G. E. LYNCH.

BACK RAIL LOCOMOTIVE.

APPLICATION FILED JAN. 26, 1906.

901,975.

Patented Oct. 27, 1908.

3 SHEETS—SHEET 1.

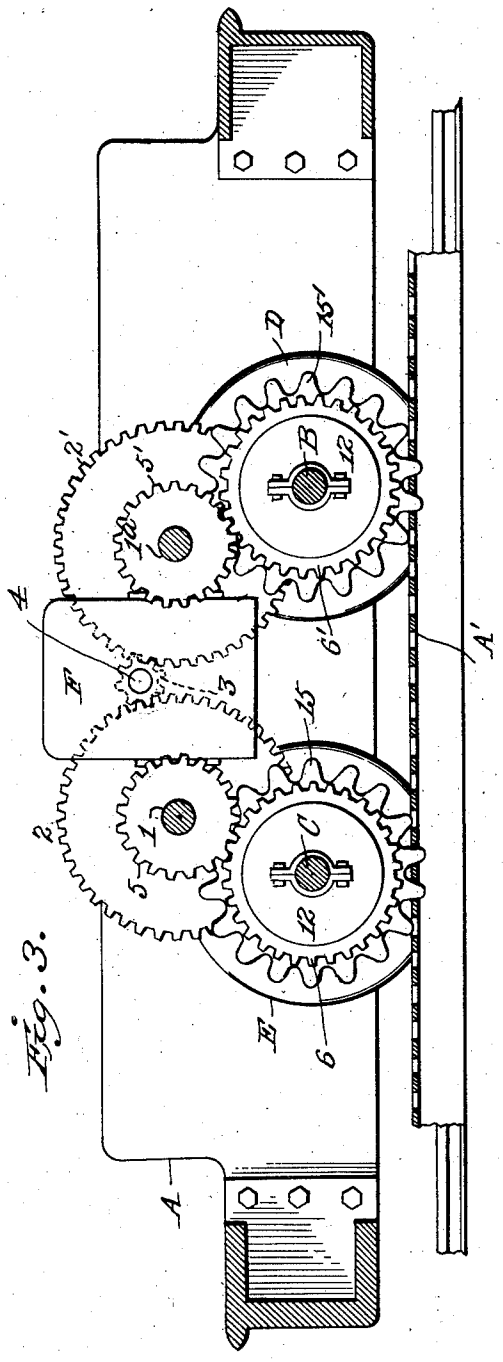


Fig. 3.

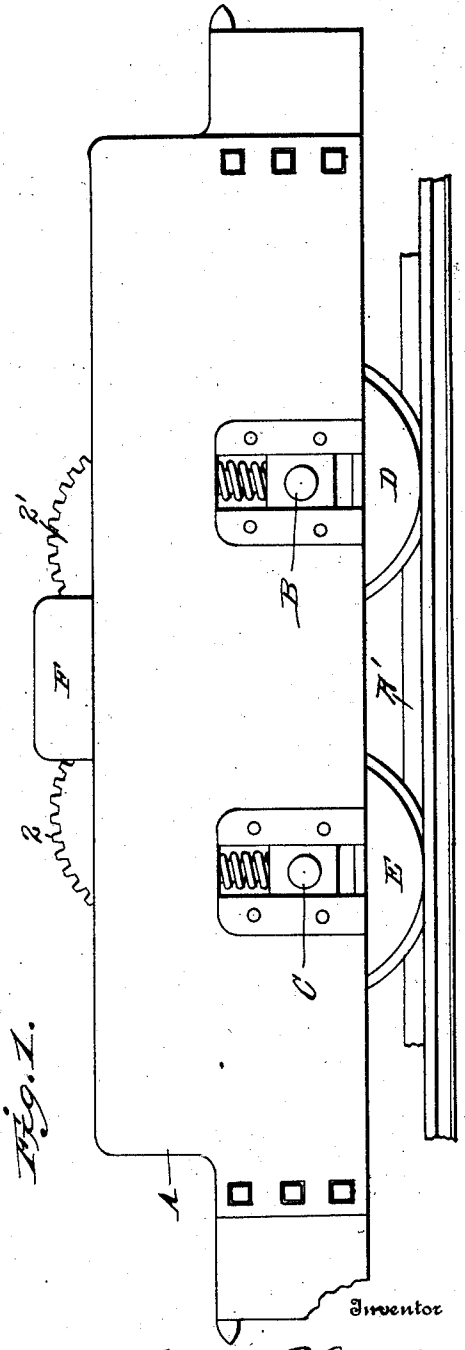


Fig. 1.

