Dec. 22, 1964 J. SCHMITZ 3,162,463

TWIN-AXLE TRACKING ASSEMBLY

Filed Sept. 6, 1961 5 Sheets-Sheet 1

Fig. 2

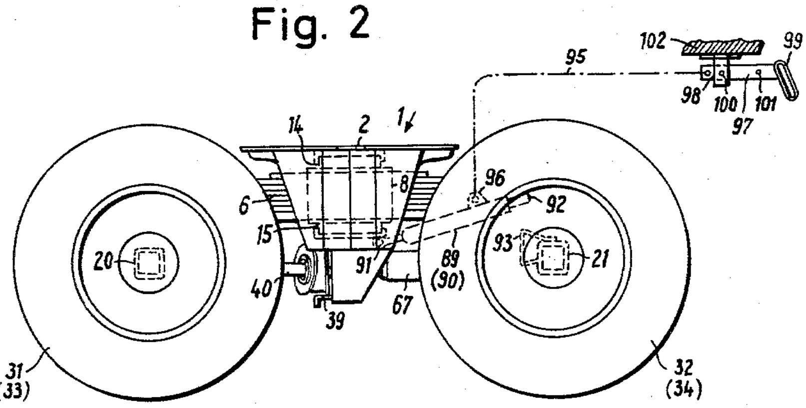

Fig. 1

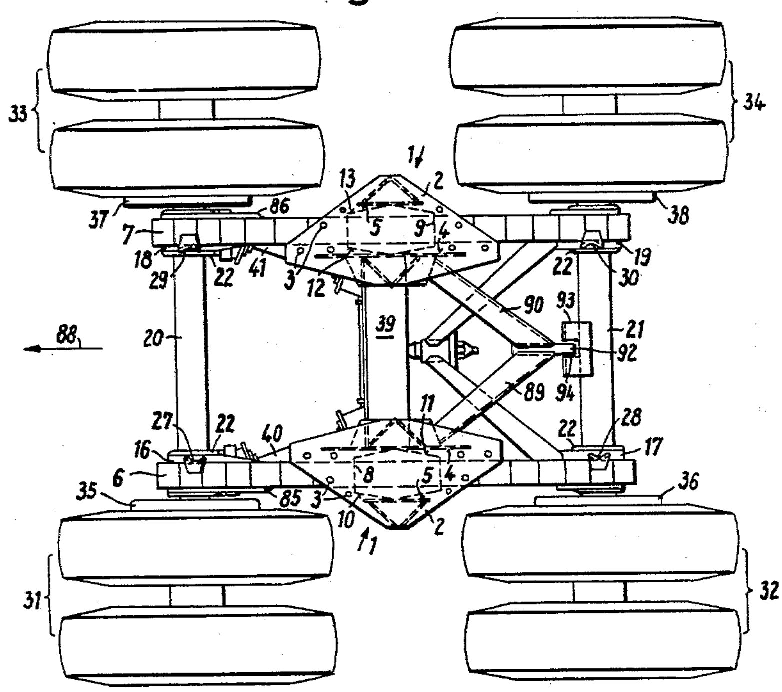

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Fig. 4

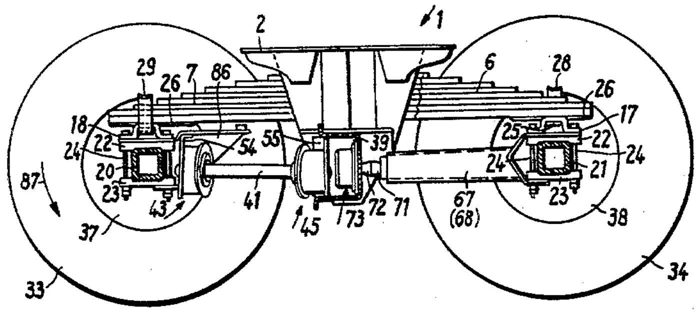
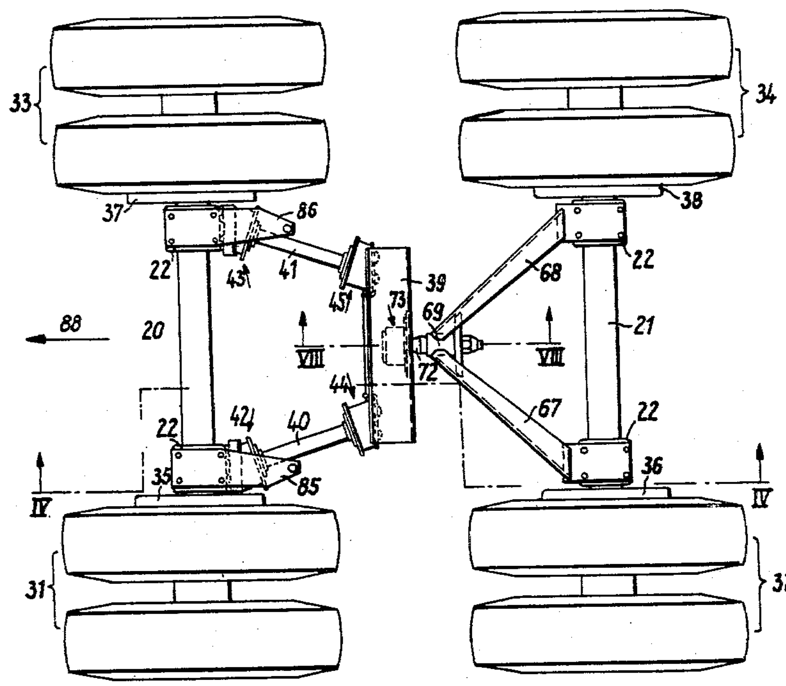


