J. S. WARNER.

AXLE TRUCK OR UNDERCARRIAGE FOR RAILWAY, TRAMWAY, AND MINING VEHICLES.

APPLICATION FILED OCT. 18, 1909.

1,022,054.

Patented Apr. 2, 1912.

8 SHEETS—SHEET 1.

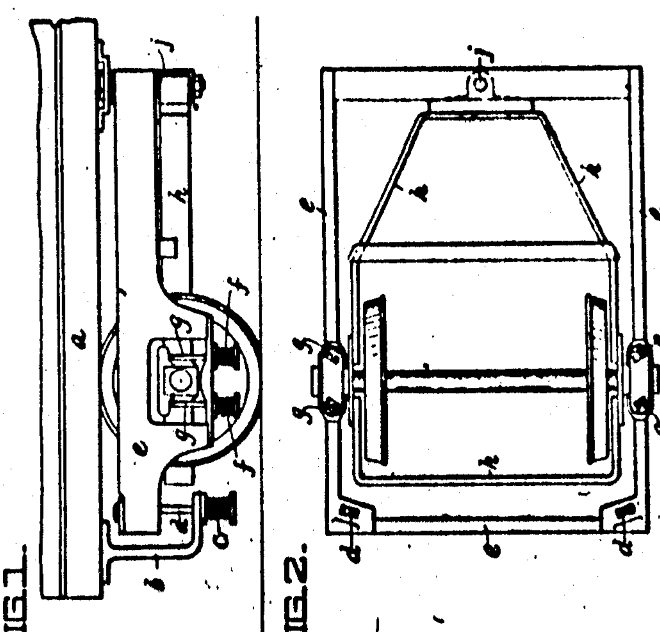

FIG. 1.

FIG. 2.

Witnesses

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6 SHEETS—SHEET 2.

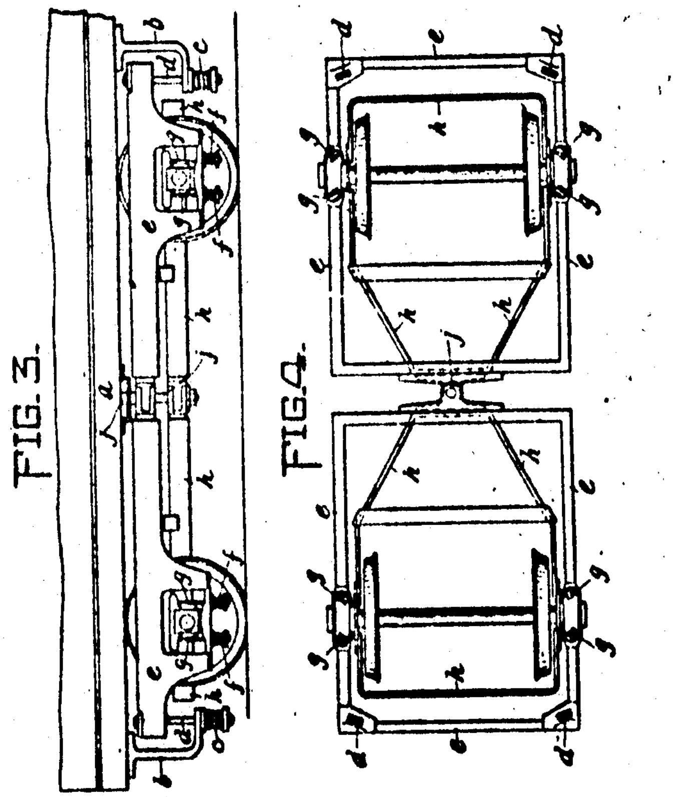

FIG. 3.

FIG. 4.

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3 SHEETS-SHEET 3.

FIG. 7.

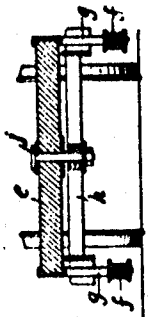

FIG. 8.