Witnesses

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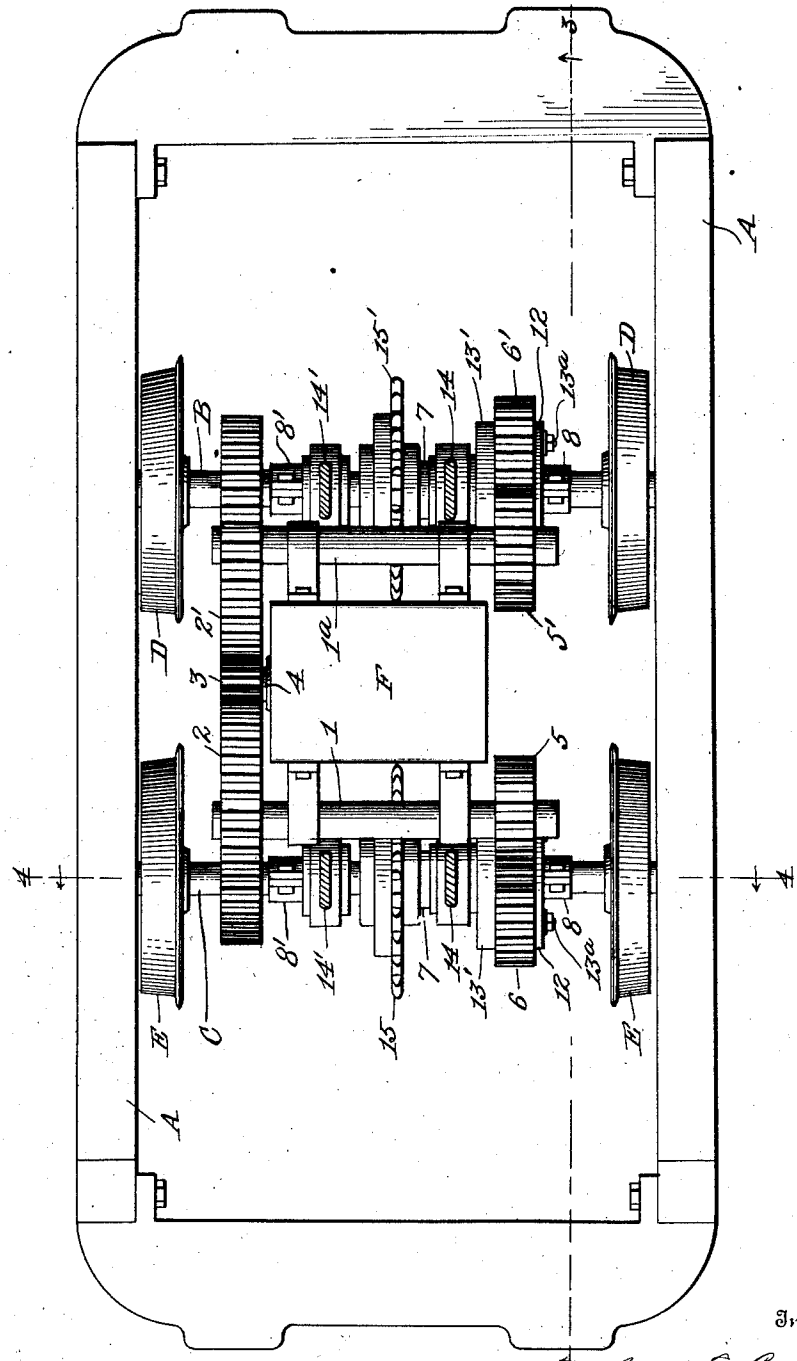


Fig. 2.

