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(54) A device for the automatic handling of an auto vehicle in a tower parking lot and a handling process concerning said device

(57) A device to park a car (1) in an automated parking lot of the tower type, either underground or on the outside, provided with an entry platform to the parking lot, with several levels of parking spots (55) and with an elevator suitable to carry cars (1) of different types and sizes to the various levels, said device comprises a combination of first and second means to measure the wheel base of the cars (1) to be parked; means to pick up and to carry the cars (1) from the entry platform to the elevator and from the elevator to the parking spots (55) and vice versa; and command and control means of the first and second measure means and of the means suitable to pick up and to carry the cars (1).

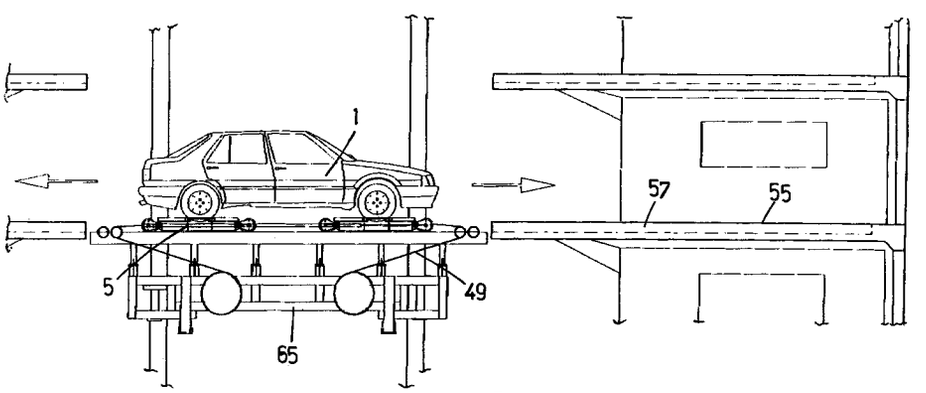

FIG.16

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Description

The present invention refers to a device for the automatic handling of a car in a tower type parking lot, either underground or on the outside, and refers to a handling process that utilizes such device to leave or to pick up the car from the parking lot.

Automatic parking devices are known in the art which can pick up and carry a car to its assigned position inside the parking lot and then, after a certain parking time, carry back the vehicle to the pick up point.

In a parking lot of the known type, the parking spots of the vehicles are distributed over several levels, and each car is carried to its parking spot with the aid of an elevator suitable for the task. Said vehicles are picked up by mobile carriers which are then moved to the various levels by the elevator. These carriers are inserted underneath the vehicle and therefore they have a smaller width than the track of the vehicles currently in circulation. They are further provided with means to lift and to center the cars thereon, so as to allow the vehicle to be moved also in presence of engaged parking brakes and gear. Obviously, the centering and the lifting means operate on the wheels of the two car axles, so as to avoid all the possibilities of damaging the body or the mechanical parts of the car during its handling. One of the major problems that these handling systems must solve is the wheel base difference, sometimes significant, of the existing car fleet, whereby the need arises to adjust the various locking and lifting means that usually are positioned on a single carrier and that can be moved along its longer axis, at least concerning their fitting to one of the two axles of the car.

For this purpose, rack or worm screw systems are generally used. These systems, used to center and to adjust the carriers to the wheel base and to the track of the different cars, are though quite slow, whereby the parking operations can last for an excessive period of time.

A purpose of the present invention is to realise a device to park a car in an automated, multilevel tower parking lot, said device has the possibility to suite the various dimensions of the car wheel bases, in a short time and safely, so that the total parking time can be contained to the minimum value.

A further purpose of the invention is to realise a device to park a car in an automatic tower parking lot that comprises car transport carriers, particularly suitable to lock and to lift the car in a rapid and safe way.

Another purpose of the present invention is to realise a process for handling cars in a parking lot that utilizes this device.

These and other purposes are achieved, according to the present invention, by a device suitable to park a car in an automated tower parking lot, either underground or on the surface, said device has the characteristics of the first claim.

A further purpose is achieved by the present invention through a car handling procedure using said device which has the characteristics of the eighteenth claim.

Further characteristics and advantages of the device according to the invention will be clear from the following description referred to the attached drawings provided as a non limiting example, in which:

- Figure 1 is a view of the entry platform to the parking lot with a car in the starting position of the parking operation;
- Figures 2 to 8 are side views of a carrier according to the invention positioned in the various working phases relative to pick up and to lift the car to be parked;
- Figures 9 to 12 are front views of the carrier in the various above working phases, with the carrier positioned inside the parking spots;
- Figures 13 to 15 are top views of the carrier of the invention equipped with the centering and the locking/lifting systems of the car, in the rest position and at work;
- Figure 16 is a view of car positioned on the carrier of the invention and carried by an elevator to the assigned parking level.

Referring to the figures, and particularly to Figures 2 and 13-15, numeral 3 indicates a transport and handling carrier of the cars 1 to be parked in a tower multilevel parking lot.

The carrier 3 is formed by a first self-moving half carrier 5 and by a second self-moving half carrier 7.

The half carriers are connected by a couple of hydraulic cylinders 9, 11, wherein a piston connected through its stem 12 to the second half carrier 7 separates two communicating chambers obtained in cylinder 13 which is connected to the first half carrier 5. The piston can slide inside the cylinder by leaving in the open position a communication passage existing between the two chambers or it can be locked in a fixed position by closing the passage between the two chambers through an on-off valve or another device suitable for the purpose, realising in this way a rigid connection between the two half carriers 5 and 7. Naturally, the chambers of the cylinders 9 and 11 are also selectively connected to a source of pressurized fluid and to an exhaust pipe, so that the piston can be moved in either direction within said chambers.

