Aug. 11, 1970 F. J. McGUINNESS 3,523,318

COLLAPSIBLE PONTOON BRIDGE

Filed Oct. 30, 1968 3 Sheets-Sheet 1

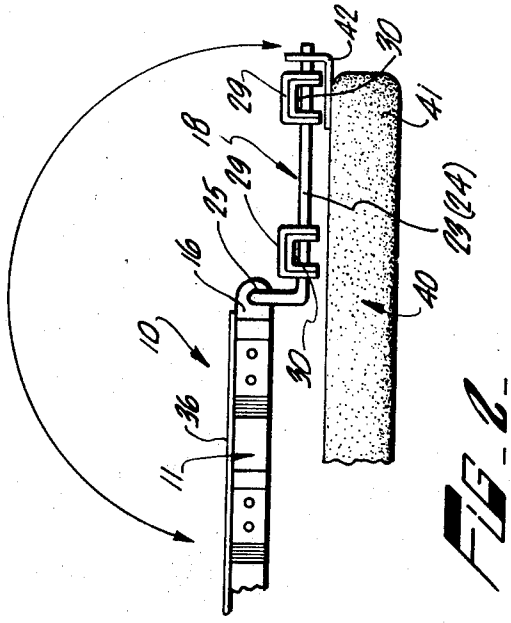


FIG. 2

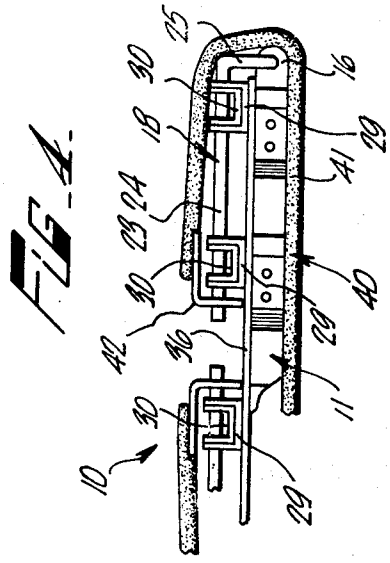