Fig. 3



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Dec. 22, 1964 | J. SCHMITZ | 3,162,463

TWIN-AXLE TRACKING ASSEMBLY

Filed Sept. 6, 1961 | 5 Sheets-Sheet 3

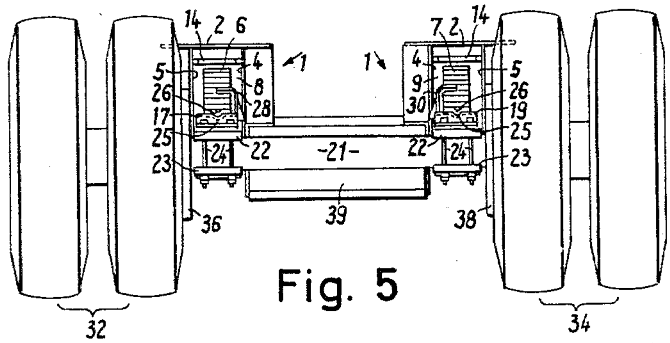

Fig. 5

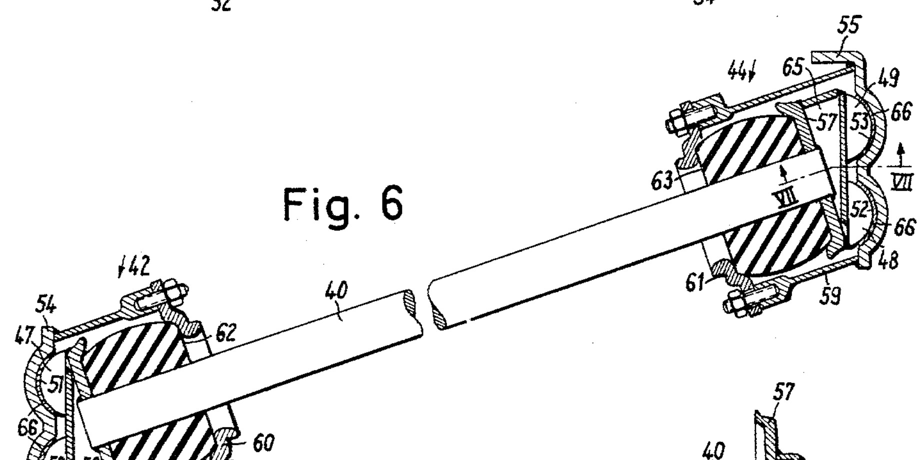

Fig. 6

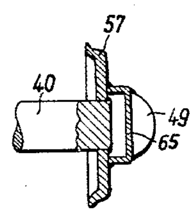

Fig. 7

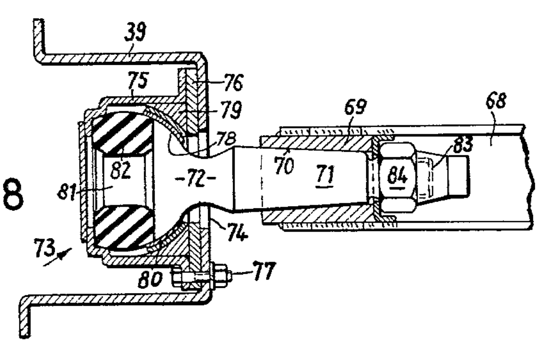

Fig. 8

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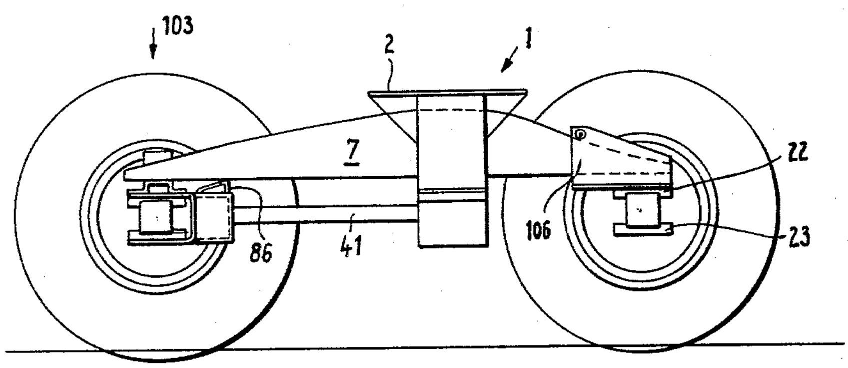
Dec. 22, 1964 J. SCHMITZ 3,162,463

