Aug. 5, 1969 J. T. GURGANIOUS 3,458,884

DYNAMICALLY BUOYANT PORTABLE BRIDGE

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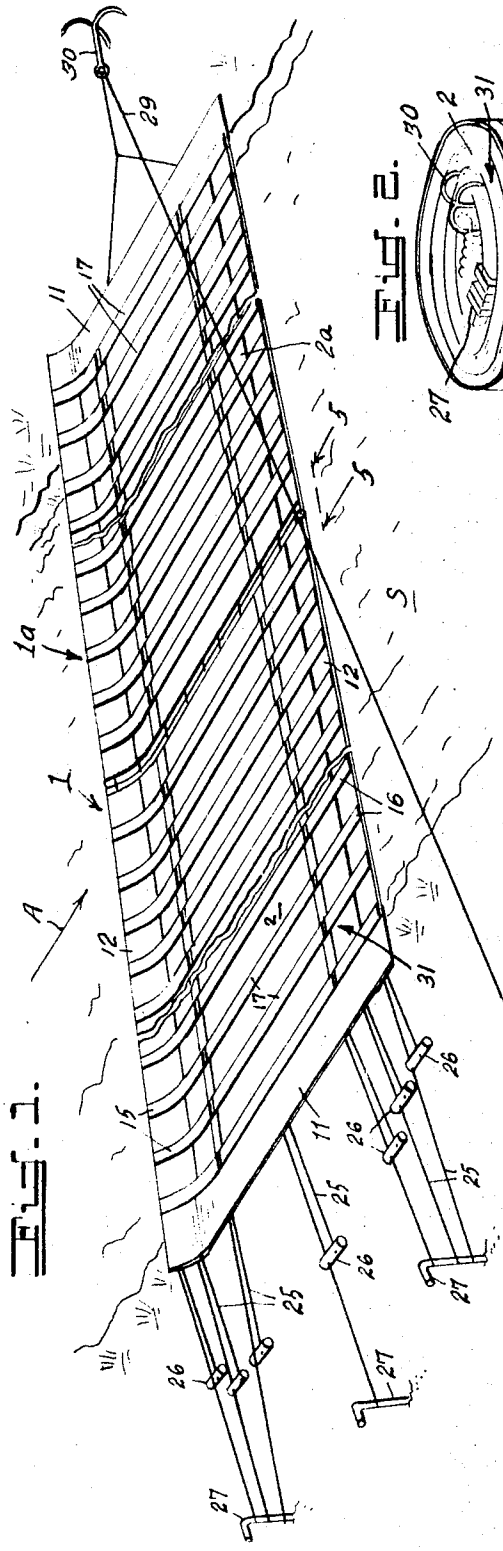


Fig. 1.

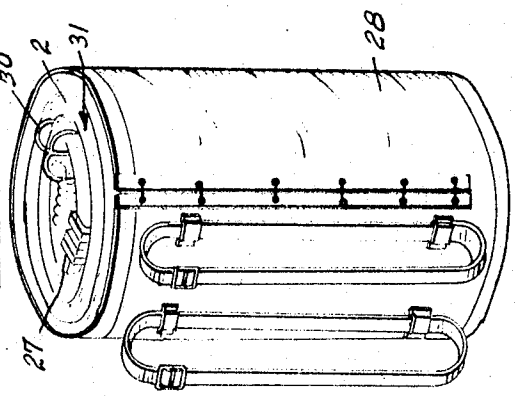


Fig. 2.

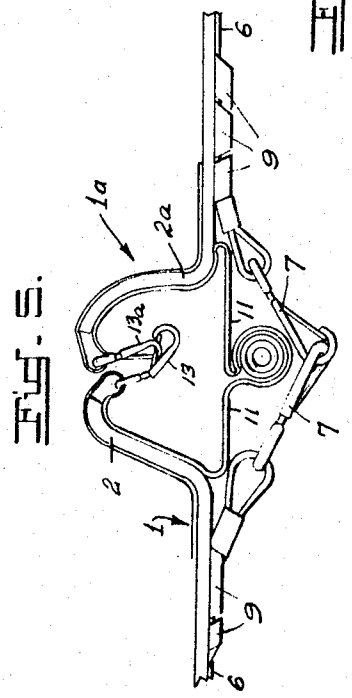


Fig. 5.

