

ARRANGEMENTS FOR THE RESETTING OF THE WHEELS
OF TRAILING STEERING AXLES

The invention relates to a device for resetting the wheels of trailing steering axles, from their deflected position back into the straight steered course, of vehicles comprising at least one guiding axle and one trailing steering axle, wherein the wheels of the trailing steering axle are connected by a track rod and are provided with brakes actuatable independently of one another. The device is particularly suitable for heavy goods vehicles.

Axle units with at least one rigid guiding axle and at least one trailing steering axle are known in a diversity of constructions. Whereas the wheels of the guiding axle are mounted rigidly, i.e. not steerably, on the axle shaft, the wheels of the trailing steering axle perform a steering movement as a result of a pivotable mounting of their steering stub axles of the axle shaft. This steering movement, in every trailing steering axle, is automatically brought about when the vehicle corners, this cornering being itself brought about by at least one actively actuatable steering axle of an associated vehicle or of an associated vehicle train. Such steering trailing axles enjoy the advantage, in addition to reduction of up to 50% in tyre costs, of increased driving comfort and

increased safety when cornering, for which, moreover, less room is required as a result of the reduction of tyre width.

To return the wheels of the trailing steering axle out of their deflected position back to the straight course, it is necessary for the contact between the associated tyre and the road surface to generate resetting forces on the associated deflected wheel of the trailing steering axle. These resetting forces can be supported by external-force-assisted steering stabilization members or by the mounting of undulating pressure bearings between axle shaft and steering stub axle which, dependings on the respective wheel loading from the vehicle weight, automatically assist the resetting forces exerted on the respective wheel.

Under normal conditions, the resetting forces exerted on the deflected wheels of a trailing steering axle through the contact between road surface and tyre tread are adequate, in conjunction with the measures described above, in order to reset without interruption the deflected wheels of trailing steering axles back to the straight course. However, when the resistance to running and the contact surface between the tyre and the road surface are high, difficulties may arise which can prevent

at least an adequately fast return of the deflected wheel back to the straight course. For example, in the case of twin-tyred heavy goods vehicles, such as four-axle container transporters with solid rubber tyres, there is a possibility that the wheels will not return, or not completely return, to the straight course, but will persist in a deflected position. As a result, the trailed vehicle, after the bend has been negotiated, will not return to a position in which its vehicle longitudinal axis corresponds to the direction of travel, but remains in a slightly slanting position in which the longitudinal axis of the vehicle extends at an acute angle to the direction of travel. Apart from a high degree of wear, particularly of the tyres, this leads to an increase of the width of roadway which the vehicle will require.

According to the invention, there is provided a device for a vehicle having an axle unit comprising a guiding axle and a trailing steering axle including a stub axle pivotally connected at each end thereof and a wheel mounted on each stub axle, a track rod being associated with the wheels of the trailing steering axle so that, when the vehicle turns a corner, one stub axle pivots forwardly relative to the trailing steering axle and the other stub axle pivots rearwardly relative to the trailing steering axle to turn the wheels, the wheels being brakable independently of one another, the device comprising means which operate following turning of the wheels to assist the resetting of the wheels of the trailing steering axle into the straight steering course by increasing the friction between the roadway and the

wheel of the stub axle that is forwardly pivoted, by a brief actuation of the wheel brake of said wheel of the forwardly pivoted stub axle.

As a result of the brief braking of the forwardly deflected wheel, the frictional engagement of this wheel between road surface and tyre tread is increased. Thus, in spite of a high resetting resistance, adequately great resetting forces are exerted on this wheel which, because of its advance relative to the axle shaft, return it from the deflected position back into the straight course, and by means of the track rod, also return the associated opposite wheel. With trailing steering axles which are mounted behind at least one rigid guiding axle of a vehicle, the inner wheel (relative to the bend) of the trailing steering axle is, on going round a bend, forwardly deflected and thus briefly braked. On the other hand, if the trailing steering axle is mounted in front of a rigid guiding axle, there occurs on taking a bend a deflection of the wheel of the trailing steering axle on the outside of the bend, so that in this case the wheel of the trailing steering axle on the outside of the curve is briefly braked into the straight course.

As the wheels of the trailing steering axle are fitted

with brakes actuatable independently of one another, the arrangement of the invention requires only a small expenditure of force to provide automatically, on a return of the vehicle from the curve to the direct forward running, a brief braking of the associated forward-deflected wheel of the trailing steering axle. If there are several trailing steering axles in the axle unit it will be sufficient in each instance to brake briefly a wheel of the last one, or of the last two trailing steering axles, as these take up the greatest deflection angle on cornering.

