

Nov. 8, 1966

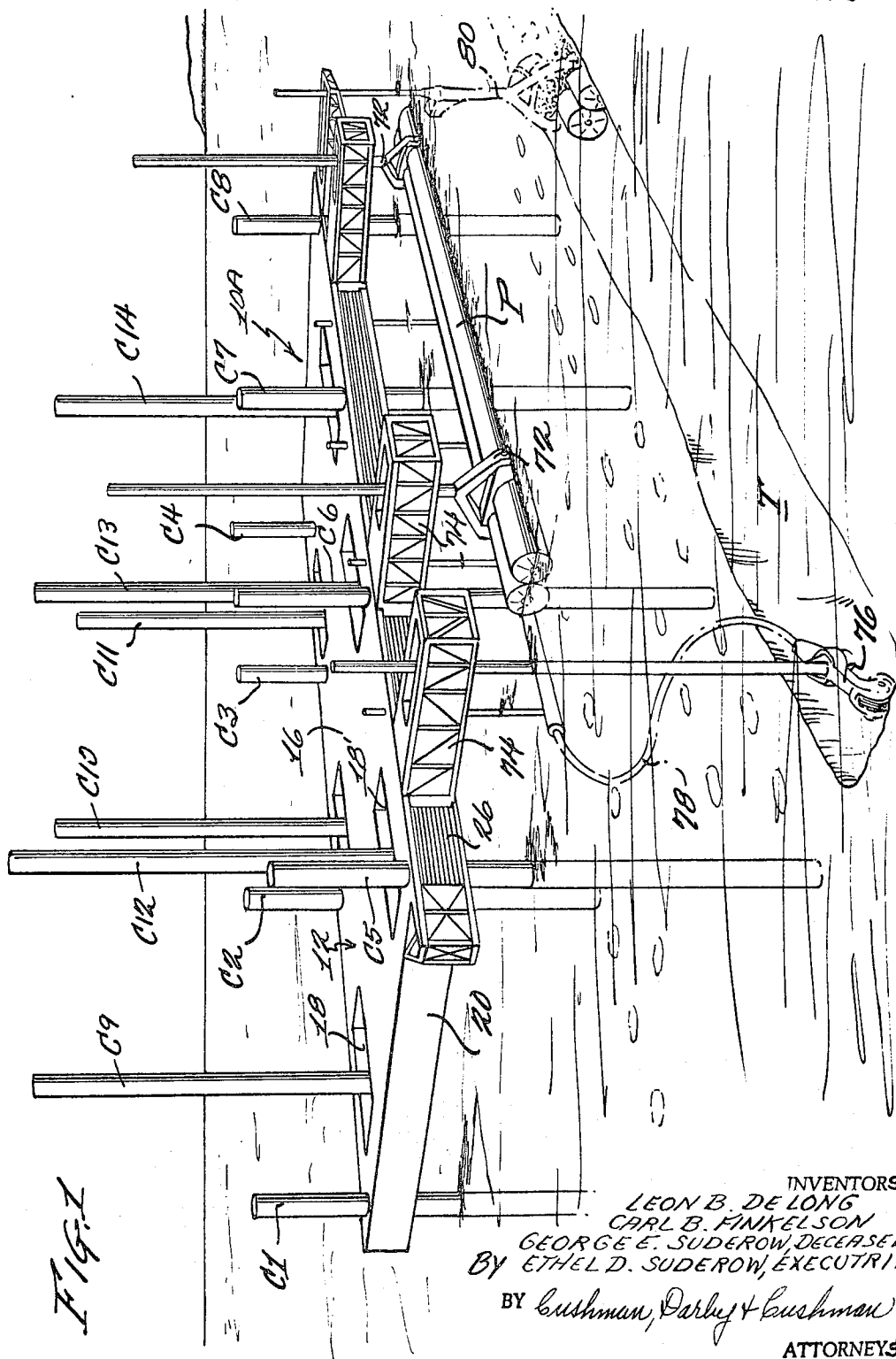
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**3,283,516**

