PUBLISHED MAY 25, 1943. BY A. P. C.

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ELASTIC SUSPENSIONS OF AXLE AGGREGATES

Filed April 4, 1940

Serial No. 327,769

4 Sheets-Sheet 1

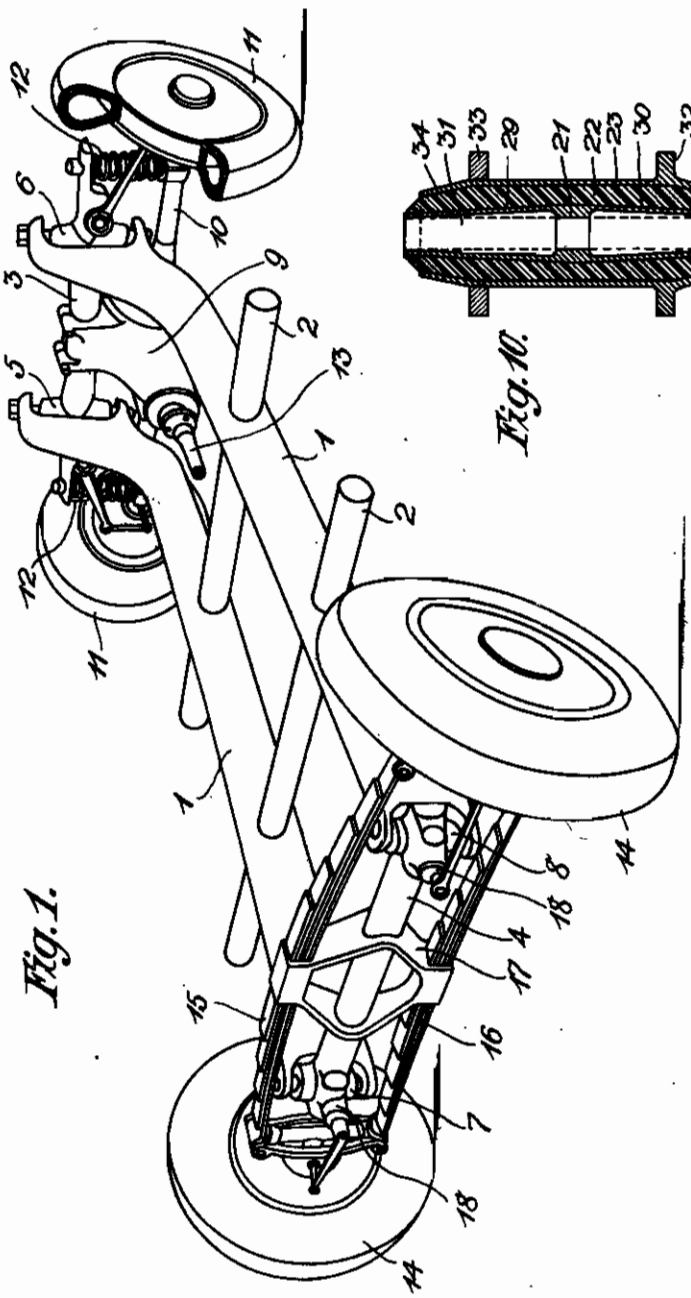

Fig. 1.

Fig. 10.

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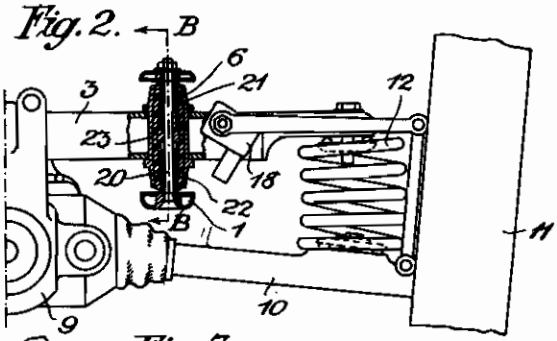
Fig. 2.



