

[54] PIPE TRANSPORTING AND LAYING
VEHICLE AND METHOD

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Related U.S. Application Data

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1973, Pat. No. 3,761,132.

[52] U.S. Cl. 61/72.1, 61/46.5, 37/73,
115/1, 180/8 E, 214/138

[51] Int. Cl. F16l 1/00, E02b 1/00, B60f 3/00

[58] Field of Search 61/72.1, 72.3, 72.6, 46.5,
61/63; 37/73; 214/138; 180/8 E; 115/1

[56]

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[57]

ABSTRACT

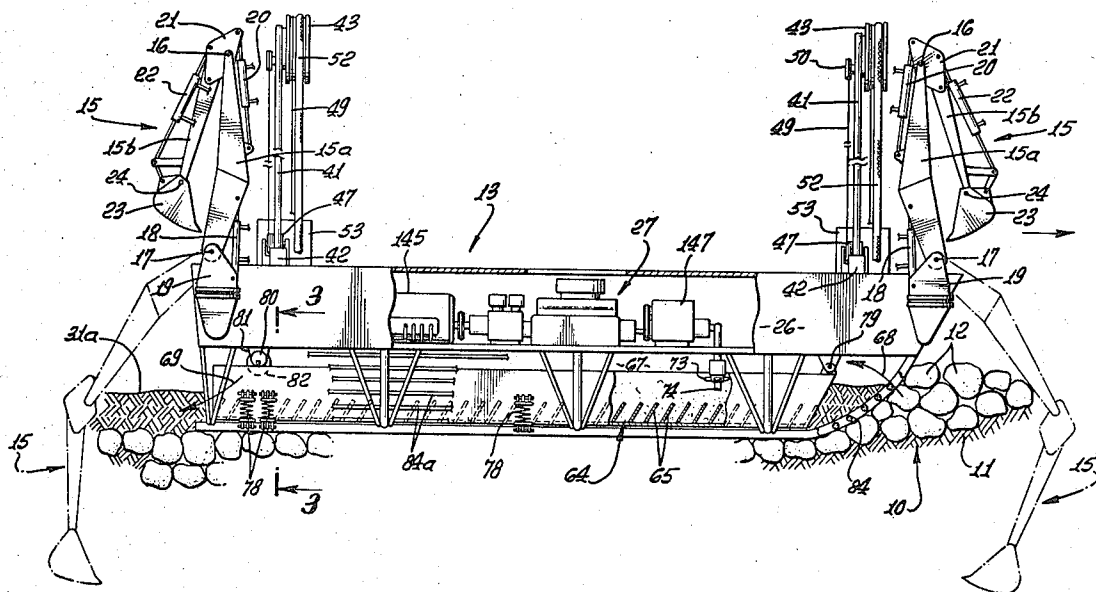
A carrier vehicle movable over terrain and water comprises

a. a floatable hull to float the vehicle in a body of water, and

b. articulated legs carried by the vehicle and connected therewith to engage the terrain for lifting and advancing the vehicle thereover.

The vehicle is especially adapted to laying pipe over difficult terrain and through rivers and lakes.

14 Claims, 15 Drawing Figures



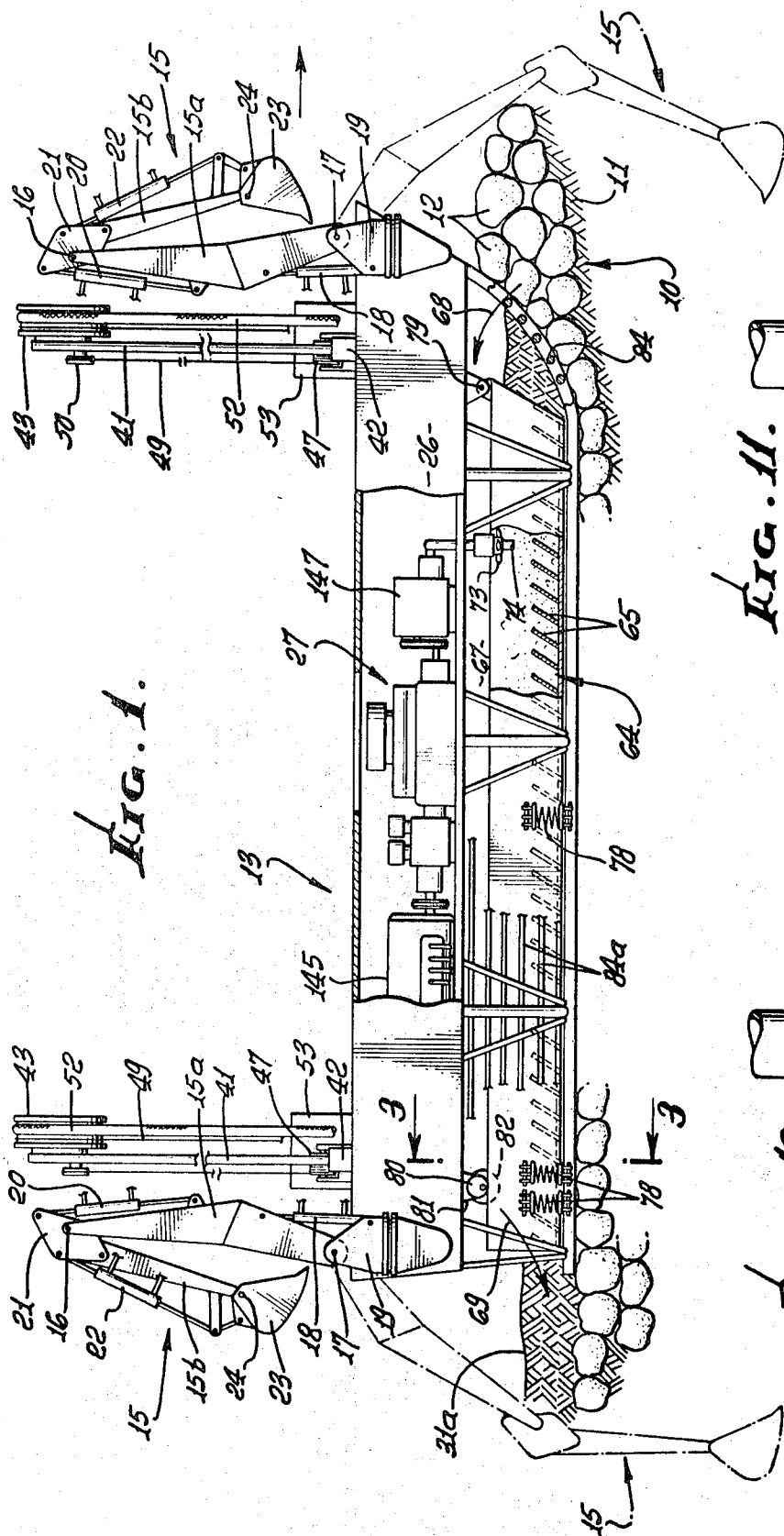


FIG. 1.

