No. 896,208. PATENTED AUG. 18, 1908.

E. G. HOFFMANN.

MOTOR VEHICLE.

APPLICATION FILED SEPT. 26, 1907.

3 SHEETS—SHEET 1.

Fig. 2.

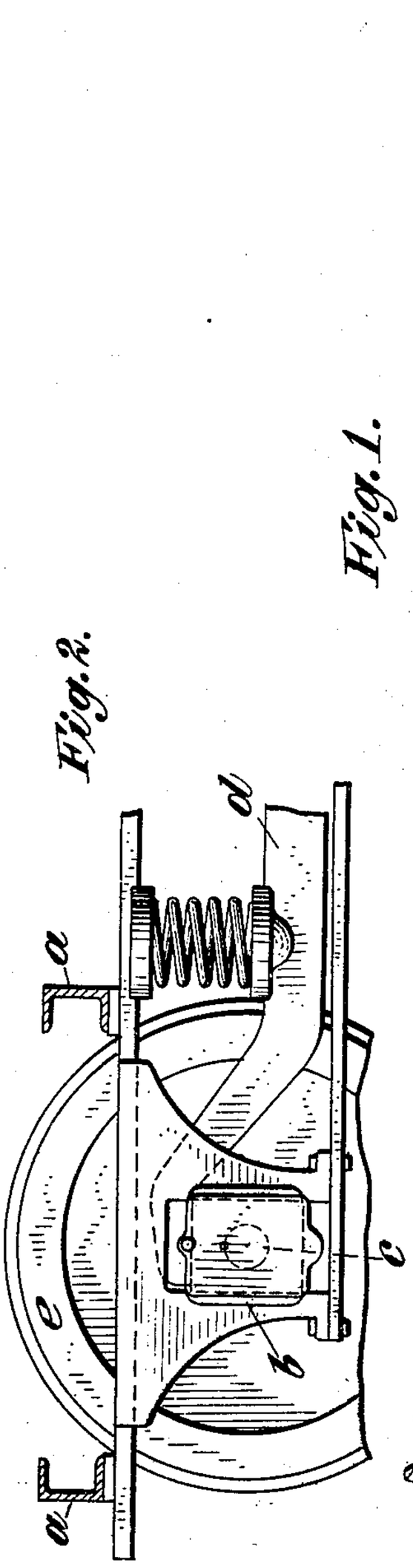
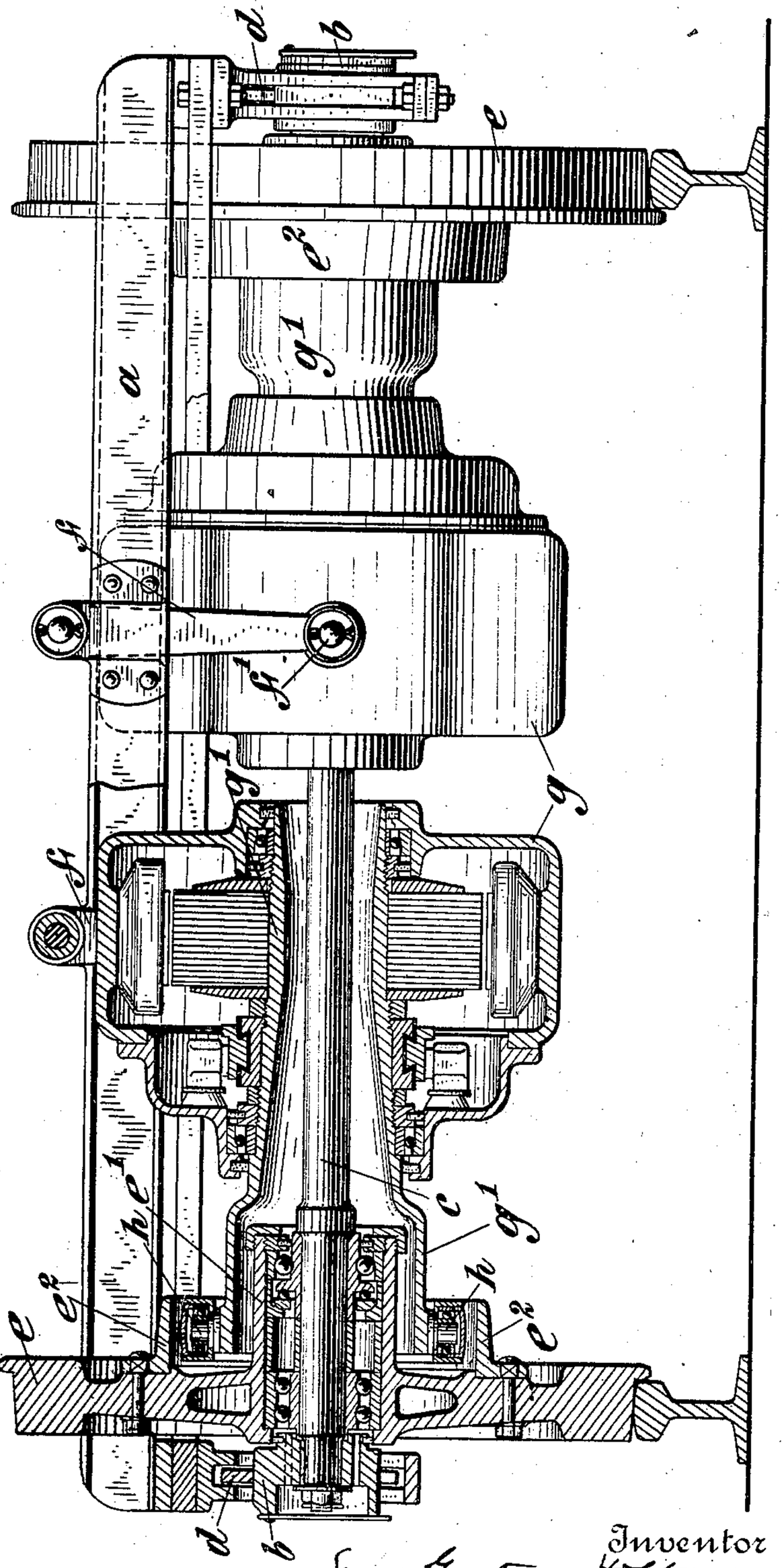


Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 4.

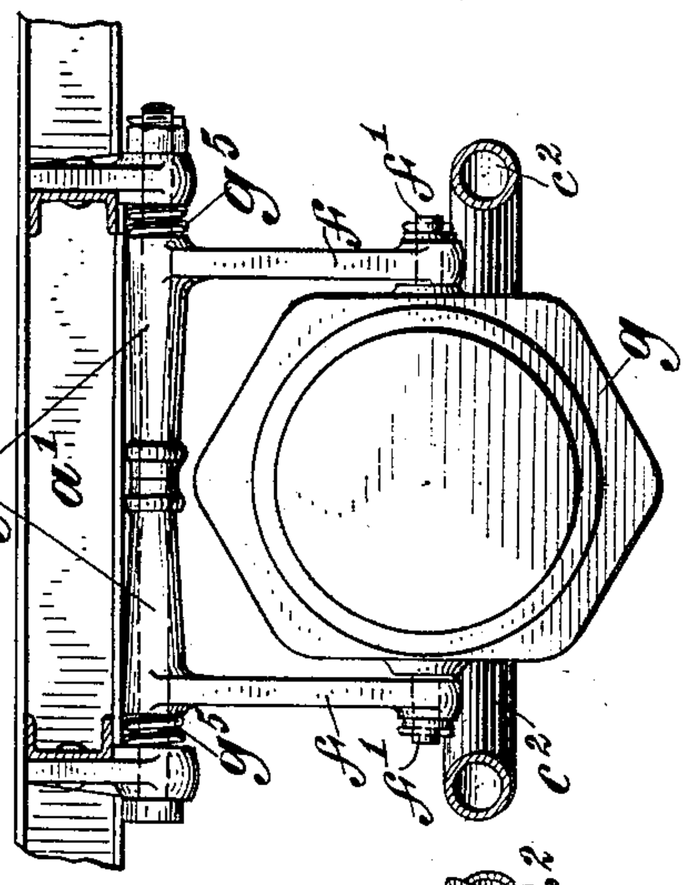

Fig. 3.

