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(54) A lifting mechanism for road vehicles

(57) A forklift mechanism (1) has a frame (2) which is fixed in position by connection to a plate on a road vehicle at a coupling (3). The forklift mast (4) is tilted by a ram (8) to the different operative tilt positions. Wheels (20) are connected to the frame (2) by an independent suspension (21). Vertical position of the wheels (20) is controlled by hydraulic rams (24) so that they may be urged downwardly to distribute the load of the forklift between the wheels 20 and the wheels of the road vehicle to dynamically provide the correct balance and traction. This is extremely important for control and safety purposes.

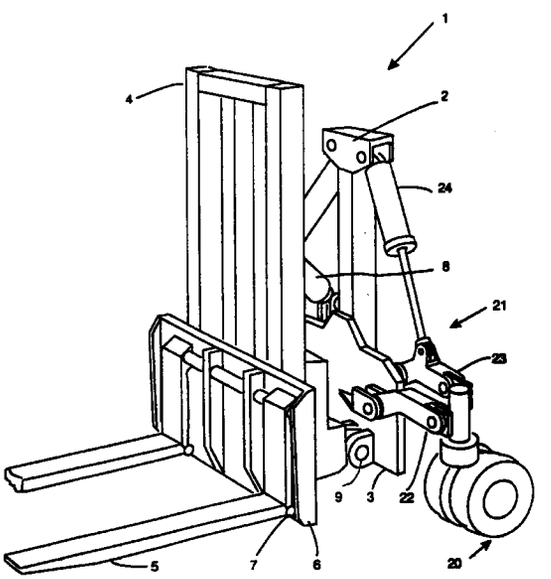

Fig. 1

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Description

The invention relates to a lifting mechanism for attachment to the front of a road vehicle. More particularly, the invention relates to a lifting mechanism of the type comprising:-

a fixed frame having means for securing to a road vehicle;

a lifting device and associated drive means connected to the fixed frame; and

ground-engaging wheels connected to the frame by a suspension which allows movement of the wheels with respect to the frame.

Such a mechanism is described in United States Patent Specification No. US 4,177,001 (Blackwood).

It has long been appreciated that there are considerable benefits to be gained if a lifting mechanism attached to the front of a road vehicle could operate effectively. For example, a tractive unit which hauls a large load would be able to disconnect from the trailer on arrival at the depot and then the driver could use the lifting mechanism attached to the front of the tractive unit for removal of the goods from the trailer and deposit them into the depot or warehouse. Major practical advantages could be achieved by doing this. For example, very often the load will arrive outside of normal working hours for depot personnel and thus, use of a lifting mechanism attached to the front of the road vehicle would allow the load to be delivered into the warehouse in such situations. Very often, the fact that the goods are unloaded before the start of work the following morning provides a significant time advantage in delivery of the goods.

Attempts have been made at development of such a lifting mechanism. For example, in British Patent Specification No. GB-A-940844 (Page), a forklift mechanism is described which is attached to the front of an articulated lorry tractive unit. This arrangement, however, suffers from the disadvantage that it is necessary for the tractive unit to incorporate a ballast weight positioned near the back axle of the tractive unit. Further, in the United States Patent Specification No. 4139111 (Fritz), there is shown a forklift mechanism attached to the front of an automotive vehicle. It appears that a ballast weight at the rear of this vehicle would also be required to prevent instability problems which would arise when a load is lifted. United States Patent Specification No. 4177001 (Blackwood) also describes a forklift attachment for highway vehicles. This mechanism includes a pair of castor wheels attached to a rectangular box suspension on the forklift attachment. The suspension is movable with respect to the vehicle in a wheeled carriage arrangement so that irregularities in the ground are followed.

Such forklift mechanisms have not gained widespread usage and it appears that there are several reasons for this. In particular, it appears that there have been significant vehicle control and balance problems, particularly with heavy loads on the forklift tines. Such problems can lead to instability of the road vehicle.

Another problem would appear to be lack of traction of the vehicle drive wheels, causing steering problems. The prior art mechanisms also appear to be quite cumbersome for attachment to the road vehicle and for storage.

The invention is directed towards providing a lifting mechanism having features which allow it to be attached to the front of a road vehicle and to operate in a manner whereby there is excellent balance and traction, almost as if the road vehicle were designed incorporating the mechanism.

Another object is that the mechanism be easy to handle and store when not in use.

A still further object is that the mechanism be reliable in operation.

The invention is characterised in that the mechanism further comprises load compensating means comprising means for urging the wheels downwardly with respect to the frame to compensate for loads on the lifting device whereby a load is distributed for desired vehicle and mechanism balance and traction.

What the invention provides, therefore, is a very simple additional feature which causes load compensation to provide balance and traction for safety and manoeuvrability. It therefore essentially solves the major problems which have contributed to preventing widespread use of such mechanisms.

In one embodiment, the compensating means comprises means for operating independently on each wheel or set of wheels.

In one embodiment, the compensating means comprises a user operating means for mounting inside a road vehicle. Preferably, the compensating means comprises an hydraulic drive means. The hydraulic drive means may comprise an hydraulic ram connected to each suspension. Preferably, each hydraulic ram is double acting.

The pressure applied by the load compensating means is preferably in the range of 30 bar and 150 bar.

In one embodiment, each wheel or set of wheels has an independent suspension.

In another embodiment, each independent suspension comprises a gas accumulator connected to a hydraulic circuit of the compensating means to provide independent shock absorbtion.

In a further embodiment, each suspension comprises a moving parallelogram wheel support.

In one embodiment, the lifting device comprises a forklift mast and tines. Preferably, the tines are pivotable to a vertical transport position.

In a further embodiment, said securing means of the fixed frame comprises a downwardly-extending socket for reception of a corresponding plug member secured to a vehicle.

The mechanism may comprise means for automatically sensing the lifting load and providing a control signal for the compensating means.

According to another aspect, the invention provides a lifting mechanism comprising:-

a fixed frame having means for securing to a road vehicle;

a lifting device and associated drive means connected to the fixed frame;

ground-engaging wheels; and

load compensating means comprising means for urging downwardly said wheels of the mechanism or wheels of a vehicle rearwardly of the front steering wheels to compensate for loads on the lifting device whereby a load is distributed for desired vehicle and mechanism balance and traction.

The invention also provides a road vehicle comprising a lifting mechanism as described above.

In another aspect, the invention provides a road vehicle trailer comprising a pair of apertures for reception of forklift mechanism tines and a lower skid member positioned with respect to the apertures for support of a mast of the forklift mechanism.

Preferably, the trailer further comprises a pair of support bars slidably mounted to project rearwardly and positioned with respect to the apertures for support of the forklift mechanism.

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view from above of a lifting mechanism, namely, a forkift mechanism of the invention;

Fig. 2 is a diagrammatic front view of the mechanism;

Fig. 3 is a diagrammatic rear view of part of the mechanism showing a suspension arrangement in more detail;

Figs. 4(a), 4(b) and 4(c) are diagrammatic side views showing the mechanism, in use;

Fig. 5(a) is a perspective view of a coupling of the mechanism;

Figs. 5(b) and 5(c) are diagrammatic, cross-sectional views of part of the coupling showing the manner in which a locking bolt is operated;

Fig. 6(a) is a perspective view showing the mechanism coupling connected to a road vehicle plate;

Fig. 6(b) is a diagrammatic front view showing the plate in position on the road vehicle;

Fig. 6(c) is a perspective view showing the plate in more detail;

Figs. 7(a) and 7(b) are diagrammatic front and side views respectively showing the mechanism in operation;

Figs. 8(a) and 8(b) are diagrammatic rear and side views respectively showing the manner in which the mechanism is transported; and

Fig. 9 is a diagrammatic side view showing operation of the mechanism after removal from the transport position.