Each half carrier 5 and 7 is provided with two pairs of wheels 13 and 15 which rotate on support arms 17 which are suitable to swing in respect to the chassis 21 of the half carriers 5 and 7. In fact each pair of support arms 17 is integral respectively with a pair of axles 23 supported, in a rotating manner, on each half carrier and driven, in a known way, by means of a pinion located outside of a lever which operates on a fixed geared portion, in order to rotate in either direction, following the activation of a couple of electric motors 25 located one on each axle, to lift or to lower the carrier 3.

On the central part of each half carrier, a mechanism 29 is located, said mechanism has a left and right worm screw , which are coaxial and integral with each other, driven by an electric motor 31, which through a system formed by nut screws and levers 33 moves, with a symmetric movement, the arms 35 suitable to clamp the tires of the car, said arms are usually located on the sides of each half carrier and are parallel to their longitudinal axis.

Coaxially to the mechanism 29, but in an upper position, a second mechanism 36 is located, which is formed by a right screw and a left screw integral with each other, said mechanism, through the rotation caused by a motor 37 to each half carrier 5 and 7, causes the axial sliding, in opposite directions along the screws, of a couple of nut screws supporting the pushing portions 39 (two for each half carrier).

These pushing portions are suitable to exercise a pressure on the wheels belonging to the same axle, so as to eventually move the car exactly in a central position on each half carrier 5 and 7.

This operation is facilitated by the fact that the platform 40 (Figure 1) whereon the car stops at the parking lot entry, is realised in smooth steel or in other equivalent material, so as to oppose a minimum friction to the sliding of the tires.

A further couple of motors 41, for each half carrier 5 and 7, are located at the opposite corners, one on the front portion an the other on the rear portion (in respect to the carrier motion underneath the car) of the half carriers, and are connected directly to the respective wheels 15, said motors allow the independent movement of each half carrier controlled by a central control processing unit. This computer provides to control the necessary connections in order to send the required power supply, through connections cables 49 (schematically illustrated in Figure 16) for a predetermined period of time to the activating electric motors located on the half carriers).

On the front end of the first half carrier, the invention provides an optic sensor 50, suitable to detect the position of the edges of each front and rear tire, when the first half carrier is moved under the car. On the basis of the signals of the sensor, the position of the carrier is detected in relation to the axles of the car. The measures of the sensor are constantly sent to the central processing unit which controls the movement of the half carrier through the electric motors, by means of known systems and of wire or wireless connections 49, or by means of a mixed system.

The parking device according to the invention provides, in every area inside the parking lot, as well as in the parking entry area, parking spots 55 with dimensions suitable to contain the majority of the car models currently on the market. Both the platform 40 and the parking spots 55 have a longitudinal axial cavity 57 suitable to contain the carrier 3 and to allow the carrier to be moved under the car 1. Said parking spots or platforms are provided, including the one at the parking lot entry, of a fixed an defined lock point for the front wheel of the car. In the illustrated realisation this fixed point is formed by a groove 59 on their front edge, so as that the front tire of the car can engage the groove when the car enters in the parking lot, both in the parking area and at the parking spots, so as to always find an exactly defined stop position. The entry platform 40 has, on its front portion, in correspondence of at least one of the rear wheels of the car, a plate 60 whereon several load cells 62 are located at close range with each other. The plate/s 60 have a length suitable to cover all the wheel base range of the cars currently on the market, so that when a car has its front wheels in the groove 59, the rear wheel/s are positioned on the plate 60 and therefore on one of the loading cells 62 which is provided thereon.

Each cell 62 is connected with the central processing unit through known equipment suitable for said purpose, so that, for each car entering in the parking lot, a corresponding wheel base measure X can be detected and memorised, said measure is defined by the distance between the center of the groove 59 and the loading cell/s activated by the rear wheel/s. The device of the invention works as described herebelow.

When the car 1 arrives at the parking lot entry, it has to get on the platform 40 and to proceed until the front axle wheels engage with the groove 59, taken as reference point. When the car is in this position, the measure of the wheel base of the car to be parked is taken through the impulse sent to the central processing unit from the load cells 62.

The impulse generated by the cells 62 gives also the go ahead signal to the central processing unit to handle the carrier 3, or the two half carriers 5 and 7, by means of the electric motors 25 which drive the wheels 15. In Figures 2-7, the handling of the two half carriers is illustrated, said carriers move in the direction of arrow F. Said carriers are joined together, i.e. the pistons inside the cylinders 13 are locked by the closing of the connection passage between the two chambers. The two carriers are locked in the configuration of maximum distance between them i.e. at the maximum stroke of the hydraulic cylinders 9 and 11. In said joined configuration, the half carriers 5 and 7 are moved underneath the car into chamber 57. The optic sensor 50 detects and sends to the central processing unit the position of the edges of each front and rear wheel in order to obtain their distance. The carrier 3 moves until the second half carrier 7 reaches the fixed end run position which locates the car front axle and which coincides with the center line of the groove 59 wherein the front wheels of the car 1 are positioned. The first half carrier is now at the maximum end run position and it is move in the opposite direction after opening of the connection between the chambers of the cylinders 9 and 11 in order to free the two half carriers. The first half carrier 5 moves in opposite direction in respect to the arrow F,

until the rear wheel is in a central position in respect to said half carrier (Figure 7), said position has been defined both through the weight measure (load on the cells 62), and through optic detection which has the purpose of safety measure in case of malfunctioning of the cells 62 (reciprocal safety redundancy).

