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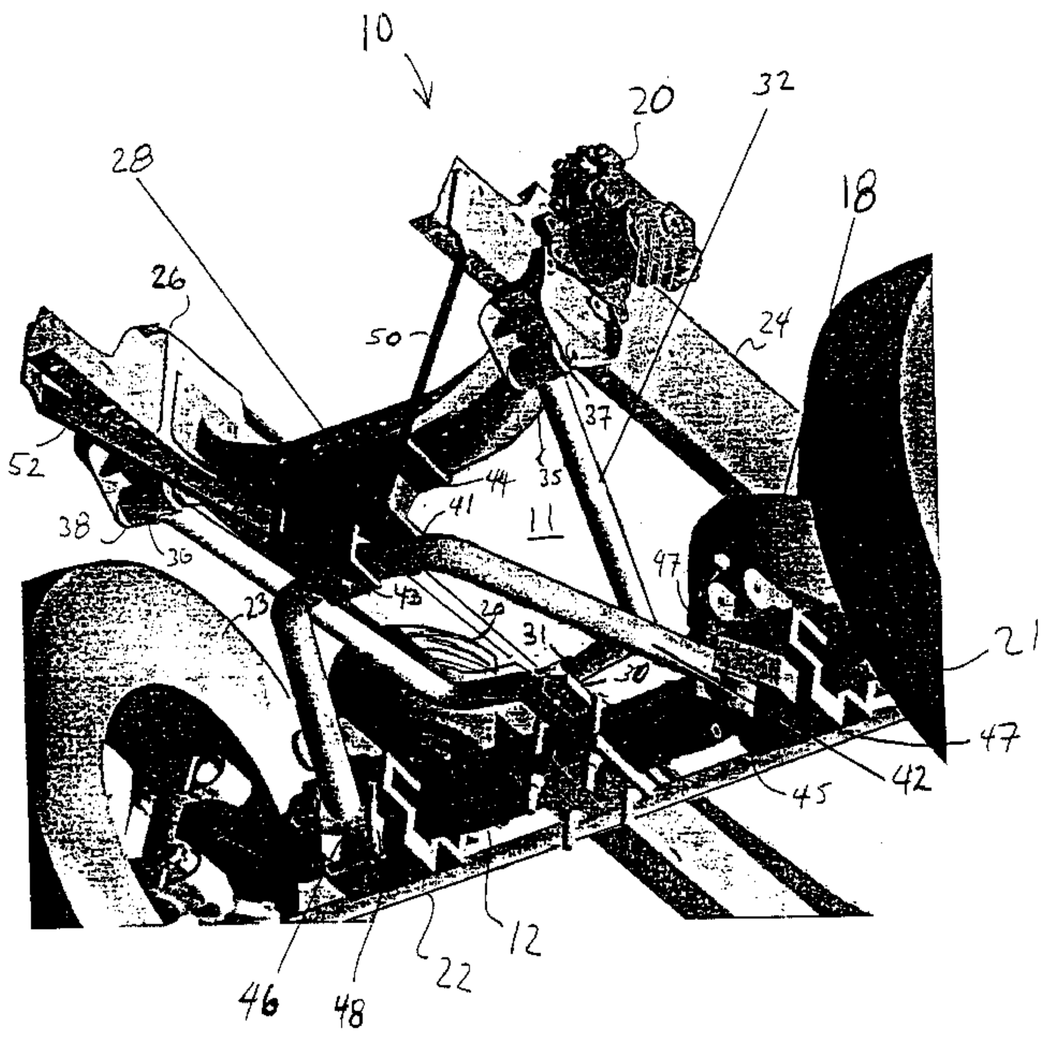
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(72) WARINNER, DEREK K., US
(72) VIG, JUSTIN W., US
(71) NAVISTAR INTERNATIONAL TRANSPORTATION CORP., US

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(54) **SYSTEME DE STABILISATION A DEUX BIELLETTES EN V POUR SUSPENSIONS PNEUMATIQUES**

(54) **DOUBLE V-LINK STABILIZING SYSTEM FOR AIR SPRING SUSPENSIONS**



(57) A system for stabilizing the location and attitude of an axle on a vehicle using an air spring suspension is disclosed. A first V-link member, having a first end, a second end and an apex section between its first and second ends, is pivotally attached at each end to opposings ends of the axle and pivotally mounted from the vehicle frame at a point centered between elongated frame rails and displaced from the axle in the direction of elongation of the frame. A second V-link member, having a first end, a second end and an apex section between the first end and the second end, is mounted between the vehicle and the axle by pivotally attaching its first and second ends to the outside frame rail at points displaced from the axle parallel to the direction of elongation of the frame and by a third pivot mount to the center of the axle. The points of attachment of the first V-link member are vertically displaced from the points of attachment of the second V-link member to avoid the attachment points of different V-link members being coaxial with the roll axis of the vehicle.

Docket No. D-4886

ABSTRACT OF THE DISCLOSURE

DOUBLE V-LINK STABILIZING SYSTEM FOR AIR SPRING SUSPENSIONS

A system for stabilizing the location and attitude of an axle on a vehicle using an air spring suspension is disclosed. A first V-link member, having a first end, a second end and an apex section between its first and second ends, is pivotally attached at each end to opposings ends of the axle and pivotally mounted from the vehicle frame at a point centered between elongated frame rails and displaced from the axle in the direction of elongation of the frame. A second V-link member, having a first end, a second end and an apex section between the first end and the second end, is mounted between the vehicle and the axle by pivotally attaching its first and second ends to the outside frame rail at points displaced from the axle parallel to the direction of elongation of the frame and by a third pivot mount to the center of the axle. The points of attachment of the first V-link member are vertically displaced from the points of attachment of the second V-link member to avoid the attachment points of different V-link members being coaxial with the roll axis of the vehicle.