Referring to the drawings, there is shown a lifting mechanism of the invention, namely, a forklift mechanism 1. The mechanism 1 comprises a fixed frame 2 having a coupling 3 for attachment to a road vehicle. The coupling 3 and the frame 2 may therefore to be regarded as being fixed in position when considering operation of the mechanism 1. The mechanism 1 further comprises a triplex forklift mast 4 to which a pair of tines 5 are connected via a tine support 6. The tines 5 are pivotally connected to the support 6 at pivot connectors 7 so that they may pivot at the rear of the tines to a vertical inoperative position. The connectors 7 are mounted behind the tines for additional strength. The mechanism 1 also comprises a tilt hydraulic ram 8 mounted between the frame 2 and the mast 4 for tilting the mast 4 between the various rearward and forward tilt positions which are required for operation. This tilting motion is about a pivot connector 9 between the mast 4 and the frame 2. An hydraulic drive 10 is provided for lifting the tines after connection to a vehicle hydraulic circuit.

The mechanism 1 also comprises two pairs of wheels 20 which are connected by a moving parallelogram 21 to the frame 2. The parallelogram 21 comprises a front suspension arm 22 and a rear suspension arm 23 which are pivotally connected to a support hub for the wheels 20 to provide the moving parallelogram effect (illustrated most clearly in Fig. 3) whereby the wheels 20 always remain vertically aligned, irrespective of their position.

A very important aspect of the mechanism 1 is that it comprises a load compensating means which urges the wheels 20 downwardly to compensate for loads on the tines so that traction and balance of a vehicle/mechanism combination is controlled by compensating for the load. A very important aspect is that the rear vehicle wheels have sufficient traction because of downward pressure on the mechanism wheels. In this embodiment, the compensating means comprises a two-way

hydraulic ram 24 for each pair of wheels 20. The rams are connected to a single support pillar of the frame 2. The pressures are preferably between 30 bar minimum and 250 bar maximum. As shown in Fig. 3, each hydraulic ram 24 is connected to an hydraulic circuit 25 which is illustrated in diagrammatic form. There is a Nitrogen gas accumulator 26 connected in a downward supply line 27 for each ram 24. There is also an upward supply line 28 connected to the circuit 25. Hydraulic pressure through the downward supply line 27 keeps the wheels 20 at a particular vertical position selected by the vehicle driver. The gas accumulator 26 provides for independent shock absorbtion so that irregularities in the ground do not cause instability. The gas accumulator 26 together with the parallelogram 21 may be regarded as an independent suspension.

The circuit 25 is connected to driver control handles for mounting in a cab and being powered from a vehicle battery. These controls comprise solenoids for connection to a vehicle electrical system.

The coupling 3 is illustrated in Figs. 5(a), 5(b) and 5(c) and comprises a coupling base plate 40 welded to a socket member 41 which has side members which are inclined downwardly and outwardly. There is also a pair of lock pin assemblies 42, each of which comprises a handle 43, a pin 44 and a biassing spring 45. As shown in Figs. 6(a), 6(b) and 6(c), a coupling plate 50 is secured to the front of the vehicle cab and is anchored in position by a support frame 51. The connection may alternatively be to a centre towing pin of the vehicle or the chassis. The shape of the coupling plate 50 corresponds in shape to that of the socket 41 so that when the mechanism 1 is lowered downwardly, the socket 41 surrounds the plate 50 (which acts as a plug) until the weight of the mechanism 1 holds it in place. The locking assembly 42 is then operated by the handle 43 so that the pin engages, as shown in Fig. 5(b), through apertures in the socket 41, the coupling plate 50 and the base plate 40.

Operation of the tilt ram 8 is illustrated in Figs. 4(a), 4(b) and 4(c) whereby the tilt ram 8 causes the mast 4 to tilt to a 4° front tilt for engagement with a pallet 30 back to a 6° rear tilt for transport of the pallet.

In Figs. 7(a) and 7(b), the mechanism 1 is shown attached to the front of a road vehicle, in this embodiment a tractor unit of an articulated lorry. In Fig. 7(a), the wheels 20 are shown lifted well clear of the ground and the tines 5 are in a substantially vertical inoperative position. The allows the mechanism 1 to be transported for short journeys and around a warehouse when not in use.

In use, the wheels 20 are lowered either separately or together by the rams 24, as shown in Fig. 7(b). These actions are controlled by the driver in the cab by connections, not shown, of the hydraulic circuit 25 into the cab of the tractor unit 52. It is essential that the driver control these actions so that the wheels 24 are urged downwardly under hydraulic pressure so that there is optimum compensation for the current load being supported on the tines, while at the same time ensuring that the traction of the front wheels of the tractor unit 52 is not reduced to the extent where control problems could arise. This pressure is controlled dynamically by the driver so that at all times, the downward pressure on the wheels 20 reflects the load being carried by the mechanism 1 so that there is a correct load distribution and good driving and steering control. This aspect is extremely important as it allows the mechanism and the tractor unit 52 to act in unison, although the tractor unit was not designed for such a use. Indeed, it has been found that loads of up to 2 to 3 tonnes can be carried without causing any instability and in a manner whereby any competent lorry driver is capable of controlling the mechanism adequately with little or no training. A very important aspect of the invention is the fact that the mechanism provides controls for a driver for overall safe and effective driving control as if the mechanism were an integral part of the vehicle.

Referring now to Figs. 8 and 9, the manner in which the mechanism 1 may be transported for longer journeys is illustrated. The tractor unit drives to the rear of its trailer 55 and moves the mechanism 1 forward so that the tines 5 engage in apertures 56 in the rear crash bar of the trailer 55. Slidable support arms 57 are pulled out, as indicated by the arrow A, so that they project rearwardly and support the mechanism 1 by engagement underneath the suspensions 21. The mechanism 1 is then secured in place by use of chains, not shown. The arms 57 are not necessarily left in position during transport, however, they may be used for disconnection as they provide a support for raising and lowering the mechanism by operation of the rams 24. Skid bars 58 are secured to the rear of the trailer 55. If the tines are "raised", the mast is moved downward in relation to them for engagement onto the skid bars 58.

As shown in Fig. 9, the mechanism 1 may be easily removed by releasing the chains and causing downward movement of the frame 2 and the mast 4 with respect to the tines 5 so that the coupling 3 engages the plate 50 at the front of the tractor unit 52 as shown in Figs. 5 and 6. The mechanism 1 may then be operated, as shown in Fig. 9, to remove pallets from the trailer 55.

It will be appreciated that the invention provides a forklift mechanism which may be very easily secured to the front of a road vehicle such as a tractor unit. The mechanism 1 may then be operated in a manner whereby there is load compensation for optimum traction and balance whereby the mechanism 1 effectively becomes part of the road vehicle. This is extremely important in providing for ease of use and safety. Further, the mechanism 1 may be easily transported for either short-haul or long-haul in a simple and convenient manner. It would, therefore, be very convenient for trucking companies to provide convenience in situations where a load arrives out of working hours, or if a forklift truck is not available for any other reason.

It will further be appreciated that the invention is extremely simple and indeed the comprehensive bal-

ance and traction control which is provided is achieved by use of simple parts of an hydraulic circuit. Because relatively simple and conventional parts may be used to achieve these features, it is envisaged that the mechanism 1 will be extremely reliable in use and also simple to manufacture.

The invention is not limited to the embodiments hereinbefore described. For example, independent suspension may be provided by any other suitable manner and it is not essential that gas accumulators be fitted for shock absorbtion. Where one is used, it may operate with any other suitable inert gas. The wheels could alternatively be connected to a pivotally-mounted support arm. It is also envisaged that the wheels could be of the retractable type. Control from a vehicle cab may be provided by use of a remote control radiation transmitter/receiver arrangement or alternatively by pneumatic or mechanical devices. It is also envisaged that a threaded spindle may be used to provide wheel movement. Where hydraulic circuits provide load compensation, there may be safety stops mechanically mounted to prevent collapse of the load in the event of hydraulic failure. Hydraulic pressure may be variably controlled by the speed of the vehicle engine. While power for the tines is provided by an hydraulic pump driven off the vehicle gearbox, it could alternatively be provided by a mechanical coupling. It could also be provided by an electrically-driven hydraulic pump with power supplied from the vehicle electrical circuit, or a dedicated supply.