In summary, in accordance to the software in the central processing unit, and in case of normal cycle, the measure obtained through weight measure has always the priority, while in an emergency case (loss of memory, faulty weight measure system) the control system of the central processing unit provides the automatic change of priority to the optic system. An emergency sequence to measure the wheel base is also provided, for instance, in the case of having to take back the car after having started the exit sequence, and having, again, to position the car in a parking spot, or having to pick up the car from the entry side or from the parking spot by way of manual or semiautomatic controls. In such cases, since the memory data of the wheel base measure are lost, the car handling cycle is based only on the optic measure.

When the two half carriers 5 and 7 are positioned exactly under the two axles (Figure 7), the motors 37 of each half carrier receive power supplies, through the computer controls, so that the pushing portions 39, by moving in opposite directions on the pair of screws of the mechanism 36, can center the car in respect to the carrier. Naturally, the pushing force exercised by the portions 39 will be controlled by a torque sensor (not shown) or the likes, which will provide to cut the power supply to the motors 37 in case of going over a certain threshold, in order to avoid overcharges on the car suspensions.

At the end of the centering operation, the connection cylinders 9 and 11 between the two half carriers will be able to slide in order to allow, in correspondence to the following phases, the correction of small clearances and mistakes which have been accumulated.

At this point the mechanism 29 positioned on each half carrier 5 and 7 is activated , said mechanism, through the motors 31 and the lever systems connected to the worm screws, allow the 90° rotation, with symmetric runs, of the clamping arms 35 to lock the car wheels, so that the car is fixed to the carrier 3. Then, by activating the motors 25, the carrier can be lifted together with the car (Figures 8 and 12). When the lifting operation is completed, the connection circuit of the cylinders 9 and 1 is locked in order to realise a rigid connection between the two carriers and to avoid that the wheels exit the clamping arms 35. The carrier 3, so positioned, will be moved, by means of the wheels 13 and 15, on the elevator 65 which will reach the parking spot 55 assigned to the car.

The carrier, when the elevator is positioned at the floor of the assigned parking spot, moves until it reaches the point of maximum fixed run defined, for the front wheels, by the groove 59, and unloads the car on the parking lot by executing in reverse order the above described operations.

Then the carrier goes back to the position of maximum distance between the half carriers, as the cylinders slide (the half carrier 2 moves in relation to the half carrier 1), and the carrier moves back to the elevator in order to be ready for another car parking or pick up.

In order to take back the car from the parking spot, the wheel base measure will not be necessary, since the central processing unit has memorised and associated said measure X of the car wheel base to the corresponding parking lot. Therefore, the central processing unit will be able to define, without any problem, the distance between the two half carriers 5 and 7 so that the wheels of the car 1 are positioned in the required point for taking back the car.

It has to be understood that the invention is not limited by the described example and that the example can undergo several changes, without leaving the scope of the present invention.

So, it is possible to think about other types of connections between the two half carriers, having the same functions of the hydraulic cylinders, for instance a system combining a worm screw and a nut screw electrically driven. Other systems for defining the wheel base measure can also be provided, for instance by using optic systems also on the entry platform 40, and the carrier lifting could be done by a pneumatic or hydraulic system which will achieve an equivalent result.

Claims

1. A device to park a car in an automated parking lot of the tower type, either underground or on the outside, provided with an entry platform (40) to the parking lot, with several levels of parking spots and with an elevator suitable to carry cars of different types and sizes to the various levels, characterised in that said device comprises a combination of:

   - first and second means (59, 60, 62, 50) to measure the wheel base of the cars to be parked;
   - means (3) to pick up and to carry the cars from the entry platform to the elevator and from the elevator to the parking spots and vice versa;
   - command and control means of the first and second measure means and of the means suitable to pick up and to carry the cars.

2. A device according to claim 1, characterised in that said first means suitable to measure the car wheel base are formed by a fixed locking point (59) for the front wheels of the cars (1), said point is integral with the front portion of the entry platform (40), and by an elongated plate (60) suitable for the localized measurement of weights or images, said plate is positioned on said platform in correspondence to at

least one of the wheels of the car rear axle at a known distance from said fixed locking point (59).

3. A device according to claim 2, characterised in that said plate (60) is provided, along its longest axis, with a series of load cells (62) positioned at close range one from another.

4. A device according to claim 2, characterised in that said plate (60) is provided, along its longest axis, with a series of optic sensors positioned at close range one from another.

5. A device according to claims 1, 3 and 4, characterised in that the load cells (62) and the optic sensors are able to send a signal to said command and control means.

6. A device according to claim 1, characterised in that said second measure means are formed by an optic sensor (50) positioned on one end of said means (3) suitable to pick up and to carry the cars (1).

7. A device according to claim 6, characterised in that the optic sensor (50) is suitable to send signals to said command and control means.

8. A device according to claim 2, characterised in that said means suitable to pick up the cars comprise a carrier (3) self-moved by means of electric motors (41) and formed by two half carriers (5, 7) joined together in a fixed, but releasable manner through means (9, 11) with a length adjustable at will.

9. A device according to claim 8, characterised in that said connection means of the half carriers (5, 7) are formed by at least two hydraulic cylinders, wherein the working chambers can be connected to each other or, selectively, to a pressurized fluid source or to an exhaust pipe.

10. A device according to claims 5, 7 and 9, characterised in that the connections to the chambers of the hydraulic cylinders (9, 11) are controlled by said means command and control means according to the signals received from said cells or from said sensors.

11. A device according to claim 8, characterised in that said carrier (3) is suitable to go underneath the cars to be carried and is provided with means (36, 37, 39) suitable to center the cars (1) thereon.