WALKING WORK BARGE

Original Filed Nov. 19, 1962

5 Sheets-Sheet 1



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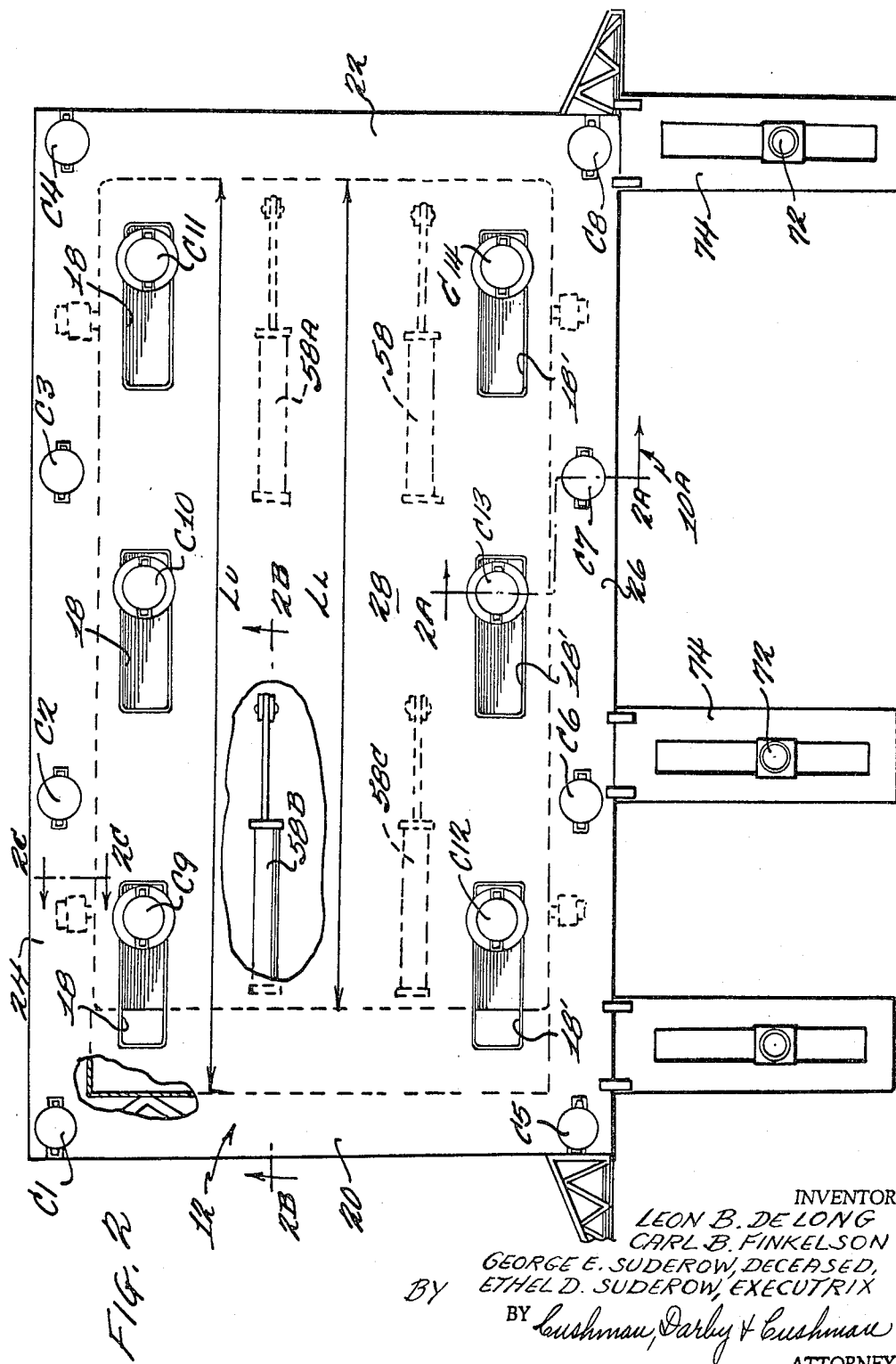
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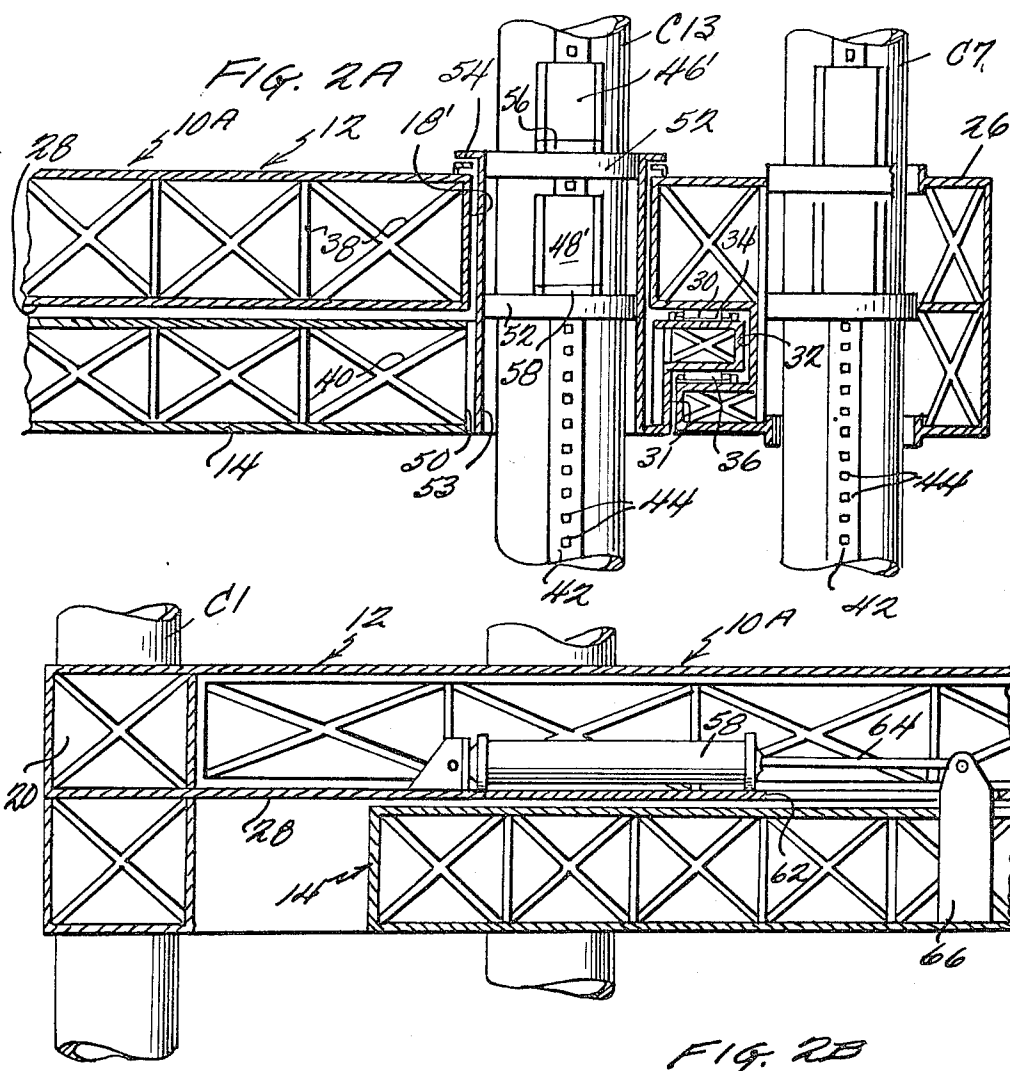
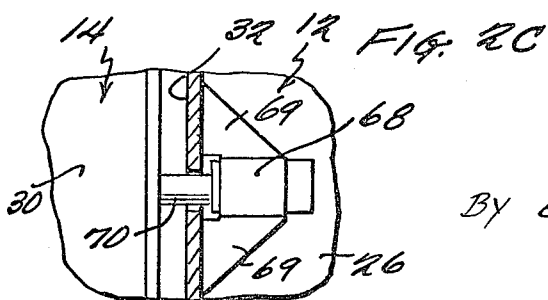
