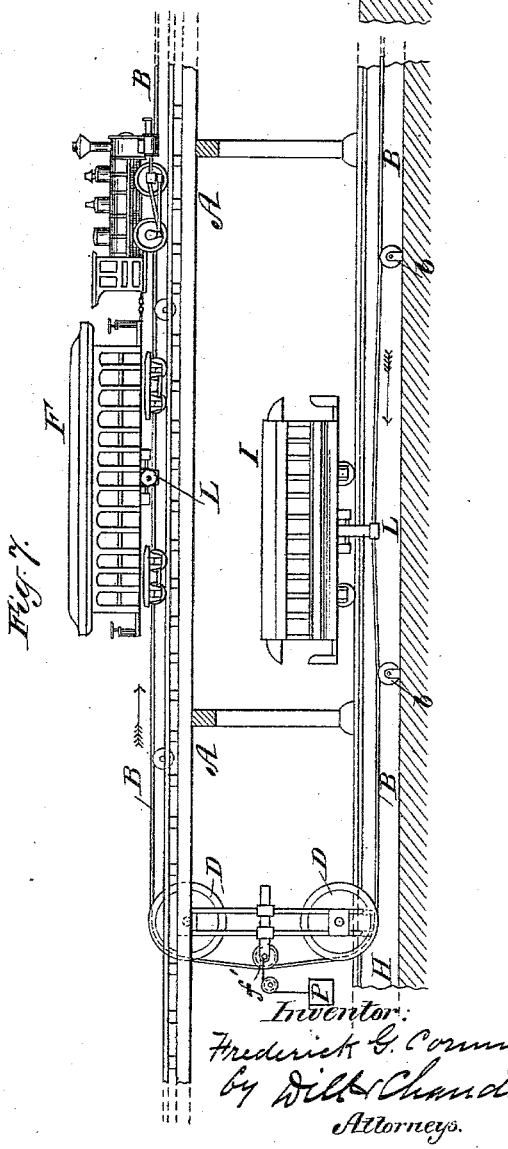


Fig. 7.



Witnesses:
Henry F. Parker
Henry Wetherop

Inventor:
Frederick G. Corning
by Dill & Chandler
Attorneys.

(No Model.) 3 Sheets—Sheet 3.

F. G. CORNING.

MECHANICAL OPERATION OF STREET CARS BY ENDLESS CABLE TRACTION.

No. 303,214. Patented Aug. 5, 1884.