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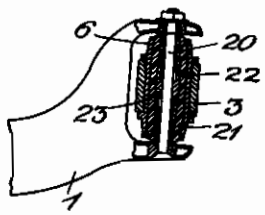

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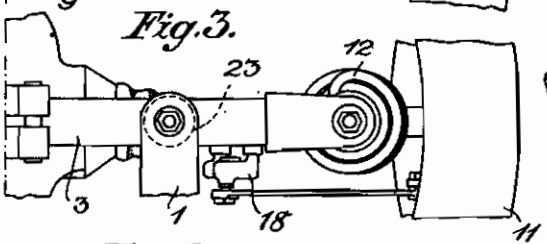

Fig. 8.

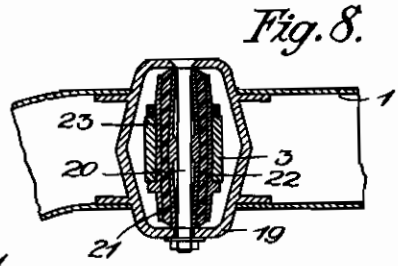

Fig. 5.

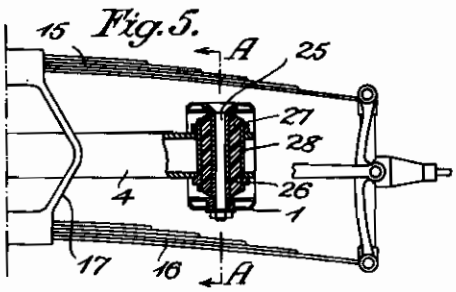

Fig. 7.

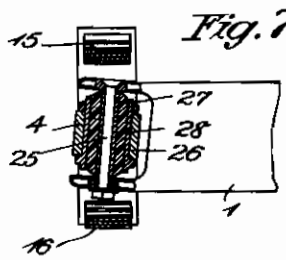

Fig. 6.

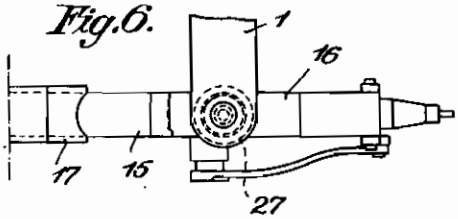

Fig. 9.

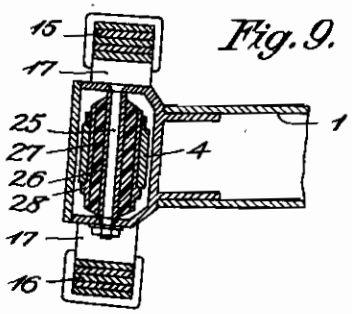

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Fig. 11.

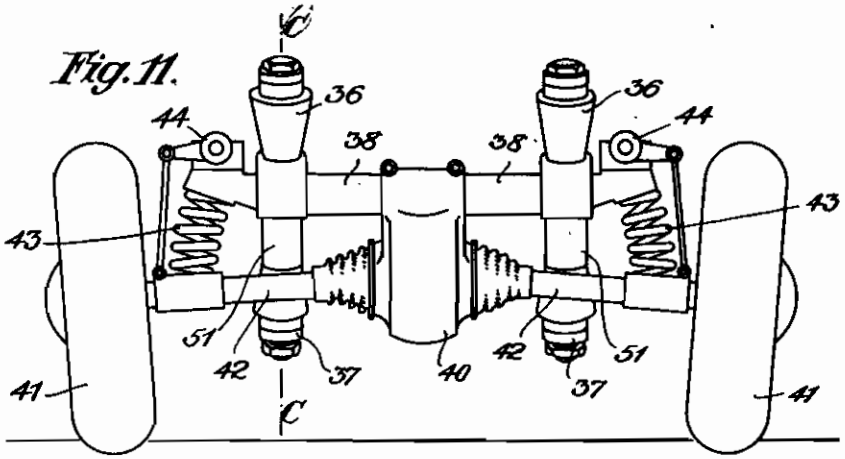

Fig. 12.

