United States Patent

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[72] Inventors **Douglass K. Blood**
Wilmette;
Harold H. Hansen, Lake Zurich, Ill.

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[73] Assignee **Contracting and Material Company**
Evanston, Ill.
a corporation of Illinois

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[54] **TRACTOR ATTACHED VACUUM LIFTER**
10 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** **214/147,** 214/652; 294/65
[51] **Int. Cl.** **B66c 1/02**
[50] **Field of Search** 214/1B5, 1BS3, 1BS4, 147, 149, 650SG, 652; 294/65

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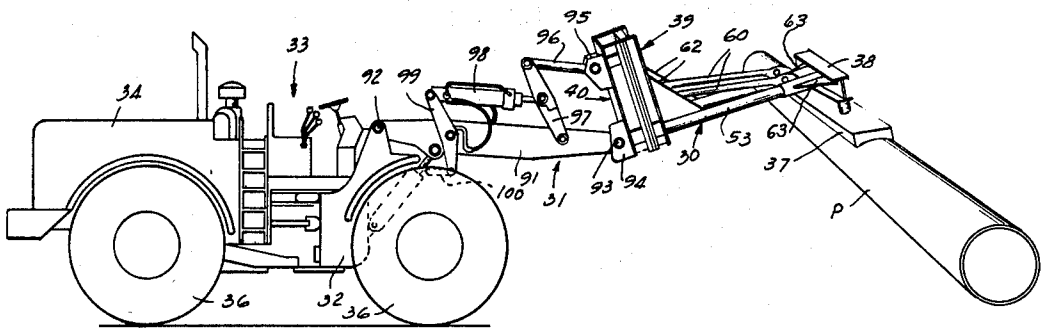
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—George F. Abraham
Attorney—Hill, Sherman, Meroni, Gross and Simpson

ABSTRACT: A vacuum lifter attachment for the lift mechanism of tractors having vacuum shoes for seating on pipes and the like objects to be picked up and conveyed wherein each shoe has its own integrally connected adjacent vacuum reservoir and a control valve to provide fast and safe evacuation of the shoes. The attachment has controls for tilting on a horizontal axis, the shoes are mounted to accommodate misalignments and bending of the pipe being lifted and the lift mechanism is preferrably mounted on an articulated four wheel tractor.



