July 26, 1966 W. H. MANNON 3,262,592

APPARATUS AND METHOD FOR MOVING DRILLING EQUIPMENT

Filed Nov. 26, 1963 5 Sheets-Sheet 1

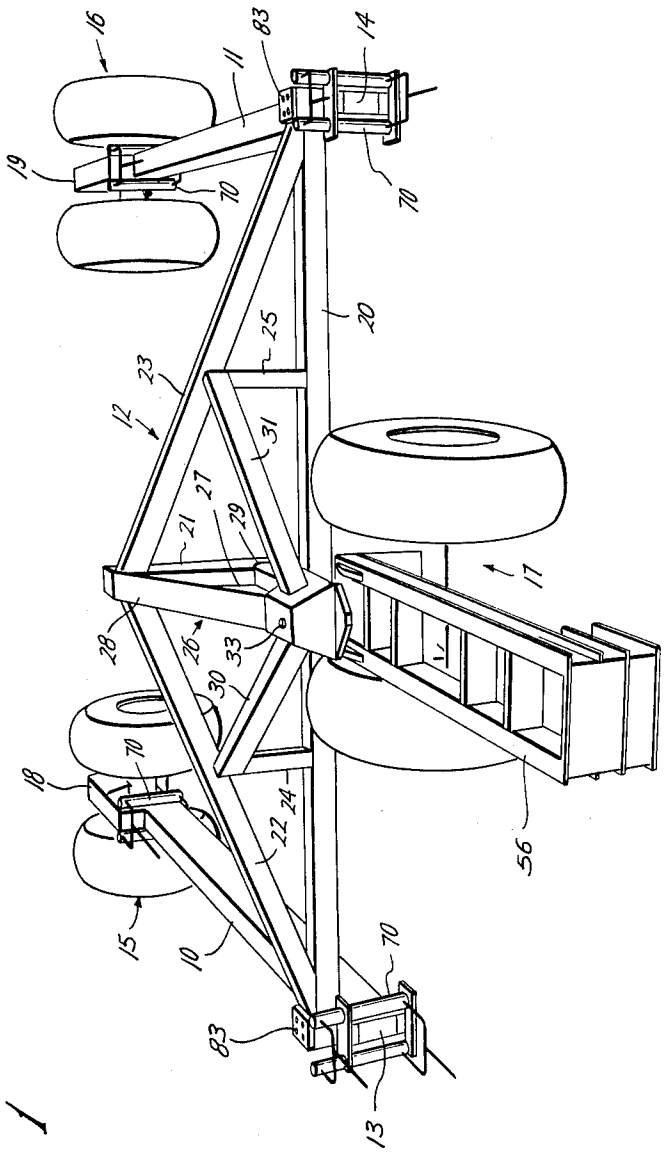


Fig. 1

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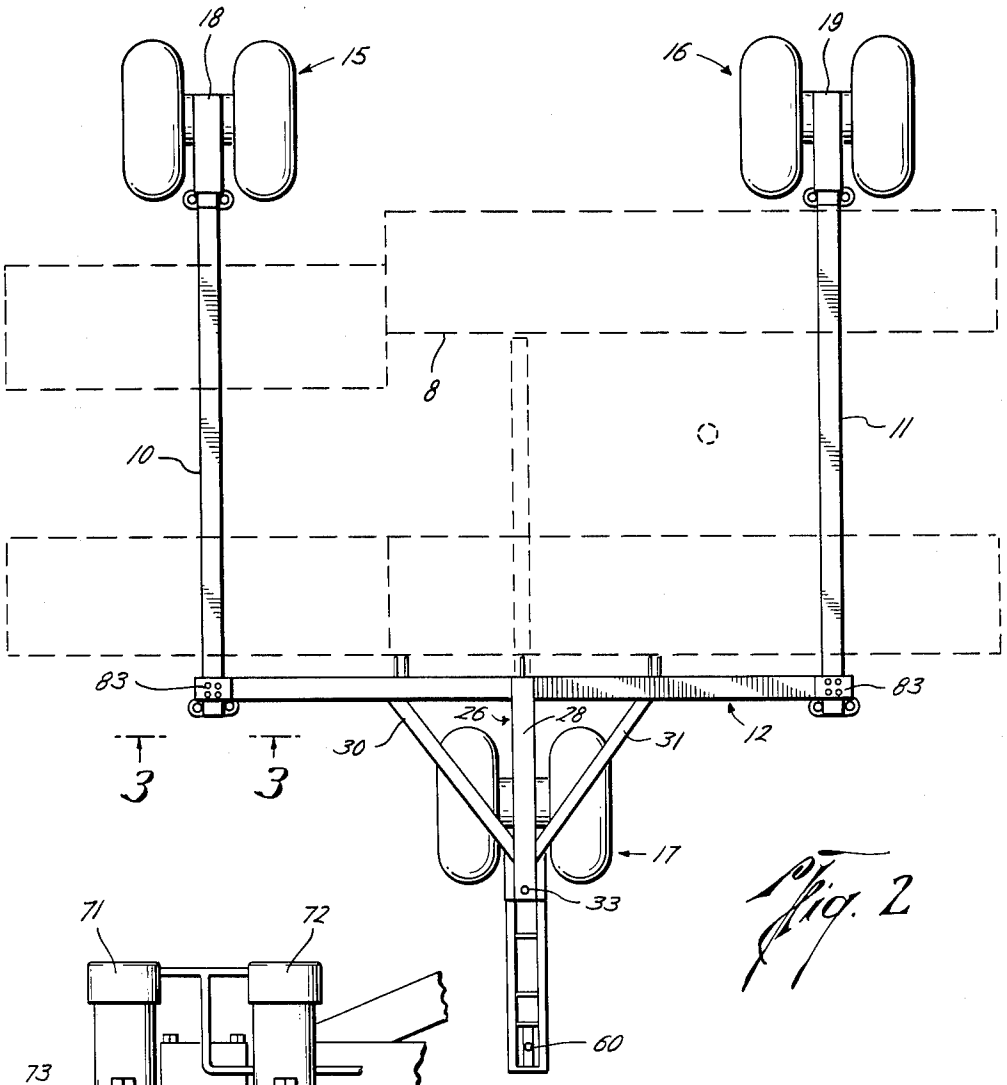