TWIN-AXLE TRACKING ASSEMBLY

Filed Sept. 6, 1961 5 Sheets-Sheet 4

Fig. 9



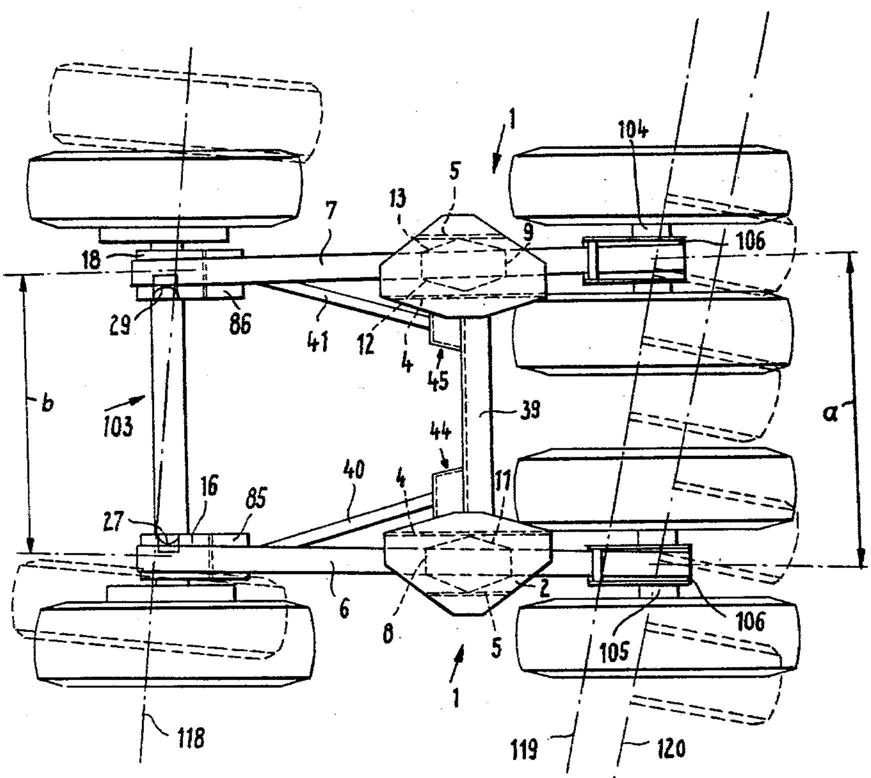


Fig. 10

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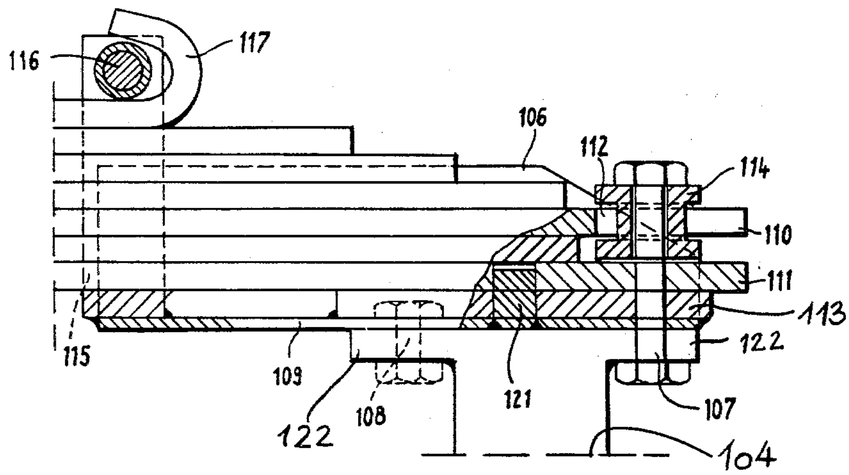
Dec. 22, 1964 J. SCHMITZ 3,162,463

TWIN-AXLE TRACKING ASSEMBLY

Filed Sept. 6, 1961 5 Sheets-Sheet 5

Fig. 11



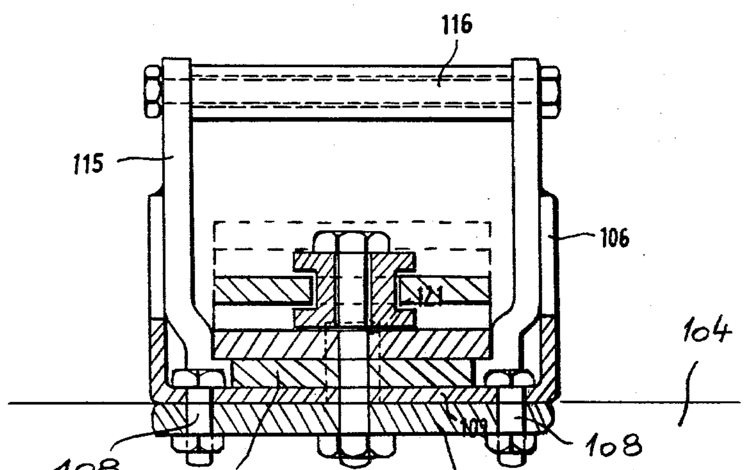


Fig. 12

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TWIN-AXLE TRACKING ASSEMBLY

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Filed Sept. 6, 1961, Ser. No. 136,310
Claims priority, application Germany, Sept. 6, 1960, Sch 28,443
14 Claims. (Cl. 280—104.5)

This invention relates to a tracking assembly for twin axles on automobiles in which the axles are articulated to the chassis of the vehicle by way of stays and automatically adjust themselves to curves through the intermediary of load-supporting springs mounted pivotally on the chassis, the springs being mounted on convex lateral surfaces in spring-blocks and bearing freely at their ends upon the axles which have convex surfaces that touch or are tangential to the inner sides of the springs.