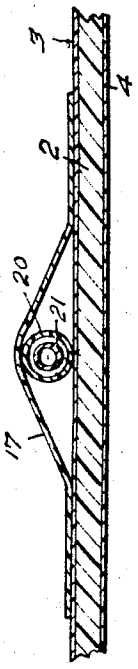


Fig. 6.

INVENTOR,
Joseph T. Gurganious

BY: Harry M. Saragovitz,
Edward J. Kelly & R. P. Gibson
ATTORNEYS.

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Fig. 3.

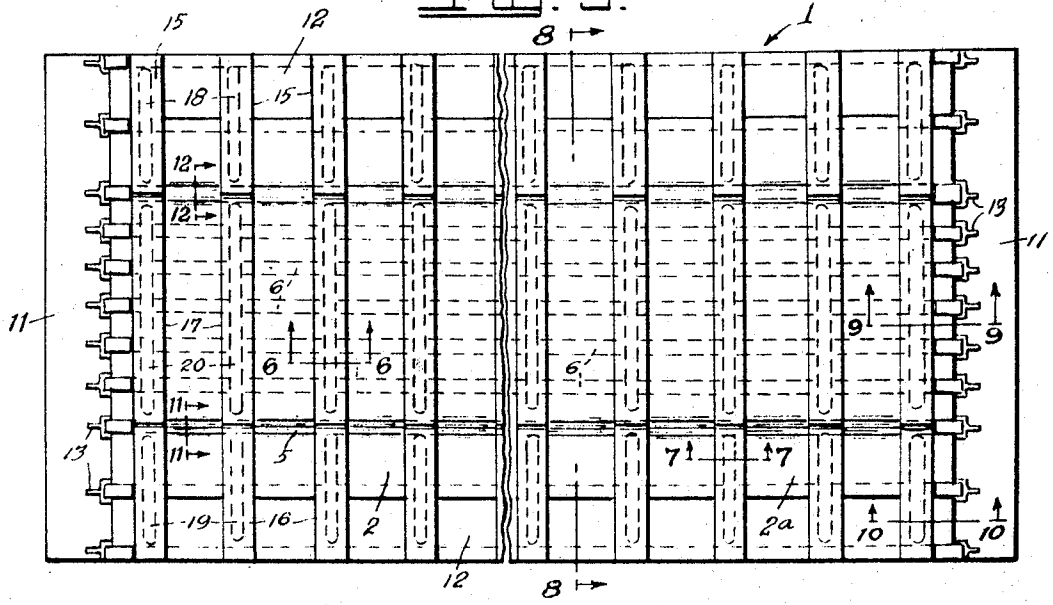


Fig. 4.

