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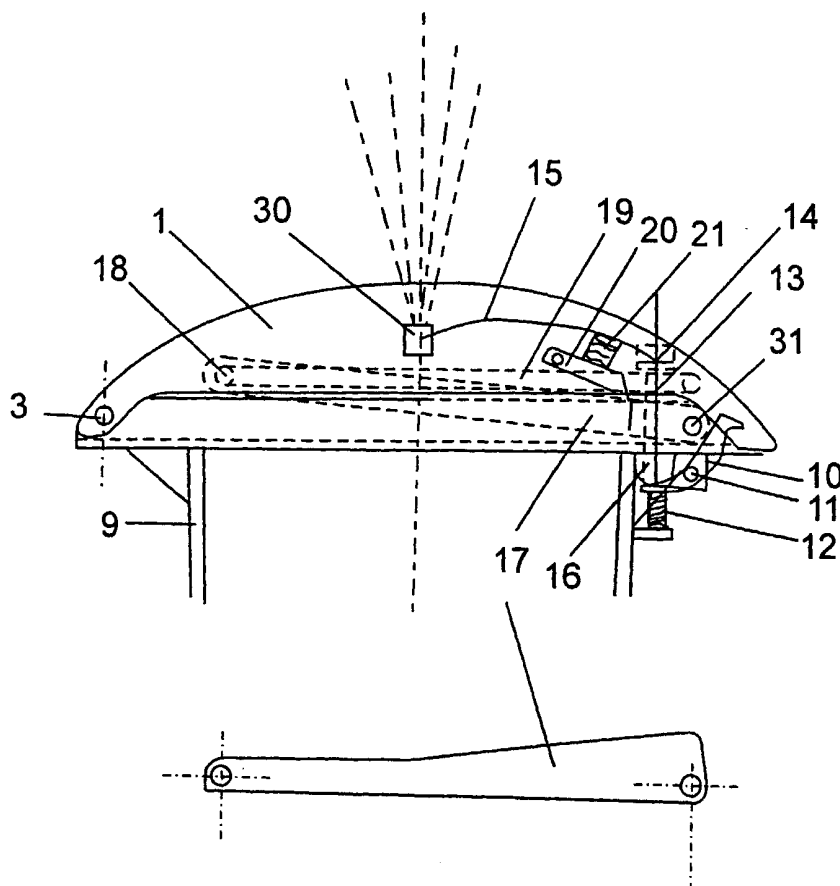
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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(54) Title: COLLISION SAFETY DEVICE FOR VEHICLES



(57) Abstract: Device for motor vehicles designed to prevent traffic accidents or to reduce their injurious consequences. The extent of injuries in traffic accidents can be reduced significantly by employing the vehicle bumper (1) as a crumple (deformation) zone. A sensor (2) is used to record this distance from and speed relative to an obstacle in the direction of travel. When a collision is unavoidable, one end of the bumper (1) is projected outward by a propellant charge (13) so that, together with a strut (17, 22, 24), it forms a crumple zone ahead of the vehicle. The device can also be provided with a system to warn of dangerous traffic situations, and to brake the vehicle automatically or reduce its speed if the risk of a collision exists. In the case of trucks and buses, the bumper (1) may be deployed by means of a pneumatic cylinder (4) and valve (7), which are controlled by the vehicle's ordinary speedometer. The bumper remains depolyed above a certain threshold speed.



WO 01/10683 A1

Collision safety device for vehicles.

5 The present invention relates to a device to prevent or reduce the effects of traffic collisions of various types.

Background to invention

10 In Sweden alone, 500 to 600 people are killed and about 4,000 injured in traffic accidents every year. Worldwide, the number of annual fatalities is almost one million. In no other activity does society tolerate such an enormous rate of death and injury. Compared with air travel, the risk of being injured in a road traffic accident is 500 times higher.

15 The total cost to the community of traffic accidents in Sweden alone exceeds SEK20 billion per year.

20 The desire and necessity of reducing the number of traffic accidents and their effects is particularly high all over the world. Road networks are being expanded and improved continuously to achieve this goal. Vehicles have also been improved in various ways, for example by the provision of seat belts, driver and passenger airbags, side airbags and seat belt pretensioners. The design of the front end of a vehicle is now such that a crumple (deformation) zone is provided to absorb the kinetic energy of the collision
25 with an oncoming vehicle or other traffic obstacle, thereby lessening the stresses on the driver and passengers.

30 Patents for several types of extendable bumper designed to reduce retardation in a collision have been sought in recent years. However, none of these inventions has been adopted in practice, probably because they are complex, heavy and expensive, and because they rely on hydraulic operation, which does not provide the requisite speed of deployment.

Purpose and most important characteristics of invention

The purposes of the present invention are, firstly, to provide a crumple zone which is sufficiently long to prevent or reduce vehicle damage and injury to the vehicle and its occupants in frontal collisions of various types and, secondly, to provide a deflecting action such that the vehicles are displaced laterally in a collision in which only a small part of the vehicle fronts collide, or in a collision with a tree, post or similar obstacle at the side of the road.

The invention is also designed to reduce the risk of injury and damage in lateral and rear-end collisions. The invention also has a beneficial effect in collisions with pedestrians, cyclists and wild animals.

The invention can also make the driver aware of a traffic obstacle in sufficient time to brake or take evasive action (cf. the collision warning indicator in an aircraft). It can also be used to operate the vehicle brakes if a collision is unavoidable (this feature should be used only on vehicles with anti-lock brakes), to warn the driver if his vehicle is too close to the vehicle in front and to deliver a warning if driving without seat belts above a certain speed.

The invention can be used on vehicles of all types, including trucks, buses, minibuses and cars. It can also be used in both left and right-hand drive traffic, although mirror-image versions must be made to suit each application. The collision protection can also be made convertible so that adjustment of the function from left to right-hand drive traffic, and vice versa, can be performed manually.