The basic problem in such twin-axle tracking assemblies, various constructional forms of which are already known, is to improve the curve-following properties of vehicles equipped with twin axles by ensuring that the two axles will automatically adjust themselves to the curves, i.e. to be convergent towards the inner side of the curve, under the control of the ground-adhesion of the tires. For this purpose, the axles in known twin-axle assemblies are both individually suspended from the vehicle chassis in an articulated manner by means of triangular stays, the triangular stay of the rear axle being articulated either to the vehicle frame between the two axles or to the vehicle chassis in front of the front axle of the pair. This arrangement, however, necessitates the provision of a large constructional space beneath the vehicle chassis, especially for the parts disposed in front of the front axle. Constructions are also known, however, in which the triangular stays of both axles are disposed between the latter. In this case, however, the front axle of the pair, during forward travel of the vehicle is pushed along by the associated triangular stay which extends rearwards therefrom, so that the front axle arrangement tends, during the travel of the vehicle, to oscillate about the pivot point of the front triangular stay within the range of movement permitted by the convex surfaces of the front axle that are applied against the load-supporting springs. These oscillations operate very disadvantageously upon the quietness of running of the twin-axle assembly and cause considerable wear of the bearing points involved.

According to the invention the disadvantages set forth above of a front anxle arranged to be pushed along are avoided by reason of the fact that the front axle is pivotally connected with two track-rods set at an angle to each other and pivotally engaged with the vehicle frame at spaced points. The rear axle may be connected pivotally with the vehicle frame by means of a triangular stay. This arrangement not only affords an advantageous space-saving method of construction but also imparts to the twin-axle assembly a quietness of running such as could not hitherto be achieved with twin-axle tracking assemblies.

Preferably the track-rods are held in their neutral positions by the pre-stressing of elastic members in their articulations whereby are obtained both a stabilization of the basic position of the front axle, which is of importance for quietness of running, and a restoring force for the front axle.

In the preferred construction of the invention the track-rods are each provided at their ends with two adjacently arranged spherical segments the circular surfaces of which both lie in a plane parallel with the axles during straight ahead travel, the spherical segments being mounted in corresponding recesses of a bearer plate.

With advantage, the articulations of the track-rods are so constructed that each pair of spherical segments is arranged on a plate secured to the end of the track-rod, which plate is disposed within a preferably cylindrical housing secured on the bearer plate and provided with a cover flange, an elastic rubber ball being gripped, with pre-compression, between the plate and the cover flange.

In a yet further improved constructional form of the twin-axle tracking assembly according to the invention the rear wheels are each mounted on adjacently arranged suspended axles.

The advantages of suspended axles in vehicle construction are generally recognized. As the most important may be mentioned the capacity of the wheels to conform exactly to unevennesses in the road surface particularly in the transverse direction. In this way there is secured, as contrasted with rigidly arranged twin wheels, rolling with substantially no rubbing or scuffing. This advantage is noticeable also in the case of unequal tire pressures of the twin wheels as even under such conditions uniform wear is ensured. The mounting of the load-supporting springs of the vehicle between the two wheels of a suspended axle has the result that the distance apart of the springs disposed one at each side of the vehicle is increased whereby the transverse stability of the vehicle is considerably improved. This advantage becomes particularly noticeable in the case of high centers of gravity as the lateral rocking which usually arises is reduced. As a further advantage of the suspended axle arrangement, it may be mentioned that the braking capacity is considerably increased with such a construction of the twin-axle assembly as each wheel-pair may be provided with two brake drums instead of one so that there will be six brake drums instead of four in a twin-axle assembly of the form proposed.

Preferably, the suspended axles are secured directly to the ends of the load-supporting springs which extend at an angle to each other. This arrangement of the suspended axles affords a further improvement by reason of the simple and cheap construction of the rear axle mounting. An exact adjustment of the rear axle to curves is achieved by this construction in that the load-supporting springs disposed one at each side of the vehicle extend at an angle to each other in such fashion that the distance between the rear ends of the springs is greater than that between the front ends, i.e. the springs converge in the normal direction of travel of the vehicle. In this embodiment, in which the rear wheels are mounted on suspended axles, the front axle may with advantage also be provided with a single wheel at each end. This construction has the advantage that the whole transport fleet of vehicles or trailers need only have a single type of spare tire as all the wheels of the vehicles are constructed in the same manner.

According to a further feature of the invention two rearwardly directed support brackets are secured on the front axle which is engaged by the track-rods, the ends of these brackets, upon braking occurring, applying themselves against the undersides of the load-supporting springs which are rockably suspended in the spring-blocks. By reason of this arrangement the rotary movement of the front axle occurring during braking is transmitted by way of the support brackets to the load-supporting springs, a proportion of the transmitted forces being passed on to the rear axle through the rockably suspended springs so that in an advantageous manner there occurs a transmission of the road pressure from the front axle to the rear axle.

