

ROTARY CONTROL DEVICE FOR A TRAILER STEERED AXLEField of the Invention

The present invention relates to a device for controlling
5 in rotation the steering axle of a trailer.

Such a device is particularly adapted for trailers of a train comprising a tractor vehicle and several trailers; the first trailer is generally a semi-trailer, and is coupled in a hinging way to the tractor vehicle; the following trailers are
10 each coupled in a hinging way to the trailer, which precedes. Hereinafter, when we say that a trailer or one of its parts is coupled to the preceding trailer, the words «preceding trailer» should be understood as being the preceding trailer in the train or, in an equivalent way, the semi-trailer coupled to the
15 tractor vehicle of the train, or even the tractor vehicle itself.

The invention relates to the trailers with at least two axles, one steering axle movable in rotation about a vertical steering axis and which, through its rotation, permits to steer
20 the trailer, and at least another axle, normally located closer to the rear of the trailer than the steering axle, and which we will refer to as « rear axle » in the following text.

The invention is more generally related to the field of the guiding of MTS (Multi Trailer System) trains, consisting in
25 guiding each of its trailers.

State of the art

The guiding of a trailer occurs, in the state of the art, by means of a mechanical beam integral with the steering axle of
30 a trailer, and coupled to the rear of the preceding trailer by means of a hinged cleat freely rotating about a substantially vertical axis. Such a beam constitutes a hinging means, and at the same time a means for controlling the orientation of the steering axles.

35 FR2780377A1 discloses such a solution for guiding a train.

When the beam is integral with the steering axle of the trailer, it inscribes the latter when turning generally over a smaller radius than that of the preceding trailer, and the more as the steering axle of the trailer is far behind the coupling point.

The steering axle must therefore be placed under the trailer as close as possible to its end on the side of the tractor vehicle. Now, one sometimes wants to place said axle farther back, in order to ensure a better distribution of the constraints induced by the heavy loads.

Furthermore, since the connection is hinged, it does not permit to drive backwards, except over a very small distance and provided the train is rectilinear.

Summary of the Invention

The present invention is aimed at solving these various drawbacks, and provides a device for controlling in rotation a steering axle of a trailer, said steering axle being movable in rotation about a substantially vertical steering axis, said trailer being aimed at being coupled in a hinging way to a preceding trailer, or directly to a tractor vehicle.

The device according to the invention is particular in that it comprises a hinged means fixed at one of its ends in a way hinging about a substantially vertical axis to said preceding trailer, and fixed at its other end to a means for controlling in rotation the steering axle. Said control means is movable in rotation about a substantially vertical control axis. The device includes in addition a means for retroaction from the steering axle onto the means for controlling in rotation.

Thus, the steering axle can be positioned under the trailer in an optimal way for distributing the constraints induced by the heavy loads, without any position constraint related to the function of guiding the train. The guiding function is indeed ensured by the control means and the retroaction means.

According to a preferred embodiment of the invention, said hinging means is a rod.

Such an embodiment permits to omit the steering beam, and to replace it by a rod.

5 According to a preferred embodiment of the invention, said means for controlling in rotation is a slide valve of a rotary feeder, which feeder supplies hydraulic and/or pneumatic steering actuators of said steering axle.

10 Such a solution permits a simple and light embodiment, the more that, often, a hydraulic power-pack is anyway present for controlling in rotation the rear axle of the trailer.

Such a rotary feeder can be arranged integral with the steering axle, this integral connection ensuring said mechanical retroaction means.

15 According to a preferred embodiment of the invention, said retroaction means is a means capable of producing a predetermined kinematic law between the means for controlling in rotation and the steering axle. This can, for example, be a set of tooth wheels, or tooth wheels and chain, connecting the
20 steering axle to the body of the rotary feeder or to the fixed portion of said means for controlling in rotation.

According to a preferred embodiment of the invention, said control axis is offset with respect to the steering axis and said retroaction means is a linking rod connecting the steering
25 axle to the body of the rotary feeder, said linking rod being so arranged that it produces a rotation of said body with respect to the chassis of the trailer, thus permitting, depending on the coupling points, to select a predetermined kinematic law between the means for controlling in rotation and the steering axle.

30 This embodiment permits to select a predetermined kinematic law between the coupling and the steering axle, so that for a given angle of rotation of the rod, the steering axle turns according to a smaller or larger angle, depending on the relative positions and shapes of the linking rod and the rotary
35 feeder.

The geometrical design of the trailer can thus be optimised, and the rotary feeder can be arranged at a favourable point for ease of construction of the trailer, without being constrained by the kinematics looked for.

