(No Model.) 3 Sheets—Sheet 1.

# H. ROOT.

## CABLE RAILWAY.

No. 285,514. Patented Sept. 25, 1883.

*Fig. 1.*

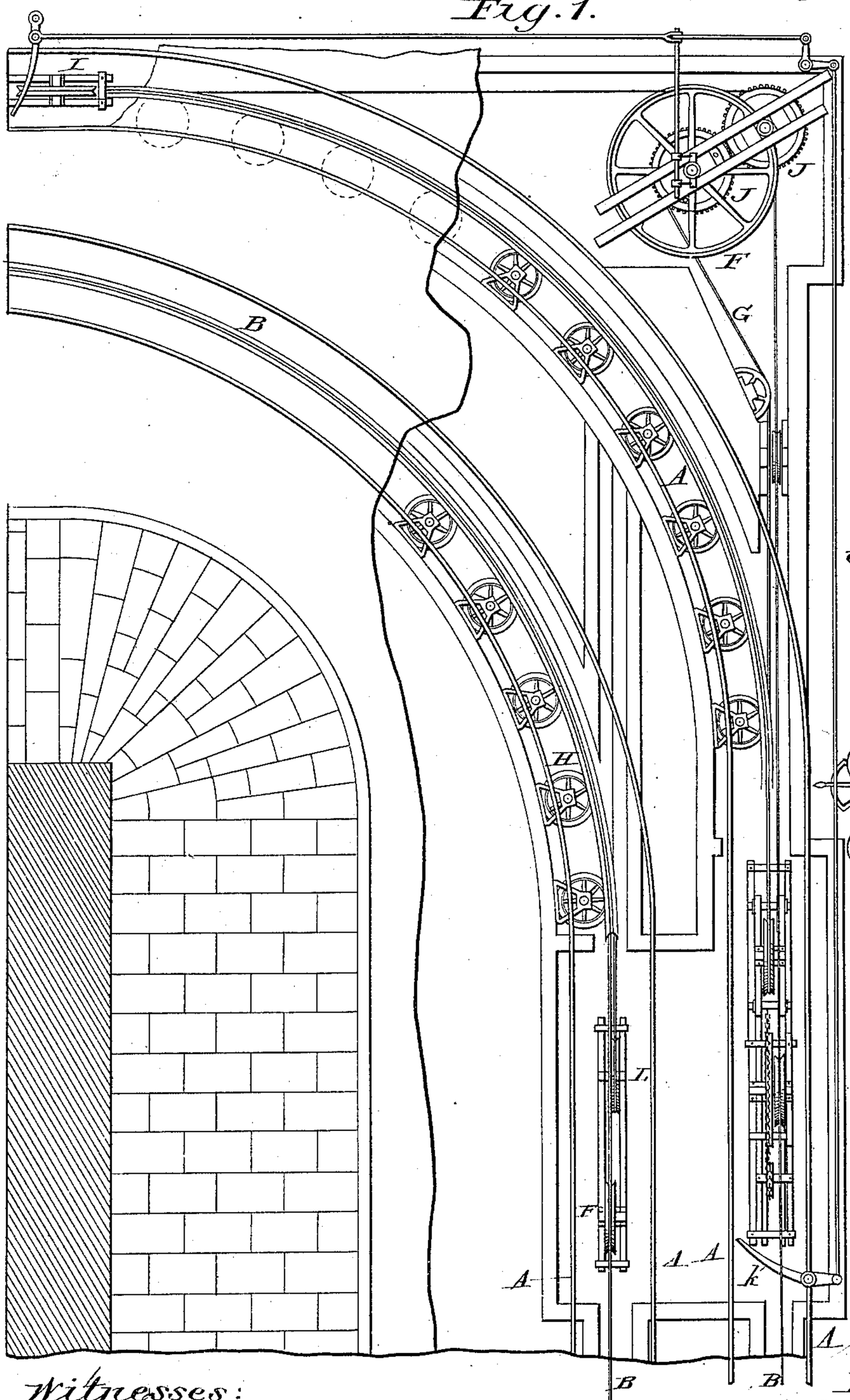
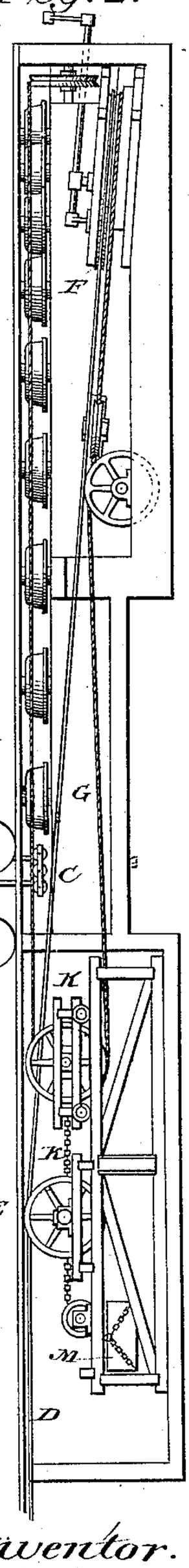