There is a wide variety of ways in which the mechanism may be connected to a vehicle. A bracket attached to the chassis may have anti-twist support bars. A cover may be provided for safety.

Other ways within the scope of the invention to achieve load compensation will be appreciated by those skilled in the art. As the mechanism wheels are connected to the fixed frame, a mechanical equivalent would be connected to a bracket on a vehicle. For example, the load compensating means could also act on rear wheels of the vehicle. It is also envisaged that load compensation could be achieved by action on vehicle wheels rearwardly of the front steering wheels alone. This could be achieved by connection of a control circuit of the compensating means to the suspensions of vehicle wheels. An example is application of downward pressure sufficient for load compensation via pneumatic suspensions of vehicle front wheels. The important point is that the compensation means urges wheels of the mechanism/vehicle combination downwardly for load compensation.

It is also envisaged that load compensation could be achieved by causing an extraordinary level of tilt back of the tines, in combination with associated downward pressure on the wheels and/or outward movement away from the vehicle. Indeed, in general the wheels may be mounted for both outward and downward movement.

While the compensating means has been described as operating under driver control, it is envisaged that it may operate in an automatic manner in response to applied load. For example, load sensors mounted between the tines and the frame could be mounted to provide the required control inputs. In another example, such an input could be provided by the drive hydraulic ram for the tines by connection of a suitable pressure sensor to the ram. The load could alternatively be sensed in the tilt ram, for example. In these embodiments, a driver control unit may be provided as a "manual" override.

It is also envisaged that the mechanism need not be a forklift mechanism and may indeed comprise a different type of lifting device such as a loading shovel or bucket, a platform or a crane assembly, depending on the desired application. Further, the fixed frame has been described as an item secured to a plate on the road vehicle, however, it could be integral with the plate on the vehicle.

Claims

1. A lifting mechanism comprising:-

a fixed frame (2) having means for securing to a road vehicle;

a lifting device (5) and associated drive means (10) connected to the fixed frame, and

ground-engaging wheels (20), each connected to the frame by a suspension (21) which allows movement of the wheels with respect to the frame, characterised in that,

the mechanism further comprises load compensating means (24, 25) comprising means for urging the wheels downwardly with respect to the frame to compensate for loads on the lifting device whereby a load is distributed for desired vehicle and mechanism balance and traction.

2. A mechanism as claimed in claim 1, wherein the compensating means (24, 25) comprises means for operating independently on each wheel or set of wheels.

3. A mechanism as claimed in claims 1 or 2, wherein the compensating means comprises a user operating means for mounting inside a road vehicle.

4. A mechanism as claimed in any of claims 1 to 3, wherein the compensating means comprises an hydraulic drive means (24, 25).

5. A mechanism as claimed in claim 4, wherein the hydraulic drive means comprises an hydraulic ram (24) connected to each suspension.

6. A mechanism as claimed in any preceding claim wherein the compensating means provides a downward pressure of in the range 30 bar to 150 bar.

7. A mechanism as claimed in any preceding claim, wherein each wheel or set of wheels has an independent suspension.

8. A mechanism as claimed in claim 7, wherein each independent suspension comprises a gas accumulator (26) connected to a hydraulic circuit of the compensating means to provide independent shock absorbtion.

9. A mechanism as claimed in any of claims 7 or 8, wherein each suspension comprises a moving parallelogram (21) wheel support.

10. A mechanism as claimed in any preceding claim, wherein the lifting device comprises a forklift mast (4) and tines (5).

11. A mechanism as claimed in claim 10, wherein the tines are pivotable to a vertical transport position.

12. A mechanism as claimed in any preceding claim wherein said securing means of the fixed frame comprises a downwardly-extending socket for reception of a corresponding plug member secured to a vehicle.

13. A mechanism as claimed in any preceding claim further comprising means for automatically sensing lifting load and providing control signals for the compensating means.

14. A lifting mechanism comprising:-

a fixed frame having means for securing to a road vehicle;

a lifting device and associated drive means connected to the fixed frame;

ground-engaging wheels; and

load compensating means comprising means for urging downwardly said wheels of the mechanism or wheels of a vehicle rearwardly of the front steering wheels to compensate for loads on the lifting device whereby a load is distributed for desired vehicle and mechanism balance and traction.

14. A mechanism substantially as hereinbefore described, with reference to and as illustrated in the accompanying drawings.

15. A road vehicle comprising a mechanism as claimed in any preceding claim.

16. A road vehicle trailer comprising a pair of apertures (56) for reception of forklift mechanism tines and a lower skid member positioned with respect to the apertures for support of a mast of the forklift mechanism.

17. A trailer as claimed in claim 16 further comprising a pair of support bars (27) slidably mounted to project rearwardly and positioned with respect to the apertures for support of the forklift mechanism.