FIG. 11.

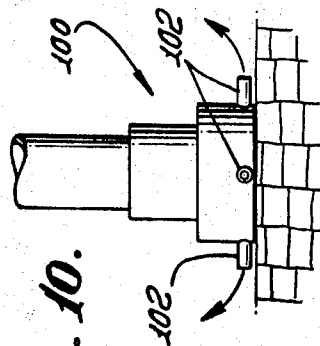


FIG. 10.

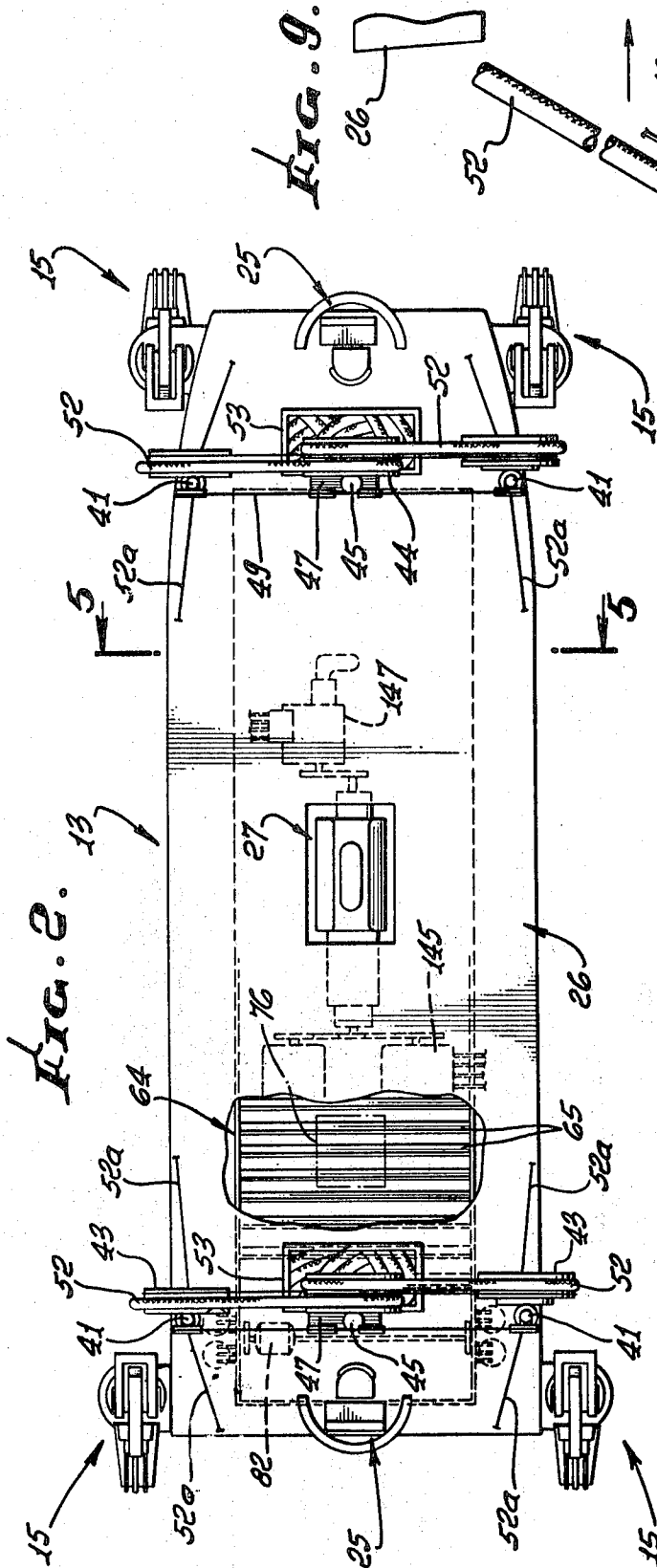
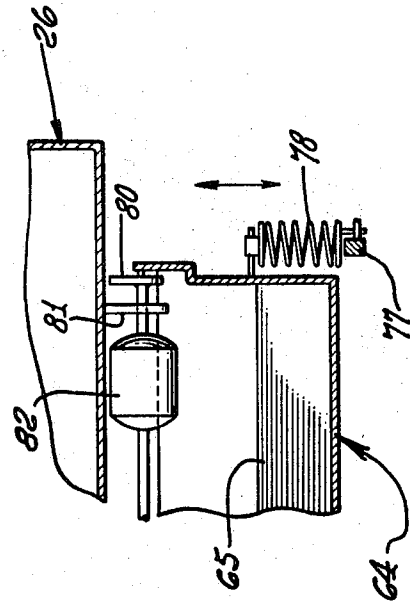
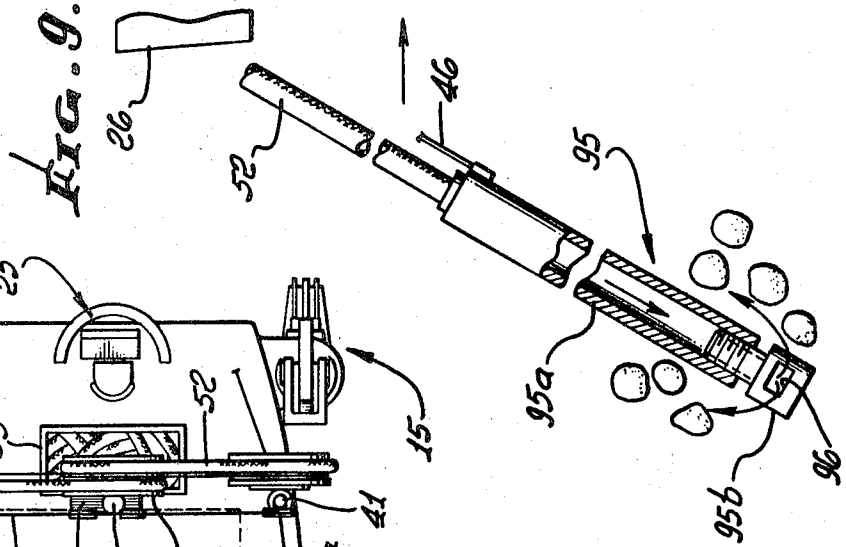


FIG. 6.