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SHEET 1 OF 5

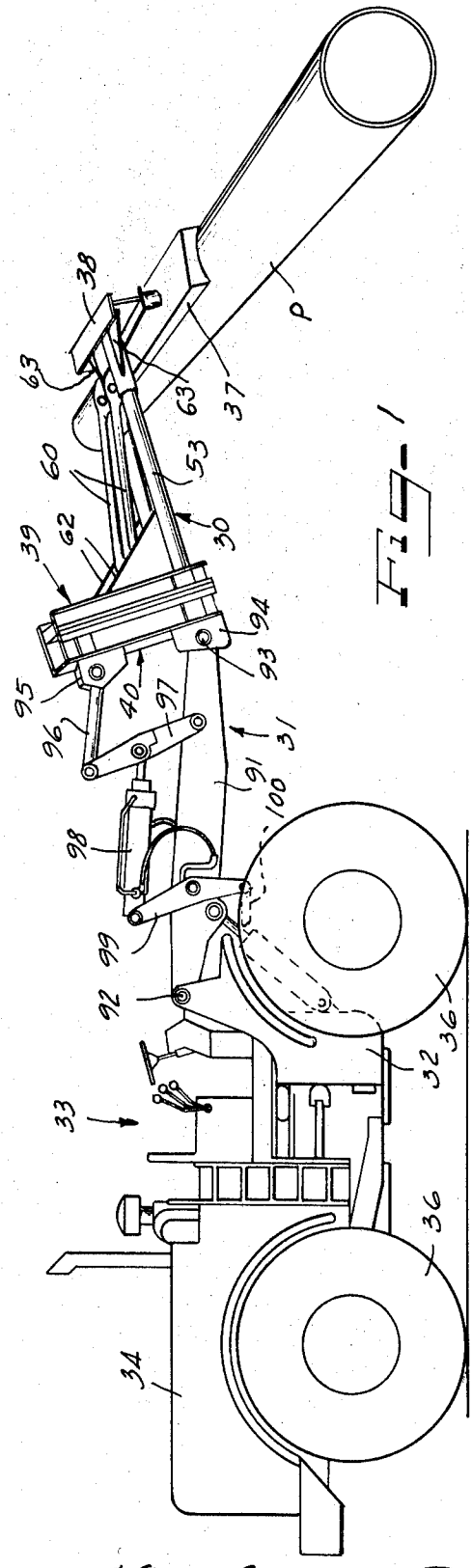


FIG. 1

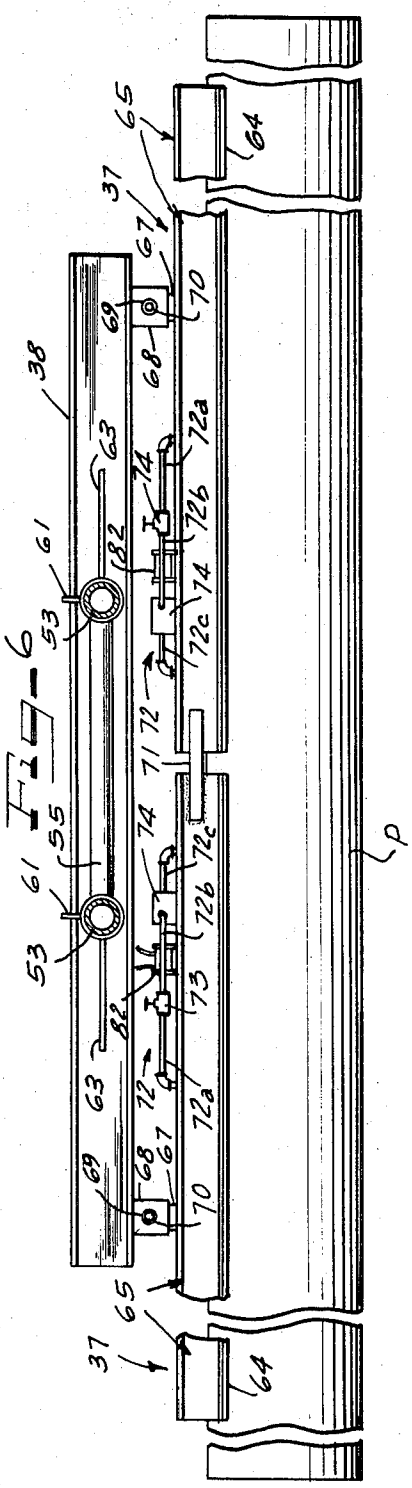


FIG. 6

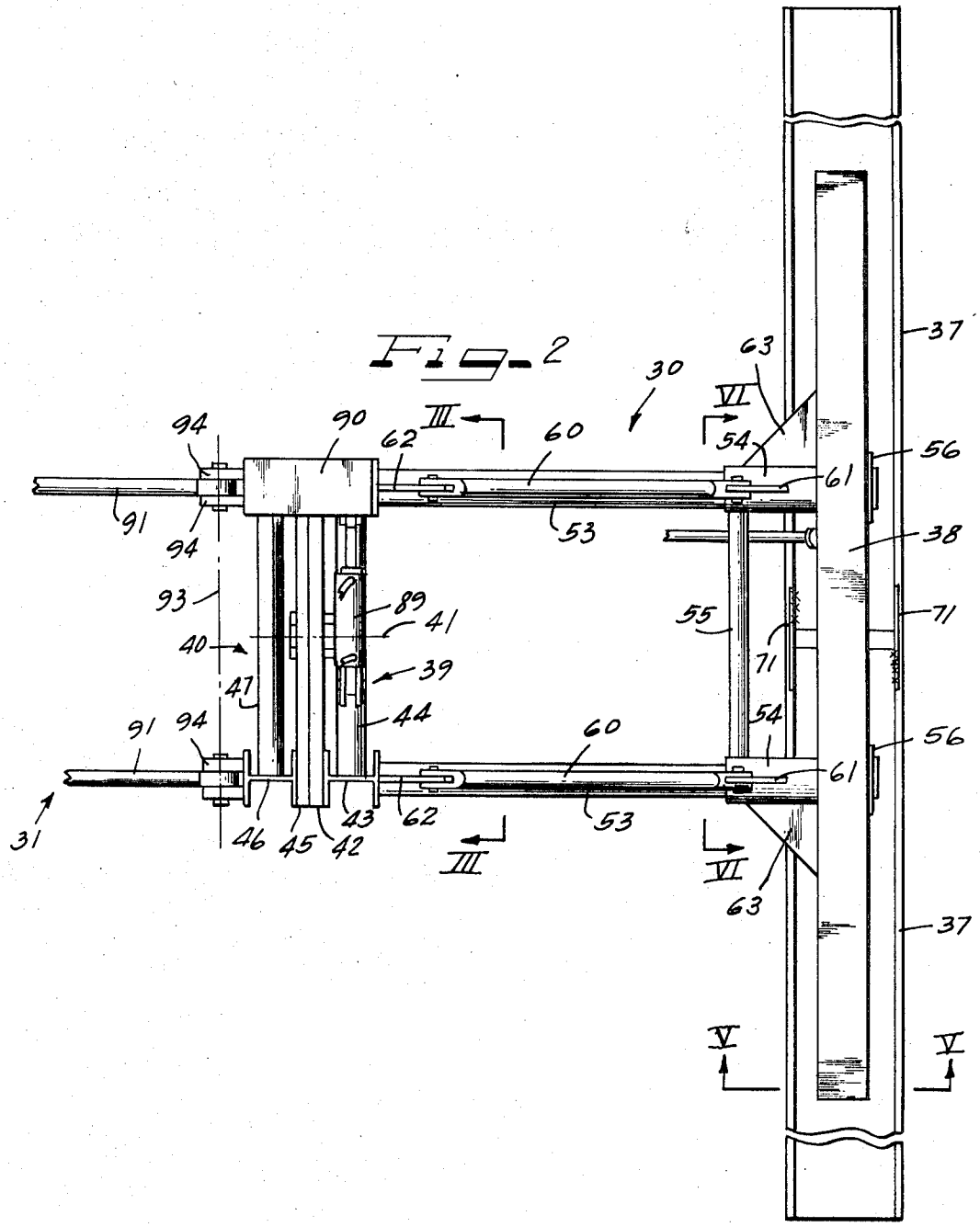
INVENTOR.

DOUGLASS K. BLOOD

HAROLD H. HANSEN

BY Lee, Sherman, Meroni, Gress & Hemplis ATTORNEYS

Fig. 2



INVENTOR.
DOUGLASS K. BLOOD
HAROLD H. HANSEN
BY Kill, Sherman, Morsell, Gault & Kimpton ATTORNEYS

Fig. 3

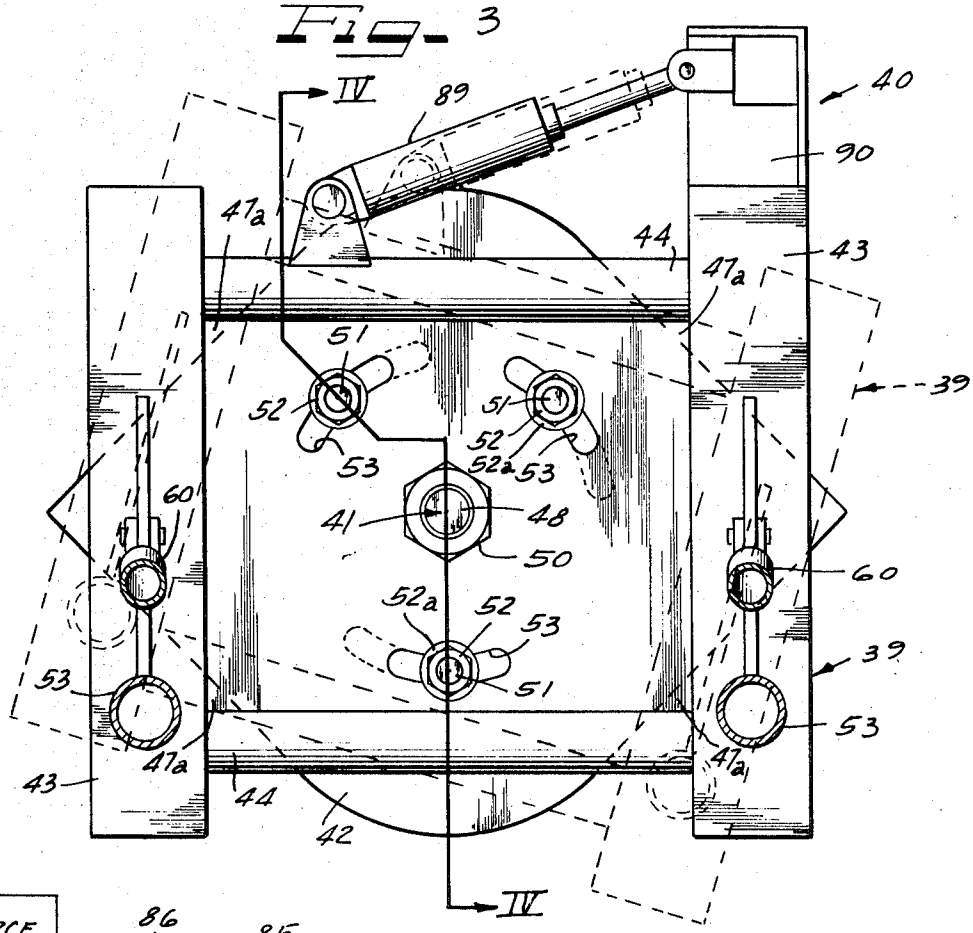
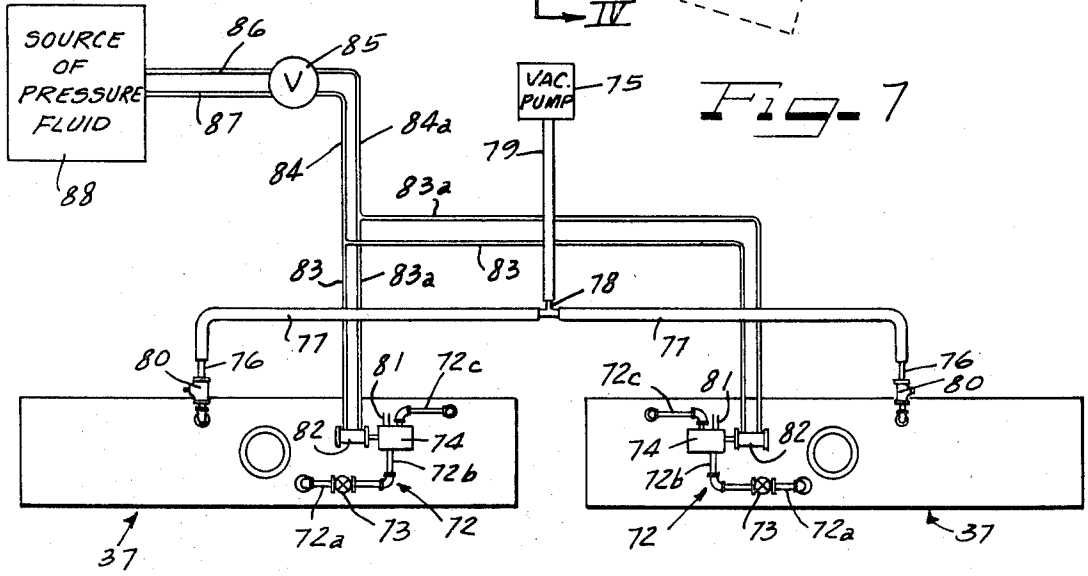