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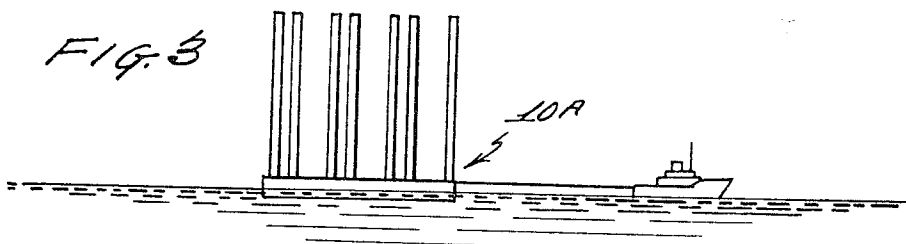
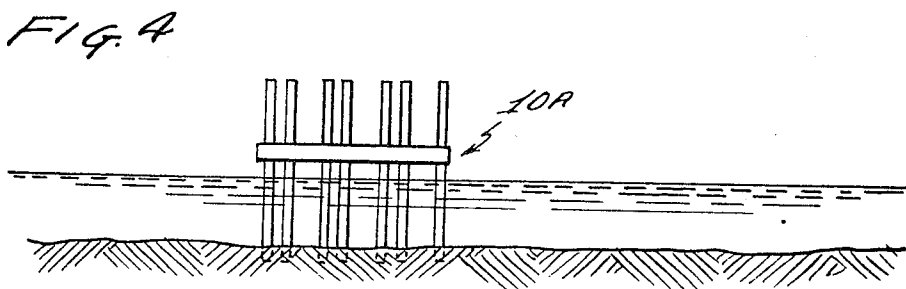
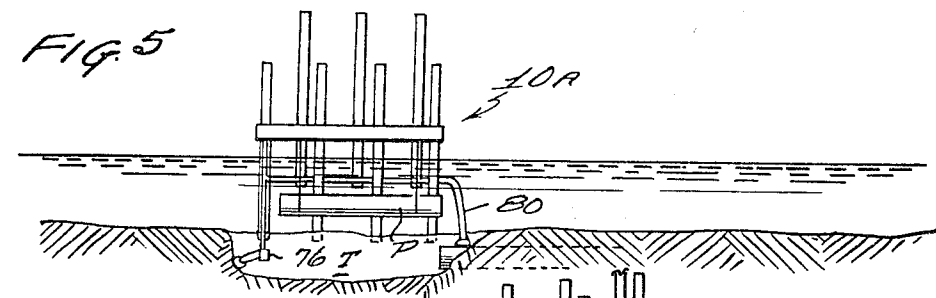
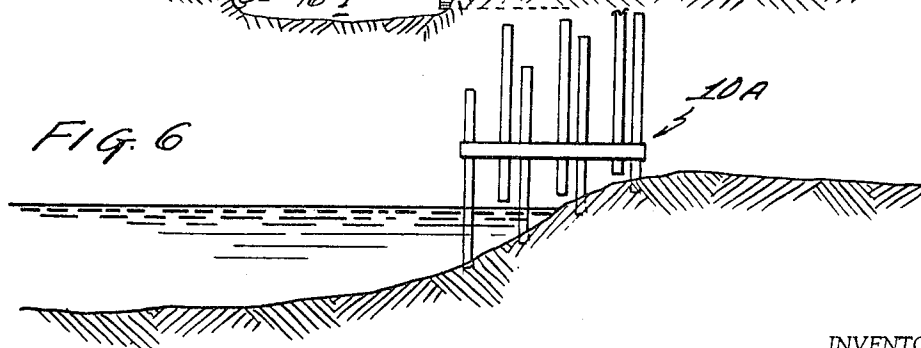
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WALKING WORK BARGE