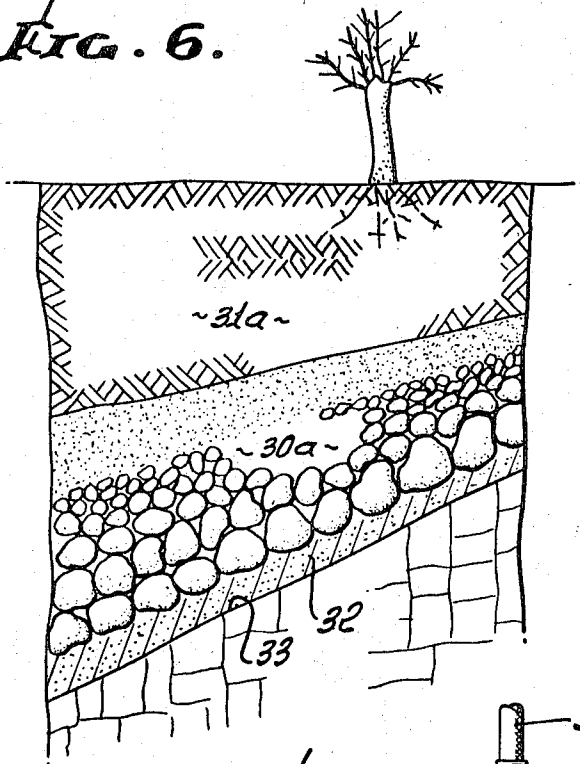


FIG. 7.

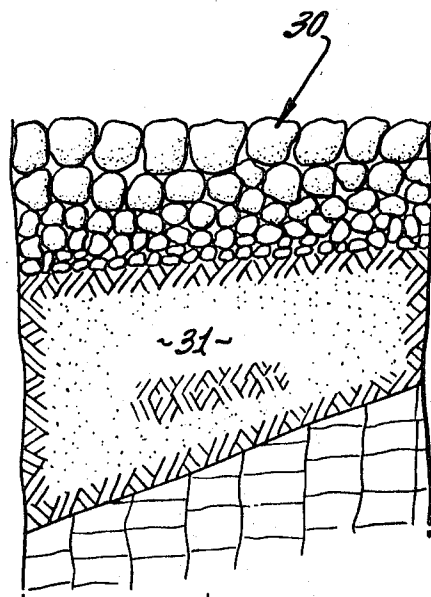


FIG. 12.

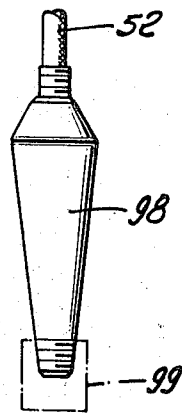


FIG. 4.

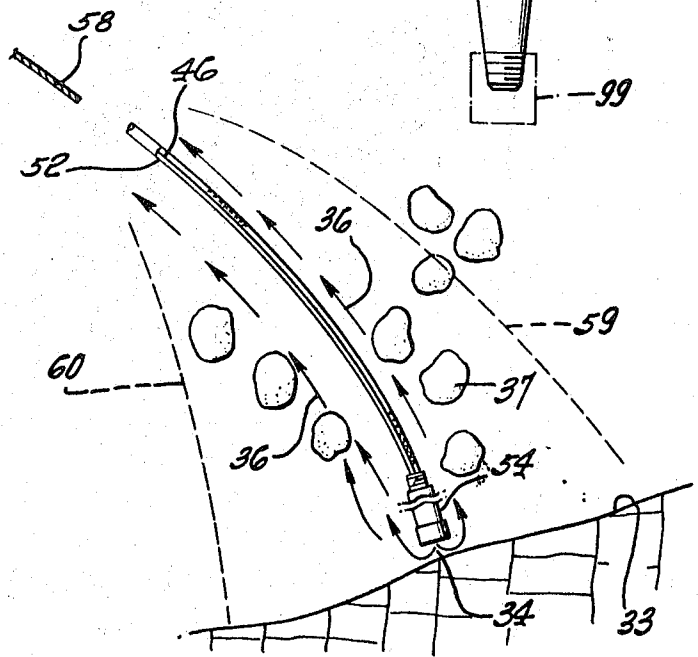


FIG. 8.

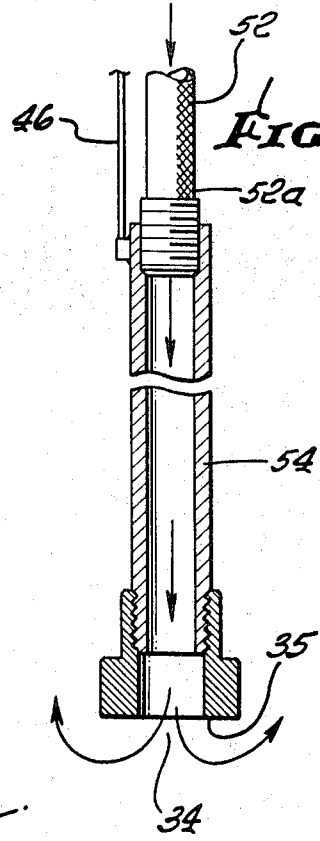


FIG. 5.

