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SYSTEM AND APPARATUS FOR ERECTING MOVING AND DISMANTLING SHORING AND THE LIKE

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FIG. 1

FIG. 2

FIG. 3

FIG. 4

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SYSTEM AND APPARATUS FOR ERECTING MOVING AND DISMANTLING SHORING AND THE LIKE

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ABSTRACT OF THE DISCLOSURE

Apparatus for erecting, moving and dismantling modular sections of shoring and the like including a pair of oppositely disposed vertical side frames with interconnecting members at one end, the entire apparatus being transportable on wheels in contact with the ground and having a hydraulic tractive drive coupled thereto to propel and steer the apparatus from one work area to another. Each side frame is provided a pair of hoist drums with depending hook driven by hydraulic motors powered through flow metering and regulating valves so that the hooks may be moved in unison and in registry with each other. In addition each of the four carriage wheels may be elevationally positioned selectively to maintain the entire apparatus plumb in respect to the ground. The coordinated hoist control and plumb alignment of the apparatus provides stability of an entire shoring column comprised of a plurality of modular section which may thereby be maintained in stable vertical alignment.

A common problem encountered in the construction industry is the erection, movement, and dismantling of various types of frames used to support men and equipment at or near work under construction. A typical example is shoring, sometimes referred to in the trade as falsework, to support concrete forms for the pouring of overhead structures such as soffits of roadways and the like.

In recent years numerous improvements have been made in the aforementioned frames such as the use of light weight pipe to form portions, usually the end panels, of modular sections. A number of such sections may be removably stacked and secured to each other in vertical alignment to build up falsework or shoring.

The basic problem of erecting and dismantling an improved frame remains the same. Typically, during erection, a first section of such a frame is assembled and placed on ground pads at a desired predetermined elevation, allowance being made where necessary for screwjacks which may serve as bearing supports between each corner of the bottom of the frame itself and the ground pad upon which it rests. The screwjacks may then be adjusted to plumb the vertical axis of the first section. After the placement of such first section, a second similar modular section is stacked on top of the first and secured thereto, usually by internal sleeve couplings which fit within the four abutting corner legs of each of the sections. Thereafter, to place sections at the higher elevations, wooden planks or the like upon which erecting personnel may stand are placed on supporting cross members of the modular section. Erecting personnel then climb onto such higher planking, and the end panels for successive additional modular sections are hauled up from the ground to the personnel above who secure such end panels to the corresponding sections already in place. The added modular section is completed in place at its elevated position by securing cross braces between the end panels as may be necessary. To proceed with the next higher modular section, additional planking is passed up from ground elevation, placed in position on the supporting cross members of the modular section last placed, and the entire process repeated until the shoring or falsework is erected to a predetermined desired height, usually between 25 and 65 feet above the ground, and occasionally even higher. The structure is thus usually completed with personnel required to work at relatively great heights above the ground securing whatever capping components are required by the type of falsework erected.

After the construction work is completed, dismantling of the shoring is accomplished by placing workmen into the frame at the top most section, again using planking and the like as described above, and reversing the process described for erection.

There are several disadvantages to the aforementioned prior art method of erecting scaffolding, shoring, falsework and the like. For example, when the first section is placed, all four corners are normally levelled separately by means of the screw jacks to insure plumb positioning thereof at a desired elevation. As erection proceeds, workmen must erect the individual end panels working from planking supported by a section of the shoring immediately therebelow. Eventually, such erection occurs at heights substantially above ground elevation which makes such work hazardous and normally requires increased pay. Concurrently, additional workmen are required at intermediate levels to pass additional planking and components of modular sections up to the point where such erection is then to occur. Completion of the modular sections must be done with the components in place at the higher elevations, since it is not practical to prefab the sections on the ground and pass them up as completed structures. Capping arrangements, as may be required to support concrete forms and the like, must also be completed with the workmen atop the erected shoring. In terms of manpower alone, using the foregoing prior art techniques, which are also relatively hazardous, placement of 48 of such falsework columns, averaging about 28 feet in height each, generally require a crew of seven to eight men four working days, or about 256 man hours.