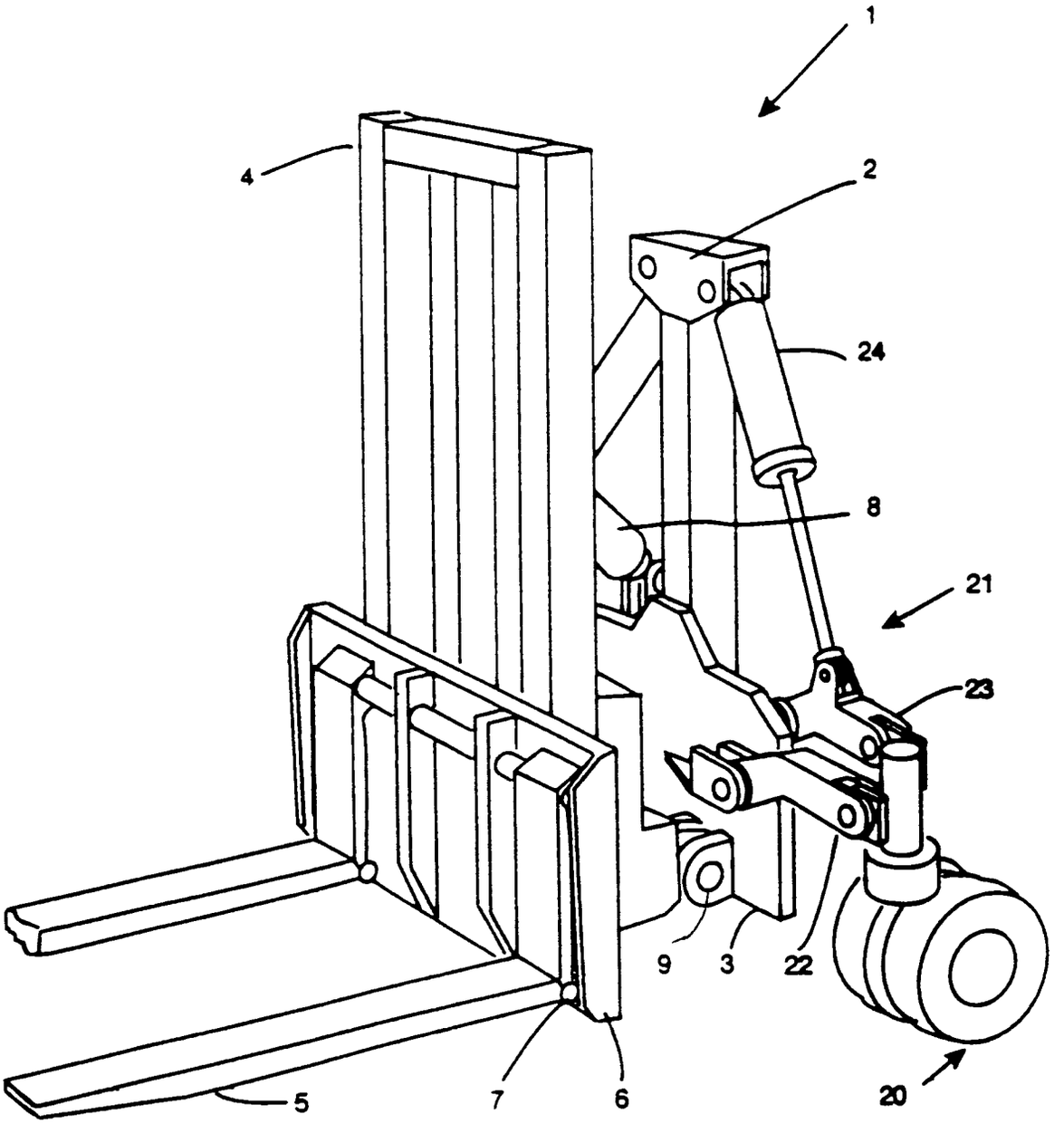


Fig. 1

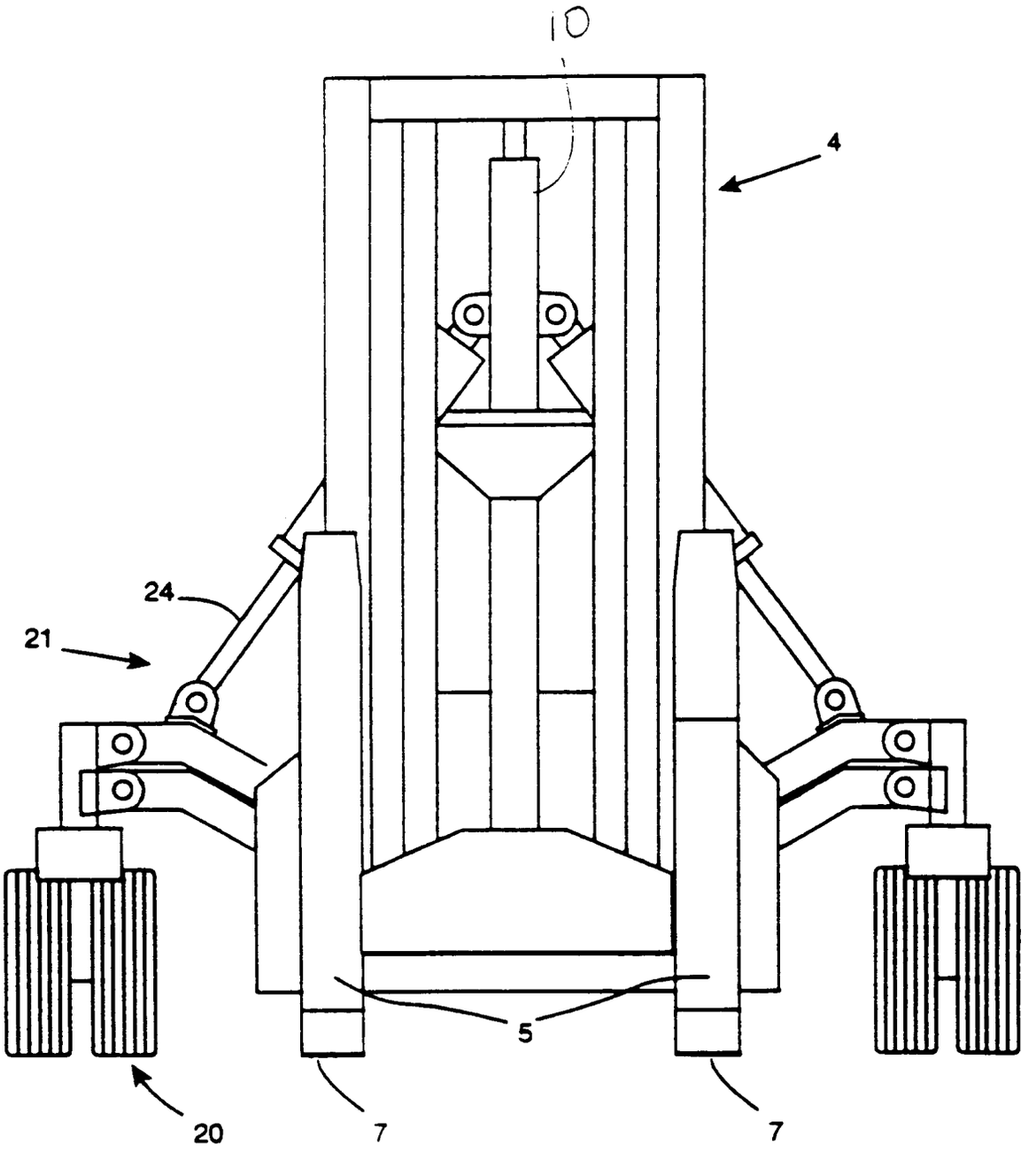


Fig. 2

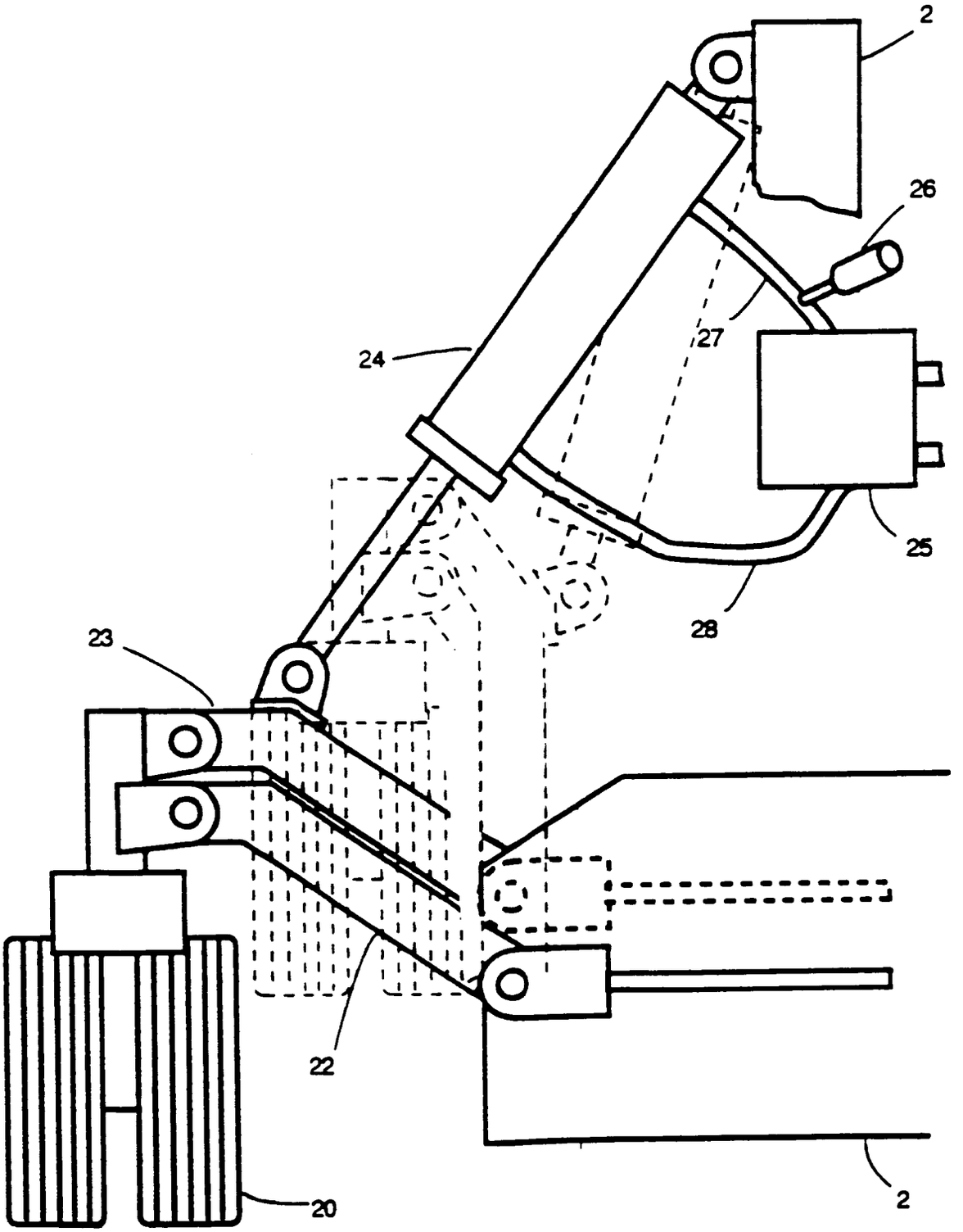