Witnesses

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3 SHEETS—SHEET 3.

Fig. 4.

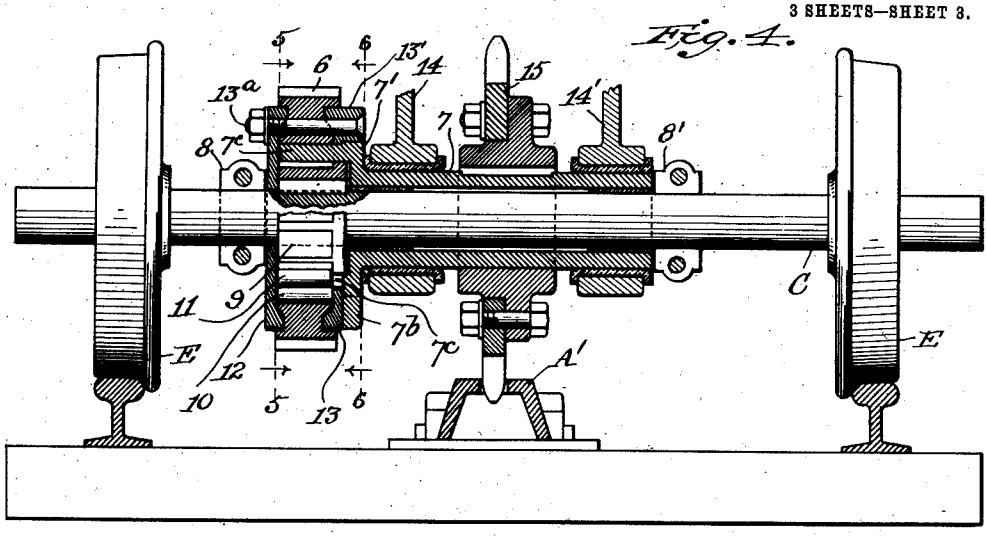


Fig. 5.

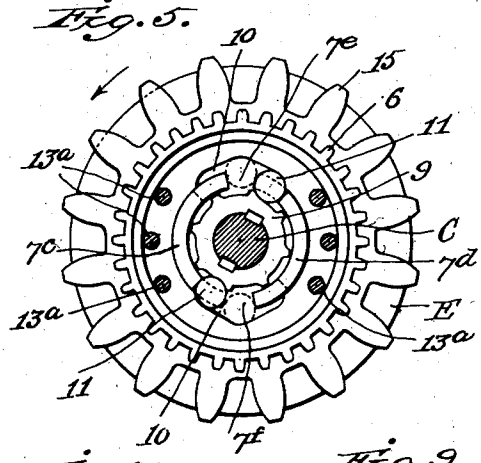


Fig. 6.

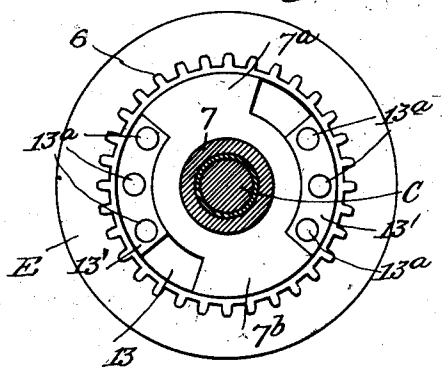


Fig. 7.

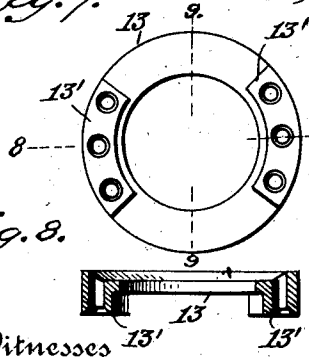


Fig. 8.

Fig. 9.

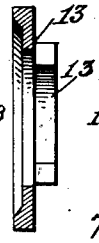


Fig. 10.

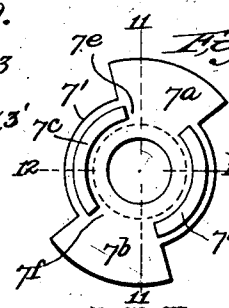


Fig. 11.