Thus it is an object of this invention to provide apparatus for erecting and dismantling shoring and the like, of the type utilizing modular sections removable stacked and secured to each other in vertical alignment which operates entirely at about ground level elevation without requiring any above-ground crews for the stacking thereof.

Another object of my invention is to provide apparatus and method for the erection of falsework in which the entire assembly of modular sections making up such falsework may be performed at the ground level, including the placement on the top section thereof of any cap assemblies.

A still further object of this invention is to provide apparatus for the erection and dismantling of shoring and the like which is not only self propelling to the station where such shoring is to be erected, but which also provides means to plumb itself in respect to the earth's surface and hence erect such falsework in a true and vertical manner.

A feature and an advantage of my invention is that the erection and dismantling of shoring and the like may be accomplished with fewer men and in a shorter period of time than has generally been possible utilizing prior art techniques and apparatus with which I am familiar.

A more specific object of this invention is to provide apparatus for the erection of falsework or shoring which requires that only one ground pad be specifically located in respect to elevation in order to erect the entire shoring from a predetermined ground elevation reference and in plumb alignment with the surface of the earth.

A feature and advantage of this invention is that initial preparation of the first modular section of the shoring to be placed is greatly minimized and simplified compared to the prior art techniques with which I am familiar.
Still a further object of this invention is to provide an apparatus which may transport entire columns of shoring or staking from one structure to another without dismantling and re-erecting the same.

Numerous other objects, features, and advantages will become apparent to one of ordinary skill in the art upon a reading of the following specification which makes reference to the accompanying drawings wherein similar characters of reference refer to the same or corresponding parts in each of the several views.

Turning now to the drawings:

FIG. 1 is a partial side elevation showing a typical installation to which my invention may be applied;

FIG. 2 is a perspective view of the apparatus of my invention with a portion of the installation as shown in Fig. 1 being erected thereby;

FIG. 3 is a schematic of the hydraulic circuit utilized in my invention and including a portion thereof in perspective view;

FIG. 4 is a continuation of the schematic of FIG. 3 and shown interconnected thereto with certain additional apparatus added;

FIG. 5 is a schematic detail of a portion of the hydraulic equipment utilized in my invention and shown in FIG. 3;

FIG. 6 is a front elevation of the apparatus of my invention;

FIG. 7 is a side elevation of my invention partly in schematic form and partially shown cut away to disclose certain details more clearly; and

FIG. 8 is a partial perspective view of a portion of my invention.

Referring first to FIGURE 1, I show a typical installation to which my invention pertains, although it may be applied to a variety of other types of modular frame structures. FIG. 1 exemplifies the use of shoring or falsework to support concrete 12 forming the soft of an elevated roadway wherein the upper surface of form board 14 is located at a predetermined elevation above the surface of ground 16. The form board, and concrete when poured, are supported by joists 18 which rest on stringers 20; and these in turn bear upon cap beams 22.

The entire aforementioned assembly is supported in position above the surface of the ground by a number of pipe column frames such as shoring 24 having the lowermost vertical leg portions supported by bottom screw jacks 26 with bearing plates 28 in contact with ground pads 30. (Note in FIG. 1 is a side elevation and only shows two of the four legs of the shoring column being described.) Upper screw jacks 32, similar in all respects to screw jacks 26, except for the inverted position in which they are installed, provide adjustable support of cap beams 22 to the top of the shoring and may be adjusted after final erection to achieve a more exact desired elevation of the form work thereof. Dimen.

sion 34, which indicates the total height of the shoring column, including the interval occupied by the screwjacks, may vary up to as much as about 80 or 90 feet or higher with an average generally of about 25 to 35 feet.

More particularly, showing 24 is made up of a number of modular sections 36, 38, 40, and 42 (sections 38 and 40 being only partially shown); and the height of such sections, as exemplified by dimension 44, may vary and in general is usually either 3, 4, or 5 feet, so that almost any height of shoring column may be established by using the proper combinations thereof. Each section in turn is made up of end panels 46 (designated by the same numeral herein regardless of height) connected to each other by means of removable panel brackets 48. The corner vertical members of each modular section are generally constructed of light-weight hollow pipes; and successive modular sections are quickly, easily, and removably secured to each other by the insertion of a typical internal slip coupling 50 which fits slidably down into the leg of one modular section end panel and upwardly into the leg of the section removably stacked thereon. Flange 52 prevents the coupling from slipping down into the vertical members. Typically, the stub portion of the screwjacks, which engage the upper and lowermost corner legs of the end panels of the modular sections, are constructed in a manner similar to the aforementioned couplings; except that the flanges on the screwjacks are somewhat elongate to provide handles for turning the threaded stub members into and out of the cooperatively threaded jack base to provide adjustment of the height thereof.