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WALKING WORK BARGE

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FIG. 7

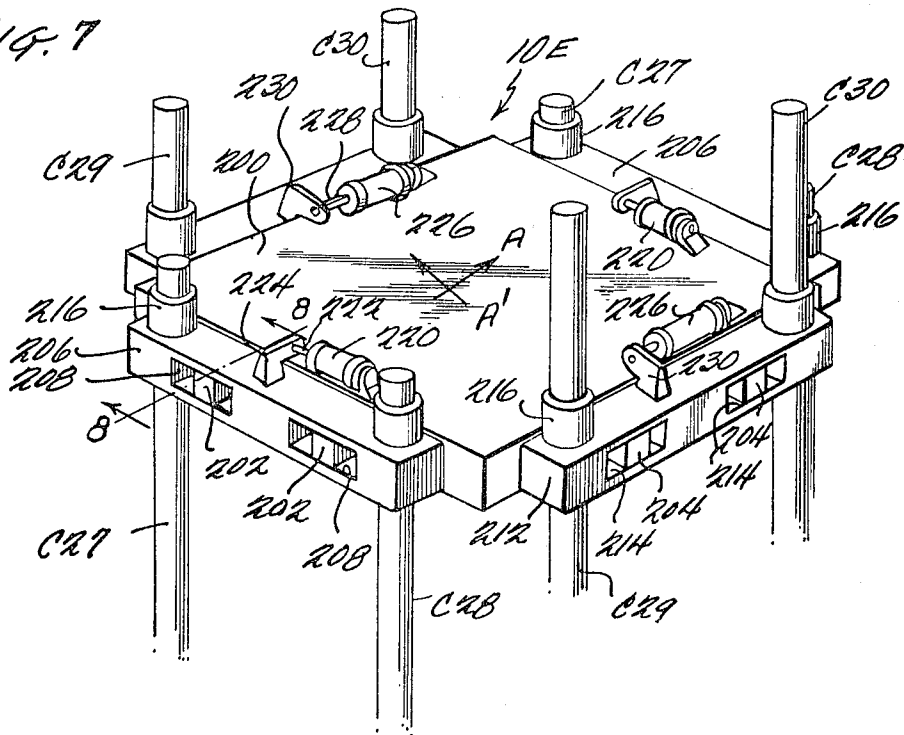
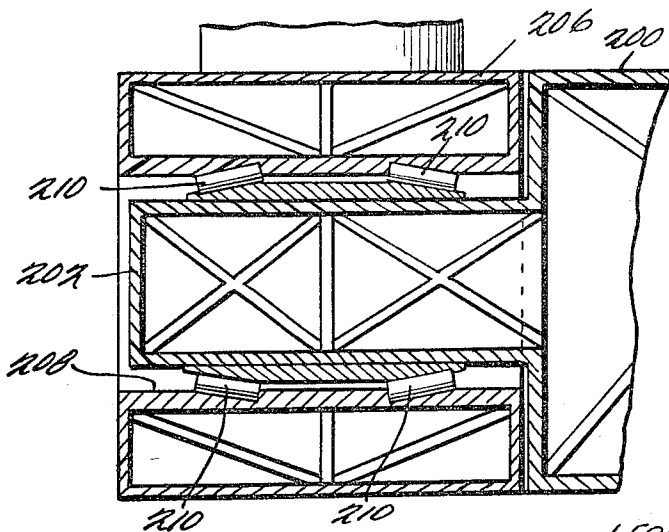


FIG. 8

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3,283,516

## WALKING WORK BARGE

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Original application Nov. 19, 1962, Ser. No. 238,803, now Patent No. 3,230,721, dated Jan. 25, 1966. Divided and this application Apr. 14, 1965, Ser. No. 449,388

6 Claims. (Cl. 61-46.5)

This application is a division of our copending application Serial No. 238,803, filed November 19, 1962.

This invention has reference to a walking barge operative for marine construction purposes such as laying tunnel pipes and the other uses wherein the barge must be movable to a marine work site.

