(No Model.) 3 Sheets—Sheet 1.

W. L. JUDSON.

STREET RAILWAY.

No. 402,933. Patented May 7, 1889.

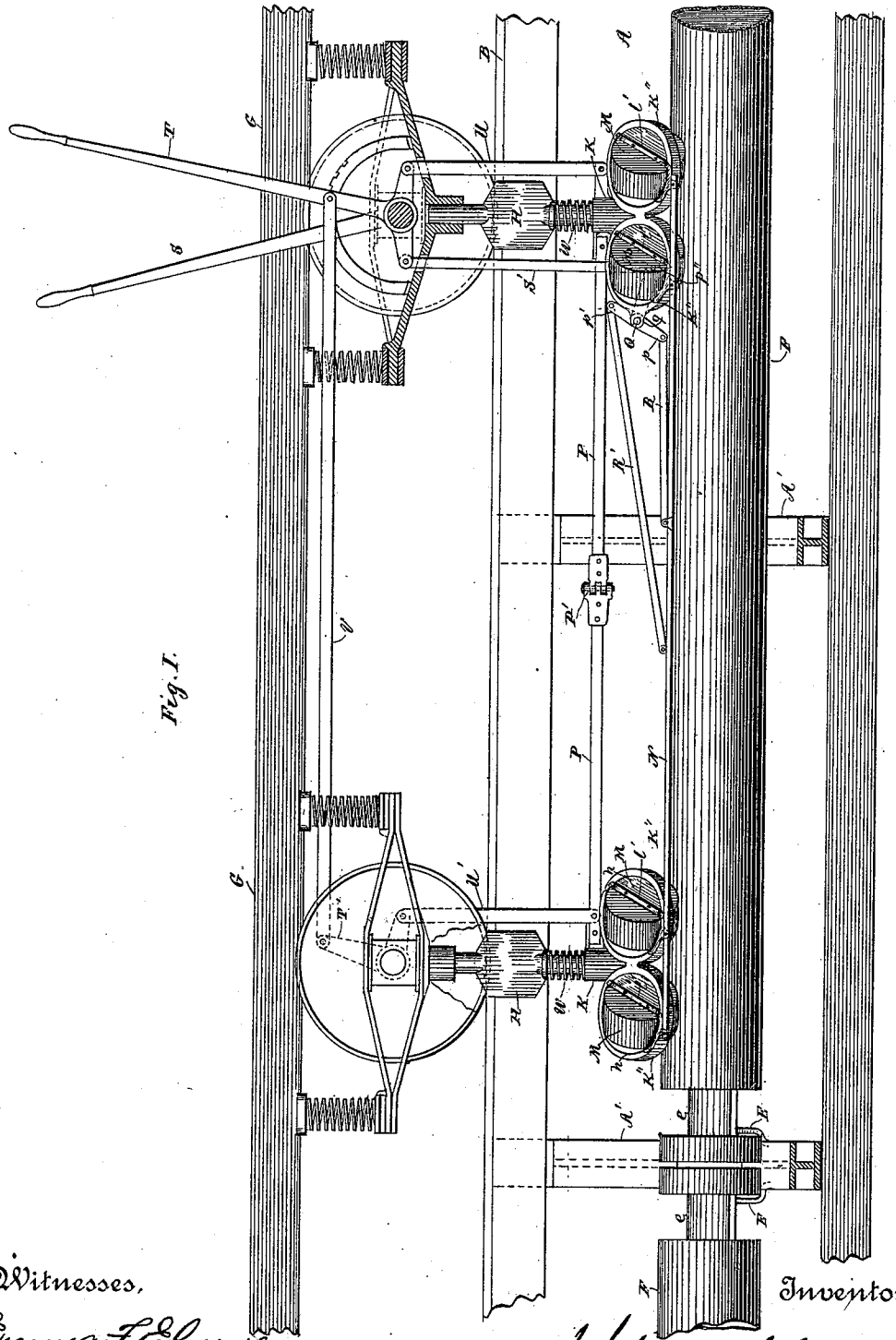


Fig. 1.