With the foregoing description of a typical installation to which my invention pertains, the invention itself may be best understood by referring first to FIGURE 2 wherein the erecting and dismantling apparatus 54 of my invention is shown positioned with a first modular section 42 in place for hoisting so that other similar sections may be stacked thereunder to erect shoring as exemplified in FIG. 1. The apparatus comprises a pair of oppositely disposed vertical side frames 56, 58 interconnected by means of front beam 60 and front brace 62 for stabilizing the side frames, said beam and brace being connected to the side frames by suitable means such as by bolting, riveting, welding or the like, the preferred material of the frame itself being structural steel. Each side frame carries a hoist assembly 64, best seen in FIG. 7, which, in the embodiment shown, includes a pair of flanged hoist drums 66 carried by rotating drum shafts or axles 68 and 70. Each of the axles in turn are supported on either side of the drum by bushings or bearings mounted in brackets 72, 74 connected to side beam 76 in the one side frame and beam 78 of the other side frame. Each pair of drums 66 are secured so that the drums on one side frame are in coaxial alignment with the axis of rotation thereof parallel to the axis of rotation of the drums secured to the opposite side frame. Hooks 78, 80 depend from each pair of the hoist drums by single wire rope cables 83 which in turn are fastened to the drums; thus when the drums are rotated the hooks may be raised or lowered accordingly. Each pair of hooks are held in fixed spaced apart relationship by means of spacer bar 82.

In the embodiment of my invention which I show, each pair of hoist drums 66 are driven by means of a separate hydraulic motor 84 coupled to each hoist drum shaft 68, 70 by conventional chain and sprocket drive assembly 86 and cross shaft 88 connected between the sprocket drive assemblies by means of coupling 90. The hydraulic drive arrangement for the hoists, as well as the other drives of my invention, are best understood by referring now to FIG. 3, an understanding of which is desirable before proceeding with a more detailed description of the operation of the entire apparatus.

In FIG. 3, I show a suitable source of power, such as gasoline engine 92, mounted on side truck 138 and conventionally coupled, for example by means of V-belt drive assembly 94, to hydraulic pump 96 having intake line 98 in fluid communication with hydraulic oil reservoir 100 through a conventional oil filter 102. Output line 104 leads from the hydraulic pump to a bank of seven conventional four-way hydraulic valves at 106 and marked in FIG. 3 according to their respective functions as viewed looking toward side frame 76 of my apparatus as seen in FIG. 2. Each of the separate motion valves is of the spring return, self centering type which, when in neutral position, are as shown in FIG. 5 where a portion of the bank of hydraulic valves 106 is shown in greater schematic detail, particularly the hoist and tractive hydraulic control valves. The arrangement of the control valves is that of a conventional flow-through hook-and-valve control system; that is, when in neutral position all supply lines close up; and when one of the control valves, for example for that for the hoist, is manually actuated in one direction or the other, the co-
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responding spool portion thereof directs oil through the internal ports of the actuated valve so as to be directed outwardly therefrom, as by lines 108, 110 depending upon the direction of flow as determined by the positioned setting of the spool. Generally, the same actuating motion is given hereafter to each of the motions except that the other motions do not utilize a flow metering valve such as valve 118 nor regulating valves such as valves 124, 126. The hydraulic circuit for each motion comprises a conduit loop away from and back to the particular motion's valve spool. The flow of hydraulic fluid to actuate one motion is then circulated through the valve bank to the next valve for ultimate return through return line 104y and oil filter 112 to reservoir 100. In this type of arrangement there is continuous circulation of hydraulic fluid available for powering any or all of the motions simultaneously, limited only by the amount of available flow of hydraulic fluid pumped through the system by gasoline engine 92 and pump 96. Relieve valve 114 is provided upstream of the entire valve bank 106; if an overload should occur and a predetermined pressure exceeded in the hydraulic system, the entire oil supply is by-passed and oil returned via line 116 to the reservoir.