Technical advancements in the field of marine construction in the last half century have rendered possible marine construction projects of a monumental nature. Early developments in the field of marine barges of this character are typified by the early United States patents to Piercy, Nos. 968,975, 1,127,507, 1,128,039 and 1,128,040. These patents disclose forms of marine staging constructions and the like supported by caissons or legs on the ocean floor. For example in the U.S. Piercy Patent, 968,975, there is shown a walking barge construction including movable caissons, the structure being buoyant by virtue of the pontoons carried thereby.

Moreover, marine construction tasks of large magnitude have been rendered practical by virtue of caisson jacking apparatus which are capable of supporting extremely heavy loads, these jacks being operatively carried by the barge to move the caissons in a vertical direction. Such jacking apparatus are typified by the U.S. patents to Pointer, No. 2,775,869, and Suderow, No. 2,932,486, which teachings are included herein by reference.

The present invention contemplates the provision of a new and improved buoyant walking barge which enjoys significant advantages over prior art constructions of this character. According to this invention, the barge construction includes a deck area over its major portion so as to provide a maximum work area consistent with structural requirements for the caisson supporting means.

This invention also contemplates a walking barge including new and improved means for effecting movement of the barge while the same is supported on caissons or other types of legs above sea level or the normal water level. By virtue of the construction according to the instant invention, the barge, being buoyant, may be towed to a work site and thereafter elevated to a position above the sea level and supported by caissons. In this regard, the barge may be formed of two platforms with a set of caissons joined to each of the platforms, each set of caissons being operative to support the entire barge weight. With one set of caissons raised, the other set supports the entire structure. Hydraulic means are provided to move one platform longitudinally relative to the other, and its set of caissons is then lowered for support on the ocean floor. When the barge is to be moved again in a longitudinal direction, the set of caissons which formerly remained stationary is then raised and the relative movement effected between the two platforms, this entire operation taking place above the water line or sea level.

It is another object of this invention to provide a walking barge of the character described that is capable of being walked selectively in either of two directions extending substantially at right angles to each other.

These and still further objects, advantages and novel features of the present invention will become apparent in

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the specification and claims, taken in connection with the accompanying drawings.

In the drawings:

FIGURE 1 is a perspective view of the walking barge construction according to the invention while laying tunnel pipe on the ocean floor;

FIGURE 2 is a plan view of the structure shown in FIGURE 1;

FIGURES 2A, 2B and 2C are sectional views taken along lines 2A-2A, 2B-2B, and 2C-2C, respectively, in FIGURE 2;

FIGURES 3-6 are diagrammatic elevational views of the walking barge;

FIGURE 7 is a perspective view of another embodiment of the walking barge according to this invention; and

FIGURE 8 is a sectional view taken along lines 8-8 of FIGURE 7.

### The walking barge in FIGURES 1-6

Referring first to FIGURES 1, 2, 2A, 2B, and 2C, there is shown a walking barge 10A which includes an upper buoyant platform 12 and a lower buoyant platform 14. The upper platform 12 has a generally continuous deck area 16 and is of rectangular configuration. However, the upper platform 12 has long vertical slots 18 and 18' therethrough which extend longitudinally relative to the deck 16. As best shown in FIGURES 2 and 2A slots 18 are positioned on one side of the deck 16 while the other side of the deck 16 has aligned slots 18'. Generally speaking, the upper platform 12 takes the form of an inverted open box-like structure, having depending peripheral forward and rearward end structures 20 and 22, respectively, and opposed side structures 24 and 26, all of which depend below a continuous rectangular central portion 28. The slots 18 and 18' are thus positioned within the central portion 28 of the upper platform 12.

The lower platform 14 is carried within the central portion 28 of the upper platform 12 and is of a length  $L_L$ . The length  $L_L$  is less than the length  $L_U$  of the central portion 28 so as to be longitudinally movable with respect to the upper platform 12 a distance substantially equal to  $L_U - L_L$ , or increments of this distance.

Referring now to FIGURE 2A, the connection between the upper platform 12 and the lower platform takes the form of a longitudinal tongue-and-groove joint along the side structures 24 and 26 of the upper platform 12. To this end, the lower platform has a laterally extending lip structure 30 along the upper end of its sides 31 which is received in a cooperatively-shaped lateral recess 32 on the inside of the side structures 24 and 26. The top surface of the lower platform 14 above the lateral lip structure 30 carries longitudinally-spaced roller bearings 34; and also roller bearings 36 are carried between the bottom surface of the lip 30 and the cooperatively facing upper surface in the lateral recess 32. These roller bearings 34 and 36 are so mounted to the lower platform 14 to allow the lower platform 14 to move along the central portion 28 of the upper platform 12 as described, so that friction is reduced as much as possible. Moreover, suitable structural framing 38 is provided in the upper platform 12 and likewise structural framing 40 is provided in the lower platform 14 as necessary to provide a rigid and rugged construction.