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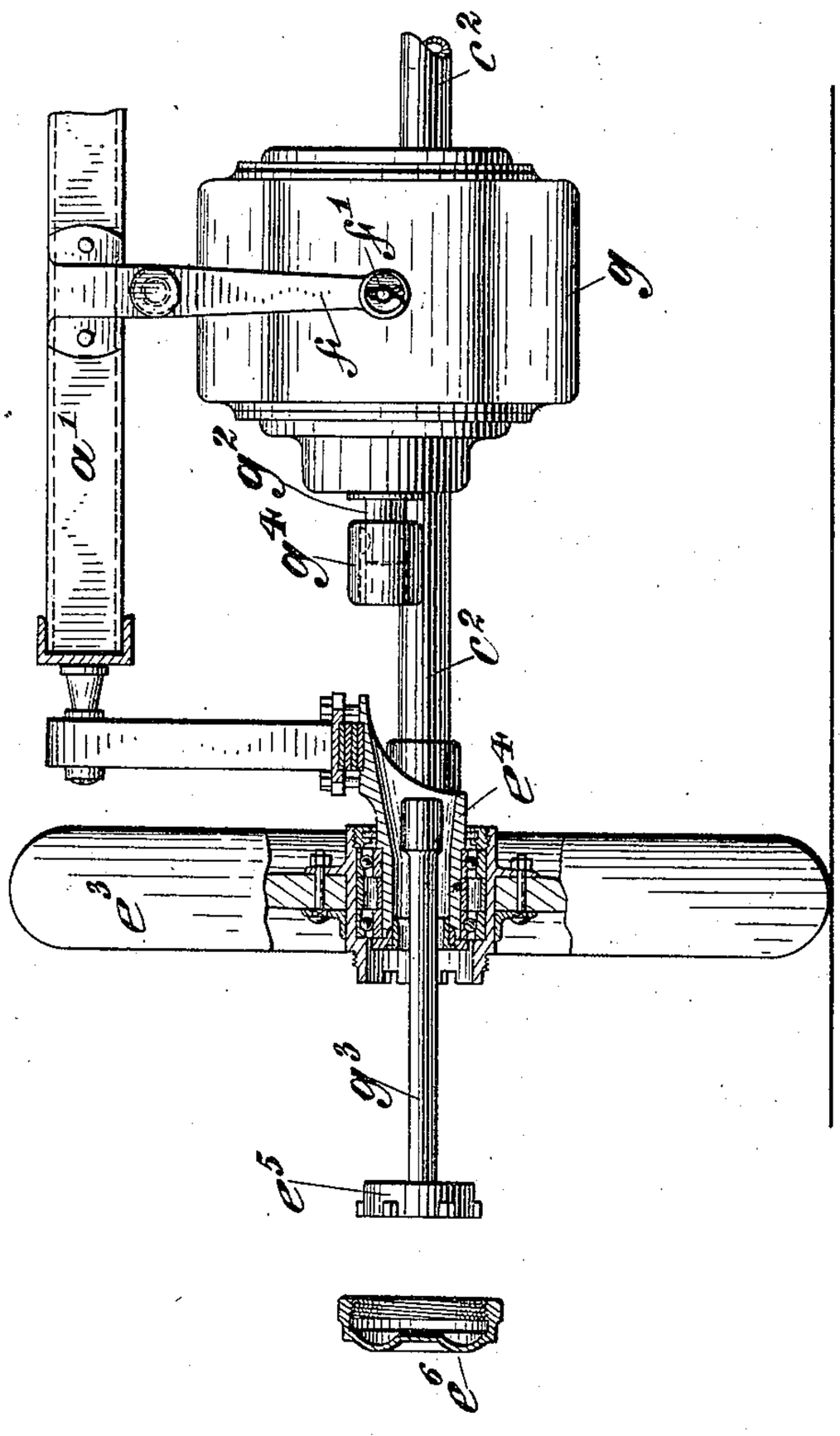
3 SHEETS—SHEET 3.

Fig. 5.



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ERNST GUSTAV HOFFMANN, OF NEW ROCHELLE, NEW YORK.

MOTOR-VEHICLE.

No. 896,208. Specification of Letters Patent. Patented Aug. 18, 1908.

Application filed September 26, 1907. Serial No. 394,602.