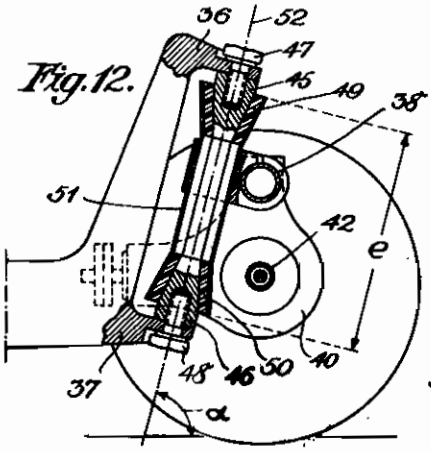

Fig. 13.

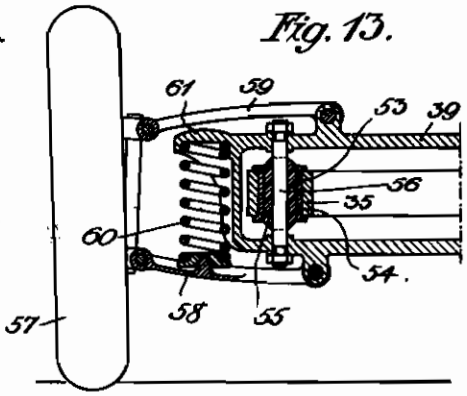

Fig. 14.

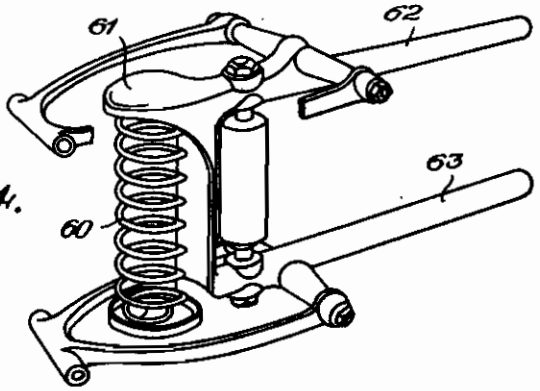

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Fig. 15.

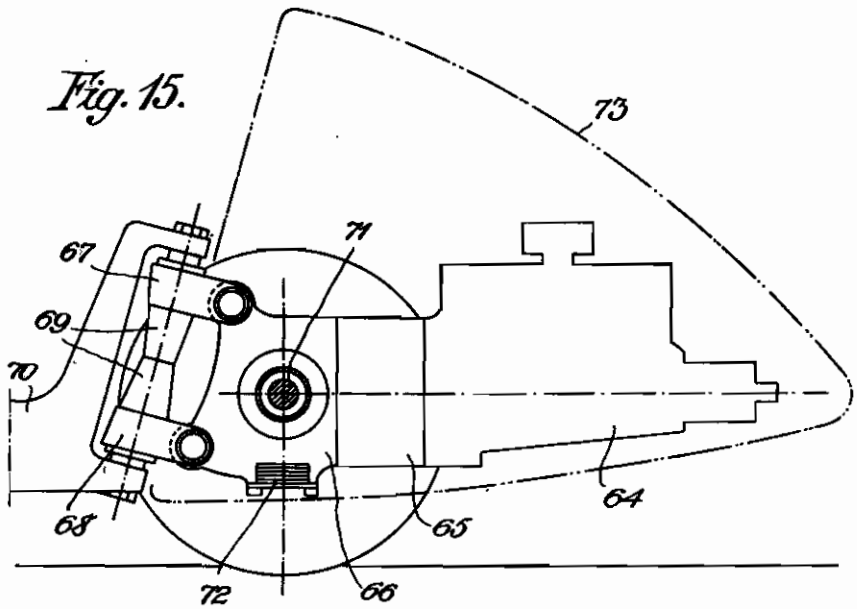


Fig. 16.

