July 12, 1932. R. B. FAGEOL 1,866,637

ROAD VEHICLE

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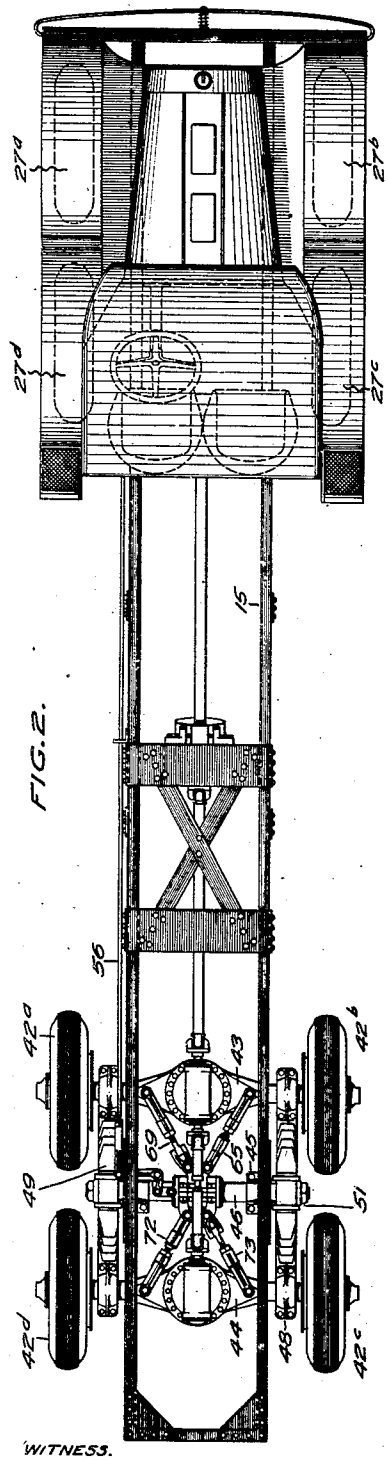

FIG. 2.

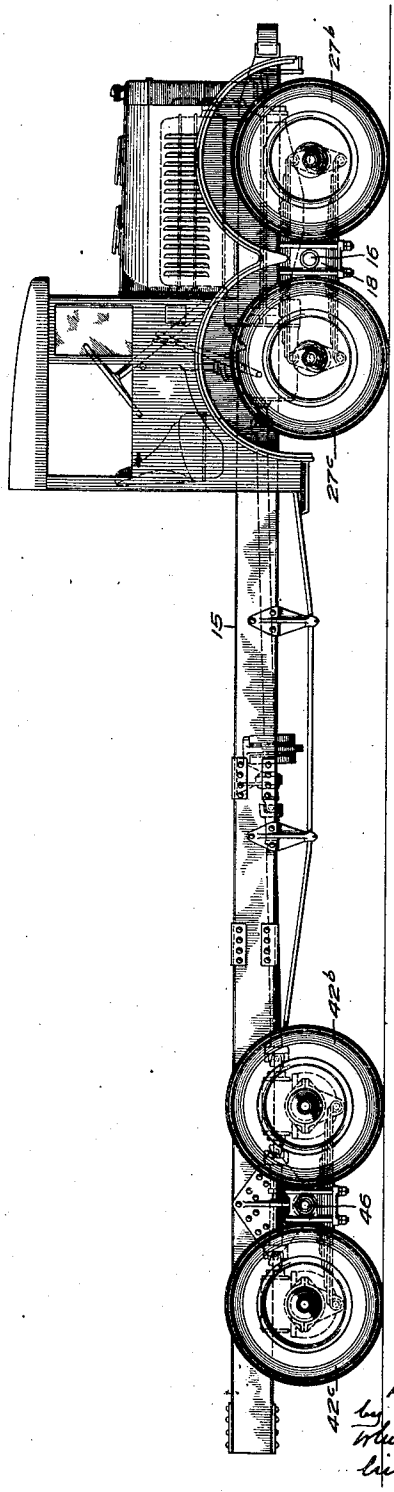

FIG. 1.

