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Provisional Patent Application

for:

TOW TRUCK LOAD DISTRIBUTION SYSTEM

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TOW TRUCK LOAD DISTRIBUTION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention.

This invention is related to tow trucks and, more specifically, systems and methods of distributing the loads imposed by a towed vehicle.

2. Description of the Related Art.

Most tow trucks now being manufactured include means of lifting and towing vehicles by engaging the tires, axle, or suspension of the towed vehicle, lifting, and securing the towed vehicle to these means before transporting the towed vehicle from the load site. These means are called wheel lifts or underlifts. Examples of several configurations on the market are shown in FIGS. 1A through 1D.

FIG. 1A shows an L arm type wheel lift, in which the L arms 11 and 12 are manually inserted behind the tires 13 of the towed vehicle and pinned to the tow truck crossarm extensions 14 and 15. (See U.S. Pat. No. 4,637,623, issued in January 1987 to Bubik, and U.S. Pat. Nos. 4,679,978 and 4,836,737, issued in July 1987 and June 1989, respectively, to Holmes.) The tires of the towed vehicle are then secured to the L arms and crossarm usually by ratchet-strap assemblies 16. A secondary means of securing the towed vehicle to the tow truck is necessary for safety (and usually required by law). Such a means is represented by the chain assembly 17. (Two chain assemblies are actually used. One has been omitted in the figure for clarity.)

FIG. 1B is a claw type wheel lift. This example was disclosed in U.S. Pat. No. 4,473,334, issued in September 1984 to Brown. The claws 18 and 19 are kept at an angle with the crossarm 20 by means of springs 21 until the tires of the towed vehicle are contacted. The stinger 22 is then extended so that the claws are forced to their extreme outward angular position on the crossarm, and the tires are secured to the claws and crossarm, usually by means of strap and ratchet assemblies (not shown).

FIG. 1C is a wheel lift crossarm with hydraulically actuated L arms 23 and 24 that are pinned to the crossarm 25 and which swing out to contact and entrap the tires of the towed vehicle. This invention was disclosed in U.S. Pat. No. 4,564,207, issued in January 1986 to Russ. Straps (not shown) are used to secure the tires to the crossarm.

FIG. 1D is an axle or suspension lift crossarm on an underlift stinger. The axle or suspension components of the towed vehicle are secured to the forks 26 and 27 by means of straps or chains.

Wheel lift tow trucks can be used to tow light duty through heavy duty vehicles. Axle and suspension type underlift tow trucks are often used to tow medium duty and heavy duty vehicles, which are more likely to have straight axles and more robust suspensions than light duty vehicles.

Prior to the development of wheel lifts and underlifts, tow trucks incorporated means of securing the towed vehicle to a device such as a sling or tow bar that contacted the bumper and grill of the towed vehicle. This sling or tow bar was hung from the tow truck boom with a wire rope or chain. However, damage to the towed vehicle often resulted from the use of slings and towbars, and, as a result, wheel lifts and underlifts were developed.

When a tow truck lifts a vehicle, part of the load from the towed vehicle is distributed to the rear axle of the tow truck, and load is removed from the front axle of the tow truck because of the load moment from the lifted vehicle, for which the fulcrum is the rear axle of the tow truck. This effect is illustrated in the diagrams in FIGS. 2A and 2B. The tow truck 28, without load, is shown in FIG. 2A. The horizontal line 29 with associated arrows 31 and 32 represents the Free Body Diagram for the tow truck 28. In this diagram, 30 represents the Center of Gravity (CG) of the tow truck 28 without load, and the arrows at 31 and 32 represent the reaction forces at the front and rear axles, respectively, on the tow truck 28 from the road surface. The magnitudes of these reaction forces depend on the location of the CG and must equal the gravitational force on the mass represented by the CG when added together, as long as the tow truck 28 is in static equilibrium in the vertical direction. FIG. 2B illustrates the case in which the tow truck 28 has lifted a vehicle 33 by the tires of the vehicle 33 using one of the wheel lift means 34 in common use today. The CG 30 in the diagram still represents the mass of the tow truck 28 only. However, arrow 35 in the force balance diagram 29 has been added to represent the load imposed on the tow truck 28 by lifting one end of the vehicle 33 to be towed. This load 35 alters the magnitudes of the reaction forces

31 and 32 at the front and rear axles of the tow truck 28. It has reduced the value of 31 and increased the value of 32. The numerical values of these reaction forces may be calculated by algebraically expressing vertical force equilibrium and moment equilibrium for the Free Body Diagram illustrated.