Preferably, the brief actuation of the wheel brake is limited to angles of lock below 15° , particularly under 10° .

It is also preferred that two pulse generators are mounted on the track rod of the trailing steering axle, each pulse generator actuating the wheel brake of an associated one of the wheels of the trailing steering axle when the associated wheel is the forwardly deflected wheel. These pulse generators automatically effect a brief actuation of the wheel brake of the respective wheel to be braked when the trailing steering axle is returning to the straight course when cornering is completed.

Each pulse generator may be fitted with a direction detector for determining the direction in which the associated wheel is being deflected.

Each pulse generator may be a cam secured on the track rod which activates an associated switching member secured on the axle shaft on the deflection of the associated wheels out of the straight steered course and into the forward deflected position, and on the resetting of the associated wheel effects an actuation of the associated wheel brake into the straight course. Each switching member may be a valve connected with the brake pressure container through a pressure reducing valve which actuates a shuttle valve mounted in the brake duct of the associated wheel brake of at least one trailing steering axle.

This construction has the advantage that it is possible to make use of the existing brake installation for the arrangement of the invention, normal braking processes still having the priority. For the device of the invention only a pressure-reducer, two shuttle valves and two valves co-operating with the cams are required, so that the expenditure on construction and the extra weight for the device of the invention are minimized.

Shown in the drawing is an example of embodiment of the

device of the invention, wherein:

Figure 1 is an articulated vehicle train moving forward in a straight course;

Figure 2 is the train of Figure 1 taking a corner;

Figure 3 is a diagrammatic representation of the trailing steering axles of the train according to Figures 1 and 2 following a straight course; and

Figure 4 is a representation corresponding to Figure 3 when cornering.

The articulated vehicle train 1 shown in Figures 1 and 2 comprises a prime mover 2 and a semi-trailer 3. The prime mover 2 has two steerable front wheels 2a and two twin-tyred rear axles 2b, of which at least one is driven. The semi-trailer 3 is provided with two rigid guiding axles 3a and three trailing steering axles 3b. The construction of these trailing steering axles 3b is shown diagrammatically in detail in Figures 3 and 4. Whereas Figures 1 and 2 show respectively twin-tyred guiding axles 3a and trailing steering axles 3b, the trailing steering axles 3b are drawn single-tired only in Figures 3 and 4 for a better overall view.

Each trailing steering axle 3b comprises an axle shaft 4, with the ends of the axle shaft 4 carrying respective steering stub axles 5. Each stub axle 5 is pivotally mounted on the associated axle shaft 4 and carries a wheel suspension for a wheel 6. Each axle shaft 4 is provided with two upright axles which form the respective pivotal connections between the axle shaft and the associated steering stub axles 5 and which are disposed in the direction of travel in front of the longitudinal centre line of the associated axle shaft 4, so that a trailing steering effect is produced for the wheels 6 of the trailing axles 3b. A track rod 7 connects steering knuckles 7a associated with the wheels 6 of each steering axle 3b to synchronise the steering movement of the two wheels.

As shown in Figures 3 and 4, each wheel 6 of each trailing steering axles 3b is provided with an independently actuatable wheel brake which is actuated by a brake cylinder 8. By means of brake ducts 9, shown in dot-dashed lines in Figures 3 and 4, each brake cylinder 8 is in communication with a brake pressure container 10.

By means of an additional duct 11 in which a pressure reducing valve 12 is mounted, the brake pressure container 10 is connected with two valves 13 which in turn actuate respective shuttle valves 15. These shuttle valves 15, in

the example of embodiment, are mounted in the brake ducts 9 of the two rear trailing steering axles 3b, there being in fact one shuttle valve 15 for the brake cylinders 8 mounted on one vehicle side and one shuttle valve 15 mounted on the other vehicle side.

The valves 13 operate as on-off valves and are respectively actuated by a tappet by means of a cam 16 which is mounted on the track rod 7 of the rearmost trailing steering axle 3b. The representations in Figures 3 and 4 is intended to show that an impact of a slanting side of the cam 16 on the tappet of a valve causes only an activation of the switching process, and that the actual switching process is carried out when a steep flank of the cam 16 impacts the tappet of the valve 13 when the track rod 7 returns from a laterally displaced position to a central one.