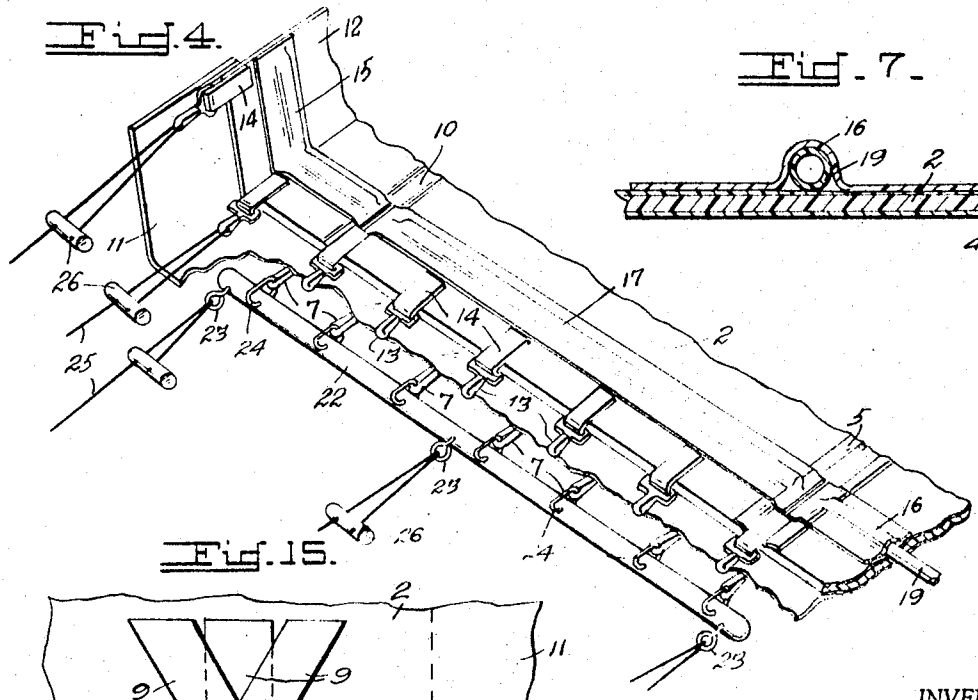
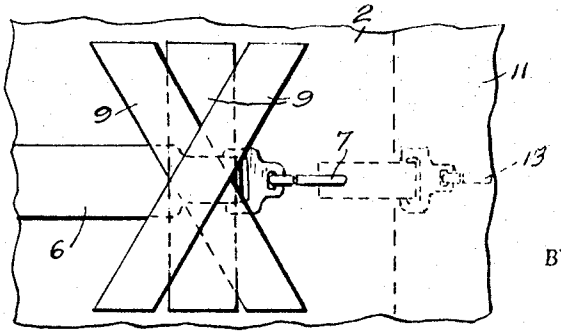


Fig. 7.

Fig. 15.