DOUBLE V-LINK STABILIZING SYSTEM FOR AIR SPRING SUSPENSIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to vehicle suspension systems and, more particularly, to auxiliary axle stabilization for an air spring suspension system. The invention provides for reducing axle lateral deflection and for improving vehicle stability by increasing resistance to reactive brake dive and to vehicle roll.

2. Background:

Truck suspension systems provide isolation of passengers and cargo from road shock while keeping the vehicle stable and preserving operator control. These objectives are met using combinations of springs, motion damping devices and auxiliary axle positioning elements. Achieving acceptable levels of performance, while supporting the vehicle's weight over a wide range of vehicle load conditions, is preferably achieved with a mechanically simple, compact and light weight suspension system.

The central element of any suspension system is the spring, and the four most popular, basic types of suspension systems used on trucks are categorized by the spring used, i.e.: leaf spring systems; equalizing beam systems; torsion bar systems; and air spring systems. Hybrid combinations of these are also used.

Air spring based systems have recently gained in popularity and have been applied to both steering and non-steering axles as well as driven and undriven axles. In an air spring based system, air bellows are positioned with respect to an axle and a vehicle frame to support the frame from the axle. Air spring suspensions give excellent load and vibration isolation by eliminating the interleaf friction found in traditional multiple leaf spring designs and, in some systems, by allowing active

control of the spring rate. In addition, an air spring usually has a lower deflection rate than a lea spring exerting the same force, giving the system greater capacity for absorbing shocks for a given displacement between the axle and the frame. Air spring pressure can be adjusted to compensate for vehicle load changes by adding air to or exhausting air from the spring. This aspect of the springs also benefits other suspension design objects, since by adding or exhausting air the vehicle height need not vary with load or positioning of the load.

A drawback of nonhybrid air spring suspension systems, especially when compared with leaf spring systems, is that they require more auxiliary stabilization to maintain the proper location and attitude of the axle with respect to the vehicle and to prevent excessive vehicle roll. Absent stabilization, air springs will extend to their maximum lengths or widths in the direction of least resistance and can cause an unevenly loaded vehicle to fall over to one side, while leaf springs, because of twin points of connection to the vehicle frame both fore and aft of the axle, are partially self-stabilizing and provide better directed support.

Auxiliary stabilization may be directed to controlling one or more specific types of undesired movement of a vehicle or axle. To some extent, the control of one type of movement may be more readily accomplished by trading off control of another type of movement. Some auxiliary stabilizing elements can even promote certain types of undesired vehicle body or axle movement while achieving control of some other movement. Among the problems to be controlled are vehicle roll occurring during cornering, suspension compression (front end dive) occurring on braking, suspension expansion adjacent a driven axle on acceleration (acceleration lift), and lateral deflection of the axle, particulalry during turning. Some auxiliary stabilizing systems produce axle caster changes with vertical motion of an axle.

Where air springs are used and an auxiliary stabilization system is applied to a steering axle, additional complications are presented. For a steering axle, an air spring is usually placed adjacent each wheel and over the axle, directly below the side rails of the vehicle frame. In attaching components of the auxiliary stabilization system, the position of the steering pitman and connecting link must be taken into account. Lateral deflecting forces, while a concern with any axle, will be particularly strong, and the consequent possibility of suspension steering more likely.

Parallelogram auxiliary stabilizing systems have been used as auxiliary stabilizing systems in recent air spring suspension designs. Parallelogram systems solve a number of problems, but do not provide any inherent stabilization against body roll and do not provide lateral stabilization of axles. Additional stabilizing elements, adding both weight and complexity, have been required with parallelogram systems. In addition, while parallelogram systems attached to each end of an axle can prevent castor change of the axle, they require heavy and bulky mounting braces connected to the axle, which also add weight to the vehicle and, in some cases, reduce the available room for mounting of the air spring. Parallelogram systems are neutral respecting any response to reactive brake forces, in that they neither contribute to nor prevent front end dive or acceleration related rise of a vehicle.

Countering some or all of all these problems is preferably obtained with a system which is not excessively complex, bulky or heavy, which allows the full capacity of the air springs to be utilized.

SUMMARY OF THE INVENTION

It is an object of the invention to provide auxiliary axle stabilization for an air spring suspension system characterized by improved vehicle stability.

It is a further object of the invention to provide an air spring suspension system having improved resistance to roll.

It is another object of the invention to provide a suspension system which enhances steering axle lateral stability without use of a track bar.

The foregoing objects and others are achieved as is now described. The invention provides a system for stabilizing the location and attitude of an axle on a vehicle using an air spring suspension. A first V-link member having first and second opposing ends and an apex section between its first and second ends is pivotally attached by its opposing ends to opposing ends of the axle and is further pivotally mounted by the apex section to the vehicle frame at a point centered

between the elongated frame rails and displaced from the axle along the direction of elongation of the frame. A second V-link member having first and second opposing ends and an apex section between the first end and the second end is mounted between the vehicle and the axle by pivotally attaching its first and second ends to the outside frame rail at points displaced from the axle along the direction of elongation of the frame and by a third pivot mount connecting the apex section and the center of the axle. The points of attachment of the first V-link member are vertically displaced from the points of attachment of the second V-link member, avoiding the attachment points of different V-link members being simultaneously coaxial with the roll axis of the vehicle.

Additional effects, features and advantages will be apparent in the written description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Fig. 1 is a bottom perspective view of an embodiment of the suspension stabilizing system of the invention used with a steering axle of a truck;

Fig. 2 is a partial side elevation view of the embodiment of **Fig. 1**;

Fig. 3 is a bottom perspective view of a second embodiment of the suspension stabilizing system applied to tandem drive axles of a truck;

Fig. 4 is a top perspective view of a second embodiment of the suspension stabilizing system applied to tandem drive axles of a truck; and

Fig. 5 is a partial side elevation and cutaway of the suspension stabilizing system of **Fig. 3**.