Witnesses,
Emma F. Elwood
A. H. Ossahl

Inventor,
By his Attorney
Whitcomb L. Judson
Jas. F. Williamson

(No Model.) 3 Sheets—Sheet 2.

W. L. JUDSON.

STREET RAILWAY.

No. 402,933. Patented May 7, 1889.

Fig. II.

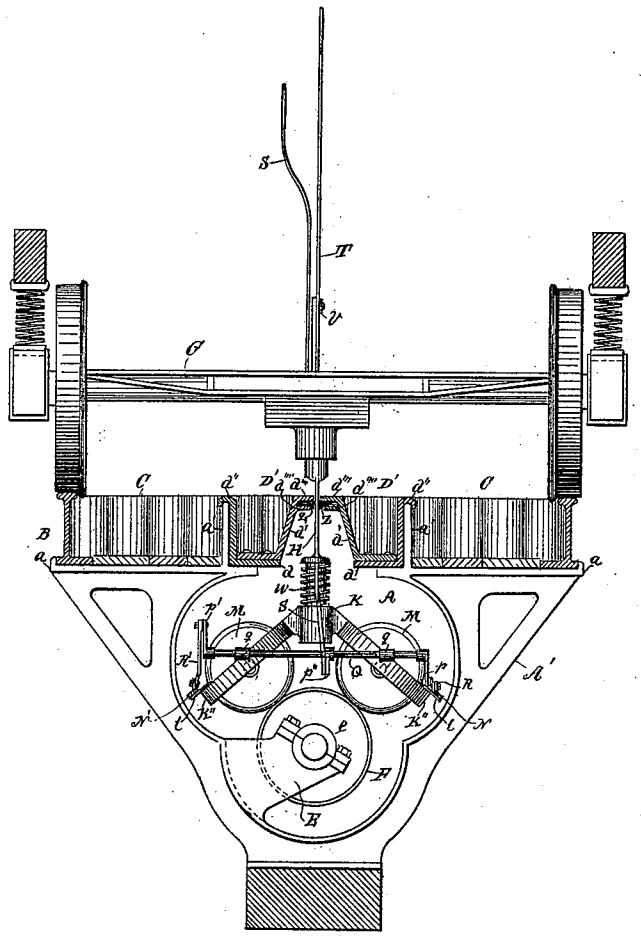


Fig. V.

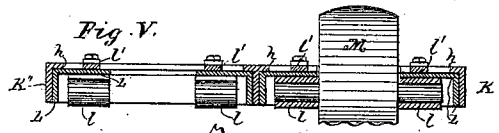
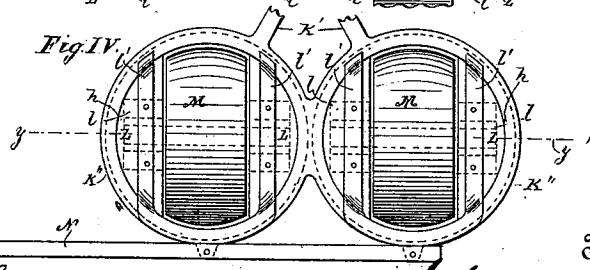


Fig. IV.



Witnesses:
Emma F. Elmore
A. H. Ipsahl.

Inventor,
Whitcomb L. Judson
By his Attorney
Jas. F. Williamson

(No Model.) 3 Sheets—Sheet 3.

W. L. JUDSON.

STREET RAILWAY.

No. 402,933. Patented May 7, 1889.