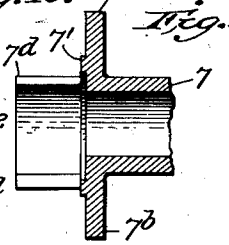
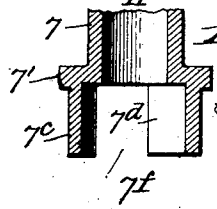


Fig. 12.



Witnesses

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UNITED STATES PATENT OFFICE.

GEORGE E. LYNCH, OF COLUMBUS, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE JEFFREY MANUFACTURING COMPANY, A CORPORATION OF OHIO.

RACK-RAIL LOCOMOTIVE.

No. 901,975. Specification of Letters Patent. Patented Oct. 27, 1908.

Application filed January 26, 1906. Serial No. 298,043.

To all whom it may concern:

Be it known that I, GEORGE E. LYNCH, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented certain new and useful Improvements in Rack-Rail Locomotives, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to a driving or propelling mechanism for a motor-driven vehicle.

It pertains particularly to mechanism through which power is applied from the motor on the vehicle for rotating two vehicle-supporting and driving wheels arranged oppositely to each other on the same horizontal axis transverse of the vehicle as well as a rack wheel sprocket arranged on the said axis and between the said drive wheels, said mechanism being arranged to allow for compensation between the said supporting and driving wheels and the said rack wheel in accordance with the relative speeds of rotation of the pitch circle of the latter and the tread circles of the former. Its object is to insure the continuous and uniform operation of said rack wheel along a rack rail section irrespective of whether the ground-engaging and driving wheels through which power may also be transmitted are rotating at the same speed as it, or at different speeds, and to compensate for such difference in speed and to obviate the slippage of the vehicle-supporting and driving wheels along their supporting surfaces.

For the purposes of illustration I will herein describe a mechanism embodying my improvements and applied to driving the rack wheel and the track wheels of an electric rack rail locomotive in which the said wheels are all mounted on the same axis.

Figure 1 is a side elevation of an electric locomotive embodying my improvements. Fig. 2 is a plan view of the same with the top casing or cover detached. Fig. 3 is a section on the line 3—3, Fig. 2. Fig. 4 is a vertical transverse section on the line 4—4, Fig. 2. Fig. 5 is a section on the line 5—5, Fig. 4. Fig. 6 is a section on the line 6—6, Fig. 4. Figs. 7 to 12 show details.

In the drawings A represents as an entirety the framework of an electric locomotive; B, C, the front and rear axles thereof, and D, D, E, E, the track wheels rigidly secured to the said axles, respectively.

F indicates a motor suitably mounted on the locomotive frame in any well known manner, and which in this particular embodiment of my invention is arranged substantially in a plane midway between the vertical planes containing the axes of the front and rear axles, B, C.

1, 1^a, are counter shafts mounted transversely of the locomotive frame in suitable bearings carried thereby.

2, 2′, are spur gears rigidly connected to these counter shafts respectively, and both meshing with and being driven by a pinion 3 secured to the armature shaft 4 of the motor.

5, 5′, are gear wheels rigidly secured to the rear and front counter shafts respectively at the opposite ends thereof from the gears 2, 2′.

6, 6′, are gear wheels loosely mounted on the axles C and B respectively, and the former meshing with and driven by the gear 5, and the latter meshing with and driven by the gear 5′.

7 is a sleeve loosely mounted upon the axle C and held from longitudinal movement thereon by means of collars 8, 8′, secured to the said axle. The end of the said sleeve in the vertical plane of the gear 6 has the laterally extending annular flange 7′ which carries the outward extending sector-shaped plates or arms 7^a, 7^b, and the longitudinally extending curvilinear arms or projections 7^c, 7^d. The latter projections extend for only a portion of the distance about the circumference of the said flange, as indicated, their adjacent ends being separated by the spaces 7^e, 7^f. The gear 6 is loosely mounted on these curvilinear arms or extensions 7^c, 7^d, so as to be free to revolve relatively thereto.