DETAILED DESCRIPTION OF THE INVENTION

Figs. 1 and **2** illustrate a double V-link member axle stabilizing system **11** installed under a portion of a vehicle frame **10.** Frame **10** is supported by a suspension system positioned between the vehicle frame and a steering axle **12**. While a preferred embodiment of the invention is illustrated used with an air spring suspension, it is not limited to use with air springs and may also be effectively employed with coil springs or other spring systems. The preferred embodiment of the invention is also illustrated as used with a vehicle having a conventional frame, however it is equally applicable to vehicles constructed using a space frame or a unibody vehicle.

Air springs **18** and **20** are positioned directly above and supported on steering axle **12**, substantially adjacent the opposed ends of the steering axle, and directly beneath elongated side rails **24** and **26** of vehicle frame **10** to support frame **10** from the axle. A steering gear box **20** is positioned on left side rail **24** forward from steering axle **12**. A pitman and trailing link are usually associated with gear box **20** and link it to the vehicle wheel **21** but are not shown for the sake of clarity. A steering tie rod **22** connects wheels **21** and **23**, which are mounted on opposed ends of axle **12**. Frame **10** further includes a cross member **28** positioned between the left side and right side rail members **24** and **26** to positionally support the rail members and to provide an attachment point for a lower V-link member **42**.

Auxiliary suspension stabilization is provided by the double V-link member system **11** which comprises two stacked, oppositely oriented V-link members **32** and **42**. An upper V-link member **32** is mounted at three, triangularly arranged points between frame **10** and steering axle **12**, with one point being on steering axle **12** and the remaining two points being on frame **10**, along left side and right side of frame rails **24** and **26**. V-link member **32** is attached to frame **10** at the opposed ends of V-link member, which terminate in sleeves **35** and **36**, and to axle **12** along an apex section **31** of the V-link member. Apex section **31** is pivotally enclosed in a sleeve member **30** which depends from and is rigidly attached to steering axle **12** by any appropriate mounting system. Apex section **31** pivots in a sleeve **30** centered on axle **12.** The three mounting points of V-link member **32** are positioned at the vertices of a regular triangle.

Sleeves **35** and **36** of V-link member **32** are pivotally supported on rods (not shown) set in mounting brackets **37** and **38** which in turn depend, respectively, from left side frame rail **24** and right side elongated frame rail **26**. Brackets **37** and **38** hang from frame rails **24** and **26** respectively, at a position forward from air springs **18** and **20**. Accordingly, upper V-link member **32** is disposed as a trailing link from frame **10** to axle **12** and open toward the forward end of the vehicle.

Lower V-link member **42** is positioned directly below V-link member **32**. V-link member **42**, like V-link member **32**, is supported at three points distributed between frame **10** and steering axle **12** and which lie at the vertices of a regular triangle. V-link member **42** is supported at two points along steering axle **12** and at a single point with respect to frame **10**. The points of connection for V-link member **42** lie in a plane below the plane of the points of connection for V-link member **32**. Apex section **41** of V-link member **42** is pivotally mounted in a sleeve **43** which rigidly depends from a block **44**, which is in turn attached to cross member **28**. Block **44** is braced against frame rails **24** and **26** by rods **50** and **52**. The opposed ends of V-link member **42** terminate in sleeves **45** and **46**. Sleeves **45** and **46** are pivotally attached in bushings **47** and **48** which are inwardly canted toward the centerline of the vehicle along the direction of elongation and tolerate any conicity introduced by the canted position.

Although more than one pivotal mount may be established over a broad apex area, a V-link member which is straightened to allow such connections and is supported at more than one point between the ends of the V-link member begins to resemble a stabilizer bar in function.

Sleeve mount **30** for apex section **31** of upper V-link member **32** is positioned along the upper side axle **12**, whereas brackets **47** and **48** which support the sleeve endings **45** and **46** of the lower V-link member **42** are positioned along the lower side of steering axle **12**. The three attachment points on axle **12** are thus positioned at the vertices of yet another regular triangle, with the points of attachment being distributed above and below the axle. The three points of support provide substantial lateral stability and longitudinal stability. The vertical offset of the V-link apex joints from one another prevent both points from simultaneously lying on the roll axis of the vehicle, giving good roll resistance. Support at both the upper and lower portions of the axle substantially prevents caster change with vertical travel of the axle **12**.

The support points for the opposed ends of the upper V-link member **32** and of the apex section **41** of the lower V-link member **42** also lie at the vertices of a triangle, but with a reverse orientation from that of the mounting points on steering axle **12**. This gives steering axle **12** two slightly offset axes of rotation during vertical travel, helping prevent caster change of the axle .

Particular reference to **Fig. 2** illustrates that while lower V-link member **42** lies substantially flat, that is horizontal with respect to the vehicle, upper V-link member **32** is upwardly canted from apex sleeve **30** toward mounts **37** and **38**. V-link member **32** may be given an upward cant from axle **12** forward whenever a trailing link configuration is used. This geometry allows transfer of torque reaction from braking as an upward force onto frame rails **24** and **26** to counter front end dive during braking. This orientation is not used where a V-link member is used in a leading configuration or on an axle positioned away from the forward part of the vehicle. A shock absorber **62** positioned behind air spring **18** dampens axle **12** motion.

Figs. 3-5 illustrate a second embodiment of the invention applied to tandem rear drive axles of a truck. Tandem drive axles **64** and **66** support frame **10**, along left elongated side rail **24** and right elongated side rail **26**, on four air springs **75**. Two auxiliary suspension stabilization subsystems **72** and **74** are provided, with auxiliary stabilization system **72** operating to stabilize axle **64** and auxiliary stabilization system **74** operating to stabilize axle **66**. Stabilization system **72** is oriented as a leading configuration while stabilization subsystem **74** is oriented in a trailing configuration.

Each of the auxiliary stabilization systems **72** and **74** comprises an upper and lower V-link, upper V-Link **80** and lower V-link **82** being in stabilization system **72** and upper V-link member **84** and lower V-link member **86** being in stabilization system **74**.