INVENTOR,
Joseph T. Gurganious

BY: Harry M. Saragovitz,
Edward J. Kelly & R. P. Gibson
ATTORNEYS

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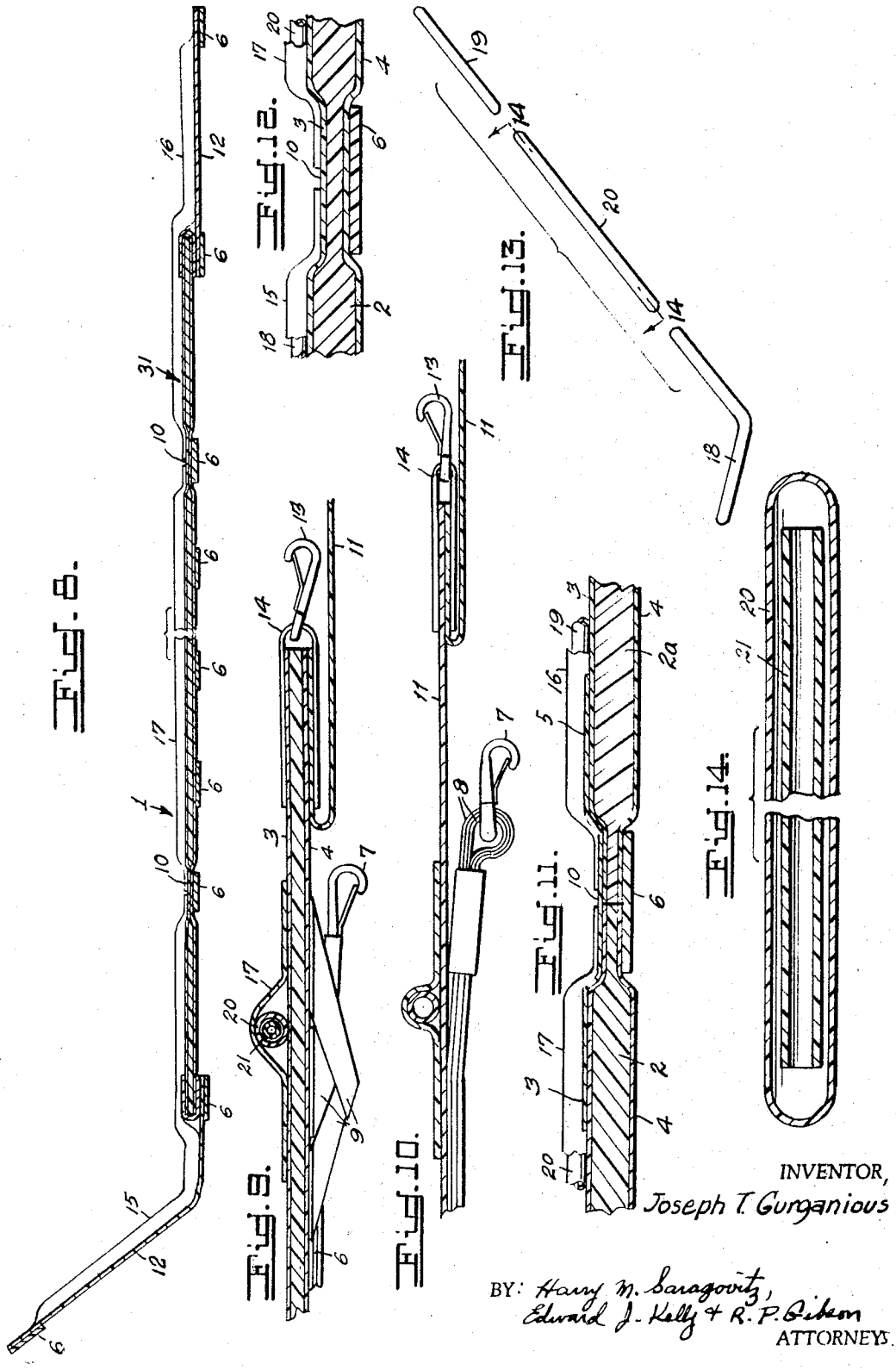


Fig. 8.

Fig. 12.

Fig. 13.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 14.

INVENTOR,
Joseph T. Gurganious

BY: Harry M. Saragovitz,
Edward J. Kelly & R. P. Gibson
ATTORNEYS.

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DYNAMICALLY BUOYANT PORTABLE BRIDGE

Joseph T. Gurganious, Bel Air, Md., assignor to the United States of America as represented by the Secretary of the Army

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U.S. Cl. 14—27 9 Claims

ABSTRACT OF THE DISCLOSURE

A flat, flexible self-buoyant foot bridge unit consisting of a laminated blanket rigidized laterally by spaced flexible ribs and supported by longitudinally arranged straps. Snap hooks at each end of the straps provide means for tying the unit on each side of a stream and a row of snap hooks attached to the blanket edges provide means for attaching additional units to accommodate wider streams.

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

There has long been a need for portable bridges that can be carried by troops to cross streams. Existing portable bridges, including bridges having pontoons are too heavy to be transported by personnel and therefore must be transported by vehicles which cannot be used in certain areas such as jungles, soft ground, etc.

Further, a portable bridge is needed that can be quickly assembled and disassembled.

Existing portable bridges are often of a definite length and cannot reach across the body of water to be crossed or are too long for smaller streams.

The present invention is designed to overcome the aforesaid difficulties by providing a portable bridge consisting of a light laminated blanket of buoyant material which is rigidized by laterally spaced buoyant tubes. The tubes on the upstream side are bent upwardly to prevent water from engulfing the blanket. As a pedestrian travels along the surface of the blanket the area directly under him creates water displacement buoyancy and dynamic buoyancy supporting forces when it momentarily presses into the water surface. The blanket surface returns to its floating configuration as the pedestrian moves along, shedding any water accumulated on it.