9 is a ratchet rigidly secured to the axle C in the space bounded by the said axle, the flange or web 7′ of the sleeve, and the arms 7^c, 7^d, carried thereby.

10, 10, are pawl recesses in the inner surface or circumference of the gear 6. These recesses are preferably arranged diametrically opposite to each other in the said gear and each one has oppositely inclined bottom surfaces, each of which extends from the inner circumference of the gear to the deepest point of the recess therein.

11 are pawls preferably cylindrical in

shape and adapted to be fitted between the walls of the pawl recesses in the gear 6 and the perimeter of the ratchet wheel 9. These pawls are of such diameter that when they are seated in the deepest portion of the recesses in the gear wheel 6, the ratchet wheel 9 may turn without engaging them, while when they are seated at other points within said recess on either side of the center thereof, they will be engaged by the ratchet teeth of the wheel and, when in operative position, each will be gripped between the walls of one of the said teeth and the wall of the recess on the side thereof in which it is located.

12 is an annular plate arranged on the outer side of the gear wheel 6 and about the axle C.

13′, 13′, are curvilinear lugs or projections arranged on the inside of gear 6 and carried by an annular plate 13. The plates 12, and 13 are held in position by bolts 13^a, arranged as shown. The lugs 13′, 13′, are fitted about the flange 7′ of the sleeve 7 and have their radial edges adapted to engage with or be engaged by the radial edges of the outwardly extending projections 7^a, 7^b, on said sleeve. The spaces between the radial edges of the lugs or projections 13′, 13′, are greater in width than the width of the extensions 7^a, 7^b, so as to permit a certain amount of lost motion or play between the coöperating radial edges of these parts and to allow the relative rotation of the gear and the sleeve so as to separate either of the pairs of radial coöperating edges of the said parts and bring the coöperating edges of the other pairs into engagement with each other.

The sleeve 7 may be supported in bearings in hangers 14, 14′, carried by the locomotive frame. 15 is a rack or sprocket wheel rigidly secured to the sleeve 7 and adapted to rotate therewith in either direction.

When power is applied from the motor to rotate the gear wheel 6 through the interposed power transmitting mechanism, the said gear is caused to revolve in a given direction in accordance with the direction of rotation of the armature shaft of the motor. Assuming that the power is applied so as to rotate the said gear in the direction indicated by the arrow in Fig. 5, this will cause the blocks or lugs 13′, 13′, to engage the projections 7^a, 7^b, upon the sleeve 7 in such manner as to rotate the sleeve in the same direction, under which circumstances the longitudinal projections 7^c, 7^d, carried by the said sleeve, will be rotated within the gear 6 to the position shown in Fig. 5 in which they prevent the rollers or pawls 11 from operating at one side of the recesses in the gear 6 as shown, and the pawls are advanced if necessary about the ratchet wheel 9 by the edges of the projections 7^c, 7^d, then at the innermost end of the recess wall on the same side of each recess until the pawl therein engages with one of the teeth of the ratchet and a gripping action is set up between the gear wheel 6 and the ratchet wheel and the pawls. When the parts have assumed this relation to each other, power will be transmitted from the gear wheel through the ratchet and pawl mechanism to drive the axle in the same direction as the sleeve 7 is being driven.

In many traction systems where grades of different degrees are met with, it is often desirable to provide along such grades sections of rack rail and to equip the locomotive or tractor for the system with a rack or rack wheels which will operate in conjunction with said rack rails to increase the traction effort of the locomotive at those points where grades are encountered. This makes the locomotive adaptable both for rack rail purposes and for operating along ordinary track sections not equipped with rack rails. Owing to the relatively small space available in electric locomotives for mine work, yard work and the like, it is essential in a locomotive of this combined type that the power transmitting mechanism between the motor and the track wheels and rack wheel or wheels should be as simple and readily accessible as possible, confined in the smallest possible space, and it is desirable that it be automatic in its operation.

It is well known that it is almost impossible to construct a locomotive having a rack wheel mounted on the same axis as a pair of locomotive-propelling track wheels and to maintain the tread circles of the track wheels absolutely equal in diameter to the pitch circle of the rack wheel. The wear and tear on the parts is such as to preclude the maintenance of such relationship where the machine is used to any considerable extent, and this being the case, the desirability of providing such a compensating mechanism as herein disclosed is at once apparent.