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ROAD VEHICLE

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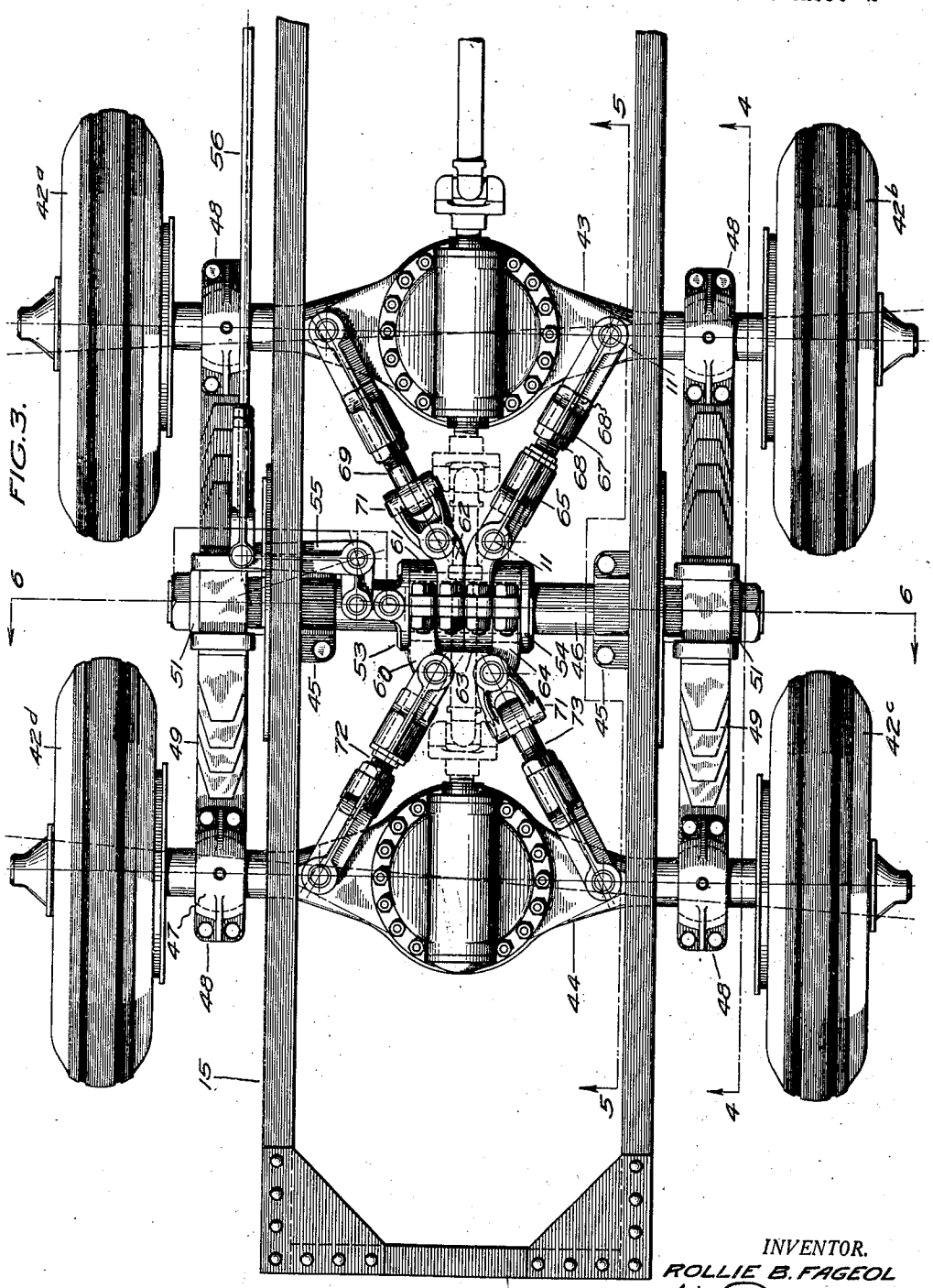

FIG. 3.

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ROAD VEHICLE

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FIG. 4.

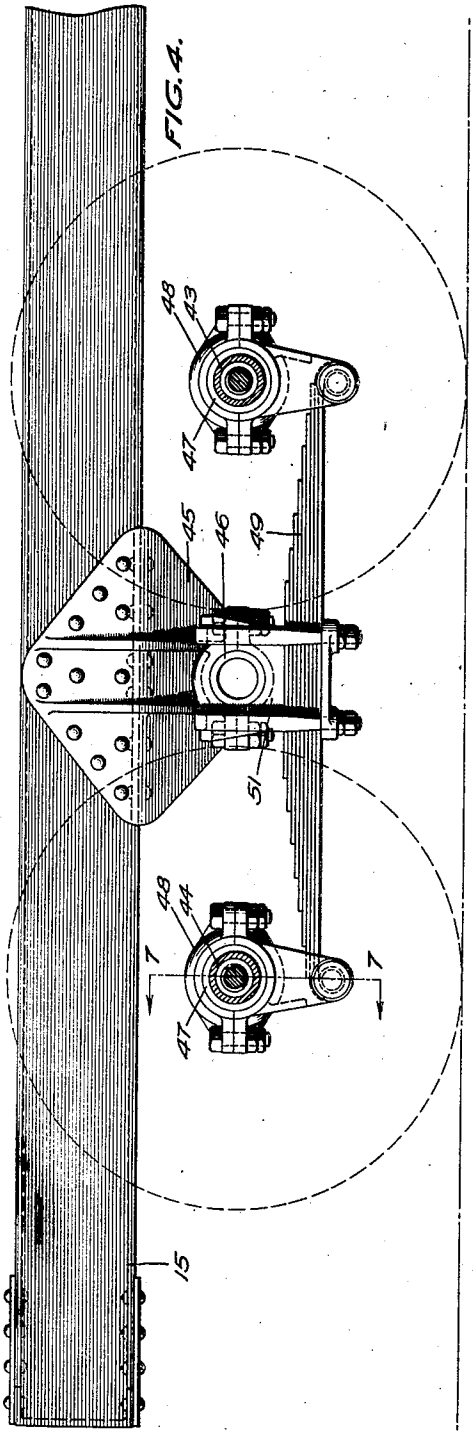
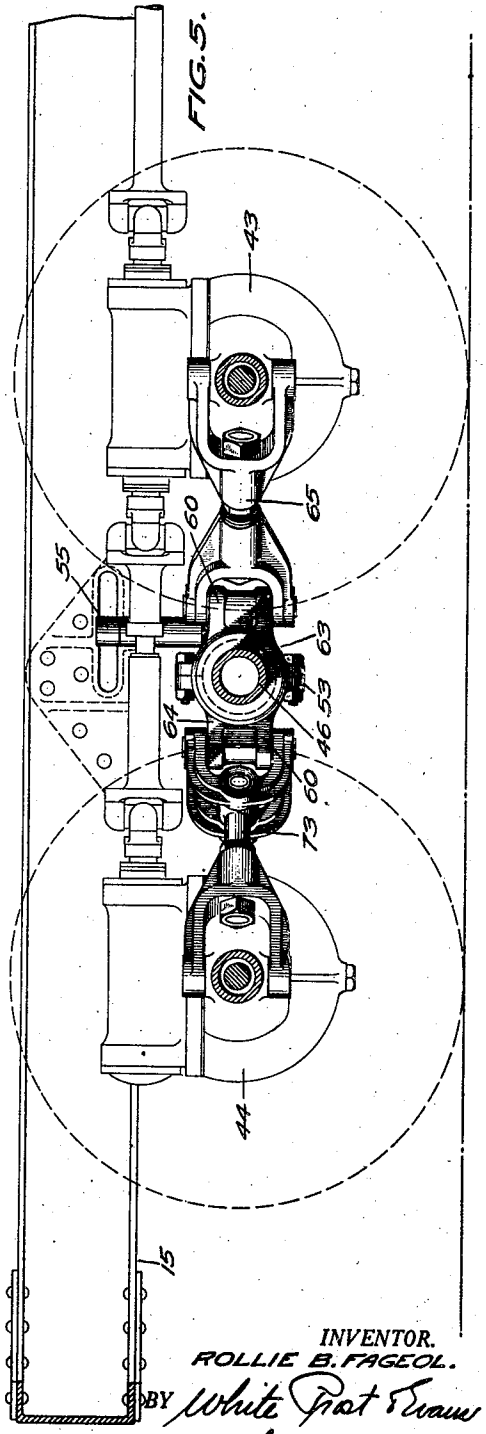