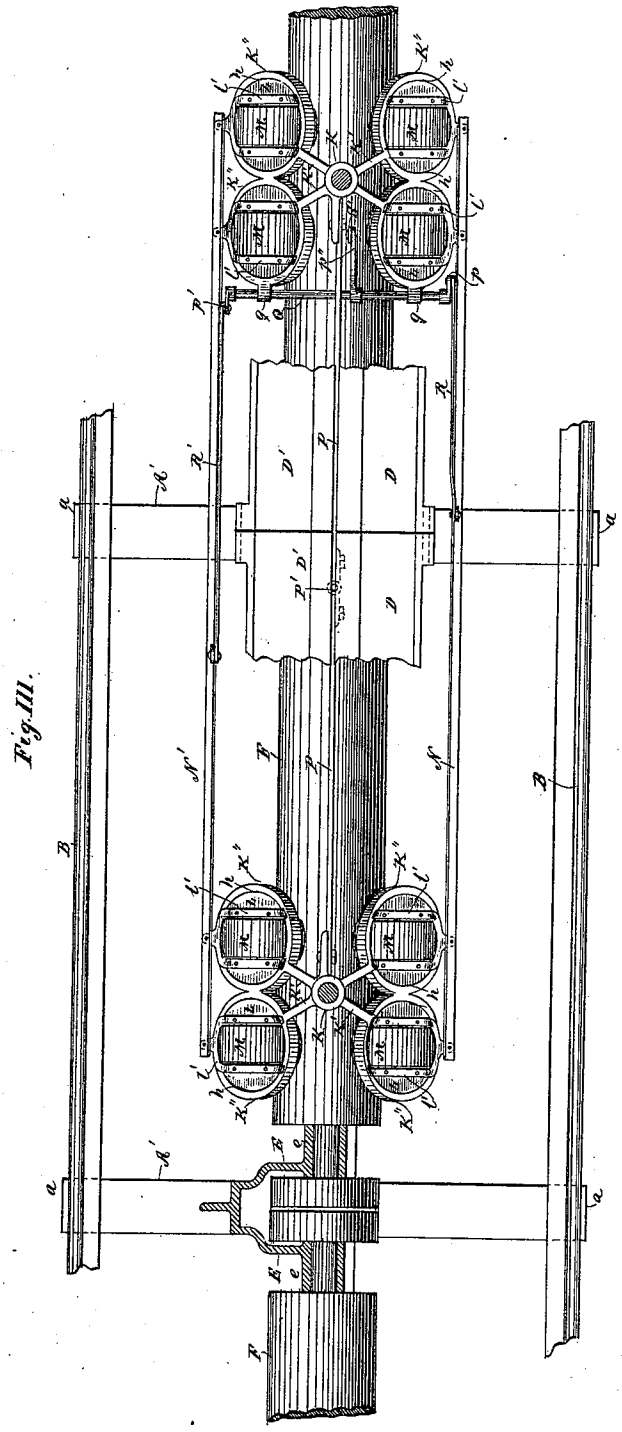


Fig. III.

Witnesses.
Emma F. Elmore.
A. H. Ofsahl.

Inventor,
Whitcomb L. Judson
By his Attorney
Jas. F. Williamson

UNITED STATES PATENT OFFICE.

WHITCOMB L. JUDSON, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO THE JUDSON PNEUMATIC RAILWAY COMPANY, OF SAME PLACE.

STREET-RAILWAY.

SPECIFICATION forming part of Letters Patent No. 402,933, dated May 7, 1889.

Application filed November 15, 1888. Serial No. 290,880. (No model.)

To all whom it may concern:

Be it known that I, WHITCOMB L. JUDSON, a citizen of the United States, and a resident of the city of Minneapolis, county of Hennepin, State of Minnesota, have invented a certain new and useful Street-Railway, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to street, suburban, and other railways. It was designed more particularly as a substitute for the cable system; and it has for its object to provide a simple and efficient construction, which shall at the same time be economical in first cost and in running expenses.