Fig. 7



INVENTORS
DOUGLASS K. BLOOD
HAROLD H. HANSEN

BY Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

Fig. 4

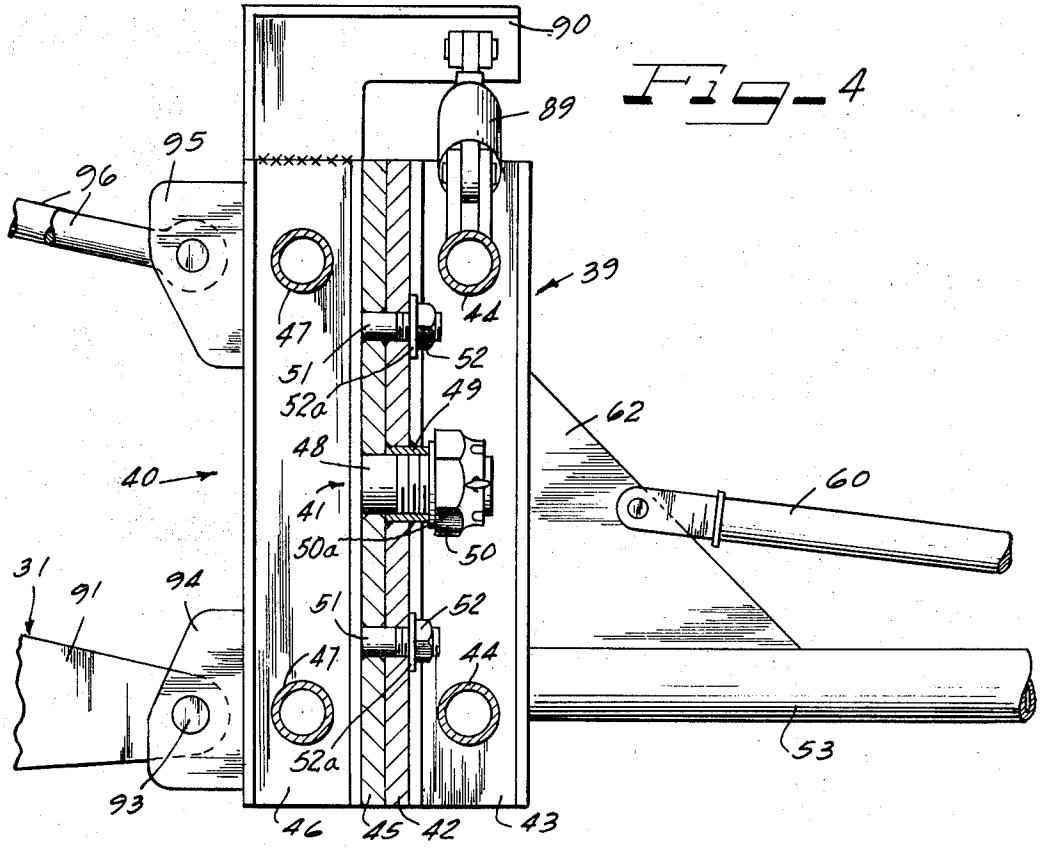
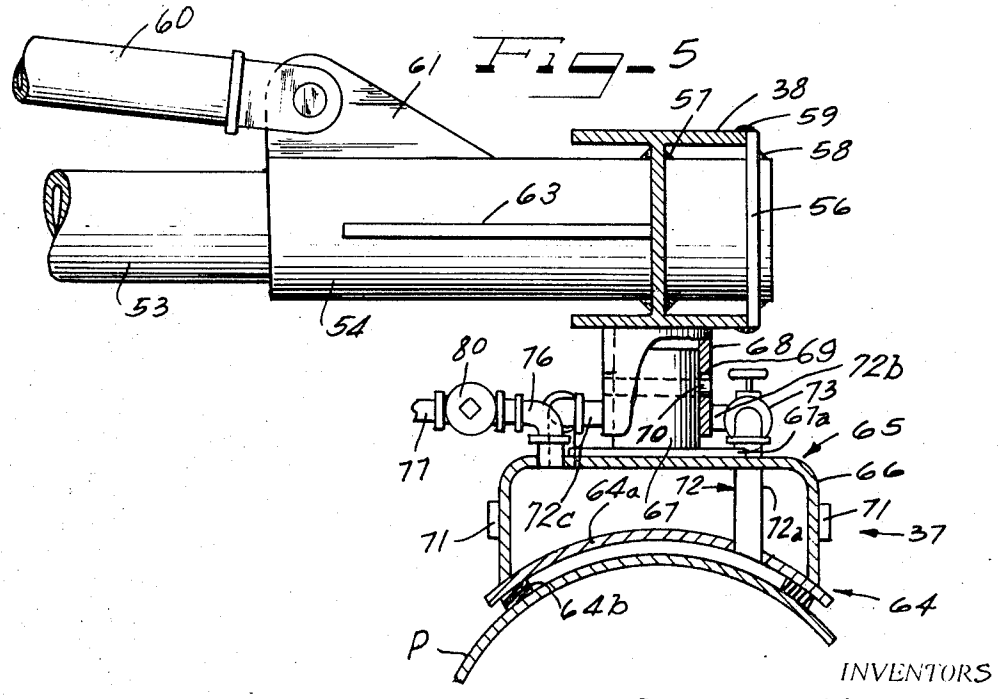