12. A device according to claim 8, characterised in that said carrier (3) is provided with means (29, 31, 33, 35) suitable to lock the wheels of the cars (1).

13. A device according to claim 8, characterised in that said carrier (3) is provided with means (23, 25) suitable to lift said carrier.

14. A device according to claims from 11 to 13, characterised in that said centering, locking and lifting means are operated by electric motors (25, 31, 37).

15. A device according to claims 1, 8 and 14, characterised in that said electric motors (25, 31, 37, 41) are controlled by said command and control means.

16. A device according to claim 1, characterised in that said command and control means comprise a computer provided with suitable connections (49).

17. A device according to claim 1, characterised in that said parking spots (55) are provided with a fixed locking point (59) for the front wheels of the cars (1).

18. A process, based on the device according to the preceding claims, for the parking operations of a car in an automated parking lot of the tower type, either underground or in the outside, provided with an entry platform (40) to the parking lot, with several levels of parking spots (55) and with an elevator (65) suitable to carry cars of different types and sizes to the various levels, characterised in that said process comprises the following phases:

a) stop the car at a predetermined position;
b) measure, for the first time, the car wheel base;
c) move the means, suitable to carry the car, underneath the car itself and, at the same time, measure the wheel base for the second time;
d) center the car on the carrier;
e) lock the car wheels on the carrier;
f) lift the car locked on the carrier;
g) move the carrier from the entry point to the parking point.

