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(54) A VEHICLE INCLUDING FRONT WHEEL SUSPENSION

(71) We, VOLVO CAR BV., a body corporate organised under the laws of the Netherlands, of P.O. Box 1015, Eindhoveneweg 122, Geldrop — Eindhoven, Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a vehicle with the engine or an element instead of the engine located in the front, the vehicle including a front wheel suspension comprising a cross beam, which is located behind and below said engine.

In a head-on collision of known vehicles having such a construction, the engine and the cross beam are pressed rearwardly into the passenger compartment. Thus, there may result a rearward movement of that portion of the steering bar to which the steering wheel is secured.

According to the invention, there is a vehicle with the motor engine, or an element instead of the engine located in the front, the vehicle including a front wheel suspension comprising a cross beam which is located behind and below said engine or said element and is so fastened to the body or to the longitudinal runners at both sides of the body and is so positioned in relation to other parts of the vehicle that, in the event of a front collision, the fastenings will permit the cross beam to become detached from the body, and in which adjacent parts of the body or longitudinal runners are so shaped that the cross beam will be constrained to move in a rearward downward direction.

The invention can also be applied with success in a vehicle in which the engine is not located in the front but in which at the location of the engine in the front a device is provided having the same effect that a motor would have in a head-on collision.

In a preferred embodiment, the cross beam substantially comprises at each end an upper plate which is removably connected to the longitudinal runners, and a lower plate carrying a wheel support arm bearing. The upper plate preferably has two separate fastening points, to wit a front fastening point having a recess forwardly

opening with a longitudinal centre line at an acute angle to the longitudinal axis of the vehicle and a rear recess with a longitudinal centre line substantially extending parallel to the longitudinal axis of the vehicle, in which between the fastening points some material is removed from the upper plate.

In the preferred embodiment, to prevent penetration of the steering wheel into the compartment, an outer tube of the steering column has complete freedom of longitudinal movement with respect to the steering bar, said outer pipe having a crumpling zone comprising four radially spaced portions defined by four longitudinal slots equidistant from each other about the circumference of the outer tube, each slot having at both ends an enlarged aperture and a central aperture, said apertures being contiguous with said slots, the outer pipe material between the slots being deformable outwardly to the longitudinal axis of the steering column in the event of a crash.

The invention is now described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a schematic side view of the front portion of a vehicle which is equipped with a front wheel suspension, showing the suspension before and after a frontal crash, e.g. a head-on collision;

Figure 2 is a top view showing the removable fastening of a cross beam to a longitudinal runner, to a larger scale;

Figure 3 is a cross section along the line III-III of Figure 2;

Figure 4 is a schematic side view of a steering column before and after a frontal crash;

Figure 5 is a detail (to a still larger scale) of the connection between the outer tube and the steering bar of the steering column, and

Figure 6 shows a detail of a shearing bolt.

The most important components are a bonnet 1 (which is shown at 1' after a crash has occurred) and engine 2 (which can arrive at the location 2' after a crash), a bumper 3, a longitudinal runner 4 which can have the crumpled shape 4' after the crash, a separation wall 5

between the engine compartment and the passenger compartment where a steering wheel 6 is present. The steering wheel 6 is fastened to the one end of a steering bar 7 surrounded by an outer tube 8 which is fastened to the wall 5 by a support 9. Another portion 7a of the steering bar 7 is connected to a steering housing 10, which can be displaced to the position 10' after a crash, as said steering housing, by virtue of the structure according to the invention, will rotate around a cross coupling 11 interconnecting the two portions 7 and 7a of the steering bar 7.

In accordance with the invention, the longitudinal runners 4 extend rearwardly and downwardly at an inclination to the horizontal adjacent the location of attachment of a cross beam 20. Said cross beam is only partly indicated in Figure 1 in order to show more clearly the condition before and after a crash has taken place, but it will be further elucidated with reference to Figures 2 and 3.