*Fig. 2.*




Witnesses:
A. E. Fansmann.
Court a Cooper

Inventor.
Henry Root
by Foster & Freeman
Attys.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

3 Sheets—Sheet 2.

# H. ROOT.

## CABLE RAILWAY.

No. 285,514.

Patented Sept. 25, 1883.

*Fig. 3.*

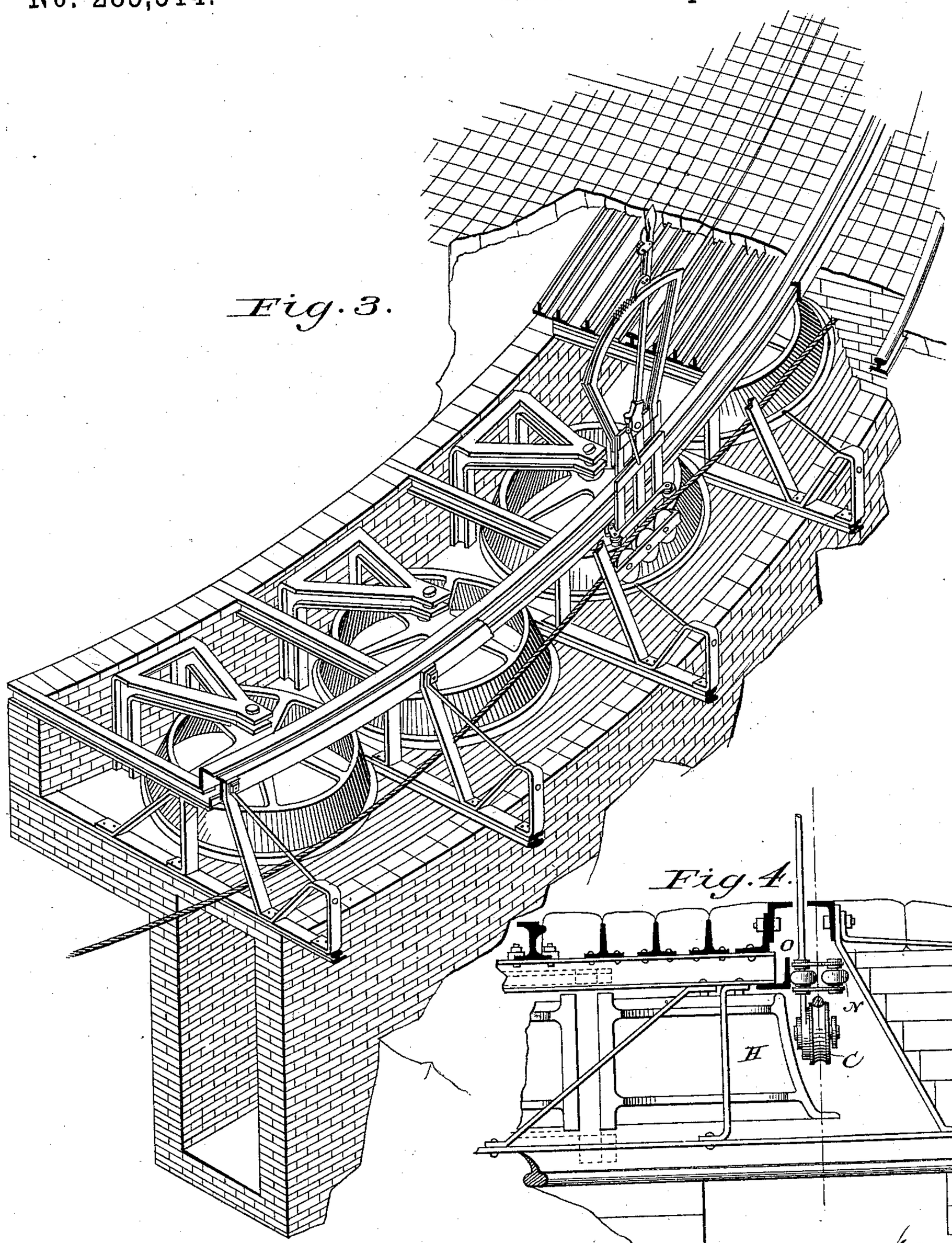


*Fig. 4.*

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(No Model.)

3 Sheets—Sheet 3.

# H. ROOT.

## CABLE RAILWAY.

No. 285,514. Patented Sept. 25, 1883.