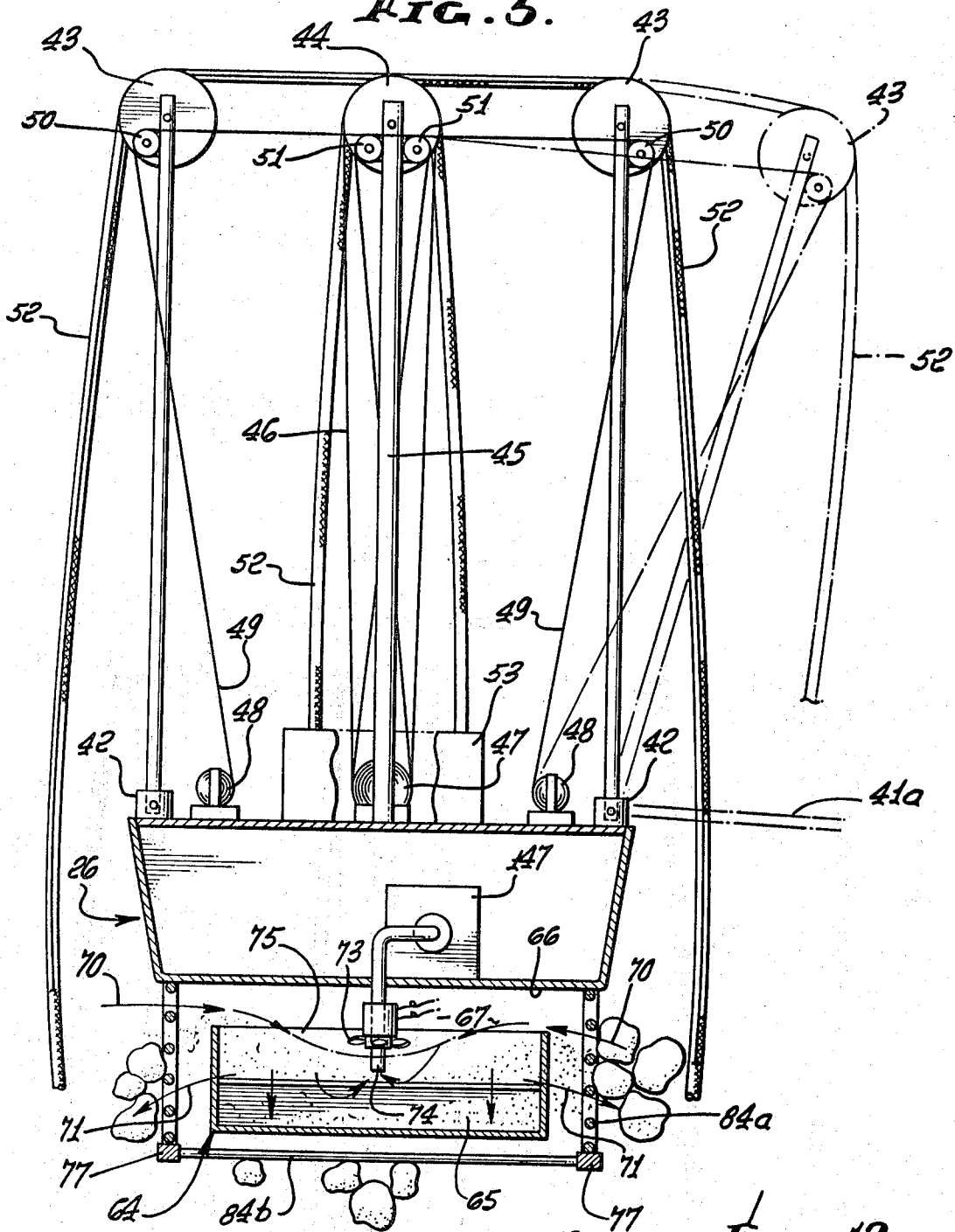


FIG. 13.

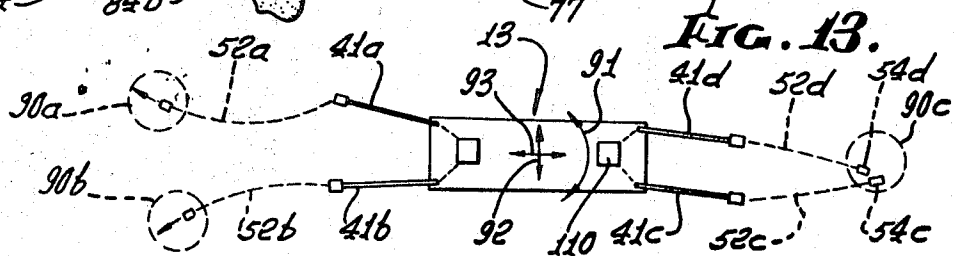


FIG. 14.