In pursuance of the inventive concept the spring-blocks, secured to the vehicle chassis in a known manner, are merely connected with one another by means of a transverse member disposed at about axle height, the track-rods and the triangular stay engaging with this member. With this arrangement there is advantageously afforded between both spring-blocks, the transverse member and the vehicle chassis or structure a considerable space which, for example, may be utilized for the installation of tipping cylinders, piping, discharge outlets and delivery hoppers. Especially in the case of tankers does such a space offer considerable advantages for the installation of important parts.

Further details of the invention will appear from the following description of examples of the way in which it may be carried into practical effect, reference being made to the accompanying drawings, wherein:

FIG. 1 is a plan view of a twin-axle tracking assembly constructed in accordance with the invention,

FIG. 2 is a side elevation thereof,

FIG. 3 is a view similar to that of FIG. 1 but omitting the spring-blocks and the load-supporting springs,

FIG. 4 is a section taken on the line IV—IV of FIG. 3 but showing the load-supporting spring with its associated spring-block,

FIG. 5 is a rear view of the assembly,

FIG. 6 is a sectional elevation, to a larger scale, of a track-rod arrangement in the position in which it is shown in FIGS. 1 and 3,

FIG. 7 is a section taken on the line VII—VII of FIG. 6,

FIG. 8 is a section taken on the line VIII—VIII of FIG. 3,

FIG. 9 is a side elevation of another example according to the invention,

FIG. 10 is a plan view thereof,

FIG. 11 is a detail, shown partly in section, of the assembly shown in FIGS. 9 and 10 and

FIG. 12 is a further detail of this assembly.

The twin-axle assembly is secured, preferably detachably, to the vehicle chassis (not shown), for example to the longitudinal members thereof, by means of bearer plates connected to the spring-blocks 1. For this purpose the bearer plates 2 are formed with fixing holes 3 (see FIG. 1). Each block 1 has two vertical inner surfaces 4 and 5 disposed in parallel planes between which is mounted the shackle 8 or 9 which clamps together the leaves of the respective load-supporting spring 6 or 7. The lateral surfaces 10, 11 or 12, 13, respectively, of the shackles 8 and 9 are convexly shaped and bear on the inner surfaces 5 and 4 of the spring-blocks 1. This arrangement makes it possible for the load-supporting springs 6 and 7 to swing laterally in their blocks 1. The springs 6 and 7 are mounted, in the region of their shackles 8 and 9, between upper and lower elastic rubber pads 14 and 15 (see FIGS. 2 and 5) arranged in the spring-blocks 1 so as to be tiltable vertically.

In the example of FIGS. 1 to 5, the ends of the load-supporting springs bear freely upon the spring pads 16 to 19 which are releasably secured on the axles 20 and 21. The securing means for the pads, as can be seen from FIG. 4, each consist of an upper and a lower bar 22 and 23, respectively, which are drawn together to clamp the axle 20 or 21 between them by means of tension bolts 24. The bolts 24 also pass through the spring pads 16 to 19. As can be seen from FIGS. 4 and 5, each spring pad is formed with a longitudinal groove 25 in which engages a rib 26 disposed on the lower face of the respective end of the load-supporting springs. This known arrangement ensures a certain stabilization of the spring mountings.

Against the inner sides of the ends of the load-supporting springs are applied limiting pieces 27 to 30 which touch the inner sides of the springs 6 and 7 by their convexly curved surfaces. These limiting pieces are secured on the axles 20 and 21, preferably on the spring pads 16 to 19 secured thereon, and have horizontal extensions which engage over the springs 6 and 7. On the ends of the axles 20 and 21 are rotatably mounted, for example, twin-wheel arrangements 31 to 34. For the sake

of simplification, only the brake drums 35 to 38 of the braking equipment for these wheel arrangements are shown.