It is particularly important to equip heavy vehicles with this invention in view of the fact that a collision between a car and a heavy vehicle is almost invariably disastrous for the smaller vehicle. As a result, the collision protection should always be designed for collision with a car. To ensure that the invention affords maximum protection, international agreement is needed to standardise the height of the bumper above the road on all types of vehicle.

Principle of operation

Extension of the crumple zone is achieved by mounting one end of the bumper, which is designed for the purpose, in a pivoted manner on the left front end of the vehicle for right-hand traffic (or on the right front end for left-hand traffic) by means of a vertical pin, the other end of the bumper being secured by a disengagable latch. If a collision is imminent, the right-hand side of the bumper (or the left-hand side as appropriate) will be projected forward so that the bumper, together with a strut which locks it in the extended position, will assume the shape of a snow plough. The strut may take different forms.

Deployment is initiated by means of an instrument consisting of a sensor and a computing device mounted on the bumper or, alternatively, inside the vehicle windscreen to keep the sensor optics clean. The purpose of the sensor, which may be of the laser, radar or infrared (IR) type, is to detect and register obstacles in the direction of travel, and to record the vehicle's speed relative to and distance from the obstacle. The sensor may be linked to the steering system so that it also follows the vehicle's direction of travel when cornering.

When an obstacle appears at a distance approaching the vehicle's stopping distance, the computing device shall provide the driver with a warning signal which may be either optical and/or acoustic. The optical signal can be projected onto the windscreen in the lower part of the driver's field of vision, allowing him or her to brake the vehicle or take evasive action. The warning system is particularly valuable in darkness and fog, and is designed especially for drivers with impaired reactions, such as those affected by alcohol, drugs or medicines, drivers who have fallen asleep, and older drivers with impaired vision and hearing. Drivers who take excessive risks in traffic due to inattention or poor driving behaviour will also receive a warning from the system.

Integrating a signal from the seat belts in the warning system will provide a warning signal for that function also. The warning system may, in future, also be interlinked with speed information supplied to the driver. However, this assumes that speed limit signs will be equipped with electronic transmitters which send the information to the driver by wireless transmission.

If the driver neglects to reduce speed in spite of the warning signals, the system may take over the driver's role and reduce the speed of the vehicle until the warning signal ceases.

The computing device receives a signal from the vehicle's own speedometer to enable it to compute the stopping distance. Since the stopping distance is dependent, firstly, on the driver's reaction time and, secondly, on the road surface conditions, provision should be made for entering different surface conditions manually. The driver's reaction time may be a single, constant value or may be a separate value for each driver.

If the vehicle continues towards an unavoidable collision despite the warning system, the sensor will initiate deployment of the bumper. This will take place only a short distance before the collision actually occurs and when the speed of the vehicle relative to the obstacle exceeds a certain threshold value. As a result, deployment must take place within a very short time. This is achieved by means of a propellant charge, which is ignited by an electrical igniter connected to the sensor through the computing device. The charge, which may be of the same type as the seat ejector cartridge used in combat aircraft, or may consist of some type of combustible gas, propels the free end of the bumper forward with high force after the latch has been disengaged.

The bumper, and the strut which locks it in the deployed position, then form the desired crumple zone, while also acting as a deflector in a collision with an obstacle which impacts only a small section of the vehicle front.

In a total frontal collision at high speed, the bumper and strut will be deformed, absorbing the kinetic energy of the vehicles so that the retardation is limited to an acceptable value.

To improve protection for cyclists, pedestrians and wild animals, all or part of the vehicle front, particularly the radiator grille, may be mounted on the bumper and carried with it.

Protection for the aforementioned road user categories may be further improved by deploying a special type of air cushion along the entire length of the bumper. This is designed, when inflated, to form a curtain in the form of an air mattress in front of the bumper-mounted grille. In this case also, inflation is initiated by the computing device so that it takes place at an instant related to the collision speed.

On vehicles with anti-lock brakes, the signal from the computing device may also be used to apply the brakes immediately before the instant of impact. Since this eliminates the driver's reaction time, the brakes are applied for longer and the collision speed is reduced.

A simpler variant of the collision protection may be used on trucks and buses. In this case, the protection may be deployed with the aid of a double-acting pneumatic cylinder instead of a propellant charge. The protection will remain deployed while the vehicle is travelling at a speed in excess of the preset threshold value. The device does not interfere with the handling of the vehicle.

The protection is retracted and no longer adds to the length of the vehicle when the speed falls below the threshold value.

A valve controlled by electrical signals from the vehicle's speedometer is used to control the compressed air supply from the vehicle's ordinary compressed air system, to ensure that the protection is deployed at the correct speed. Since the optronic sensor and propellant charge are not required, this version of the system is considerably simpler, cheaper and more reliable.

List of drawings

Fig. 1 is a side view of a truck with the collision protection in the retracted position.

Fig. 2 is a plan view of a car and a truck immediately prior to collision.

Fig. 3 is a plan view of the collision protection in the retracted position.

Fig. 4 is a plan view of the collision protection in the deployed position.

Fig. 5 shows an alternative design of strut.

Fig. 6 shows the pneumatically operated version of the collision protection in the retracted position.

Fig. 7 shows the pneumatically operated version of the collision protection in the deployed position.

Fig. 8 is a side view of a truck with the collision protection deployed.

Fig. 9 is a plan view of a car and a truck immediately prior to collision.

List of components

1. Bumper and collision protection

2A. Sensor, with computing device (30) mounted on bumper

2B. Sensor mounted inside windscreen

3. Vertical pin

4. Compressed air cylinder

5. Piston rod

6. King pin

7. Compressed air valve

8. Roller

9. Vehicle chassis

10. Latch

11. Pin

12. Spring

13. Propellant charge

14. Electrical igniter

15. Cable between electrical igniter and computing device

16. Sleeve

- 17. Strut
- 18. Vertical bolt
- 19. Longitudinal channel in bumper
- 20. Latch
- 5 21. Spring
- 22. Strut, rear section
- 23. Viscous medium
- 24. Strut, front section
- 25. Fixed restrictor
- 10 26. Sealing diaphragm

- 27. Radiator grille mounted on bumper
- 28. Air cushion
- 29. Channel for non-deployed air cushion
- 15 30. Computing device, integrated with sensor (2)

Typical embodiment

Fig. 1 shows the front section of a truck equipped with collision protection (1) and a
20 sensor (2), with a computing device (30) to record relative speeds and distances in the
direction of travel.