FIG. 4

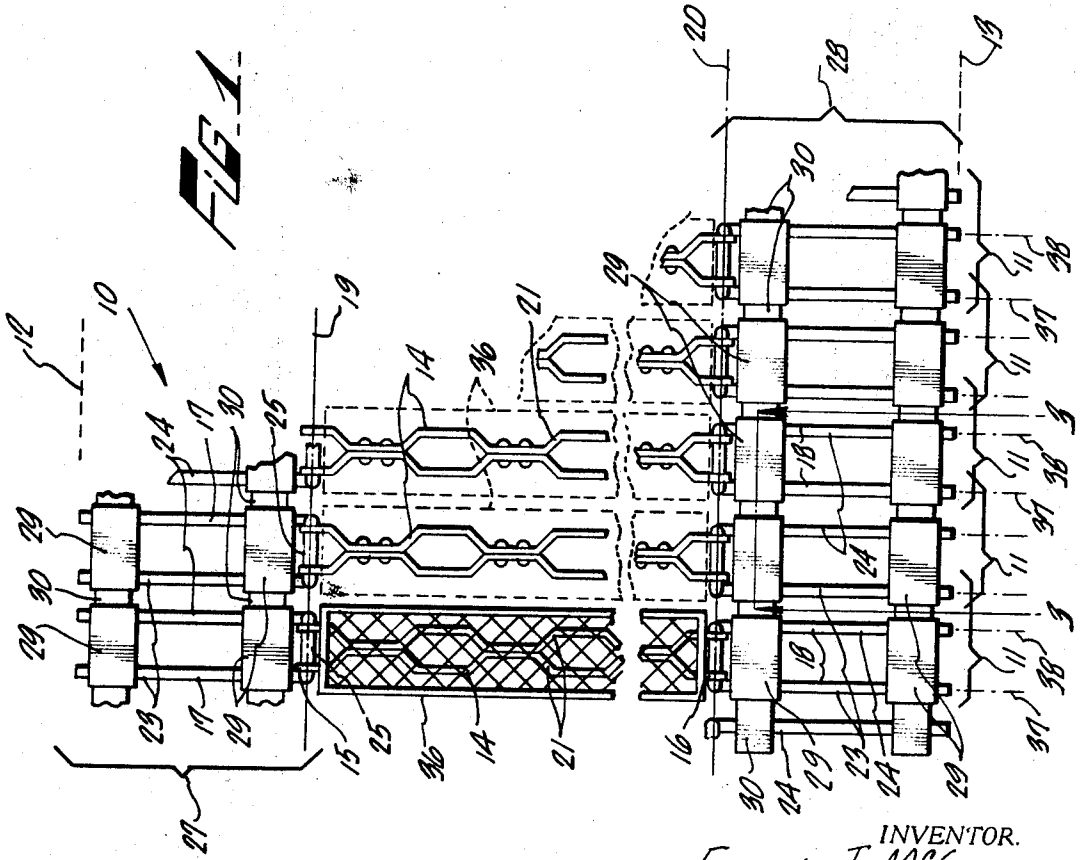


FIG. 1

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FIG. 3

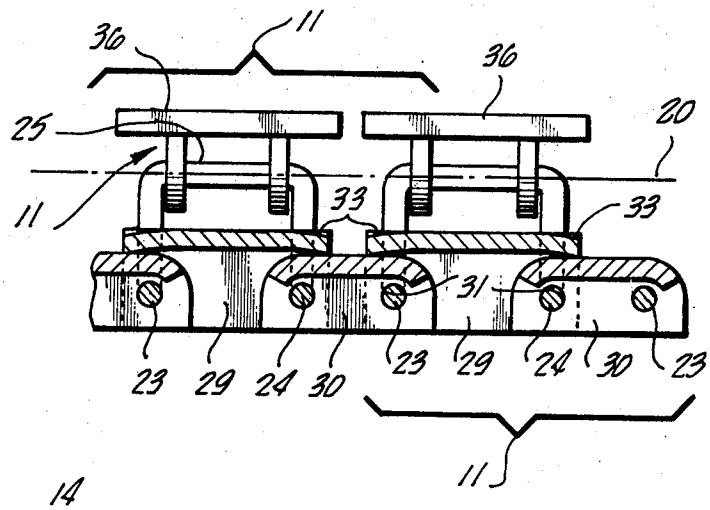
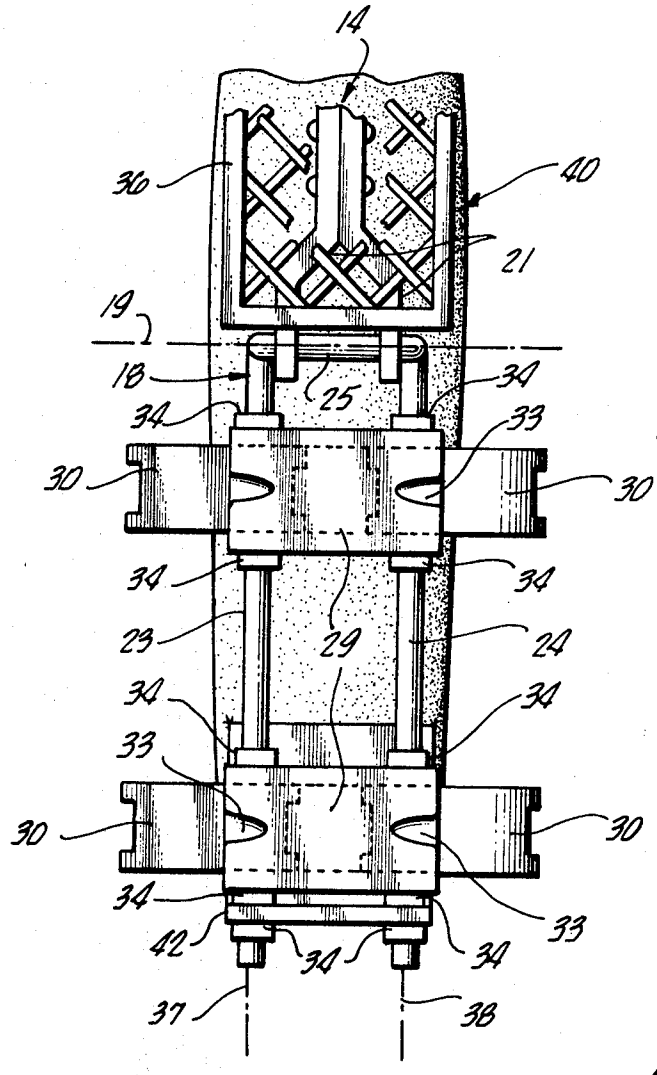