Each of V-link members **80, 82, 84** and **86** is attached between vehicle frame **10** and one of axles **64** and **66** at each of three points. The attachment points on the V-link members are at the opposed ends of the V-link members and the apex section of each V-link member. With two V-link members per axle, the mounting points on frame **10** and on axle are distributed so that three are provided on the axle and three are provided fixed with respect to the frame. For tandem rear axles **64** and **66** this means that there are three attachment points on axle **64**, three on axle **66** and a total

of six on frame **10**. Between axles **64** and **66,** and depending from frame **10,** are three inverted pylons **76**, **77** and **67**. Hollow pylons **76** and **77** are mounted from rails **24** and **26** respectively, and each provide two pivoting connection points. V-link members **82** and **86** are pivotally attached at their opposing ends to inverted pylons **76** and **77**. Inverted pylon **67**, which depends from a frame cross member **69**, provides pivot mounting for apex section of upper V-link members **80** and **84**. Upper V-link member **80** of forward auxiliary stabilization system **72** is connected by pivoting mounts **90** and **91** to opposed ends of axle **64**. Upper V-link member **80** is further connected by a pivoting joint **93** along its apex to inverted pylon **67** which depends from cross member **69** between exterior elongated side rails **24** and **26**. Lower V-link member **82** is connected by a pivoting mount **94** at the bottom of differential **68** and to the bottom of inverted pylon **76** and **77** by pivoting links **96** and **95** respectively.

The aft auxiliary stabilization subsystem **74** is similarly connected to axle **66**. There are six connections between auxiliary stabilization system **74** and frame **10** and axle **66** with three points of connection on each. Upper V-link member **84** of aft stabilization system **74** is connected along its apex to inverted pylon **67** via pivoting member **113** and each end thereof by pivoting mounts, including pivoting mount **97**, to axle **66**. A lower V-link member **86** is pivotally attached at its apex section to differential **70** by pivoting joint **117** and by pivot mounts **99** and **119** to the bottoms of inverted pylons **74** and **76** respectively.

The invention provides improved vehicle stability by providing for increased resistance to front end dive on braking, improved resistance to roll, good axle lateral stability without the use of a track bar and substantially prevents caster change of an axle during vertical travel. The use of tubular V-link members and the ability to displace stabilizer bars, track bars and heavy motion restraining frames reduces weight over the prior art.

While the invention is shown in only one of its forms, it is not thus limited but is susceptible to various changes and modifications without departing from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for stabilizing an axle on a vehicle, comprising:

spring means positioned to support the vehicle from the axle;

a first V-link member having a first end, a second end and an apex section between the first end and the second end;

a second V-link member having a first end, a second end and an apex section between the first end and the second end;

first V-link mounting means for pivotally attaching the first and second ends of the first V-link member to the axle toward opposed ends thereof, and for pivotally attaching the apex section of the first V-link member to a section of the vehicle longitudinally displaced from the axle and between the opposed ends of the axle; and

second V-link mounting means for pivotally attaching the first and second ends of the second V-link member to mutually spaced points on the vehicle, each of the points being longitudinally displaced from the axle, and for pivotally attaching the apex section of the second V-link member to the axle between the opposed ends of the axle.

2. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 1, further comprising:

the first V-link member and the second V-link member being disposed to one side of the axle.

3. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 2, wherein:

the second V-link mounting means comprises first, second and third pivot mounts, the first and second pivot mounts connecting the second V-link to an underside of the vehicle, and the third pivot mount connecting the first V-link member to the axle;

the first V-link mounting means comprises first, second and third pivot mounts, the first and second pivot mounts connecting the first V-link and the axle and the third pivot mount connecting the first V-link to the underside of the vehicle; and

the first and second pivot mounts of the first V-link mounting means are positioned below the third pivot mount of the second V-link mounting means and the third pivot mount of the first V-link mounting means is position below the first and second pivot mounts of the second V-link mounting means.

4. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 3, further comprising:

the axle being a steering axle; and

the second V-link being canted so that its apex section is higher than the first and second ends thereof.

5. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 3, wherein the first and second V-link members are each tubular sections of selected gauges.

6. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 3, wherein the first and second V-link members are arranged as trailing links.

7. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 3, wherein the first and

second V-link members are arranged as leading links.

8. Apparatus for stabilizing an axle on a vehicle as set forth in Claim 3, wherein the spring means further comprises first and second air springs, with the first air spring positioned above the axle to support the vehicle from adjacent one end of the axle and the second spring is positioned above the axle to the support the vehicle from adjacent the opposed end of the axle.

9. An axle location and attitude stabilizing system for a vehicle, comprising:

first, second and third axle brace points positionally fixed with respect to the axle, the first and second axle brace points being located toward opposed ends of the axle and defining a parallel line to the axle with the third axle brace point being vertically displaced from the parallel line and centered between the first and second axle brace points;

first, second and third vehicle brace points positionally fixed with respect to the vehicle and displaced from the axle along a direction of elongation of the vehicle, the first and second vehicle brace points being located toward opposed sides of the vehicle and defining a perpendicular line to the direction of elongation of the vehicle, with the third vehicle brace point being vertically displaced from the perpendicular line and substantially centered between the first and second vehicle brace points;

first resilient linkage means for connecting the third axle brace point with the first and second vehicle brace points; and

second resilient linkage means for connecting the third vehicle brace point with the first and second axle brace points.

10. An axle location and attitude stabilizing system for a vehicle as set forth in Claim 9, wherein:

the first and second resilient linkage means are tubular V-link members.

11. An axle location and attitude stabilizing system for a vehicle as set forth in Claim 10, further comprising:

the axle being a steering axle;

the first and second resilient linkage means being disposed as trailing links from the vehicle to the axle; and

one of the resilient linkage meams being canted to rise from its connection to the axle to its connection to the vehicle.