It consists in the construction or constructions fully disclosed in the following description and claims. In a general way it may be outlined as consisting of a revoluble drum or shaft mounted in suitable bearings and extending along the entire line of the car's travel and a car provided with one or more sets of friction-wheels adapted to be brought into contact with the revolving drum or shaft at an angle to its axis. These friction-wheels are so mounted as to be capable of swinging on their supports through about half a circle. In virtue of this fact the friction-wheels may be placed at different angles to the axis of the drum. When the friction-wheels are at right angles to the driving-drum, the car stands still. When at an acute angle to the axis of the drum forward of a right angle, the car will move in one direction, and when rearward of a right angle the car will move in the other direction. Practically this converting mechanism is a threadless screw with variable pitch-lines, according to the angle of the friction-wheels, frictional contact taking the place of a screw-thread or flange. The drum may be conceived as the screw-stem and the friction-wheels as traveling nuts traversing imaginary thread-lines on the periphery of the screw at a definite pitch, variable at the will of the operator. The result is a variable speed and a variable power. In other words, the speed and power are introconvertible at will. If the wheels approximate a right angle to the axis of the shaft, there is obtained the equivalent of a fine threaded screw with corresponding great power. If they are set at an acute angle approximately parallel with the shaft, there is obtained high speed, but with less power. This especially adapts the construction to street-car propulsion. In starting the load great power and slow speed are desirable. After the car is started less power is required and more speed is desired. The drum is driven by a series of stationary motors of any suitable kind (not shown) arranged along the line of travel. I preferably use for the purpose compressed-air motors or electric motors; but steam, water, or other motors will also answer the purpose.

The friction-wheels are so mounted as to be adjustable to and from the car for throwing them into and out of engagement with the drum. As shown, I connect the friction-wheels to the cars by vertically-movable supporting-frames or spiders adapted to overhang or straddle the drum. The friction-wheels are mounted in these spiders in couples, so as to engage opposite sides of the driving-drum at like angles to its axis, thereby affording a wedging or crowding action between the wheels and the drum. Preferably there are used two or more sets of these spiders or friction-wheel-supporting frames connected to different points on the car longitudinally, and on each spider is mounted one or more couples of the friction-wheels. This insures traction at all times between some one or another of the set of wheels and the driving-drum. The spiders are all coupled together longitudinally by pivotal connections, allowing free movements in reference to each other in the horizontal plane for the better traversing of curves. When the drum is mounted in a slotted conduit, as is the case when applied to a surface road, the friction-wheel-supporting frames or spiders are connected to the car by vertical bars or standards having a swiveled connection with both for the same purpose of adapting the construction to traversing curves.

Provision is made for varying the amount of traction on the friction-wheels in accordance with the load of the car.

The system is equally well adapted both to surface and elevated roads of all kinds. Here-

in I show it as applied to a surface road. When so applied, I use, as before stated, an underground slotted conduit somewhat similar to the cable system.

I will now describe the construction shown in detail.

Referring to the drawings, wherein like letters refer to like parts throughout, Figure I is a side elevation of the driving-drum and car, a part of the conduit having been removed. Fig. II is a cross-section of the conduit, showing end elevation of the car and driving-drum. Fig. III is a plan of Fig. I, the car and part of the road-bed being removed. Fig. IV is a plan view of part of the frame in which the friction-wheels are mounted; and Fig. V is a cross-section on the line Y Y′ of Fig. IV, one of the wheels being removed.

A is the conduit, which is formed of a series of Y-shaped yokes, A′. These yokes are backed by masonry or concrete in the customary way. These yokes have a clear central space in their cap-plates of sufficient width to permit the passage of the driving-drum into the conduit and to give ready access to the same. On their edges the caps of the yokes are provided with small vertical flanges *a*, and near the central spaces they are provided with vertical flanges *a′* of a height equal to the depth of the road-bed.

B are the rails mounted on the outer edges of the cap-pieces of the yokes.

C are the side sections of the road-bed supported by the yokes and held in place laterally by the rails on the outside and the vertical flanges on the inside.

