

May 27, 1969

B. GRANGE ET AL

3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Filed April 5, 1967

Sheet 1 of 6

FIG.1.

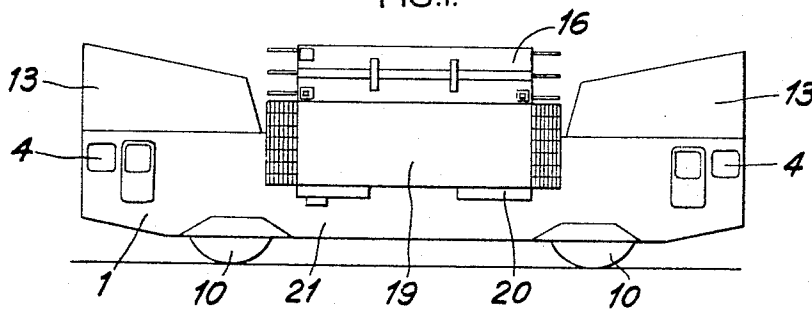


FIG.2.

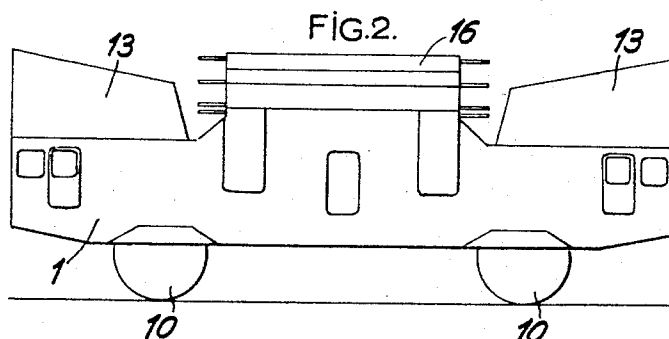


FIG.3.

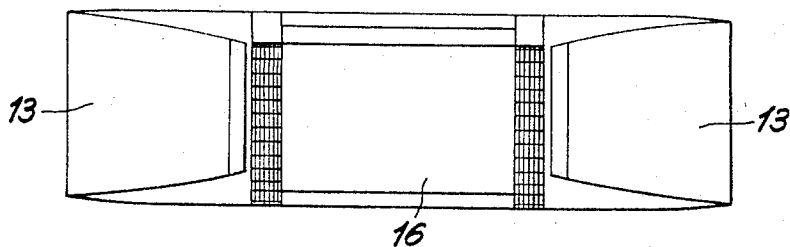


FIG.4.

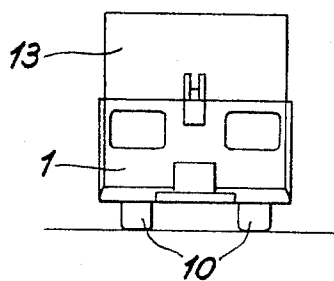
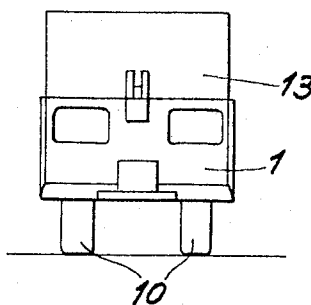


FIG.5.