FIG. 5.



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ROAD VEHICLE

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FIG. 6.

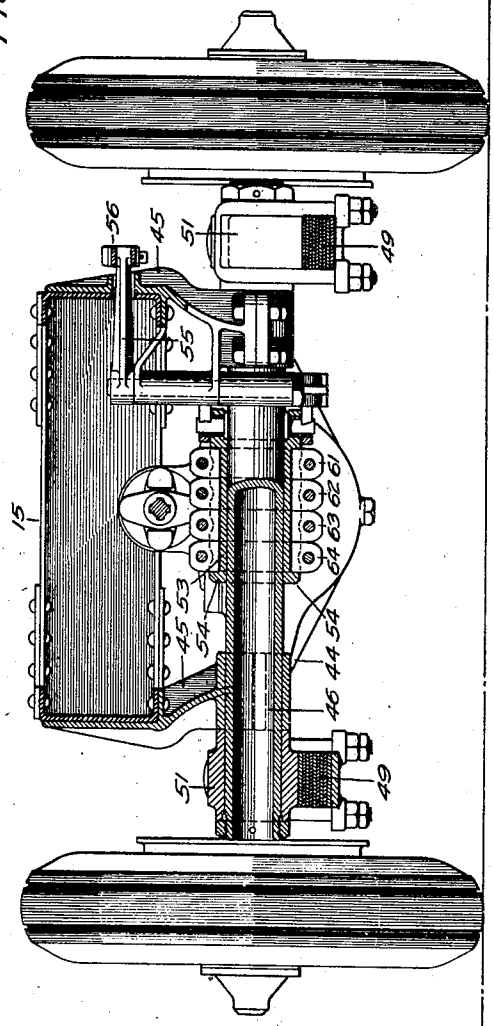


FIG. 8.

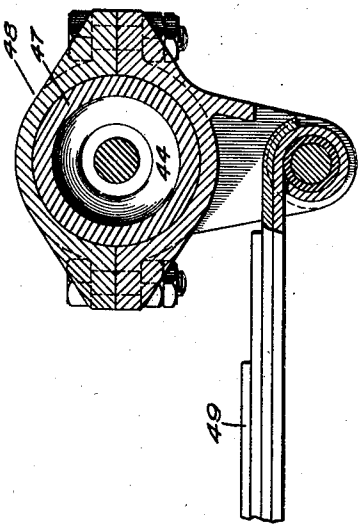
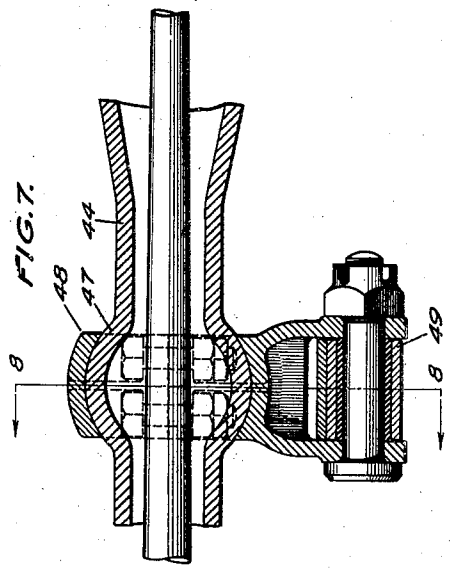


FIG. 7.