This dynamic support results from a combination of (1) the water displacement buoyancy caused by the temporary trough like depression under the moving load, (2) the water mass inertial resistance to the bridge surface being pressed into the water, and (3) the surface behavior factor over that area of water surface which is held intact by the bridge surface.

Each unit is a bridge within itself and can be rolled into a shoulder pack to be carried by one man. The units can be rapidly connected into a bridge of any desired length.

It is a principal object of this invention to provide a self-buoyant, portable bridge unit which can be easily and quickly deployed for crossing streams and as quickly removed and repacked for a shoulder carrying pack by one man.

It is another object to provide a bridge unit to which additional units can be attached to accommodate crossing of bodies of water of varying length.

A further object is to provide a portable bridge unit consisting of a laminated blanket, rigidized by lateral tubing and supported by longitudinally arranged load straps.

A still further object is to provide a portable bridge made of buoyant and flexible material.

These and other objects and advantages of the present invention will be fully apparent from the following description when taken in connection with the annexed drawings, in which:

FIG. 1 is a somewhat schematic perspective view of the portable bridge of this invention as deployed across a stream and showing two units thereof as connected end to end;

FIG. 2 is a perspective view of one of the bridge units as rolled into a shoulder pack;

FIG. 3 is a top plan view of one of the bridge units;

FIG. 4 is a detail perspective view of one end of a bridge unit with fabric cut away to show the manner in which a tie down bar is used;

FIG. 5 is an enlarged end view looking in the direction indicated by arrows 5—5 of FIG. 1 and illustrating the manner in which bridge units are connected;

FIG. 6 is a cross sectional view taken along line 6—6 of FIG. 3;

FIG. 7 is a cross sectional view taken along line 7—7 of FIG. 3;

FIG. 8 is a cross sectional view taken along line 8—8 of FIG. 3;

FIG. 9 is a cross sectional detail taken along line 9—9 of FIG. 3;

FIG. 10 is a cross sectional detail taken along line 10—10 of FIG. 3;

FIG. 11 is a cross sectional detail taken along line 11—11 of FIG. 3;

FIG. 12 is a cross sectional detail taken along line 12—12 of FIG. 3;

FIG. 13 is a perspective view of the stiffener tubes and their alignment as used to rigidize the blanket;

FIG. 14 is a sectional view of the center stiffener tube and taken along line 14—14 of FIG. 13, and,

FIG. 15 is a fragmentary view of a method of securing one of the snap hooks to a supporting strap.

With reference to the drawings in detail, in which like numerals indicate like parts throughout the several views, the reference character 1 designates generally a bridge unit of the invention.

Bridge unit 1 consists of a laminated blanket indicated generally by 31 and made of one quarter inch sheet (or sheets) of a buoyant material 2, for example, a thick closed cell polyethylene foam between an upper sheet 3 and a lower sheet 4, both of which may be fabricated from a material, such as, for example, a three ply, nylon, reinforced, high density polyethylene film, each ply consisting such as for example, two sheets of high density polyethylene film with a one quarter inch mesh nylon open scrim laminated between (construction not shown).

The bridge unit 1, for foot bridge use, is preferably seven by fifteen feet, although if used for small vehicles, it can be made wider.

If a sheet of foam 2, wide enough to fabricate a bridge of seven feet wide is not obtainable, a two foot strip can be butted to the edge as shown in FIG. 11, the extra strip being indicated by 2a.

When one or more lengths of foam 2 are to be butted, a connector strip 5 of a material similar to sheets 3 and 4 is centered over the seam, as seen in FIG. 11. The strip will be integrally and completely heat sealed to the laminated blanket 31. The additional length of foam is indicated by 2a.

Laminated blanket 31 is supported by load straps 6 extending longitudinally of the bridge unit 1 and spaced laterally from each other and being fabricated of a similar material as sheets 3 and 4. These straps 6 are best seen in FIGS. 3 and 8. There are eleven as shown, but the

number may vary as is expedient and are heat sealed to the lower sheet **4**.