Fig. 5



INVENTORS
DOUGLASS K. BLOOD
HAROLD H. HANSEN
BY Kiel, Sherman, Morris, Glass & Simpson ATTORNEYS

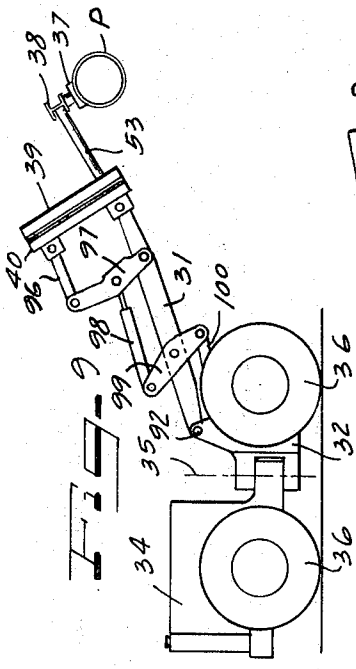


FIG. 9

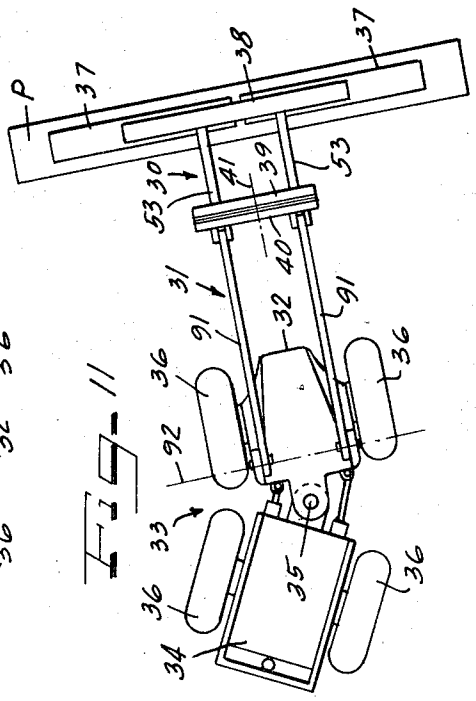


FIG. 11

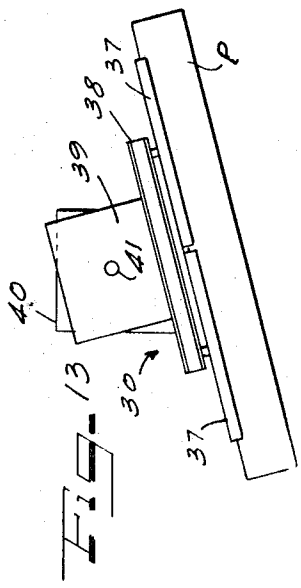


FIG. 13

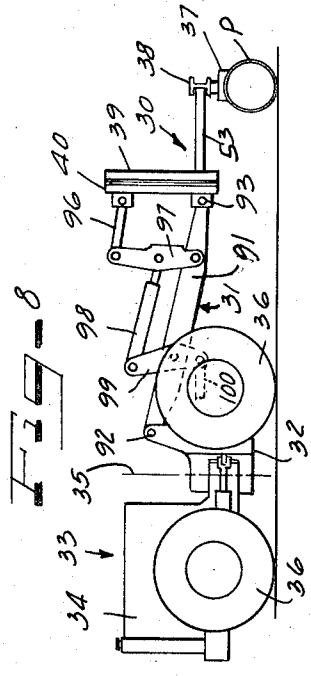


FIG. 8

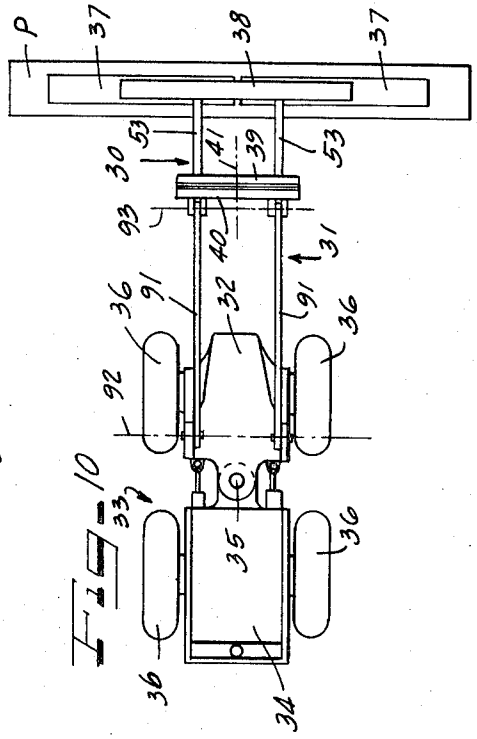


FIG. 10

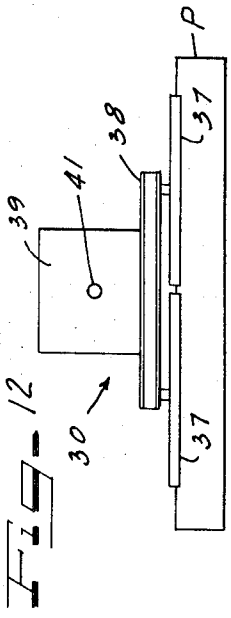


FIG. 12

INVENTORS
DOUGLASS K. BLOOD
HAROLD H. HANSEN
BY Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

TRACTOR ATTACHED VACUUM LIFTER

BACKGROUND OF THE INVENTION

This invention relates to a vacuum lifter and more specifically, to a tractor attached vacuum lifter for pipes.

When sections of pipe are to be transferred individually from a pile of pipe on the ground to trucks and vice versa, difficulties in attaching the lifter to the pipe sections have been encountered, because the pipe sections in a storage pile may lie at different horizontal and vertical angles with respect to one another. The problem then is to orient the pipe lifter and the tractor carrying the lifter at the angle required for picking up a given pipe section.

Vacuum lifting of long heavy pipe sections has not heretofore been very successful because of the difficulty in snugly seating of the vacuum shoe or shoes on the pipe sections to be lifted, and because of time delays in evacuating the shoes and then safely maintaining the vacuum throughout the lifting and carrying operation.

The present invention now insures rapid and safe vacuum gripping of heavy cumbersome objects such as lengthy pipe sections, plates, and the like. While the invention will hereinafter be specifically described as embodied in an attachment for a lift mechanism of an articulated tractor for the purpose of handling pipe sections, it will of course be understood that the principles of this invention are generally applicable to vacuum lifters, and the scope of the invention is not limited to this particular usage.

