(54) Title: TRACTOR CAB SUSPENSIONS

(57) Abstract: A tractor cab suspension for suspending a tractor cab (10) from an associated chassis (11) is provided. Each corner of the cab (10) is supported by a fluid damper/spring unit (12, 13). The damper/spring unit (12) at each of the two front corners of the cab is connected with the chassis via a link (14) of a fixed length and which extends generally transverse relative to the chassis (11). The link (14) is pivoted at one end (14b) on the chassis and at the other end (14a) on the cab about axes which extend generally longitudinal relative to the chassis. This connection allows generally vertical movement (X) of the cab relative to the chassis but resists transverse movement of the cab relative to the chassis. A roll bar (41) acting between the cab and chassis is provided to control roll of the cab relative to the chassis.
TRACTOR CAB SUSPENSIONS

This invention relates to tractor cab suspensions which suspend the cab relative to a chassis of the tractor.

Such suspensions are well known which include a fluid damper/spring unit located at each corner of the cab. Problems arise, however, in controlling roll and transverse movement of the cab relative to the chassis.

Thus according to the present invention there is provided a tractor cab suspension for suspending a tractor cab from an associated chassis, each corner of the cab being supported by fluid damper/spring unit, the damper/spring unit at each of the two front corners of the cab being connected with the chassis via a link of a fixed length and which extends generally transverse relative to the chassis and is pivoted at one end on the chassis and at the other end on the cab about axes which extend generally longitudinal relative to the chassis to allow generally vertical movement of the cab relative to the chassis but resist transverse movement of the cab relative to the chassis, and a roll bar acting between the cab and chassis to control roll of the cab relative to the chassis.

Such a cab suspension provides improve control of transverse movement and roll of the cab relative to the chassis.

Limiting means are preferably provided to limit the range of pivoting movement of the link. The limiting means may comprise a longitudinally extending pin which is slidably engaged within a guide slot. In a preferred arrangement the guide slot is provided by an arcuate cut out in an extension of the link and the pin is held relative to the chassis. Advantageously, by forming the guide slot integrally with the link, the number of components required is reduced.

The damper/spring unit at each of the two rear corners of the cab are preferably connected with the cab via a support arm which has a single degree of freedom in the vertical direction. Limiting means may be provided to limit the range of vertical movement of the support arm. For example, the rear limiting means may include a vertically extending slot formed in the
support arm and a longitudinally extending pin held relative to the chassis which is slidably engaged within said slot.

The fluid damper of each damper/spring unit may act through a fixed damping orifice to provide passive damping of the cab relative to the chassis.

Alternatively, the fluid damper of each damper/spring unit may act through a variable damping orifice, the size of the damping orifice being varied in response to the variation of one or more tractor operating parameters to provide semi-active damping of the cab relative to the chassis.

Each damper preferably includes a piston moveable in a chamber with damping being achieved by movement of fluid from one side of the piston to the other via the orifice.

In such a damper fluid is supplied to and exhausted from either side of the piston of each fluid damper via a solenoid operated fluid flow control valve to adjust the height of the cab relative to the chassis.

One or more height sensors may be provided which provide an indication of the height of the cab relative to the chassis to a control unit, the control unit controlling the operation of the solenoid operated fluid flow control valves to maintain a specified cab height relative to the chassis.

The tractor operating parameters in response to which the size of the damping orifice may be varied may include one or more of the following namely cab position relative to the chassis, vehicle speed, brake application, throttle position and gear selected.

Preferably the roll bar comprises a pair of arms which extend generally longitudinally relative to the chassis, the arms being pivoted at their first ends on the chassis about axes generally transverse to the chassis and rigidly connected at their second ends by an torsion bar which extends generally transverse relative to the chassis, the torsion bar also being pivotally connected with the cab for pivoting about its longitudinal axis so that any tendency of the cab to roll relative to the chassis loads the torsion bar in torsion.
The present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

- Figure 1 shows a perspective view of a tractor cab suspension in accordance with the present invention;

- Figure 2 shows a perspective view of the damper/spring unit and roll bar configuration of the system of Figure 1;

- Figure 3 shows a perspective view of one of the rear damper/spring units of the system of Figure 1;

- Figure 4 shows a side view, partly in section of the roll bar mounting of the system of Figure 1;

- Figure 5 shows a perspective view from beneath of part of the suspension system again showing the roll bar mounting arrangements, and

- Figure 6 shows diagrammatically a passive fluid damping a spring circuit suitable for use in a tractor cab suspension in accordance with the present invention.

Referring to the drawings, a cab 10 is suspended from a tractor chassis 11 by two front damper/spring units 12 and two rear damper/spring units 13.

Each front damper/spring unit 13 acts on the outer end 14a of a link 14 whose inner end 14b is mounted on the chassis 11 via rubber bush 15 carried on a bolt 16 which extends through mounting ears 17 formed integrally on the chassis.
Each front damper/spring unit is itself mounted on the chassis via a support bracket 18 which is bolted at 19 to the chassis. The front damping/spring unit 12 is connected with the link 14 by a bolt 20 which passes through a rubber bush (not visible) in an aperture in the link 14.