FIG. 6



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COLLAPSIBLE PONTOON BRIDGE

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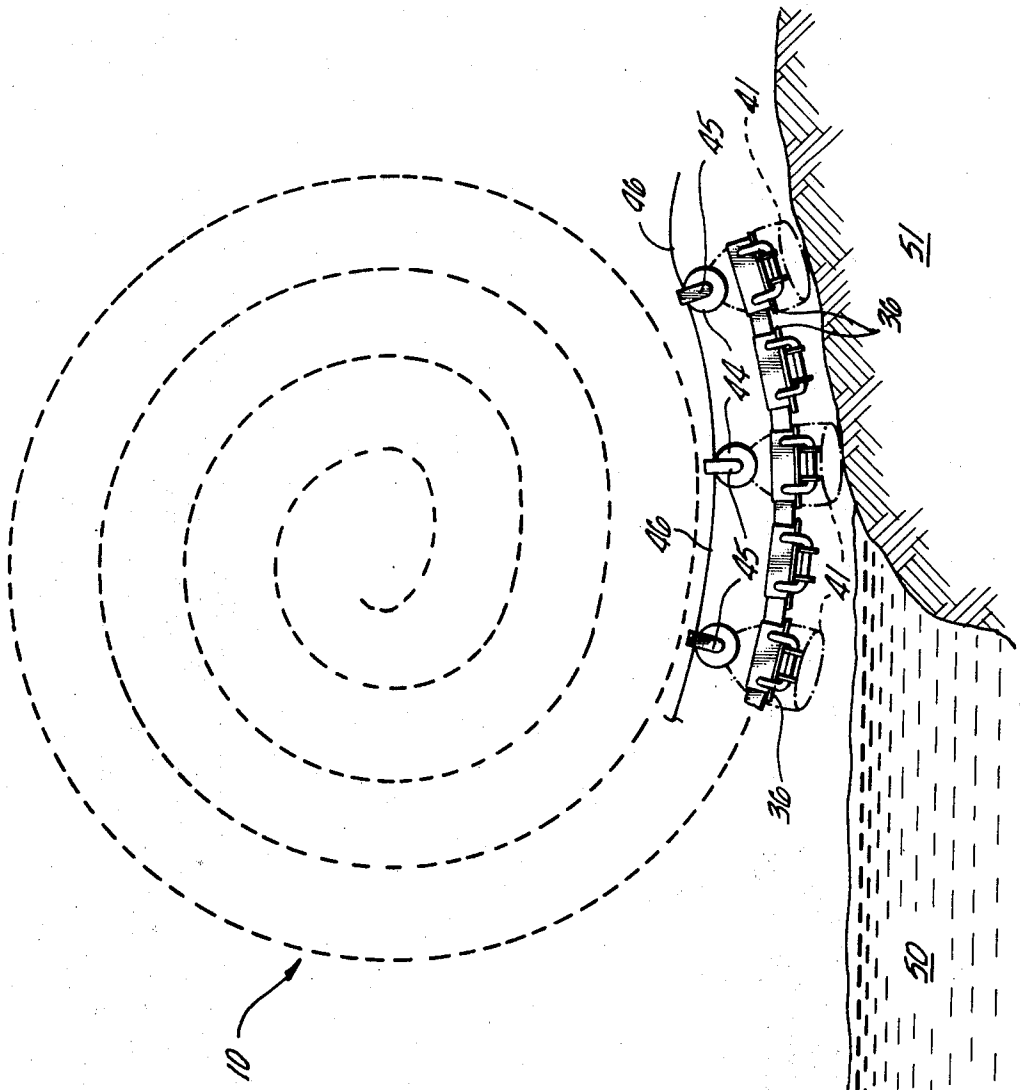


FIG 5

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3,523,318

COLLAPSIBLE PONTOON BRIDGE

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Int. Cl. E01d 15/14
U.S. Cl. 14—27 17 Claims

ABSTRACT OF THE DISCLOSURE

A self-erecting pontoon bridge having uni-directionally hinged tracks extending along the margins of the bridge, transverse trusses disposed between the tracks and to which the tracks are hinged lengthwise of the bridge, and inflatable pontoons secured between the outer edges of the tracks below the bridge. The tracks are hingable from outwardly of the trusses into overlying relation to the trusses to reverse the direction of stiffness of the bridge from its erected state to its collapsed or collapsible state.

BACKGROUND OF THE INVENTION

This invention relates to a floating structure, and more particularly it concerns a self-erecting, collapsible pontoon bridge which can be used for spanning large bodies of water.

Pontoon bridges are used to provide temporary or semi-permanent passage over water or swampy terrain which normally is impassable to vehicles or pedestrian traffic. Most of the structures heretofore employed required total assembly and disassembly at the site of use before and after each use. The operations involved in the assembly and disassembly of such bridge structures are both time-consuming and expensive, and generally require considerable manpower primarily because such structures are bulky and weighty. Additionally, the original cost and the installation costs of such bridges tend to be prohibitive except in military uses, because of the complexity of the prior bridge structures in which numerous parts are assembled in relatively precise fashion to provide a completed bridge of sufficient load-carrying capacity.