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July 12, 1932. R. B. FAGEOL 1,866,637

ROAD VEHICLE

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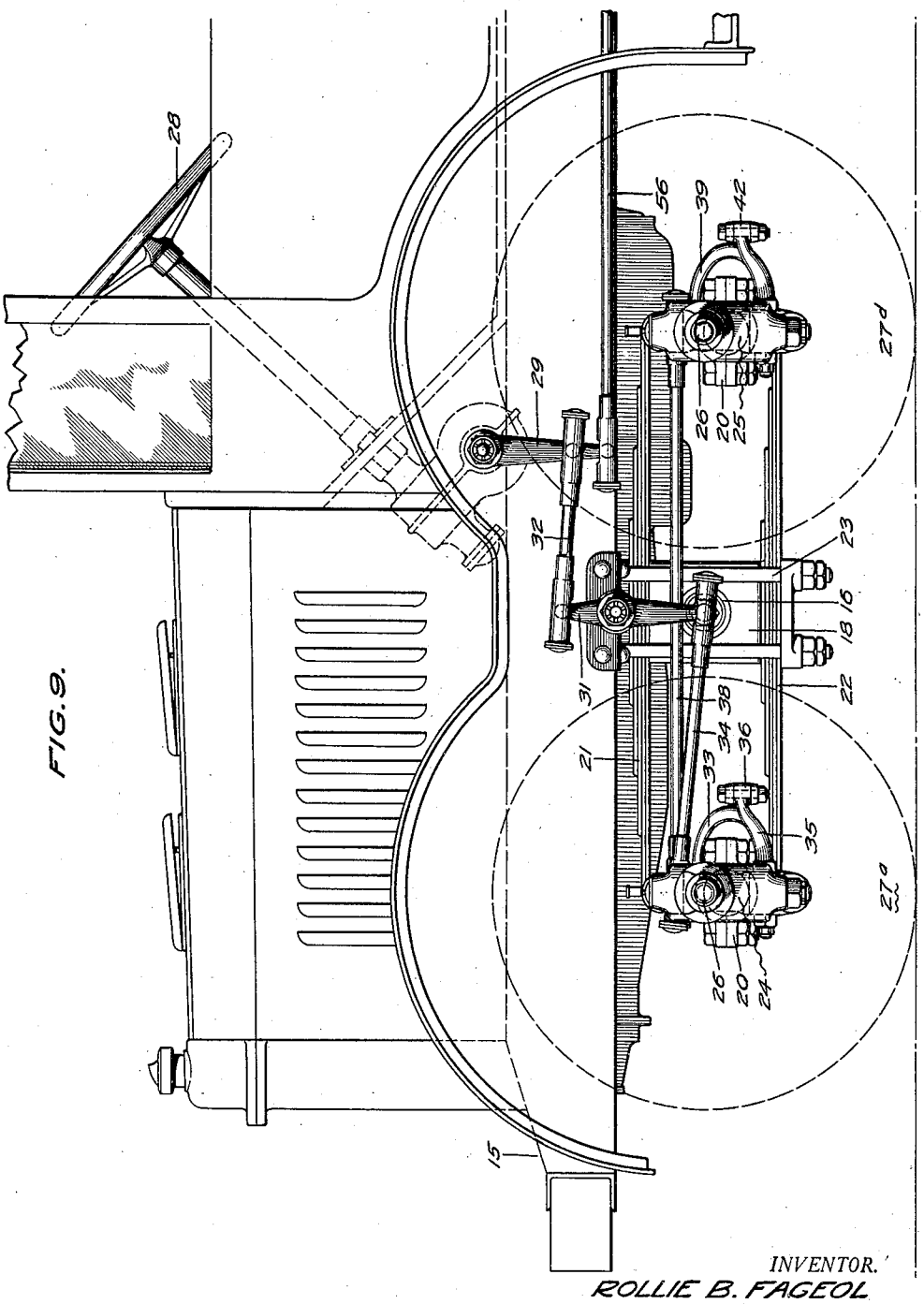

FIG. 9.

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ROAD VEHICLE

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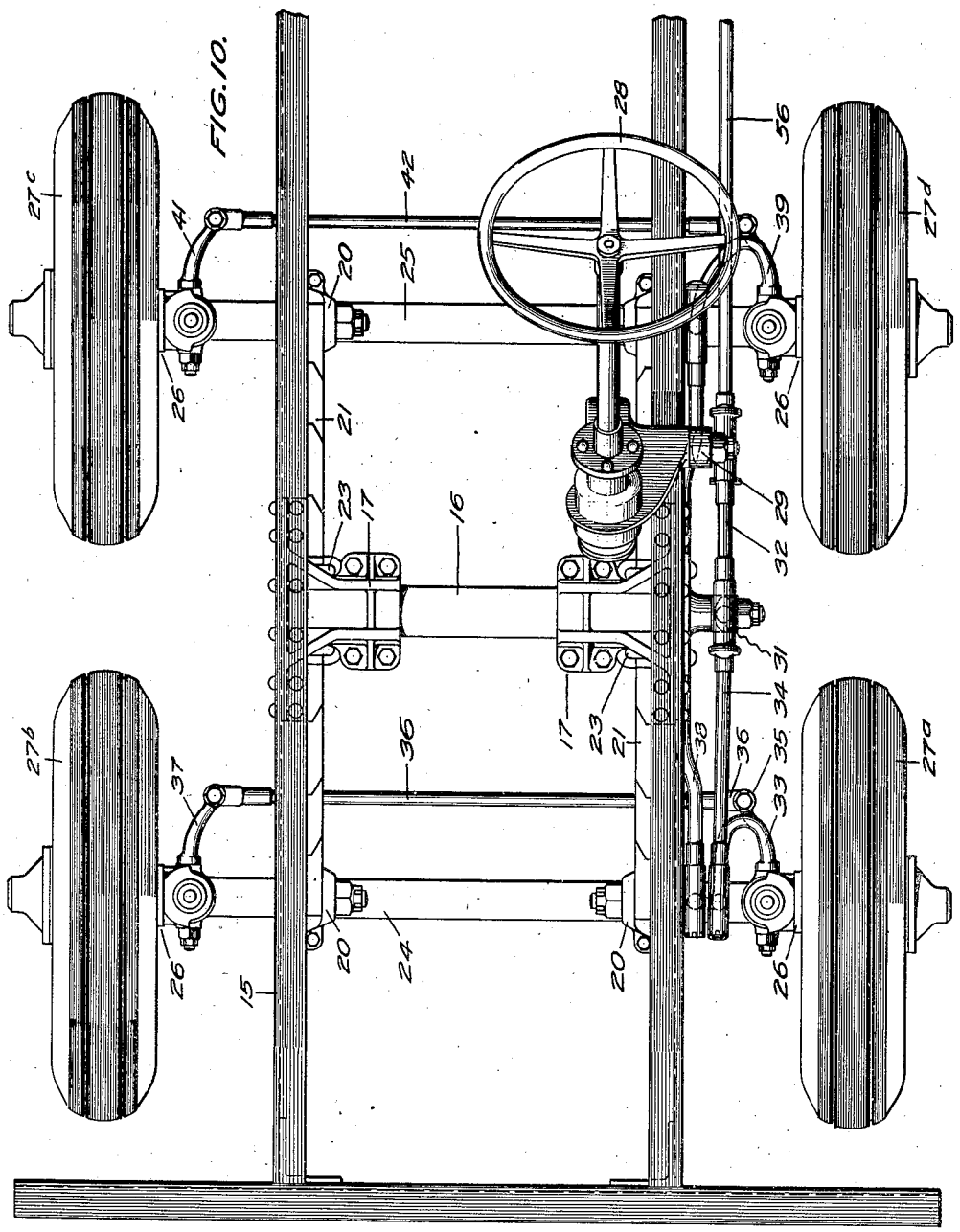
FIG. 10.