To all whom it may concern:

Be it known that I, ERNST GUSTAV HOFFMANN, a citizen of the United States, and a resident of the city of New Rochelle, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Motor-Vehicles, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

In an application for Letters Patent of the United States filed September 16, 1907, and Serial No. 393,048 an improved vehicle driving mechanism is set forth in which there are two electric motors mounted upon the vehicle body and between the driving wheels, which motors are directly connected with their respective driving wheels by a shaft, universal connections being provided at each end of each shaft to permit the shafts to oscillate freely as the body moves with respect to the driving wheels, and the shafts being lengthened by extending them into the respective driving wheel hubs or into the respective motors in order to reduce the extent of the oscillations of the shafts. In that improved driving mechanism, the electric motors are rigidly mounted upon the vehicle body.

The present improvements relate to the driving mechanism just referred to and the object of these improvements is to secure the motors upon the vehicle body in such a way that they may oscillate freely in a vertical plane and have at least a small movement in the direction of the axes of rotation of their armatures. In this way, the universal joint at the inner end of each intermediate shaft may be eliminated and moreover there will be no need of providing a sliding joint in the intermediate shaft, such as is necessary in the driving mechanism referred to to compensate for the variation in distance between the motor and driving wheels during the running of the vehicle.

To attain the object of the present invention, each motor may be suspended from the vehicle body by means of two arms hinged securely thereto, the motor being supported in these two arms on trunnions provided upon each side of the motor casing. It will be obvious, however, that this object may be attained through some other equally good construction, the only requirement being that the motor shall be capable of having oscillations in a vertical plane and of moving slightly in a longitudinal direction.

The improvements are applicable to what may be referred to as any "direct driving" system, that is, any system in which the motor is directly connected with its corresponding driving wheel by means of an intermediate shaft without the interposition of clutches, gearing, or anything of the kind; and while in those cases it will be desirable to extend this intermediate shaft in the manner explained in the application hereinbefore referred to, the present improvements may be employed where the intermediate shaft is not so extended. In vehicles which are constructed to run upon rails the relative motion between the axle or driving wheels and the vehicle body is generally very small and is certainly much less than the relative motion between these parts in road vehicles, and the present improvements are particularly applicable in cases where the relative movement between the body and driving wheels is small such as in railroad cars, trolley cars, and the like.

Besides compensating for the relative movement between the vehicle body and wheels, the present improvements act to conserve the vehicle springs in that the gyratory effect produced by the inertia of the motor armature tends to oppose the oscillations of the motor and therefore, as will be seen, the construction possesses what may be referred to as shock absorbing qualities. Moreover, as the force tending to oppose the oscillations of the motor is proportional to the speed of the armature, the shock absorbing qualities are proportionately greater as the vehicle increases its speed, and thus are automatically adjusted to the needs of the vehicle at any given moment.

The invention will now be more fully described in connection with two embodiments thereof which, for purposes of illustration and explanation, are shown in the accompanying drawings.

In said drawings, Figure 1 is a view partly in elevation and partly in section of the driving mechanism of a railroad car to which the improvements have been applied. Fig. 2 is a detail view partly in section and partly in end elevation of the driving mechanism shown in Fig. 1. Fig. 3 is a similar view, but

broken away, of the driving mechanism of a motor road vehicle in which the improvements have been applied. Fig. 4 is a detail view of the same mechanism, and Fig. 5 is a view similar to Fig. 3 with some of the parts removed, to show the manner of assemblage.