More recently, collapsible pontoon bridges, capable of being rolled up into compact structures, have been described in an attempt to overcome the handling and installation problems of more conventional pontoon bridges. One structure, described in U.S. Pat. 3,258,800, uses longitudinal spring steel flotation chambers which deform into a flat condition so that the bridge may be rolled up; the spring steel members impart longitudinal stiffness to the bridge when erected. This bridge may be erected quite rapidly and, for this reason, is potentially useful in military applications where the intended site of the bridge may be under fire from hostile forces. While this bridge significantly reduces the time and effort needed for its erection and installation, the structure of the bridge is such the bridge is practical essentially only for use with pedestrian traffic; a bridge of this type suitable for use by even light vehicles would be extremely heavy and difficult to transport to the site of intended use.

STATEMENT OF THE INVENTION

The present invention contemplates a collapsible pontoon bridge having a superstructure composed of tracks along its longitudinal edges and truss members disposed between and interconnecting the tracks. Inflatable pontoons are secured between the tracks and are disposed beneath the superstructure to support the bridge on water. The tracks are hingably attached along their lengths to the truss members for movement between a closed position, in which the tracks overlie the truss

members, and an open position in which the tracks lie outwardly of and substantially in the plane of the truss members. Preferably, each track is a series of overlapping channel links hingably connected transversely of the length of the tracks such that they can hinge together only in a single common direction to permit rolling up the bridge when the tracks are in their closed position. When the tracks are in an open position relative to the trusses, however, the tracks present a stiff supporting surface over which vehicles can be driven. That is, the uni-directional hinging tracks, when the bridge is open and in use, cannot be deformed significantly by forces applied downwardly to them by vehicles or pedestrians crossing the bridge. Conversely, when the tracks are moved about hinge axes extending along the length of the bridge, to lie over the truss members, the stiffness of the tracks is reversed relative to the truss members so the bridge may be rolled up across the water surface upon deflation of the pontoons.

The pontoons can be constructed of any gas-tight flexible material, and preferably they are provided with compressed-gas filling cylinders, triggered by lanyards, for successive inflation of the pontoons so that the bridge automatically unrolls and opens after inflation of the first pontoon.

In addition to the excellent load-supporting features of the bridge, storage of the rolled-up structure is greatly simplified because of the compact form of the bridge in its collapsed state. For example, a fifty foot long, six foot wide bridge can be easily rolled into a coil of approximately four feet long and five feet or so in diameter. A pontoon bridge of such dimensions can be conveniently handled and installed by two men.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features of the invention are more fully set forth in the following detailed description of a pontoon bridge, which description is presented with reference to the accompanying drawings, wherein:

FIG. 1 is a top plan view of a portion of a pontoon bridge according to this invention;

FIG. 2 is a fragmentary elevation view of the bridge in its erected state;

FIG. 3 is an enlarged cross section view taken along line 3—3 in FIG. 1;

FIG. 4 is a fragmentary elevation view of the bridge in its collapsed condition;

FIG. 5 is an elevation view of the bridge in its collapsed condition ready for installation across a stream, for example; and

FIG. 6 is an enlarged plan view of a portion of the structure shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A pontoon bridge **10** according to this invention, as shown in the drawings, is composed of a plurality of essentially identical transverse sections **11**. Any number of sections **11** may be connected together in side-by-side relation to define a complete bridge, or a bridge sub-length, of any length desired and in which the longitudinal edges **12** and **13** of the bridge are formed by the ends of the individual sections.

Each transverse bridge section **11** includes an elongate central truss **14** having opposite ends **15** and **16**, and a pair of U-shaped track hinge pin members **17** and **18**. Each truss end preferably is bifurcated as shown in FIGS. 1 and 6 so that the hinge pin members are connected to the truss for movement relative to the truss about fixed hinge axes **19** and **20**, respectively, disposed transversely

of the length of the truss adjacent the opposite ends of the truss. The trusses preferably are defined by a pair of strips **21** of sheet metal formed into serpentine configuration and welded or riveted together in an arrangement like that shown in FIGS. 1 and 6, the hinge pin members being engaged in aligned holes formed through the strips adjacent their ends. The length of the truss members defines the width of the bridge in its collapsed state.