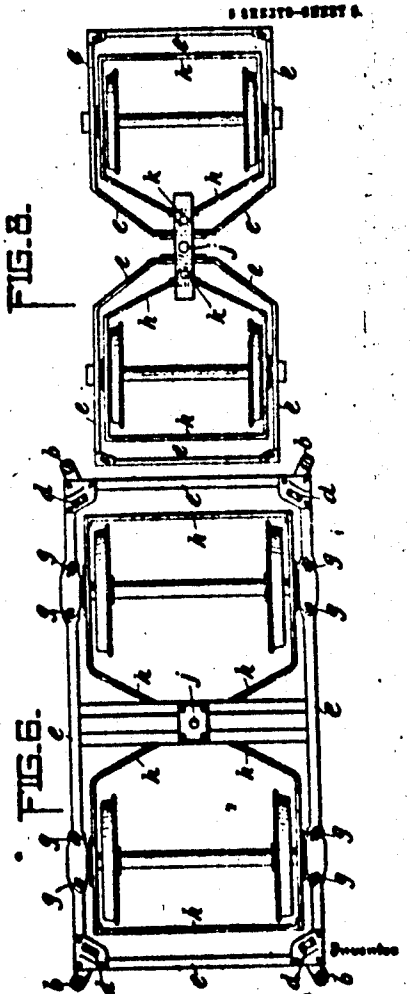

FIG. 5.

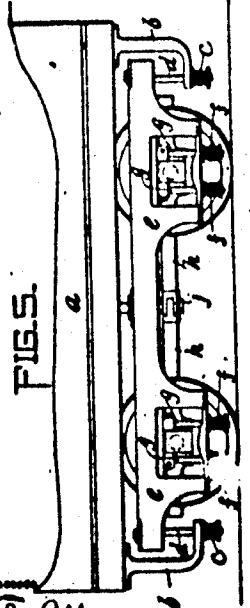

FIG. 6.

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1,022,054. Patented Apr. 2, 1912.

3 SHEETS-SHEET 6.

FIG. 9.

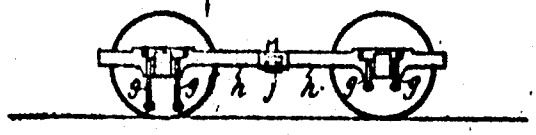
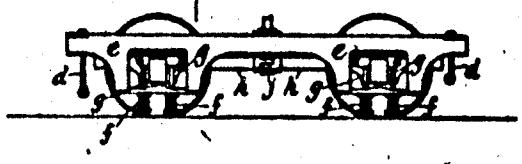


FIG. 10.



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AXLE TRUCK OR UNDERCARRIAGE FOR RAILWAY, TRAMWAY, AND MINING VEHICLES.

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3 SHEETS-SHEET 3.

FIG. 11. Links unsymmetrical with Longitudinal axis.

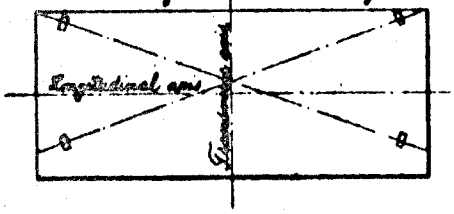


FIG. 12. Links unsymmetrical with Transverse axis.

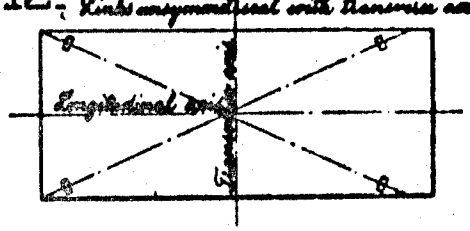
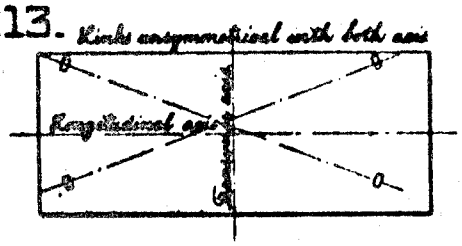


FIG. 13. Links unsymmetrical with both axes



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1,022,054. AXLE-TRUCK OR UNDERCARRIAGE FOR RAILWAY, TRAMWAY, AND MINING VEHICLES. JAMES SUTHERLAND WARNER, Forest Gate, England. Filed Oct. 18, 1909. Serial No. 523,337.