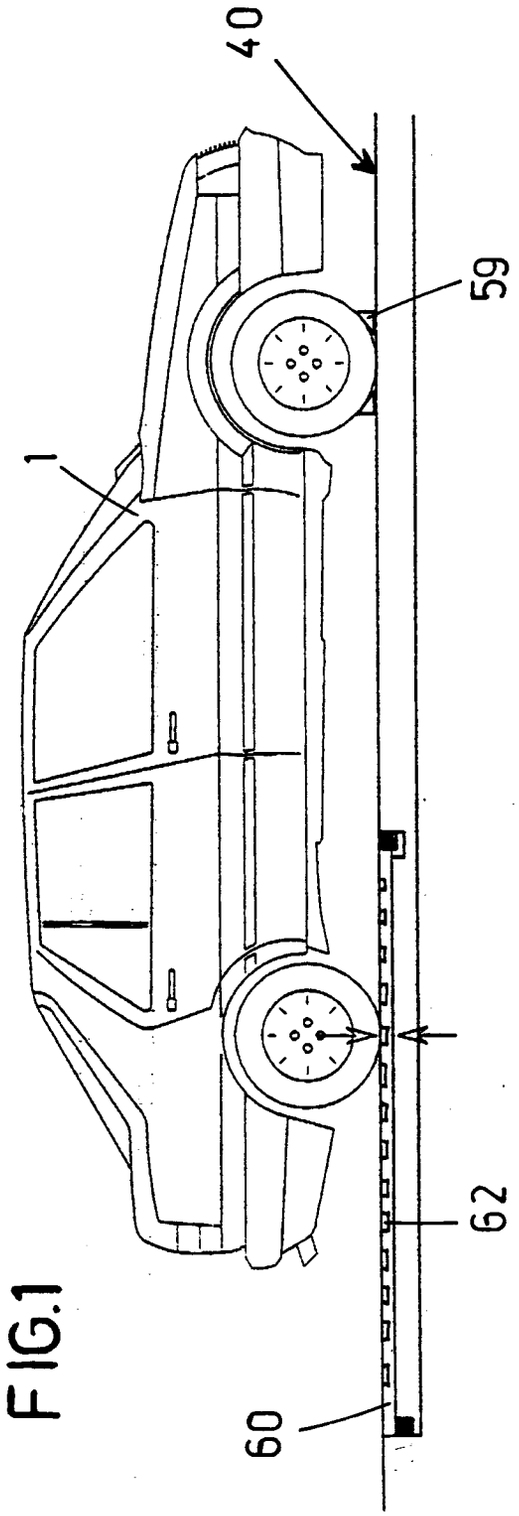

FIG.1

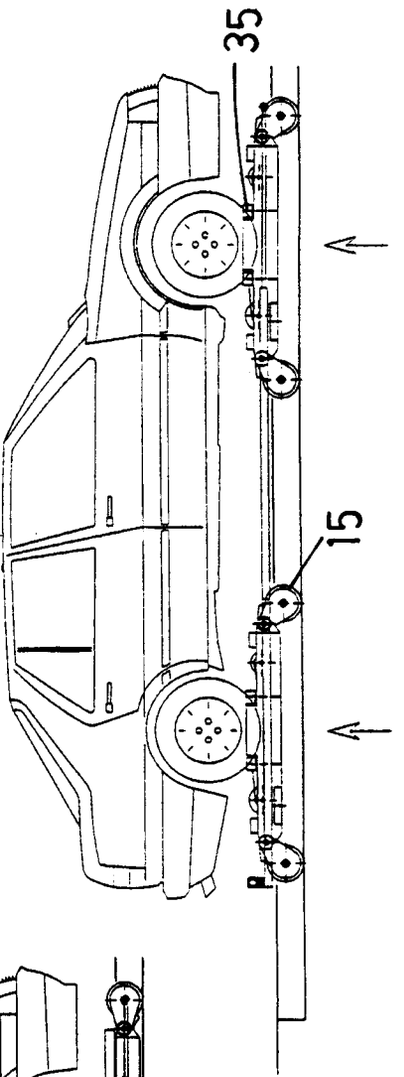

FIG8

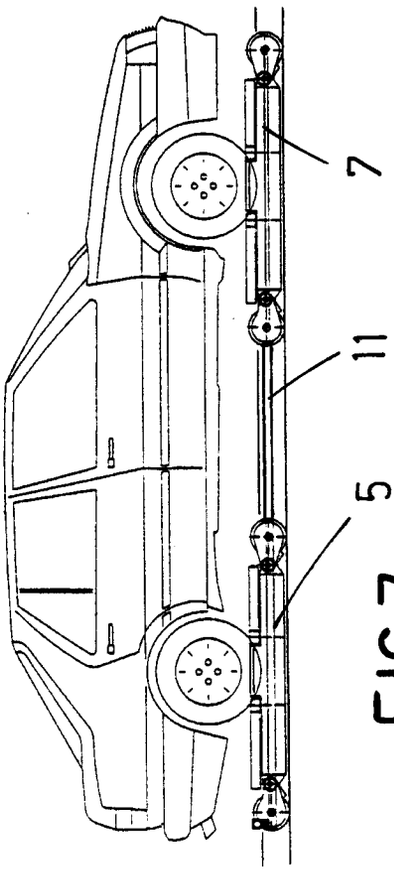

FIG.7

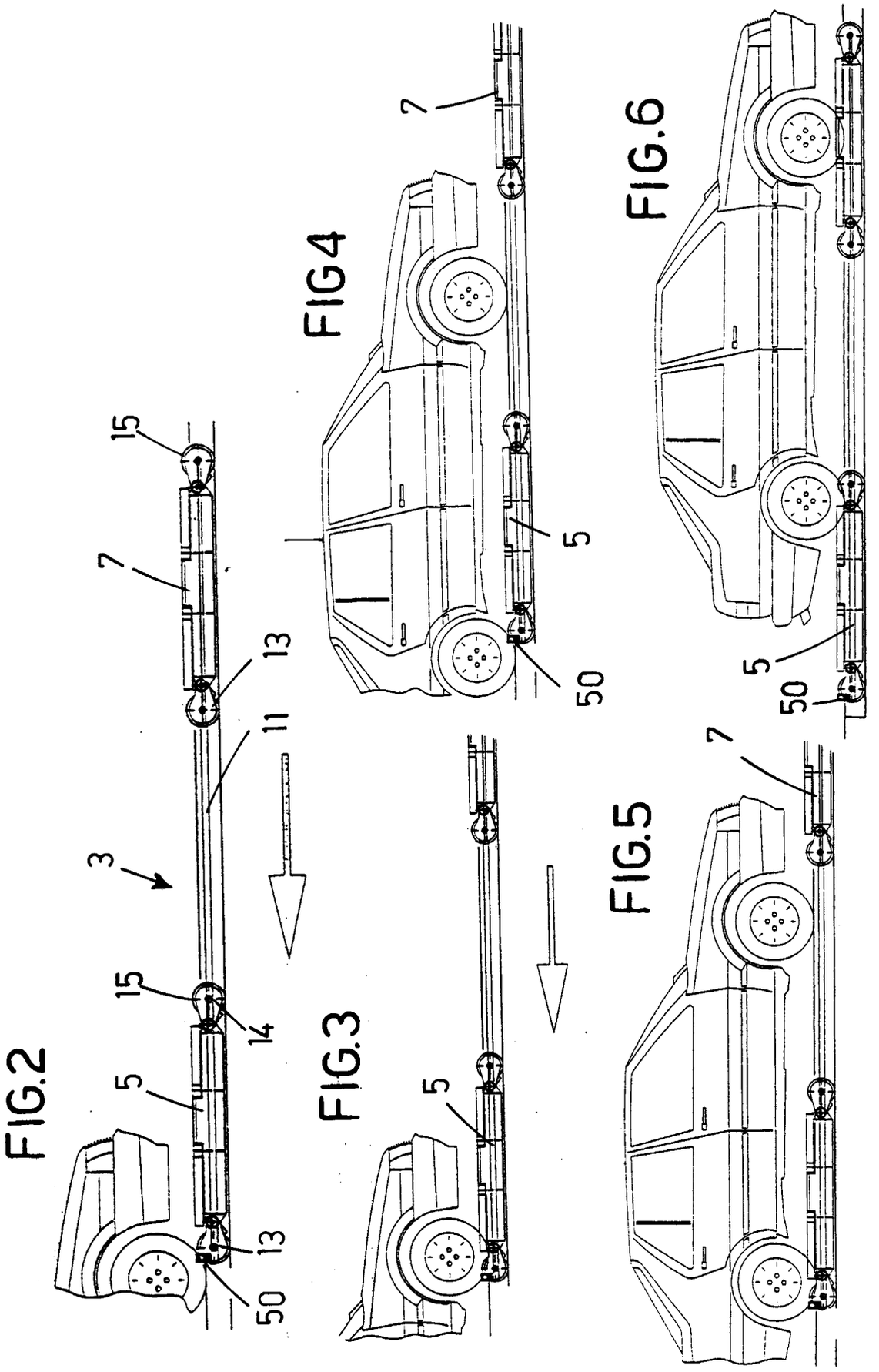
FIG.2
FIG.3
FIG4
FIG.5
FIG.6
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7
11
13
14
15
50