Each of hinge pin members **17** and **18** includes a pair of parallel legs **23** and **24** which extend from a base return bend section **25** disposed normal to the legs. As shown in FIGS. 2, 3 and 4, the base of each hinge pin members, when the bridge is disposed in its erected state so that the hinge pin members lie outwardly of their trusses, lies above the plane of legs **23** and **24** which extend parallel to the truss below the truss (see FIG. 2). The total length of each hinge pin member is no greater than one-half the distance between hinge axes **19** and **20** along the length of the trusses. The hinge pin members preferably are fabricated of round bar bent into the desired configuration.

Hinge pin members **17** and **18** are components of a pair of articulated tracks **27** and **28**, respectively, which are interconnected by trusses **14** and which lie between longitudinal hinge axes **19** and **20** and the longitudinal edges **12** and **13** of the bridge. Each track is comprised of the corresponding hinge pin members and of a plurality of major and minor links **29** and **30**, respectively. The links preferably are defined by lengths of metal channel, links **29** being identical and formed from larger channel than links **30** which are all identical. Links **30** are sized to nest loosely within links **29** as shown in FIGS. 3 and 6. A hole **31**, sized to make a loose fit with a leg of the hinge pin member, is provided through each flange of each of links **29** and **30** adjacent each end of the link, as shown in FIG. 3; the holes adjacent each end of the link are aligned.

Assume that the bridge is in its erected state shown in FIGS. 1, 2, 3, and 6. A link **29** is disposed between legs **23** and **24** of each hinge pin member **17** and **18** adjacent the base of the hinge pin member with the legs **23** and **24** journalled in the aligned holes of the link. One end of a link **30** is nested within link **29** and journals leg **24**, the other end of link **30** of each bridge section being nested in the inboard link **29** of the next adjacent bridge section to journal leg **23** of the hinge pin member thereof (see FIG. 3). A second link **29** and a second link **30** are similarly mounted to legs **23** and **24** of each hinge pin member adjacent the unconnected ends of the legs so as to be spaced from the links mounted to the same hinge pin member adjacent the truss of the bridge section. The links are disposed on the hinge pin members so that, when the bridge is in its erected state, the web of the channel configuration of each link is disposed upwardly.

Preferably the web of each link **29** at each of its ends is dimpled at **33** (see FIGS. 3 and 6) in the direction of the link flanges. Also, it is preferred that the length of the web of each of links **30** be somewhat less than the length of the link flanges, and that the corners of such flanges adjacent the relieved webs be rounded concentric to the adjacent holes **31** to provide for free hinging movement of links **30** relative to links **29** about hinge pin member legs **23** and **24** for the purposes described below.

Links **29** are maintained in their desired position along legs **23** and **24** by retainer snap rings or spacers **34** engaged in peripheral recesses in the legs, four retainer rings being used with each link **29** as shown in FIG. 6.

A deck plate **36** is mounted to the top of each bridge section **11** over truss **14**; most of the deck plates are shown in phantom lines in FIG. 1 for the sake of clarity of illustration. Preferably the deck plate is made of aluminum grille or expanded metal, rather than metal plate as such, to keep the bridge structure as light in weight as possible. It is also preferred that the trusses, hinge pin members and links be made of aluminum or the like.

The foregoing description has been presented with reference to bridge sections **11**, each of which is identical. The bridge sections are interconnected, as described above, by links **30** which hingably interconnect adjacent sections. It is apparent, therefore that each of legs **23** and **24** define hinge axes **37** and **38**, respectively, about which the sections are movably connected, such hinge axes lying normal to hinge axes **19** and **20** parallel to the common plane of these latter axes.

In bridge **10**, two sections **11** and an inflatable pontoon **40** define a bridge module, an indeterminant number of such modules being used in each bridge or bridge length; it will be understood, however, that a pontoon may be provided for each section **11** or for each three or more sections without departing from the scope of this invention. As shown in FIGS. 2, 4, and 6, each pontoon **40** is comprised of an elongate bag **41** of gas-tight, substantially unexpansible flexible material; in bridges intended for military use, the interior of each bag may be coated with a puncture sealing compound of the type used in self-sealing aircraft fuel tanks or in tubeless automobile tires. A mounting member **42** is connected to each end of each bag and preferably is of L-shaped configuration as shown in FIGS. 2 and 4. The stem of each L is connected to the bag and the leg of each L defines a pair of holes spaced and sized so that the mounting member is engageable with the outer ends of the legs of the hinge pin members of a desired one of the bridge sections of the bridge module of which the pontoon is a component. The pontoon bags are mounted to the bridge so that they extend transversely of the bridge on the side of the trusses opposite from the deck plates. Bags **41** are approximately as long as the bridge is wide.