One unfortunate result of using wheel lift and underlift tow trucks is that the load distribution on the axles of the tow truck, as illustrated in FIG. 2B, is more adversely affected than it was with slings and towbars. This occurs for the following reasons:

a. The point of contact with the towed vehicle is further from the tow truck rear axle with a wheel lift or underlift, resulting in a greater moment about the fulcrum (rear axle of the tow truck).

b. Lifting a vehicle at its wheels or axle results in a lesser mechanical advantage for lifting the mass of the towed vehicle than lifting the vehicle from a position at the bumper of the towed vehicle.

These effects on the load distribution for a tow truck result in potentially dangerous conditions. Adding load to the rear axles of the tow truck can cause the carrying capacity of the axle, tires, springs, brakes, and bearings to be exceeded. In addition, overloading the rear tires reduces sidewall flexibility and, consequently, adversely affects handling and control. Removing load from the front axle of the tow truck can result in reduced steering and braking response because these functions depend on the friction forces available between the tires and road surface, and these friction forces depend on the normal force between the tires and the road surface. It is an accepted criterion in the tow truck industry that reducing the load at the front axle of a tow truck by more than fifty percent is not safe.

For a tow truck to meet specific lift and tow rating criteria, the tow truck designer must provide body and chassis structures that satisfy the appropriate factors of safety, a hydraulic system that provides sufficient hydromechanical power to perform the required lift and tow functions, and a weight distribution that is safe. Structural and hydraulic design issues are relatively straightforward. Incremental cost effects of changes in these systems are nominal. However, design measures currently used to adjust weight distribution of the tow truck can significantly affect the labor and materials costs for the tow truck body and the chassis cab on which the body is mounted. To maintain a safe load distribution at the axles of a given tow truck, tow truck manufacturers do two things:

a. Increase the wheel base of the tow truck to move the Center of Gravity of the tow truck further from the rear axle (fulcrum) to better balance the opposing moment from the towed vehicle.

b. Add mass as ballast to the front of the tow truck.

Option (a) adds to the total cost of manufacturing and installing a tow truck body because significantly more materials and labor are required to build the additional length into the tow truck body (or add filler toolboxes) and to provide for longer truck frames, driveshafts, and electrical and fluid lines. This option increases the turning radius of the tow truck, and maneuverability is an important feature for any tow truck. Limited maneuverability limits the range of vehicle a tow truck can be used to tow because it will not be able to fit into some areas to pick up a disabled or illegally parked vehicle. It also adds additional weight to the tow truck, which affects operating cost and carrying capacity (Gross Vehicle Weight Rating and highway vehicle weight limits).

Option (b) adds to the installation cost for the tow truck and can have deleterious effects on steering and braking, depending on the amount of ballast added.

Thus, there is a need in the art for improved systems and methods of distributing the loads imposed on tow trucks by towed vehicles. However, the prior art does not satisfy this need.

Consider, for example, the prior art references set forth below, all of which are incorporated by reference herein.