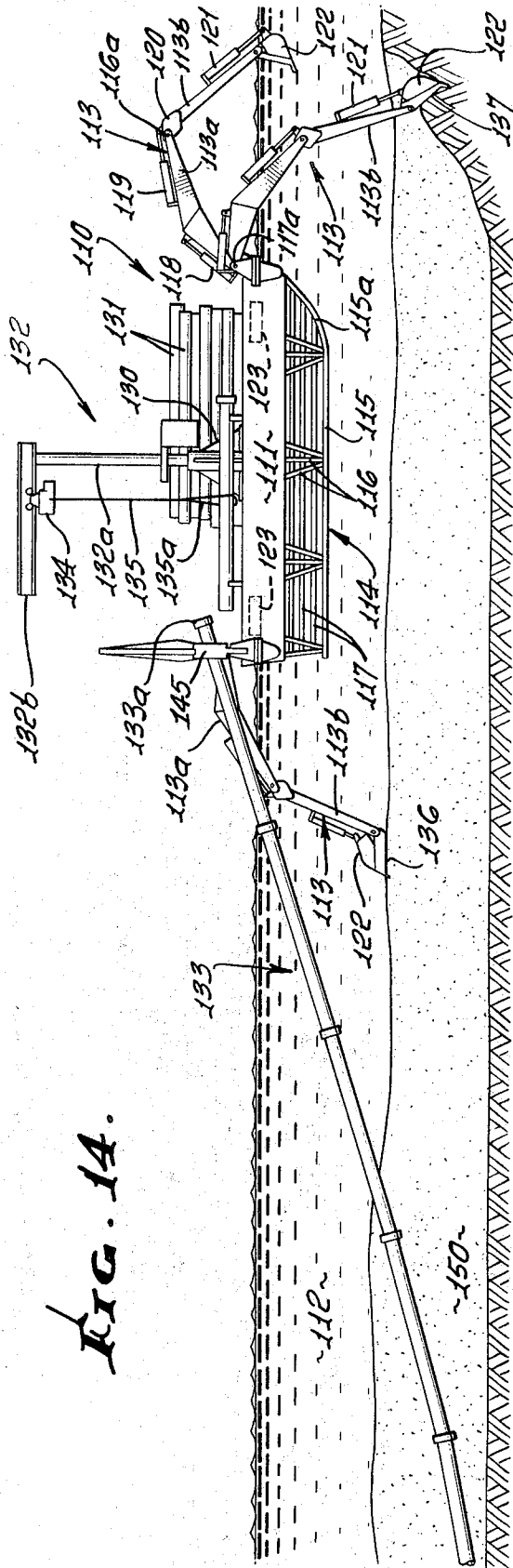
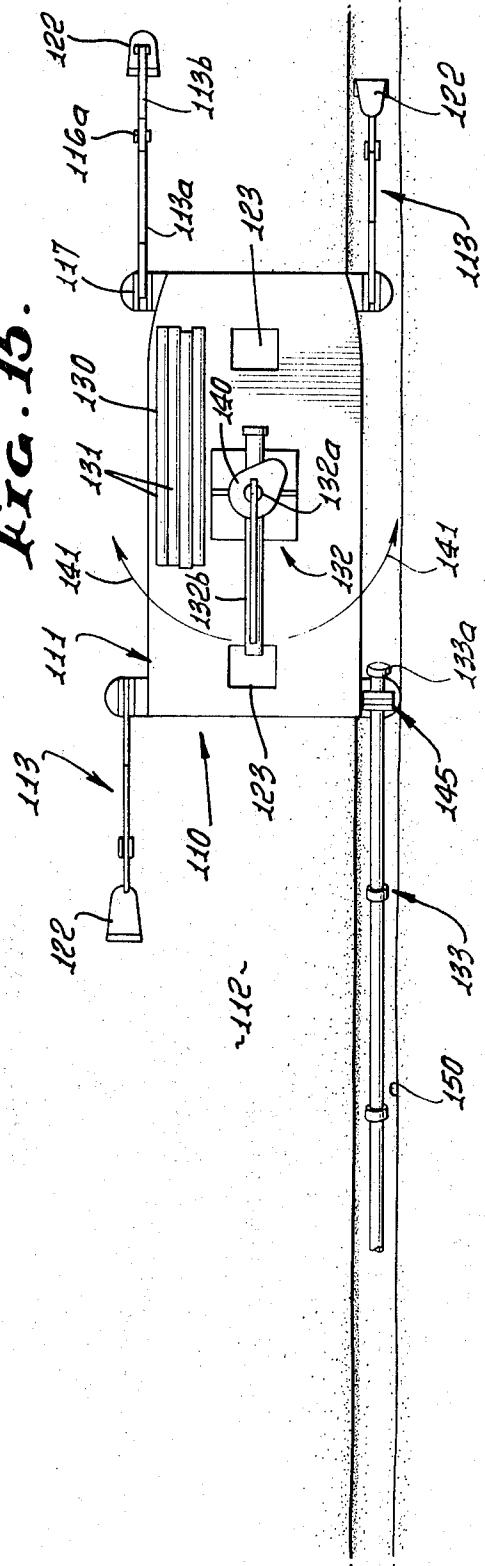


FIG. 15.



PIPE TRANSPORTING AND LAYING VEHICLE AND METHOD

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of my co-pending application Ser. No. 323,769, filed Jan. 15, 1973 now U.S. Pat. No. 3,761,132 and entitled, "Apparatus and Method for Repositioning Earthen Material."

This invention relates generally to all-purpose carrier vehicles, and more particularly concerns a vehicle movable over terrain and water, and adapted among other things to transporting and laying pipe.

In many areas of the world, rough, roadless terrain, which may include ponds, lakes, rivers and swampy lands, prevents ready access of carrier vehicles such as are useful for laying pipe and other tasks. Vehicles provided with large wheels and/or tracks have been built to pass over difficult terrain; however, such vehicles cannot move over large boulders or deep water bodies. Also, such carriers cannot be seated downwardly on the earth surface, whenever desired, and free of wheel or track support, as for example when the vehicle is to be partially sunk or "puddled in," as will be described.

SUMMARY OF THE INVENTION

It is a major object of the invention to provide solutions to the above problems which will enable vehicle access to many different types of formerly inaccessible terrain, and as may be separated by water bodies, such as may be found in arctic areas, for example.

In its apparatus aspects, the invention basically contemplates the provision of a carrier vehicle including a floatable hull to float the vehicle in a body of water; and, articulated legs carried by and connected with the vehicle to engage the terrain for lifting and advancing the vehicle. As will appear, the legs may be carried at opposite ends and sides of the vehicle and have raised and lowered positions; they may have terminal backhoes; and they may incorporate power cylinders between leg sections to enable their selective operation.

In its method aspects the invention includes supporting pipe sections on the vehicle and operating the legs to transport the vehicle over the terrain; and intermittently connecting pipe sections carried by the vehicle endwise onto a pipe string being laid and extending proximate the vehicle. At times the vehicle may be floatably supported by a hull on a body of water through which the pipe line is to be laid, and the endwise connection of pipe sections onto the line is effected during such floating, and typically while at least two of the legs engage the earth to position the vehicle relative to the pipeline. Also, another leg may be operated to support and maneuver the end of the pipe line to facilitate connection of pipe lengths to the line, as will be described.

DRAWING DESCRIPTION

FIG. 1 is a side elevation showing one preferred form of apparatus incorporating the invention;

FIG. 2 is a top plan view of the FIG. 1 apparatus;

FIG. 3 is an enlarged fragmentary vertical section taken on lines 3—3 of FIG. 1;

FIG. 4 is an elevation showing subterranean earth agitation apparatus in use;

FIG. 5 is an enlarged vertical section taken on lines 5—5 of FIG. 3;

FIG. 6 is a vertical section through an originally undisturbed underground formation;

FIG. 7 is a view like FIG. 6 showing the same formation after dredging or stripping to produce a top layer of rock;

FIG. 8 is an enlarged section taken through the washing shoe seen in FIG. 4;

FIGS. 9—12 show modified washing shoes;

FIG. 13 is a schematic plan view; and

FIGS. 14 and 15 show pipe being laid from the carrier vehicle.