In Figure 2, in which only the most important components of the vehicle are indicated, there are shown a wheel support arm 15 fastened at one end to a lower plate 13 of the cross beam 20 at a point 14. A swivel nozzle and a shock absorber (not shown) with a hub 17 are connected to the other end of arm 15 via a swivel ball 16, and a front wheel (not shown) is mounted on the hub 17. The wheel support arm 15 is connected by a reaction bar 18 to a reaction bar support 19 which, like an upper plate of the cross beam 20, is also fastened to the lower side of the longitudinal runner 4 (Figure 3). The hub 17 can be rotated around the swivel ball 16 and the shock absorber bar by the steering housing 10 (Figure 1) via a steering rod 21.

A further feature of the invention is that at each end of the cross beam 20 its upper plate is removably connected to the longitudinal runner 4 by two fastening bolts 22. In the illustrated embodiment this is achieved by the upper plate having a forwardly opening recess 23 with its longitudinal centre line at an acute angle to the longitudinal axis of the vehicle, and a second recess 24 with a longitudinal centre line extending substantially parallel to the longitudinal axis of the vehicle, in which between the material surrounding the recesses some material is removed from the upper plate with the result that two legs occur in which said recesses have been arranged. As shown, the second recess 24 merges with a substantially square hole 25 which is considerably wider than the width of the recess 24. It seems that the omission of some material from the upper plate between the recesses together with the inclined position of the recesses 24 gives a more favourable deformation to the cross beam. When the cross beam is detached from the longitudinal runners during a frontal crash, then, as appears from Figures 1 and 3, the cross beam will move rearwardly and downwardly and the lower portion 7a of the

steering bar 7 will rotate around the cross coupling 11 so that the upper portion of the steering bar 7 will keep its position. Furthermore, it can be seen from Figure 3 that reinforcements 26 are welded to the longitudinal runners, said reinforcements carrying sleeves 27 in which stretching bolts 22 are screwed and locked. Between the heads of the bolts 22 and the upper plate 20, lock rings 28 are provided, while in the recesses 23 and 24 surface-treated spring steel clips 38 (Figure 6) are present to reduce friction. Said clips are particularly important when shearing bolts are used.

In Figure 3 a reaction bar support 19 at the front of the longitudinal runners is also visible in addition to the cross beam 20, which support can be fastened to the longitudinal runners 4 by some bolts 29 in the same way as the upper plate. It is, however, also possible that the reaction bar support is integral with a binding joint.

In the instance of a very severe frontal impact, the upper position of the steering bar 7 is substantially kept in its position but the separation wall 5 (Figure 1) to which the outer tube of the steering column is fastened via the support 9, is pressed inwardly. To prevent the steering wheel 6 moving rearwardly towards the driver, a structure is inserted in the steering column 8 (see Figures 4 and 5) which ensures collapse of the outer tube 8 of the steering column relative to the steering bar 7. The outer tube 8 is provided with a crumpling zone constructed so that four portions 31 can collapse outwardly. The portions 31 are defined by four circumferentially spaced slots 33 extending longitudinally of the tube 8, each slot having three enlarged apertures 32 to encourage collapse at those locations. The collapsed situation of the tube 8, i.e. the situation after a crash, is shown in Figure 4 in dotted lines.

Figure 5 clarifies on a larger scale the freedom of longitudinal and rotational movement between the steering bar 7 and the outer tube 8 at the lower end of the outer tube. An inner ring 34 of a ball bearing race is freely movable on the steering bar 7 and an outlet ring 37 is fixedly connected to the outer tube 8, there being a plurality of ball bearings 36 located between the rings 34 and 37, and a spring 35 biases the ring 34 towards the steering wheel, thus maintaining the ball bearings in position, and effectively spring loading the tube 8.