In the embodiment of the invention illustrated in Figs. 1 and 2 of the drawings the body of the car is not shown but, so far as the present invention is concerned, is represented by the truck frame *a* which is spring supported with reference to the axle *c*, Fig. 2 showing how levers, one of which is shown at *d*, distribute the load to guide blocks *b* upon the ends of the axles. Each axle *c* is preferably formed and supported as described in an application for U. S. Letters Patent filed March 27, 1907 and Serial No. 364,923, being received at each end in the guide blocks *b* and having a suitable ball bearing provided at each end between said shaft and an extended portion *e'* of the usual flanged wheel *e*. The two motors *g* are provided between the wheels *e* upon each end of the shaft *c* and are supported on the truck frame *a* so as to be capable of oscillations in a vertical plane extending transversely of the vehicle and to have at least a slight movement in the direction of their armature shafts, that is in a longitudinal direction with respect to said shafts. For this purpose each motor is provided with a pair of trunnions *f'*, one on each side of its casing, and these trunnions are journaled in arms *f* pivoted to and depending from the truck frame *a*, such arms preferably having long bearings f^2, as shown in Fig. 4. The shaft *c* extends through both motors, and the armature shafts *g'* of these motors are made hollow for this purpose and sufficiently large to permit the vertical oscillations of the shaft *c* to take place. The outer end of each armature shaft *g'* is connected to the corresponding wheel *e* by means of a flexible joint *h*, one terminal member of which is secured upon the periphery of this shaft and the other terminal member being secured to the inner side of a flange e^2 secured to the wheel *e*. It will thus be seen that as the truck frame *a* moves up and down with respect to the wheels *e*, the motors *g* will have slight oscillations in a vertical plane and a slight movement in the direction of their armature shafts, while the connection between the armature shafts and driving wheels permits the latter to be driven directly by the oscillating motors without any lost motion or without any interference in the transmission of power as these oscillations take place.

In Figs. 3, 4 and 5 where the invention is illustrated as applied to a motor road vehicle, the vehicle body is indicated at *a'* and the motors *g* are supported from the vehicle body in the same manner as has just been described with respect to the motors *g* in Figs. 1 and 2. The driving wheels e^3 however are supported upon hollow axle ends e^4 which are rigidly secured to the main axle c^2. The armature shafts g^2 of each motor are extended through the hollow axle end e^4 into the wheel hub, and, as shown in the drawings, are connected to the outer end of the wheel hub by means of a flexible joint e^5, such shafts being extended in order to lengthen them and reduce their oscillations, as explained more particularly in an application for Letters Patent, filed June 8, 1907 and Serial No. 377,851.

It is not necessary to describe the details of construction of the wheel hub, flexible joint and the like, for they form no part of the present invention and moreover they are set forth in detail in the application just referred to. Fig. 5 illustrates the method of assembling these parts, and from this figure it will be seen that the extended portion of the armature shaft g^2 comprises a short intermediate shaft g^3 which is secured to one terminal member of the universal joint e^5 and is inserted through the hollow axle e^4 and secured to the shaft g^2 by means of a suitable coupling piece g^4. A cap e^6 is provided for the end of the wheel hub in order to hold the parts in position.

It will be understood that the improvements may be applied to road vehicles without extending the motor shaft into or through the wheel hub, this construction being referred to in the present case as being possibly the preferable one and as furnishing a simple basis for explaining the application of the improvements to a motor road vehicle.

It will be easy to understand the effect of the gyratory action of the motor armatures upon the spring system, for it is obvious that when the armatures are in rotation, any force tending to change the plane of rotation of the armatures, such as is produced by the relative movements of the vehicle body and wheels, will be resisted by a counter force depending upon the speed of rotation of the armatures.

Referring particularly to Figs. 3, 4 and 5, it will be seen that the connection g^3 between the motor armature and the corresponding driving wheel affords a means of deflecting the plane of rotation of the armature when any relative movement between the vehicle body and wheels occurs, whereby the counter force referred to is produced. The result of this counter force will be a steadying effect upon the vehicle springs tending toward a smoother running of the vehicle and substantially reducing the possibility of damage to the springs. When the vehicle is being driven at high speed the gyratory force will be considerable and will obviously act as a shock absorbing medium and when the speed is decreased, the gyratory force will also decrease, grading itself automatically with the speed of the vehicle. If the motors are run at high

speed, it is preferable to mount the motors so that they may displace themselves in a direction at right angles to their plane of oscillation, that is in a direction lengthwise of the car or vehicle, on account of the tendency to swerve which the motors have when run at high speed and oscillated. For this purpose springs g^5 are provided between the bearings f^2 and their supporting brackets upon the truck frame a or a' as the case may be. In this way when the motors tend to swerve either in a forward direction or in a backward direction, they are resisted by the springs which, as the swerving action becomes sufficiently strong, yield and permit the motors to displace themselves slightly.

It will be understood that the motors may be otherwise mounted and may be otherwise related to the driving mechanism, the vehicle body and wheels in order that the gyratory effect of the rotation of their armatures may be availed of to perform the functions just described. Moreover, the improvements are capable of various other embodiments besides those shown and described herein.