The spring-blocks 1 are interconnected at axle height by the transverse member 39 which is of a flanged channel-shape in cross-section, as shown in FIGS. 4 and 8. The axles 20 and 21 are articulated to this transverse member, as can best be seen from FIG. 3. The front axle 20 is connected through articulations 42 and 43 with the adjacent ends of two track-rods 40 and 41 which are set at an angle to each other. At their other ends the track-rods 40 and 41 are connected through further articulations 44 and 45 to the transverse member 39. The track-rods and their articulations are illustrated in greater detail in FIGS. 6 and 7 with reference to the rod 40 and the articulations 42 and 44. At each of its ends the rod 40 is provided with two adjacently arranged spherical segments 46 and 47 or 48 and 49, respectively, which engage in corresponding recesses 50 to 53 formed in bearing plates 54 and 55. The bearing plates 54 at the ends of the rods 40 and 41 adjacent to the axle, as can be seen from FIG. 4, are attached to the securing means for the spring pads 16 and 18. The bearing plates 55 are secured to the transverse member 39. On the ends of the track-rods 40 and 41 are secured plates 56 and 57 which are disposed within housings 58 and 59, preferably of cylindrical shape, secured to the bearing plates 54 and 55. These housings 58 and 59 are each provided with a bolted-on cover-flange 60 or 61, respectively, elastic rubber balls 62 and 63 being gripped between the plates 56 and 57 and the cover-flanges 60 and 61, preferably with some pre-compression. Wedge-shaped intermediate elements 64 and 65 are secured on the plates 56 and 57 and upon these are fixed the spherical segments 46, 47 or 48, 49. The articulations 42 to 45 thus constructed permit a vertical movement of the front axle 20 against the elastic resistance of the balls 62, 63, the spherical segments 46 to 49 remaining in their recesses 50 to 53. The articulations also permit, however, a lateral swinging of the track-rods 40 and 41 against an increased elastic resistance of the balls 62 and 63, a spherical segment rising out of its associated recess in the respective bearing plate in each of the articulations. By reason of the construction of the articulations 42 to 45 described above, restoring forces are exerted upon the track-rods 40 and 41 whereby is secured a stabilization of the front axle 20. The articulations are preferably arranged not to require lubrication, bearing liners 66 of synthetic material being arranged in the recesses 50 to 53 and the spherical segments 46 to 49 consisting of non-rusting metal.

In the example of FIGS. 1 to 5 there is secured on the rear axle 21 a triangular stay consisting of limbs 67 and 68 and having its base constituted by the axle 21. The securing of the limbs 67 and 68 to the axle 21 is effected, as can be seen in FIG. 4, at the securing points for the spring pads 17 and 19. The apex ends of the limbs 67 and 68 are attached to a sleeve 69 which receives in a conical bore 70 the truncated conical end 71 of a bearing pin 72 which is a component of a ball-joint 73 by means of which the triangular stay is articulated to the transverse member 39. The ball-joint arrangement 73 can best be seen in FIG. 8.

Referring to FIG. 8, the bearing pin 72 extends through an opening 74 in the member 39 and into the housing 75. This housing together with a cover plate 76 is detachably connected, as by means of bolts 77, to the transverse member 39. A part-spherical curved surface 78 of the pin 72 bears against a bearing liner 79 arranged within the housing 75, this liner being covered with a liner 80 of synthetic material so that it requires no lubrication. The pin 72 is extended beyond its spherically curved zone 78 as a projection 81 which is surrounded by an elastic rubber ball 82 which bears at one side on the housing 75 and at the other side on the pin 72, preferably with some pre-compression. Swinging of the triangular stay therefore occurs against the elastic resistance of this elastic rubber ball 82. The truncated conical end 71 of the pin 72 is formed with a screw-threaded extension 83 upon which is screwed a nut 84 which is then prevented from rotating in some suitable manner, for example, by means of a locking washer.

As can be seen from FIGS. 3, 4, 9 and 10, two rearwardly directed abutment brackets 85 and 86 are secured on the front axle at the fixing points for the spring pads 16 and 18. These abutment brackets 85 and 86 apply themselves by their ends to the adjacent surfaces of the load-supporting springs 6 and 7 when the front axle 20 rotates in the sense indicated by the arrow 87 in FIG. 4 due to braking of the wheel arrangements. Such a rotation may also arise should the wheel arrangements encounter an increased resistance to rolling. The braking reaction is therefore transmitted by the abutment brackets 85 and 86 to the load-supporting springs 6 and 7 which, in consequence of their swingable suspension in the spring-blocks 1 described above, tilt vertically and transmit a proportion of the force applied by the abutment brackets to the rear axle 21 with relieving of the ground pressure on the front axle 20. The proportion of the force transmitted to the rear axle 21 may be pre-determined by correspondingly selecting the lengths of the abutment brackets 85 and 86. By that means displacement of axle load is prevented and equal braking of both axles is achieved, which is not existent at all known pushed axles.

In order to explain the operation of the twin-axle tracking assembly reference will be made to FIGS. 1 and 3. In these figures the direction of travel for straight ahead driving is indicated by the arrow 88. Should the rear axle arrangement now swing about its ball-joint arrangement 73 in consequence of travel of the vehicle in a curved path, for example in a clockwise direction, the load-supporting spring 6 is taken along with it by reason of the limiting piece 28 and also swings in the clockwise direction. The end of the spring 6 which bears upon the front axle takes along with it, through the intermediary of the limiting piece 27, the font axle aangement and displaces this upwardly or to the right (as seen in FIG. 3) whereupon the distance between the front axle and the transverse member, due to the inclined arrangement of the track-rods 40 and 41, is increased in the neighbourhood of the track-rod 40 and reduced in the neighbourhood of the track-rod 41. There is thus produced an inclination of the front axle 20 with respect to the rear axle and to the vehicle. The sequence of movements described above by way of example with reference to a right-hand curve will also occur in analogous manner upon the vehicle travelling around a left-hand curve. The degree of adjustment of the axles 20, 21 will of course depend on the radius of curvature of the curve followed by the vehicle.