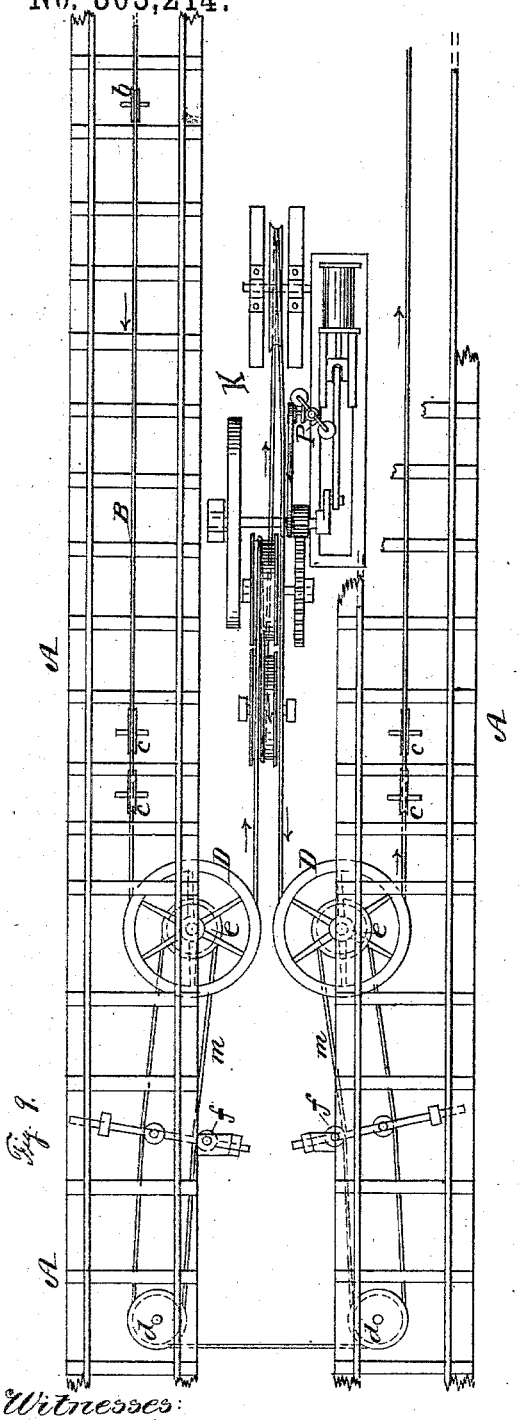


Fig. 9.

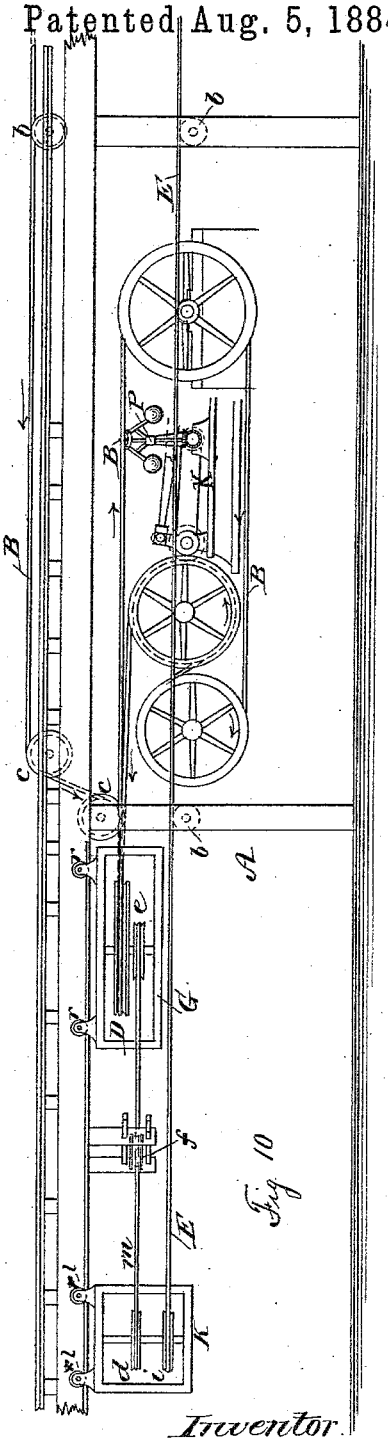


Fig. 10

Witnesses:
H. F. Parker.
H. C. Armstrong

Inventor.
Frederick G. Corning
by Dill & Chandlee
Attorneys

UNITED STATES PATENT OFFICE.

FREDERICK G. CORNING, OF BROOKLYN, ASSIGNOR OF FORTY-NINE ONE-HUNDREDTHS TO HENRY WESTON, OF NEW YORK, N. Y.

MECHANICAL OPERATION OF STREET-CARS BY ENDLESS-CABLE TRACTION.

SPECIFICATION forming part of Letters Patent No. 303,214, dated August 5, 1884.

Application filed December 29, 1883. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK G. CORNING, of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement for the Mechanical Operation of Street-Cars by Endless-Cable Traction; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification.