Fig. 2

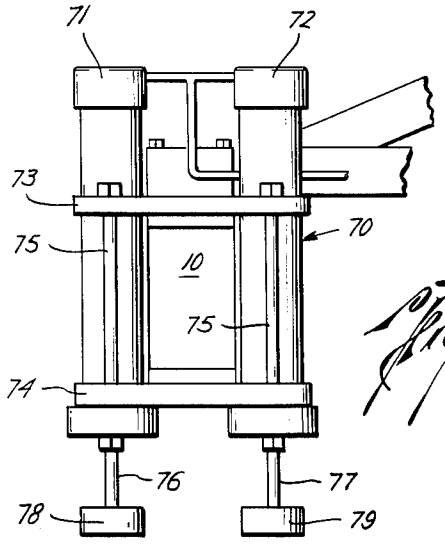


Fig. 3

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APPARATUS AND METHOD FOR MOVING DRILLING EQUIPMENT

Filed Nov. 26, 1963 5 Sheets-Sheet 3

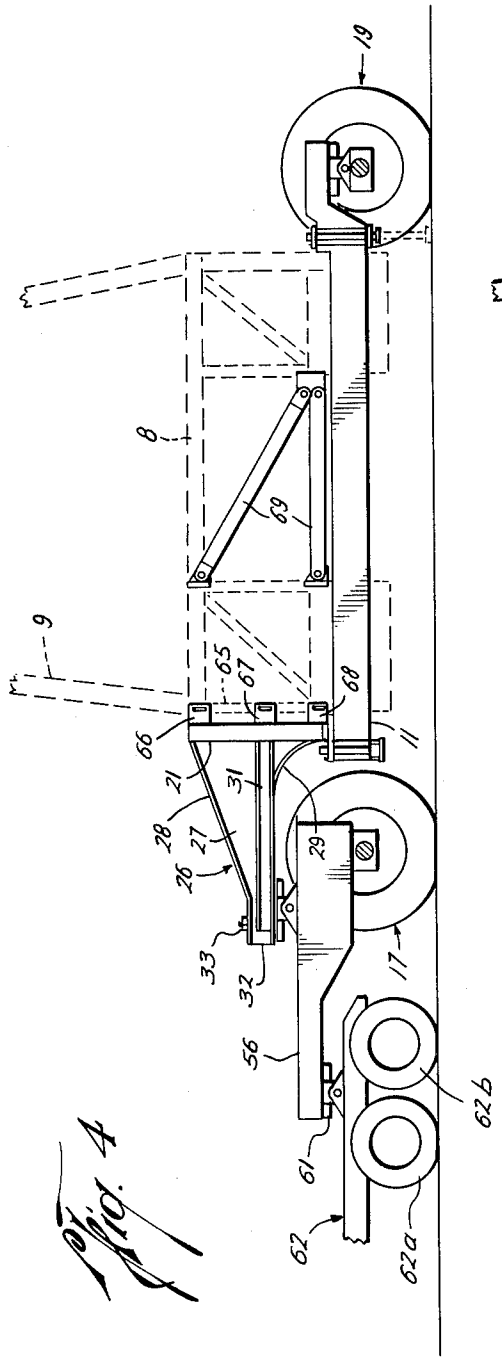


Fig. 4

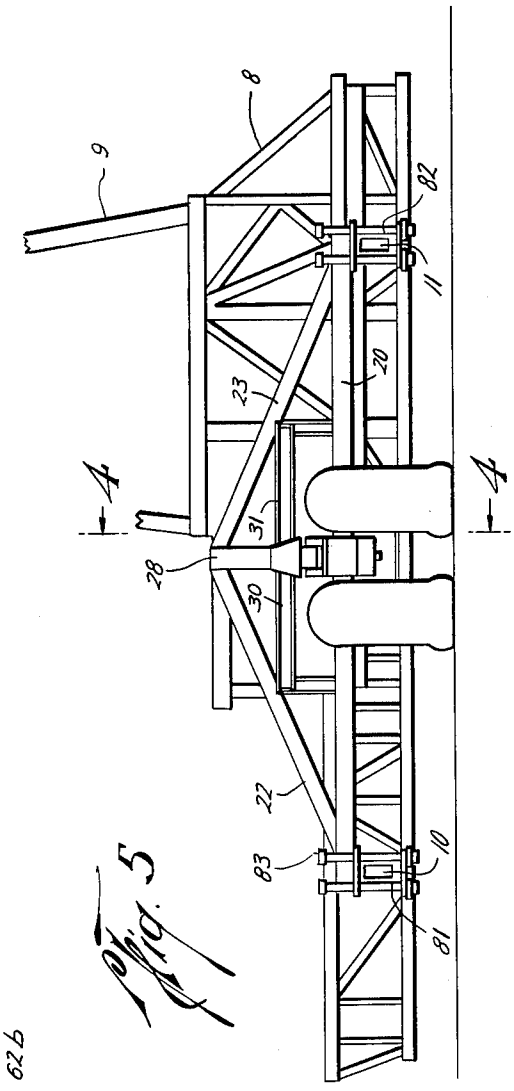


Fig. 5

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APPARATUS AND METHOD FOR MOVING DRILLING EQUIPMENT

Filed Nov. 26, 1963 5 Sheets-Sheet 4

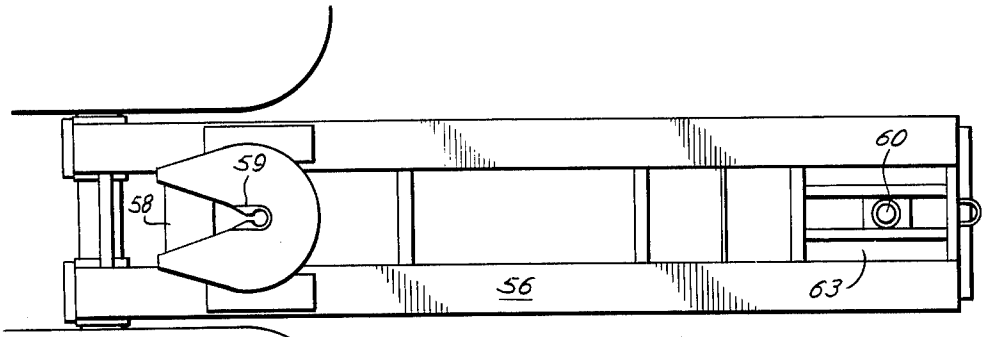


Fig. 6

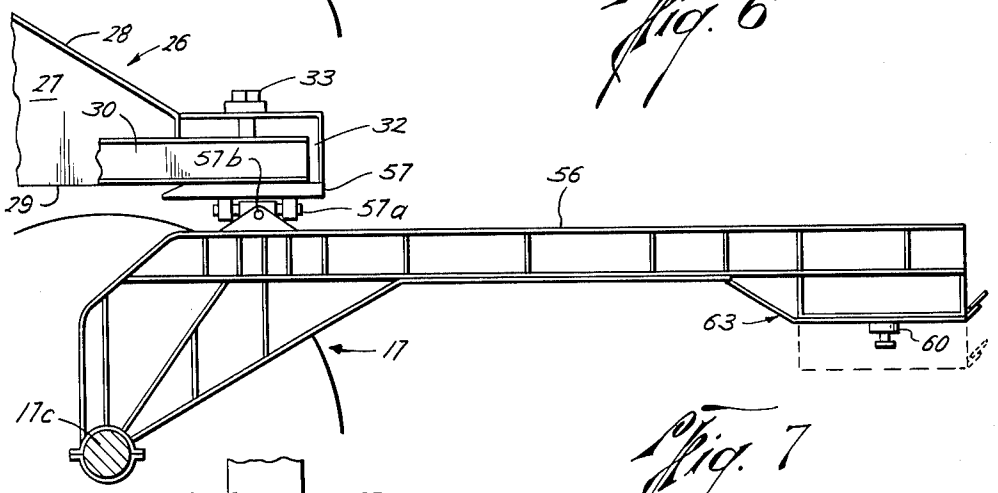


Fig. 7

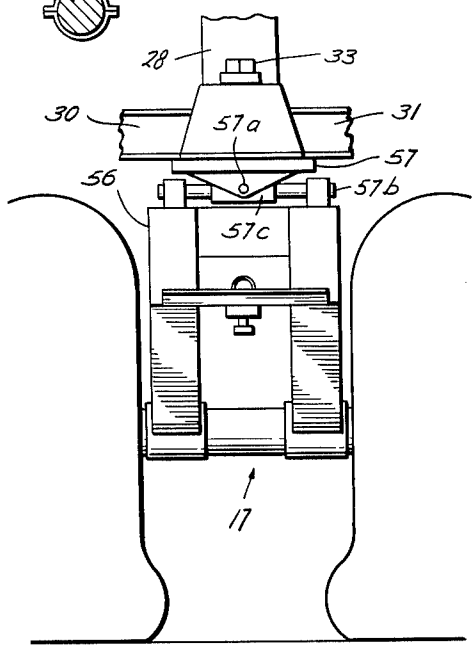


Fig. 8

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APPARATUS AND METHOD FOR MOVING DRILLING EQUIPMENT

Filed Nov. 26, 1963 5 Sheets-Sheet 5

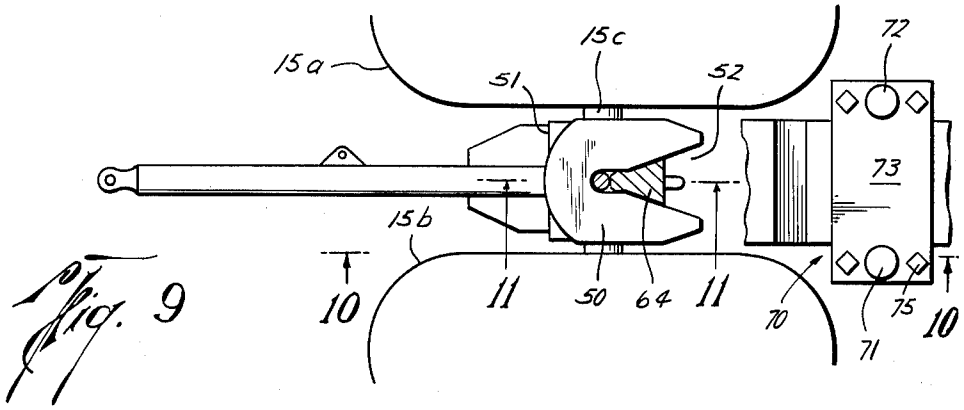


Fig. 9

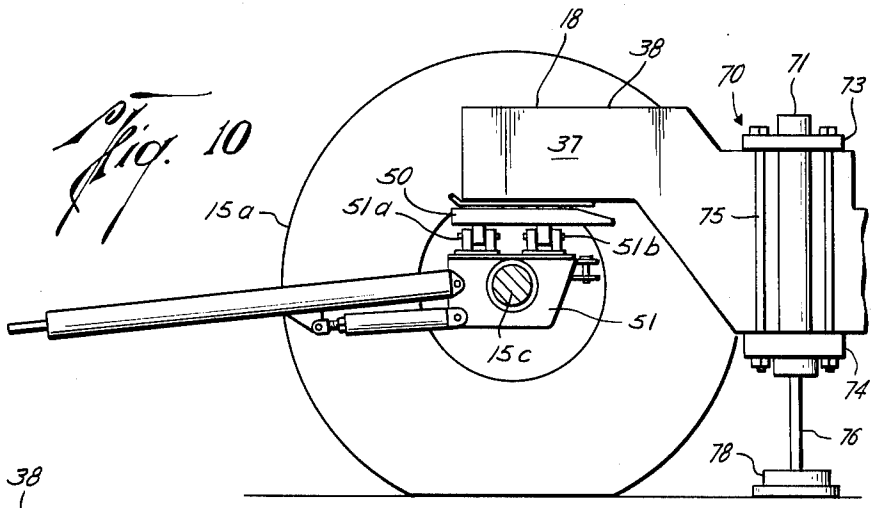


Fig. 10

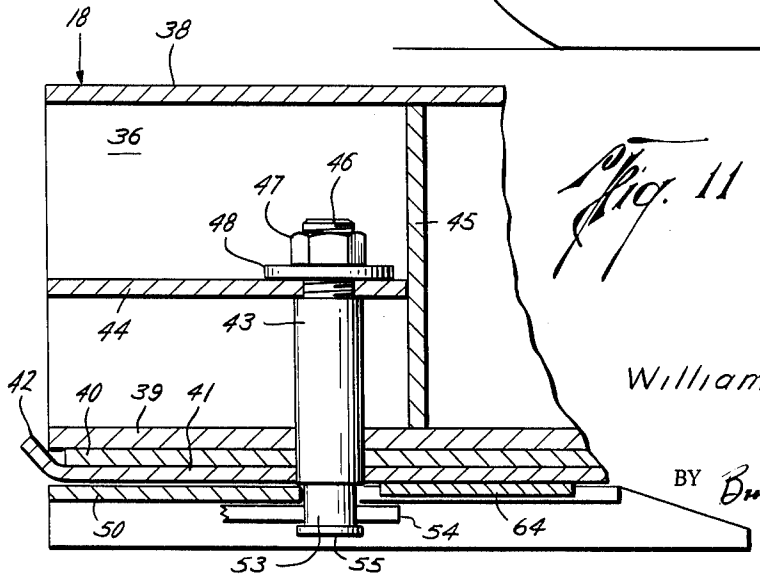


Fig. 11