The following are patents for the wheel lift and underlift configurations currently in use in the tow truck industry:

4,473,334	9/1984	Brown
4,564,207	1/1986	Russ
4,637,623	1/1987	Bubik
4,679,978	7/1987	Holmes
4,836,737	6/1989	Holmes
5,350,271	9/1994	Weller
5,762,465	6/1998	Zackovich
5,988,974	11/1999	Zackovich
6,095,748	8/2000	Zackovich

The following are patents covering the use of load distribution systems for towing trailers:

2,223,375	9/1939	Le Tourneau
2,453,941	11/1948	Smit
2,549,814	4/1951	Hume
2,597,657	5/1952	Mathisen
2,817,541	12/1957	Mathisen
3,542,394	11/1970	Palage
5,626,356	5/1997	Harwood
5,951,036	9/1999	Sargent
5,984,341	11/1999	Kass *et al.*
6,860,501	3/2005	Schmidt *et al.*

The following are advertising brochures for tow trucks currently on the market:

- Miller Industries, www.millerind.com/products, product information for Century, Holmes, Chevron, Vulcan, and Eagle tow trucks and car carriers;
- Zacklift, www.zacklift.com, product information for Zacklift add-on underlifts;

- Jerr-Dan Corporation, www.jerrdan.com, product information for Jerr-Dan tow trucks and car carriers;
- NRC, www.nrc-industries.com, product information for NRC tow trucks and carriers.

The following is an SAE International Surface Vehicle Recommended Practice:

- SAE J2512 Issued Aug1999: Towing Equipment Ratings and Practices.

The following is an article from Popular Mechanics Magazine, February 2011 (page 16):

- "Europe's Closely Watched Roads: An International Program to Improve Highway Safety Increases Roadside Surveillance – and Aggressive Law Enforcement".

None of the existing patents for tow trucks and towing equipment addresses the issue of load distribution between the front and rear axles of the tow truck or car carrier. Load distribution mechanisms for trailers, however, were documented in patents as far back as 1939. Patent No. 2,597,657, Mathisen, presents the configuration for trailer load distribution systems which is generally in common use for trailers currently. Patents developed since then, including a second patent by Mathisen, No. 2,817,541, modified and improved the hardware used to redistribute the load on vehicles towing trailers. The common configuration described by these trailer load distribution patents consists of a linkage parallel and beneath the tongue of the trailer which is connected to the tow hitch on the tow vehicle in such a way that it can transmit a moment to the tow vehicle frame through the tow hitch. The other end of the linkage is connected to the tongue of the trailer by mechanical means (usually with a chain) that can be tensioned so that an upward vertical force may be applied to the linkage, thereby creating a moment. (These trailer load distribution devices are actually required by law for some classes of trailer tow hitch.) However, none of the trailer load distribution patents addresses tow trucks and car carriers or the very different geometry and load configuration that tow trucks and car carriers present.

The advertising brochures from the web sites listed represent the products offered by the major tow truck manufacturers in the US. These brochures show that the wheel lift and underlift configurations used in the industry are very similar and that the invention disclosed herein can be applied with probable common success to all brands of tow truck.

SAE J2512 is a recommended practice for designing and rating tow trucks. It includes the accepted guideline in the industry that removing more than 50 percent of the weight from the front axle of the tow truck when loaded is not recommended.

The Popular Mechanics article discusses automated systems being evaluated in Europe for detecting unsafe conditions of highway vehicles. It includes high speed scales embedded in traffic lanes that calculate the load balance between a commercial vehicle's axles and report these data.

SUMMARY OF THE INVENTION

A system is needed in the tow truck industry that distributes the load from a towed vehicle between the front and rear axles of the tow truck in a less disadvantageous manner without the necessity of extending the tow truck body and chassis or adding ballast to the front of the tow truck. This system would keep the reaction force at the front axle of the loaded tow truck at a value closer to the original reaction force before the vehicle to be towed was loaded on the tow truck and would reduce the tendency to overload the rear axle of the tow truck when lifting and towing a vehicle. This system would, therefore, allow tow truck manufacturers to build tow trucks with shorter wheelbases to tow the same loads and would increase the towing capacity of tow trucks with long wheel bases. The result would be significant decreases in cost to manufacture and install tow trucks with given capacities.