Assuming then that the sprocket or rack wheel 15 has its pitch diameter slightly greater than the tread diameter of the track wheels, it will be noted, that when the rack wheel is operated on a section of the rack rail A′ it will tend to cause the advance of the locomotive at a linear speed of travel greater than that at which the track wheels tend to advance it and in consequence the track wheels will slip along the rails unless there is some compensation by means of which they are permitted to turn sufficiently rapidly to have the peripheral speed of their tread circles equal in feet traveled to the speed of advance of the locomotive under propulsion of the rack wheel. Now, as the tread circle of the track wheels is less in diameter than the pitch circle of the rack wheel, when the locomotive is being operated principally through the rack wheel and rack rail section, the track wheels will have to be permitted to rotate faster than usual. The

ratchet and pawl mechanism provides for this, since when there is a tendency for the track wheel to rotate faster than normally and faster than the sleeve 7 is rotating, the ratchet wheel 9 on the axle will turn relatively to the sleeve in such manner as to advance the pawls 11, 11, toward the deeper parts of the recesses 10, 10 in the gear 6 in such manner as to permit the ratchet to turn relatively to the said sleeve and to slip by the pawls if the difference in speed of rotation of the sleeve 7 and the axle C requires it in order to effect the proper compensation of these parts.

When it is desired to cause the locomotive to travel in the direction opposite to that indicated by the arrow in Fig. 5, the armature shaft is caused to reverse its direction of rotation and consequently that of the gear wheel 6, which will cause the curvilinear wheel-controlling stops 13′, 13′ on said gear to rotate relative to the sleeve 7 until they have engaged the extension 7^a, 7^b, thereon. The lost motion between the radial edges of the parts 13′, 13′, and the coöperating edges of the extension, 7^a, 7^b, carried by the sleeve, permits of the movement of the gear 6 relative to the sleeve 7 in such manner as to bring the edges of the projections 7^c, 7^d, into the relative positions indicated in dotted lines in Fig. 5, in which they compel the pawls to act on the opposite sides or sections of each recess 10 10, from that in which they operated when the gear 6 was rotating in the other direction.

The ratchet and pawl mechanism operates to compensate in the same manner for the relative speeds of the pitch circle of the rack wheel and the tread circle of the track wheels when the parts are revolving in the opposite direction to that indicated by the arrow in Fig. 5 as it does when operating in the direction indicated thereby.

A set of power transmitting parts similar to those arranged on axle C are also arranged on the front axle B between the said axle and gear 6′, and since these parts are identical in every detail with those on the rear axle, it is not deemed necessary to further describe them. The rack wheel on the sleeve on the axle B is indicated by 15′ and the gearing between the motor pinion 3, and the rack wheels 15, 15′, may be so constructed and related, that the rack wheels will operate synchronously and simultaneously upon the rack rails. In this manner it may be provided that at least one of the teeth of one rack wheel will always be in operative engagement with the rack rail so as to be imparting motion to the locomotive in the desired direction.

It will be noted that irrespective of the different relations of each rack wheel on each axle to the track wheels on the said axle, that the power transmitting mechanism between the driving gears 6, 6′, and their respective rack wheels and track wheels is such that compensation between the driving parts on each axle will be effected so as to insure the travel of the locomotive without the slippage of any of the track wheels.

When desired, the motor may be used to drive simply the parts referred to on the axle C and this axle may then, if desired, be connected with the axle B by sprockets and chains or in any other suitable and well known manner, so that power from the motor may be applied to both axles.

Various mechanisms have been devised for propelling a rack rail locomotive both by track wheels and a rack wheel but I know of none in which both the rack wheel and the track wheels are arranged on the same axle and both are adapted to be driven from the same motor, and for which automatically acting compensating mechanism is provided to permit the rotation of the track wheels relative to the rack wheel when the latter is operating on a rack rail section. In locomotives of this type which are adapted to narrow-gage roads it is essential to encompass the driving mechanism on the driving axle in as small a space as possible. Where manually operated clutches have been employed between the axle carrying the track wheels and the rack wheel on the said axle, such clutches have taken up a considerable amount of room which it could ill be afforded to spare. In a mechanism such as I have devised it will be noted that the same gear which transmits the power for rotating both the axle and the rack wheel carries the mechanism for effecting the necessary compensation in rotation between these parts and that the two sets of propelling devices, the track wheels and the rack wheel, operate about the same axis and in differential radiation to each other.