To all whom it may concern:

Be it known that I, JAMES SUTHERLAND WARNER, a subject of the King of England, residing at Glen Deep, Disraeli Road, Forest Gate, Essex, England, have invented certain new and useful Improvements in Axle-Trucks or Undercarriages for Railway, Tramway, and Mining Vehicles, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

The object of this invention is to build railway, tramway, and mining carriages so that the mass of the vehicle or vehicles, may pass over the track in a line which I have designated the "conformity line." The "conformity line" I use for the purpose of summing up the practical irregularities of the track, and I suppose it to be generated by a point at the center of gravity of a car running on rails, or by a longitudinal axis passing through the center of gravity of the car. In order to make clear this conception which I call the "conformity line" I point out that if a carriage were a projectile passing through the air, provided there was no rotation of the projectile around its own center, a passenger seated in such a carriage would be entirely free from the vibration and fatigue inseparable from travel in carriages as at present constructed. My "conformity line" therefore, is a trajectory which, instead of following the usual path of a projectile, is bent in conformity with the general direction and changes of direction of the track, and thus no longer retains its characteristic as a parabola, while it does retain in a large measure its tendency to be mathematically straight. Over a piece of straight track, then, I find that, relatively, this "conformity line," which is theoretically and practically a line as straight as it is possible for a mass in motion to generate, contrasts strongly with the vertical and transverse irregularities of each rail, considered separately, and it averages up the two rails, each irregular in itself, by an ideal line which is both a reference line relative to either rail, and, at the same time, is a natural path for the mass of a car in motion to follow.

I find that considerable provision by means of springs has always been made for vertical irregularities of track, but that transverse irregularities, having been inadequately provided for, have resulted not only in transverse disturbances, but also in rolling movements of the carriage, including vertical movement other than would have resulted had a more elastic transverse connection been employed.

Not only is all straight track inherently irregular, which necessitates an ideal line of transition for it, such a conception as the "conformity line," but the tendency of the path of the car to vary from the path defined by the track, as well as for the car to rotate about its own axis or center by some chance force, or forces, imposed upon it by the track—or by propulsion, have also been considered in my improved suspension, so as to insure that any point on a carriage, or train of carriages, will follow as far as possible a mathematically straight line, by running on, or parallel to, the "conformity line."

According to this invention, I connect the axle by means of a V frame, or sub-truck, to a king pin placed on the longitudinal center of the car so that this V frame constrains the axle to swing in an arc of a circle approximately around this center pin in a horizontal plane, while at the same time the weight of the vehicle is imposed on the lower ends of links constructed to swing in an arc of a circle; the weight imposed on these links being a horizontal major truck frame rotating about the same or an adjacent king pin, and which carries dependent links on to the lower ends of which, by drop brackets, or otherwise, the car body rests. The second horizontal rotating frame may comprise a rigid X frame with the king pin at the center of the X, or may be articulated at the center of the X so that the two V's forming the X may rotate independently of each other.

For long wheel base four wheel tramcars and four wheel wagons, I prefer to use two king pins and independent minor and major V frames, but for "bogie cars" I prefer to use one king pin to each pair of axles, and the rigid X major truck frame, which may rotate, more or less, together with its two axles, as a whole in a manner similar to ordinary railway bogies.

I may interpose a third or other truck frames in a series with the above. I may also arrange that the wheels on any one axle may rotate independently of each other, and I may employ wheels of unequal diameter after the manner of the style of truck usually known as the maximum traction type. I may also employ in connection with my suspension the various well known devices for propelling, supporting, or permitting the rotation of bogie and other trucks, and also segmental plates, ball and socket connections, and equivalent devices for displacing the turning center, such as are well known in pres-

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ent day use with bogie and radial trucks. In special cases, such as for the suspension of railway carriages for transporting huge girders, long pieces of ironwork, timber, etc., for large restaurant and saloon carriages, I may employ two pairs of X or double V framed non-parallel axle-bogies as described in the foregoing, one pair at each end of the car, the two at one end connected by a suitable device, such as a third X or double V frame having a center common to one or neither of the pair of bogies at one end of a carriage, the support of the carriage upon this third X or double V frame being either of the center bearing description, or by links variously placed.

Since it is desirable in building rolling stock to follow the "conformity line" to insure that the mechanical advantage of the application of the forces exerted by the track to disturb the relation of an axle relatively both to the carriage and the track should be for certain purposes as great as possible, I may place the circular swinging suspension links supporting the weight of the carriage as described in the foregoing between the axle and the king pin, or on the other hand, only on the side of the axle remote from the king pin.