This invention provides a means of creating a moment at the contact point between the tow truck and the towed vehicle which counteracts the load imposed on the rear axle of the tow truck and the force that is removed from the front axle of the tow truck when the towed vehicle is lifted. This moment is created by either:

(a) Attaching a load distribution connector such as a chain, wire rope, strap, spring, wire rope assembly, turnbuckle or similar construct or combination of such constructs from the rear surface of the wheel lift or axle/suspension lift mechanism to the frame, crossmember, or other rigid part of the towed vehicle at a point to the rear of the tires being lifted by the tow truck. This construct is then tensioned before the vehicle is towed, so that a moment is created in the tow truck boom that will be transmitted to the tow truck frame and body.

(b) Attaching a mechanism which is mechanical, hydraulic, or otherwise powered at the front surface of the wheel lift of axle/suspension lift mechanism and energizing the mechanism to apply upward force between the tow truck lift mechanism and the frame, crossmember, or other rigid part of the towed vehicle. This upward force creates a moment in the tow truck boom with the same rotation direction as Option (a).

There are a number of advantageous effects resulting from the invention. Specifically, this invention will do the following:

(a) Effect a safer load distribution on a tow truck from a towed vehicle by reducing the load on the rear axle and increasing the load on the front axle, compared to the same tow truck without the invention.

(b) Reduce the necessity of increasing the wheelbase of a tow truck or adding ballast to the front of a tow truck in order that the tow truck lift and tow vehicles in a given weight range.

(c) Reduce the cost, complexity, and unladen weight of a tow truck due to the removed necessity for a long wheel base or ballast.

(d) Provide a system that is compatible with common means of lifting and towing vehicles.

(e) Provide a system that uses available mechanical means and hardware that is similar to that commonly used in the towing industry.

(f) Provide a system that is convenient and safe to use for a trained tow truck operator.

(g) Reduce the potentially dangerous oscillatory effects of towing a load whose mass is suspended from the tow truck boom and wheel lift or axle/suspension lift by springs (i.e., the suspension of the towed vehicle). This changes a “live” load to a more easily handled “dead” load. With the live load, the force on the tow truck is constantly varying. At times the load exceeds the actual weight of the static load as force is used to change the kinetic energy of the moving mass of the towed vehicle, and then the load is reduced to values below the static load as the kinetic energy is reversed again. Oscillatory loads like this can exceed the capacity of the towing equipment and can result in fatigue failure of tow truck components.

(h) Improve handling of the tow truck while towing a vehicle, by reducing the swaying effect of a sprung mass tied to the tow truck wheel lift or underlift.

(i) Possibly replace one of the two means of securing the towed vehicle to the tow truck (i.e., wheel lift straps and chains between the tow truck body and the frame or axle of the towed vehicle – usually required by state law in the United States).

(j) Use the suspension of the towed vehicle to secure the vehicle to the tow truck in a manner that reduces or eliminates oscillation of the towed vehicle and makes it less likely for a towed vehicle to break the means of securing it to the tow truck or damaging a component of the towed vehicle, for the reasons discussed in (g).

(k) Reduce the need for suspension leveling systems on tow trucks, like modified rear springs, overload springs, and pneumatic adjustable springs and shock absorbers.

In one aspect of the present invention, a tow truck load distribution system is disclosed for a tow truck having a front axle, a rear axle, and a lift arm for supporting one end of a vehicle. The tow truck load distribution system comprises a load distribution connector having a first end and a second end. The first end of the load distribution connector is attached to the lift arm and the second end of the load distribution connector is shaped for attaching to a rigid part of the vehicle. The load distribution connector creates a moment when the lift arm supports the one end of the vehicle. This moment is located at a contact position where the lift arm supports the one end of the vehicle and counteracts a load imposed on the rear axle of the tow truck and a force removed from the front axle of the tow truck when the vehicle is supported by the lift arm.

In one embodiment, tensioning of the load distribution connector before the vehicle is towed creates a moment in the lift arm that is transmitted to the tow truck.

In another embodiment, the first end of the load distribution connector is attached to a rear surface of the lift arm and the second end of the load distribution connector is attached to a point behind a tire on the one end of the vehicle when the vehicle is supported by the lift arm.