I claim—

1. In a rack rail locomotive, the combination with a locomotive frame, axles therefor, track-engaging supporting wheels on the said axles, and a motor on the frame, of a rack wheel mounted on the frame, and the train of power transmitting devices interposed between said motor and both said rack wheel and one of said axles and adapted to rotate both the rack wheel and the axle with power, and having in said train compensating mechanism to allow the said axle to rotate relative to the said rack wheel.

2. In a rack rail locomotive, the combination with a locomotive frame, axles carried thereby, track wheels connected with the axles and a motor on the said frame, of a rack wheel mounted on one of said axles, and a train of power transmitting devices interposed between said motor and both the said rack wheel and the axle upon which it is mounted and adapted to rotate both the

rack wheel and the axle with power, and having in said train compensating mechanism adapted to permit the relative rotation of the rack wheel and the said axle.

3. In a rack rail locomotive, the combination with a locomotive frame, axles mounted in the frame, at least one of which is a driving axle, supporting wheels rigidly secured to said driving axle, and a motor on the frame, of a rack wheel loosely mounted upon the driving axle, and a train of power transmitting devices interposed between said motor on the locomotive and the said rack wheel and axle and adapted to drive both the rack wheel and the axle with power, and having in said train compensating mechanism arranged to allow the axle to rotate relative to the rack wheel.

4. In a locomotive of the class described, the combination with a locomotive frame, axles mounted therein, track wheels rigidly secured to the axles, and a motor on the frame, of a rack wheel loosely mounted on one of said axles, power transmitting compensating mechanism interposed between said rack wheel and said axle, and power transmitting mechanism interposed between said power transmitting compensating mechanism and said motor.

5. In a locomotive of the class described, the combination with a truck frame, axles mounted therein, track wheels rigidly secured to said axles and a motor on the frame, of a rack wheel loosely mounted on one of said axles, a differential power transmitting mechanism interposed between said axle and said rack wheel, and having an external gear, and a train of power transmitting devices interposed between said differential power transmitting mechanism gear and the said motor.

6. In a locomotive of the class described, the combination of a truck frame, axles mounted therein, track wheels rigidly secured to said axles, and a motor mounted on the frame, of a rack wheel loosely mounted on one of said axles, a differential power transmitting mechansim interposed between said rack wheel and the axle upon which it is mounted and adapted to transmit power for rotating both said axle and said rack wheel and to permit, when necessary, the relative rotation of said rack wheel and axle, and a train of power transmitting mechanism interposed between said differential mechanism and said motor.

7. In a locomotive of the class described, the combination with a locomotive truck frame, axles mounted therein, track wheels rigidly secured to the axles, and a motor on the frame, of a rack wheel loosely mounted on one of said axles, and power transmitting mechanism interposed between said motor and both the said rack wheel and the axle on which it is mounted and adapted to drive the said rack wheel and the track wheels and the said axles with power, and comprising means for automatically permitting the rotation of said track wheels relative to said rack wheel when the rack wheel is operating along a rack section and the diameter of its pitch circle varies from the diameter of the tread circles of the track wheels on the said axle.

8. In a locomotive of the class described, the combination with a locomotive frame, axles mounted therein, track wheels rigidly secured to the axles, and a motor on the frame, of a rack wheel loosely mounted on one of said axles, and a train of power transmitting devices interposed between said motor and both the said rack wheel and the said axle upon which it is mounted and adapted to rotate the rack wheel and the track wheels on the said axle with power, and provided with means for automatically permitting the rotation of the track wheels relative to the rack wheel to prevent their slippage along the track rails when the rack wheel is operating along a rack section to propel the locomotive.