*Fig. 5.*

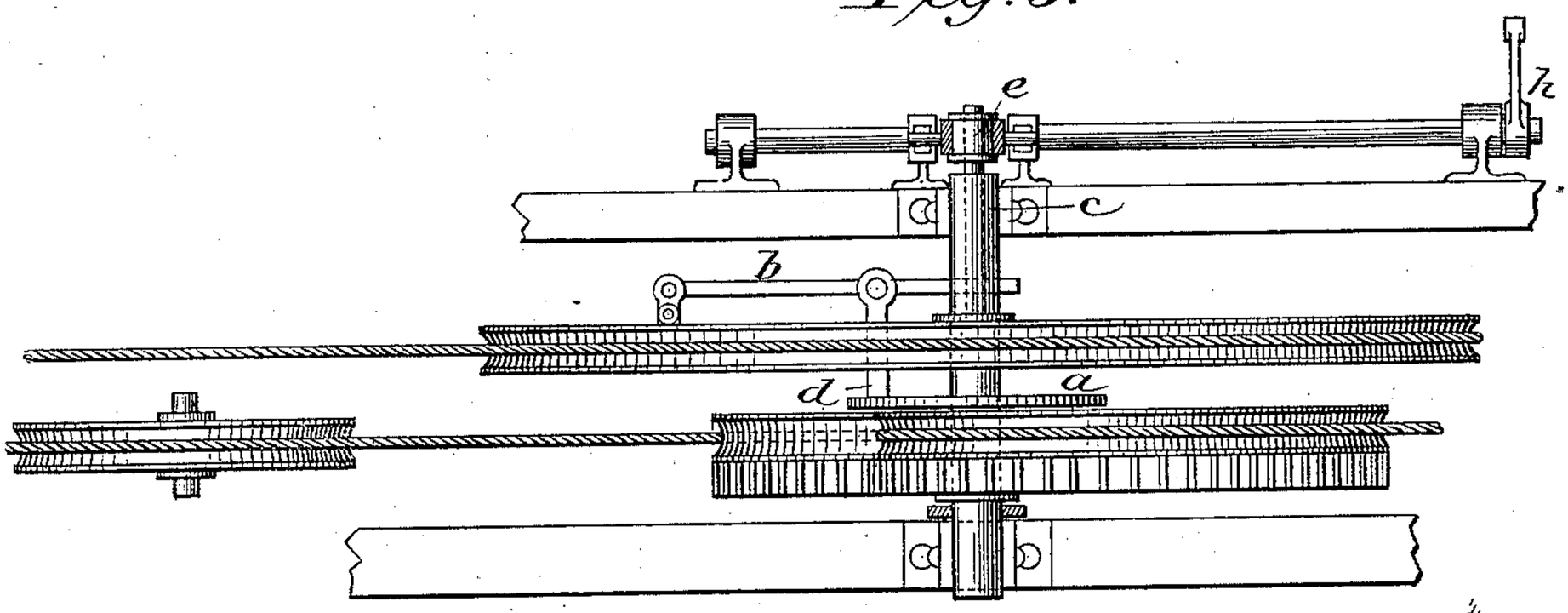