5 The invention also relates to a trailer comprising a device for controlling in rotation as described above.

According to a preferred embodiment of the invention, said trailer comprises in addition a circuit for controlling in rotation axles permitting to drive each of them individually.
10 Such a control circuit permits to drive in reverse motion at reduced speed, which provides a much higher flexibility for positioning the train for example on a ship loading dock.

The invention finally relates to a method for controlling in rotation a steering axle of a trailer coupled in a hinging
15 way to a preceding trailer. The method is special in that it comprises the following steps:

- putting into rotation a hinging means fixed at one of its ends in a hinging way to the preceding trailer

- detecting the rotary motion of said hinging means by
20 a means for controlling in rotation,

- putting into rotation the steering axle, according to the information transmitted by said means for controlling in rotation,

- retroaction from the steering axle onto the means for
25 controlling in rotation permitting to interrupt the rotation of the steering axle in a given position.

Brief Description of the Drawings

Further advantages of the invention will become clear when
30 reading the description of an exemplary embodiment and the attached drawings, in which :

- figure 1 represents a view from above of a trailer with a device for controlling in rotation according to the state of the art,

- figure 2 represents a view from above of a trailer with a device for controlling in rotation according to the invention,

- figure 3 represents a detailed view of a device for controlling in rotation according to the invention in three successive positions,

- figure 4 represents a perspective view of an essential element of the device of figure 3,

- figure 5 represents a schematic view of a hydraulic circuit connecting the rotary feeder of figure 2 to the steering axle of the trailer of figure 1.

Detailed Description of an embodiment of the invention

When referring to figure 1, a trailer 1 according to the state of the art comprises a steering axle 3 and at least one rear axle 4. The steering axle 3 is connected to the preceding trailer or to the tractor vehicle 2 through a beam 5, which orientates the steering axle depending on the position and the orientation of the preceding trailer 2 and the distance from the preceding trailer 2 to the steering axle 3. One understands that, when this steering axle 3 is positioned far towards the rear, for example in an optimal position for the distribution of the constraints induced by heavy loads in the trailer 1, its guiding is influenced in a way that is not necessarily optimal.

When referring to figure 2, a trailer 1 according to the invention comprises a steering axle 3 and at least one rear axle 4. A rod 6 connects the preceding trailer 2 to a rotary feeder 8 positioned off-set with respect to the steering axle 3, generally closer to the front end of the trailer 1 than said steering axle 3.

When the train makes a turn, the preceding trailer 2 imparts an angle α to the rod 6 with respect to the longitudinal axis of the trailer 1, which produces a rotation of the slide valve 7 of the rotary feeder 8 about the control axis 9.

The hydraulic scheme shown in figure 4 shows that such a rotation of the slide valve 7 with respect to the body of the feeder 8 results into permitting an oil flow towards the

actuator for the rotation 11 and/or 12 of the steering axle 3, and thus produces a rotation of said axle about the steering axis 10, in a direction determined by the direction of rotation of the slide valve 7.

5 When referring to figure 3, the body of the feeder 8 is movable in rotation with respect to the chassis 15 of the trailer 1 about the control axis 9. Within the framework of this application, the word chassis designates a part of the trailer 1 that is fixed with respect to said trailer 1, in contrast to the
10 movable parts, such as the axles 3, 4, the rod 6, the feeder 8 and its slide valve 7 or the linking rod 14. The driving in rotation of the body of the feeder 8 is achieved by a connecting rod 14 connected to the steering axle 3.

 The situation of the rectilinear train 1, 2 is shown in
15 fig. 3a. The feeder 8 has its outlets A, B towards the actuators 11, 12 closed, the direction actuators 11, 12 are, in turn, in their reference position, and the steering axle 3 too. In fig. 3b is shown the situation in which the rod 6 is rotated, through the rotation of the preceding trailer 1, according to an angle α
20 with respect to its reference position. The outlets A, B of the feeder 8 are open, so that the pressure P can be exerted at B, and the oil returning at A can flow at T. It will be understood that, should the rod 6 have been rotated in the opposite direction, point A would have received the pressure coming from
25 P, and point B would have been put in connection with the point of return T.

 An oil pressure will be exerted on the right-hand actuator 12 by the oil pressure coming from B, which will cause the steering axle 3 to rotate. Fig. 3c shows that, when the rotation
30 of the steering axle 3 has reached an β , by means of the connecting rod 14, the body of the feeder 8 has reached the angle α , which closes the outlets A, B of the feeder 8 and immobilises the steering axle 3 in this position.