In order to support both the upper and lower platforms, two sets of vertically movable legs are provided. In this regard, the upper platform 12 carries legs, shown as caissons C1-C4 along its side structure 24 outwardly of its central portion 28, and caissons C5-C8 are carried in opposed relationship along the opposite side structure 26. These caissons take the form of vertical pipes having long channel-shaped members 42 joined to their

front and rear sides, and have a vertically extending series of uniformly-spaced rectangular apertures 44. Mounted in cooperative relationship with the caissons C1-C8 are upper and lower jacking mechanisms 46 and 48, which, in the preferred embodiment of this invention, are of the type disclosed in the patent to Suderow, No. 2,932,486. The jacking mechanisms 46 and 48 are cooperative with the channel members 42, to thereby raise and lower the caissons C1-C8 relative to the upper platform 12. Preferably, the upper jacking mechanisms are carried by the framing in the side structure as best shown in FIGURE 2A. However, it should be appreciated that the particular jacking mechanism is not critical to the invention; alternative jacking mechanisms are well-known in the art for such a purpose.

The lower platform 14 has slotted openings 50 in alignment with the slots 18 and 18'. These vertical openings are defined by cylindrical plates 52 which are rigidly joined to the lower platform 14 via a long vertically extending cylinder 53 which extends upwardly through the slots 18 and 18' and terminate at the upper deck 16 with a lateral flange 54. In this manner, the lower platform 14 carries caissons C9-C11, these caissons extending through the slots 18 and the vertical cylinders 53, while the caissons C12-C14 extend through the slots 18' in a like manner. These caissons C9-C14 carry longitudinally opposed vertical extending channel members 42 with rectangular recesses 44 while the cylindrical plates 52 carry upper and lower opposed jacking mechanisms 46' and 48'. These jacking mechanisms are carried within the cylindrical plates 52 by upper and lower framing members 56 and 58, respectively, joined thereto.

With the caissons C1-C8 lowered to the marine ground and supporting both the upper and lower platforms 12 and 14, the caissons C9-C14 may be raised by their respective jacking mechanisms 46' and 48'; conversely with the caissons C9-C14 supporting the entire barge 10A on the marine ground, the caissons C1-C8 may be raised.

In FIGURE 2B there is shown a hydraulic piston and cylinder arrangement for moving the platforms 12 and 14 longitudinally relative to one another when one set of caissons has been raised while the other set of caissons supports the barge 10A on the marine ground. This arrangement takes the form of a battery of hydraulic cylinders 58, 58a, 58b, 58c (FIGURE 2), although it will be appreciated that the actual number of cylinders utilized depends on design conditions. Each hydraulic cylinder is mounted in a longitudinal direction at the underside of the top platform central portion 28 by suitable structural framing 60. These hydraulic cylinders 58 are thus stationary with respect to the upper platform 12. A longitudinally extending slot 62 is formed in the bottom of the central portion 28 along the axis of the hydraulic cylinder 58 and the piston rod 64 of the cylinder 58 is joined to the upper end of the lower platform 14 (through the slot 62) by way of a bracket connection 66. Thus, the hydraulic cylinder 58 has a stroke which is a maximum of the distance  $L_L-L_U$  but is preferably an incremental portion thereof.

FIGURE 2C shows an arrangement for insuring proper lateral alignment of the lower platform 14 within its tongue-and-groove recess connection with the upper platform 12. Here shown is a small adjusting cylinder 68 mounted to the vertical side wall of the lateral recess 32 of the side structures 24 and 26 via web plates 69. The cylinder 68 has a piston rod 70 which extends through an appropriate aperture in the side wall and is thereby operative to align the lower platform 14 to insure unobstructed longitudinal movement within the tongue-and-groove recess. Four such adjusting cylinders 68 are shown in FIGURE 2, although it will be appreciated that the actual number can be varied according to design conditions.

The caissons C9-C14 are positioned relative to the vertical slots 18 and 18' so as not to interfere with

the stroke length. Thus, for example, when the caissons C1-C8 support the barge 10A on the marine ground and the caissons C9-C14 are raised, the hydraulic cylinders 58 are actuated to move the piston rods 64 within the cylinder 58 so that the lower platform 14 is moved toward the forward end 20 of the upper platform 12. Subsequently, the caissons C9-C14 are lowered for supporting engagement with the ground and the caissons C1-C8 are raised. The hydraulic cylinders 58 are then actuated to move the piston rods 64 out of the cylinders 58 so that the upper platform 12 is moved forward in another step. By virtue of this arrangement, it will be apparent that the barge 10A can be walked on the marine ground while positioned above the sea or water level.