The sensor is manufactured in accordance with known technology and is adapted for
this particular application. When the distance between the vehicle and an obstacle
25 exceeds a certain threshold value, the sensor triggers the propellant charge (13) by
means of an electrical igniter (14) connected to the computing device (30) by the cable
(15).

This causes one end of the bumper (1) to be projected forward about the vertical pin (3),
30 which is supported by a bearing in the vehicle chassis (9). The right-hand end of the
strut (17) pivots about a second vertical pin (3'), which is supported by a bearing in the
vehicle chassis (9). At the left-hand end, the strut (17) is attached to the bumper (1) by
the vertical bolt (18), which may be provided with a roller (8).

The latch (10) for the bumper (1) is released at the same instant that the propellant charge (13) is ignited, the sleeve (16), which partially encloses the charge, being pushed backward to disengage the latch (10).

5 Fig. 3 shows the strut (17) and bumper in the retracted position. Fig. 4 shows the collision protection in the deployed position, mounted on a vehicle chassis.

10 When the right-hand side of the bumper (1) is projected forward, the left-hand end of the strut (17), carrying the bolt (18), slides along a channel (19) in the bumper (1) until its movement is terminated by the channel length. The strut (17) is locked in this position by the latch (20) and spring (21).

15 Fig. 5 shows an alternative design of strut (17) with hydraulic energy absorption. In this version, the strut consists of two telescopic sections. The hollow space in the rear section (22) is filled with a viscous medium (23). The front section is provided with a fixed restrictor (25) and sealing diaphragm (26), the purpose of which is to prevent the liquid medium (23) from flowing into the front section (24).

20 This version of the strut is deployed in the same manner as in the alternative described previously. However, at the instant of collision, when a severe load is imposed on the bumper (1), the two sections are forced together, subjecting the viscous medium (23) to an extremely high pressure and bursting the sealing diaphragm (26), so that the medium (23) in the rear section flows through the restrictor into the front section (24). This produces a controlled braking action, which also varies automatically depending on the collision speed. The higher the speed, the greater the resistance offered by the strut, which is precisely the effect sought. At low collision speeds, this enables the strut to absorb the entire kinetic energy of the vehicles without deformation.

30 The strut sections (22 and 24) may be square, rectangular or circular in section, and may be duplicated to increase the resistance. In this case, only the rear sections (22) are rigidly attached to each other, the front sections (24) being connected through the bolt (18).

In both alternatives, the bumper and strut are designed in such manner that they can absorb, while undergoing deformation, the kinetic energy of a light vehicle (a medium-class car) in a collision at a speed which is average for collisions of different types.

5 Figs. 6 and 7 show a simpler variant of the collision protection, which is suitable for use on trucks and buses.

10 In this case, the bumper (1) is deployed by a double-acting compressed air cylinder (4), whose piston rod (5) actuates the strut (17) and, as a result, the bumper (1). The air supply to the cylinder (4) is controlled by a valve (5) which, in turn, is controlled by an electrical signal from the vehicle speedometer. The compressed air is taken from the vehicle's ordinary compressed air system.

15 Deployment occurs at a specific, preset, threshold speed. When the speed falls below this value, the piston rod (5) is pulled inward and the bumper (1) is returned to the retracted position, in which it does not add to the vehicle length.

20 Fig. 8, which is a side view of the collision protection (bumper) in the deployed position on a truck, also shows the radiator grille (27) mounted on the bumper, as well an inflated air cushion in front of the grille. In the non-deployed position, the air cushion is seated in a channel (29) in the bumper (1).

25 Fig. 9 shows a truck with the collision protection (bumper) deployed, as well as the car, also with the collision protection deployed, immediately prior to collision. The overlap between the vehicles is 40%, which is the mean value derived from a number of studies of frontal collisions in right-hand traffic.

Patent claims

1. Device for motor vehicles designed to prevent serious traffic accidents and to reduce the injurious consequences of accidents which do occur. The state of the art of the technology has already been described under the heading of **Background to invention** on page 1.

The present invention is

c h a r a c t e r i s e d i n t h a t

the vehicle's ordinary bumper (1), modified for the purpose, is projected forward at one end by a propellant charge (13) immediately prior to collision with an obstacle. The bumper is locked in the deployed position by a strut (17) which, together with the bumper (1), forms a crumple zone which is sufficiently long to prevent or reduce damage to the vehicle and injury to its occupants in frontal collisions. The bumper is further designed to provide a deflecting action so that the vehicles are displaced sideways in collisions in which only a small part of the each vehicle front impacts the other, or in a collisions with trees, posts and similar obstacles at the side of the road.

The propellant charge (13) is triggered by the electrical igniter (14), which receives a current impulse from the sensor (2) through the computing device (30). The computing device may be mounted in alternative locations, for example on the bumper (1) or inside the windscreen. The sensor, which may employ either laser, radar or infrared (IR) technology, is based on known technology but is designed for this specific application. The sensor is connected to the computing device (30), which may be installed in an optional location in the vehicle.

The sensor (2) records the speed of the vehicle and its distance from the obstacle in the direction of travel. When the distance decreases to a certain limiting value and the speed of the vehicle relative to the obstacle exceeds a certain threshold value, the sensor (2) triggers the electrical igniter (14) and propellant charge (13) through the computing device (30). The gas pressure actuates the sleeve (16) to release the latch (10), whereupon one end of the bumper is projected forward in the direction of travel, also under the action of the gas pressure generated by the propellant charge (13). The

bumper (1) pivots about the vertical pin (3), which is supported by a bearing in the vehicle chassis.