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United States Patent Office 3,262,592 Patented July 26, 1966

3,262,592

APPARATUS AND METHOD FOR MOVING DRILLING EQUIPMENT

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Filed Nov. 26, 1963, Ser. No. 325,886
8 Claims. (Cl. 214—515)

This invention relates to a method and apparatus for moving a drilling rig.

Wherever the terrain permits, it is usually advantageous to move a drilling rig from one drilling location to another in as nearly an assembled condition as possible. In other words, the less time spent on disassembling the drilling equipment at the old location and reassembling it at the new location, the cheaper and faster the move can be made.

It is particularly advantageous to move the derrick with its supporting substructure intact as a unit from the old to the new location. This not only saves the time of dismantling or lowering the derrick and either rebuilding or raising it at the new location, but it also allows all of the equipment supported by the substructure and derrick to be moved along with them without having to be handled separately thus affording a further saving in time and expense.

Heretofore, in the moving of the substructure of a drilling rig with the derrick erected thereon, each corner post of the substructure was jacked up and placed on a low truck or bogie usually equipped with tracks. These bogies provided a rolling support for each corner of the substructure and allowed the substructure and derrick to be moved to the new location by an appropriate prime mover, such as a tractor equipped with tracks. An alternate method was to extend two beams through the substructure, jack up and place a bogie under each end of the beams to thereby support the substructure and derrick, and then move the equipment in the same manner as above.