It is then an object of the invention to provide a lifter for heavy cumbersome objects which is readily attached to a tractor, and capable of being manipulated to handle pipe sections and the like regardless of the angled or tilted positions of the sections.

Another object of the invention is to provide a vacuum lifter, which is easily attached to the lift mechanism of an articulated tractor, and which is easily aligned with the work to be handled.

Another object of this invention is to provide a vacuum lifter for heavy pipe sections having a plurality of lifting shoes, each with individual adjacent vacuum reservoirs and control valves to provide rapid and safe evacuation of the shoes.

Another object of the invention is to provide a vacuum pipe lifter having a rigid mounting beam supporting a plurality of vacuum shoes in end-to-end relation, and accommodating independent movement of the shoes to insure a snug seating of the shoes on the object to be lifted.

A specific object of the invention is to provide a vacuum lifter for pipes mounted on an articulated four-wheel tractor, which is easily manipulated to present the lifter for picking up random arranged pipe sections, and wherein the lifter has a tilt control accommodating variations in inclination of the pipe sections.

Other and further important objects of this invention will become apparent from the attached drawings and the detailed description following the brief description of the drawings.

SUMMARY OF THE INVENTION

The present pipe lifter comprises a pair of vacuum shoes arranged end-to-end, vacuum reservoirs integrally associated therewith through common walls, an elongated carrier to which the vacuum shoes are floatingly connected, a base fixed to the elongated carrier in spaced relationship, and a support carrying the base for tilting movement of the same, the elongated carrier, and the vacuum shoes. The support is connected to a lift arm on an articulated tractor composed of two sections pivotally connected with one another on a vertical axis, each section having driven wheels.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of the pipe lifter of the present invention and the tractor to which it is connected;

FIG. 2 is a fragmentary plan view, with parts omitted for the sake of clarity, of the pipe lifter and a tractor-attached arm;

FIG. 3 is a sectional view taken on the line III–III of FIG. 2 and showing the base of the pipe lifter;

FIG. 4 is a fragmentary sectional view taken on the line IV–IV of FIG. 3 and showing one end of the pipe lifter including the base and a support for the base;

FIG. 5 is a sectional view taken on the line V–V of FIG. 2 and showing the other end of the lifter including vacuum shoes and an elongated carrier to which they are connected;

FIG. 6 is a sectional view taken on the line VI–VI of FIG. 2 and showing the vacuum shoes and elongated carrier therefor;

FIG. 7 is a schematic plan view of the vacuum shoes and the vacuum and hydraulic pipe connections thereto for operating the shoes;

FIG. 8 is a schematic elevational view showing the tractor and the pipe lifter engaging a section of pipe on the ground;

FIG. 9 is a schematic side elevation showing the tractor and the pipe lifter elevated to hold a pipe section in lifted position;

FIG. 10 is a schematic plan view of the tractor and the lifter, the tractor sections being positioned so that their wheel axes are in parallel;

FIG. 11 is a schematic view similar to FIG. 10, but showing the tractor sections angled so that the wheel axes are at an angle to one another;

FIG. 12 is a schematic end view of the lifter positioned so as to be capable of lifting a pipe section in horizontal position on the ground; and

FIG. 13 is a similar schematic view showing the pipe lifter tilted so as to be capable of lifting a pipe section resting on the ground at an angle to the horizontal.

PREFERRED EMBODIMENT OF THE INVENTION

As shown in FIGS. 1, and 8 to 13, inclusive, a pipe lifter 30 of the present invention is carried by a lift arm mechanism 31 pivoted on a front section 32 of an articulated tractor 33. The tractor has a rear section 34 connected to the front sections 32 on a vertical axis 35. Each of the tractor sections 32 and 34 has at its sides two driven ground wheels 36.

The lifter 30 has vacuum units 37 arranged end-to-end, an elongated carrier 38 supporting the vacuum units, a base 39 fixedly secured to the elongated carrier 38 in spaced relationship thereto, and a support 40 to which the base 39 is connected on a pivot axis 41 for tilting.

When the lifter 30 is lowered to the position of FIG. 8 by lowering of the lift arm mechanism 31, the units 37 of the pipe lifter are in position to engage a pipe section P. The pipe section P is lifted, as shown in FIG. 9, by upward angling of the lift arm mechanism 31 on the tractor 33. When the pipe section P is in the position of FIG. 10, the pipe lifter 30 is brought up in proper position to the pipe section by the tractor 33 with the sections arranged, for example, with their wheel axes parallel, as shown in FIG. 10. When the pipe section P is differently angled as shown in FIG. 11, the lifter 30 may be oriented to engage the pipe section by manipulation of the tractor 33 with the sections thereof disposed so that their wheel axes are, for example, at an angle with respect to one another. When the pipe section P rests horizontally, as shown in FIG. 12, the pipe lifter is angled so that the vacuum units 37 are horizontal and thus properly positioned to engage the pipe section P for lifting. When as shown in FIG. 13, the pipe section P is at an angle to the horizontal, the pipe lifter 30 is angled by tilting of its base 39 with respect to its support 40 about the pivot axis 41 and is thus made capable of engaging the pipe section for lifting.

As shown in FIGS. 3 and 4, the base 39 comprises a plate 42, two H-beams 43, and two tubes 44. The plate 42 is in the form of a square with two opposed corners rounded and two opposed corners square. The beams 43 are welded to the plate 42 across and slightly inwardly of the square corners thereof, one flange of each beam 43 engaging the plate 42. The beams 43 are parallel to and spaced from one another. The tubes 44 are parallel to and spaced from one another, are perpendicular to the beams 43, and have their ends welded to the webs of

the beams. The support **40** has a plate **45**, two H-beams **46**, and two tubes **47**, respectively similar to the plate **42**, beams **43**, and tubes **44** of the base **39** and connected to one another similarly to the manner in which the plate, H-beams, and tubes of the base are connected.

Because the beams **43** and the tubes **44** are oriented on the base **39** with respect to the plate **42** so as to extend across the corners thereof, four openings **47***a* are formed, two below at opposite sides, and two above at opposite sides. Each opening **47***a* appears to be triangular as viewed in FIG. **3** and is bounded by one beam **43**, one tube **44** and one edge of the plate **42**. Four similar openings are formed by the plate **45**, beams **46** and tubes **47** of the support **40** and lie directly behind the openings **47***a* of the base **39** when the base **39** is in the full-line position of FIG. **3**. The openings **47***a* and the undesignated openings accommodate hydraulic and vacuum lines running from the tractor **33** to the lifter **30**, as will appear presently.

We have discovered that very good results were reached in the construction of the base **39** and support **40** with the beams and tubes extending across the corners of the plates. The base **39** and support **40** were constructed without distortion and could be assembled, as shown in FIG. **4**, with their plates **42** and **45** in close facing relation. We believe that the absence of distortion achieved with the arrangement of beams, tubes, and plate shown in FIG. **3**, may be due to the fact that the length of welds between the plate and beams is not excessive.