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ROAD VEHICLE

Filed July 17, 1922 7 Sheets-Sheet 7

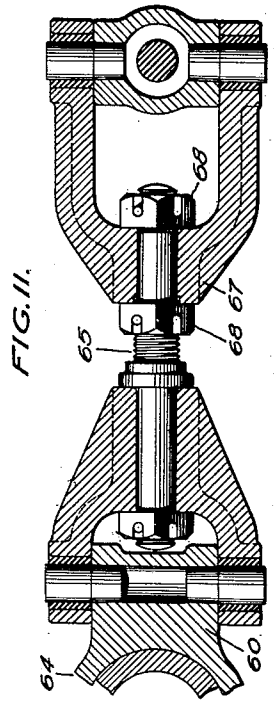

FIG. 11.

FIG. 12.

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Patented July 12, 1932 1,866,637

UNITED STATES PATENT OFFICE

ROLLIE B. FAGEOL, OF OAKLAND, CALIFORNIA

ROAD VEHICLE

Application filed July 17, 1922. Serial No. 575,598.

The invention relates to road vehicles and particularly to motor driven trucks in which two pairs of driving wheels are arranged at the rear end of the vehicle.

An object of the invention is to provide an interconnected steering mechanism for all of the wheels of the vehicle, so that none of the wheels will drag as the vehicle makes a turn.

Another object of the invention is to provide means for turning the driving wheels only sufficient to take out the drag.

A further object of the invention is to provide means for simultaneously and oppositely swinging the driving axles to cause the wheels thereon to make a turn without dragging.

Another object of the invention is to provide an improved form of spring suspension which provides easy riding qualities.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description, where I shall outline in full, that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification. In said drawings I have shown one embodiment of my invention, but it is to be understood that I do not limit myself to such form, since the invention, as set forth in the claims, may be embodied in a plurality of forms.

Referring to said drawings:—

Figure 1 is an elevation of a truck embodying my invention.

Fig. 2 is a plan view of the truck shown in Fig. 1.

Fig. 3 is a plan view, on a larger scale, of the rear end of the truck.

Fig. 4 is a section taken on the line 4—4, Fig. 3.

Fig. 5 is a section taken on the line 5—5, Fig. 3.

Fig. 6 is a section taken on the line 6—6, Fig. 3.

Fig. 7 is a section taken on the line 7—7, Fig. 4.

Fig. 8 is a section taken on the line 8—8, Fig. 7.

Fig. 9 is an elevation of the front end of the truck, parts of the structure being omitted to disclose the construction.

Fig. 10 is a plan view of the front end of the truck chassis, showing the steering mechanism.

Fig. 11 is a section taken on the 11—11, Fig. 3.

Fig. 12 is a diagrammatic representation showing the relative positions and paths of travel of the wheels on making a turn.

In the drawings I have shown the invention embodied in an eight wheel truck having two axles at the front, on which are arranged two pairs of steering wheels and having two driving axles at the rear on which are arranged two pairs of driving wheels. While the invention is particularly applicable to a truck of this character, it is to be understood that it is not limited to such application, since it may be embodied in a truck having one pair of front wheels. It has been proposed heretofore, to connect the rear, or driving wheels of a truck with the front or steering wheels, so that on making a turn, the rear wheels will follow in the path of the front wheels, or in other words, so that all of the wheels will track. This requires the turning of the rear wheels through a considerable angle with respect to the frame of the vehicle. I have found that perfectly satisfactory results can be obtained by turning the rear wheels only sufficiently to eliminate the drag on turning. This I accomplish by arranging the steering mechanism, so that the vehicle turns about a center lying in a line perpendicular to the frame of the vehicle at a point midway between the two driving axles, as shown in Fig. 12.