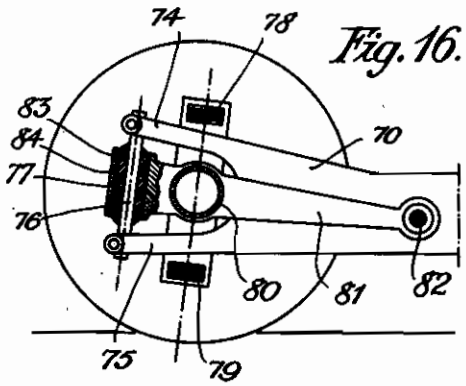
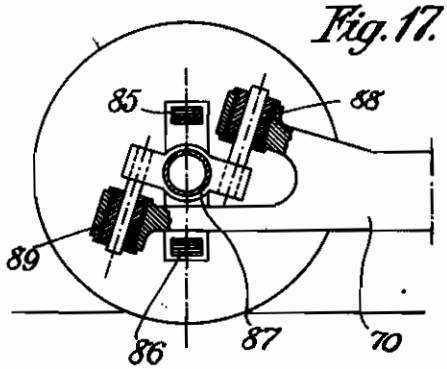


Fig. 17.



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ALIEN PROPERTY CUSTODIAN

ELASTIC SUSPENSIONS OF AXLE AGGREGATES

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Application filed April 4, 1940

This invention relates to an improved connection of the axle aggregates with the vehicle top, elastic members being arranged between the axle aggregate and the vehicle top.

The invention aims at decreasing or preventing the noises being transferred through the wheels onto the vehicle top. With the expression vehicle top particularly the frame with the carriage body or a self contained carriage body is meant, connecting the axles directly. Above all the invention is important for bodies manufactured of sheet steel, because such steel bodies are specially inclined to vibrations or to a roaring noise, proceeding from the oscillations of the wheels.

A further object of the invention is an elastic connection of the vehicle axles with the vehicle top in such a manner that, in spite of interposing elastic means, a secure position of the car on the road is reached, free of undesirable vibrations, difficult to deal with. For this purpose the elastic means particularly are so arranged and provided that they allow a greater yielding capacity between the axle or a carrier for the axle parts, and the vehicle top in approximately vertical direction, but only a small yielding capacity in lateral direction. Specially practical in this case may be the arrangement of the elastic members in such a way, that the main yielding capacity between the carrier and the vehicle frame may exist in a direction coincident with the shock direction of the wheels. The shock direction principally results here by the fact that the shock forces arising at the wheel during running have in longitudinal direction a small horizontal and backward directed component and a larger vertical and upward directed component, so that the resulting shock force will be directed steeply upward and backward, deviating from the perpendicular by an angle of 5° to 30°.

Furthermore the invention provides an elastic connection of such a kind that the forces arising at the axle will be received very securely, and which is at the same time particularly simple with respect to construction and mounting. This object will be reached most completely by means of rubber bushes making a connection between the axle and the vehicle top and being preferably so arranged that the axles of the bushes extend about vertically and if possible in the shock direction of the wheels. By arranging two rubber bushes axially to each other and in a certain distance from each other, a particularly good reception of the forces and moments can be obtained.

Furthermore the invention provides an arrangement in which the axles of all wheels, i. e. the front and the rear wheels of the vehicle are connected yieldingly with the frame or the body. By these means the advantages aimed at will be reached most completely. Eventually the axle piece carrying the wheels yieldingly may be connected to the vehicle by one or more thrust members, between the axle piece and the vehicle top, elastic members being interposed, allowing a small swinging motion of the axle together with the thrust member around its pivoting point at the vehicle top.

In the drawings several types of the invention are illustrated by way of example.

Fig. 1 shows a perspective illustration of a car frame in which the front axle aggregate as well as the rear axle aggregate are yieldingly connected to the frame by means of rubber-metal members.

Fig. 2 shows a partial sectional view of the rear axle aggregate according to Fig. 1, in which the rubber-metal connection between the rear axle aggregate and the frame is shown in section.

Fig. 3 shows a view from above onto the arrangement according to Fig. 2.

Fig. 4 shows a section through the line B—B of Fig. 2.

Fig. 5 is a partial view of the front axle aggregate according to Fig. 1, in which the rubber metal connection between the front axle aggregate and the frame is again shown in section.