Fig. 3

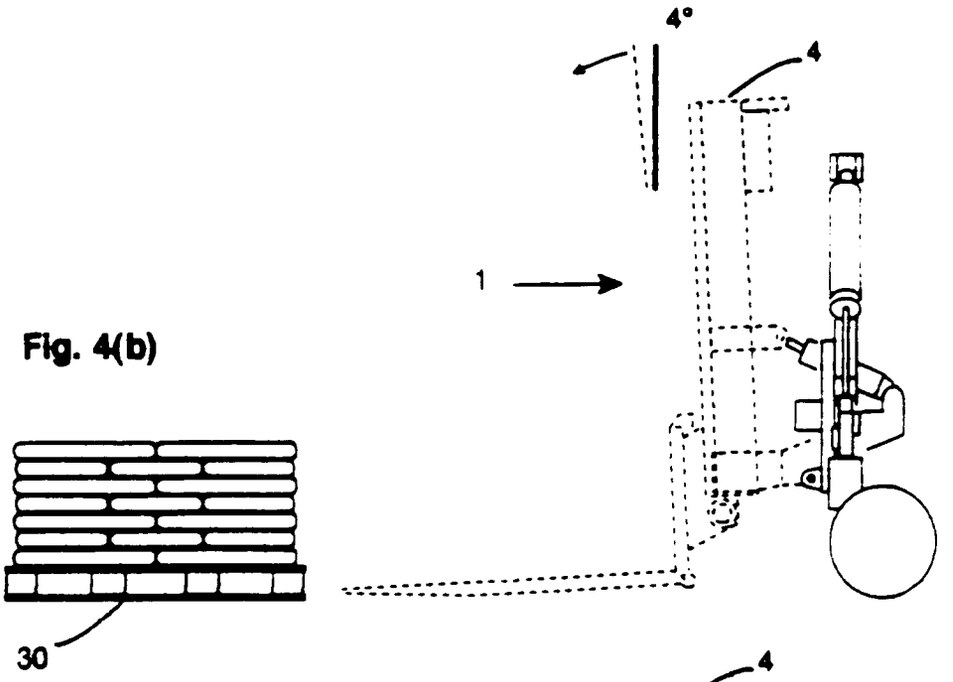


Fig. 4(b)

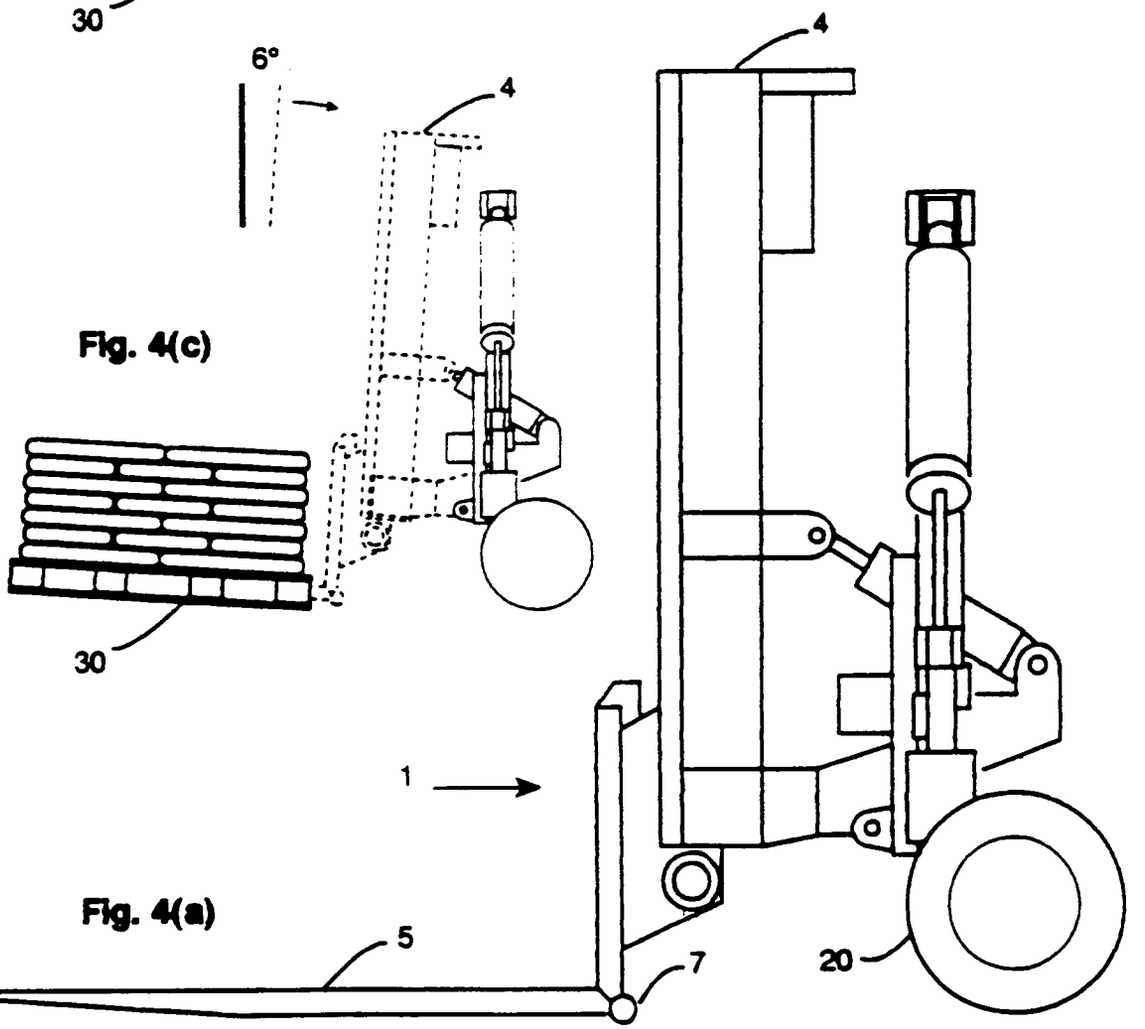


Fig. 4(c)

Fig. 4(a)