Figure 1 is a side elevation of one end of a vehicle supported according to the simplest form of this invention. Fig. 2 is a plan with the body removed. Figs. 3 and 4 are similar views of a modification in which there are two "major" and two "minor" frames free to turn about each king pin *j*, thus forming a four wheeled bogie. Figs. 5 and 6 are similar views. Fig. 7 is a transverse section of another modification in all respects similar to that shown at Figs. 3 and 4, except that the two "major" frames are rigidly connected together, thus forming a single "major" frame. Fig. 8 is a plan of another modification similar to that shown at Figs. 3 and 4, except that three king pins are employed, the "major" frames being pivoted to the body by the pin *j* and the "minor" frames being pivoted to the "major" frames by the pins *k*. Fig. 9 is a side elevation of another modification showing minor links of varying lengths. Fig. 10 is a side elevation of another modification showing major links of varying lengths. Figs. 11, 12 and 13 are diagrammatic plan views of the floors of vehicle bodies, illustrating different arrangements of the links with respect to said bodies, these arrangements being applicable to each of the embodiments shown in the several figures of the drawings.

a is the body of the vehicle having fixed to it brackets *b* supported on springs *c* carried by links *d* suspended from the "major" frame *e*. The "major" frame *e* is similarly supported on springs *f* carried by links *g* suspended from the "minor" frame *h* which in its turn is supported by the axle boxes. *j* is a king pin about which the body and the "major" and "minor" frames are free to turn relatively to each other.

Various modifications may be made in the arrangements shown in the drawings, thus springs may be interposed between the "minor" frames and the axle boxes in the usual manner, and instead of being vertical as shown, some or all of the links may be inclined. Again, the links supporting the body are shown at the corners of the "major" frames, and the links supporting the "major" frames are shown suspended from the tops of the axle boxes, but they may be placed in other positions. Also, the links supporting the "major" frame at one end of the truck may be made distinctly longer than the links supporting the "major" frame at the other end of the truck. This will have the effect of shifting the center of oscillation of the truck, in a horizontal plane, toward the end of the truck which has the shorter links. Any horizontal movement of the truck frame about this center would then have to displace one or more of the king pins to which the sub-trucks are attached by an appreciable amount. Since the transverse displacement of any king pin requires skidding of the two wheels to which it refers, the tendency of any king pin to resist transverse movements may by this means be utilized to prevent oscillation of the truck frame.

The links supporting the body from the major frames may also be made of distinctly different lengths to each other and to the links supporting the major frames from the minor frames, with the object of damping any tendency of the major frames to oscillate in a horizontal plane.

I claim:

1. In a railway, tramway or mining truck, the combination of a "minor" frame, a "major" frame supported on links from the "minor" frame, a body suspended on links from the "major" frame, and a king pin, or king pins, about which the frames and the body can rotate, relatively to each other.

2. In a railway, tramway or mining truck, the combination with a body, major frame, and minor frame, of links of distinctly different lengths supporting respectively said body from said major frame, and said major frame from said minor frame.

3. In a railway, tramway or mining truck, the combination with a body and a major frame, of links of distinctly different lengths supporting said body from said major frame.

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4. In a railway, tramway or mining truck, the combination with a major frame, of a body oscillatable about a center, and links disposed at different distances from the center of oscillation and supporting said body from said major frame.

5. In a device of the character described, the combination with a major frame, of a minor frame, means for swingingly suspending one of said frames from the other, a vehicle body, and means for swingingly suspending said vehicle body from one of said frames.

6. In a device of the character described, the combination with a major frame, of a minor frame, means for swingingly suspending one of said frames from the other, a vehicle body, and means for swingingly suspending said vehicle body from one of said frames, said body and frames being in addition pivotally connected to each other.

7. In a device of the character described, the combination with a minor frame, of a major frame swingingly supported by said minor frame and pivotally connected thereto at a point distant from said swinging support, and a vehicle body swingingly supported from said major frame.

8. In a device of the character described, the combination with a minor frame, of a major frame swingingly supported by said minor frame and pivotally connected thereto at a point distant from said swinging support, and a vehicle body swingingly supported from said major frame, the swinging support of said vehicle body being distant from the pivotal connection between said frames.

9. In a railway, tramway, or mining truck, the combination with an axle oscillatable in the horizontal plane of its axis, of a frame swingingly suspended from said axle, and a body movably suspended from said frame.

In witness whereof I have signed this specification in presence of two witnesses.

JAMES SUTHERLAND WARNER.

Witnesses:

FREDK. L. RAND,

B. WILLIAMS.