9. In a locomotive of the class described, the combination with a locomotive frame, axles mounted therein, track wheels secured to the axles and a motor on the frame, of a rack wheel loosely mounted on one of said axles, differential mechanism interposed between said rack wheel and said axle, and comprising ratchet and pawl mechanism automatically acting to drive the rack wheel and axle together or to permit of their rotation relative to each other, and power transmitting mechanism interposed between said ratchet and pawl mechanism and the motor.

10. In a locomotive of the class described, the combination with a locomotive frame, axles mounted therein, track wheels secured to the axles and a motor on the frame, of a rack wheel loosely mounted on one of said axles, a ratchet and pawl mechanism interposed between said rack wheel and said axle and adapted both to cause the rack wheel and axle to rotate together and to permit of their rotation relative to each other, and power transmitting mechanism interposed between said ratchet and pawl mechanism and said motor.

11. In a locomotive of the class described, the combination with a locomotive frame, axles mounted therein, track wheels secured to the axles and a motor on the frame, of a sleeve loosely mounted on said axle and having longitudinal curvilinear sections with their ends separated from each other, a gear wheel loosely mounted on said sections and having pawl-receiving recesses into which the ends of the curvilinear sections on the sleeve are adapted to extend, means carried by the said gear and also by the said sleeve for causing the gear to rotate the sleeve, said means allowing for a certain amount of lost motion

between the gear and the sleeve when the direction of rotation of the gear is changed in order to change the position of the edges of the curvilinear extensions on the sleeve within the pawl recesses in the gear, a ratchet wheel rigidly secured to the axle, and pawls in the said recesses in the gear arranged to engage with the walls of the said recesses and with the said ratchet wheel.

12. In a locomotive of the class described, adhesive track wheels, a rack wheel and power-transmitting mechanism interposed between the rack wheel and one of the track wheels, said power-transmitting mechanism having in its chain of elements a device permitting variation of the ratio between the angular velocities of said rack wheel and track wheel, substantially as set forth.

13. In a locomotive of the class described, the combination with a locomotive frame, a pair of driving axles mounted therein, track wheels rigidly secured to the said axles, and a motor or motors on the frame, of a pair of rack wheels, trains of power transmitting mechanism interposed between the motor or motors on the frame and both the axles and the said rack wheels, and having in said trains compensating mechanism adapted to permit the track wheels and rack wheels to rotate at different speeds, the said trains of power transmitting mechanisms also being arranged to operate said rack wheels synchronously.

14. In a locomotive of the class described, the combination with a locomotive frame, a plurality of driving axles, track wheels rigidly secured to said driving axles and a motor or motors on the frame, of a plurality of rack wheels each loosely mounted on one of the said axles, power transmitting compensating mechanism interposed between each of said rack wheels and its respective axle, and power transmitting mechanism interposed between said motor or motors and said rack wheels and adapted to operate them synchronously.

15. The combination with a supporting frame, axles therefor, traction wheels mounted on the axles and a motor mounted in the frame, of a rack wheel also mounted in the frame, and two sets of gearing driven by the motor, one rotating the traction wheels and the other the said rack wheel, one set of gearing comprising an automatically operating clutch arranged to permit both the traction and the rack wheels to be positively driven even though the pitch circle of the rack wheel and the tread circles of the traction wheels may vary in diameter, substantially as set forth.

16. In a locomotive of the class described, the combination of adhesive track wheels, a rack wheel, a motor, a train of gearing connecting the motor to one of the track wheels, and a train of gearing connecting the motor to the rack wheel, one of said trains of gearing having between two of its elements a variable gear ratio connection, substantially as set forth.

17. In a locomotive of the class described, the combination of adhesive track wheels, a rack wheel, a motor, and a system of power transmitting devices interconnecting the motor, one of the track wheels and the rack wheel, two of the elements of said system of power transmitting devices having a variable gear ratio connection, said connection being so located as to be operatively interposed between the rack wheel and the said track wheel, substantially as set forth.

In testimony whereof I affix my signature, in presence of two witnesses.

GEORGE E. LYNCH.

Witnesses:
F. E. VAN SLYKE,
C. E. WAXBOM.