For the purpose of enabling others to apply the mechanism of my invention, I will describe its use and application thus:

My invention relates to a new system and combination of mechanical devices for operating street-cars conjointly with the operation of elevated railways, in which system the locomotives and trains upon such elevated railways constitute the common motor, in connection with the mechanical devices used, to cause directly by traction the continuous towing or working of endless cables, and indirectly the traction of cars on a lower plane, power being transmitted from the locomotives or trains or any suitable moving motors on such elevated railways, either directly or indirectly, through endless cables worked by grip-connections with such alternating sets of locomotives or trains, or both, running upon such elevated railways. The power is transmitted direct to the cars when the cable, operated as above indicated, by or on such elevated railways is the same which draws the cars on a lower plane by or under or over grip-connections, and indirect when a second cable worked through pulley transmission by the main elevated cable for the purpose of transmitting the tractive force to better advantage in point of velocity and direction, conformable to the existing location and requirements of the cars on a lower plane causes the traction of such cars.

I may use a stationary equalizing-motor connected with the main sheaves, as illustrated in Figures 9 and 10. The purpose of this equalizing-motor would be, first, to start the main elevated cable before the grip-connection is effected from the moving motors on the elevated railroad; second, to serve as a regulator or equalizer of power throughout the entire system when inequalities and variations in power of the circle of force created by different degrees of tractive power on the part of the alternately acting elevated motors shall make themselves manifest as a consequence of the inherent irregularities of elevated railroad traffic; third, in the event of accident to the moving motors, thus rendering them temporarily useless, to serve as the sole operating-motor of the entire system, or the stationary equalizer may be operated in such a manner as to decrease the tractive force of the elevated motors to a minimum.

I may operate motors on the elevated railways in such a manner as to start the cable system, and thus avoid variations in the towing or tractive force.

At one or both ends of a line of my system, or at suitable intermediate points, I arrange a tightening mechanism, to compensate for the expansion and contraction of the entire cable system with fluctuating temperatures. This contrivance consists of substantially three main parts: first, a frame-work carrying the main sheaves of the upper elevated cable, and which is movable on wheels, so as to slide backward or forward conformable to the expansion and contraction of the cable, holding the same at a constant tension; second, a similar contrivance carrying the lower sheaves to meet similar conditions incident to the lower cable; third, a differential slack-tightener to tighten or loosen the transmitting belting or cables, which will be the result of unequal expansion and contraction of the upper or elevated cable in the sun and the lower cable in the shade.

As the necessities of the case may require, the sheaves of the upper cable, and also of the transmitting cables, may be placed above the elevated structure on a plane with the same or just below the structure. The elevated or upper cable is situated between the tracks of the elevated railway, where it is conducted and kept in place by stationary guide-pulleys, or may be placed at the side of the tracks above the ties. Where the same in that position would interfere with switch-tracks and switch-

ing on the elevated railway, it is conducted by guide-pulleys and sheaves under the ties of the elevated rails, and again conducted back to its normal position on top of the ties when such switches shall have been passed.

I may have my main or upper cable disconnected and divided into sections, consisting of a series of endless cables in successive order. This system would be used to reduce the friction incident to acute curves, making two or more endless cables instead of a single one, thus lessening the friction consequent upon traction on horizontal guide-pulleys around such acute angles, all cables, however, to participate in operating the lower cable.

My system will also be used for operating cars on a lower plane running at varying angles to the line of the elevated road as well as for the operation of lines parallel to the same.

My invention also embraces other details of mechanism to be set forth in the description of the drawings and of the operation of the mechanism.

The mode of operation in my system is as follows:

In Fig. 1, in which A represents an elevated railway structure, and B the elevated and main cable resting on stationary guide-pulley *b*, the cable B is set in motion by grip-connection with locomotives F on elevated railway, and which cable B operates the sheaves D after being conducted under track by sheaves C. *m* are transmitting-cables from pulleys *e* to *d*, which are tightened and guided by differential slack-tightener *f*. This tightener consists of pulleys on movable arms, which can be extended or contracted in a direction vertical to the common tangent of *e* and *d*, which operates the system in conformity with foregoing general description.