In a further aspect of the present invention, a tow truck load distribution system is disclosed for a tow truck having a front axle, a rear axle and a lift arm for supporting one end of a vehicle. The tow truck load distribution system comprises a mechanism for applying an upward force on the one end of the vehicle. The system also comprises a load distribution connector having a first end and a second end. The first end of the load distribution connector is attached to the lift arm and the second end of the load distribution connector is shaped for attaching to a rigid part of the vehicle. The upward force by the mechanism creates a moment when the lift arm supports the one end of the vehicle. This moment is located at a contact position where the lift arm supports the one end of the vehicle and counteracts a load imposed on the rear axle of the tow truck and a force removed from the front axle of the tow truck when the vehicle is supported by the lift arm.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

FIGS. 1A through 1D illustrate examples of wheel lift and underlift tow trucks in common use today.

FIGS. 2A through 2C illustrate in diagrammatic form the effect of the load induced by the towed vehicle on the tow truck, both with and without the invention.

FIG. 3 is one means of incorporating the invention, shown for an L arm type wheel lift, although it would work just as well on any of the typical wheel lifts in use today, including but not limited to those shown in FIGS. 1A through 1C.

FIG. 4 illustrates the invention installed on an underlift tow truck that has lifted a vehicle by means of forks which have engaged the towed vehicle’s axle.

FIGS. 5A and 5B show how the load distribution connector, such as a chain, strap, wire rope, turnbuckle, or spring assembly, can be tensioned simply by lowering the towed vehicle from its initial lifted elevation and allowing the change in geometry to pull the load distribution connector tight.

FIGS. 6 through 11 are various embodiments of the load distribution connector, depicting alternative assemblies using straps, chain, springs, turnbuckles, and load binders.

FIG. 12 illustrates an embodiment of the invention that includes a means of measuring the tension on the assembly.

FIGS. 13A and 13B illustrate an embodiment of the invention that provides a means of limiting the load on the invention and the force at the point of attachment to the towed vehicle.

FIG. 14 shows an embodiment of the invention that provides for adjustment in length.

DETAILED DESCRIPTION OF THE INVENTION

In the following description of the preferred embodiment, reference is made to a specific embodiment in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

Effect of the Invention

In one example, the effect of this invention is illustrated in the diagram in FIG. 2C. The load distribution connector 36 has added a vertical force 37 to the Free Body Diagram 29. The effects of this force are to increase the reaction force 31 at the front axle of the tow truck 28 and to reduce the reaction force 32 at the rear axles of the tow truck 28, compared to the values for these forces in FIG. 2B.

Embodiments of the Invention

Various embodiments of the invention are set forth below.

One embodiment of the invention is shown in FIG. 3. This figure shows an L arm type of wheel lift, but the invention can be used just as easily with any of the other types of wheel lift and underlifts in common use. A loop or ring 38 is attached by welding or other mechanical means to the back surface of the L arm 11. A set of holes cut into the back surface could also be used. The figure shows a chain assembly 39 which is attached by means of a latch hook 40 to the loop 38 in the L arm at one end, and to the towed vehicle frame 41, crossmember, or other rigid part of the towed vehicle at the other end. In the figure, this other end has a "T" hook 42, but it could also be any of several types of open hooks, latch hooks, or grab hooks, or an assortment of same. The T hook is in common use on many chain and strap assemblies used in towing, because most vehicles on the road today have slots 43 cut in their frames for the specific use of inserting a T hook. The presumptive purpose for these slots is to facilitate tying down the vehicles during transit on ships and in trailers and car haulers. These slots are typically located at strong points in the frame of vehicles. Generally, one or more T hook slots are often located on the portion of the vehicle frame running between the wheel openings of the car and in close proximity to the wheel and tire. In other words, the slots are generally located in the appropriate location for attaching the chain assembly 39 shown in the figure. In addition to T hook slots, there is normally a number of round and keyhole shaped holes in most vehicle frames that can accommodate other types of hooks, and chain, wire rope, and strap hardware.