 In fact, these three successive situations are nearly
35 instantaneous, and the rotation of the slide valve 7 according to an angle α is instantaneously accompanied by a rotation of

the steering axle 3 according to an angle β . Through the choice of the coupling points of the connecting rod 14 on the steering axle 3 and the body of the feeder 8 can be selected the ratio between the angles β and α , in other words the kinematic law
5 between the steering axle 3 and the feeder 8. Depending on what will have been predetermined as being favourable, for example at a single-line path of the train formed by a tractor element and several trailers 1, 2 according to the invention, a kinematic law can be selected with β smaller or larger than α .

10 The passing of oil into the feeder 8 is schematically shown by a line. In reality, the openings in the feeder are made by outlet pipes 13 of the feeder 8 and machining operations, not shown, in the cylinder forming the slide valve of the feeder 7 (see figure 4).

15 A complementary hydraulic circuit, not shown, permits, through an individualised driving, a specific guiding of the steering axles 3 and rear axle 4, for a driving in reverse motion of the train. The hydraulic connection between the slide valve 7 of the rotary feeder 8 with the steering axle 3 is then
20 de-activated, and replaced by a hydraulic circuit with individual driving. Other circuits mounted on other axles become also active, permitting to adjust, at slow speed, the rotation of each axle 3, 4 for a satisfactory driving in reverse motion of the train 1, 2.

25 Although the invention has been described with respect to particular structures, it is in no way limited to same and numerous variants are possible.

The combinations of the various embodiments shown in the drawings or described above do not depart from the framework of
30 the invention as defined in the appended claims.

The reference numerals inserted after the technical features mentioned in the claims are only intended to facilitate the understanding of the latter and do in no way limit their reach.

Claims

1. Device for controlling in rotation the steering axle
5 (3) of a trailer (1), said steering axle (3) being movable in rotation about a substantially vertical steering (10), said trailer (1) comprising a chassis (15), and being aimed at being coupled in a hinging way to a preceding trailer (2), said device comprising also a hinging means (6), fixed in a hinging way
10 about a substantially vertical axis, at one of its ends, to said preceding trailer (2), and fixed, at its other end, to a hydraulic and/or pneumatic means for controlling in rotation (7) the steering axle (3), which means (7) is movable in rotation about a substantially vertical control axis (9), characterised
15 in that it includes a mechanical means for retroaction from the steering axle (3) onto the means for controlling in rotation (7).

2. Device according to the preceding claim, wherein said hinging means (6) is a rod.

20 3. Device according to one of the preceding claims, wherein said means for controlling in rotation (7) is a slide valve (7) of a rotary feeder (8), which feeder supplies hydraulic and/or pneumatic direction actuators (11, 12) of said steering axle (3).

25 4. Device according to one of the preceding claims, wherein said retroaction means is a means capable of producing a predetermined kinematic law between the means for controlling in rotation (7) and the steering axle (3).

30 5. Device according to the preceding claim, wherein said control axis (9) is offset with respect to the steering axis (10) and said retroaction means is a connecting rod (14) connecting the steering axle (3) to the body of the rotary feeder (8), said connecting rod (14) being so arranged that it produces a rotation of said body (8) with respect to the chassis
35 (15) of the trailer (1) thus permitting, depending on the coupling points, to select a predetermined kinematic law between

the means for controlling in rotation (7) and the steering axle (3).

6. Device according to one of claims 4 or 5, wherein the angle of rotation of the steering axle (3) is smaller than the
5 angle of rotation of said slide valve (7).

7. Device according to one of claims 4 or 5, wherein the angle of rotation of the steering axle (3) is larger than the angle de rotation of said slide valve (7).

8. Trailer comprising a device for controlling in
10 rotation according to one of the preceding claims.

9. Trailer according to the preceding claim, comprising in addition a circuit for controlling in rotation the axles (3, 4) with individual driving of each axle.

10. Method for controlling in rotation a steering axle
15 (3) of a trailer (1) comprising a chassis (15) and coupled in a hinging way to a preceding trailer (2), characterised in that it comprises the following steps

- putting into rotation a hinging means (6) fixed at one of its ends in a hinging way to the preceding trailer (2)

20 - putting into rotation a means for controlling in rotation, preferably a slide valve (7) of a rotary feeder (8), produced by the rotary motion of said hinging means (6)

- putting into rotation the steering axle (3), according to the information and/or orders transmitted by said
25 means for controlling in rotation,

- retroaction from the steering axle (3) onto the means for controlling in rotation (7) permitting to interrupt the rotation of the steering axle (3) in a given position.