The pivot axis **41** of the base **39** on the support **40** is formed by a central stud **48** welded to the support plate **45** and a bushing **49** welded to the base plate **42** and receiving the stud **48**. A nut **50** threaded on the stud **48** bottoms a washer **50***a* against the bushing **49** to draw the plates **42** and **45** into engagement. The plates **42** and **45** are also held together by outer studs **51** welded to the plate **45**. The studs **51** have nuts **52** threaded thereon to bottom washers **52***a* against the plate **42**. The studs **51**, extend through arcuate slots **53** in the base plate **42**.

As shown in FIGS. **2**, **3**, **4** and **5**, two tubes **53** extend between the H-beams **43** of the base **39** and the elongated carrier **38** which is in the form of an I-beam. Each tube **53** has one end secured as by welding to the flange of the H-beam **43** that is away from the base plate **42** at a region adjacent to the lower tube **44**. The other end of each tube **53** is tightly received in a sleeve **54**. A tubular brace **55** has its ends secured to the sleeves **54** and extends between them. The sleeves **54** extend through the web of the carrier beam **38** and through a plate **56**, being secured to the web and to the plate by welding as indicated at **57** and **58**. The plate **56** is secured by welding as indicated at **59** to the flanges of the carrier beam **38** and is parallel to the web thereof. A tubular strut **60** extends along and above each tube **53** and has one end connected to an ear **61** on the sleeve **54** and the other end connected to a gusset plate **62**, one edge of which is secured to the outer flange of the H-beam **43** and the other edge is secured to the tube **53**. Two gusset plates **63** are provided between the sleeves **54** and the carrier beam **38**, each plate **63** having one edge secured to the web of the beam and the other edge to one of the sleeves **54**.

As shown in FIGS. **2** and **6**, the vacuum units **37** are arranged end-to-end and extend along and beneath the carrier beam **38** and beyond the ends thereof. Each unit **37** as shown in FIG. **5**, includes an elongated vacuum shoe **64** composed of an elongated cylindrically curved wall **64***a* and a resilient seal strip **64***b* attached to the concave side of the wall **64***a* and extending therealong in the form of a closed four-sided loop, two opposite sides of which are parallel to the axis of the wall **64***a*. Each unit **37** also includes an elongated vacuum reservoir **65** which is coextensive and integrally associated with its vacuum shoe **64** and comprises the curved wall **64***a*, or more particularly the convex side thereof, and a box **66** which is closed on its lower side by the wall **64***a*, to which it is welded.

Each vacuum unit **37** is floatingly supported by the carrier beam **38** by means of an inner stud **67** projecting upwardly from the box **66** and an outer sleeve **68** depending from the bottom of the beam **38**. The inner stud **67** has a base **67***a* secured as by welding to the upper side of the reservoir **65**, or more particularly, to the side of the box **66** opposite to the curved wall **64***a*. The outer sleeve member **68** is secured as by welding to the lower flange of the carrier beam **38**. The stud **67** and sleeve **68** have aligned horizontal front to rear bores or holes **69** therethrough receiving a pin **70** which fits tightly in the stud and loosely in the sleeve to accommodate relative independent axial tilting of the units **37**.

The vacuum units **37** are guided relative to one another by means of two strips **71** at the adjacent ends of the boxes **66**. One strip **71** is welded to one box **66** and slides against the side of the other box **66** while the other strip **71** is welded to the other box and slides against the first mentioned box.

As shown in FIGS. **5** and **7**, each vacuum shoe **64** is connected with the associated vacuum reservoir **65** by a pipeline **72** having a section **72***a* extending from an opening in the curved wall **64***a* through the vacuum reservoir **65** and out the top thereof to a manually controlled valve **73**, a section **72***b* extending therefrom to a power-operated valve **74**, and a section **72***c* extending therefrom to an opening in the top of the vacuum reservoir **65**. Thus the line **72** is connected at one end to the vacuum shoe **64** at the opening in the curved wall **64***a* and at the other end to the vacuum reservoir **65**. Each vacuum reservoir **65** is connected with a vacuum source such as vacuum pump **75** through a short pipeline **76**, a hose **77**, a T-fitting **78**, and a hose **79**. The pipeline **76** is connected to the top of the vacuum reservoir **65** and contains check valve **80** ahead of the hose.

The manual valve **73** opens or closes the pipeline **72**. The power-operated valve **74** either connects the vacuum reservoir **65** with the vacuum shoe **64** through pipeline sections **72***a*, **72***b*, and **72***c* while closing a vent **81** located on valve **74**, or vents the vacuum shoe by connection of the vent **81** with pipeline sections **72***a* and **72***b* leading to the vacuum shoe while closing the pipeline section **72***c* leading to the vacuum reservoir. The valve **74** is operated by a hydraulic power unit **82** which may include a cylinder and a piston, connected through lines **83**, **83***a*, **84**, and **84***a*, a control valve **85**, and lines **86** and **87** with a source **88** of fluid under pressure. The vacuum pump **75** and the pressure fluid source **88** may be located on, and operated from the tractor **33**.

Attention is directed to the advantages inherent in the arrangement in each of the vacuum units **37**, of the vacuum shoe **64** and its integrally associated vacuum reservoir **65** connected thereto by the pipeline **72**, which is composed of rigid strong metal and permanently associated with the vacuum shoe and reservoir. If the vacuum pump **75** fails or the connections therefrom upstream from the check valve **80** are broken or disconnected, the check valve **80**, permanently associated with the vacuum unit **37** in the pipeline **76**, closes and preserves the vacuum in the reservoir **65**. Because the vacuum shoe **64** is connected with the reservoir **65** by the permanent pipeline **72**, the vacuum shoe continues to have a vacuum. Thus, the vacuum shoe **64** will not drop the pipe section **41***a* in the event of failure upstream from the check valve **80**.

Tilting of the vacuum units **37** between the positions of FIG. **12** and FIG. **13** is accomplished by rotation of the base **39** with respect to the support **40** about the pivot axis **41**. This movement is effected by means of a power unit **89** that may include a cylinder and a piston movable therein by fluid under pressure. As shown in FIGS. **3** and **4**, one end of the power unit **89** is connected to a bracket **90** secured to the upper end of one beam **46** of the support **40** and overlying the base **38** in spaced relation thereto, and the other end of the power unit is connected to the upper tube **44** of the base **39**. Thus the power unit **89** may tilt the base **39** from the full-line position of FIG. **3** in which the beams **43** of the base **39** are vertical and parallel to the beams **46** of the support **40**, to the broken line position of FIG. **3** in which the beams **43** of the base **39** are at an angle to the vertical. The base **39** may also be tilted in the opposite direction so that the beams **43** thereof are angled to the vertical oppositely to the broken-line position of FIG. **3**. The

power unit 89 may be connected for operation to the source 88 of fluid under pressure, which may be supplied from the tractor 33.