The truck comprises a suitable frame 15 upon which is mounted the propelling engine or motor. At its front end, the frame is provided with a transverse shaft 16 disposed below the frame and suitably supported in brackets 17 secured to and depending from the frame. The front springs are journalled at their centers on said shaft and are free to oscillate in a vertical plane about said shaft. Journalled on the shaft on each side of the frame, is a block 18, to which the upper and lower leaf springs 21—22 are clamped at their

centers, by the U-bolts 23. The springs are attached at their ends, to brackets 20, secured to the axles 24—25 by ball or universal joints, the upper spring 21 being attached to the brackets 20 above the axles 24—25 and the lower spring 22 being attached to the brackets below the axles. Pivoted to the ends of the axles are spindles 26 on which the front wheels 27^a—27^b—27^c—27^d of the truck are mounted. The axles and springs are so designed, that with a normal load on the truck, the axes of the spindles lie in the same horizontal plane as the axis of the shaft 16, thereby permitting the spring and axle assembly to rock freely on the shaft, without causing any fore and aft rocking of the assembly.

The front wheels 27 are interconnected by steering mechanism controlled or actuated by the hand wheel 28. The hand wheel is connected through the usual steering column mechanism with the lever 29. Journalled on a bracket secured to the frame and disposed above the shaft 16, is a lever 31, which stands vertical when the vehicle is travelling a straight path, and the fulcrum of which is disposed in the vertical plane of the axis of the shaft 16. The upper end of the lever 31 is connected to the lever 29 by the drag link 32 and the lower end of the lever 31 is connected to the steering arm 33 of the front wheel 27 by the drag link 34. The axis of the connection between the lever 31 and the drag link 34 is concentric with the axis of the shaft 16, so that the rocking of the spring and axle assembly about the shaft 16, will not cause deflection of the steering wheels. The steering arm 33 is provided with an integral extension 35 to which a reach rod 36 is connected, the other end of the reach rod being connected to the steering arm 37 of the front wheel 27^b. The steering arm 33 is provided with another extension, at the free end thereof, which is connected by the drag link 38, with the steering arm 39 of the wheel 27^d and this steering arm is connected to the steering arm 41 of the wheel 27^c by the reach rod 42. In so far as the structure heretofore described, is concerned, the steering column might be arranged so that the mechanism therein was directly connected to the lever 31, thus eliminating the use of lever 29 and link 32, but the construction shown is preferable, when means are employed for steering the rear or driving wheels of the truck.

The truck is driven by the four driving wheels 42^a—42^b—42^c—42^d secured to drive axles disposed within the axle housings 43—44. Disposed midway between the axle housings and supported on brackets 45 depending from the truck frame, is a transverse shaft 46 on which the driving truck is journalled. Each axle housing is provided, adjacent each end, with a spherical or zone shaped bearing element 47, on which is journalled a spring hanger 48 having a complementally shaped seat, so that the hanger has a universal motion with respect to the housing. The hangers depend from the housings, and carry the ends of the rear leaf springs 49, there being one spring on each side of the truck and each spring connecting the two hangers on the one side of the truck. Secured to the center of each spring, midway between the axle housings, is a journal box 51, rotatably mounted on the transverse shaft 46. The load on the rear wheels is thus hung from the axle housings in such manner that the frame may swing with respect to the axle housings. The spring hangers 48 and the springs, are constructed, so that with a normal load on the truck, the axes of the drive axles and the transverse shaft lie in the same horizontal plane, thus permitting the axle and spring assembly to rock freely on the transverse shaft without subjecting the assembly to a fore and aft motion. Either axle may be elevated or depressed, due to irregularities in the road, without subjecting the whole assembly to bodily motion, as occurs when the transverse shaft is disposed in a plane above the axes of the axles.

The rear axle housings are normally parallel to each other and perpendicular to the frame of the truck, but due to the swivelled connection between the ends of the springs and the axle housings, the axles may be moved so that they lie at acute angles to the frame, thus turning the rear wheels slightly. Means are provided for varying the angular relation of the axle housings to the frame and this means is preferably connected to the front wheel steering mechanism, so that the rear axles are turned simultaneously with the front wheels. The rear axles are turned oppositely, that is, when one rear axle turns in a clockwise direction, the other turns in a counter-clockwise direction.

Slidably mounted on the transverse shaft 46, is a sleeve 53 which is provided with end flanges 54. Fulcrumed on the vehicle frame is a bell crank lever 55, which is connected at one end to the sleeve 53 and at the other end to the front wheel steering gear, by a rod 56, connected in the present construction, to the lever 29. The leverage of the connection between the steering gear and the rear axles, is such that the rear wheels are turned through a lesser angle than the front wheels.

Journalled on the sleeve 53 are four collars 61—62—63—64, the collars being arranged in contact and between the end flanges 54, so that they are not movable longitudinally with respect to the sleeve. Each collar is provided with an ear 60 having a bolt hole therethrough, which stands vertically when the truck is normally loaded. The axes of the bolt holes in collars 61 and 62 lie in a vertical plane parallel to the longitudinal axis of the truck and the axes of the

bolt holes in the collars 63 and 64 lie in a vertical plane parallel to the longitudinal axis of the truck and spaced from the plane of the other bolt holes. The collars are connected to the axle housings on opposite sides of the centers thereof, by longitudinally rigid links which serve as toggles to move adjacent ends of the two axle housings in opposite directions as the sleeve 53 is moved longitudinally and thus vary the angle of the axle housings with respect to the longitudinal axis of the truck. One side of the axle housing 43 is connected to the collar 63 by the torque rod or link 65 which is provided on its ends with clevises which are connected respectively to the collar 63 and the axle housing 43 by vertically disposed pivots. The link 65 is formed in two parts, rotatable, but not movable longitudinally with respect to each other. The rotational movement permits the axle to assume varying inclinations in the vertical plane, with respect to the frame of the truck. The clevis 67 rotatably receives the rod, which is provided on opposite sides of its bearing in the clevis, with nuts 68, which prevent it from moving longitudinally in the clevis. The link 65 is therefore rigid longitudinally, permitting it to act as a torque rod and to vary the inclination of the axle housing with respect to the longitudinal axis of the vehicle.