DETAILED DESCRIPTION

In FIGS. 1—3, apparatus for repositioning the earthen material 10, that includes intermixed soil 11 and rocks 12, comprises a carrier craft or vehicle 13, and means operatively connected with the vehicle for advancing it over terrain to be repositioned. Such advancing means may, with unusual advantage, include articulated legs as for example are generally seen at 15 carried by the vehicle. The legs may be located at opposite ends of the vehicle, i.e., one at each corner, to have retracted raised positions as seen in full lines, and various extending, i.e., "walking" positions (as seen in broken lines) in which the legs are lowered to grip the terrain in order to relatively raise, lower, advance and retract (linearly and/or rotatably) the carrier over rough as well as smooth terrain. The legs may include booms or links 15a and 15b pivotally interconnected at pivot locations 16, and the backhoe booms or links 15a may be pivotally supported at 17 on the carrier. Fluid pressure responsive actuators 18 are connected between leg support structure 19 on the vehicle and links 15a to extend and retract the latter; fluid pressure responsive actuators 20 are pivotally connected between links 15a and supports 21 for the inner ends of booms or links 15b to pivotally extend and retract the latter relative to links 15a; and fluid pressure responsive actuators 22 are pivotally connected between links 15b and the claws or backhoes 23 (which are pivotally connected at 24 to the outer ends of legs 15b) in order to pivot the claws as required. Controls 25 are located at each end of the vehicle for operating the legs. Accordingly, the carrier vehicle may be moved (i.e., "walked") over very rough, rocky terrain and set down wherever desired in order to "puddle in," as will be described, for repositioning the terrain as by sinking the rocks and elevating the soil to reclaim the land in a most rapid and efficient manner.

The vehicle itself may include an elongated hull 26 designed to carry the pumping equipment 27, legs 15, controls 25 as well as other equipment to be described. Also, the hull is sized to floatably support such equipment during the "puddling in" process to be described, the legs being long enough to be lowered and operated to enable walking of the vehicle out of a shallow puddle formed during reclamation. Also, the dug-in legs may resist vehicle movement, as may be desired. 63

Means is provided for locally hydraulically agitating the subterranean earthen material to effect sinking of rocks relative to the vehicle, and to effect deposition of a layer of soil overlying the rocks in response to vehicle advancement. In this regard, reference is made to FIG. 7 showing terrain wherein an upper layer 30 of rocks has been deposited over the top soil and sandy silt 31,

typically as a result of past dredging activity. The latter was carried out in the past in certain areas of California to recover gold particles naturally deposited in a layer 32 just above sloping bedrock 33 as from streams flowing downstream from a "mother lode" of gold ore, as better seen in FIG. 6. During such recovery, the dredged land became useless for farming or recreation. Also, substantial amounts of the gold remained unrecovered due to inability of dredge buckets to closely scoop the bedrock or to scoop the cracks and crevices in the bedrock wherein gold particles naturally collect.

FIG. 6 shows the top soil 31a as it originally overlay the rocks in layer 30a. The rocks and top soil are to be repositioned from the condition as seen in FIG. 7 to a condition approximating that seen in FIG. 6, and in a most efficient manner; at the same time, it is a purpose of the invention to enable remanent gold or other precious metal recovery. The bedrock over which the terrain is to be repositioned typically lies between 20 and 150 feet below the surface; however, the described method is applicable to other areas, where bedrock may be much deeper, as for example in reclaiming land subjected to strip mining during coal or other mineral recovery.

The above referenced means for locally hydraulically agitating the subterranean material may typically include one or more elongated agitators operable to penetrate into and to agitate the earthen material to be repositioned, such agitators being carried by the vehicle for movement therewith. Further, such agitators may include ducts for flowing liquid downwardly into the soil and rocks subject to agitation, and means may be provided on the vehicle to supply or deliver pressurized fluid, such as water and/or air, to the ducts.

Turning to FIGS. 4, 5 and 8, one form of such ducting comprises a flexible hose 52 extending downwardly from a hose supply means 53 on the vehicle 13. A heavy weight, as for example a steel collar or shoe 54, may be connected with the outboard end 52a of the hose to sink same in the fluidized earthen material and to resist the reaction force of the jet 34 emanating from the hose and hydraulic collar. Pressurized water, air or other hydraulic fluid jetting from the bottom terminal 35 of the collar entrains soil and sand for return flow upwardly through the formation and about the hose as indicated by arrows 36. This in turn fluidizes the formation about the hose to sufficient extent that rocks and boulders 37 gravitate downwardly, whereby the soil is repositioned upwardly and the rocks downwardly.

In this process, with the duct lower terminal located proximate bedrock 33, precious metal particles lying close to the bedrock or in cracks or crevices are washed loose and carried upwardly in the rising stream of water, soil and sand. The formation itself through which the duct has been lowered, as aided by hydraulic jetting, may or may not be saturated with water, i.e., below or above the water table level.

Initial launching of the weighted hose may be directed by a "shoe horn" 58 at an angle relative to vertical, and the hose may be repeatedly extended and withdrawn, i.e., endwise oscillated, to cause the cutting action of the hydraulic jet to form or cut a swath in a vertical plane, i.e., between broken lines 59 and 60, for example. Also, the hose may be dragged or oscillated in directions normal to or at angles to the plane of FIG. 4, as by carrier vehicle movement, whereby a wide up-

wardly facing zone of the bedrock may receive the washing action of the shoe 54.

Control means on the carrier vehicle or craft is used for displacing an upper portion of the ducting relative to the carrier vehicle. Such control means may, with unusual advantage, comprise boom structure carried by the vehicle to support an above-ground portion of the hose or hoses for movement relative to the vehicle. In the example seen in FIGS. 1, 2 and 5, the boom structure includes multiple booms 41 the lower ends of which are universally pivotally supported at 42 (as by ball and socket) proximate the sides of the craft near its opposite ends, so as to be capable of lowering to near or below horizontal position as indicated at 41a in FIG. 5. This configuration facilitates the "trailing" mode of operation to be described.

The boom structure also includes sheaves 43 at the outboard ends of the booms, and over which upper, above-ground portions of the hoses and trained. The hoses are extensible or supplied as from coils within supply boxes 53 on the craft deck, as previously referenced, and they may extend upwardly therefrom toward idler sheaves 44 on masts 45, to be directed toward boom sheaves 43.

Further, the control means may include cables 46 the outboard ends of which are connected with the weighted lower ends of the hoses, as for example are provided by hydraulic collars 54. The cables extend upwardly generally alongside the hoses and have above ground portions supported by the boom structure, as for example sheaves 43, dual annular grooves in each of the latter respectively training a cable and its corresponding hose. The control means may also include actuator means in the carrier vehicle for selectively displacing the boom structures, and also for endwise extending and retracting the cables relative to the carrier. For example, powered winches 47 reel and unreel the cables 46, and powered winches 48 reel and unreel lines 49 controlling raising, lowering and swinging of the booms. Lines 49 may typically be trained over small pulleys 50 and 51 respectively attached to the booms, and mast 45, as shown. Auxiliary lines 52a may be attached to the booms and to the carrier as seen in FIG. 2, for controlling swinging and orientation of the booms in different azimuthal directions.