The outer end 14a of each link 14 is connected with the cab via a mounting disc arrangement 21 which is described and claimed in the Applicant’s co-pending UK patent application number GB0803998.4 and will not therefore be described herein in detail. The mounting disc arrangement 21 is secured to the end 14a of link 14 by a bolt 22 which extends through a rubber bush (not visible) again mounted in an aperture of the end 14a of link 14.

As can be seen from Figure 2, the disc mounting arrangement 21 has an upper cone shaped portion 23 which is received in a cooperating cone shaped socket provided in a component secured to the under surface of the front corner of the cab with the cone 23 and socket being held in contact with each other by bolts 24 when the cab is mounted on the chassis.

As can be seen clearly from Figure 2, as the cab 10 moves up and down, as indicated by the arrow X, the links 14 each pivot about their mounting bolts 16 which extend generally in the fore and aft direction relative to the tractor chassis. This pivoting of each link 14 is indicated by the arrows Y and is limited by a pin 25 which extends through an arcuate cut out 26 in an extension 27 of each link 14. The vertical movement of the cab at each front corner is therefore limited and the transverse movement of the front corners of the cab relative to the chassis is controlled by the links 14 which themselves extend generally transversely. As will be described below, the pivoting of the links 14 is controlled by the front damper/spring units 12.

Turning now to the rear mounting of the cab, the rear damping/spring units 13 are mounted on the back axle 28 of the chassis by mounting brackets 29 by bolts 30. Each damping unit 13 is connected with a cab support arm 31 by a bolt 32 which extends through a rubber bush bracket (not visible) provided in a block 33 on the lower end 31 of each arm. The upper end 31b of each arm 31 is provided with a generally fore and aft extending projection 34 which is received in a socket 35 provided in the lower portion of each rear corner of the cab the connection 34 being held in the socket 35 by bolts 36.
Also mounted on the rear axle is a further support bracket 37 which is secured thereto by bolts 38. The bracket 37 carries a pin 39 which extends through a generally vertically extending slot 40 formed in the arm 31 to limit the vertical oscillation of the rear corners of the cab.

Also mounted on the brackets 37 is a roll bar 41 which comprises a pair of generally longitudinally extending arms 42 whose rear ends 42a are mounted on the upper ends of brackets 37 by bolts 43 which extend through rubber bushes (not visible) provided in the rear ends 42a and through mounting ears 37a provided on the brackets. The front ends 42b of the arms 42 are non-rotatably connected with a generally transversely extending torsion bar 44 so that any tendency of the arms 42 to move in a non-parallel manner about the longitudinal axis Z of the torsion bar 44 results in the torsion bar 44 being loaded in torsion.

As best seen in Figures 2 and 4, the front ends 42b of the arms 42 are pivotally mounted on the underside of the cab 10 by clamping shells 45 which are bolted to generally rearwardly extending flanges 46 provided on the underside of the cab.

Thus, as will be appreciated, any tendency for the cab to roll relative to the chassis as indicated by the arrow R on Figure 2, will result in the vertical height of the forward end 42b of one of the links 42 varying from the vertical height of the forward end of the other link thus tending to place the torsion bar 44 in torsion.

The vertical movement of the rear corners of the cab is damped by the rear damping/spring units 13 as will be described below.

We have seen from the above that the use of the generally transversely extending mounting links 14 at the front corners of the cab controls the transverse movement of the cab relative to the chassis and the use of the roll bar 41 controls the roll of the cab relative to the chassis. The movement of both the front and rear corners of the cab is additionally controlled by the damping/spring characteristics of the front and rear units 12 and 13.

As is conventional in a damper/spring unit used to support a tractor cab, each unit 12,13 (see Figure 6) includes a piston 50 moveable in a cylinder 51 with the damping effect being achieved by the movement of fluid (hydraulic fluid or air) from one side of the piston to the
other via a damping orifice 52. The spring effect is achieved by the fluid trapped in the
cylinder 51 below the piston 50 in a chamber 53 which is connected with an accumulator 54.
The piston is connected with the cab mounting arrangement via a piston rod 55. In the
arrangement shown diagrammatically in Figure 6, each unit 12, 13 is connected with a
centralised control system 56 which is supplied with pressurised fluid as indicated by the
arrow P and which returns surplus fluid to an associated storage tank as indicated by the
arrow T. The centralised control system includes various hydraulic valves which both control
the pressure within the various parts of the system and also allow the chambers 53 of the
damper units 12 and 13 to have further fluid supplied thereto or to have fluid removed there
from in order to adjust the support height at each corner of the cab. The cab suspension
system is provided with cab height sensors 57 which act as inputs into an electronic control
circuit 58 which forms part of the control system 56 in order to enable a desired cab height to
be maintained. For example, typically the left hand front damping spring unit 12 and the rear
right hand damping unit 13 will be provided with such cab height sensors 57 to enable the cab
right height to be controlled. If desired, each damper unit 12, 13 could be provided with its
own sensor to provide height inputs signals into the centralized control system 56.