Each bag is provided with an inflation mechanism which, as shown in FIG. 5, preferably includes a bottle **44** of compressed gas, mounted to the bag so that gas released from the bottle enters and inflates the bag, and a gas-releasing trigger device **45** for each bottle. Each trigger device is operated by a lanyard **46**. Alternately, one larger capacity bottle with a single trigger mechanism may be used.

An inspection of FIGS. 1, 3 and 6 will reveal that links **29** and **30** are so arranged that the links are hingable about axes **37** and **38** from the condition of substantial alignment shown in FIG. 3 only in the direction in which the flanges of the links extend from the link webs. That is, with reference to any given bridge section **11** as illustrated in FIG. 3, the nesting of links **30** in links **29**, especially where the ends of links **29** define dimples **33** as described, prevents links **30** from being moved counterclockwise about leg **24** of the section or clockwise about leg **23** of the adjacent bridge section to which link **30** is connected. Thus, tracks **27** and **28** are stiff to loads applied to the bridge in the direction of the link webs but can deform substantially in response to loads applied in the opposite direction, i.e., the direction in which the link flanges extend from the link webs. This uni-directional stiffness is present in the tracks, rather than between longitudinal hinge axes **19** and **20**, and this fact is most significant to the usefulness of a bridge according to this invention, which usefulness can best be illustrated by the manner in which the bridge is installed.

Prior to use of this bridge, the bridge is stored in a collapsed and rolled-up state shown in FIGS. 4 and 5. In its collapsed state, pontoon bags **41** are deflated and tracks **27** and **28** are disposed over deck plates **36** with the webs of links **29** in abutment with the deck plates. The pontoon bags extend from adjacent the center of trusses **14**, around the ends of the trusses to below the trusses to their opposite ends which are disposed above the deck plates adjacent the center of the trusses. When the bridge is collapsed, the stiffness of the tracks is such that the bridge may be rolled up in such manner that the center portions of the deflated pontoon bags are disposed toward the outside of the roll, as shown in FIG. 1. The lanyard connected to the pontoon at the outer end of the roll extends from the roll for access; the other lanyards are con-

nected, without slack in the lanyards, from their respective trigger devices to a point on the trigger device, for example, of the bridge module next adjacent thereto toward the outer end of the roll.

If it is desired to use the bridge to span a stream **50** (see FIG. 5), the rolled-up bridge is placed on or adjacent the stream bank **51** so that the outer end of the roll is disposed below the bulk of the roll and the end of the roll faces away from the stream. The outer end of the rolled bridge is secured to the near bank of the stream in an appropriate manner. Any lashing which has been applied to the roll to maintain the bridge in its collapsed and rolled state is removed, and the lanyard extending from the roll is pulled to release inflation gas to the pontoon bag nearest the outer end of the roll. As the first bag inflates, it exerts force on the bulk of the roll which urges the roll to unroll. As the bridge unrolls, the remaining lanyards of the gas-releasing trigger device are successively tightened so that the bags are inflated successively proceeding to the inner end of the roll. Successive inflation of the pontoon bags accelerates unrolling of the collapsed bridge across the surface of stream **50**.

As the pontoon bags inflate, more and more force is applied to tracks **27** and **28** by the bags in a manner urging the tracks to hinge about hinge axes **19** and **20** into the position shown in FIG. 2 relative to the bridge trusses. As soon as the bridge is fully unrolled, as described above, these forces are effective to snap the tracks about axes **19** and **20**, thereby to place the bridge in its erect state and to reverse the direction in which the bridge is stiff to applied loads. The far end of the bridge is then suitably secured to the far bank of the stream and the bridge is ready for use by foot and vehicular traffic.

If stream **50** is too wide to be spanned by a single length of pontoon bridge **10**, the installation of a bridge across the stream proceeds as described above, except that the far end of the bridge length extended from bank **51** is suitably moored so as to be held in place along the line of the bridge after the first bridge length has fully erected itself. A second bridge length is then connected to the far end of the erected length and is allowed to erect itself to complete the traverse of the stream, or a second bridge length may be connected to a rolled section and rolled over the first section if the added length is necessary.

From the foregoing, it is apparent that bridge **10**, or any given length thereof, is essentially self-erecting following actuation of the inflation mechanism for the outermost pontoon in the rolled-up, collapsed bridge. Conversely, the bridge is readily collapsed, following deflation of the pontoons, by reversing the above-described erection process; the bridge is not self-collapsing.