Referring again to FIGURE 1, the barge 10A is shown at a marine working site where large tunnel pipes are being laid. In this regard, the tunnel pipes P may be floated out to the barge 10A with its ends sealed. The pipe P is then grasped by pipe handling members 72 which are mounted for vertical movement on transversely extending, cantilevered members 74 extending from the side wall structure of the upper platform 12. The tunnel pipe P is then lowered to the marine ground by virtue of the jacking arrangement (not shown) where it is aligned with previously laid pipe. The platform 10 also carries a dredging apparatus 76 at its forward end which forms a trench T in the marine ground. This bottom silt is transferred back to the rearward end of the barge 10A via piping 78 where it is transferred onto the previously laid tunnel pipe through a suitable conduit arrangement 80. The pipe handling equipment and the dredging equipment are here disclosed to show the utility of the barge 10A, and any suitable equipment for the dredging and pipe laying operation may be carried by the barge 10A to accommodate this pipe laying operation.

Referring now to FIGURES 3-6 the sequence of using the barge 10A is diagrammatically shown. In FIGURE 3, the barge 10A is being towed at sea by a ship with the caissons C1-C14 all raised to the uppermost position so as to render the barge 10A sufficiently seaworthy to be towed in the water.

In FIGURE 4, the barge 10A is shown at the working site and the caissons C1-C14 have been lowered. With all the caissons C1-C14 so lowered, the barge 10A is elevated above the water level so as to be free from interference by waves and the general surface conditions of the water. The barge is then ready for the pipe laying operation, as previously described, the barge 10A being walked along the marine ground while the platforms are above sea level.

In FIGURE 6, the barge 10A is shown in a shallow area adjacent the shoreline wherein one set of caissons C9-C14 is elevated while the caissons C1-C8 support the barge 10A in a horizontal position, the caissons C1-C8 assuming various relative vertical positions with respect to the barge 10A so as to properly support the same. The jacking mechanism for each set of caissons may be operated from a suitable station (not shown) whereby the horizontal position of the barge can be maintained.

For purposes of brevity, the description of the walking barge 10A includes those structural arrangements which render the same operative for purposes described. However, many refinements to the basic construction here described will be evident to those skilled in the art. For example, the platforms may be compartmentalized for living purposes and the like, and the deck area will carry materials handling equipment and other structures found in marine barges of this character. Helicopter landing facilities may be provided as well as the usual small boat handling equipment so as to render the same habitable and seaworthy. The walking barge 10A lends itself to very large constructions. For example, the exterior dimensions of the upper platform 12 may be in the order of 300 feet by 500 feet with perhaps a 40

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foot maximum walking stroke,  $L_L-L_U$ , provided between the upper platform 12 and the lower platform 14. Such a construction may support the barge 10A in perhaps 220 feet of water and 50 feet from the water level to the bottom surface of the barge 10A, while the upper platform 12 may have a maximum cross-sectional height of 40 feet. In such an arrangement, the caissons may assume a diameter of in the order of 20 feet. These dimensions are not intended to restrict the disclosure of the walking barge 10A but rather to afford a description of a typical size range contemplated by the instant invention.

#### The walking barge in FIGURES 7-8

In FIGURES 7 and 8, a walking barge 10E is shown which is constructed in a manner generally similar to the other embodiment of this invention. However, this barge construction is operative to be walked in perpendicular directions. There is provided a central platform 200 which is of rectangular configuration. This platform 200 has horizontally extending supporting members 202 at its forward and rearward ends, two such members being shown in FIGURE 16 at the rearward end. The opposed sides of the central platform 200 likewise have horizontally extending supporting members 204, there being shown two in FIGURES 16, although the number of such elements depends on the particular design conditions. A pair of generally rectangular auxiliary platform members 206 are positioned adjacent the front and rear ends of the central platform 200, the platform members 206 having longitudinally extending transverse slots 208 which are of substantially greater length than the corresponding dimension of the supporting members 202. The sides of the supporting members 202 together with the ends of the slots 208 define stops for limiting relative movement between the central platform 200 and the platform members 206.

The supporting members 202 are carried within these slots 206 by pairs of roller bearings 210, positioned in inclined relationship above and below the supporting members 202 so as to prevent movement of the supporting members 202 out of the slots 208. This arrangement of roller bearings 210 allows the auxiliary platform members 206 to move transversely with respect to the supporting members 202, i.e., parallel to the adjacent edge of the central platform 200. The other sets of supporting members 204 are carried within corresponding slots 214 in corresponding platform members 212. An identical roller bearing arrangement (not shown) is provided to limit the movement of the auxiliary platform members 212 to parallel relative movement with respect to the adjacent edge of the central platform 200.

The auxiliary platform members 206 each carry a set of two spaced-apart caissons C27 and C28 vertically movable by jacking mechanisms 216, as previously described. Likewise, the auxiliary platform members 212 each carry a set of spaced-apart caissons C29 and C30 operative for vertical movement with respect to the barge 10E by jacking mechanisms 216. Any of the caisson sets C27, C28, C29 or C30 is operative to stably support the barge 10E on the marine ground independently of the other set.