These methods of moving drilling equipment have a serious disadvantage. With four bogies supporting the equipment, one on each corner, each bogie can support its share of the load only if the bogies are traveling on level ground. Terrain this level does not occur very often between drilling locations, even in the desert areas, so with these methods, the weight of the equipment being moved is continuously shifting between the bogies. This shifting of the load causes sudden changes in stress on the substructure and creates the constant danger that the shifting of the load from one bogie to another may provide sufficient momentum to cause the equipment to topple over.

It is an object of this invention to provide a method and apparatus for moving a drilling rig which eliminates any sudden shifting of the load from one support joint to another.

It is another object of this invention to provide apparatus for moving a drilling rig which is simple and compact and which can be quickly and easily positioned for moving drilling equipment.

It is further an object to provide apparatus for moving a drilling rig which transmits a portion of the weight of the drilling rig to the prime mover supplying the motive power for moving the drilling rig to increase the normal force between the prime mover and the ground to thereby increase the frictional force between the prime mover and the ground and improve its traction.

It is a further object of the invention to provide apparatus for moving drilling equipment over uneven terrain without causing stresses in the apparatus or the equipment being moved.

It is a further object of the invention to provide supporting apparatus which freely adjusts to uneven terrain without creating any undue stresses in the apparatus or the equipment being moved.

It is a further object of the invention to provide a two-wheeled truck or bogie for rollingly supporting the apparatus supporting the equipment being moved which can be quickly and easily attached to and detached from the apparatus.

Other objects, features and advanatges of the invention will be apparent to one skilled in the art upon consideration of the description thereof contained in this specification, the attached drawings and appended claims.

One embodiment of the invention is illustrated in the drawings, in which:

FIG. 1 is an isometric view of one embodiment of the invention as it appears when it is assembled ready to move drilling equipment to a new location;

FIG. 2 is a plan view of the apparatus of FIG. 1 illustrating with dotted lines a substructure supported by the apparatus;

FIG. 3 is a front view taken along line **3—3** of FIG. 2 illustrating the structure of the support beams and how the jack assemblies are attached thereto;

FIG. 4 is a side view of the apparatus of the invention supporting a substructure and a derrick, showing the prime mover coupled to the apparatus preparatory to moving it with a substructure and derrick supported thereon; a portion of the substructure being broken away along line **4—4** in FIG. 5 to illustrate how the substructure itself can be modified to provide means for supporting the portion of the apparatus used to transmit the load to the front bogie and the prime mover;

FIG. 5 is a front view of the assembled apparatus supporting a typical substructure and derrick;

FIG. 6 is a top view of the front bogie employed with the apparatus;

FIGS. 7 and 8 are side and front views, respectively, of the bogie illustrated in FIG. 6 which show how the front bogie is positioned to support its share of the load;

FIG. 9 is a top view of one of the rear bogies with the trailing end of the support beam broken away to show the key carried by the support beam for engaging a keyway provided in the support plate carried by the bogie to prevent the bogie from pivoting relative to the support beam and also showing a top view of the jack assembly used to lift the support beams into position to be mounted on the bogies;

FIG. 10 is a sectional view of the rear bogie shown in FIG. 9 taken along line **10—10** showing the trailing end of the support beam in position on the bogie and also showing a side view, in elevation, of the jack assembly used to lift the support beams into position to be mounted on the bogie; and

FIG. 11 is vertical sectional view taken through the trailing end of the support beam and the support plate carried by the bogies showing the details of their construction. The view is taken along line **11—11** of FIG. 9 and shows the beam as it would appear if it were not broken away.

A preferred embodiment of the apparatus of this invention, as illustrated in FIGS. 1, 2, 4, and 5, comprises two support beams **10** and **11** which directly support the equipment being moved, load transmitting means generally indicated by the numer **12** which extends between the front ends **13** and **14** of the beams, and three two-wheeled trucks, or bogies, as they are usually called, designated as **15**, **16** and **17**, respectively. Bogies **15** and **16** support trailing ends **18** and **19** of beams **10** and **11**, respectively, while truck **17** supports load transmitting means **12** at about its midpoint. Thus, as opposed to the

apparatus heretofore used, the drilling equipment being moved, which in the drawings consists of substructure 8 and derrick 9, is supported at three rather than four points, thereby insuring that each of the support points will be supporting a portion of the load at all times. This arrangement also eliminates the possibility of the load being suddenly shifted among the support points as the equipment moves over uneven terrain which frequently occurred when four support points were used.

Since the support beams must support the entire weight of the equipment being moved, which may exceed 500,000 pounds, and since the beams will be subjected to some side loading as the equipment moves over unlevel ground, a fabricated, box type beam is preferred. Thus, beams 10 and 11 have a rectangular cross section as shown in FIGS. 1 and 3. The trailing or rear ends 18 and 19 of the beams are raised to form "goosenecks" to reduce the heights the beams must be raised above the ground in order for their ends to extend over the axles of the rear bogies.

The front or forward ends of the beams are not supported directly by bogies, but are carried by means 12 which interconnects the front ends of the beams and transmits the force required to support the front ends of the beams to the front bogie 17. In the embodiment of the invention illustrated, the load transmitting means 12 is a truss which comprises a horizontal member or tie beam 20 which is attached to the front ends of the support beams, an upright member or king post 21 located midway between the beams, and two inclined members or cords 22 and 23 which extend from the top of the upright member to opposite ends of the horizontal member or tie beam 20. Additional braces are provided in the form of struts 24 and 25 to further strengthen the truss as required.