The left-hand end of the strut (17) is moved forward by the movement of the bolt (18) in the channel (19) and is locked in this position by the latch (20).

2. Device as per patent claim 1,

characterised in that

the sensor (2) is interlinked with the vehicle speedometer through the computing device (30) so that the computing device can compute the braking distance at different speeds, enabling the driver to be provided with a warning of the distance from an obstacle or warned if the distance from a vehicle in front is approaching the stopping distance of his own vehicle. The warning signal may be acoustic and/or optical. The optical signal can be projected onto the windscreen at the lower edge of the drivers field of vision. If the driver fails to reduce speed, the computing device will automatically reduce the speed to an approved value.

3. Device as per patent claims 1 and 2,

characterised in that

the warning system as per patent claim 2 is integrated with the seat belt warning system so that a warning signal as per patent claim 2 is received if the seat belts are not fastened when the vehicle reaches a certain threshold speed.

4. Device as per patent claim 1,

characterised in that

the signal for triggering the electrical igniter also acts on the braking system so that the brakes are applied simultaneously with, or immediately before the collision protection is deployed.

5. Device as per patent claim 1,

characterised in that

the radiator grille (27) of the vehicle is mounted on the bumper (1) and is carried with it when the bumper (1) is deployed.

6. Device as per patent claim 1,

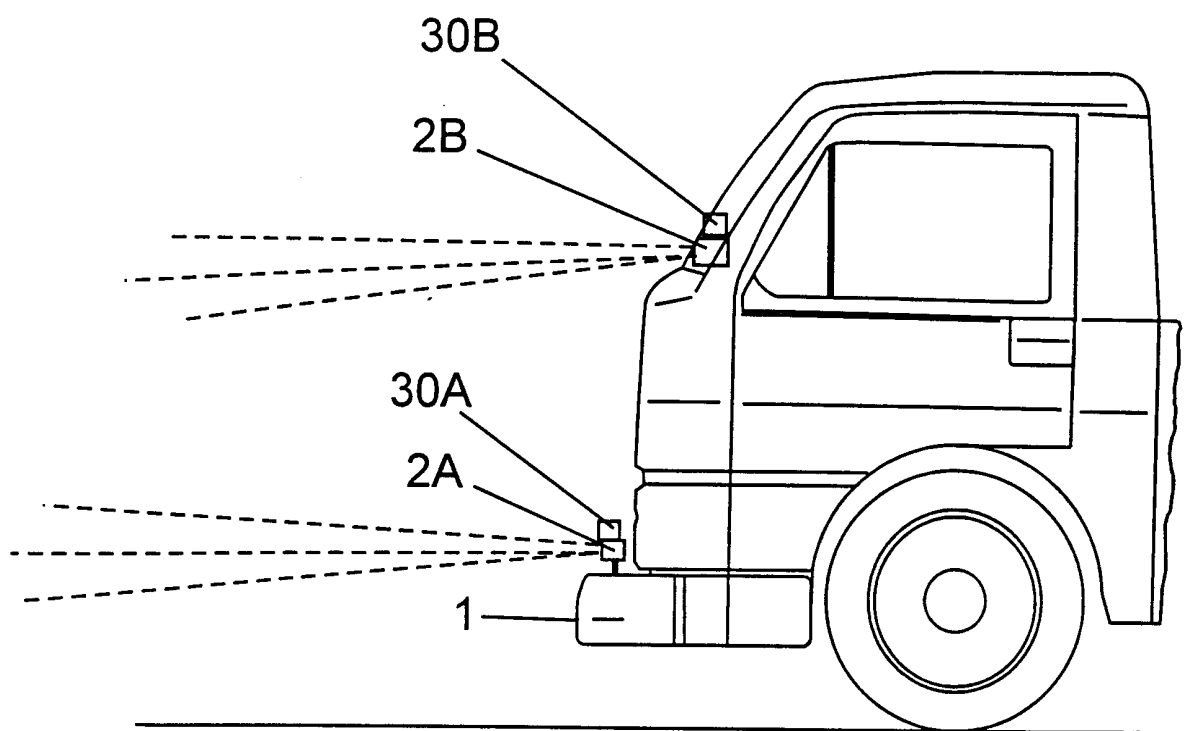
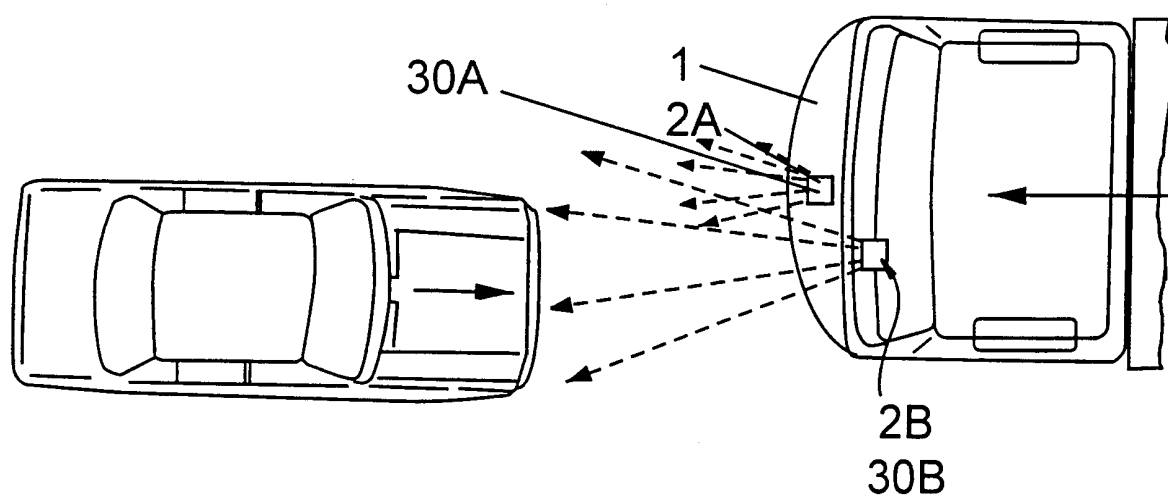
c h a r a c t e r i s e d i n t h a t

an air cushion (28) is seated in a channel (29) in the bumper (1) and is inflated in front
of the radiator grille (27) mounted on the bumper (1) at an instant related to the collision
5 speed. Inflation is initiated by the computing device (30).