Finally, in order that the statement in the first paragraph of the specification to the effect that the improvements are applicable to a direct drive system, may not be misunderstood, it should be mentioned that the motor or other driving element may of course be provided with reduction gearing or the like or the same may be introduced between the motor and driving wheel or wheels without interfering with the results which the present improvements are designed to effect. In other words, where it is desirable to employ a high speed motor and to support the motor and transmit the power to the driving wheels in accordance with the invention set forth and described herein, reduction gearing may be employed and may, if desired, be embodied with the motor in such a way as to partake of its oscillatory motion.

I claim as my invention:

1. In a motor vehicle, the combination of a driving wheel, an axle for the wheel, a driving element, a support for the driving element having relative movement with the axle, a shaft operatively connecting the driving element and wheel, means to suspend the driving element from the support so that it may have oscillations in a vertical plane and movement substantially in the direction of the shaft, and a flexible coupling between the shaft and wheel.

2. In a motor vehicle, the combination of a driving wheel, an axle upon which the wheel is journaled, an electric motor, a support for the motor having relative movement with the axle, a shaft between the motor and driving wheel operatively connecting the motor and wheel, means to suspend the motor from the support so that it may have oscillations in a vertical plane and movement substantially in the direction of the shaft, and a universal coupling between the shaft and driving wheel.

3. In a motor vehicle, the combination of a driving wheel, an axle upon which the wheel is journaled, a driving element, a support for the driving element having relative movement with the axle, a shaft operatively connecting the driving element and wheel, arms pivoted upon the support and depending therefrom, trunnions upon the motor journaled in said arms, and a flexible coupling between the shaft and the driving wheel.

4. In a motor vehicle, the combination of a driving wheel, an axle upon which the wheel is journaled, a motor, a vehicle body spring connected to the axle, means to suspend the motor from the body so that it may oscillate in a vertical plane and have movement in the direction of the axis of its armature, the armature shaft being extended to the driving wheel, and a flexible coupling between said shaft and driving wheel.

5. In a motor vehicle, the combination of an axle, driving wheels at either end thereof, a vehicle body having relative movement with the axle, a motor, flexible means to connect the driving shaft of the motor with one of the driving wheels, and means to support the motor so that it may have oscillations in a vertical plane and movement substantially in the direction of its axis.

6. In a motor vehicle, the combination of an axle, driving wheels thereon, a vehicle body spring connected to the axle, an electric motor for each driving wheel provided with trunnions, means depending from the body in which said trunnions are journaled to permit the motors to swing freely in vertical planes and to move longitudinally in the direction of the axes of their armatures, and flexible means to connect the driving shafts of the motors with their respective driving wheels.

7. In a motor vehicle, the combination of an axle, driving wheels journaled thereon, an electric motor for each driving wheel having a hollow armature shaft through which the axle is extended, means to support each motor so that it may have oscillations in a vertical plane and movement in a longitudinal direction, and a flexible connection between each motor and its corresponding driving wheel.

8. In a motor vehicle, the combination of driving mechanism containing a rotating element mounted to permit deflection of its plane of rotation, the vehicle body, the vehicle wheels, the vehicle springs between the body and wheels, and means to deflect the plane of rotation of the rotating element as the springs are compressed or expanded.

9. In a motor vehicle, the combination with the vehicle body, vehicle wheels and vehicle springs, of an electric motor mounted

upon the vehicle body and capable of oscillating thereon, and a connection between the motor and one of the wheels adapted to cause the motor to oscillate when the body and wheels move with respect to each other, in order that the gyratory effect of the motor armature may oppose the relative movement of the body and wheels.

10. In a motor vehicle, the combination with the vehicle body, vehicle wheels and vehicle springs, of an electric motor mounted upon the vehicle body and capable of oscillating thereon, a connection between the motor and one of the wheels adapted to cause the motor to oscillate when the body and wheels move with respect to each other, and yielding means to resist the tendency of the motor to swerve when the axis of rotation of its armature is deflected by the relative movement of the body and wheels.

This specification signed and witnessed this 19th day of September A. D., 1907.

ERNST GUSTAV HOFFMANN.

Signed in the presence of—

LUCIUS E. VARNEY,

AMBROSE L. O'SHEA.