The truss is also provided with a gooseneck 26 which extends forward from the truss and is connected to the front bogie 17 to transmit the load carried by the truss to the front bogie and prime mover in a manner to be described below. As illustrated in FIG. 4, gooseneck 26 preferably consists of a vertical plate 27 which is shaped with a bottom edge curving upwardly and outwardly and an upper edge sloping downwardly and outwardly. Thus, the plate extends outwardly from king post 21 with an ever decreasing vertical width with its end 32 located substantially above the plane of the support beams. The edge of the plate which is connected to the king post of the truss, extends substantially the length of the post to thereby distribute the load more uniformly along the post. Flanges 28 and 29 are attached along the upper and lower edges, respectively, to strengthen plate 27 and lateral supports 30 and 31 are provided to support the plate against side loads. At outer end 32, the edges of the plate are horizontal to allow lower flange 29 to provide a wide bearing surface for transferring the load carried by the truss to the front bogie. A hole is drilled vertically through the flanges and the plate to receive a king pin 33 which, as will be explained below, connects the gooseneck to front bogie 17.

As stated above, the trailing ends of support beams 10 and 11 are raised to reduce the amount the beams must be lifted to clear the axles of the trucks 15 and 16. The support beams and rear bogies are of identical construction so only one of each will be described in detail. As shown in FIGS. 10 and 11, end 18 of beam 10 is formed of two vertical side plates 36 and 37, a top plate 38 and bottom plate 39. Two adidtional plates are attached to the bottom plate, support plate 40, and guide plate 41 which has an upturned end 42 to help guide the end of the beam into position on the bogie. An opening extends through these plates and bottom plate 39 to receive king pin 43. The additional plates are provided to increase the area of the king pin 43 engaged by the beam as well as to increase the strength of the beam end. The king pin is supported in the opening by horizontal mounting plate 44 which is welded to side plates 36 and 37 of the beam and to a vertical member 45 which is located within the rectangle formed by the plates making up the beam. The king pin has a threaded upper end 46 of reduced diameter which extends through an opening in the mounting plate and is held in place by nut 47 and washer 48.

Each of the three two-wheeled trucks or bogies 15, 16 and 17 supporting the structure consisting of the support beams and the truss has two wheels mounted on an axle in the conventional manner. Bogie 15, for example, as shown in FIGS. 9 and 10, has wheels 15*a* and 15*b* rotatably mounted on shaft 15*c* by means of bearings (not shown). The wheels are preferably provided with large pneumatic tires, as illustrated, rather than the heretofore used tracks since pneumatic tires allow the equipment to be moved at a much faster speed. Also, pneumatic tires absorb much of the shock of bumps, etc., encountered as the equipment is being moved.

The rear bogies are designed so that the line of force exerted by the beams on the trucks will pass vertically through the center line of the axles of the trucks. Thus, end 18 of beam 10 rests on a bearing plate 50 which is pivotally mounted to bracket 51 by means of pins 51*a* and 51*b* which allow the beam and the support plate to pivot around an axis parallel to the longitudinal axis of the beams. Bracket 51 is, in turn, rotatably carried by axle 15*c* to allow the support plate and beam to rotate in a plane perpendicular to the axle. With this arrangement, wheels 15*a* and 15*b* of bogie 15 can move vertically up and down relative to each other or the entire bogie can move up or down as the terrain demands without causing any twisting stresses in the beam or the equipment being carried. In the first instance, when the wheels move relatively up and down, the bogie pivots with respect to the load around the longitudinal axis of pins 51*a* and 51*b*, the pivotal connection between bracket 51 and bearing plate 50. In the latter instance, bracket 51 rotates around axle 15*c*. Thus, bogies 18 and 19 can both rotate around a line extending parallel to the longitudinal axis of the support beams and also around one ending perpendicular to the longitudinal axis of the beams.

As shown in FIGS. 9 and 11 the bearing plate is provided with a tapered slot 52 to receive king pin 43 which has a section 53 of reduced diameter to pass through slot 52. The pin 43, once in position in the slot, is held in position by spring loaded latch dogs 54 carried below bearing plate 50, which lock around the reduced section of the pin. The pin also has an enlarged end 55 which engages the under side of the latch dogs 54 and keeps the beam from bouncing on the bearing plate during the move.

To keep bogie 18 from rotating around king pin 43 and hold it in alignment with the support beam, a key 64 (FIGS. 9 and 11) is attached to plate 41 on the under side of the beam to engage slot 52 in the bearing plate and hold the bearing plate and the bogie against relative rotation.

The construction of front bogie 17 is illustrated in FIGS. 6, 7 and 8. As mentioned above, it differs from the rear bogies in that preferably the line of force exerted downwardly by gooseneck 26 on its support does not pass through the axle of the front bogie, but rather in front of the axle to thereby distribute part of this force to the prime mover pulling the front bogie. Thus, bogie 17 is provided with a drawbar 56 which is rotatably mounted on axle 17*c* and extends forward from the bogie to connect to prime mover 62. Mounted on drawbar 56 is bearing plate 57 which is identical to bearing plate 50 described in connection with the rear bogies.

To allow the drawbar to pivot relative to the load it supports in the same manner as does rear bogies 18 and 19, support plate 57 is pivotally mounted on pin 57*a* which is parallel to the longitudinal axis of the gooseneck and drawbar. The pin supporting bearing 57*c*, in turn,

is pivotally mounted on shaft **57***b* to allow the drawbar and gooseneck to rotate relative to each other around the longitudinal axis of pin **57***b* which is parallel to the longitudinal axis of axle **17***c* of front bogie **17**. Thus, the prime mover and the front bogie can move vertically relative to each other around pin **57***b* and, in addition, the gooseneck and drawbar can rotate relative to each other around pin **57***a*.