7. Device as per patent claim 1,

c h a r a c t e r i s e d i n t h a t

deployment and retraction of the collision protection (1) on trucks and buses are
10 performed by a pneumatic cylinder (4), instead of a propellant charge, when the speed
of the vehicle reaches a certain threshold value. Deployment and retraction are
controlled by an electrical signal from the vehicle's ordinary speedometer, which
operates a solenoid valve (7).

*Fig. 1**Fig. 2*

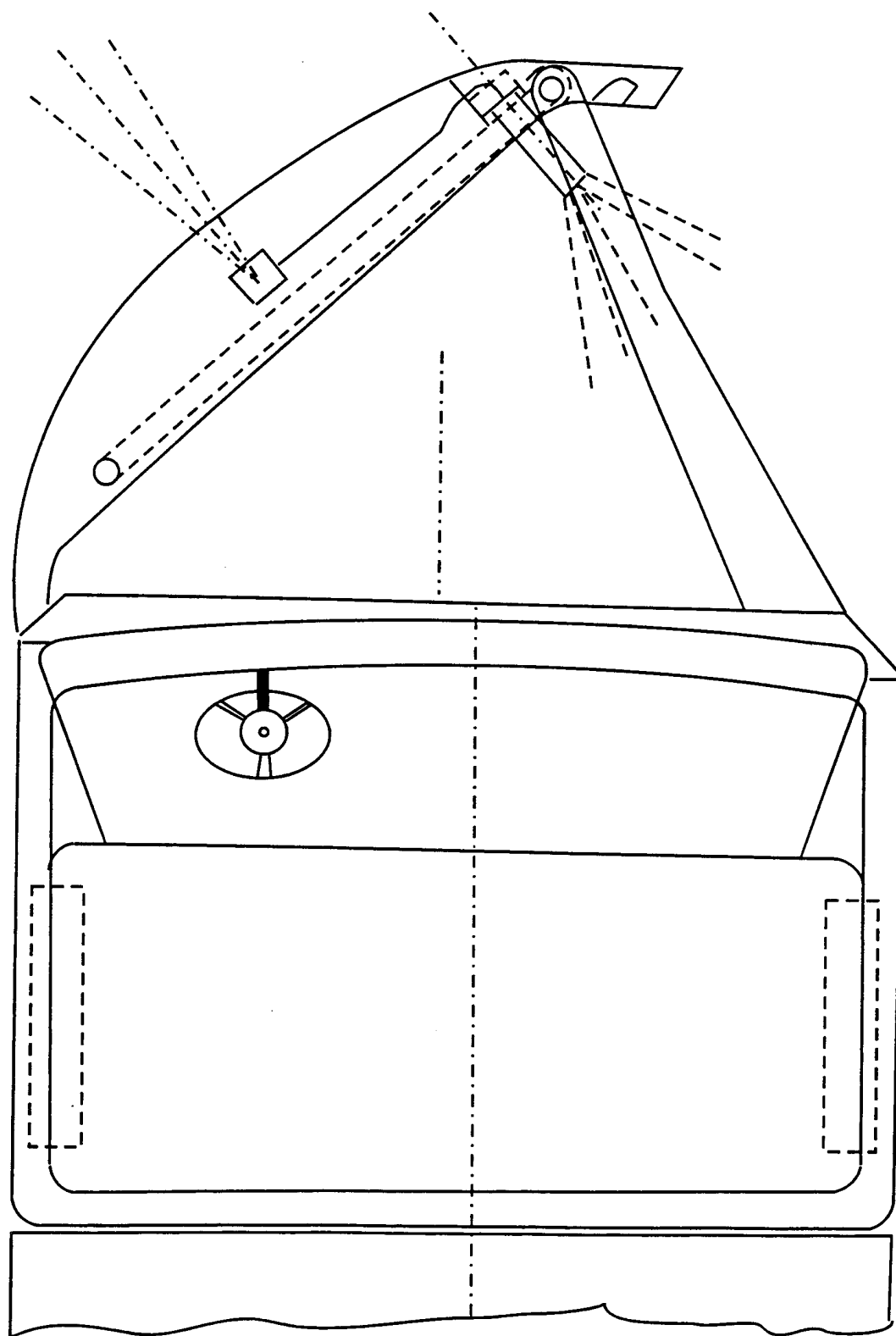


Fig. 4

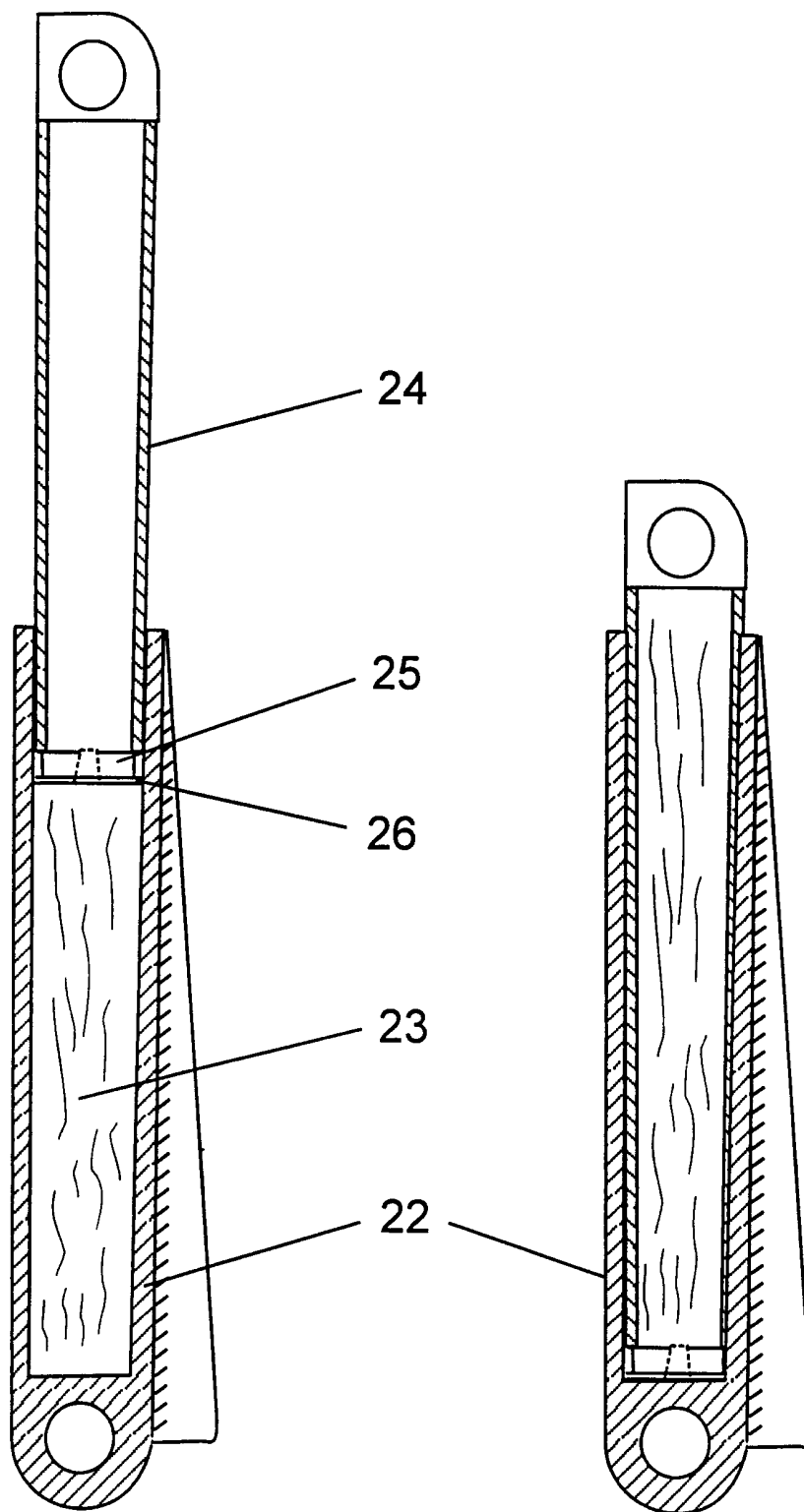
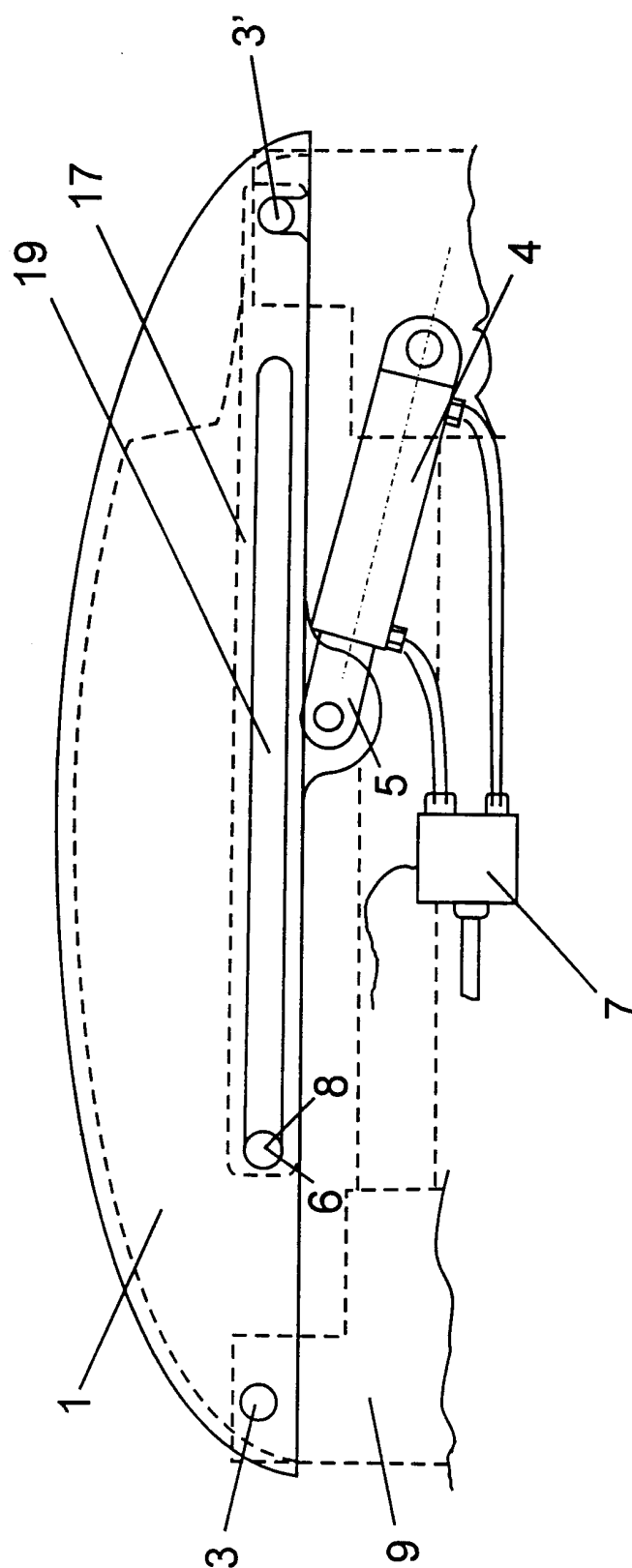
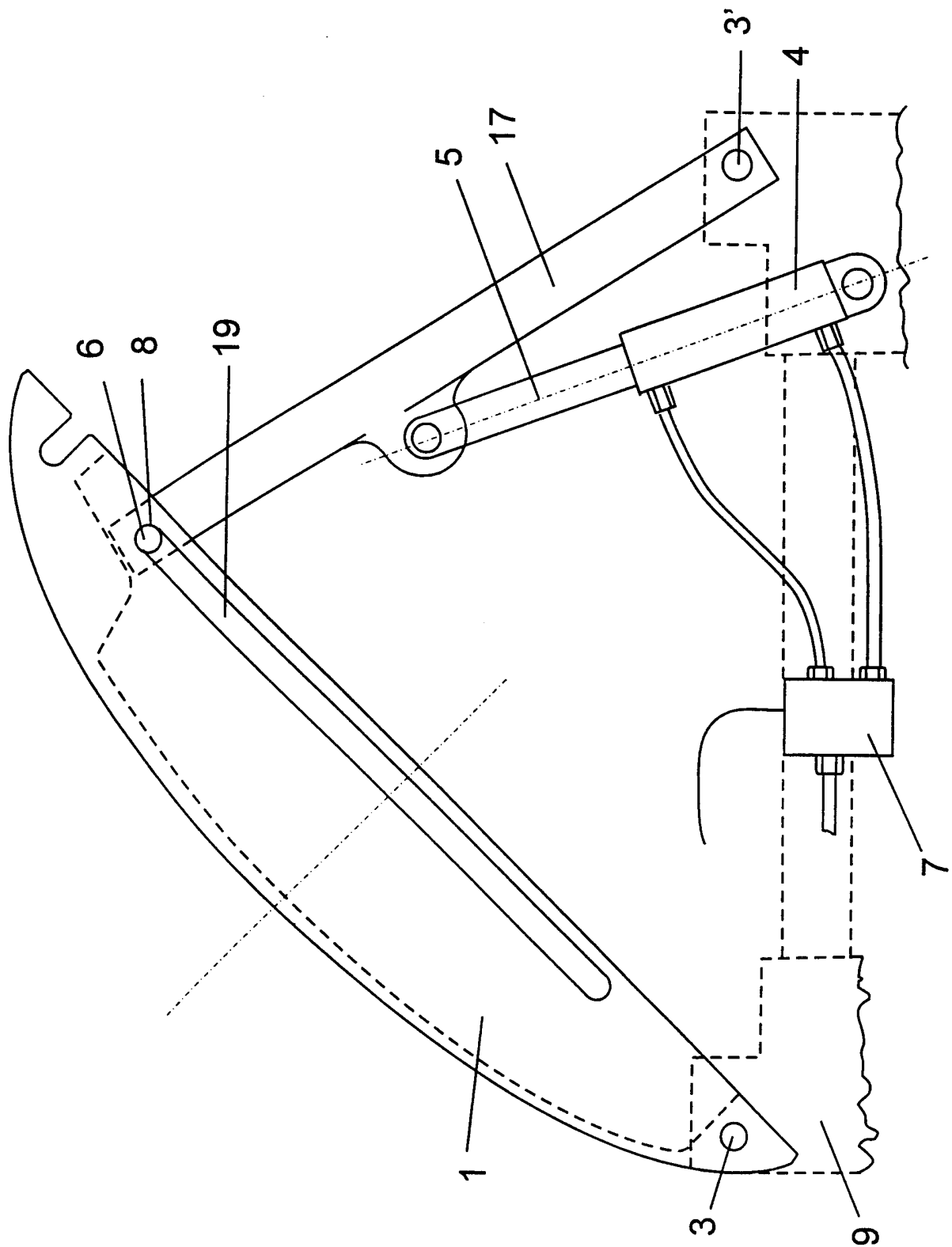