12. An axle location and attitude stabilizing system for a vehicle as set forth in Claim 9, further comprising:

pivoting mounts providing the connections between the resilient linkage means and the vehicle and axle brace points.

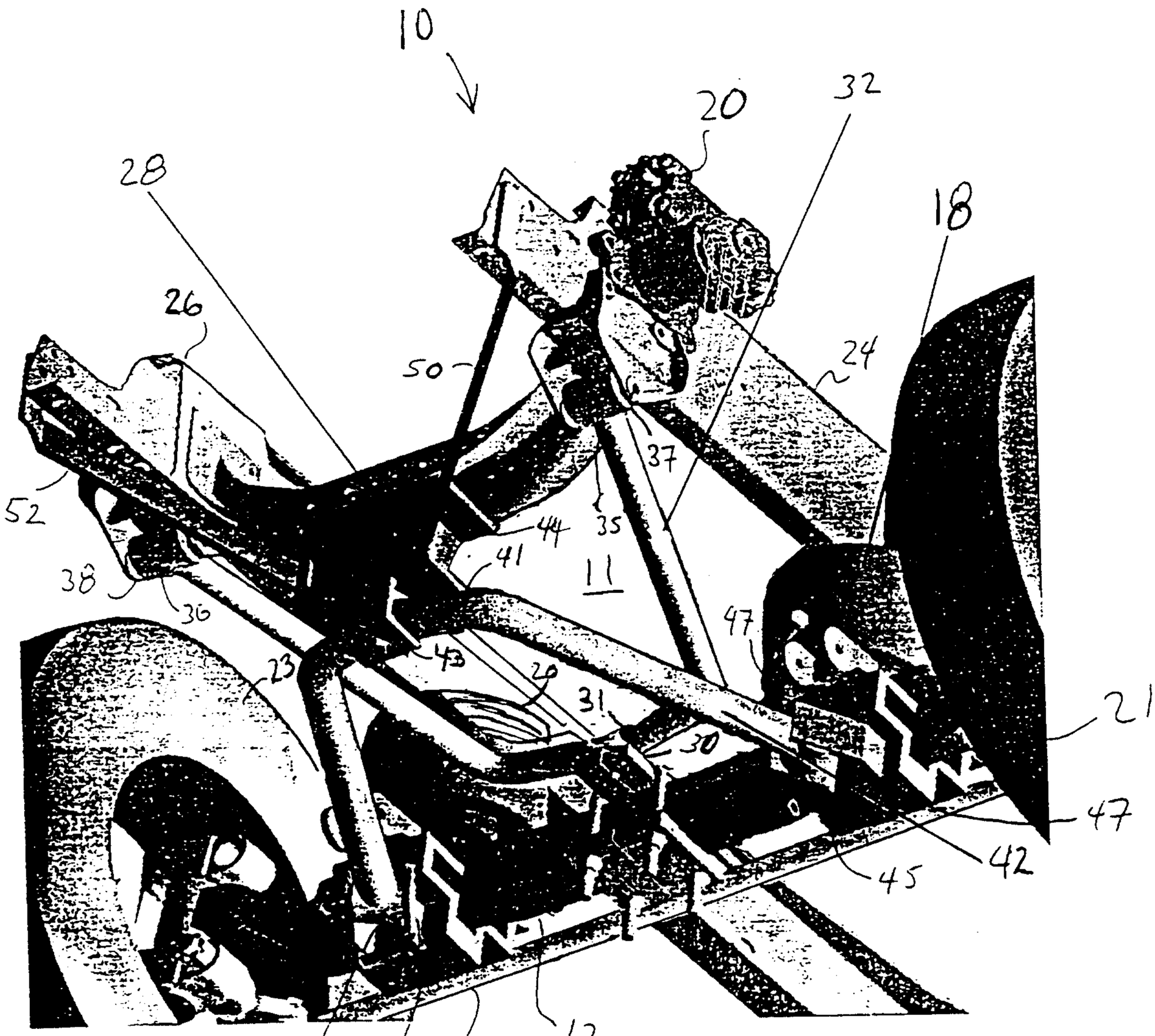


FIG. 1

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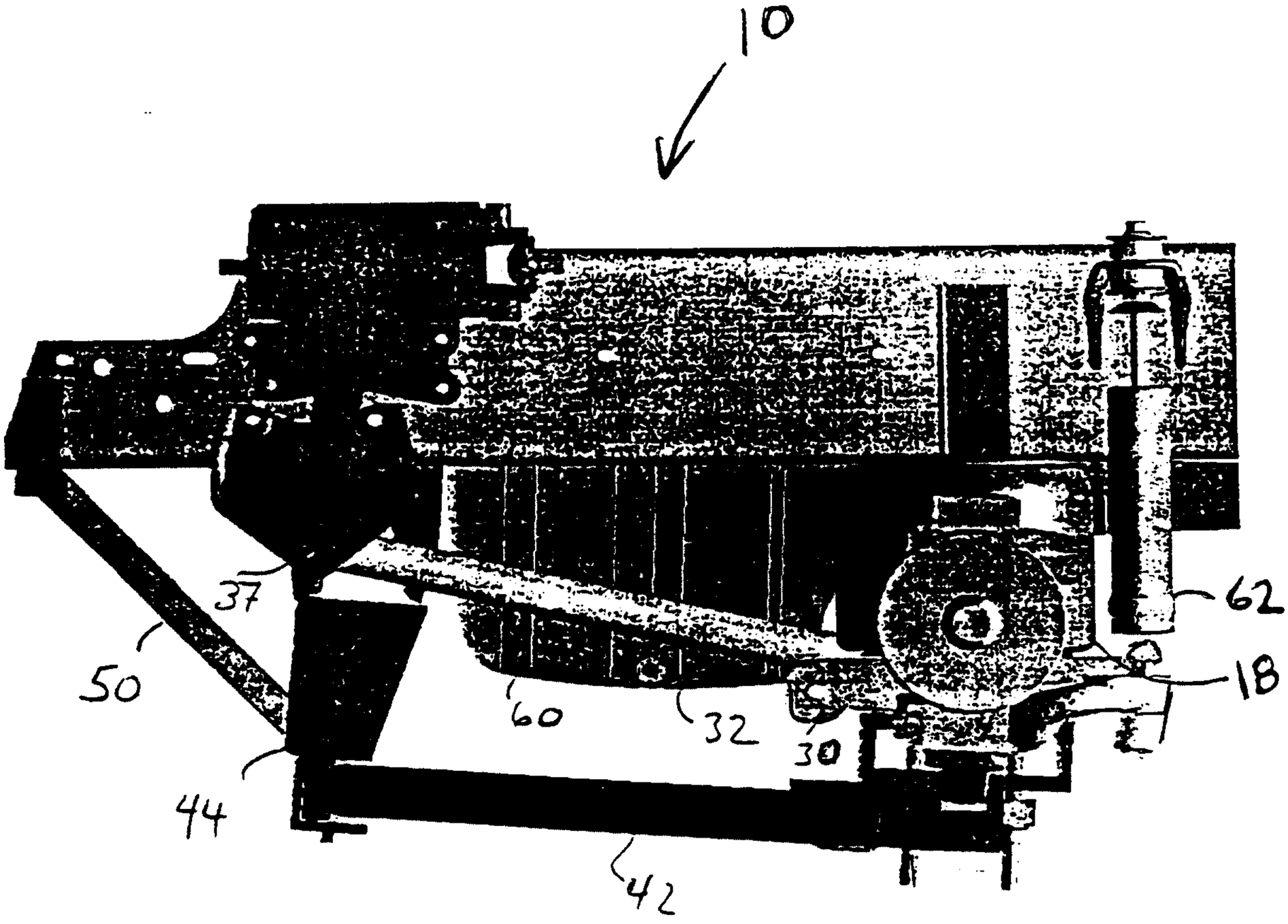


FIG. 2

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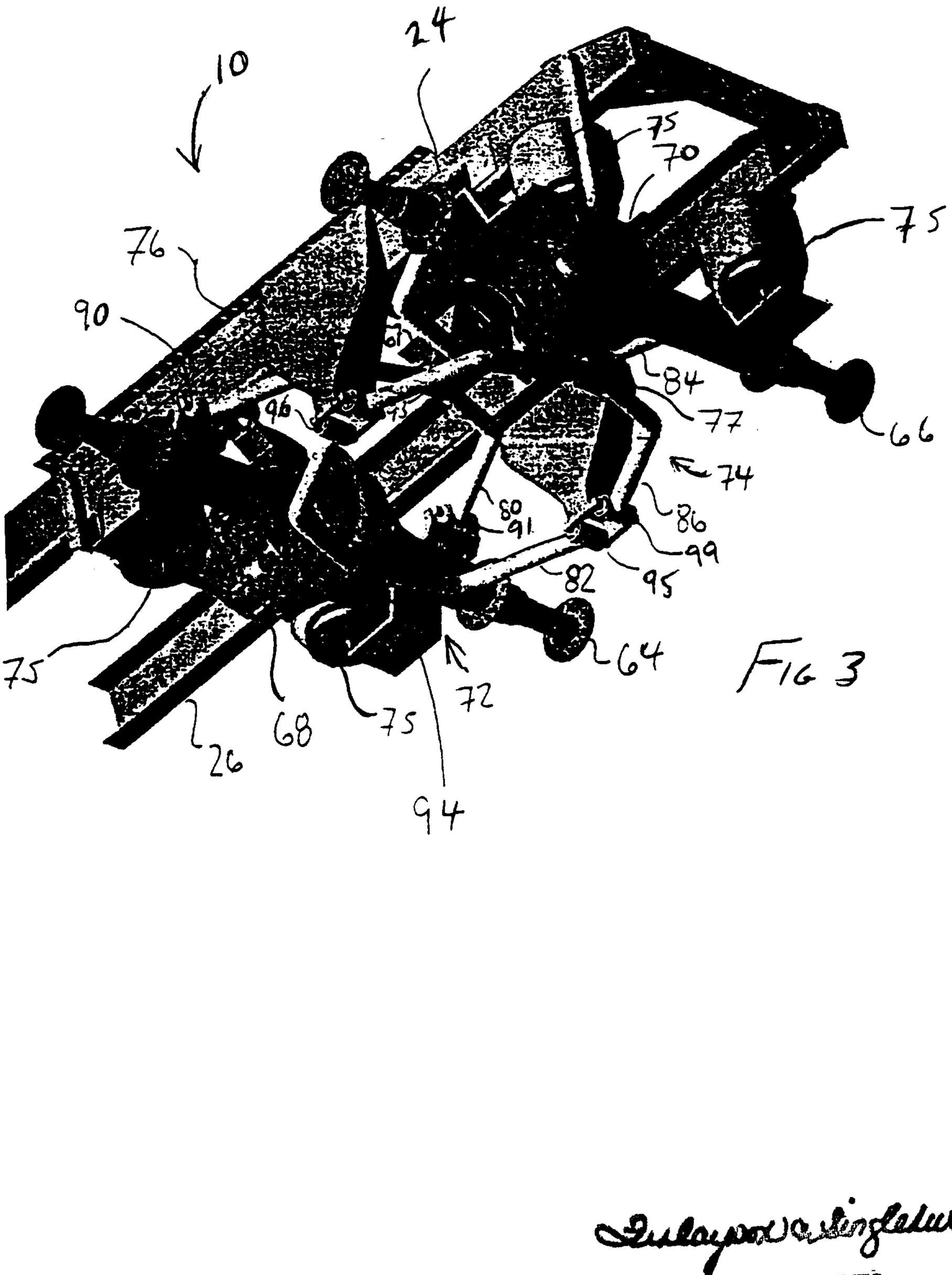