D D′ are the right and left pieces of the central section of the road-bed. This central section of the road-bed is so constructed as to be readily removable from any part or the whole of the line. To this end the pieces D D′ are made in short sections, and are supported and held in place from the interior edges of the yokes and the tops of the vertical flanges *a′*. A construction adapted to the purpose is obtained by the angle-irons *d d′*, the outer of which is provided with a hook, *d″*, on its upper edge, adapted to overhang and engage with the top of the vertical flange *a′*. The two angle-irons are bolted together at their bases, and the inner one projects upward and inward at an angle to the outer and is provided with a pair of lateral flanges, *d‴ d⁗*, on its upper edges, with a clear space between the two. The inner angle-iron, *d′*, of the right and left pieces, D D′, is so set as to leave a clear space between the flanges *d‴* of the proper width to form the slot for the passage of the bar connecting friction-wheel-supporting frames with the car.

E are bearing-brackets formed integral with the yokes A′, projecting from one side thereof to the vertical center of the conduit and provided with suitable bearing, *e*.

F is the main driving drum or shaft journaled in the bearing *e*. This shaft is made in sections coupled together in any suitable way which will permit curvature. It revolves continuously in one direction and may be driven from a source of power in any suitable way. In my preferred construction I drive it, as before stated, by a series of stationary motors arranged at intervals of about one thousand feet.

G is the car. On its front and rear truck-frames are swiveled vertical bars H, which pass downward through the slot into the interior of the conduit. These bars are preferably cylindrical at their extremities and flattened into a thin blade where they pass through the slot. On the lower ends of these swiveled bars H are mounted a friction-wheel-supporting frame-work, K, which, for convenience, will be referred to as a "spider." These spiders, as shown, consist of a pair of arms, K′, crossing each other at an angle and provided at their outer extremities with circular rims K″, all preferably cast integral with each other. These circular rims K″ are provided with inwardly-projecting flanges *h* on their upper edges.

L are revoluble heads mounted in the rims K″, and provided with journal-bearings *l* and overlapping plates *l′*, resting upon the top surfaces of the rims *k″*.

M are the friction-wheels mounted in the bearing *l*.

It will thus be seen that the heads L will freely turn within the rims K″, and are held from vertical displacement therein by the inwardly-projecting flange *h* and the overlapping-plate *l′*.

N N′ are rigid bars or rods connecting the revoluble heads of the front and rear spiders.

P is a brace-bar connecting the two spiders or frames, which is preferably formed in two pieces having a pivotal connection.

Q is a transverse rock-shaft mounted in bearings *q*, cast integral with one of the spiders and provided with cranks *p p′ p″*.

R R′ are connecting rods or links connecting the cranks *p p′* with the rods N N′, respectively.

S is a bell-crank lever mounted on the rear axle of the car.

S′ is a link connecting the same with the crank *p″* of the rock-shaft Q.

T T′ are bell-crank levers mounted, respectively, on the rear and front axles of the car.

U U′ are links connecting the same with the front and rear spiders.

V is a rod connecting T and T′.

W are springs mounted on the swiveled bars H intermediate the spiders and the flat portions of the bars. The spiders K are freely movable up and down on the swiveled bars H against the resistance or traction springs W. The two sections of the brace-bar P are pivotally connected by a clevis-joint, P′, so as to allow movement in the horizontal but not in the vertical plane.

The operation is evident. The driving-drum or shaft F being in motion, the spiders K are lowered until the friction-wheels M are in

contact therewith. If the friction-wheels are at an angle to the driving-drum, the car will be propelled in one direction or the other, according to the angle of the friction-wheels. If the friction-wheels are at right angles to the driving-drum, the car will stand still; if inclined forward of a right angle, the car will move forward; if they are set rearward of a right angle, the car will move backward. The speed may be varied by simply changing the acuteness of the angle. The more nearly the friction-wheels approach positions parallel to the driving-drum the more rapidly the car will move. The wheels are varied in this respect, from the forward to the backward motion by the lever S and its connections at the will of the operator. The traction of the friction-wheels on the driving-drum is varied to suit the requirement of the load by the lever T and its connections U U′. By this lever the friction-wheels may be lifted entirely away from the driving-drum, or be made to bear upon the same with any desired pressure. This is one important advantage of the construction. The traction may be increased at will to start the car and its train, and then reduced to an amount simply sufficient to carry the car forward under its initial momentum.