FIG. 4 illustrates the use of the invention with an underlift tow truck. This figure shows the towed vehicle frame 44, axle 45, suspension 46, and tires 47 and 48. The body of the vehicle and sections of the frame have been omitted from the illustration for clarity. The underlift stinger 49 has been extended from the tow truck to position the crossarm 50 under the towed vehicle, and the forks 26 and 27 have engaged the axle of the towed vehicle. The invention, comprising load distribution connectors in the form of chain assemblies 52 and 53, has been installed so that the chain assemblies connect loops 54 and 55 on the fork receivers 56 and 57, respectively, to the frame 44 of the towed vehicle. This is but one example of how the invention can be deployed on an underlift tow truck. It can be used on such trucks when they engage the towed vehicle by means of the axle, frame, or suspension, and it can be secured to the towed vehicle by attaching to the vehicle frame, suspension, or other suitable structural member.

FIGS. 5A and 5B show how the invention can be easily tensioned when installed between the tow truck wheel lift grid or underlift forks and the frame or suspension of the towed vehicle. In FIG. 5A, the tow truck has engaged the tires of the towed vehicle and raised one end of the vehicle. The load distribution connector in the form of a chain assembly 39 has been installed between the wheel lift grid 58 and the frame 59 of the towed vehicle. Because of the pivotal geometry of the tow truck boom 60, the wheel lift grid 58 actually moves in an arc as it is raised, and is, therefore, closer to the towed vehicle frame in the raised position than it is when the boom is lowered. Tensioning the chain assembly 39 can be accomplished by simply lowering the vehicle to the appropriate elevation for towing. As the vehicle is lowered, the tension in the chain assembly 39 is increased to a taught condition, after which the action of further lowering the tow truck boom causes the suspension of the towed vehicle to be compressed. If the towed vehicle has insufficient mass to create the required tension, the hydraulic lift cylinder actuating the tow truck boom 60 up and down can be used to pull the wheel lift grids 58 down.

Other embodiments of the invention can use any of several other means of connecting the back surface of the L arm or other wheel lift or underlift mechanism to the towed vehicle frame. One of these is illustrated in FIG. 6. The straps 61 and 62 in this assembly would be made from a webbing material such as nylon. The ratchet 63 in the assembly would be used to apply a preload tension or full tension to the strap once it is connected between the tow truck and the towed vehicle. Similar nylon strap assemblies are in common use on tow trucks, car carriers, and car haulers and have capacities in the thousands of pounds force. A latch hook 40 and a T hook 42 are shown at the ends of the assembly in this figure, but a variety of readily available hooks, D rings, and loops can be used for the ends.

The chain/spring assembly shown in FIG. 7 offers the advantage of overload protection to prevent damage to the towed vehicle frame, if this is a potential concern. The spring 64 is a tension spring and can be designed to have a specific spring rate. Thus, any force on the assembly will be divided between the force necessary to extend the spring and the force on the attachment point on the towed vehicle. A strap or wire rope could be used in place of the chain in this assembly, and a variety of hooks, D rings, or loops could be used singly or in combination at each end.

FIG. 8 illustrates an embodiment of the invention using a section of wire rope 65 which is attached to a latch hook 40 at one end and a T hook 42 at the other end by means of crimp ferrules 66. All components of this assembly are readily available in the industry and fabricating this type of assembly is simple and straightforward.

The turnbuckle assembly shown in FIG. 9 is a further embodiment of the invention which provides means of connecting the towed vehicle frame and the wheel lift mechanism adjustably. When the turnbuckle nut 67 is turned in one direction, both screw ends 68 and 69, which have threads opposite to each other, retract into the nut 67, thus tensioning the assembly. When the nut 67 is turned in the other direction, tension in the assembly is decreased. The turnbuckle can be used to adjust both the length and tension of this embodiment of the invention. This illustration shows a latch hook 40 at one end of the assembly, and an assortment of three types of hook 42, 70 and 71 at the other end. This assortment affords the tow truck operator a choice of the best means of attachment for any vehicle being towed.

FIG. 10 illustrates another type of turnbuckle assembly. This one has a built-in ratchet mechanism 72 and handle 73. This handle may be removable. Such ratchet mechanisms, both with and without removable handles, are readily available in the industry.