Fig. 2 represents a side elevation of elevated structure, A showing motors F, moving in opposite directions, towing continuous cable B, and operating through transmitting lower cable, E, whereby cars I I′ are tracted. Transmission-pulleys *e* operate through transmitting-cables *m* transmission-pulleys *d*. The latter pulley, *d*, operates sheave *i*, which propels street-car cable E. The lower cable, E, guided and supported by pulleys *b*, thus set in motion, is utilized for the traction of cars I I′, drawn by connection with grip L. Sheaves C conduct cable B under elevated structure A to sheaves D. G is an expansion-frame carrying sheaves D and pulleys *e*, movable on rollers *r r*, for the purpose of tightening cable B. K is frame-work carrying pulleys *d* and sheaves *i*, movable on rollers *l l*, for tightening lower cable, E; *m*, transmitting-cables, and *f* their differential tightener. (More particularly shown in Fig. 1.)

Fig. 3 is a cross-section of Figs. 1 and 2, showing vertical symmetrical disposition of elevated and lower railways, in which F are the cars on the elevated structure; A and B, the elevated cable; C, the pulleys; E, the lower cable; L, the grips of the cars on the lower plane; I I′, the lower cars.

Fig. 4 illustrates a cross-section showing modification of system, in which the cars on the lower plane are at the side and between the elevated structure A, and parallel therewith, and operated by the same indirect system.

Fig. 5 is a side elevation representing the transmission direct, in which the endless cable B is operated in a vertical plane by the elevated motors F by means of the grip L, and the lower car, I, is operated by gripping to the lower half of cable B by means of grip L. D is the sheave of cable B, movable by any constant pressure, as represented by P, for the purpose of causing a constant tension of cable B.

Fig. 6 shows cross-section of Fig. 5, in which the cable B operates in a vertical plane in opposition to the indirect system shown in Figs. 2 and 3, in which figures the cables operate in horizontal planes, the mechanism used being the same as already described.

Fig. 7 represents sectional elevation of the direct system, in which the lower cable is conducted in underground conduits. Pulley *f′* and sheaves D constitute the tightening mechanism of this system, holding cable B in constant tension by means of weight P. H is underground conduit, in which lower half of cable B is conducted in guide-pulleys *b*. Car I is drawn by grip-connection L with cable B.

Fig. 8 represents a cross-section of Fig. 7, of which Fig. 7 is a longitudinal elevation according to the lines *x x*.

Fig. 9 represents a plan view of system as in Fig. 1, showing the stationary equalizer K operating the main cable B, which passes from main sheaves D around the traction or grip pulleys T of stationary equalizer K.

Fig. 10 represents side elevation of Fig. 9, showing the equalizing-engine K, with governor P and grip-pulleys T, by which main cable B, coming from sheaves D, is tracted and the entire system operated.

My system of running endless cables by means of elevated moving motors on existing elevated railways, and by such means operating cars on a lower plane, is not open to the objections of cable-traction systems heretofore in use, inasmuch as the original cost of construction, of operating, and of repairs is materially lessened, in addition to its possessing all the advantages of cable traction of street-cars over animal traction.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. The system of moving cars or carriages simultaneously on two or more roads, consisting of the combination, with the line of such two or more roads, of an endless cable mounted on and moving on running-gear parallel to the line of each road, and grip-connections of said cable with moving motors on one such

line, and with the cars or carriages to be mounted upon the other line.

2. The combination of an elevated railway-line having cars running thereon, and an endless cable drawn or tracted thereby, with a depressed or street-level line having cars thereon drawn or tracted by and from an endless cable connected with and operated by the elevated line-cable.

3. The combination, with a railway-line, of an endless cable operated by one or more moving motors attached thereto by grip-connections, and a series of cars operated and drawn by similar connections to such endless cable, or to a cable connected therewith.

4. The combination of two railway-lines operated on different levels, the cars of which are drawn or moved by grip-connections to a cable or cables connected and operated from one line to the other.

5. The combination of two railway-lines the cars of which are drawn or moved by grip-connections to a cable or cables connected and operated from one line to the other, and an equalizing-motor for regulating or modifying the speed of the cable of one line as transmitted to the other.

December 27, 1883.

FREDERICK G. CORNING.

Witnesses:

L. A. CHANDLER,

HENRY WESTON.