The other end of the axle housing 43 is connected to the collar 62 by a radius rod 69, which is connected to the collar and to the axle housing in the same manner as the torque rod 65 and is of the same construction as the torque rod, with the exception that it is provided intermediate its ends, with a horizontal hinge 71 which permits the rod to buckle slightly as the axle housing assumes varying angular positions in the vertical plane. By providing the hinge joint in one of the rods connected to the axle housing, the axle housing is free to assume varying angular positions in the vertical plane, due to road irregularities, regardless of the angular position of the housing in the horizontal plane.

The axle housing 44 is similarly connected to the collars 61 and 64 respectively, by the torque rod 72 and the radius rod 73, these rods being disposed oppositely to their arrangement in respect to axle housing 43. This places a torque rod and a radius rod on each side of the vehicle. As the sleeve 53 is shifted toward the right, the axle housings are separated on the right side of the vehicle and drawn together on the left side, so that both axle housings are simultaneously moved to assume equal and opposite angular positions with respect to the longitudinal axis of the vehicle. The sleeve is normally in central position, so that the axles are parallel and the wheels travel in straight paths. Movement of the sleeve to either side of its central position causes the angles of the wheels to be varied to permit the vehicle to make the turn without dragging any of the rear wheels. The wheels are inclined from the straight ahead path, only sufficiently to eliminate the drag and not to cause them to track with the front wheels. The rear wheels are inclined in opposite directions to the longitudinal axis of the vehicle, so that they travel along a different circle than the front wheels.

By suspending the load from the rear axle housings on a bracket which is universally movable with respect to the housings, the housings may be moved sufficiently to obtain the desired inclination of the wheels.

I claim:—

1. A road vehicle comprising a frame, a pair of axles arranged adjacent the front end of the frame, steering wheels on said axles, a pair of driving axles arranged adjacent the rear end of the frame, driving wheels on said axles, hangers universally mounted on said rear axles and depending therefrom, springs pivotally connected at their ends to said hangers and pivotally connected at their centers to said vehicle frame and means connected to the steering gear of the vehicle for varying the angular position of the rear axles with respect to the longitudinal axis of the vehicle.

2. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers and non-extensible torque rods connecting said shaft with said axles.

3. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journaled at their centers and non-extensible torque rods and radius rods connecting said shaft with said axles.

4. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft and a plurality of rods connecting the sleeve with each axle.

5. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to

the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft and rods connecting the axles on opposite sides of the center thereof with said sleeve.

6. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft and a radius rod connecting each axle with the sleeve.

7. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft and a torque rod connecting each axle with the sleeve.

8. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft and a plurality of diverging rods connecting the sleeve with each axle.

9. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft, collars rotatably mounted on said sleeve and a plurality of rods connecting the collars with the axles.

10. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft, collars rotatably mounted on said sleeve, a plurality of rods connecting the axles at spaced points with said collars and means for moving the sleeve longitudinally.

11. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft, collars rotatably mounted on said sleeve, and rods pivoted to said axles at spaced points by vertical pivots and connected to said collars by vertical pivots.

12. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft, collars rotatably mounted on said sleeve, and torque rods connecting said axles and said collars.

13. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft, collars rotatably mounted on said sleeve, rods connected to said collars by vertical pivots connected to said axles at opposite sides of the center thereof, by vertical pivots and means for sliding the sleeve on the shaft to vary the angular relation of the axles.

14. The combination with a road vehicle frame of a driving truck comprising two driving axles, springs connected at their ends to said axles to permit movement of the axles in a horizontal plane with respect to the spring ends, a transverse shaft carried by said frame upon which said springs are journalled at their centers, a sleeve slidably mounted on said shaft, four collars rotatably mounted on said sleeve, a rod connected to each collar by a vertical pivot, and connected at their other ends to the said axles at opposite sides of the center thereof by vertical pivots, there being two rods connected to each axle, and means for moving the sleeve longitudinally of the shaft to vary the angular relation of the axles.

15. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers mounted on said axles for universal movement with respect thereto depending from said axles, springs pivotally connected at their ends to said hangers, a transverse shaft carried by said frame upon which the springs are journalled at their centers, a sleeve mounted on said shaft, rods connecting the sleeve with the axles on opposite sides of the centers thereof and means for moving the sleeve longitudinally to vary the angular relation of the axles.

16. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers mounted on said axles for universal movement with respect thereto depending from said axles, springs pivotally connected at their ends to said hangers, a transverse shaft carried by said frame upon which the springs are journalled at their centers, a sleeve mounted on said shaft, diverging torque rods connecting the sleeve with the axles and means for moving the sleeve longitudinally to vary the angular relation of the axles.

17. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers mounted on said axles for universal movement with respect thereto depending from said axles, springs pivotally connected at their ends to said hangers, a transverse shaft carried by said frame upon which the springs are journalled at their centers, a sleeve mounted on said shaft, collars rotatably mounted on said sleeve and torque rods connecting the collars and the axles.

18. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers mounted on said axles for universal movement with respect thereto depending from said axles, springs pivotally connected at their ends to said hangers, a transverse shaft carried by said frame upon which the springs are journalled at their centers, a sleeve mounted on said shaft, collars rotatably mounted on the sleeve, and rods connected to the collars by vertical pivots and connected at their other ends to the axles at opposite sides of the center thereof, by vertical pivots.

19. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers mounted on said axles for universal movement with respect thereto and depending from said axles, springs pivotally connected at their ends to said hangers and a transverse shaft carried by the frame upon which the springs are journalled at their centers, the shaft being normally disposed substantially in the horizontal plane of the axles.

20. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers rotatably mounted on said axles and depending therefrom, springs pivotally connected at their ends to said hangers and pivotally connected at their centers to the vehicle frame in the horizontal plane of the axles.

21. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers journalled on said axles and depending therefrom, springs pivotally connected at their ends to said hangers, and trunnions carried by the frame substantially in a plane comprising the axles on which said springs are pivotally mounted at their centers.

22. The combination with a road vehicle frame, of a driving truck comprising two driving axles, a spherical bearing at each end of each axle, a hanger journalled on each bearing and depending from the axle, and a spring on each side of the vehicle, the ends of the springs being pivotally connected to said hangers.

23. The combination with a road vehicle frame, of a driving truck comprising two driving axles, hangers mounted on said axles for universal movement with respect thereto, springs pivotally connected at their ends to said hangers, a transverse shaft secured to said frame, said springs being journalled at their centers to said shaft and means connecting the shaft and the axles operative to prevent rotational movement of the axles and to vary the angular relation of the axles with respect to the longitudinal axis of the frame.

24. The combination with a road vehicle of a truck comprising two axles; a leaf spring; means comprising hangers, each connected to an axle at one end by a universal joint and pivoted to the spring at its other end for suspending opposite ends of said spring from and substantially below the level of said axles in a manner to permit limited universal movement of said spring with relation to said axles; a trunnion member supported on the mid portion of said spring; and a frame pivotally supported from said trunnion member.

25. A road vehicle comprising parallel axles, wheels supported on said axles, a frame, a spring suspension secured to said frame and connected to said axles by arms each having a universal connection with an axle and a pivotal connection to a spring that permit the shifting of one axle angularly relative to the other and means to shift said axles angularly with respect to each other.

26. A road vehicle comprising a frame, a plurality of forwardly disposed axles, dirigible wheels on said axles, a plurality of rearwardly disposed axles, non-dirigible wheels secured to said axles, said last named axles being secured to said frame by spring suspensions that permit slight relative angular movement of said axles, and steering mechanism for simultaneously operating said dirigible wheels and shifting the axles having the non-dirigible wheels secured thereto.

27. A road vehicle having tandem driven axles secured to the vehicle frame by springs so that slight angular shifting of the axles is permitted, wheels on said axles, steering mechanism, dirigible wheels, means connecting said steering mechanism and said dirigible wheels, and means coupling said steering mechanism and said driven axles, said last named means comprising mechanism caus-

ing the driven axles to rotate slightly in opposite rotative directions upon actuation of said steering mechanism.

28. A road vehicle having tandem driven axles secured to the vehicle frame by springs attached to the axles by swinging arms that permit slight angular shifting of the axles, wheels on said axles, steering mechanism, means connecting said mechanism and axles comprising mechanism causing said axles to rotate slightly in opposite rotative directions upon actuation of said steering mechanism.

29. In a vehicle suspension of the character described, a main frame; a pair of interspaced axles disposed below the frame; springs interposed between the ends of the axles and the frame; pivotal connections between the springs and the axles; a pair of wheels on each axle; means whereby the axles may be moved towards each other on one side of the frame and away from each other on the other side of the frame; said means comprising a stationary member secured transversely of the frame; a crosshead member slidably mounted thereon; a pair of radius arms interposed between each axle and the crosshead member and connected with the respective axles and the crosshead member; and means for importing a sliding movement to the crosshead member transversely of the frame.

30. In a multi-wheel road vehicle, a frame; dual axles adjacent one end of said frame; and a spring suspension assembly for mounting said frame upon said axles; said assembly comprising a spring member, means pivotally connecting said member to said frame for movement in a vertical plane, means flexibly supporting the free ends of said spring member upon said axles to permit free transverse movement of the latter toward and from each other as said spring member deflects during operation, and additional mechanism connected to said axles and comprising a part of said assembly for stabilizing the suspension, said mechanism including means flexibly connecting it to a portion of the frame approximately midway between the axles to permit oscillation of the mechanism relative to said frame portion as the axles swing during operation.

31. In a multi-wheel road vehicle, a spring suspension including a supporting frame, a longitudinal spring member pivoted between its ends on a portion of said frame for movement in a vertical plane, dual axles supporting the free ends of said spring member in a manner to permit said axles to move transversely toward and from each other as said spring member changes in length, and a set of arms connected between said axles and said frame to stabilize the suspension and to transmit any axle torque reactions to said frame.

32. In the vehicle construction defined in claim 31, said set of arms comprising a pair of radius arms connected between said axles and points on the frame approximately at the line of the axis of spring oscillation, and a pair of torque arms connected between said axles and a portion of the frame substantially midway between the axles.

In testimony whereof, I have hereunto set my hand.

ROLLIE B. FAGEOL.