FIG. 11 illustrates a further embodiment of the invention. This embodiment incorporates a “load binder” mechanism 74 with a handle 75 that, when moved downward in the illustration, shortens the overall length of the assembly and increases the tension in the assembly. All components shown in this illustration are readily available in the industry.

A further embodiment of the invention is illustrated in FIG. 12. This embodiment incorporates a means of measuring the tension in the assembly when it is installed between the tow truck and the towed vehicle. The tension measurement means 76 shown in the figure is the “fish scale” type. When force is applied to the ends 77 and 78, a calibrated compression spring inside the housing of the scale is compressed, and the force associated with the distance the spring is compressed may be read on graduations printed on the face of the scale 76. Alternative means of measuring tension in such an assembly, some of which are known as load cells, are available in the industry with varying levels of accuracy and technical sophistication. These can incorporate linear, dial, or digital readouts.

FIGS. 13A and 13B illustrate an embodiment of the invention that provides a means of limiting tension in the assembly. This tension limiter 79 is shown in an assembly view in

FIG. 13A and in a section view in FIG. 13B. It consists of a cylindrical barrel 80 and a rod 81 which is connected to a cylindrical piston 82. The limiter contains a fluid 83 which could be commercially available hydraulic fluid or anything similar. The piston 82 has seals 84 installed in machined grooves in its curved surface which prevent significant leakage of the fluid 83 from the rod side of the piston to the blind side. When tension is applied to the assembly, the force on the rod 81 causes an increase in pressure in the fluid 83. However, movement of the piston is prevented by the check valve 85 in the fluid line leading from the rod end of the limited to the blind end of the limiter. This fluid line is the only means of escape for the fluid from the pressurized side of the piston. The check valve 85 is a pilot-operated type which is often used as a pressure limiting valve and which has reverse free flow. These valves are readily available in the industry. Flow of fluid from the rod end of the limiter is prevented until a preset pressure in the fluid on the rod side of the piston is reached. When this pressure is reached, the fluid flows from the rod end of the limiter into a bellows 86 inside the blind end of the limiter. (This bellows is necessary because the volume of fluid from the rod end of the limiter does not equal the volume created by the movement of the piston away from the blind end of the limiter because of the volume of the rod itself in the rod end of the limiter. Air entrainment may result without the bellows.) The preset pressure may be adjustable. When tension on the rod 81 is reduced to a value corresponding to fluid pressure below the setting, the internal tension spring 87 causes the piston 82 to move to the right in the illustration and the rod 81 retracts. Fluid flows through the reverse free flow channel in the valve 85 from the bellows 86 in the blind end of the limiter back to the rod end, and the limiter is again locked.

FIG. 14 shows an embodiment of the invention that can be adjusted in length to suit different towed vehicles. Different vehicles will have different ground clearances, and slots for T hooks will be located in different locations on different vehicles. This embodiment includes two or more grab hooks 88 that are fixed securely by welding or other means to the back surface of the wheel lift grid or underlift crossarm. At least one of the hooks is mounted in an open downward orientation, and at least one hook is mounted in an open upward orientation. The chain assembly 89 will include means at one end to attach to the towed vehicle. In the figure, a T hook 42 is shown, but this may be one or more of a number of attachment means such as those discussed herein. The chain is secured at the other end to the tow truck by sliding links of the chain into the grab hooks 88, using the downward oriented grab hook last before the chain extends to the towed vehicle. When the chain assembly is tensioned, the opposed set of grab hooks will keep the chain attached to the wheel lift grid or crossarm.

It is anticipated that several types and lengths of load distribution connectors would be carried on a typical tow truck or car carrier employing this invention so that a variety of towing conditions and situations could be satisfied by the same truck. It is known in the industry that there are techniques for shortening a length of chain. One technique is to twist the chain (for some types of chain) before tensioning it, and another technique is to attach a "choker" chain assembly, consisting of a length of chain with a grab hook on each end, to the main chain assembly in such a way that the overall length is reduced. It is also possible that one of the main assemblies could be permanently or semi permanently attached to the back surface of the wheel lift or underlift if it is found convenient to do so. This attachment could be achieved by bolting, welding, or pinning one end to the wheel lift or underlift.