Fig. 5

**Fig. 6**

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**Fig. 7**

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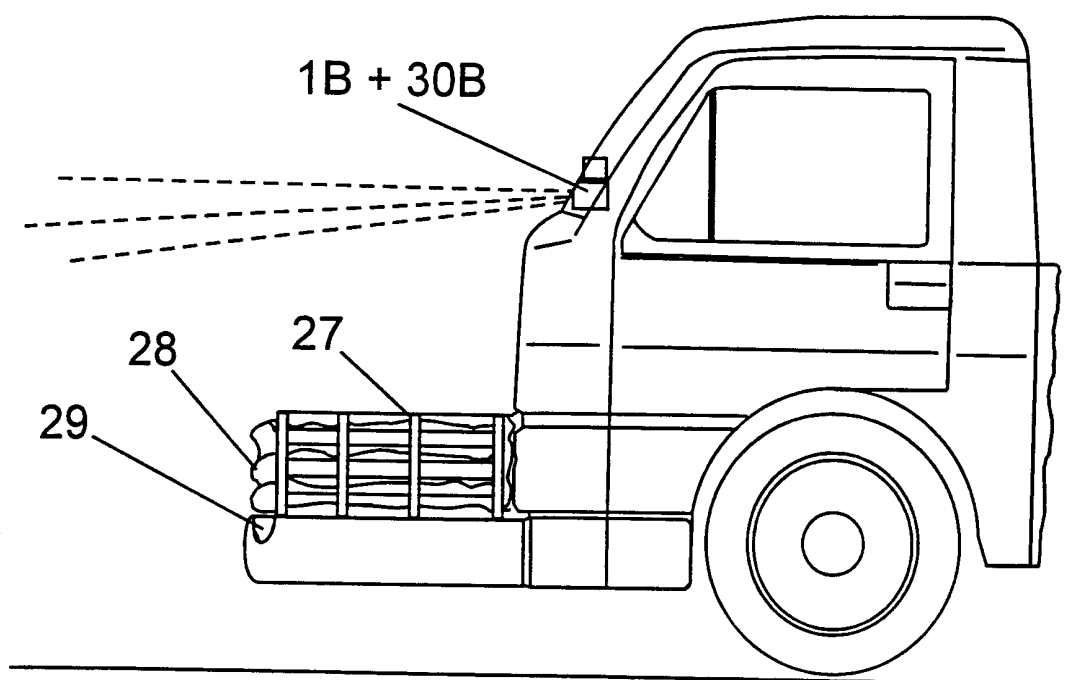
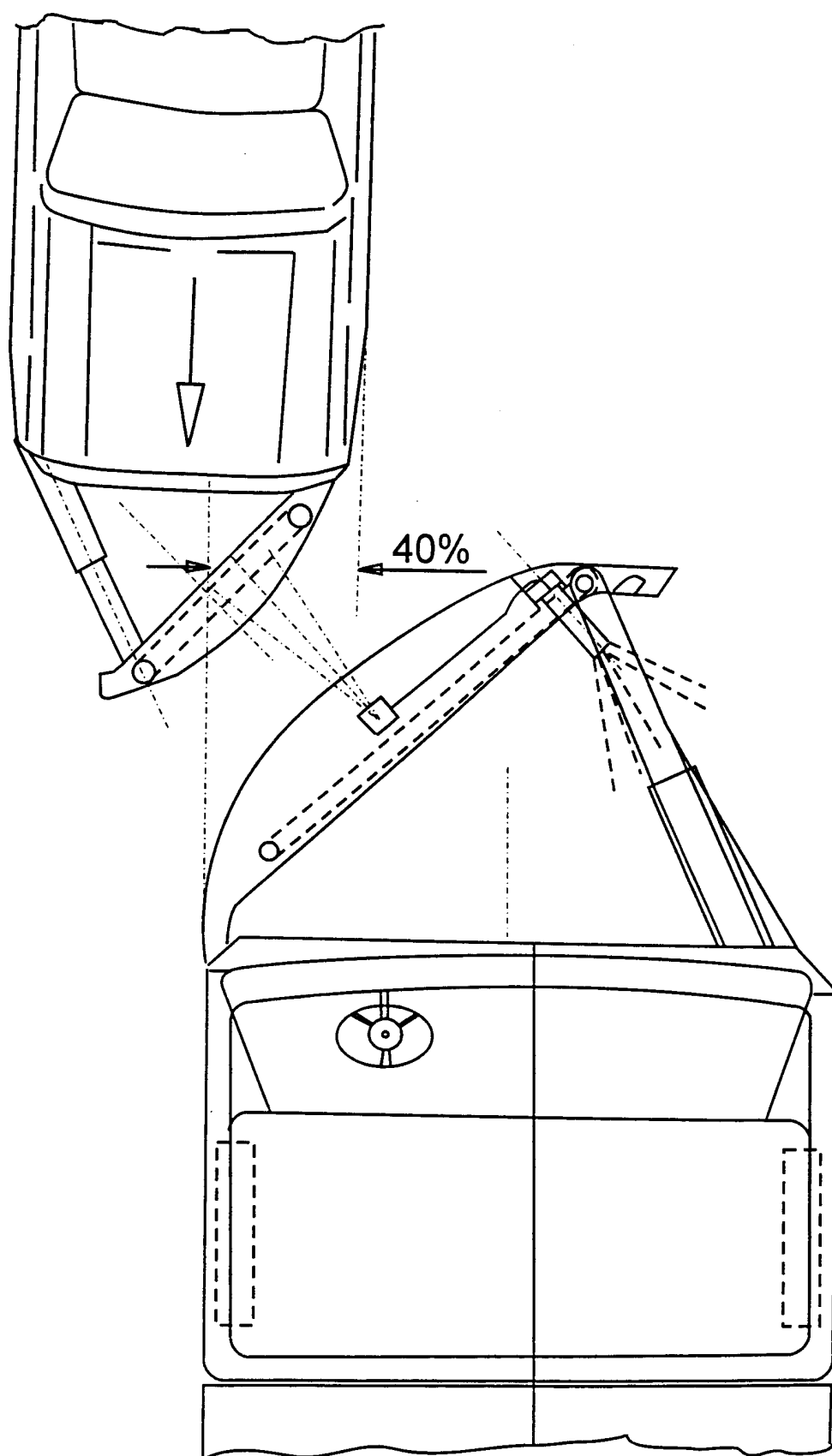


Fig. 8

*Fig. 9*

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/01533

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60R 19/40

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)

IPC7: B60R

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

SE,DK,FI,NO classes as above

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

EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 4426090 A1 (TEMIC TELEFUNKEN), 20 July 1995 (20.07.95), column 2, line 28 - line 60; column 3, line 56 - line 65 --	1-6
Y	EP 0589227 A1 (MAN NUTZFAHRZEUGE AKTIENGESELLSCHAFT), 30 March 1994 (30.03.94), column 4, line 49 - column 5, line 12, figures 4a-5	1-6
X	column 3, line 47 - column 4, line 5 --	7
A	DE 2055696 A1 (GRANIG, H), 27 May 1971 (27.05.71) --	1-7

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 November 2000

Date of mailing of the international search report

10 -11- 2000

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Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/01533

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0332830 A2 (MAN NUTZFAHRZEUGE GMBH), 20 Sept 1989 (20.09.89) --	1-6
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A	SE 319098 A (ERIKSSON, L J V), 10 August 1962 (10.08.62), abstract --	3
A	WO 9531355 A1 (HARTMANN A, BAUER J), 23 November 1995 (23.11.95), abstract --	5
A	WO 9813231 A1 (HOYAUKIN, P), 2 April 1998 (02.04.98), abstract -- -----	6

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/SE00/01533**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1-6 relate to a collision safety device for a vehicle including a bumper which is displaceable by means of a charge in dependence on the distance to an obstacle.

Claim 7 relates to a collision safety device for a vehicle including a bumper which is displaceable by means of a pneumatic cylinder in dependence on the speed of the vehicle.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims: it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE 00/01533

DE	4426090	A1	20/07/95	NONE		
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