Fig. 6 is a view from above onto the arrangement according to Fig. 5.

Fig. 7 shows a section through the line A—A of Fig. 5.

Fig. 8 shows a somewhat different form of the rubber metal connection in a sectional view corresponding to Fig. 4.

Fig. 9 shows a further alteration of the form of the rubber metal connection in a sectional view corresponding to Fig. 7.

Fig. 10 shows the rubber metal connection according to Fig. 2 or 8 in enlarged scale.

A further type of a vehicle formed according to the invention is illustrated in the Figs. 11 to 14, in which Fig. 11 shows a rear axle aggregate of this vehicle in rear view,

Fig. 12 a longitudinal section through line C—C of Fig. 11,

Fig. 13 a sectional view of the front axle aggregate, while

Fig. 14 shows in perspective illustration a relative to Fig. 13 somewhat altered form of the front axle suspension.

A third type of a vehicle formed in accord-

ance with the invention is illustrated in the Figs. 15 and 16 or 17, in which

Fig. 15 shows the rear axle arrangement,

Fig. 16 the front axle arrangement of this vehicle in side view, partially in section and

Fig. 17 a corresponding, somewhat altered front axle construction for this vehicle.

In the design according to the Figs. 1 to 7 the frame is formed by the longitudinal beams 1 and by the cross beams 2 rigidly connected with it. Furthermore a rear cross beam 3 for the rear axle and a front cross beam 4 for the front axle is provided, being connected to the frame, interposing a metal connection 5, 6, 7 and 8 to the longitudinal beams of the frame.

To the cross beam 3 the differential gear 8 is rigidly or yieldingly connected. To the casing for the gears the swinging semi axles 10 with the rear wheels 11 are laterally swivelled. For the shock absorption serve the spiral springs 12 secured on one side to the cross beam 3 and on the other side to the semi axles 10. The drive is transferred by the motor (not shown) through the Cardan shaft 13 and the differential gear 8 onto the swinging semi axles 10.

The cross beam 4 furthermore carries the front axle aggregate with the steering gear, the front wheels 14 being secured for instance to a spring carrier 17 by means of two leaf springs 15 and 16 arranged on top of each other, the carrier being secured to the cross beam 4. To the cross beams 3 and 4 furthermore the shock absorbers 18 are fastened.

The details of the rear axle bearings illustrated in the Figs. 2 and 4 show the rubber-metal connection 21, 22, 23, the inner metal sleeve 21 of which is in connection with the longitudinal frame carrier 1 through the bolt 20 and its outer metal sleeve 23, being in connection with the cross beam 3 of the frame. By these means the rubber sleeve 22 which is securely fastened to the sleeves 21 and 23, for instance by vulcanisation, is inserted into the power transmission between the cross beam 3 and the longitudinal beams 1, and the small high frequency oscillations which, as is known, cause the roaring noise are kept away from the body.

In the Figs. 5 to 7 the connection of the front cross beam 4 or of the front axle aggregate to the longitudinal beams 1 of the frame is illustrated. Here the rubber bushing 27 is connected to the longitudinal beam 1 of the frame by means of an inner metal sleeve 28 and a bolt 25, and to the cross beam 4 by means of an outer sleeve 26, the rubber being preferably adhesively connected to the metal sleeves by vulcanization.

With the design according to Fig. 8, showing a somewhat altered connection of the rear cross beam 3 with a longitudinal beam 1, the bolt 20 is not journaled directly in the longitudinal beam of the frame, but for instance in a special intermediate casing 19, being welded to this beam. A similar design for the front axle is shown in Fig. 9.