FIG.10

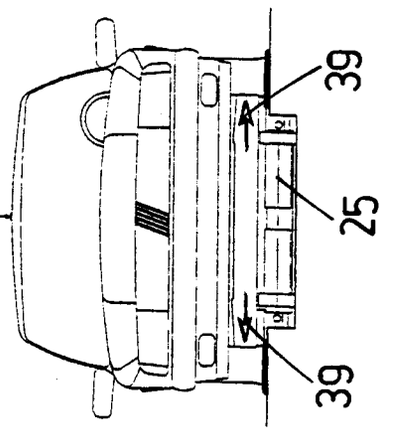


FIG.12

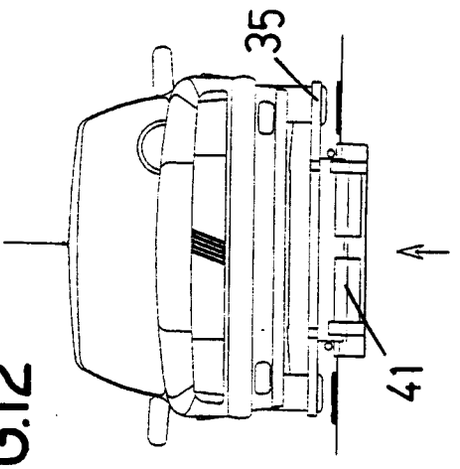


FIG.9

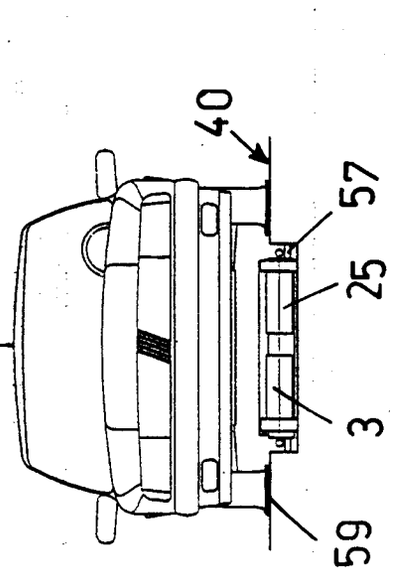
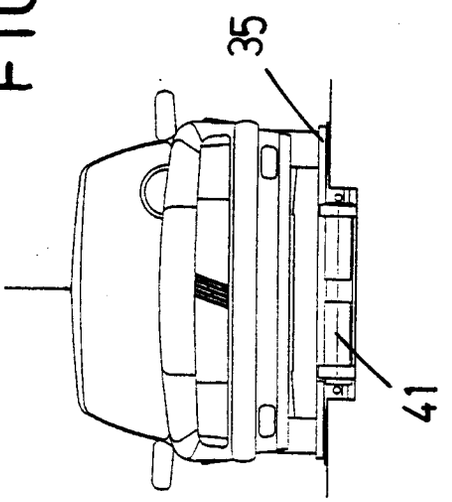