May 27, 1969

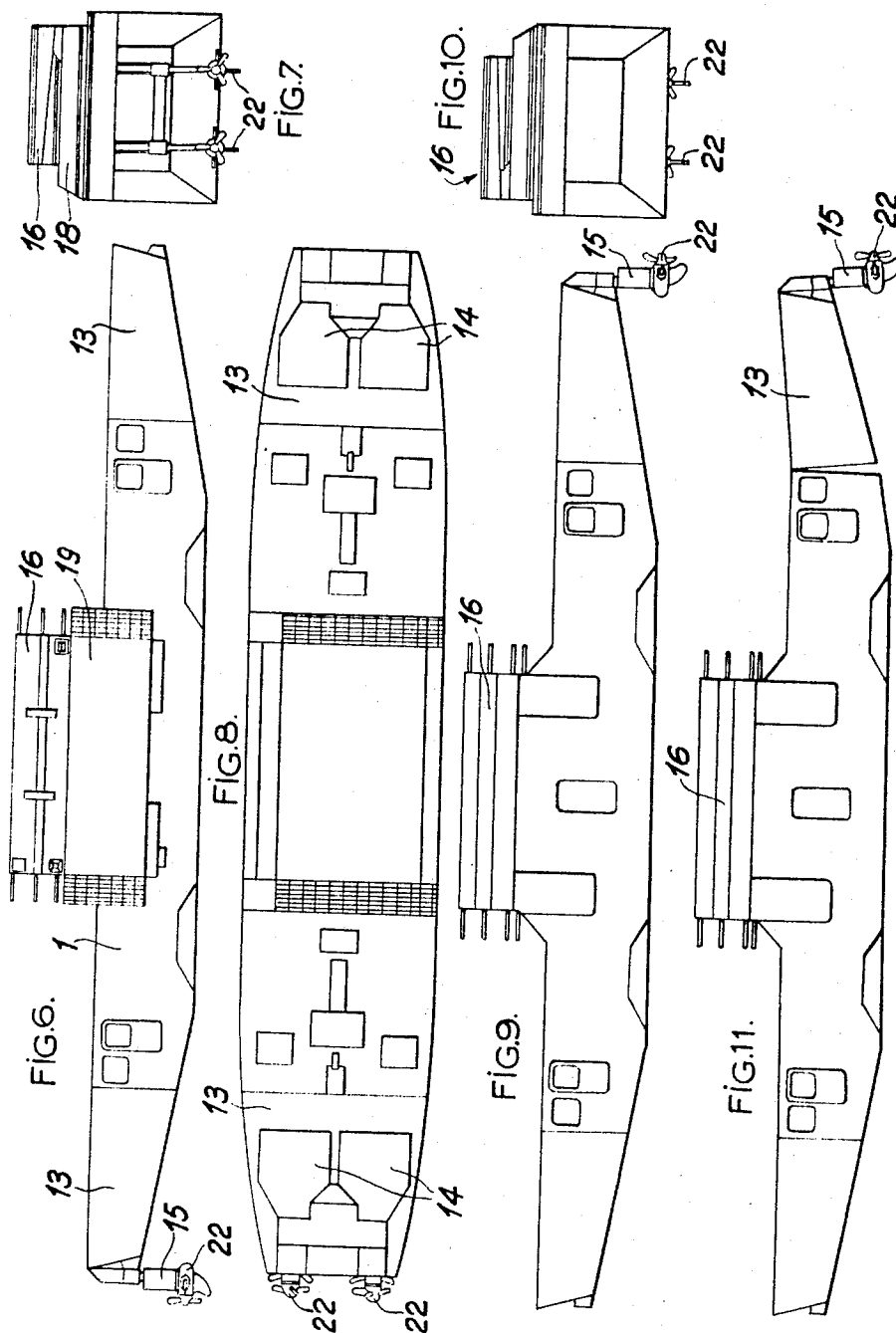
B. GRANGE ET AL

3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Filed April 5, 1967

Sheet 2 of 6



May 27, 1969

B. GRANGE ET AL

3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Filed April 5, 1967

Sheet 3 of 6

FIG.12.

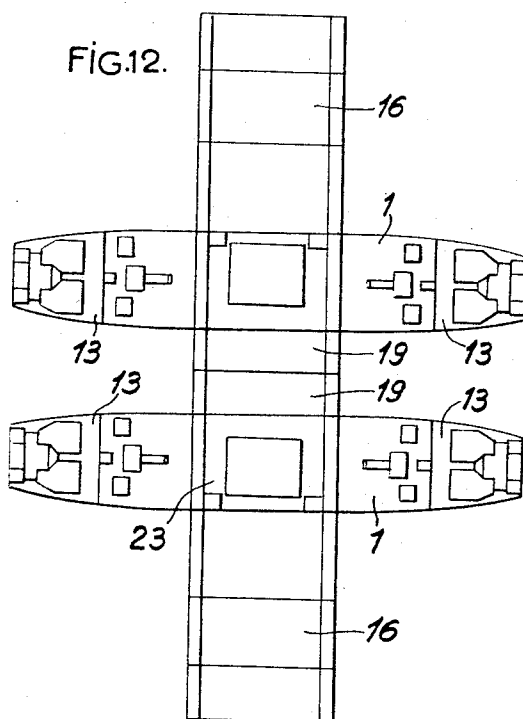


FIG.13.