An important feature of my invention in respect to hoisting is that each pair of hooks may be raised or lowered at the same rate of speed by motors 84 and in registry with each other to maintain stability of a hoisting column even after it has been erected to a substantial height. Such stability in hoisting is achieved in part by the use of a hydraulic flow metering valve 118 which assures an equal division of hydraulic fluid flow in either direction through lines 120, 122; thus each hoist hydraulic motor may be driven in unison with the other. In this manner, when each of the motors is engaged to bring the ends of a modular section such as 42 shown in Fig. 2, each end of the section may be maintained at the same relative position with respect to the other end throughout the hoisting, lowering or holding operation. In addition, in each of lines 120, 122, I provide regulating valves 124, 126, respectively, to further refine the flow rate to each hydraulic motor 84, and by such refinement of the flow rate, I regulate each of the hoist motor 84 to selectively drive each pair of hoist drums 64 and cause the latter to hoist and lower at the same rate of speed and in registry with each other to maintain stability of the hoisting column.

In connection, it should be noted that before engaging and hoisting the first modular section, each pair of hooks 78, 80 may be made level in respect to the other by shutting off completely one of valves 124, 126; actuating one set of hooks to a given predetermined elevation; and then releasing the other such regulating valve until the opposite set of hooks 78, 80 made imperative by the closing of its associated regulating valve, is brought into registry with the first set of hooks.

Having now explained the basic hydraulic and hoist system of my device, additional details of actual erection of a hoisting column may be understood: referring once again to Fig. 2, and assuming for purposes of the description which follows next that the side frames are at the same elevation and vertical, a first modular section 42 is placed in position within my apparatus by locating and resting the bottom of the frame upon pads 128, 130, 132, and 134 (hidden from view) hinged securely by suitable means to side trucks 136, 138. Each set of hooks 78, 80, previously adjusted as described above to hoist in unison and in registry with each other, are lowered. Each set of hooks may then be engaged to bring the ends of modular section 42. With the first section still in position at the lower elevation, top jack screws 32 and cap beams 22 may be installed for eventual use when the entire hoisting column is erected as shown in Fig. 1; and, in accordance with my invention, without the workmen performing such installation substantially above ground elevation. The first section may then be hoisted in true and plumb vertical orientation by the opposite pairs of hoist drums and hooks operating in unison and in registry with each other until sufficient clearance is attained there beneath for a second modular section to be placed thereunder with the legs thereof resting on each of support pads 128, 130, 132, and 134. Insertion couplings 50 are then slipped into place at the top of each of the hollow pipe legs and the previously hoisted section lowered until the lower portion of the pipe legs engage the upper half of insertion couplings 50 protruding upwardly from the second modular section. Minor misalignment between sections may be adjusted by manually shifting the second section before final lowering of the first section thereon; or, preferably, positioning legs 140 (Fig. 6) are provided to locate each successive modular section in the same relative position.

The foregoing described procedure may be repeated using third, fourth, and subsequent modular sections until a hoisting column of desired height is attained. An important feature of my invention is that such erection may be achieved without requiring the costly and hazardous procedure of laborers working at substantial elevations above the ground as described at the outset of this application. Final positioning of the hoisting column is achieved in the following manner:

After the ground location of the place where the hoisting column has been established, in accordance with procedures not pertinent to my invention, grounds pads 30 are located at designated places on the surface. One such pad, usually the pad on the relatively highest ground of the four, is then adjusted to a relatively precise elevation in relation to a known elevation reference 89. A last modular section to form the hoisting column has been placed in stacked position as described earlier, the entire hoisting column is then raised and retractable platforms 128–134 are rotated to their retracted position as indicated by the phantom lines in Fig. 6. The bottom screw jack adjusted for its proper interval when placed on the highest of pads 30 is then placed thereon, and the entire hoisting column is lowered with the corner leg corresponding thereto slipping on to said bottom jack. The remaining bottom jacks are placed in position and, with the hoisting column now correctly positioned vertically on the highest jack, adjusted to support the other three bottom modular section legs. Accordingly, I achieve another principal advantage of my invention over the prior art techniques with which I am familiar; namely, establishment of a final predetermined elevation of the hoisting column in plumb alignment with the earth's surface requiring the precise leveling of only one of four pads 30, instead of adjustment of all four corners of the bottom modular section as is usually required using prior art methods with which I am familiar.