Each load strap **6** is provided with a swivel type snap hook **7** at each of its ends. These hooks **7** are attached to the strap ends by at least two thicknesses of tape **8** as seen in FIG. 10. The tape **8** is heat sealed to its load strap **6**.

Hooks **7** are further reinforced by placing additional strips of tape **9** arranged laterally and diagonally as seen in FIG. 15 and heat sealed to the underside of blanket **31** as shown.

Blanket **31** is indented longitudinally as at **10** whereby the blanket **31** defines center, upstream and downstream portions (see FIG. 8) and to provide easy folding of the blanket **31** when rolling it into a pack.

Blanket **31** is provided with end flaps **11** and side curtains **12** both of which are approximately twelve inches wide. End flaps **11** are of a single piece of fabric similar to sheets **3** and **4** and extend the entire width of blanket **31** plus the side curtains **12** and are heat sealed at each end of blanket **31** at their underside thereof. Side curtains **12** are similarly heat sealed to the underside of each of blanket **31** and to the underside of end flaps **11** providing means of closure when two or more bridge units are used.

For purposes of interconnecting additional bridge units connector snap hooks **13** are provided. These hooks are arranged in a row at each end of blanket **31** and the manner in which they are applied is best seen in FIGS. 9 and 10. A loop of tape **14** is heat sealed to the top and undersides of blanket **31**, the hook **13** being held by the loop as shown. in FIG. 10 the connector hook **13** is shown similarly attached to an end flap **11**.

There are therefore two rows of connecting hooks **7** and **13** top and bottom of blanket **31** and there will be an equal number of hooks on the top as well as on the bottom, all hooks being of the spring snap, swivel type. Both rows of hooks **7** and **13** are in alignment in the longitudinal axis, the under row being spaced rearwardly of the top row and both rows of hooks **7** and **13** and the end flaps **11** are for purposes of interconnecting bridge units, to be described later.

The bridge unit blanket **31** is rigidized laterally by flexible and buoyant tubing of a material equivalent to Lexan, a trademark name for General Electric Company's polycarbonate thermoplastic. The arrangement of the tubing is best seen in FIGS. 3 and 13 and the manner of rigidizing is as follows: rows of laterally extending, longitudinally spaced pockets are heat sealed to the upper sheet **3** and side curtain **12** and each row of pockets consists of two end pockets **15** and **16** and a center pocket **17**. Each end pocket **15** and **16** extends the width of its corresponding upstream and downstream portion and side curtain **12**, while each center pocket extends the width of the center portion, as best seen in FIG. 3. In each pocket there is contained a flexible tube, the end tubes being indicated by **18** and **19** and the center tube **20**, see FIG. 13.

Tubes **18**, **19** and **20** are rounded and closed at their ends so as to not damage the fabric of blanket **31** or the pockets **15**, **16** and **17**.

All tubes **18** are shown bent upwardly in FIG. 1 and are designed to hold side curtain **12** upwardly so that this side of the bridge being located upstream when in use, to prevent water from engulfing the bridge.

Center tube **20** is composed of an outer tube **20** and inner tube **21** for purposes of extra rigidity, and to conserve weight since the center portion of the bridge between indentations **10** will constitute the bridge's pathway.

Once the tubes **18**, **19** and **20** are placed in pockets **15**, **16** and **19** respectively, the ends of these pockets will be closed by heat sealing, thus completely preventing any entrance of water in the pockets, as well as adding to the buoyancy of the blanket **31**.

Means of tying a bridge unit to each shore of a body of water are provided and consists of an aluminum tie-down bar **22**, closed and rounded at each end. In case only one unit is used, two tie-down bars will be necessary, one at each end of unit **1** (see FIG. 4).

Bar **22** is provided with three eye bolts **23** evenly spaced along the bar and with spaced rings **24** to which connector hooks **7** are attached.

If more than one unit is used, there will be a tie-down bar only at the shore ends of the bridge.