In those cases where the steerable property of the axles 20, 21 is not desirable, for example, when the vehicle is to travel in reverse, the rear axle 21 may be prevented from swinging by a locking device. A suitable locking device for the rear axle 21 is shown in FIGS. 1 and 2. A triangular stay consisting of limbs 89 and 90 and having its base constituted by the transverse member 39 is connected with the spring-blocks 1 by means of bearing pins 91 (FIG. 2) so as to be swingable vertically. At its apex the triangular stay carries a pin 92 which cooperates with a locking member 93 secured on the rear axle 21. To this end, the locking member 93 has a recess 94 in which the pin 92 may be laid. In the unlocked condition the triangular stay is swung upwardly as shown in FIG. 2. The swinging motion may be brought about by means of a flexible transmission element 95 shown in FIG. 2 as a chain-dotted line. For example, a chain or a flexible shaft may be employed, it being engaged with an eye 96 secured on the triangular stay. The transmission element is deflected from a vertical direction into a horizontal direction by suitable means and is connected at its other end to a push-rod 97 which is displaceable longitudinally through a guide 98. The push-rod 97 is provided at its outer end with a handgrip 99 and can be arrested at the positions indicated at 100 and 101. The distance between the points of arrest 100 and 101 corresponds to the swinging movement of the pin 92 from its raised position to the position in which it is engaged in the recess 94 and vice versa. The guide 98 is secured, for example, on the vehicle superstructure or on the vehicle chassis, which is shown fragmentarily at 102 in FIG. 2. The operation of the push-rod may also be controlled remotely from the driver's seat through the intermediary of an interposed compressed-air cylinder and an electro-pneumatic valve.

In the described arrangement of the articulations 42 to 45 for the track-rods 40 and 41, there is provided in each only one elastic rubber ball 62 or 63, respectively, which elastically holds the spherical segments 46 to 49 in engagement with the recesses 50 to 53 in the bearing plates 54 or 55, respectively. It is however also possible so to construct the arrangement that two elastic rubber balls are provided for each articulation. For this purpose, the recesses 50 to 53 are not formed in the bearing plates 54 and 55 but are arranged in a plate disposed within the housing 58 or 59 and supported from the plate 54 or 55 by means of an additional elastic rubber ball. In this arrangement, therefore, the articulation composed of the spherical segments and bearing recesses is disposed in the housing 58 or 59 sandwiched between rubber balls.

The constructional example shown in FIGS. 9 and 10 is concerned with a form of the twin-axle assembly according to the invention having a rigid front axle with a single road-wheel at each end. This construction is particularly advantageous by reason of the interchangeability of all the wheels of the vehicle. The construction of the front axle as well as its mounting on the vehicle chassis (not shown) corresponds with that of the embodiment shown in FIGS. 1 to 5, except however that the spring-blocks 1 are not arranged in the centre between the front and rear wheels in order to correspond with the relationship between the axle pressures which now obtains. According to this constructional example the wheels of the rear axle are mounted on suspended axles 104 and 105 which are preferably secured directly to the rear ends of the load-supporting springs 6 and 7.

The supporting of the ends of the springs upon the suspended axles 104 and 105 is more clearly shown in FIGS. 11 and 12. The pad is constituted by a bearing shoe 106 of U-shape in cross-section which embraces the packet of springs both laterally and on the underside. In order to achieve the desired adjustment of the wheels to curves, the rear end of each load-supporting spring must be capable of executing swinging movements over a certain range. Furthermore, on account of the direct securing to the suspended axles, provision must be made for the transmission of tensile forces from the load-supporting springs to the suspended axles. Moreover, lifting of the ends of the springs from the suspended axles 104, 105 must be prevented. In the constructional form shown, the tensile forces are transmitted to the suspended axle 104 or 105 through a pin 121 which is secured on the bearing shoe 106 and engaged in an aperture in the spring-packet. Bolts 108 are provided for securing the bearing shoe 106 on the axle or the axle flange 122. The bolts 108 are merely passed through the bottom wall 109 of the bearing shoe 106. A rearwardly located fifth bolt 107, on the other hand, is extended above the bottom wall 109 and serves for strong bolting of the lower spring leaf 111 and a sleeve 114 with the axle for the purpose of the transmission of tensile forces from the load-supporting spring. The sleeve 114 overlaps the end of spring leaf 110, which is provided with a slot 112, and mounted for sliding movement, but which is also mounted for transmission of brake reactions and swing motion. A distance plate 113 on the bottom wall **109** of the bearing shoe **106** served for equalizing elevation. At the front end of the bearing shoe **106** is provided a yoke **115** which embraces the spring packet and thereby also prevents lifting of the latter. The yoke **115** carries at its upper end a distance tube **116** which bears on the upper side of the spring packet and is secured against displacements by means of a spring leaf **117** bent to hook shape.

In FIG. 10 of the drawings the positions assumed by the individual wheels and axles of the twin-axle assembly during travel of the vehicle in a curved path are indicated in broken lines. In order that the desired adjustment to curves without rubbing or scuffing may be achieved, it is preferred to arrange the load-supporting springs **6** and **7** so that they converge towards each other, the distance *a* between the rear ends of the springs being greater than the distance *b* between the front ends. By such an arrangement of the springs **6** and **7** it is ensured that the axes of all the axles, when extended as lines **118**, **119** and **120**, will meet at a common point. When travelling in a curve, therefore, all the axles extend at an angle to each other and the desired effect is obtained.