In Fig. 10 the rubber metal connection, for instance for the rear axle, is shown in enlarged scale. Evidently the inner sleeve 21 extends from the middle to both sides somewhat conical as shown at 29 and 30, receiving in a bore 31 the connecting bolts (here not shown), for instance the bolt 20 or the bolt 23 when applied to the front axle. The inner sleeve 21 is surrounded by the rubber sleeve 22 which again is enclosed and held by the outer sleeve 23. The outer sleeve has the solid supporting flange 32 and the screwed-in flange 33 between which for instance the crossbeams 3 or 4 are held. Furthermore the sleeve 23 is so shaped that between the two flanges 32 and 33 it is cylindrical at both ends, however at 34 it is conical, and more conical than the surfaces 29 and 30 of the inner sleeve. The result will be that the thickness of the rubber sleeve in axle direction is of unequal size, and that according to the size of the arising forces a progressive damping action will take place. At the same time the loading forces acting in vertical direction will be sure to be securely received.

With the further designs given e. g. in the Figs. 11 to 14 the frame for instance consists of longitudinal beams 35 ending in backward formed arms 36 and 37 respectively, arranged in a vertical plane, essentially one above the other. In this place however a correspondingly shaped self-supporting body could be used. The frame is similar to the one shown in Fig. 1, provided with cross beams connecting rigidly the the longitudinal beams, and has at the same time further cross beams 38 and 38 being yieldingly connected to the longitudinal beams in the manner hereafter described, and serving as carrying pieces for the rear axle and the front axle. Onto the rear crossbeam 38 the rear axle gear 40 is secured rigidly or with interposition of rubber pieces tightened by means of clamping screws or in any other suitable way. The rear wheels 41 are journaled on the axle casing 40 for instance by means of pivoted semi axles 42 swingingly secured by cylindrical pins and supported by unguided spiral springs 43 thrusting with their upper end against the ends of the cross beam 38. On the ends of the cross beam also the shock absorbers 44 are arranged.

The yielding connection of the cross beam 38 with the longitudinal beams 35 is provided as follows: Between the forked ends 36 and 37 of each of the longitudinal beams of the frame conical pins 45 and 46 are inserted and secured by means of screws 47 and 48, serving for the reception of the conical rubber bushings 48 and 50 which are surrounded by a specially formed steel sleeve 51. The arrangement is thus, that the axis 52 of the parts 45 to 51 forms an angle with the road, amounting to about 75°, the axis 52 extending steeply forward and downward meets the road before the middle of the wheel.

Evidently the entire axle aggregate consisting of the crossbeam 38, the differential gear 40, the semi axles 42, the wheels 41, the springs 43 and the shock absorbers 44 is so connected to the frame, interposing the rubber bushings 49 and 50, that there is no metallic contact between the axle aggregate and the frame and the car body respectively. An inclined arrangement of the axis 52 of the yielding connection has the advantage that the shocks which the wheel is met with on its course on the road are effective about in the axle direction of the rubber bushings so that the yielding capacity of these rubber bushings in their longitudinal direction may fully be made use of. The distance between the rubber bushings 49 and 50 is chosen comparatively great; their guided length i. e. the distance *e* of the upper end of the upper rubber bushing 49 from the lower end of the rubber bushing 50 amounts to more than half the wheel diameter in the illustrated example, with the effect that the axle aggregate is most securely supported. The rubber bushing 49 may then be within the range of the upper wheel covering,

and the rubber bushing 50 within the range of the lower wheel covering.

The front cross beam 39 is formed essentially as a hollow beam, as shown in Fig. 13, through which the longitudinal beam 35 of the frame is led, having a vertical bore 53 in the plane of the cross beam. Into this bore, by means of a metal sleeve 54 a rubber sleeve 55 is inserted being for instance vulcanised to this metal sleeve, through which a connecting bolt 58 is led, fastened in the upper and lower wall of the cross beam 39. Preferably the connecting bolt is also fastened to the rubber sleeve 55 by means of vulcanisation. The wheel 57 of the vehicle is guided in parallel by means of the two guiding levers 58 and 59 which are jointed to the cross beam 39. For the shock absorption of the wheel serves the spiral spring 60 the upper thrust bearing of which is also on the cross beam at 61. The bolt 56 may be arranged perpendicular or in a certain angle to the road, for instance corresponding to the shock direction of the wheel.