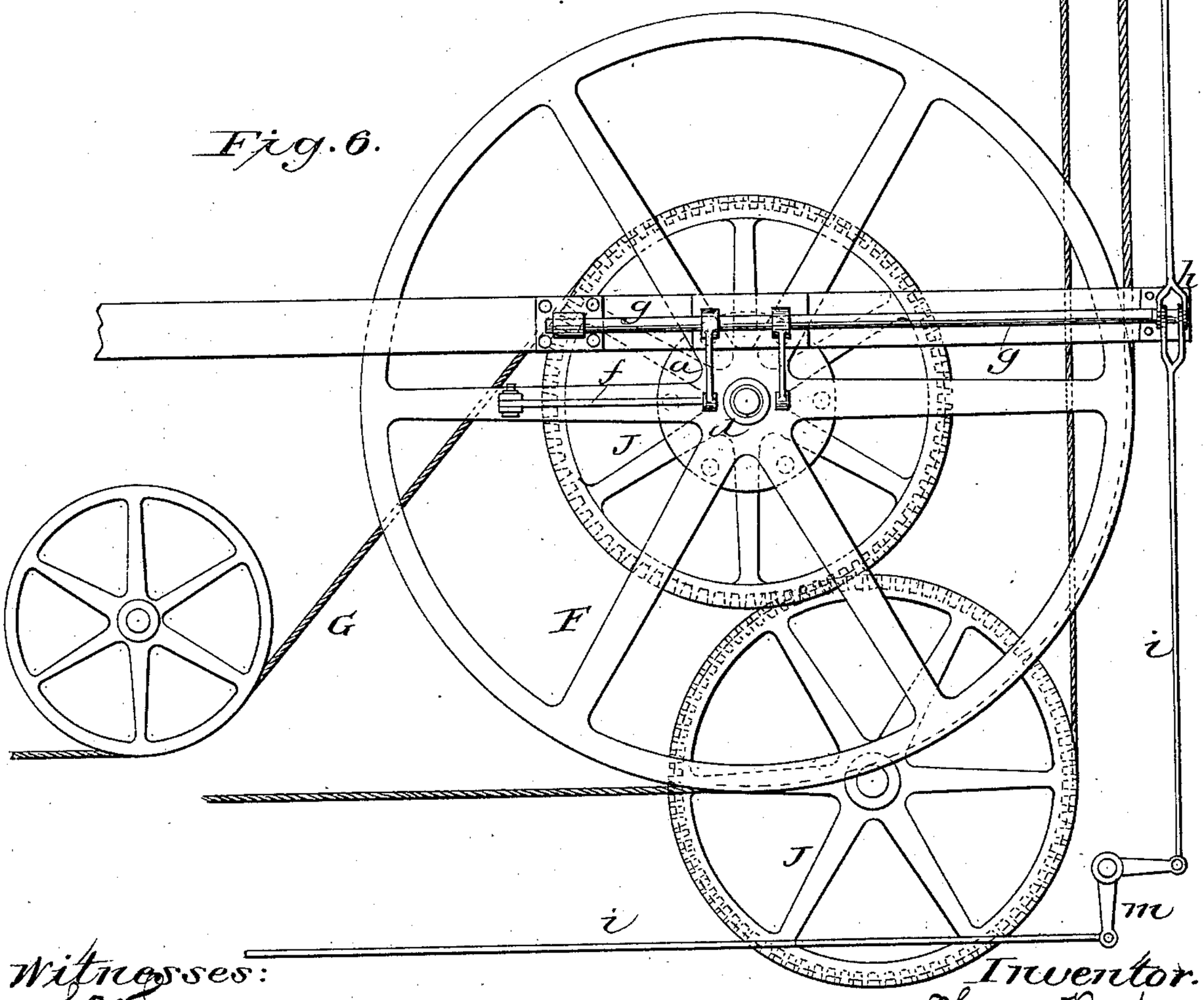