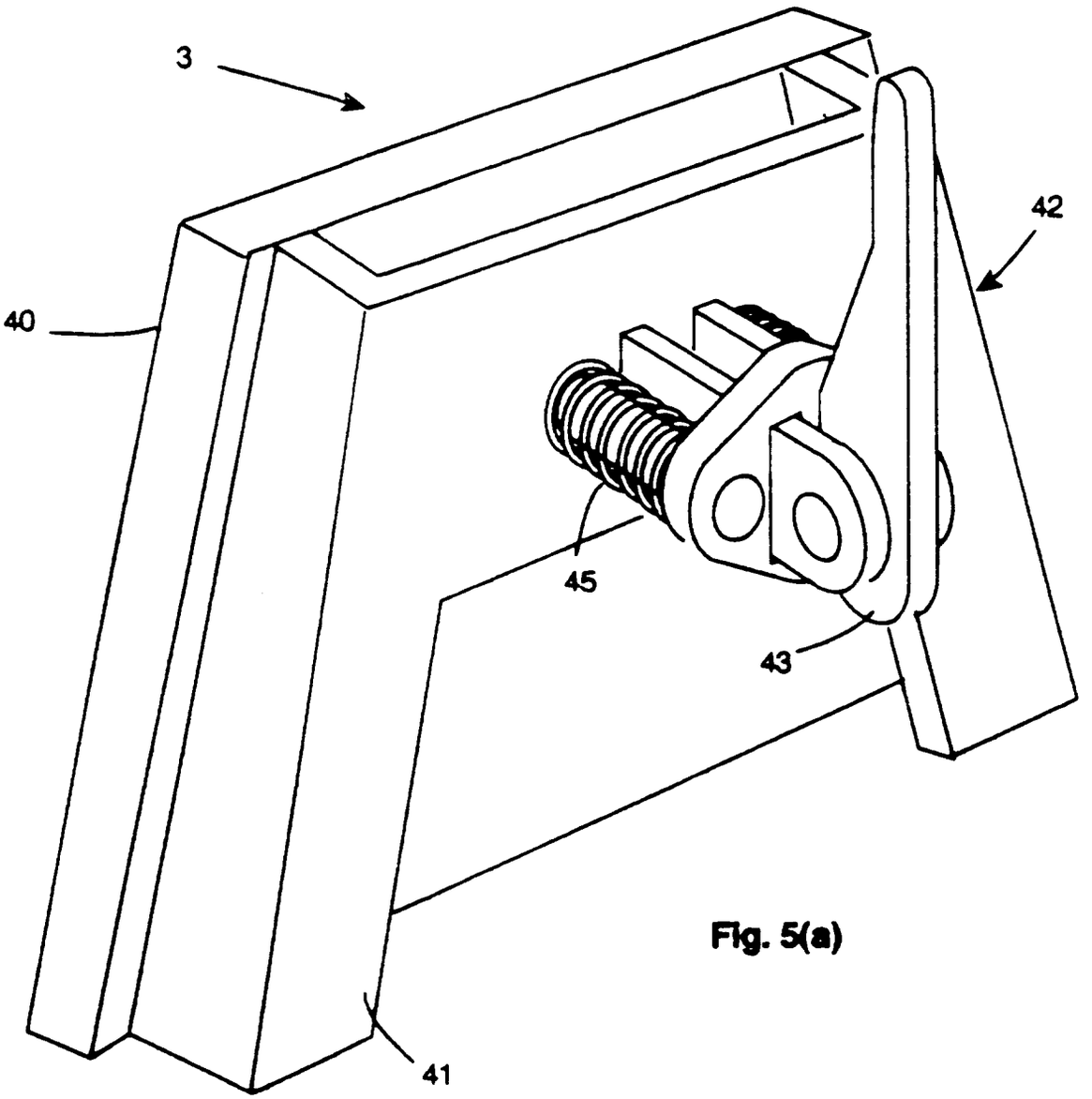


Fig. 5(a)

Fig. 5(b)

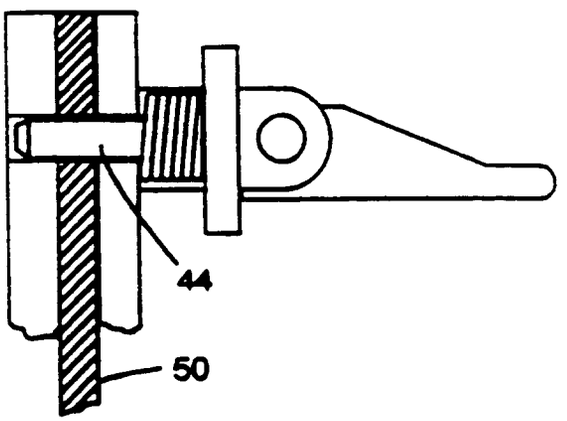
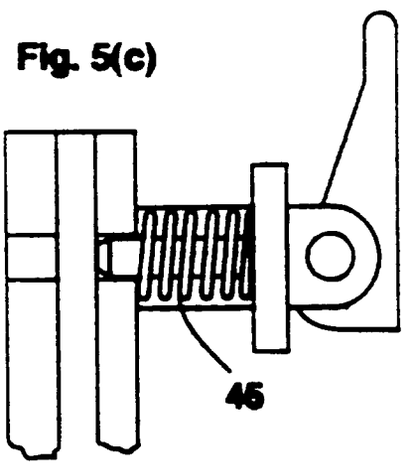


Fig. 5(c)



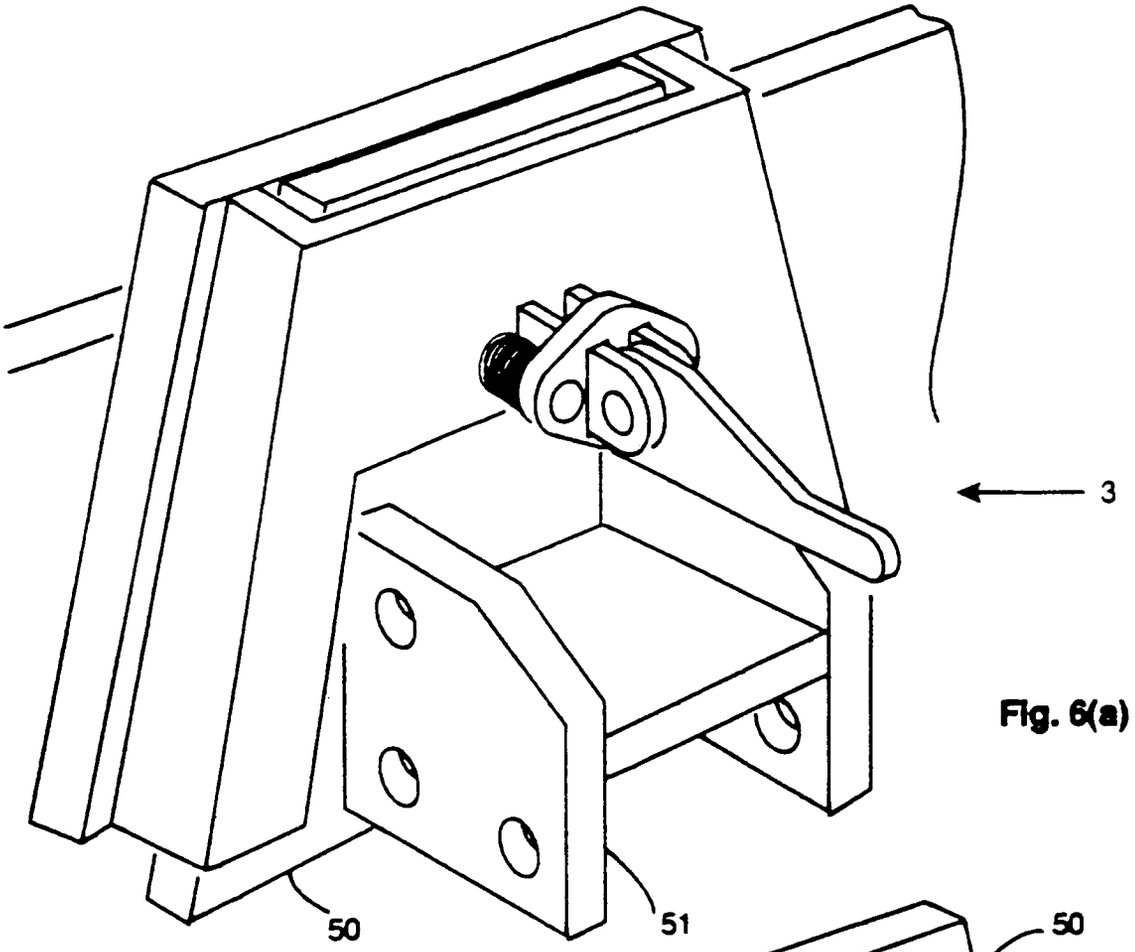


Fig. 6(a)

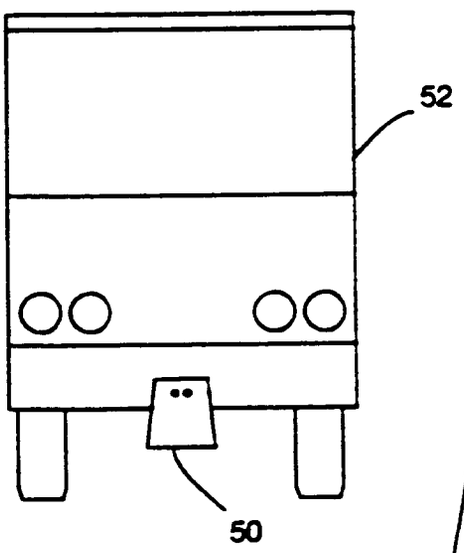


Fig. 6(b)