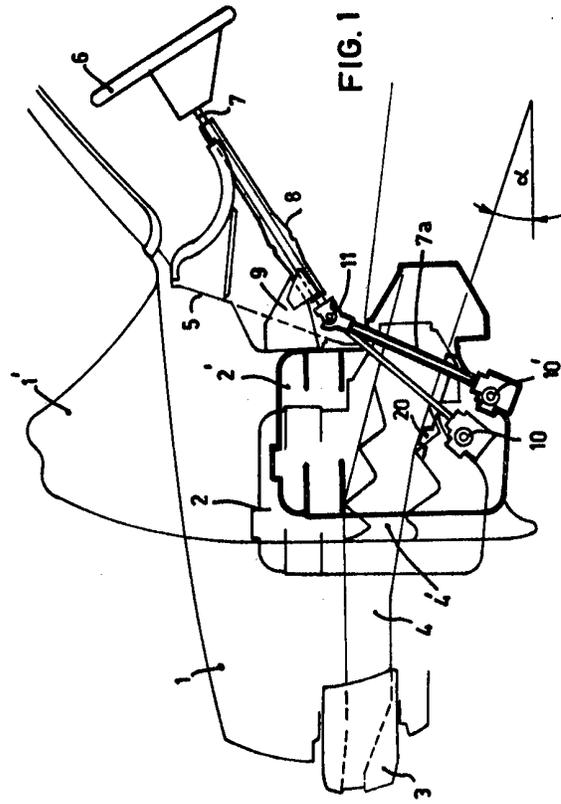
As indicated in Figure 6, shearing bolts 39 can be used instead of the fastening bolts 22 and 29 of Figure 3.

WHAT WE CLAIM IS:—

1. A vehicle with the motor engine or an element instead of the engine located in the front, the vehicle including a front wheel suspension comprising a cross beam which is located behind and below said engine or said element and is so fastened to the body or to longitudinal runners at both sides of the body and is so

- positioned in relation to other parts of the vehicle that, in the event of a front collision, the fastenings will permit the cross beam to become detached from the body, and in which adjacent parts of the body or longitudinal runners are so shaped that the cross beam will be constrained to move in a rearward downward direction.
2. A vehicle according to Claim 1 in which the cross beam is fastened to the longitudinal runners which have an inclination rearwardly and downwardly at the location of the fastening.
3. A vehicle according to Claim 1 or 2 in which the cross beam is clamped to the body or runners.
4. A vehicle according to Claim 1 or 2 in which the fastening is by means of shearing bolts.
5. A vehicle according to any one of Claims 1-4 in which the cross beam comprises an upper plate which is removably connected to the longitudinal runners and a lower plate carrying a wheel support arm bearing.
6. A vehicle according to Claim 5 in which the upper plate provides two separate fastening points with the cross beam, to wit a front fastening point having an open recess with a longitudinal centre line intersecting the centre plane of the vehicle at a sharp angle and a rear fastening point having a second recess with a longitudinal centre line extending substantially parallel to the centre plane of the vehicle, in which between the fastening points some material is removed from the upper plate.
7. A vehicle according to Claim 6 in which the recess of the rearmost fastening point merges into a substantially square hole.
8. A vehicle according to any one of Claims 5-7 in which the upper plate has a V-shape at both sides when viewed from above and in which two upper portions of said cross beam are fastened by means of stretching bolts to the lower side of the longitudinal runners.
9. A vehicle according to any one of Claims 5-7 in which the upper portions of the upper plate are fastened to the lower side of the longitudinal runners by means of shearing bolts.
10. A vehicle according to Claim 8 or 9 in which against the rear side of the upper plate a reaction bar support is located against the lower side of the longitudinal runners.
11. A vehicle according to Claim 10 in which the reaction bar support is integral with the upper plate.
12. A vehicle according to Claim 10 or 11 in which the reaction bar is supported on the front of the longitudinal runners.
13. A vehicle according to any one of Claims 1-12 combined with a steering device in which a steering housing thereof is mounted on the cross beam and an outer tube of the steering column has complete freedom of axial movement in relation to the steering bar.
14. A vehicle according to Claim 13 in which the outer tube has a crumpling zone which is provided with four portions which can collapse triangularly outward and are defined by longitudinal slots spaced around the tube and have at each end and centre an enlarged portion to initiate said collapse.
15. A motor vehicle having a front end substantially as hereinbefore described with reference to and/or as illustrated in the accompanying drawings.