*Fig. 6.*

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# UNITED STATES PATENT OFFICE.

HENRY ROOT, OF SAN FRANCISCO, CALIFORNIA.

## CABLE RAILWAY.

SPECIFICATION forming part of Letters Patent No. 285,514, dated September 25, 1883.

Application filed July 30, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY ROOT, of the city and county of San Francisco, State of California, have invented an Improvement in Cable Railways; and I hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to certain improvements in cable railways; and it consists in such a construction of the railway, where curves occur, that the car may be carried around the curve and at a less rate of speed than that at which it travels when upon the straight line. Its object is to enable cars on such roads to pass around curves of ninety degrees or more with a radius now commonly used in cities with narrow streets nearly or quite at right angles with each other. This is effected by means of a short or subsidiary cable for each curve, this cable passing around sheaves at either end of the curve, and being driven by the main cable-sheave where it changes direction, thereby deriving its motion from the same source of power. The connection is such that the subsidiary cable is driven at a rate of speed much less than that of the main cable, this rate being one at which it is practicable to move street-cars loaded with passengers around such short curves. The change of direction of the main cable is completed upon one large sheave, so as to reduce the wear upon this cable to the minimum.

Referring to the accompanying drawings for a more complete explanation of my invention, Figure 1 is a plan view of a street-corner, showing two tracks and a portion of the cable tubes or tunnels. Fig. 2 is a vertical section taken through the line of the grip-slot in the roadway. Fig. 3, Sheet 2, is an enlarged perspective view of a portion, showing the conical horizontal sheaves. Fig. 4 is an enlarged section of the tunnel, one of the horizontal sheaves, and the grip. Figs. 5 and 6 are views of the mechanism for stopping and starting the subsidiary cable.

A A are two lines of track passing around a curve, which, in the present case, is shown as that formed by the junction or crossing of two streets at right angles, but which may be of any other angle.

B is the slot through which the grip C passes from the car to be connected with the rope at will, this grip being of any of the ordinary or of any desired or suitable construction.

At some distance before the curve is reached the main cable D passes over a vertical pulley, E, and from that point is gradually depressed below the grade of the tunnel, so that at the entrance of the curve it is already below it, and it continues onto the large sheave F, the face of which stands at the same angle to receive the cable. This sheave is exactly in the angle formed by the meeting of the lines upon which the cable travels on the two streets, and the cable, passing one-fourth (more or less) around it, leaves it in its new direction, and rises gradually again to its normal level in the cable-tunnel, ready to have cars connected with it again after they have passed the curve. This makes the whole change of direction of the cable upon one sheave and reduces the wear of the cable and the number of moving parts to need attention to a minimum.

Experience proves that it is impracticable to move cars around short curves at the same rate of speed at which the cable should travel on straight lines, as the sudden change of direction would have an unpleasant effect upon the passengers. I therefore employ a subsidiary cable, G, which may be driven at a slower rate of speed, in the following manner: Passing around the curve, it is supported by horizontal sheaves H, having conical faces, for a purpose to be hereinafter described. The sheaves sustain it in a line as nearly as possible beneath the grip-slot. At each end of the curve this cable G passes over vertical pulleys or sheaves I, and from there it is led to and around the sheaves J, one of which is secured to the shaft of the large sheave F, while the other is so placed with relation to it that the cable takes a sinuous or S-shaped course in passing around them. This insures a sufficient friction to prevent the cable from slipping, and enables me to drive it by the main cable as it passes around the sheave F.