Bridge **10** is suited for use by pedestrian and vehicular traffic. Pedestrian traffic conveniently uses the central portion of the bridge defined by deck plates **36**. Tracks **27** and **28** preferably are spaced apart between centerlines thereof a distance equal to the width of the wheelbase of such vehicles as may use the bridge. The loads applied to the bridge by vehicular traffic are distributed along the lengths of the tracks to a plurality of pontoons by reason of the uni-directional stiffness of the tracks. Therefore, a bridge according to this invention may be light in weight and still be capable of supporting substantial locally applied loads.

In a presently preferred bridge **10**, the bridge has a width of six feet between side edges **12** and **13**. Tracks **27** and **28** are each eighteen inches wide, the trusses being thirty-six inches long between longitudinal hinge axes **19** and **20**. Transverse hinge axes **37** and **38** are spaced on four-inch centers, the minimum diameter of the hinge pin members being about three-fourths of an inch. Such a bridge weighs approximately twenty-three pounds per foot of length and, when fitted with one foot by six foot pontoons (inflated) can support applied loads up to two hundred pounds per foot of bridge length. Such a bridge fifty feet long can be stored in a package approximately six feet in diameter and can be handled efficiently by two men since the collapsed bridge can be rolled about as an oil drum may be moved. For convenience in handling, the bridge may be collapsed and rolled up around a core fitted with handles extending axially from opposite sides of the bridge roll.

Bridge **10** also has the feature that it may be assembled readily without the need for special and expensive tools. Hinge pin members may be formed to final configuration prior to engagement of the pins with the trusses. Truss sections may then be bolted or welded to provide a complete cross member. Thereafter, the links are slipped onto the legs of the hinge pin members and appropriate retainer rings are snapped into place. Deck plates may then be connected to the trusses if such plates were not mounted to the trusses at the time the hinge pin members were formed. Pontoons may also then be installed by engaging the pontoon bag mounting members with appropriate hinge pin members and by securing the mounting members in place with suitable retainer rings **42** as shown in FIG. 6.

It is apparent, therefore, that bridge **10** can be assembled from small sub-assemblies and components at a place near the site of use of the bridge so as to be of a length particularly suited for the site, and that such assembly may be performed by relatively unskilled personnel. For this reason, the present bridge is especially suited for use by local Civil Defense, Red Cross and other public and private organizations whose services are rendered in assisting in local disasters such as floods where bridges may be washed out.

Also, since the time required to install the bridge is extremely short because of the self-erecting character of the bridge, the bridge may be used to advantage by the military in appropriate situations.

The present bridge is economical to fabricate, to install, and to maintain because of the relative simplicity of its structure and because of its self-erecting character. The bridge is also efficient in terms of load-carrying capacity.

What is claimed is:

1. A pontoon bridge of an elongate nature comprising a plurality of substantially identical structural sections extending transversely of the bridge, each section having opposite terminal portions and a central portion, each section terminal portion having upper and lower surfaces and defining means for connecting the section to an adjacent section about an intersectional hinge axis extending parallel to the section and arranged so that connected sections are hingable relative to each other about said intersectional axes from a normal relative position only in the direction proceeding away from said bottom surfaces and cannot be moved in the opposite direction significantly beyond said normal relative position, each section terminal portion being connected to its central portion for movement about a hinge axis extending transversely of the section into inverted overlying relation to the central portion of the section, and a plurality of elongate flexible inflatable float units secured one between the opposite ends of each of selected ones of the structural sections to extend across the lower surfaces of the terminal portions thereof.

2. A pontoon bridge according to claim **1** wherein each terminal portion of a bridge section comprises a pair of link members one of which is connected to the section central portion for movement about said transverse axis and the other of which is connected at one end thereof to the one link member for movement relative to the one link member about an intrasectional hinge axis disposed parallel to the section, the other end of the other link being connected to the one link member of the adjacent section for movement about the intersectional axis common to the sections.

3. A pontoon bridge according to claim 2 wherein the link members of each section are arranged so that the link members can be hinged out of substantial alignment with each other about the intrasectional axes only in the direction proceeding away from the terminal portion lower surface.

4. A pontoon bridge according to claim 3 wherein the intrasectional and intersectional axes, respectively, of the terminal portions of each section are coaxial.

5. A pontoon bridge according to claim 3 wherein said link members are of channel configuration and arranged in overlapping relation with the webs thereof defining said upper surfaces.

6. A pontoon bridge according to claim 2 wherein each terminal portion of each section includes two pairs of link members.