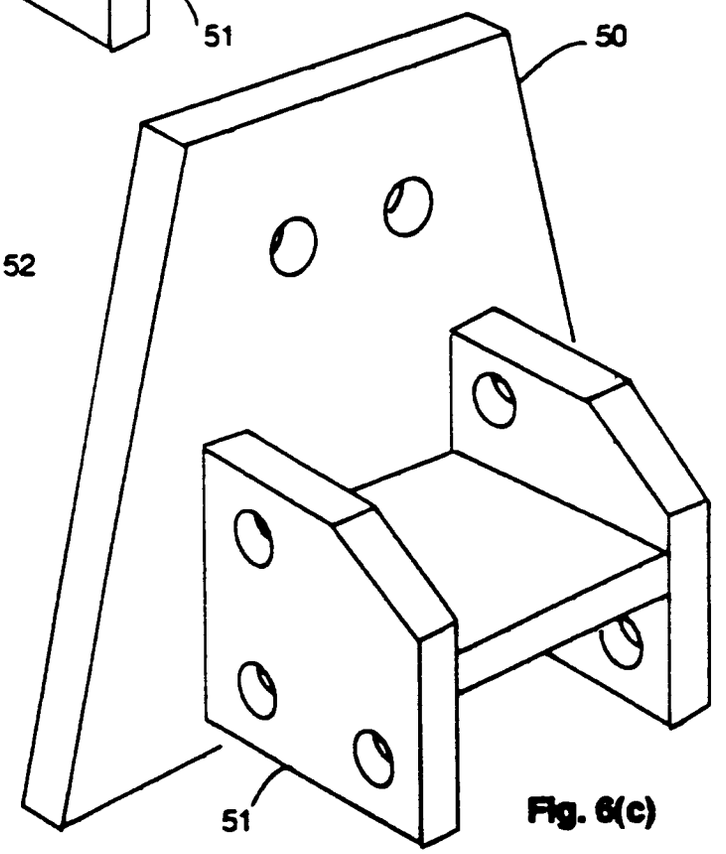


Fig. 6(c)

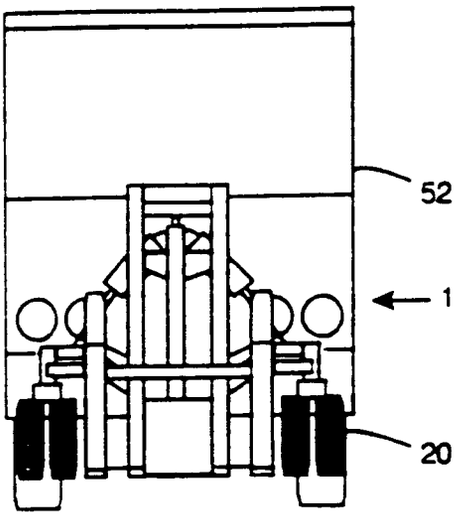


Fig. 7(a)

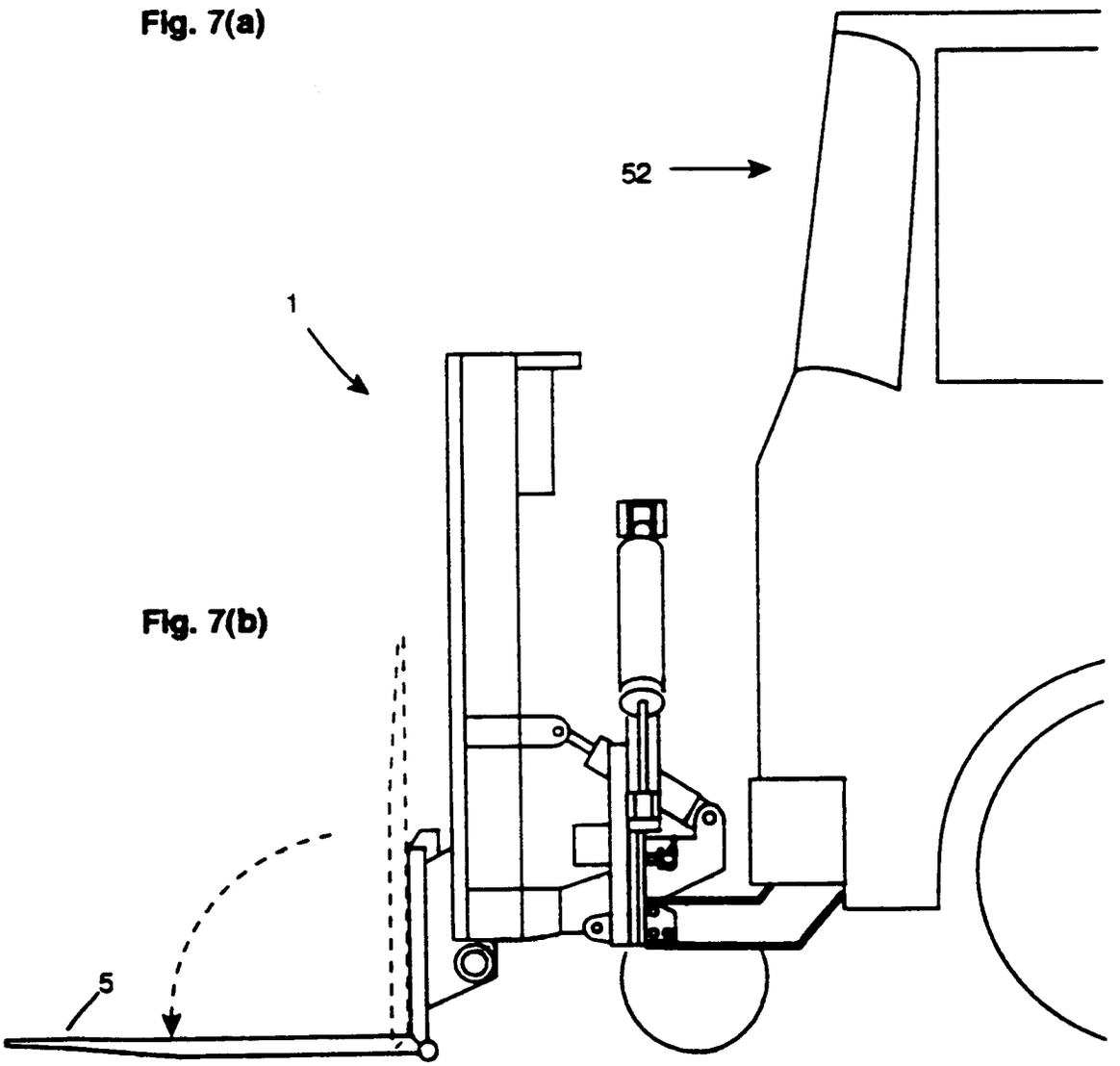


Fig. 7(b)

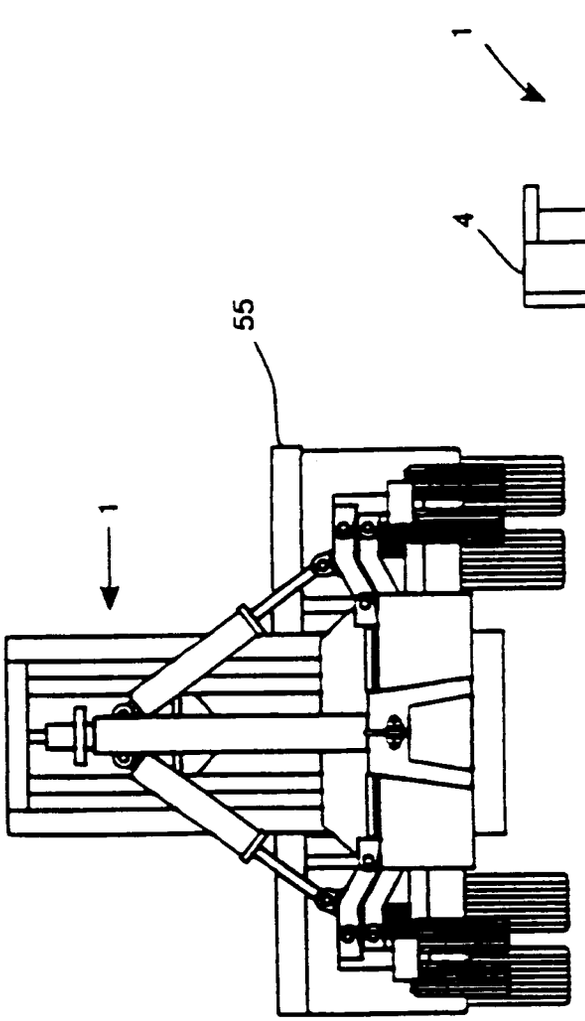


Fig. 8(a)