The manner in which a bridge unit, or units, are secured is illustrated in FIG. 1.

Tie-down ropes **25** are looped through eye bolts **23** on tie-down bar **22** and attached to a rope tensioner block **26**. The other end passes through tensioner block and is tied to stakes **27** which are pushed into the ground.

Each end of the bridge is similarly secured before the bridge is ready for use.

While only three stakes are shown, other stakes may be added for firmer securement of the bridge. Ropes **25** can also be tied to snap hooks **7** as well as the rings **24**, or even to hooks **13**.

FIG. 2 shows one of the bridge units **1** rolled up in a shoulder pack **28** to be carried on the back of one man.

Each bridge unit **1** will be supplied with a casting rope **29** of approximately one hundred and fifty feet and one grapnel hook **30**.

Operation

For crossing a stream not wider than fifteen feet only one bridge unit **1** will be necessary.

The unit is unrolled from the pack and placed on the shore at right angles to the stream with the side having the bent up end tubes **18** facing the upstream side. The flow of the current is indicated by arrow A (FIG. 1) and the stream by S.

Each end of the blanket **31** will have one tie-down bar **22** attached and the casting rope is tied to the tie-down bar **22** nearest the water's edge.

The casting rope is now passed through the eye of the grapnel hook **30** to a point to permit throwing the grapnel hook **30** to the opposite shore as far as possible to anchor rope **29** to the far shore.

Tie-down ropes are attached to the snap hooks **7** and the rings **24** of the tie-down bars **22**.

While one man feeds the bridge into the water another pulls on the rope **29** until the leading end of the bridge has reached the opposite shore.

Now the tie-down ropes **25** on the nearest end of the bridge are secured to stakes **27** which are pushed or driven into the ground at enough points to secure the bridge.

While the first man continues to pull on rope **29**, the second man crosses the bridge, with stakes **27** in his hands, to the far shore where he attaches the stakes to tie-down ropes on that end and pushes them into the ground.

Then each man tightens the tie-down ropes **25** on his respective side and regulates the tension of the ropes **25** with the tensioner blocks **26**. The bridge is now ready for crossing by troops. It may be necessary to tension ropes **25** after each crossing.

For bodies of water having a width greater than the length of one bridge unit, it will be necessary to deploy more than one unit, and the manner of connecting the units is seen in FIG. 5, wherein an additional unit is designated by **1***a*.

Again, all curved sides of the units will face upstream.

First the two units are arranged edge to edge and hooks **7** on each unit are snapped together. The two mating end flaps **11** on the unit ends are rolled together as shown and the roll will have a tendency to rest on the lower row of hooks **7**. Now the top row of hooks **13** are snapped together. The two units **1** and **1***a* are now connected and are watertight. The roll of end flaps **11** are held between the two rows of hooks **7** and **13** of the ends and are prevented from unrolling.

The deployment of more than one unit to the far shore is about the same as that of the single unit, except

that if it is too far for the grapnel hook **30** to be thrown by hand, one man must swim to the far shore carrying extra stakes **27** with him.

When the bridge has served its purpose it is retrieved and in order to remove the bridge the last man across will slant the stake, to which the casting rope has been previously tethered, approximately half way towards the stream, then remove all other stakes on that side. After crossing, the stake will be removed by a pull on the casting rope **29**. The bridge is then pulled from the stream and any additional units separated and rolled into packs.

Before rolling into a pack, the blanket unit is folded at indentations **10** making a compact strip of three layers. The strip is then rolled and wrapped by pack **28**.

While the bridge of this invention is primarily designed for crossing relatively narrow bodies of water, crossing a boggy or muddy area is also possible; it will not always be possible to retrieve the bridge since it will have been pushed too far into the mud.

Auxiliary equipment such as the ropes, stakes and grapnel hook can be carried in the pack **28** or by another man.

When the bridge has been folded for rolling into a pack, bent tubes **18**, being flexible, will flatten out as the blanket is rolled.