I claim:

1. A twin-axle tracking assembly for a vehicle comprising front and rear axles on the vehicle frame, load-supporting springs swingably mounted intermediate their ends on said vehicle frame and bearing by their front ends on said front axle and by their rear ends on said rear axle, means on said rear axle for transmitting lateral movement on the rear axle to at least one of said springs to cause swinging thereof and means on said front axle for transmitting swinging movement of either of said springs to said front axle to cause corresponding lateral movement thereof, including push means connecting said front axle to said vehicle frame for universal movement with respect thereto comprising a pair of track-rods located rearwardly of said front axle and converging in the rearward direction, means universally articulating the front ends of said track-rods to said front axle and means universally articulating the rear ends of said track-rods to said vehicle frame at points spaced apart transversely of said frame, said tracking assembly being constructed and arranged so that during vehicle turning, the axis of the front axle is inclined with respect to the axis of the rear axle, said front axle being inclined less with respect to said vehicle frame than said rear axle.

2. An assembly as claimed in claim 1, in which each load-supporting spring is mounted intermediate its ends between side faces of a spring block secured on said vehicle frame and is provided with lateral convexly curved surfaces to engage said side faces.

3. An assembly as claimed in claim 1, in which the movement-transmitting means on said front and rear axles comprises limiting pieces secured on the axles inwardly of the respective ends of said load-supporting springs and each formed with a convexly curved surface which engages the adjacent side of the respective spring.

4. An assembly as claimed in claim 1, in which each articulating means at an end of a track-rod includes a prestressed elastic element, said elements tending to hold said track-rods in their neutral positions.

5. An assembly as claimed in claim 1, including two rearwardly directed abutment brackets secured to the front axle each beneath one of the front ends of the load-supporting springs so that their ends may be applied against the undersides of said ends of the springs by partial rotation of said axle, and means in the mountings of said springs for permitting tilting thereof longitudinally.

6. An assembly as claimed in claim 2, including a transverse member disposed at about axle height and interconnecting the spring-blocks, said member constituting the part of the vehicle frame to which the front and rear axles are connected.

7. An assembly as claimed in claim 6, including as the connection between the rear axle and said transverse member a triangular stay comprising limbs converging in the forward direction and secured at their rear ends to said rear axle.

8. A twin-axle tracking assembly for a vehicle comprising a front axle, load-supporting springs swingably mounted on the vehicle frame intermediate the ends thereof, means for transmitting swinging movements of said springs to said front axle to cause lateral displacement thereof, at least one rear axle operatively connected to at least one of said springs so that lateral displacement of said rear axle will cause swinging movement of the associated spring and push means connecting said front axle to said vehicle frame for universal movement with respect thereto comprising a pair of track-rods located rearwardly of said front axle, means universally articulating the front ends of said track rods to said front axle at spaced locations and means universally articulating the rear ends of said track-rods to said vehicle frame at locations spaced apart to a lesser extent than said spaced locations on said front axle, said front and rear axles being adapted to be inclined with respect to one another during vehicle turning movement.

9. An assembly as claimed in claim 8, including a rear axle constructed in two short, spaced and aligned parts, wheel means supported for rotation on each of said parts, and means securing the rear ends of said load-supporting springs each to one of said short, spaced and aligned parts, with lateral movement of one of said rear axles causing swinging of the associated spring.

10. An assembly as claimed in claim 8, including a rear axle constructed in two spaced aligned parts, each part having a wheel mounted on each end thereof and being attached to the corresponding spring-end which bears thereon between said wheels.

11. An assembly as claimed in claim 10, wherein the load-supporting springs are arranged at an angle to each other such that the distance between the rear ends of the springs is greater than that between their front ends.

12. An assembly as claimed in claim 10, wherein the front axle carries a single wheel at each end.

13. A twin-axle tracking assembly for a vehicle comprising front and rear axles on the vehicle frame, load-supporting springs swingably mounted intermediate their ends on said vehicle frame and bearing by their front ends on said front axle and by their rear ends on said rear axle, means on said rear axle for transmitting lateral movement of the rear axle to at least one of said springs to cause swinging thereof and means on said front axle for transmitting swinging movement of either of said springs to said front axle to cause corresponding lateral movement thereof, including push means connecting said front axle to said vehicle frame for universal movement with respect thereto comprising a pair of track-rods located rearwardly of said front axle and converging in the rearward direction, means universally articulating the front ends of said track-rods to said front axle and means universally articulating the rear ends of said track-rods to said vehicle frame at points spaced apart transversely of said frame, each track-rod being provided at each end with two adjacently arranged spherical segments having their circular faces normally disposed in a plane parallel with the axles, a bearing plate being provided on the part to which said end is articulated, and seating recesses being provided in said bearing plate to receive said spherical segments.

14. An assembly as claimed in claim 13, in which each pair of spherical segments is arranged on a plate secured on the respective end of the track-rod, a housing is secured on said bearing plate, a cover flange is provided on said housing and a compressed elastic body is engaged between said bearing plate and said cover flange.

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