FIG 3

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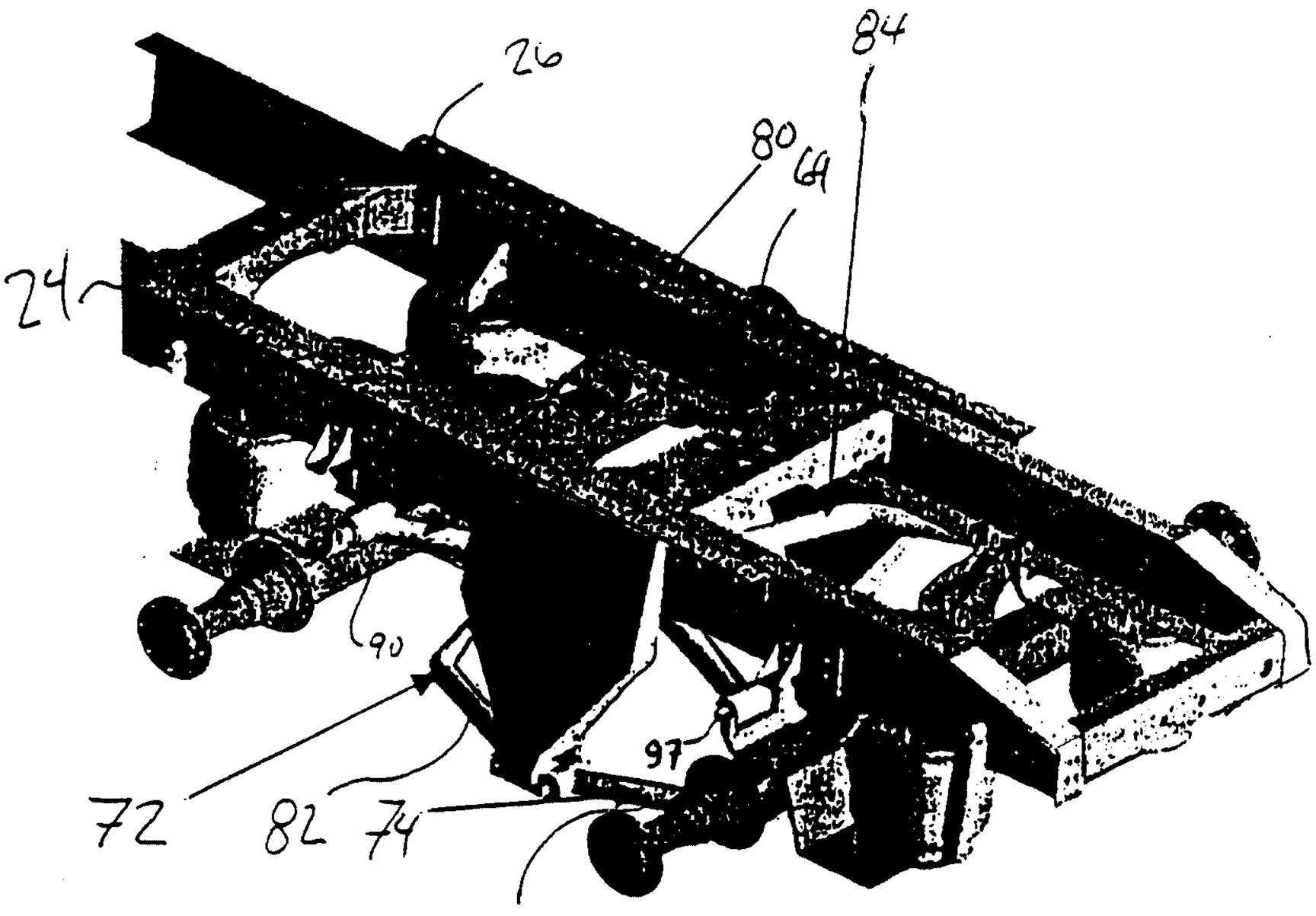