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COMPLETE SPECIFICATION

3 SHEETS

*This drawing is a reproduction of
the Original on a reduced scale
Sheet 2*

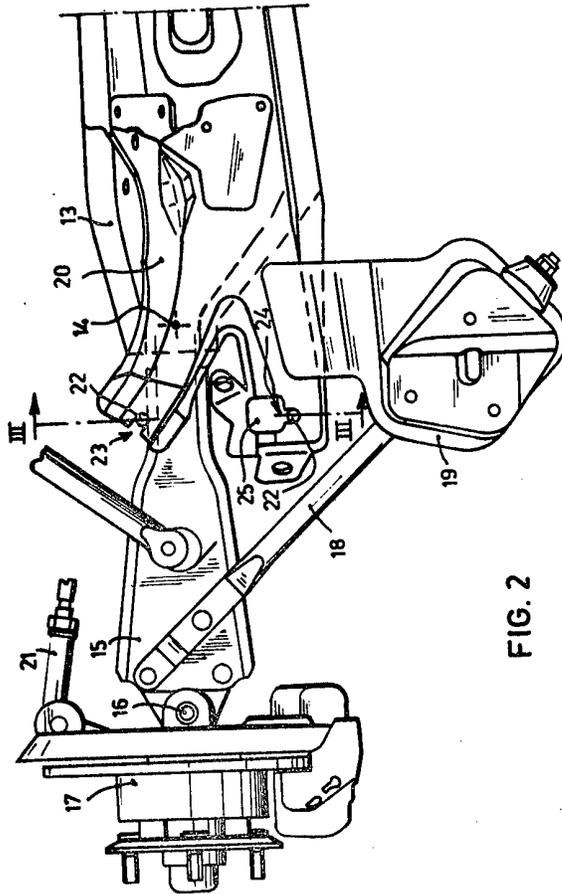


FIG. 2

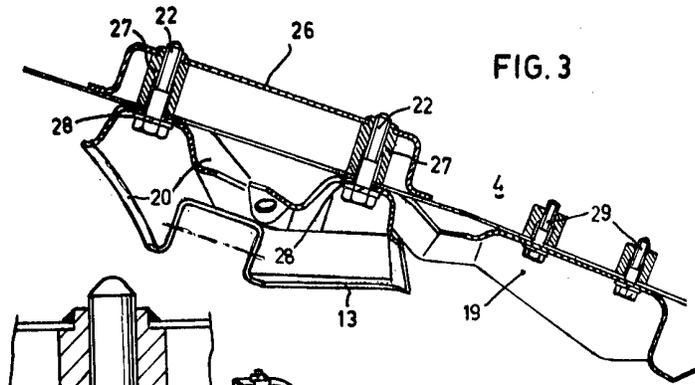


FIG. 3

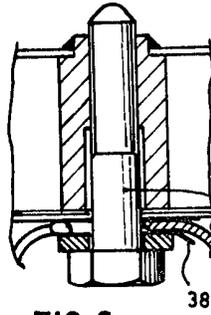


FIG. 6

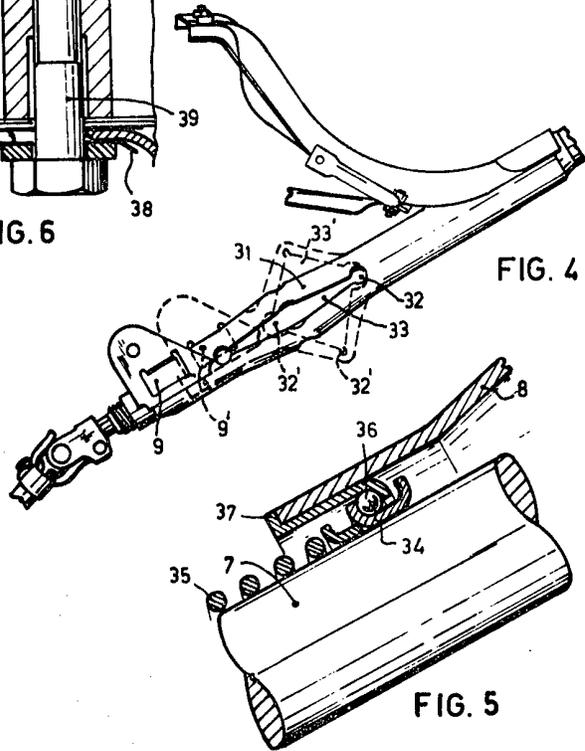


FIG. 4

FIG. 5