As an aid in night crossing, strips of white adhesive tape may be placed over the center pockets **17** to reflect light from the stars or moon thus enabling the troops to follow the "path" or center of the bridge (tape not shown).

Since the side curtains **12** are highly flexible as well as tubes **18**, the side curtains will rise and fall with the swell of the water. The indentations **10** permit both sides of the bridge to bend as the weight of troops on the center portion push this portion into the water, thus forming a trough, the bridge reassuming its flat shape after the troops have crossed.

For repair of torn fabric, straps, etc., a roll of adhesive tape will also be carried. Stakes can be replaced with sticks and the ropes by vines or even the tubing replaced by sticks.

While only a preferred form of the invention is shown and described, other forms of the invention are contemplated and numerous changes and modifications may be made therein without departing from the spirit of the invention as set forth in the appended claims.

What is claimed is:

1. A portable, flexible foot bridge unit for crossing relatively narrow bodies of water comprising, a laminated blanket having longitudinally extending, laterally spaced indentations whereby said blanket defines center, upstream and downstream portions; end flaps sealed to each end of said blanket; a side curtain sealed to said upstream and downstream portions; longitudinally spaced, laterally extending rigidizing means sealed to the top of said blanket; longitudinally extending, laterally spaced load supporting members sealed to the underside of said blanket; identical means attached to each end of said load supporting members and to each end of said blanket whereby said bridge unit may be detachably connected to a similar bridge unit, and means connected to each end of said foot bridge unit or to the end units when said units are connected in multiples, for tethering said foot bridge unit, or connected units, to opposite shores of the body of water.

2. A foot bridge unit as claimed in claim **1** wherein said laminated blanket comprises a first sheet of flexible buoyant material, a second sheet of flexible buoyant material secured to the top of said first sheet and a third sheet of flexible, buoyant material secured to the bottom of said first sheet, said second and third sheets having a thickness less than that of said first sheet.

3. A foot bridge as claimed in claim **1** wherein said rigidizing means comprise rows of longitudinally spaced, laterally extending pockets sealed to the top of said laminated blanket and said side curtains, each row of said pockets including a center pocket extending the width of said center portion and a pocket extending the width of said upstream and downstream portions and their corresponding side curtains and a flexible tube of buoyant material in each of said pockets, said center pockets being in lateral alignment with said pockets on said upstream, downstream and side curtains, said flexible tubes in all of said pockets being sealed and rounded at their ends.

4. A foot bridge unit as claimed in claim **1** wherein said load supporting members comprises a series of longitudinally extending, laterally spaced, straps of a material similar to said top and bottom sheets of said laminated blanket, each said strap extending the length of said blanket and being sealed to the bottom side thereof.

5. A foot bridge unit as claimed in claim **1** wherein said identical means attached to said ends of said load supporting members and to the end of said blanket comprise a loop of tape sealed to each end of each said member and a laterally spaced row of loops of tape sealed to each end of said blanket and a snap hook carried by each loop on said members and said blanket.

6. A foot bridge unit as claimed in claim **1** wherein said means for tethering said bridge unit to opposite shores of a body of water comprises a tie-down bar having a series of spaced rings for attachment to said identical means on said load supporting members and a series of eye bolts for attachment to tie down lines.

7. A foot bridge unit as claimed in claim **3** wherein each said pocket on each said side curtain and the corresponding upstream or downstream portion extends from the outer edge of the side curtain and terminates adjacent the edge of said center portion.

8. A foot bridge unit as claimed in claim **3** wherein said tubes in said pockets of one of said side curtains and the upstream portion of said blanket are bent upwardly to hold said side curtain upwardly to prevent engulfing of said blanket by the current of a stream.

9. A foot bridge unit as claimed in claim **3** wherein said tube in said center portion pockets comprise an outer tube and an inner tube, said outer tube being sealed and rounded at each of its ends.

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JACOB L. NACKENOFF, Primary Examiner