Support plate **5** is also provided with slot **58** (FIG. 6) to receive the lower end (not shown) of king pin **33** attached to the gooseneck **26** and latches (not shown) to latch behind the lower end of the king pin **33** and hold it in position in the slot. The lower end of king pin **33** and the latches associated with support plate **57** are not shown in the drawings since they are identical with the lower end of king pin **43** and latches **54** described in connection with FIG. 11.

The front end of drawbar **56** is also equipped with a king pin **60** (FIG. 7) which engages a slot (not shown) in bearing plate **61** (FIG. 4) carried by prime mover **62** and which, preferably, is mounted on the prime mover in the same manner as bearing plate **57** is mounted on drawbar **56** to allow the drawbar and the prime mover to rotate relative to each other around an axis parallel to the longitudinal axis of the drawbar and also around an axis parallel to the axis of the axles of the rear wheels **62***a* and **62***b* of the prime mover.

The height of king pin **60** above the ground will vary according to the type of prime mover used to move the drilling rig. It can be lowered by adjusting the height of king pin assembly **63** as illustrated by the dotted lines in FIG. 7. King pin assembly **63** can be of any general structure. However, the one illustrated in FIG. 7 is approximately the same structure as that illustrated in FIG. 11 and described in connection with the ends of support beams **10** and **11**.

The longitudinal distance between bearing plate **57** and axle **17***c* and between the bearing plate and king pin assembly **63** will determine the proportional amount of weight carried by the front bogie and the prime mover, respectively. Obviously, the closer the bearing plate **57** is to the vertical axis of the bogie, the higher will be the percentage of total load it carries.

A portion of the load carried by gooseneck **26** is placed on prime mover **62** to increase the normal force between the prime mover and the ground to thereby reduce the tendency of the wheels of the prime mover to slip. This is particularly advantageous when moving equipment in loose soil, such as sand in desert areas, etc.

Another reason for distributing the load in this manner is because the load supported by the gooseneck is somewhat more than the load carried by each of the rear bogies which are located under the rear ends of the two support beams **10** and **11**. For example, assuming that the load placed on the support beams is uniform, the reaction at each end of the beams is equal and each rear bogie will carry one-fourth of the total load, whereas the gooseneck exerts a force on bearing plate **57** equal to half the total load.

Of course, if the prime mover is of the type which needs no additional downward force for traction or cannot support any additional load, then the bearing plate can be moved to a point directly above the axle of the front bogie which will then support the entire load carried by the gooseneck.

The front bogie is used to steer the apparatus as it travels over the ground, so it is not keyed to the gooseneck allowing it to pivot freely around king pin **33** and control the direction of travel of the apparatus and the equipment it is carrying.

The gooseneck **26**, being a cantilever beam, exerts a considerable turning moment on king post **21** of the truss tending to rotate around its lower end. When moving a structure such as substructure **8**, the structure can be provided with reinforcing members as illustrated in FIG. 4 to support the upper end of the king post to help it resist the turning moment exerted on it by the gooseneck. Thus, king post **21** can be attached to an outer upright column **65** of substructure **8** by means of tabs **66**, **67** and **68** which are provided with elongated slots to match similar slots in column **65** so that a drive pin can be driven through the slots to interconnect the king post to column **65**. Drive pins and elongated vertical slots can be used for this connection since the force exerted between the two members will be horizontal and have no vertical components of any consequence.

Column **65** is then reinforced by adding struts **69** to strengthen the substructure at this point so it can adequately resist the horizontal force exerted on it by the reaction of the gooseneck.

If the apparatus of the invention is being employed to move something other than a substructure, then king post **21** is braced against the reaction produced by the gooseneck in whatever way is convenient considering the load being moved.

Removably attached to each end of both support beams **10** and **11** are identical jack assemblies **70**. As shown in FIGS. 3, 9 and 10, each assembly comprises cylinders **71** and **72** mounted on opposite sides of beam **10** by means of upper plate **73** and lower plate **74** which are interconnected by bolts **75**. The member **74** must have sufficient strength to withstand the force of the jack and to transmit the jacking force to the beams as the jacks raise the beam and its load off the ground.

The jacks illustrated are of the hydraulic or pneumatic type, each including a piston (not shown) in each cylinder with rods **76** and **77** attached to exert a lifting force against the ground through bearing shoes **78** and **79**, the force being provided by the pressure acting against the pistons and the cylinders. Hydraulic or pneumatic type jacks are preferred in this application since each individual jack can be connected to one common source of pressure fluid, resulting in each jack exerting an equal force against the ground and upon the beams being raised. If the load is not evenly distributed on the support beams, it may be necessary to have individual control of each particular set of jacks so that the pressure supplied to the jacks for raising the heaviest portion of the load can be increased over that supplied by the jacks located where the load is not so great.

As shown in FIG. 5, substructure **8** is provided with two spaced, parallel openings **81** and **82** which extend completely through the substructure and which are designed to receive support beams **10** and **11**. These windows are usually built in the substructure, when the substructure is initially constructed, especially to receive skid beams, such as support beams **10** and **11**. Therefore, they are located at predetermined points to more or less equally distribute the load between the beams. These openings are generally referred to as skid beam windows and are found in most substructures in use in drilling operations.