The openings 47*a* in the base 39 and the corresponding undesignated openings in the base 40 receive the vacuum line 79, the hydraulic lines 84 and 84*a*, and the hydraulic lines (not shown) for the power unit 89. Thus, for example, the hydraulic lines 84 and 84*a* may extend through the opening 47*a* of the base 39 at the lower left as viewed in FIG. 3 and through the associated opening in the support 40. The vacuum line 79 may extend through the opening 47*a* at the lower right and the associated undesignated opening. The lines (not shown) from the power unit 89 may extend through the undesignated opening in the support 40 which is associated with the opening 47*a* in the base 39 either at the upper right or at the upper left.

It might appear that when the base 39 is tilted to the dotted line position of FIG. 3, the vacuum line 79 and the hydraulic lines 84 and 84*a* will be pinched because the openings 47*a* in base 39 are taken completely out of registry with the associated openings in the support 40.

Such pinching of the lines 79, 84 and 84*a* will not occur, however, because the openings 47*a* and their associated openings are formed not only by the plates 42 and 45, but also by the beams 43 and 46 and the tubes 44 and 47. Referring to FIG. 4, although the plates 42 and 45 are immediately adjacent one another, the beams 43 and 46 are spaced by the combined thickness of the plates 42 and 45, and the tubes 44 and 47 are spaced by an even greater amount. Thus, in effect, the openings 47*a* and the associated undesignated opening, are spaced from one another and will not pinch the lines in the openings even when shifted out of registry.

As shown in FIGS. 2, 4 and 10, the lift arm mechanism 31, includes separate interconnected parallel beams 91, with rear ends connected to the front section 32 of the tractor 33 on a horizontal pivot axis 92 and front ends connected on a horizontal pivot axis 93 with the lower end of the support 40, the beams 91 of the lift arm mechanism 31 being pivotally connected to and between ears 94 secured to the rear flanges of the support beams 46 near the lower end thereof and the lower tube 47. The upper end of each beam 46 of the support 40 carries rear flange ears 95 between which one end of a link 96 is connected. This link is pivotally connected at its other end with the upper end of a lever 97 having its lower end pivotally connected to one beam 91 of the lift arm mechanism. A parallelogram is formed comprising the link 96, the lever 97, the portion of the beam 91 between the lever 97 and the pivot 93, and the portion of the support 40 between the pivot 93 and the link 96. An intermediate region of the lever 97 is pivoted to one end of a hydraulic power unit 98, the other end of which is pivoted to the upper end of a lever 99. An intermediate region of the lever 99 is pivoted to the beam 91, and the lower end of the lever 99 is connected by a link 100 to the front section 32 of the tractor 33.

It is to be understood that there are two sets each composed of link 96, lever 97, power unit 98, lever 99 and link 100, one set associated with each beam 91 of the lift arm mechanism 31 although only one set appears in FIGS. 1, 8 and 9, and the sets have been completely omitted from FIGS. 2, 10 and 11 for the sake of clarity.

By virtue of the link 96, the lever 97, the power unit 98 when locked, the lever 99, and link 100, the pipe lifter 30 is raised and lowered relative to the front end 32 of the tractor about the pivot axis 92. It is possible to control the vertical plane of the support 40 through the linkage of the lift arm mechanism 31 so that it may tilt as shown in FIG. 9 or remain vertical throughout its range of lift.

In operation of the present apparatus, the sealing strips 64*b* of the vacuum shoes 64 are brought into engagement with the top of the pipe section P to be lifted. The power units 82 are activated to shift the valves 74 so that the pipeline sections 72*a* and 72*b* are switched from the vents 81 to the pipeline sections 72*c* leading to the vacuum reservoirs 65. Thus the reservoirs are connected to the space between the pipe and the vacuum shoes 62 which is surrounded by the sealing strips and this space is quickly evacuated to grip the pipe P with the shoes and thus enables them to lift the pipe section P as the lift arm mechanism 31 is moved upwardly from the position of FIG. 8 to that of FIG. 9. The tractor 33 is brought to the new location where the pipe section P is to be deposited. Then the lift arm mechanism 31 is lowered to the position of FIG. 8, and the pipe section P is brought to the desired location, whereupon the power units 82 are operated to shift the valves 74 for connecting the vents 81 to the pipeline sections 72*a* and 72*b* and thus to the vacuum shoes 62, for releasing the pipe P.

If the vacuum units 37 cannot be brought parallel to the pipe section P with the tractor sections 32 and 34 arranged with parallel wheel axes as shown in FIG 10, the tractor is articulated to angle the sections 32 and 34 as shown in FIG. 11, for example, or in some other way until parallelism is achieved.

If the pipe section P is horizontal or nearly so, the vacuum units 37 may be applied to the pipe section P with the lifter 30 in the position of FIG. 12. If, on the other hand, the pipe section P is at an angle to the horizontal, the lifter 30 is tilted about the pivot axis 41 to bring about the relative position of base 39 and support 40 shown in FIG. 13 so that the vacuum shoes 37 are angled to the horizontal to about the same degree as the pipe section P. Now the vacuum units 37 can settle down onto the pipe section P for lifting it. When the pipe section is brought to its new location, the base 39 is moved angularly about the axis 41 with respect to the support 40 until the pipe section P is brought to the angle of the new location.

The floating connection of the vacuum units 37 with the carrier beams 38 provided by the stud 67 and sleeve 68 connected by the front to rear pin 69 permits axial tilting of the units 37 so that the shoes 64 may settle on the pipe P even when the pipe sags or bends. The pins 69 can be removed to quickly disconnect the units 37 from the beam 38 and accommodate replacement with different units 37 of the same or different size.

If the pipe section P is short enough to require only one vacuum unit 37 for lifting, the manual valve 73 on the other vacuum unit 37 is closed so that no vacuum is supplied to the associated vacuum shoe 62 in spite of actuation of the valve 74.

It will be understood that the illustrated embodiment of the invention has been used for illustrative purposes only and that the various modifications and variations of the present invention may be effected without a departure in the spirit and scope of the novel concept thereof.

We claim:

1. An assembly comprising:

a. a tractor comprising a pair of sections pivotally connected with one another on a vertical axis located between the sections, each section having two driven ground-engaging means, one located at one side of the axis and the other at the other side thereof;

b. a lift arm having a first end connected to one tractor section on a horizontal pivot axis and extending therefrom in a direction away from the other tractor section so as to terminate in a second end spaced from the one tractor section;

c. a support plate extending generally upwardly from a connection with the second end of the lift arm on a horizontal pivot axis and being adjustable about its pivot axis on the lift arm;

d. a base plate mounted on the support plate directly adjacent thereto for relative angular movement about an axis extending through central regions of the base and support plates, the axis of the base plate on the support being perpendicular to a plane containing the axis of the support plate on the lift arm and intersecting said plane at a point spaced from the latter axis;

e. means for adjusting the base plate about its axis on the support plate with respect thereto and for fixing the base plate with respect to the support plate;

f. a beam fixed to the base plate parallel thereto and being spaced therefrom generally in the direction in which the lift arm extends away from the said other tractor section; and

g. a pair of vacuum shoes carried by the beam, extending therealong in end-to-end relationship, and connected with one another, each shoe being loosely connected with the beam for limited vertical movement with respect to the beam.