The design according to Fig. 14 is distinguished from the one according to Fig. 13 only by the fact that the cross beam 39 is formed of two tubes or rods 62 and 63 connected to each other by the thrust bearing 61 for the springs 60.

With the design according to Figs. 15 and 16 the entire backward driving gear, consisting of the motor 64, the change speed gear 65 and the differential gear 66 is fastened by means of the two bows 67 and 68 to the metal sleeve 69 made in one or two pieces, and being journalled all around yieldingly on the frame 70, similar to Fig. 11. The shock absorption of the swinging semi axles 71 ensues by means of a laminated spring 72. The outer covering 73 enclosing the driving aggregate may be secured directly to the aggregate in order to avoid a metallic contact between it and the frame and the rest of the body.

As shown in Fig. 16 the frame 70 terminates into a fork the ends 74 and 75 of which serve for securing the bolt 76 penetrating the rubber bushing 77. The cross beam 80 carrying the laminated springs 78 and 79 (similarly to the illustration in Fig. 1), and being extended between the fork ends 74, 75 of the frame, is rigidly secured to one or two lateral thrust members 81 which are jointed on one side respectively by means of a joint 82—eontaining eventually a rubber insertion—to the frame, pivoting around a cross axle of the vehicle, and at the other side encircling with their sleeve-formed end 83, extended across the axle member the rubber bushing 77, interposing for instance a metal bushing 84 which might be vulcanised with it. In this case the springs 78 and 79 act in the same direction as the rubber bushing 77 arranged essentially tangentially to the swinging radius of the pertaining thrust member 81, in order to have the full benefit of its comparatively great yielding capacity in the axle direction of the bushing. The thrust member 81 may be arranged in the longitudinal center plane of the vehicle for instance at a crossbeam. As already hinted at, two thrust members at both sides of the frame or at both sides of the longitudinal center plane of the vehicle may be provided.

In the design according to Fig. 17 which might be used for instance in the place of the one according to Fig. 16 or also according to the Figs. 5–7 or 13–14 the axle member or cross beam member 87 carrying the front wheels by means of two laminated springs 85 and 88 arranged above each other, is yieldingly secured to the frame 70 by means of two rubber bushings 88 and 89 or by means of two pairs of such bushings, having each similarly to the before mentioned examples, a longitudinal axis extending slantingly to the road, but having in the longitudinal direction of the vehicle axes so transposed relative to each other that the bushing 89 will be before, and the bushing 88 will be about by the equal amount in back of the wheel center. The acting direction of the springs 85, 86 lies in this instance in a vertical plane.

In all cases the rubber bushings, as partly described above, can be rigidly connected with the parts penetrating or surrounding them, as bolts and sleeves, by means of vulcanisation. The connection may however be made in another suitable manner, for instance by pressing the rubber into fittings provided with corresponding flanges. Furthermore adjusting deviees for adjusting the angle may be provided, for instance by forming the pins 45, 46, shown in Fig. 11, in the shape of eccentrics, or for instance by lengthening or shortening the arms 36, 37 in the longitudinal direction of the vehicle by suitable arrangements. Also the pivoting point 82 in the design according to Fig. 16 might be displaced for this purpose in vertical direction.

The invention is not limited to the types illustrated and described above. Particularly the front- and rear axle constructions used for the different designs may be interchanged, and the rear axle constructions may be used as front axle constructions by making correspondent alterations, and vice versa.

Under circumstances it may be sufficient if only one of the axle aggregates will be connected yieldingly with the vehicle top, while the other axle aggregate is rigidly secured to it. Preferably both axle aggregates will be connected yieldingly with the vehicle top. The invention may be applied to all kinds of wheel suspensions, consequently also for rigid axles, but preferably it is to be applied to swinging axles, as here the origin of noises and vibrating symptoms is particularly to be apprehended.

As frame a usual frame formed of longitudinal and cross beams may be used or for instance a frame consisting of a central longitudinal beam, extending eventually at one or at both ends into a frame fork with two lateral fork arms, which may be understood by the expression of "longitudinal frame beam".

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