In the foregoing description of my invention, the entire apparatus is supported by wheels 142–148 secured to the frame in a conventional manner and located on relatively flat and level terrain. Under such conditions, maintaining stability of hoisting during erection is generally limited to synchronizing the rate of hook hoisting in registry with each other, as explained above. However, an important feature of my invention is that the entire frame relatively plumb with respect to the earth's surface even when the immediate terrain is uneven, thereby maintaining stability of erection, or dismantling, of the hoisting column. Such unevenness of terrain causing the apparatus to be at a tilt may readily be discerned by the operator by observing the deflections of indicators 150, 152 suitably secured in proper alignment to the forward vertical leg of side frame 56 adjacent operator's platform 57. One indicator shows vertical alignment of the apparatus in one direction, the other indicator such alignment in the direction normal thereeto.
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embodiment of my invention, the entire frame is maintained plumb by leveling means 154 mounted at each leg of the side frame, such means being illustrated in FIG. 8 with the hydraulic circuitry shown in FIG. 3.

More particularly, leveling means 154 comprises vertical struts 156 having one end secured to wheel mounting plate 158 and the other to hydraulic cylinder 160. The end of the cylinder opposite the connection to strut 156 is suitably secured as by pin 162 to the inside of vertical leg 164 which houses the entire leveling means 154 and fits slidably over strut 156. Hydraulic fluid is provided to each of the hydraulic cylinders 160 separately located in each of legs 164 by means of hydraulic lines 166a, 166b, 168a, 168b, 170a, 170b, and 172a, 172b. Each of the enumerated pairs of lines provide for transmission of hydraulic fluid from one of the control valves designated "LEG LEVELING" in FIG. 3 to one cylinder 160 and back again to the control valve, such hydraulic circuitry operating generally in the manner explained earlier in respect to the hoist control. Hydraulic cylinders 160 are of conventional construction including a reciprocally movable piston which may be moved outwardly of the cylinder when hydraulic fluid is supplied to it in one direction, and inwardly when introduced in the opposite direction. With the corresponding control valve centered, the hydraulic circuit is held static and the cylinder and piston relationship is effectively locked. In this manner, the corner elevation of each of the legs may be selectively controlled to support the entire frame in space relationship above the ground so as to plumb the vertical axis of said apparatus and maintain stability of the entire vehicle over uneven terrain.

Another feature of my invention is that the entire apparatus may be self-propelled to a desired working area and from one such working area to another. By such self-propelling, and retractable platforms 132–134 to support an entire shoring column upon the apparatus, an entire column may be removed from one working area and relocated at another without dismantling the entire column as is generally involved utilizing prior art techniques with which I am familiar. In the embodiment of my invention as shown, this is accomplished by carriage means including idler wheels 142–148 and driver wheels 144–146 which, along with steering means interconnected thereto for selectively guiding the wheels to track along a desired course of travel, is best seen in FIG. 8 with the hydraulic circuitry schematically shown in FIG. 3.

More particularly wheel 146 is suitably secured to rotating axle 166 which extends outwardly from, and is suitably journaled within, bracket 168. Sprocket drive 170, including drive sprocket 172 secured to axle 166, sprocket chain 174, and pinion sprocket 175 secured to hydraulic motor 178 output shaft 190, provide rotational power transmission from said motor to drive wheel 146. Opposite side wheel 144, mounted on the opposite side truck and opposite hand in respect to wheel 146, is provided with sprocket drive components similar in all respects to those described in respect to wheel 146. Hydraulic fluid is controllably supplied through manual controller labelled "TRACTION" in FIG. 3 via hydraulic lines 182, 184, and parallel branch lines 186, 188, to hydraulic motors 178, whereby said sprocket drive or tractive means 170 coupled to the drive wheels of said carriage means may propel the entire apparatus along the earth's surface to a desired area.