2. The assembly according to claim 1, the axis of tilting of the base on the support lying above and being spaced from the axis of the support on the second end of the lift arm.

3. In an assembly comprising a tractor having a rear section with two driven wheels, a front section with two individually driven wheels, means connecting the front and rear sections for pivoting about a vertical axis between the sections, and a power-operated lift arm mechanism extending forwardly from said front section on a horizontal pivot axis connection with the front section, the combination of:

a. a support;

b. a base;

each of the support and the base comprising:

1. a plate having inner and outer faces;

2. a pair of spaced parallel H-beams each having one flange parallel to the plate and secured to the outer face thereof; and

3. a pair of spaced parallel tubes secured to the webs of the H-beams near their ends and extending therebetween in spaced relation to the outer surface of the plate, the plates of the support and the base lying directly adjacent one another in overlapping relation with their inner surfaces facing one another;

c. means connecting the support and the base for tilting of the base with respect to the support about an axis perpendicular to the plates and located between the H-beams and between the tubes of each of the support and the base;

d. a power unit for tilting the base about said axis having one end connected to a tube of the base and the other end connected to an end of an H-beam of the support;

e. means connecting the front end of the lift arm and regions of the beams of the support adjacent one tube thereof for pivoting of the support about a horizontal axis on the front end of the lift arm, the support extending generally upwardly from said horizontal axis, the pivot axis of the base on the support being above and spaced from said horizontal axis and lying in a plane perpendicular thereto;

f. means connecting a region of the lift arm spaced from its front end with regions of the beams of the support adjacent the other tube and generally above said horizontal axis for adjusting the support about said horizontal axis or fixing the support against such adjustment;

g. an elongated carrier member spaced forwardly from the base and parallel to the plate thereof;

h. means securing the carrier member to the base; and

i. a pair of vacuum shoes extending end to end along and beneath the carrier member and being loosely connected thereto for floating movement with respect thereto.

4. A combination according to claim 3:

the means connecting the support and the base for tilting of the base comprising a central stud and a plurality of outer studs, each stud being secured to the plate of the support and extending through the plate of the base and beyond the outer surface of said plate, the central stud lying on the tilting axis of the base and being received in a bushing secured in the plate of the base and extending outwardly of the outer surface of said plate, the outer studs lying radially outward of the central stud and being distributed thereabout, the plate of the base receiving the outer studs on arcuate slots, and nuts threaded on the studs at the outer face of the base of the plate;

the plate of each of the support and the base being shaped as a square with two opposite rounded corners and two square corners, the associated H-beams extending across the plate just inward of the square corners perpendicularly to the diagonal therebetween, the associated tubes extending across the plate just inward of the round corners, four openings being located on each of the base and the support to accommodate lines leading to the vacuum shoes and the power unit for actuating the same, each opening being formed by a beam, a tube, and a side edge of a plate; and

the carrier member being parallel to the tubes of the base, the means securing the carrier member to the base comprising spaced parallel tubular members extending between the carrier member and the base and being secured to the H-beams of the base adjacent one tube at opposite sides of and below the axis of the base on the support.

5. For attachment to one end of a lift arm having its other end pivotally connected to a tractor, a lifter comprising:

a. a support;

b. a base;

each of the support and the base comprising:

1. a plate having inner and outer faces;

2. a pair of spaced parallel H-beams each having one flange parallel to the plate and secured to the outer face thereof; and

3. a pair of spaced parallel tubes secured to the webs of the H-beams near their ends and extending therebetween in spaced relation to the outer surface of the plate, the plates of the support and the base lying directly adjacent one another in overlapping relation with their inner surfaces facing one another;

c. means connecting the support and the base for tilting of the base with respect to the support about an axis perpendicular to the plates and located between the H-beams and between the tubes of each of the support and the base;

d. a power unit for tilting the base about said axis having one end connected to a tube of the base and the other end connected to an end of an H-beam of the support;

e. ears attached to the beams of the support adjacent the tubes and adapted to be connected to the lift arm;

f. an elongated carrier member spaced forwardly from the base and parallel to the plate thereof;

g. means securing the carrier member to the base; and

h. a pair of vacuum shoes extending end-to-end along and beneath the carrier member and being loosely connected thereto for floating movement with respect thereto.

6. For use with a vehicle having a lift mechanism projecting from the front end thereof, and attachment for said mechanism to grip pipe and the like objects by vacuum comprising an upright support pivotally mounted about a horizontal axis at its lower end on the front end of the lift mechanism, for tilting in a vertical plane relative to the lift mechanism, a base overlying the front face of the support pivotally mounted on the support for rotation in the plane of the support, means on the lift mechanism for tilting the support, power means on the support for rotating the base, a transverse beam spaced forwardly from said base and carried therefrom, a pair of elongated vacuum shoes in side-by-side relation pivotally suspended from said beam for limited independent axial tilting movement, and a vacuum tank on each shoe effective to maintain the shoe in an evacuated condition whereby the lift mechanism is adapted to raise and lower the vacuum shoes relative to the vehicle, the support is adapted to raise and lower the vacuum shoes relative to the lift mechanism, the base is adapted to tilt the vacuum shoes transversely of the vehicle, and the pivot suspensions for the vacuum shoes accommodate shifting of the shoes relative to the beam for settling on the pipe or other object to be gripped.

7. For use with a vehicle having a lift mechanism and a vacuum pump, a base pivotally mounted on the front end of the lift mechanism for rotation in a plane normal to the vehicle, beam means projecting forwardly from said base, a trans-

verse beam secured to the front end of said forwardly projecting beam means, longitudinally elongated vacuum shoe means suspended from said transverse beam, vacuum tank means on said shoe means, power means for rotating said base relative to the lift mechanism for tilting the shoe means transversely of the vehicle, conduit means connecting the vacuum pump with said vacuum tank means, valve means selectively connecting the vacuum shoe means with the tank thereon and with the atmosphere, and check valve means for holding vacuum in the tank means when the conduit means to the vacuum pump leaks or the vacuum pump is idle whereby the vacuum shoe means may be quickly evacuated from the tank means and vacuum therein maintained regardless of any vacuum connection with the vehicle.

8. The attachment of claim **6** wherein each vacuum shoe has a plate shaped to fit the contour of the object to be lifted, a sealing strip depends from said plate enclosing an area to be evacuated, and valve means selectively communicate the vacuum tank on the shoe with the area surrounded by the sealing strip and with the atmosphere.

9. The attachment of claim **6** wherein guides project from adjacent vacuum shoes to maintain the shoes in end-to-end relation while accommodating relative tilting thereof.

10. The attachment of claim **7** including power means between the lift mechanism and base for tilting the base relative to the lift arms.