Industrial Applicability

This invention can be applied to almost all tow trucks and car carriers being manufactured and installed in the market today, because almost all have either wheel lift booms or underlifts. It can also be applied as a retrofit kit to all wheel lift and underlift tow trucks and car carriers already in use. The kit would be composed of a metal loop or slot which can be attached to the existing lift arm (e.g. wheel lift grid, axle fork holder, or crossarm of the in-use tow truck); and a pair or a selection of pairs of load distribution connectors (e.g. strap, chain, spring, wire rope, and turnbuckle assemblies) depending on the rated capacity of the tow truck, for towing different types of vehicle within the rated capacity.

Conclusion

This concludes the description of the preferred embodiment of the present invention. The foregoing description of one or more embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

WHAT IS CLAIMED IS:

1. A tow truck load distribution system for a tow truck having a front axle, a rear axle and a lift arm for supporting a vehicle, the system comprising:

a load distribution connector comprising a first end and a second end, said first end of the load distribution connector being attached to the lift arm and said second end of the load distribution connector being shaped for attaching to a rigid part of the vehicle;

wherein the load distribution connector creates a moment when the lift arm supports one end of the vehicle, said moment located at a contact position where the lift arm supports the one end of the vehicle and wherein the moment counteracts a load imposed on the rear axle of the tow truck and a force removed from the front axle of the tow truck when the vehicle is supported by the lift arm.

2. The system of claim 1, wherein tensioning of the load distribution connector before the vehicle is towed creates a moment in the lift arm that is transmitted to the tow truck.

3. The system of claim 1, wherein the first end of the load distribution connector is attached to a rear surface of the lift arm and the second end of the load distribution connector is attached to a point behind a tire on the one end of the vehicle when the vehicle is supported by the lift arm.

4. The system of claim 1, wherein the lift arm is a wheel lift, underlift, axle lift, or suspension lift.

5. The system of claim 1, wherein the load distribution connector comprises a chain, wire rope, wire rope assembly, strap, spring, tension spring, turnbuckle or any combination thereof.

6. The system of claim 1, wherein the first and second ends of the load distribution connector comprises a T-hook, open hook, latch hook, grab hook, D ring or loop.

7. The system of claim 1, wherein the rigid part of the vehicle is a vehicle frame or crossmember.

8. The system of claim 7 wherein the second end of the load distribution connector is a T-hook shaped for engaging with a slot in the vehicle frame.

9. A tow truck load distribution system for a tow truck having a front axle, a rear axle and a lift arm for supporting a vehicle, the system comprising:

a mechanism for applying an upward force on one end of the vehicle; and

a load distribution connector comprising a first end and a second end, said first end of the load distribution connector being attached to the lift arm and said second end of the load distribution connector being shaped for attaching to a rigid part of the vehicle;

wherein the upward force by the mechanism creates a moment when the lift arm supports the one end of the vehicle, said moment located at a contact position where the lift arm supports the one end of the vehicle and wherein the moment counteracts a load imposed on the rear axle of the tow truck and a force removed from the front axle of the tow truck when the vehicle is supported by the lift arm.

TOW TRUCK LOAD DISTRIBUTION SYSTEM

ABSTRACT OF THE DISCLOSURE

A tow truck load distribution system for a tow truck having a front axle, a rear axle, and a lift arm for supporting a vehicle. The system comprises a load distribution connector having a first end and a second end. The first end of the load distribution connector is attached to the lift arm and the second end of the load distribution connector is shaped for attaching to a rigid part of the vehicle. The load distribution connector creates a moment when the lift arm supports one end of the vehicle. This moment is located at a contact position where the lift arm supports the one end of the vehicle and counteracts a load imposed on the rear axle of the tow truck and a force removed from the front axle of the tow truck when the vehicle is supported by the lift arm.