FIG.11



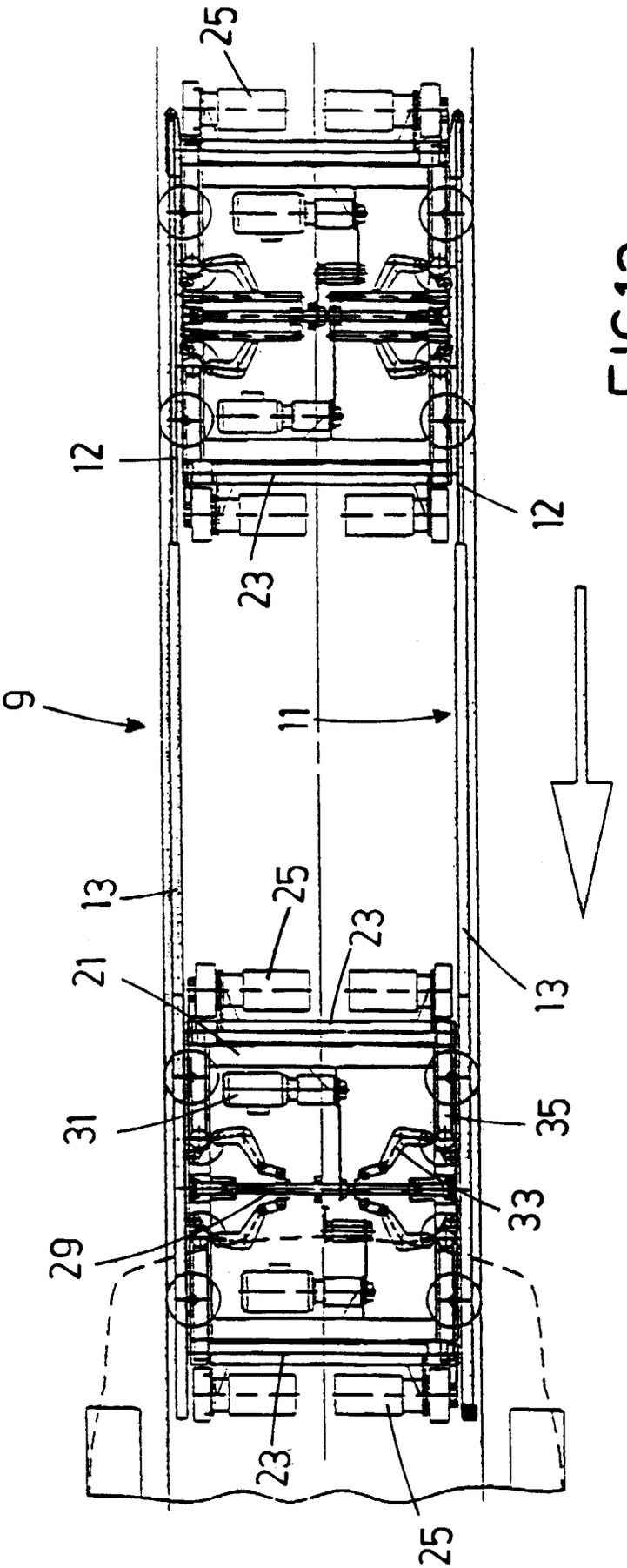


FIG.13

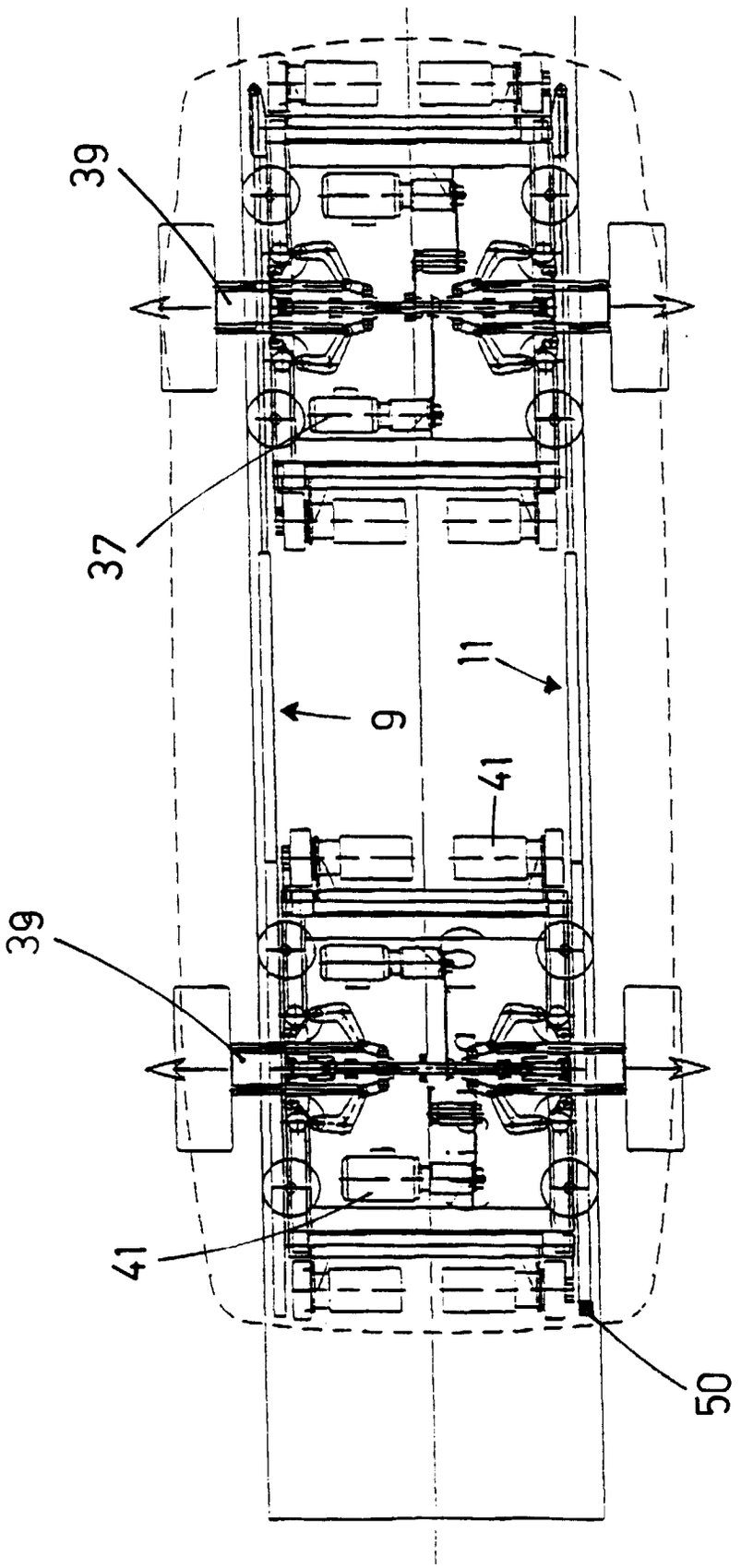