The sheaves J are much smaller than the sheave F, being so proportioned as to give the proper rate of speed to the subsidiary cable. The tension of the subsidiary cable is maintained and the stretch of the rope taken up or

compensated by mounting the sheaves I upon trucks K, which run upon rails or guides L, and are drawn back by a weight, M, similar to that shown by me in another application for a patent, in connection with the main cable. The tension of this subsidiary cable is much less than that of the main cable, as it has only to move one car around the curve at one time, while the main cable has the strain of all the cars which are running upon the various grades upon the whole line. The tension being so much less, it is easy to relieve the grip from side strain and prevent undue friction and wear in passing curves. The cable is short, not likely to get out of repair, and is easily and quickly replaced, when necessary, without disturbing the main line. The horizontal sheaves H, by which this cable is supported around the curve, have conical faces, the bases of the cones being downward, so that when the cable is within the jaws of the grip it will be opposite the upper part of the conical face, and there will be sufficient space for the grip to travel without touching the sheaves. When the cable is released from the grip, it may settle to the lower and larger portion of the sheave-face, and when in this position it is nearly or quite vertically beneath the gripping-jaws, so that they can easily pick it up at any point in the curve, if it should be dropped, as in stopping the car upon the curve. This gives perfect control of the car at all points, as the rope may be dropped and recovered at any point on the curve. The tension being very light, there will be but little side play to the grip; but what there is may be relieved by means of rollers N, which are mounted upon the grip and run upon rails O on the inside of the cable-tube; but this feature is not of great importance to this construction.

The operation will then be as follows: The track is curved slightly to one side just before reaching the main curve, to allow the grip to be thrown open and freed from the main cable. This may take place at any suitable distance from the entrance of the main curve—as fifty feet—and after the grip is opened the car will run on by its momentum until it arrives at a point where the grip may pick up the subsidiary cable and the car be carried around the curve at a slower rate of speed. When the car leaves the curve, its momentum will again carry it on far enough to allow the grip to be disengaged from the subsidiary cable and pick up the main cable, so as to renew its journey in the new direction and at the usual rate of speed.

In cases where the cars pass very frequently the subsidiary cable may be run constantly; but where the cars only pass at considerable intervals it may be found preferable to allow this cable to remain at rest during those intervals. If it does so remain at rest, it may be set in motion when the car approaches in any suitable or convenient manner. In the present case I have shown a device which is operated by the car itself. It is constructed as follows: The sheave J, around which the subsidiary cable passes, and which is driven by the main-cable direction-sheave F, may turn loosely upon the shaft and have a central disk, *a*, which has holes made through it parallel with the shaft and around the periphery. A lever, *b*, has its outer end hinged to a support or standard on top of the sheave F, while its inner end enters a slot in the central shaft, and is raised or depressed by a pin, *c*, which extends down through the center of the shaft to the point and is pinned by the lever. The lever has a stout bolt, *d*, which passes down through the sheave F, and when the lever *b* is depressed this bolt will drop into one of the holes in the disk *a*, before mentioned, so as to lock the two together and cause the loose sheave J to revolve with the main sheave, thus setting the subsidiary cable in motion. The pin *c*, by which the lever is raised, passes through a yoke, *e*, and has a head above the yoke on which the yoke acts to lift the pin. The yoke *e* is raised or depressed by lever-arm *f* from a horizontal shaft, *g*, which is rotated a short distance in either direction by a lever-arm, *h*, at one end, and this lever is moved by wire ropes, connecting-rods, or other suitable connecting devices, *i*, which lead from this point to levers *k*, so placed near the entrance of the curve at each end that they will be acted upon by the passing cars. A bell-crank lever, *m*, serves to change the direction of the connecting device *i* at the corner, as shown. By this arrangement the levers *k* stand in the position which leaves the bolt *d* withdrawn from the holes in the disk *a* and the subsidiary cable G is stationary. When the approaching car strikes the lever upon that side, it moves the lever-connecting device and the bolt-actuating mechanism, and thus drops the bolt *d* into a hole in the disk *a*, and sets the cable G in motion. This motion continues until the car has passed the curve, when it strikes the other lever, and this actuates the mechanism to again withdraw the bolt and stop the cable G. Other mechanical devices may be employed to effect the same result; but I do not confine myself in this respect to any special device, the object being to start and stop the cable at the proper time.