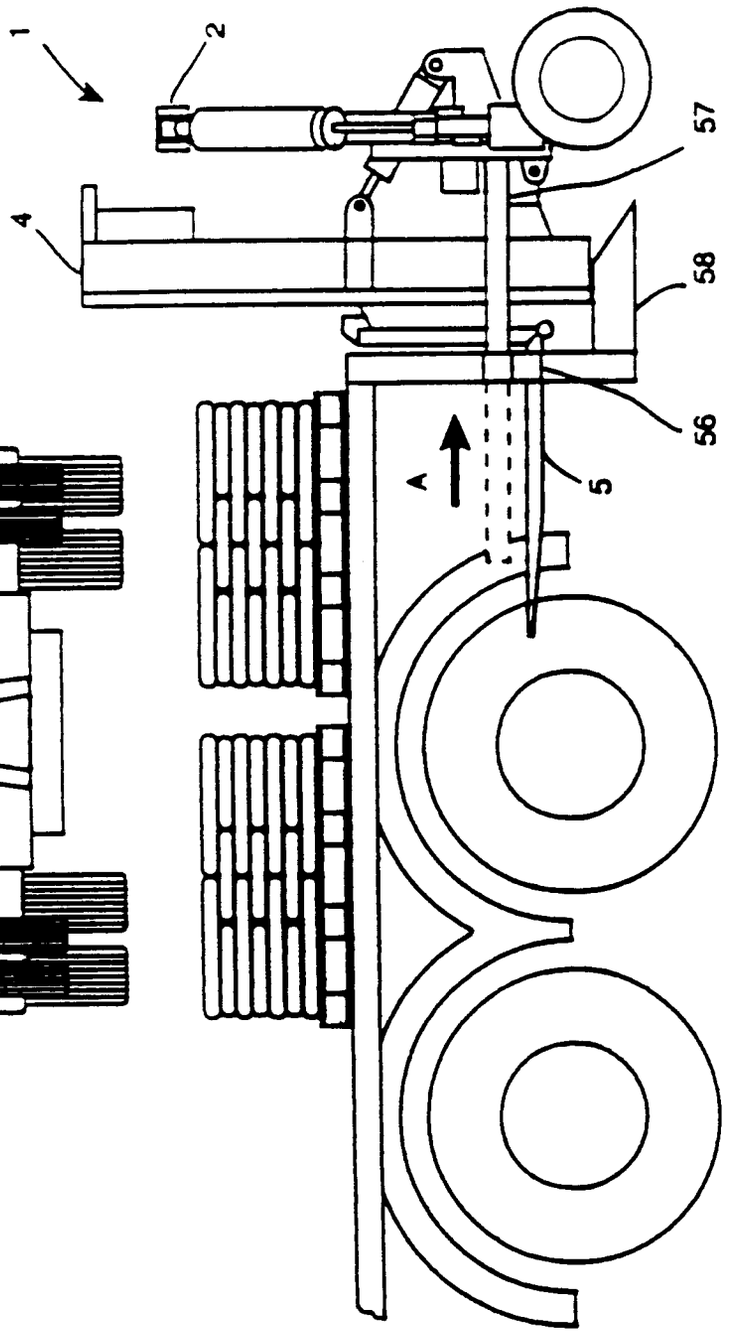


Fig. 8(b)

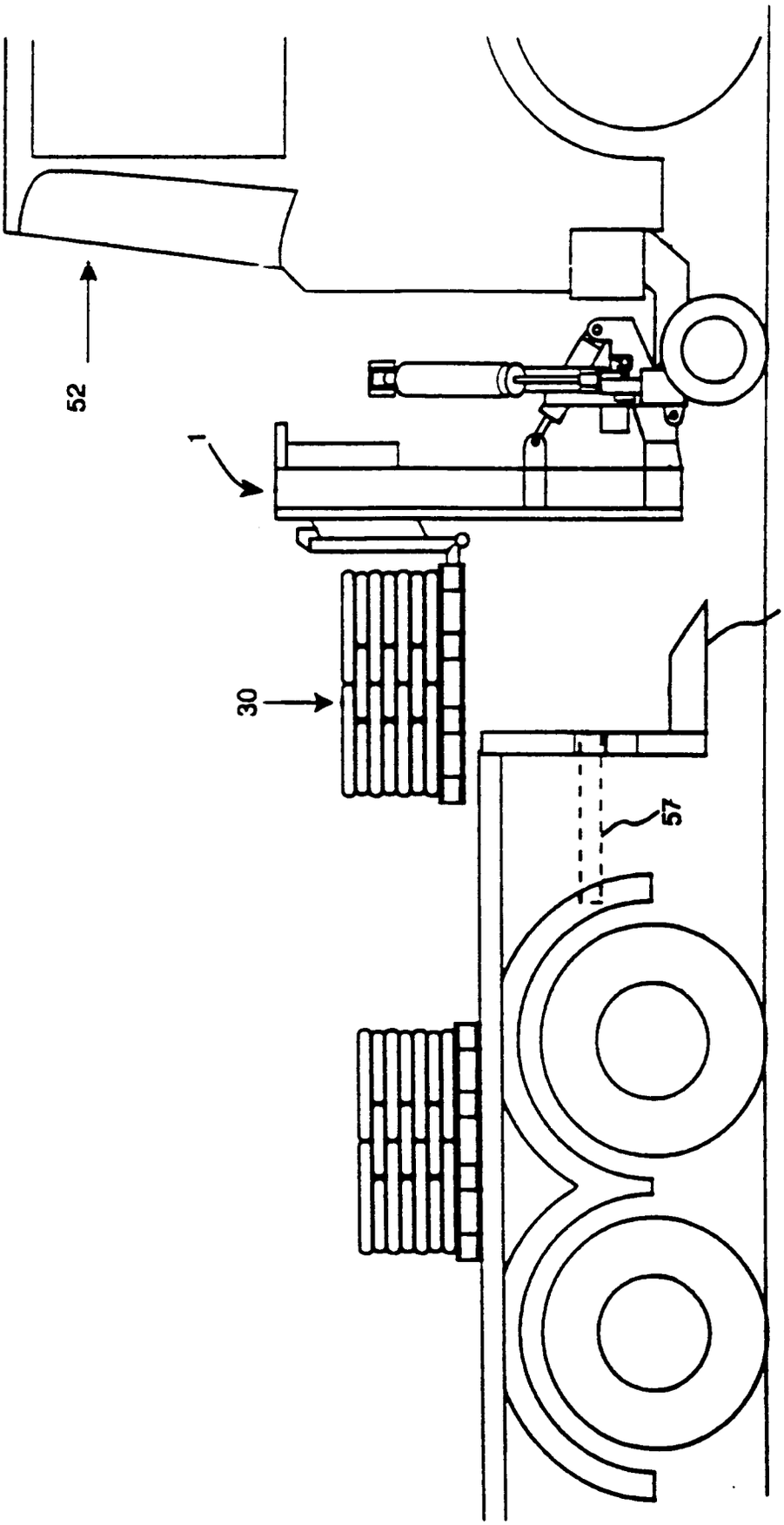


Fig. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 65 0031

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE-U-92 12 078 (VOLBERT) * the whole document * ---	1-5,7, 14,15	B66F9/06 B66F9/075
A	FR-A-2 298 454 (KOOI B. V.) * figures 1,2 * ---	16,17	
A	EP-A-0 643 009 (FDI-SAMBRON) * figures 1-5; example 1 * -----	16,17	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B66F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	27 February 1996	Thomas, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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