7. A pontoon bridge according to claim 2 including a U-shaped rod member at each end of each section central portion, the rod member having parallel legs defining, respectively, the intrasectional and the intersectional hinge axes associated with the corresponding terminal portion and having a base interconnecting the legs and defining the transverse axis between the section central portion and the corresponding section terminal portion.

8. A pontoon bridge according to claim 7 wherein the base of each rod member is parallel to but disposed out of the plane of the legs thereof.

9. A pontoon bridge according to claim 1 wherein the section central portions have lengths selected to space the terminal portions apart transversely of the bridge on centers corresponding to the width of the wheelbase of a vehicle.

10. A pontoon bridge according to claim 1 wherein each section central portion comprises an elongate truss-like structure.

11. A pontoon bridge according to claim 1 including a deck plate mounted to each section central portion for defining an upper central portion of the bridge in an erected state thereof.

12. A pontoon bridge according to claim 1 including selectively operable inflation means associated with each float unit for inflating the same.

13. A pontoon bridge according to claim 12 including means interconnecting the several inflation means for serial inflation of the float units in response to manual operation of the inflation means for the float unit at a selected end of the bridge.

14. A pontoon bridge according to claim 1 wherein the bridge has a collapsed state in which the terminal portions of the several sections are disposed in said overlying relation to the central portions of the sections, the float units are deflated and are folded upon themselves by reason of the relative positions of the terminal and central portions of the several sections, and the bridge is rolled up along its length so that the selected end of the bridge is at the outer end of the roll; and wherein the components of the bridge are cooperatively related so that serial inflation of the float units causes the rolled-up bridge first to unroll by hinging of the sections relative to each other about the intersectional hinge axes, and then to move the section terminal portions about said transverse axes out of overlying relation to the section central portions into non-inverted positions outwardly of the central portions.

15. A pontoon bridge comprising a pair of elongate track assemblies articulated for being rolled up along their length in one direction normal to their length and width but not in an opposite direction, truss members for maintaining the track assemblies in spaced parallel relation and to which the track assemblies are hingably connected along corresponding edges thereof for movement about parallel hinge axes extending longitudinally of the

bridge between first positions disposed outwardly of the truss members and the hinge axes and second positions disposed between the hinge axes, and a plurality of elongate flexible inflatable pontoons disposed transversely of and between the track assemblies along said opposite direction from the track assemblies and connected at opposite ends thereof to respective track assemblies at locations spaced from the adjacent hinge axis.

16. A pontoon bridge comprising a pair of track assemblies defining respective longitudinal margins of the bridge and central structure spacing the track assemblies apart in parallel relation, the track assemblies being connected along their inboard edges to the central structure for hingable movement relative to the central structure about respective ones of a pair of hinge axes extending longitudinally of the bridge, and a plurality of elongate flexible and inflatable pontoons disposed transversely of the bridge at locations spaced longitudinally of the bridge, each pontoon being connected at one end thereof to the outboard edge of one track assembly and connected at its other end to the outboard edge of the other track assembly, each track assembly being articulated about a plurality of hinge axes extending transversely thereof and arranged to be stiff to loads applied thereto tending to deflect the track assembly convex to the pontoons and to be compliant to loads applied thereto tending to deflect the track assembly concave to the pontoons, the track assemblies being movable about the longitudinal hinge axes between a first position outboard of the central structure and a position inboard of said axes in which the track assemblies overlie the central structure and in which the track assemblies are disposed between the portions of the pontoons adjacent the ends thereof and the central portions of the pontoons.

17. A pontoon bridge comprising a pair of elongate track assemblies of predetermined width, central spacer means spacing the track assemblies in parallel relation to each other along the length of the bridge and defining a pair of spaced hinge axes extending longitudinally of the bridge adjacent the opposite edges thereof, means mounting each track assembly to the spacer means for movement relative to the spacer means about the adjacent longitudinal hinge axis between a first position in which the track assembly is disposed outwardly of the adjacent edge of the spacer means and a second position in which the track assembly is disposed inwardly of the adjacent spacer means side edge, the track assemblies being transversely articulated to be stiff to loads applied thereto in one direction normal to the length and width thereof and to be deformable under loads applied in an opposite direction, a plurality of elongate flexible inflatable pontoons disposed transversely of the track assemblies at spaced locations along the lengths thereof, and means for connecting one end of each pontoon to one track assembly adjacent the edge thereof opposite from the adjacent longitudinal hinge axis and for connecting the other end of each pontoon to the other track assembly adajcent the edge thereof opposite from the other longitudinal axis, the pontoons being disposed along said one direction from the track assemblies.

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JACOB L. NACKENOFF, Primary Examiner

U.S. Cl. X.R.

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