It will be readily understood that instead of a double set of friction-wheels attached, respectively, to the front and rear frames of the car-truck a single set might be used attached to the center of the car. This, however, would not work so well. The advantage of two or more sets of friction-wheels connected to different points of the car longitudinally is that when any one of the sets of wheels are at the point of connection of the sections of the drum some of the other sets will be in engagement with the drum. Traction is therefore never lost. It is equally evident that instead of four friction-wheels in each spider two would answer the purpose. It is also evident that it is immaterial what form of connections are used to swing the friction-wheels in their supporting-frames.

It should be noted that all the friction-wheels always stand at like angles to the driving-shaft. This is only another way of saying that if the driving-drum be treated as a screw and the friction-wheels as nuts all the nuts follow the same thread. They all have a common pitch-line. This likeness of angularity or sameness of pitch among all the friction-wheels is preserved in varying their angularity to the driving-shaft through the lever S and its connections from the fact that the cranks p and p' are opposite to each other on the rock-shaft Q. Hence all the wheels will be turned through equal arcs in opposite directions by the movement of the lever S. These friction-wheels, in a broad point of view, constitute a form of variable-speed gearing between the driving-drum and the car.

Instead of one driving-drum and two traveling friction-wheels at like angles thereto, two parallel and adjacent driving-drums revolving in the same direction and a single traveling friction-wheel at an angle to both driving-drums may be employed.

In the space between the flanges d''' and d'''' of the central section, D D′, of the road-bed, on the opposite sides and interlacing across the slot, I support a continuous stationary brush, Z, for the purpose of excluding dust and snow from the conduit. On this brush and the special form of conduit construction herein shown and described I make in this application no claim. These features will be found described and claimed in another application filed by me of date November 17, 1888, under Serial No. 291,174.

What I herein claim, and desire to secure by Letters Patent of the United States, is as follows:

1. The combination, with a movable car or carriage, of one or more revoluble driving drums or shafts extending along the line of travel and one or more friction-wheels adjustable to different angles with respect to the axis of said drum and adapted to engage therewith, substantially as described.

2. The combination, with a movable car or carriage, of one or more revoluble driving drums or shafts extending along the line of travel and one or more friction-wheels connected with said car mounted in bearings both vertically and angularly adjustable in respect to said drum or drums and adapted to engage therewith, substantially as described.

3. The combination, with a movable car or carriage, of one or more revoluble driving drums or shafts extending along the line of travel and one or more friction-wheels connected with the car mounted in bearings revoluble in the planes of their axes, substantially as described.

4. The combination, with a movable car, of one or more revoluble driving drums or shafts extending along the line of travel, a friction-wheel-supporting frame connected to said car, and one or more friction-wheels on said frame, mounted in bearings revoluble in the planes of their axes, substantially as described.

5. The combination, with a movable car, of friction-wheels connected therewith and driving-drums extending along the line of travel, there being of said drums and friction-wheels one device of one kind opposed to and engaging two of the other kind, whereby a wedging or crowding action is secured between them, substantially as described.

6. The combination, with a movable car, of a revoluble driving drum or shaft extending along the line of travel, one or more friction-wheels adjustable in the planes of their axes adapted to engage with said drum at different angles to its axis and connections extending from said wheel or wheels to the car for changing the angle of the friction-wheels to the driving-drum, substantially as described.