On driving straight ahead, as shown in Figures 1 and 3, all brake cylinders 8 are connected in the usual manner with the brake pressure cylinder 10. The articulated train 1 can be normally braked. Even when the train 1 begins cornering according to Figure 2 by steering the front wheels 2a of the prime mover 2 out of the straight course shown in Figure 1, no change takes place with respect to the braking readiness of all brake cylinders 8,

as on the going over to the cornering situation the slanting flank of the left cam 16 on the rearmost track rod 7 only activates the left valve 13 without actuating the said valve. This may be seen on comparing Figures 3 and 4.

It is not till, on the return of the articulated train 1 from cornering according to Figure 2 to the straight ahead drive when the steep flank of the left cam 16 according to Figure 4 actuates the tappet of the valve 13, that this valve 13 is switched on, so that the valve 13 transmits the braking pressure prevailing in the brake pressure container 10 after reduction by the pressure-reducing valve 12 to the left shuttle valve 15. By switching over this shuttle valve 15, brake pressure from the brake pressure cylinder 10 goes to the two rear trailing steering axles 3b so that their advancing curve-inner wheels 6, as seen in Figure 4, are briefly braked.

As a result of this brief braking of the curve-inner wheels 6 of the two rear trailing steering axles 3b, the frictional engagement between the tread of their tyres and the road surface is increased, so that the resetting forces exerted on the deflected wheel 6 by the road surface are increased. The briefly braked wheels 6 thus return uninterruptedly into the straight course, bringing

with them in this situation, by means of their track rod 7, the associated curve-outer wheels 6. The brief braking of the respectively curve-inner wheels 6 thus leads to a reliable resetting of the deflected wheels 6 effected in proper time, without high constructional expenditure being required to that end. In Figures 3 and 4, the additional constructional parts, namely the two valves 13 with the associated cams 16, the two shuttle valves 15 and the ducts 11 and 14 with the pressure reducing valve 12 are shown in unbroken lines, to emphasize that the expenditure for the device described is slight.



CLAIMS

1. A device for a vehicle having an axle unit comprising a guiding axle and a trailing steering axle including a stub axle pivotally connected at each end thereof and a wheel mounted on each stub axle, a track rod being associated with the wheels of the trailing steering axle so that, when the vehicle turns a corner, one stub axle pivots forwardly relative to the trailing steering axle and the other stub axle pivots rearwardly relative to the trailing steering axle to turn the wheels, the wheels being brakable independently of one another, the device comprising means which operate following turning of the wheels to assist the resetting of the wheels of the trailing steering axle into the straight steering course by increasing the friction between the roadway and the wheel of the stub axle that is forwardly pivoted, by a brief actuation of the wheel brake of said wheel of the forwardly pivoted stub axle.

2. A device according to claim 1, characterised in that the brief actuation of the wheel brake is limited to angles of wheel lock below 15° , particularly under 10° .

3. A device according to either claim 1 or claim 2, wherein said means includes two pulse generators mounted on the track rod, each pulse generator actuating the wheel



brake of an associated one of the wheels during said operation to assist resetting when the stub axle on which the associated wheel is mounted is the forwardly pivoted stub axle.

4. A device according to claim 3, characterised in that each pulse generator is provided with a direction detector for determining the direction in which the stub axle on which the associated wheel is mounted is being deflected.

5. A device according to either claim 3 or claim 4, characterised in that each pulse generator is a cam secured on the track rod, and wherein the trailing steering axle also includes an axle shaft, each stub axle being pivotably connected to the shaft at respective ends thereof, the axle shaft being provided with two switching members, each switching member being associated with a respective one of the cams, each cam activating the associated switching member on said turning of the wheels when the stub axle on which the associated wheel is mounted is the forwardly pivoted stub axle, and each cam actuating the associated switching member whereby to activate the wheel brake of the associated wheel during said operation to assist resetting when the stub axle on which the associated wheel is mounted is the forwardly pivoted stub axle.



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6. A device according to claim 5, characterised in that each switching member is a valve connected by means of a pressure-reduction valve with a braking pressure container, which valve actuates a shuttle valve mounted in the brake duct of the brake of the associated wheel.

7. A device according to any preceding claim, wherein each wheel is one of two or more wheels mounted on a respective one of the stub axles.

8. A device for resetting the wheels of trailing steering axles substantially as hereinbefore described with reference to the accompanying drawings.

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