Steering of my device is provided by pivotally rotating drive wheels 144, 146 about a king-pin such as pin 190 shown in FIG. 8 in relation to wheel 146. More particularly mounting bracket 168 is secured to rotatable plate 191 which in turn is pivotally secured to wheel mounting plate 158 by means of king pin 190. One end of tie rod 192 is pivotally fastened to the leading edge of plate 191 proximate wheel 146 and the other end is similarly con-
I claim:

1. Apparatus for erecting and dismantling structural framing of the type utilizing modular sections each having side members in confronting and opposing relationship to each other so as to form a space frame, said sections removably stacked and secured to each other in vertical alignment to form said structural framing, said apparatus comprising:
a pair of oppositely disposed vertical side frames;
structural means interconnecting said frames for stabilizing the latter; and
first and second hoist means each carried by a different one of said side frames, said first hoist means to engage one side member of a modular section and the second hoist means to engage the other opposing and confronting side member of the same modular section, said hoist means for jointly hoisting and supporting therebetween one of said modular sections at an elevation sufficient to position a second of said sections in vertical alignment beneath the elevated section.

2. The apparatus in accordance with claim 1 and characterized by the addition of equalizing means to regulate each of said hoist means to sequentially hoist and lower at the same rate of speed and selectively vary the elevation of engagement of each of said hoist means with a member to be hoisted to maintain stability of said structural framing during erection and dismantling thereof.

3. The apparatus as defined in claim 1 and characterized by each said hoist means including:
a pair of drums;
shaft means for holding said drums in coaxial alignment; and
means rotatably mounting each of said pair of drums on a horizontal axis proximate a different one of said side frames and in parallel relationship to each other.

4. The apparatus as defined in claim 3 characterized by said hoist means including hook means secured to and depending from said drums for engaging opposite end portions of a modular section of said structural framing and movable vertically upon rotation of the drums; and driving means coupled to each of said pair of drums for rotation thereof.

5. The apparatus in accordance with claim 4 and wherein said driving means comprises:
a hydraulic motor; and
means to drive said motor selectively in a forward and reverse direction.

6. The apparatus as defined in claim 5 and characterized by the addition of hydraulic flow metering means for driving each said hydraulic motor in unison with the other.

7. The apparatus in accordance with claim 6 and characterized by the addition of control means associated with said hydraulic flow metering means for adjustably varying the amount of hydraulic fluid delivered to each of said motors causing the hoist drums driven by each motor to hoist and lower said hoist means at the same rate of speed and in registry with each other so as to maintain stability of said structural framing during erection and dismantling thereof.

8. The apparatus in accordance with claim 1 wherein further each said vertical side frame includes a column at each end thereof, and said apparatus is further characterized by levelling means associated with each said column to adjustably support the latter in spaced relationship above the ground so as to plumb the vertical axis of said apparatus and maintain stability of said structural framing during erection and dismantling thereof over uneven terrain, each said levelling means comprising:
foot means carried by each said column for bearing contact upon the earth therebeneath; a hydraulic cylinder and piston assembly associated with each said column having one end reciprocally movable in respect to the other end;
means carried by each said column to pivotally connect one end of said cylinder and piston assembly to said column associated therewith;
means securing the other end of said cylinder and piston assembly to said foot means associated therewith; and
means for selectively actuating each said hydraulic cylinder and piston assembly to cause said column associated therewith to be raised and lowered, alternatively, in relation to the surface of the ground therebeneath.

9. The apparatus in accordance with claim 1 and characterized by the addition of platform means located inwardly at each end of said side frames to support said structural framing in plumb alignment to maintain stability during erection and dismantling thereof when said hoist means is disengaged from the structural framing; and
hinge means connecting said platform means to the proximate portion of said end frames for pivotally retracting the platform means away from the vertical line of movement of said structural framing during erection and dismantling thereof.

10. The apparatus in accordance with claim 1 and characterized by the addition of:
carriage means in contact with the ground to support said apparatus thereon and to provide for movement along the earth's surface; and
tractive means coupled to said carriage means to propel said apparatus for movement along the earth's surface.

11. The apparatus in accordance with claim 10 characterized by said carriage means including steering means interconnected thereto for selectively guiding the carriage means to track along a desired course of travel, and means associated with said steering means controllable by an operator for causing the steering means to guide said carriage means and track along such desired course of travel.

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