7. The combination, with a movable car, of a revoluble driving drum or shaft extending along the line of travel, a vertically-movable

friction-wheel-supporting frame connected with said car, one or more friction-wheels mounted on said frame and adapted to engage said driving-drum at different angles, a connection from the car to said frame for raising and lowering the same, and a connection from the car to the friction-wheels for varying their angle to the driving-drum, substantially as described.

8. The combination, with a movable car or carriage, of a revoluble sectional drum or shaft extending along the line of travel and two or more friction-wheels connected with the car at different points of the same longitudinally, each adapted to engage said drum at an angle to its axis, whereby there will be engagement of one or more wheels with the drum while one of the wheels is at the point of connection of the sections, substantially as described.

9. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, a truck-frame or spider having friction-wheels therein engaging the said shaft or drum at an angle to its axis, and a bar or standard connecting the car with said truck-frame, having a sliding and a swiveled engagement therewith, substantially as described.

10. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, a truck or spider having friction-wheels therein engaging the said shaft or drum at an angle to its axis, and a bar connecting the car with said truck, the said bar having a sliding and swiveled engagement with said truck, and a spring interposed between the truck and bar, substantially as described.

11. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, two or more friction-wheels connected to different parts of the car longitudinally, adapted to engage said drum at an angle to its axis, and a laterally-yielding connection between said wheels, substantially as described.

12. The combination, with a movable car, of a slotted conduit along the line of travel, a revoluble drum mounted in said conduit, and one or more friction-wheels connected to the car through the slot in the conduit adapted to engage said drum at an angle to its axis, substantially as described.

13. The combination, with a movable car, of a slotted conduit extending along the line of travel, a revoluble drum or shaft within said conduit, a truck within said conduit provided with friction-wheels adapted to engage said drum at an angle to its axis, and a bar or standard extending from the car to the truck through the slot in the conduit and having swiveled connections with both, substantially as described.

14. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, and one or more sets of friction-wheels, in couples, connected to the car, adapted to engage opposite sides of the drum at like angles to its axis, substantially as described.

15. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, and one or more sets of friction-wheels, in couples, connected to the car, mounted in bearings, revoluble in the planes of their axes, adapted to engage opposite sides of said drums at any desired like angles to its axis, substantially as described.

16. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, one or more sets of friction-wheels, in couples, connected to the car, mounted in bearings revoluble in the planes of their axes, adapted to engage the opposite sides of said drum at any desired like angles to its axis, and a connection from said wheels to within reach of the operator adapted to turn the wheels of each couple in opposite directions for effecting their adjustment to different like angles to the drum, substantially as described.

17. The combination, with a movable car, of a revoluble drum or shaft extending along the line of travel, two or more sets of friction-wheels, in couples, connected to the car, mounted in bearings, revoluble in the planes of their axes, adapted to engage opposite sides of the drum at any desired like angles, and a common connection from all of said wheels to within reach of the car-operator for effecting like angular adjustment thereof, substantially as described.

18. The combination, with a movable car, of a revoluble drum extending alone the line of travel, two or more friction-wheel-supporting frames or spiders connected to different parts of the car longitudinally, friction-wheels mounted on said frames adapted to engage the drum at right angles to its axis, and pivotal connections coupling together said frames, substantially as described.

19. The combination, with a movable car, of a slotted conduit extending along the line of travel, a revoluble drum mounted in said conduit, sets of friction-wheel-supporting spiders or frames, bars or standards connecting said frames with the car through the slot in the conduit, having a swiveled connection with each, friction-wheels mounted on said frames in couples, adapted to engage opposite sides of said drum at like angles to its axis, and pivotal connections coupling together said frames, substantially as described.

20. The combination, with a movable car or carriage, of a driving drum or shaft extending along the line of travel and variable-speed gearing between the drum or shaft and the car, substantially as described.

WHITCOMB L. JUDSON.

In presence of—
JAS. F. WILLIAMSON,
EMMA F. ELMORE.