FIG. 13 shows the booms 41a and 41b extending rearwardly of the vehicle, to trail the hoses 52a and 52b, the lower ends of the latter jetting water to wash the underground zones indicated generally at 90a and 90b. Turning of the vehicle and lateral and longitudinal movement thereof in directions indicated by arrows 91-93 aids such operation. Similar booms 41c and 41d extend forwardly of the vehicle, and hoses 52c and 52d extend underground therefrom. The jet terminal collar 54d of hose 52d is shown washing hose 52c at a stuck section thereof, underground.

The design and weighting of the hydraulic collar will normally be tailored to the volume of water that can be passed through same, with the collar having enough weight to wash itself down to desired depth. A number of different hydraulic collar designs may be employed, as, for example, where sampling shows that more gold is left behind in the first washing pass. The collar 54 shown in FIG. 8 is of straight through design, whereas the trailing type unit 95 of FIG. 9 can be used to reach out away from the carrier craft and to pump itself down through the formation causing the gravel to wash and

re-wash toward the gold catching area. Unit 95 includes a tubular collar 95a and a removal shoe 95b which is three-cornered and has flat side walls. This design with a side outlet port 96 in one flat underside causes upward washing of the fluid toward the gold catching area.

The tubular weight 98 in FIG. 12 is tapered lengthwise to aid in prevention of sticking in the formation, there being a removable shoe 99 at the lower end thereof, and the hose 52 connected to the upper end. The modified cylindrical shoes 100 and 101 in FIGS. 10 and 11 have multiple side outlets 102 and 103. Outlets 102 extend radially, whereas outlets 103 extend radially and upwardly.

Separator structure may also be carried by the vehicle to be sunk downwardly in the earthen material in response to hydraulic agitation of the material, such separator structure having entrance and exit zones to pass the soil to be deposited over the rocks over which the vehicle moves. Such separator structure may include a sluice, as, for example, is generally indicated at 64, with riffle plates 65 extending upwardly and laterally to segregate metal particles from the soil and water flowing upwardly and over the sluice at 67 beneath the bottom 66 of the hull. The upward flow of water, soil and metal particles may enter the region 67 from a forward entrance zone 68, to flow rearwardly over the sluice and to ultimately discharge at exit zone 69 for deposition of soil in layer 31a, as previously described.

Reference to FIG. 5 shows water, soil and metal particles entering zone 67 via side inlet zones indicated by arrows 70, with soil discharge via side outlet zones indicated by arrows 71. Water and soil in region 67 is subjected to centrifugal displacement as by a rotating impeller 73, to segregate (by centrifugal action) the soil particles from the water being drawn into central intake pipe 74 delivering to the intakes of pumps 145 and 147 as previously described. As a result, the water surface level is lowered at 75, as in a vortex. The filled or partly filled condition of the spaces between the sluice plates or riffles may be observed as by means of a transparent plate or plates 76 in the hull bottom.

Means is also provided to vibrate the sluice or sluice box 64 relative to the carrier vehicle to aid in the separation of metal particles from soil to be deposited in layer 31a. For this purpose, the sluice box may be mounted to the vehicle via a frame 77 projecting beneath the hull, and via springs 78 connecting the box to the frame; also, one end of the box may be pivotally connected at 79 with the hull, and the opposite end of the box vibrated up and down, against yieldable resistance imposed by the springs. The up and down vibratory force may be generated by rotating eccentrics or cams 80 interconnecting the box with a bracket 81 projecting from and below the hull. A fluid operated motor to rotate the cams is seen at 82 in FIG. 3.

In order to prevent entrance of rocks into zone 67, an openwork frame or grille extends about the sluice, a forward portion of the grille being seen at 84. That grille portion deflects rocks downwardly as the vehicle advances forwardly. The grille may also extend at the sides and beneath the sluice, as at 84a and 84b in FIG. 5, whereby the sluice may be vibrated up and down free of impact with rocks.

Operation of the apparatus may be considered to embody the steps of moving the vehicle over earthen ter-

rain to be repositioned, and locally hydraulically agitating subterranean earthen material for effecting sinking or rocks relative to the vehicle and for effecting deposition of a layer of soil overlying the sunken rocks, in response to vehicle movement. In this regard, the vehicle may be moved endwise, or rotated about a vertical axis, or otherwise moved to "puddle into" a selected area of the terrain, and initially water may be supplied to the pumps and hydraulic agitators as from an external source such as a stream, lake or tank. During or after puddling into one spot with accompanying repositioning of the soil over the rocks, a water body is created from which suction may be taken by the pumps to enable further hydraulic agitation and working of the vehicle to "puddle into" ever-widening zones until a larger area has been reclaimed. Vehicle movement may be effected as by the articulated legs described, or by other means.

Gold or other precious metal recovery involves delivering water in a pressurized jet stream to a zone wherein metal particles are concentrated and underlying a formation of intermixed soil and rocks, effecting upward return flow of intermixed soil and metal particles from that zone and through the formation, and receiving the upward return flow in a separation zone and therein separating the metal particles from the soil. Water may be taken from the separation zone for pressurization and delivery to the subterranean zone in a jet stream, and the latter may be oscillated up and down as by vehicle or duct movement.

Alternatively, and assuming that neither hose 52c or 52d is stuck, the two hydraulic collars 54c and 54d may be operated in proximity to one another as seen in FIG. 13 at a sub-surface location, one hose and collar 52c and 54c supplying water under pressure to the earthen material and the other collar and hose 54d and 54c withdrawing water and entrained sand and soil at that location for upward displacement and discharge at zone 67 previously described near the separator structure. For this purpose, a suitable pump 110 may have its suction side connected to hose 52d and its discharge side delivering to zone 67.