FIG. 4

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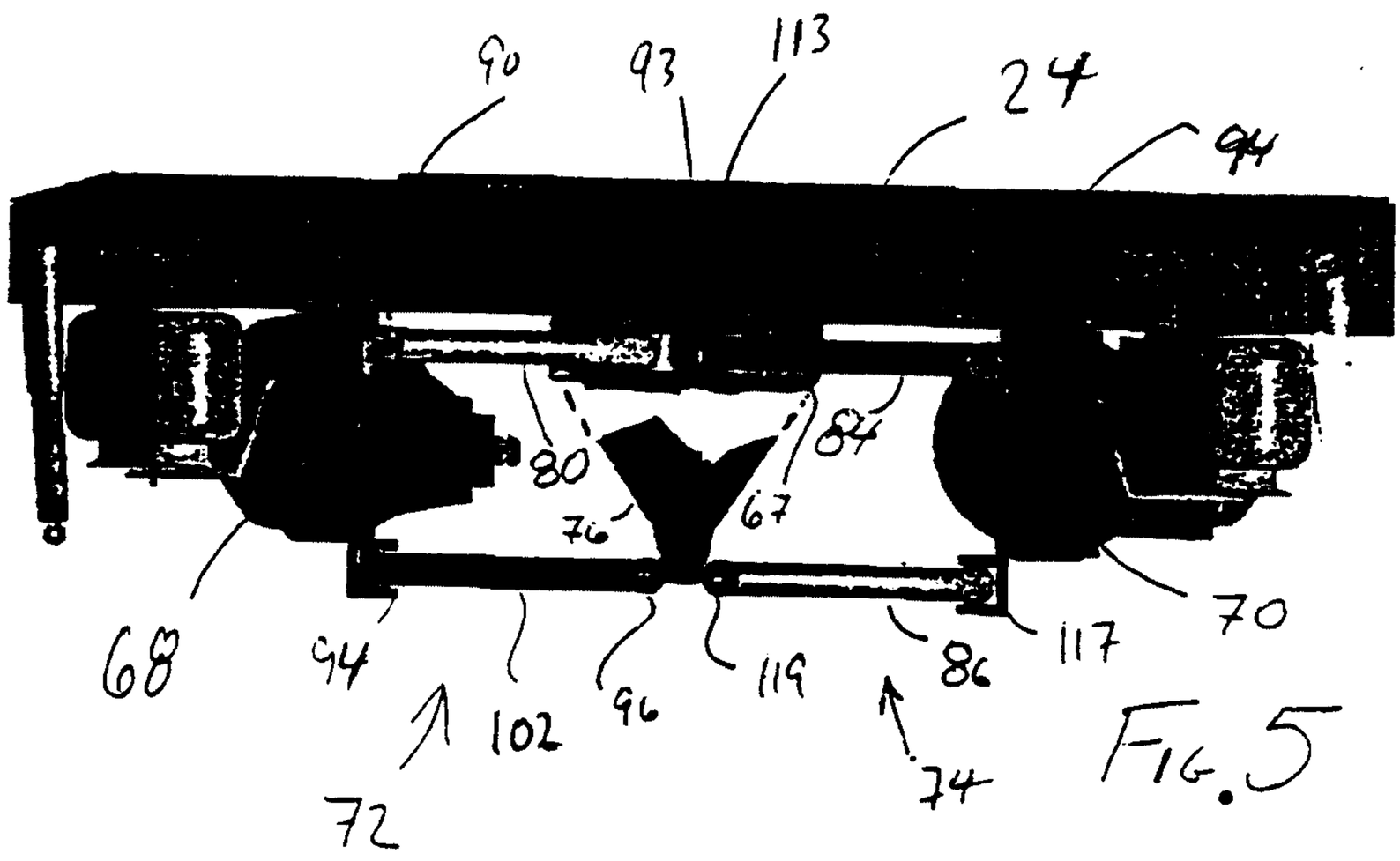
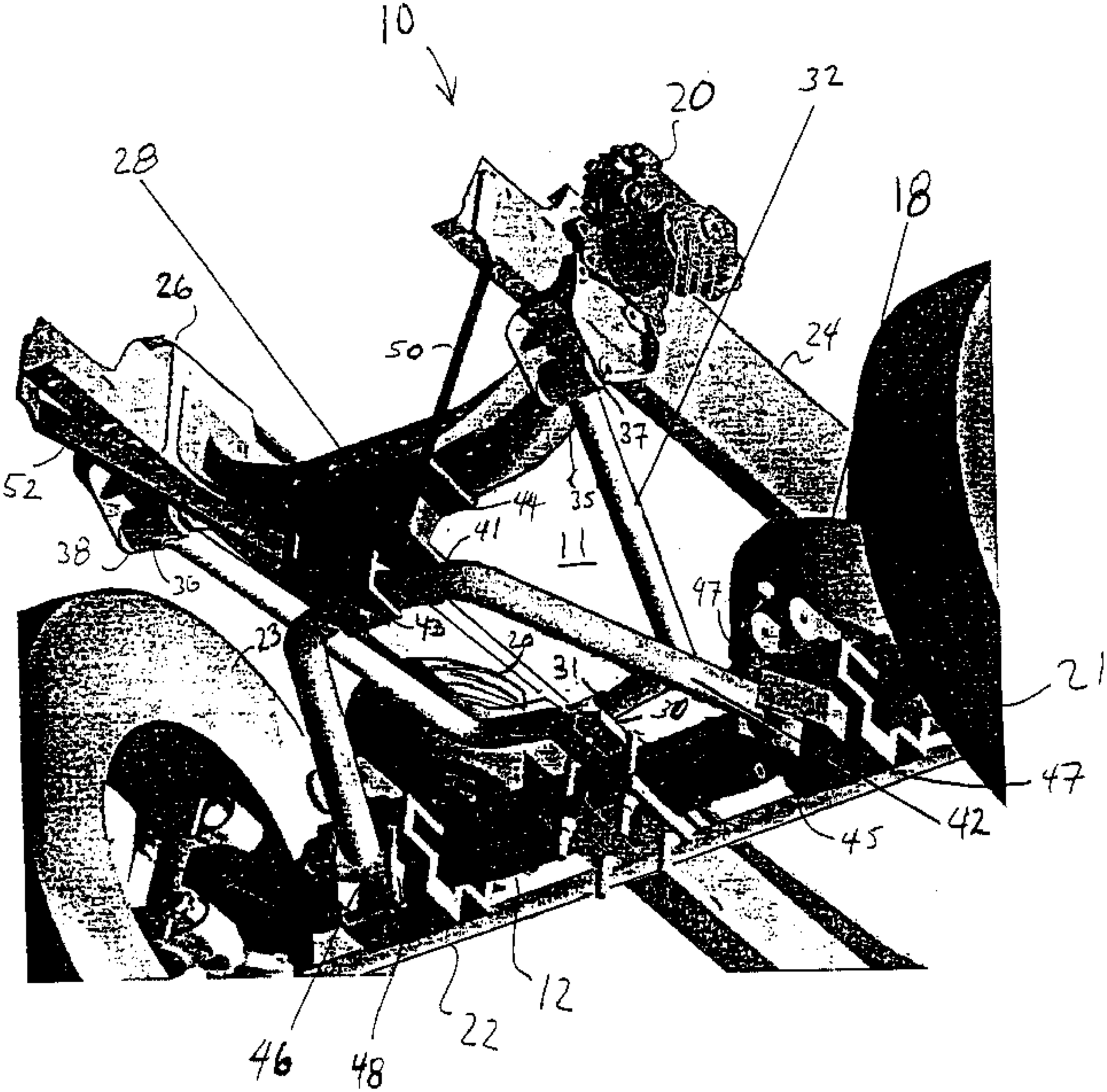


FIG. 5

Gowling Lafleur Henderson

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