I am aware that in mines cars have been propelled round curves by ropes traveling on sheaves arranged on a curved line, and that in mines cables have been made in sections, one section driven by a wheel on the same shaft as a wheel of different diameter of a different section, and that cars and boats have been transferred from one cable-driving section to another, and I do not claim these features as my invention.

I am also aware that it has been proposed to drive supplementary chains from the main cables of street-railways. My invention is distinguished from this by the fact that in the construction devised by me the supplemental

cable is so arranged, and constructed of the same material as the main cable, that the same gripping device which connects with the main cable is also constructed and used to grip the supplemental cable without any transfer of position. Moreover, the supplemental cable is supported by the ordinary sheaves, whereas a chain requires special supporting devices.

I do not herein claim the arrangement of cables, fast and loose sheaves F and J, and clutch mechanism, and means for actuating the same from the cars, nor the arrangement of pulleys to bring both the cables to the same plane, nor the arrangement of pulleys to carry the main cable away from the curved part of the track, as these form the subject-matter of a separate division of this application; but

I claim—

1. In a cable railway, which passes around a curve, the single sheave F, by which the direction of the travel of the cable is changed, and the independent subsidiary cable G, passing around the curve in the line of the grip-slot, and thence over direction-pulleys I to the traction-sheave J, so as to be driven by the movement of the main cable and at any rate of speed, all combined, substantially as herein described.

2. The endless subsidiary cable G, passing around the curve in the line of the grip-slot, in combination with the horizontal sheaves H, having the conical or tapering peripheries, substantially as and for the purpose herein described.

3. The combination, in a cable railway having a slot between each pair of rails, of driving-cables arranged below the tracks in sections, and means for driving the sections at different speeds, and cars provided with grips, each constructed to grip said cable-sections below the slot, substantially as set forth.

4. A cable railway in which the driving-cable is in different sections driven at different speeds, each section occupying the same relative position as the others to the slot, and cars provided with gripping devices constructed to grip whichever cable-section the cars may be above, substantially as set forth.

5. The combination of an underground channel communicating with a curved slot between the curved rails of the track of a street-railway, a car-driving cable extending below said slot and essentially in the same vertical plane, and deriving its movement from the main-cable-operating devices, but at a slower speed, and a car provided with a grip constructed to grip both said cables, substantially as set forth.

6. The combination, in a cable railway, of a main cable running beneath the main portion of the track, a supplemental cable running beneath the curved portion of the track and corresponding in character and relative position to the track with the main cable, and adapted to be gripped by the same gripping-jaws that serve to connect the cars to main cable, all as set forth.

7. The combination, in a cable railway, of a main cable extending beneath the main section, a supplemental cable extending beneath the curved section, arranged in relation to each other and to the rails as described, and a grip adapted to pass from the main to the supplemental cable as the car is carried by its momentum between the cables, and to grip either as the case may require, substantially as set forth.

8. The method of passing curves or other obstructions in cable railways, which consists in deflecting the main cable and in substituting therefor at the beginning of the curve or other point a supplementary cable of like character with and adapted to be grasped by the same grip-jaws as the main cable, substantially as set forth.

In witness whereof I hereunto set my hand.

HENRY ROOT.

Witnesses:

S. H. NOURSE,

G. W. EMERSON.