FIG.14

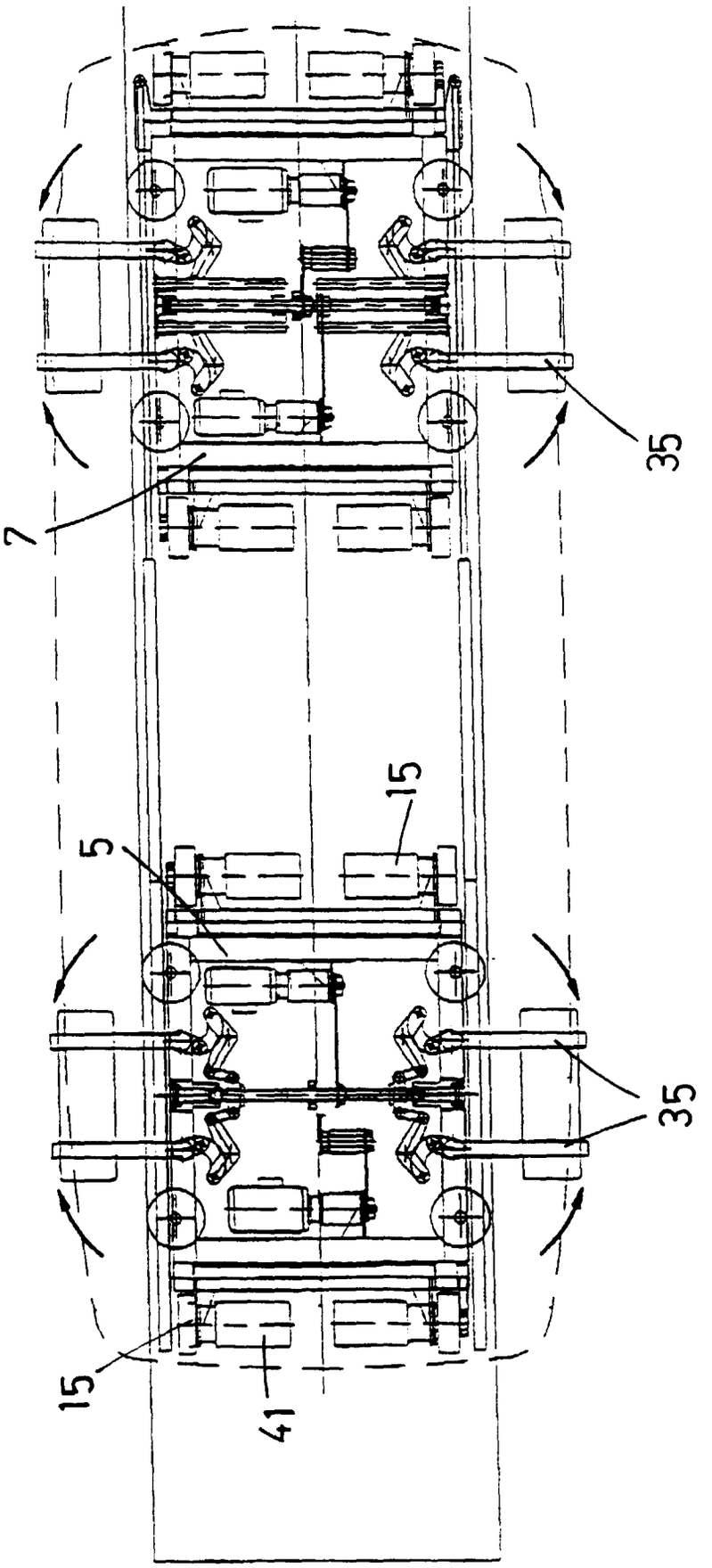


FIG.15

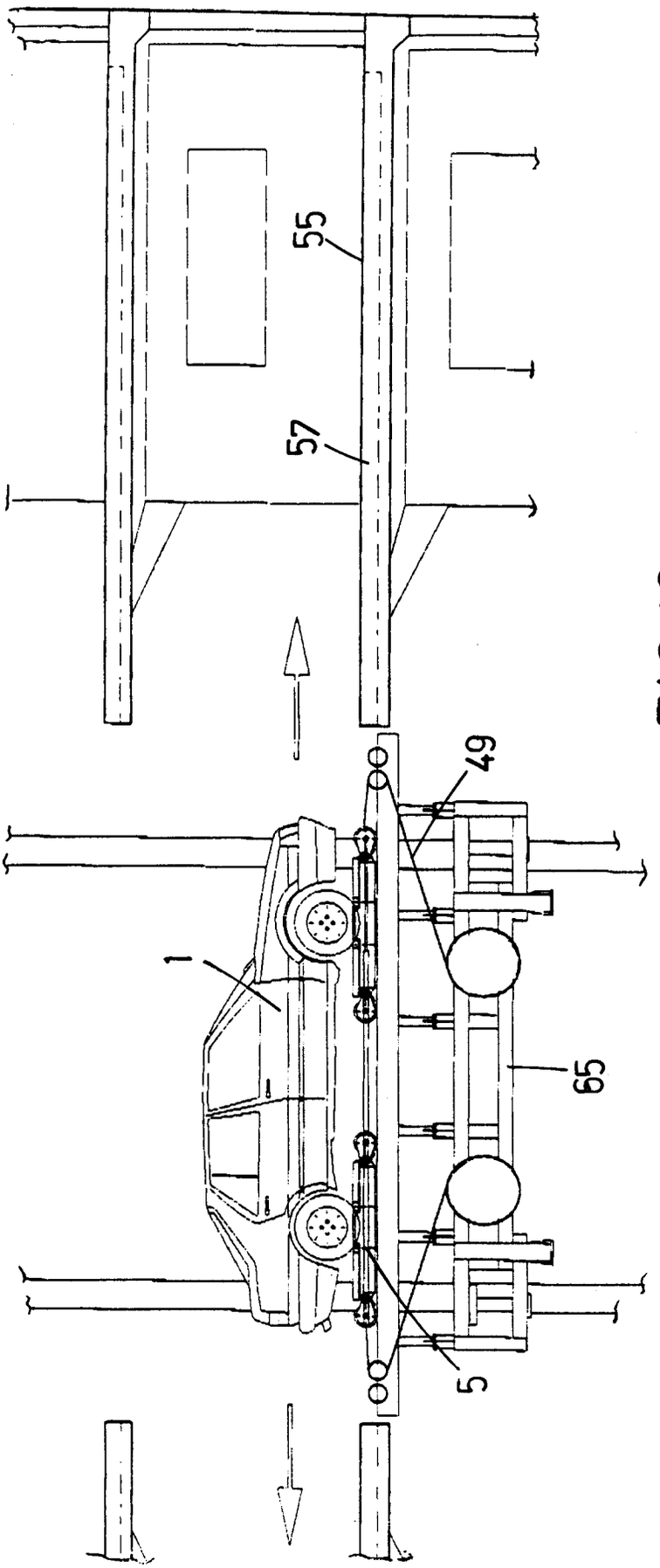


FIG.16