With reference to FIGS. 14 and 15, the carrier vehicle 110, similar to that described above at 13, includes an elongated hull 111 adapted to float the vehicle in a body of water, as is represented at 112. Four articulated legs 113 are carried by the vehicle, one at each corner thereof, to engage the terrain for lifting and advancing the vehicle over the latter. The legs typically have retracted positions, as seen in full lines in FIG. 1, in which the vehicle either floats in the water, or if overland it comes to rest as by seating of the underframework 114 on the terrain. Such framework may have a construction similar to that seen in FIG. 1, and include runner bars 115, support bars 116, and grille bars 117, with bars 115 extending upwardly at their forward ends 115a to form a sled type "skid" support frame. The legs may include booms or links 113a and 113b pivotally interconnected at pivot locations 116a, and the backhoe booms or links 113a may be pivotally supported at 117a on the carrier vehicle. Fluid pressure responsive actuators 118 are connected between leg support structure on the vehicle and links 113a to extend and retract the latter; fluid pressure responsive actuators 119 are pivotally connected between links 113a and supports 120 for the inner ends of booms or links 113b to pivotally extend and retract the latter relative

to links 113a, and fluid pressure responsive actuators 121 are pivotally connected between links 113b and the claws or backhoes 122 (which are pivotally connected to the outer ends of legs 113b) in order to pivot the claws as required. Suitable controls 123 are located at each end of the vehicle for operating the legs. Accordingly, the carrier vehicle may be moved (i.e., "walked") over very rough, rocky terrain and set down wherever desired in order to "puddle in," float, or rest on the terrain as via the sled the 114 under the hull.

The vehicle hull 111 may be designed to carry suitable pumping equipment, as previously described, the legs, and controls, as well as other equipment. Such equipment is shown in FIGS. 14 and 15 as including pipe laying mechanism as may include a pipe rack 130 carrying the pipe stands 131, and a crane 132 operable to lift and displace pipe from the rack for end-to-end connection to a pipeline 133 being laid or formed. The crane includes a column 132a and a rail 132b on which a trolley 134 controllably travels, the trolley supporting a hoisting line 135 forming a loop 135a to suspend pipe sections to be transported between the pipe rack and the end 133a of the pipeline to which pipe sections are progressively connected. The column 132a may be swivel connected to the vehicle at 140 to swing the pipe as indicated by arrows 141 in FIG. 15.

Note that two of the four legs 113 are deployed, one to engage the terrain at 136 to position the floating carrier vehicle during the pipe connection step, and the other to dig a pipe trench at 137. Pipe is laid into the trench at 150. Also, one leg and terminal claw may be elevated to support the pipe line at 145, for reception of the next pipe section.

Steps employed in operating the vehicle shown in FIGS. 14 and 15 include

- a. supporting pipe sections on the vehicle,
- b. operating the legs 113 to transport the vehicle over the terrain, and
- c. intermittently connecting the pipe sections from the vehicle endwise onto the pipe line 133 being laid and extending proximate the vehicle. In this regard, the vehicle may be floating, and certain of the legs deployed to position the vehicle against displacement, during such pipe connection. Also one leg may be elevated and positioned, by the actuator mechanism, to support the terminal end of the pipe line and maneuver it into alignment with a pipe section to be connected therewith, greatly simplifying the pipe laying operation in areas of difficult terrain. Another leg is operable to dig a trench to receive the pipe line. All four legs may be operated to "walk" the vehicle into and out of shallow lakes and streams.

I claim:

1. In a carrier vehicle movable over terrain and water,
 - a. a floatable hull to float the vehicle in a body of water, and
 - b. articulated legs carried by the vehicle and connected therewith to engage the terrain for lifting and advancing the vehicle thereover, said legs including terminal backhoes engageable with the terrain.
2. The vehicle of claim 1 wherein the vehicle is elongated, and said legs are carried at opposite ends of the vehicle and have retracted positions in which the legs are raised relative to the hull, and extended positions in which the legs are lowered relative to the vehicle.

3. The vehicle of claim 1 including power cylinder means connected between sections of each leg which are articulated.

4. The vehicle of claim 1 including a framework extending directly below the hull to support the vehicle on terrain upon upward retraction of the legs.

5. The vehicle of claim 1 including pipe laying mechanism carried by the vehicle.

6. The vehicle of claim 5 wherein the vehicle is floatably supported by the hull in a body of water, and at least one of said legs is extended to engage earthen material to resist travel of the hull in said body of water, and at least another leg is extended into a pipe trench being dug thereby.

7. The vehicle of claim 5 wherein said mechanism includes a pipe rack, and a crane operable to remove pipe from the rack for end-to-end connection to pipe being laid.

8. The vehicle of claim 5 wherein one of said legs supports the terminal portion of a pipe line to which pipe section on the vehicle are connectible.

9. The method of laying pipe, and employing a carrier vehicle supported on the terrain by articulated legs that includes

- a. supporting pipe section on the vehicle,
- b. operating said legs to transport the vehicle over the terrain, and operating at least one of said legs to dig a trench to receive the pipe; and
- c. intermittently connecting pipe sections from the vehicle endwise onto a pipe line being laid and extending proximate the vehicle, the vehicle including a floatable hull, and wherein said intermittent connection of the pipe sections is at least in part carried out while the hull is floating on a body of water.

10. The method of claim 9 wherein at least one of said legs is operated to engage the terrain to position said floating hull during the connection step.

11. The method of claim 9 including supporting the terminal end of the pipe line via one of said legs.

12. In a carrier vehicle movable over terrain and water,

- a. a floatable hull to float the vehicle in a body of water,
- b. articulated legs carried by the vehicle and connected therewith to engage the terrain for lifting and advancing the vehicle thereover, and
- c. pipe laying mechanism carried by the vehicle, said mechanism including a pipe rack, and a crane operable to remove pipe from the rack for end-to-end connection to pipe being laid.

13. In a carrier vehicle movable over terrain and water,

- a. a floatable hull to float the vehicle in a body of water, and
- b. articulated legs carried by the vehicle and connected therewith to engage the terrain for lifting and advancing the vehicle thereover, and
- c. pipe laying mechanism carried by the vehicle,
- d. one of said legs supporting the terminal portion of a pipe line to which pipe sections on the vehicle are connectible.

14. The method of laying pipe, and employing a carrier vehicle supported on the terrain by articulated legs that includes

- a. supporting pipe sections on the vehicle,
- b. operating said legs to transport the vehicle over the terrain;
- c. intermittently connecting pipe sections from the vehicle endwise onto a pipe line being laid and extending proximate the vehicle, and supporting the terminal ends of the pipe line via an articulated leg.

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