In order to effect relative movement between the central platform 200 and the two pairs of auxiliary platform members 206 and 212 a hydraulic jacking arrangement is provided. To this end a hydraulic piston and cylinder 220 is positioned adjacent each edge of the central platform 200 nearest the first pair of auxiliary platform members 206. This piston rod 222 of each hydraulic cylinder is connected to its adjacent auxiliary platform member 206 via a suitable bracket connection 224. Thus, when the caissons C27 and C28 are raised, it is evident that relative movement may be provided between the central platform 200 and the auxiliary platform 206 by suitable actuation of these hydraulic cylinders 220. In a like manner, hydraulic cylinders 226 are positioned along the

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opposite edges of the central platform 200 adjacent the second pair of auxiliary platforms 212, their piston rods 228 being connected to these auxiliary platform members 212 via a suitable bracket connection 230. When the caissons C29 and C30 are raised and the barge 10E is supported by the caissons C27 and C28, there may be provided a relative movement between the auxiliary platform members 212 and central platform 200. It will be appreciated, however, that this arrangement of hydraulic cylinders may be positioned below the deck of the central platform 200, as desired.

The operation of the walking barge 10E is as follows: After the barge 10E has been floated to the work site with all the caissons C27-C30 elevated, the caissons C27-C30 are lowered to the marine ground at the working site and the jacking mechanisms 216 and 218 are actuated to elevate the barge 10E above the water level. When it is desired to walk the barge in one direction, designated by arrow A, the caissons C27 and C28 are elevated so that the barge 10E is supported on the marine ground solely by the caissons C29 and C30. The hydraulic cylinders 226 are then actuated to move the central platform 200 horizontally relative to auxiliary platform members 212. Thus, the supporting members 204 are moved to one end of the slots 214. The set of caissons C27 and C28 are lowered; the set of caissons C29 and C30 are then raised; and the hydraulic cylinders 226 are actuated in their opposite directions to move the auxiliary platform members 212 relative to the central platform 200, the supporting members 204 thereby being positioned to the other end of the longitudinal slots 214. The set of caissons C29, C30 are then lowered and the set of caissons C27, C28 raised. The hydraulic cylinders 226 are then actuated to repeat the operation. In this manner, the barge 10E can be walked in the direction shown by the arrow A, or in the opposite direction, as is evident. When the barge is to be walked in the direction A', which is perpendicular to the axis A, the same procedure takes place with the hydraulic cylinders 220 being utilized instead of the hydraulic cylinders 226.

From the foregoing description of the various embodiments of this invention, it is evident that the objects of this invention, together with many practical advantages are successfully achieved. While preferred embodiments of our invention have been described, numerous further modifications may be made without departing from the scope of this invention.

Therefore, it is to be understood that all matters herein set forth or shown in the accompanying drawings are to be interpreted in an illustrative and not in a limiting sense.

What is claimed is:

1. A marine walking barge comprising: first platform means having first and second pairs of opposed side portions

a pair of second platform means, each of said second platform means being disposed adjacent a different one of said first side portions, and means joining said first and second platform means for relative linear horizontal movement in a direction along said first side portions;

a pair of third platform means, each of said third platform means being disposed adjacent a different one of said second side portions, and means joining said first and third platform means for relative linear horizontal movement in a direction along said second side portions one of said platform means including a deck surface over its major area to accommodate workmen and equipment and said first, second and third platform means constituting a buoyant unitary structure;

a first set of legs carried by said second platform means, and a second set of legs carried by said third platform means, the legs of each set being horizontally spaced and arranged on both members of each pair

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so as to be capable of stably supporting said structure on a marine ground independently of the legs of the other set and so as to permit said relative horizontal movement without interference between said sets of legs;

stop means carried by said platform means effective to limit said horizontal movement so that at the maximum extent of said horizontal movement either of said leg sets can stably support said structure;

jacking means associated with each leg set and with the corresponding platform means to selectively effect or restrain vertical movement of the legs of each set in either direction relative to the corresponding platform means in order to raise or lower said structure on a leg set when the latter is engaged with the marine ground and raise or lower a leg set when said structure is afloat or supported on the other leg set whereby said structure may be selectively supported by either of said leg sets;

means engageable with said first and second platform means for moving the same relative to each other horizontally in a direction along said first sides;

and means engageable with said first and third platform means for moving the same relative to each other horizontally in a direction along said second sides.

2. The structure as defined in claim 1 wherein said opposed sides on said first platform means are outer sides and wherein said pairs of second and third platform

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means are auxiliary platforms of lesser horizontal surface area than said first platform means.

3. The structure defined in claim 1 wherein said joining means for joining said first platform means with said second and third platform means includes rigid generally horizontal support members projecting from one of said platform means into slots on the adjacent platform means, said slots being horizontally elongated in the direction of relative movement between adjacent platform means.

4. The structure defined in claim 3 including roller bearing means interposed between said supporting members and the upper and lower surfaces of said slots.

5. The structure defined in claim 4 wherein said roller bearing means are disposed at angles to the horizontal in a manner to prevent withdrawal of said supporting members from said slots.

6. The structure defined in claim 4 wherein the sides of said supporting members nearest the ends of the respective slots are engageable with said ends thereby defining therewith said stop means.

#### References Cited by the Examiner

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