To move a substructure with the apparatus of this invention, support beams **10** and **11** are inserted through skid beam windows **81** and **82** in the substructure and located so the proper amount of beam extends out from each side as shown in FIG. 4. Truss **12** is then attached to the front ends of the beams by means of bolts **83** as shown in FIGS. 2 and 5. The jack assemblies **70** are then attached to the ends of the beams and substructure **8**, derrick **9**, and associated equipment (not shown) are raised off the ground by the jacks a sufficient distance for the support plates carried by bogies **15**, **16** and **17** to be moved into engagement with the king pins carried by ends **18** and **19** of the support beams and gooseneck **26** with front bogie connected to prime mover **62** by drawbar **56**. The pressure fluid in the cylinders of the jacks is then released transferring the weight of the substructure, derrick, etc., from the jacks to the bogies and prime mover, and the equipment is ready to be moved. Upon reaching the now location, the above procedure is reversed and the move is complete.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the method and apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described what is claimed is:

1. Apparatus for moving a drilling rig including a substructure with a derrick mounted thereon, comprising, two parallel support beams for extension through openings provided therefor in the substructure with their longitudinal axis parallel to the direction of travel of the substructure; first load transmitting means including a truss having a horizontal member, extending between the front ends of the support beams, a vertical king post attached to the horizontal member and located about midway between the ends of the support beams, and inclined chord members connecting the upper end king post with the horizontal member; two trailing bogies located under each trailing end of the beams; a front bogie and a drawbar having one end supported by the front bogie and one end adapted to be connected to a prime mover; and second means for transmitting the first load supported by the load transmitting means to the drawbar at a point between the front bogie and the connection between the drawbar and the prime mover.

2. The apparatus of claim 1 in which the second load transmitting means includes a gooseneck attached to the king post, means adapting the king post for attachment to a column of the substructure, and bracing means connected to said beams and adapted to be connected to brace said column against the horizontal forces exerted thereon by the king post to thereby brace the king post against the horizontal forces exerted thereon by the gooseneck.

3. Apparatus for moving a drilling rig including a substructure, comprising two parallel support beams extending in the direction of movement of the substructure for supporting the substructure while it is being moved; two rear bogies, each supporting the trailing end of one of the beams; each rear bogie having a support plate rotatably mounted thereon to pivotally support the beams for movement around an axis parallel to the direction of travel of the bogies; a truss member interconnecting the leading ends of the beams and having a forwardly extending gooseneck located about midway between the beams; a front bogie; a drawbar with one end supported by the front bogie and the other end adapted to be supported by a prime mover and a front support plate attached to the drawbar for supporting the load transmitted from the leading ends of the beams to the truss member and from the truss member to the gooseneck, said plate being pivotally mounted on the drawbar to allow the drawbar to rotate relative to the gooseneck around an axis parallel to the longitudinal axis of the drawbar and about an axis perpendicular to the longitudinal axis of the drawbar; said plate being located between the front bogie and the portion of the drawbar attached to the prime mover to distribute the load carried by the front support plate between the front bogie and the prime mover.

4. The apparatus of claim 3 further provided with means for maintaining the direction of travel of the rear bogies parallel to the direction of travel of the support beams.

5. The apparatus of claim 3 further provided with four jack assemblies; one mounted on each end of the support beams to lift the beams and the substructure high enough for the bogies to be located in load supporting position relative to the beams and gooseneck and to transfer the load from the bogies to the ground when the substructure reaches its new location.

6. Apparatus for moving a substructure with a derrick mounted thereon, comprising: two support beams for extending through the substructure in spaced, parallel relationship to support the substructure and the derrick mounted thereon; a truss member interconnecting the ends of the support beams on one side of the substructure; three bogies, one supporting the truss member about midway between the ends of the beams and one supporting each of the two unconnected ends of the beams on the opposite side of the substructure from the truss member; each bogie having a load supporting plate provided with a key slot, a pin attached to each unattached end of the support beams and to the truss member to engage the slot in the plates to provide a pivoted connection between the plates and the pins, and a key member carried by each unconnected end of the support beams to engage the key slot and prevent the plate and the bogie supporting each unconnected end from rotating around the pin, whereas the bogie supporting the truss member is free to pivot around the longitudinal axis of the pin connecting the support plate to the truss member for steering purposes.

7. The method of preparing the substructure of a drilling rig with a derrick mounted thereon for moving to a new location, comprising inserting two load supporting beams through the skid windows in the substructure; jacking up the ends of the beams until the substructure reaches a predetermined height above the ground; interconnecting the front ends of the beams on one side of the substructure with a load transmitting member to allow the front ends to be supported at a point between the ends; locating a bogie under each of the two unconnected ends of the beams and one under the load transmitting member about midway between the beams; and lowering the beams and the load transmitting member to transfer the weight of the substructure and derrick from the jacks to the three bogies to provide three point support for the substructure and derrick.

8. The method of preparing the substructure of a drilling rig for moving from one location to another comprising, locating two load supporting beams in position to support the substructure as it is being moved from one location to another; interconnecting the front ends of the beams to allow them to be supported at a point midway between them; applying a lifting force to the ends of the beams in such a manner as to transfer the weight of the substructure to the beams without tilting the substructure; and rollingly supporting each rear end of the beams and the center of said interconnecting means to provide three point support for the load supporting members.

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