As will be appreciated, the ride height control system can be used to maintain the cab in a
generally horizontal attitude at a ride height relative to the chassis which is determined by the
tractor operator. This right height will be adjusted by the admission or release of fluid from
the appropriate chambers 53 of the dampers 12, 13.

If desired, the ride height control system could be used to arrange for one side of the cab to be
higher than the other side when the tractor is in use. Such an arrangement is useful when the
cab is being driven across a steeply sloping hill or when the tractor is ploughing when the
wheels on one side of the tractor will be in furrow and thus significantly lower than the other
wheels of the cab.

Also, as will be appreciated, the above described fluid control system which is shown in
Figure 6 is a passive damping system in which the size of the damping orifices 52 does not
vary. If desired, the system can be made semi-active by arranging for the size of the orifices
52 to be varied dependant on specified operating parameters of the tractor such as, for
example, the cab position relative to the chassis, the tractor speed, the application of the
brakes, the throttle position and the gear ratio selected in the tractor gearbox. These parameters are measured or sensed by appropriate sensors and the resulting values fed as inputs to a more complex form of control circuit 58. The electronic control circuit then controls the size of the damping orifices 52 and the quantity of fluid in the chambers 53 of the dampers 12, 13 in accordance with specified control algorithms.

Since the precise details of the passive or semi-active damping system do not form part of the present invention they will not be described in any further detail herein.

From reading the present disclosure, other modification will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the field of tractor cab suspensions and component parts therefore and which may be used instead of or in addition to features already described herein.
CLAIMS

1. A tractor cab suspension for suspending a tractor cab from an associated chassis, each corner of the cab being supported by fluid damper/spring unit, the damper/spring unit at each of the two front corners of the cab being connected with the chassis via a link of a fixed length and which extends generally transverse relative to the chassis and is pivoted at one end on the chassis and at the other end on the cab about axes which extend generally longitudinal relative to the chassis to allow generally vertical movement of the cab relative to the chassis but resist transverse movement of the cab relative to the chassis, and a roll bar acting between the cab and chassis to control roll of the cab relative to the chassis.

2. A suspension according to Claim 1, wherein limiting means are provided to limit the range of pivoting movement of the link.

3. A suspension according to Claim 2, wherein the limiting means comprises a longitudinally extending pin which is slidably engaged within a guide slot.

4. A suspension according to Claim 3, wherein the guide slot is provided by an arcuate cut out in an extension of the link and the pin is held relative to the chassis.

5. A suspension according to any preceding claim, wherein the damper/spring unit at each of the two rear corners of the cab is connected with the cab via a support arm which has a single degree of freedom in the vertical direction.

6. A suspension according to Claim 5, further comprising rear limiting means to limit the range of vertical movement of the support arm.

7. A suspension according to Claim 6, wherein the rear limiting means includes a vertically extending slot formed in the support arm and a longitudinally extending pin held relative to the chassis which is slidably engaged within said slot.
8. A suspension according to any preceding claim, in which the fluid damper of each damper/spring unit acts through a fixed damping orifice to provide passive damping of the cab relative to the chassis.

9. A suspension according to any one of Claims 1 to 7, in which the fluid damper of each damper/spring unit acts through a variable damping orifice, the size of the damping orifice being varied in response to the variation of one or more tractor operating parameters to provide semi-active damping of the cab relative to the chassis.

10. A suspension according to Claim 8 or 9 in which each fluid damper includes a piston movable in a chamber with damping being achieved by movement of fluid from one side of the piston to the other via the orifice.

11. A suspension according to Claim 10 in which fluid can be supplied to and exhausted from either side of the piston of each fluid damper via a solenoid operated fluid flow control valve to adjust the height of the cab relative to the chassis.

12. A suspension according to Claim 11 in which one or more height sensors are provided which provide an indication of the height of the cab relative to the chassis to a control unit, the control unit controlling the operation of the solenoid operated fluid flow control valves to maintain a specified cab height relative to the chassis.

13. A suspension according to Claim 9 in which said one or more tractor operating parameters include on or more of the following namely cab position relative to the chassis, vehicle speed, brake application, throttle position and gear selected.

14. A suspension according to any preceding claim, in which the roll bar comprises a pair of arms which extend generally longitudinally relative to the chassis, the arms being pivoted at their first ends on the chassis about axes generally transverse to the chassis and rigidly connected at their second ends by an torsion bar which extends generally transverse relative to the chassis, the torsion bar also being pivotally connected with the cab for pivoting about its longitudinal axis so that any tendency of the cab to roll relative to the chassis loads the torsion bar in torsion.
15. A tractor cab suspension constructed and arranged substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

**INV. B62D33/06**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search: **8 July 2009**

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