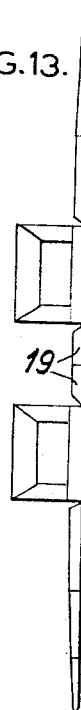


FIG.14.

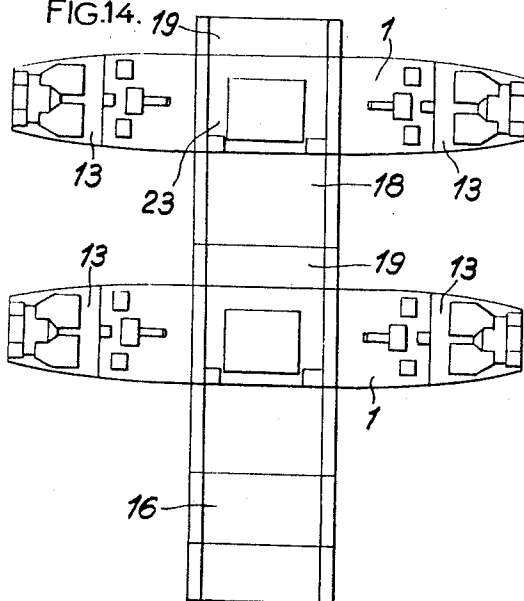
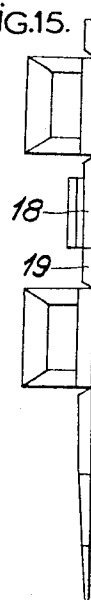


FIG.15.



May 27, 1969

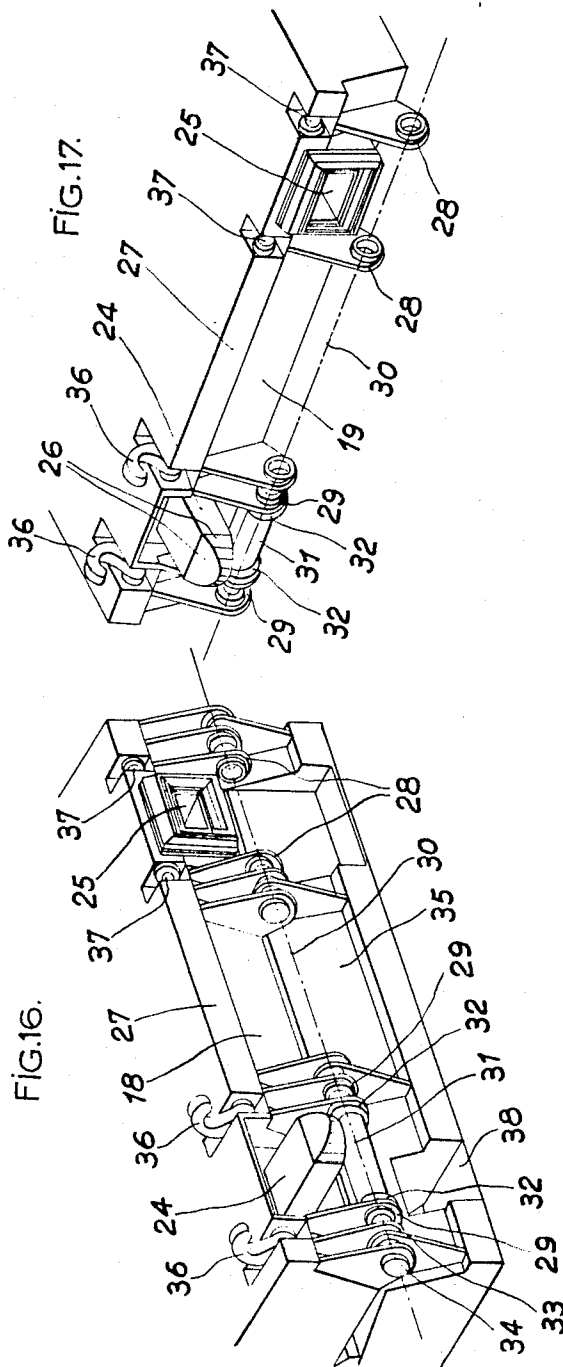
B. GRANGE ET AL

3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Filed April 5, 1967

Sheet 4 of 6



May 27, 1969

B. GRANGE ET AL

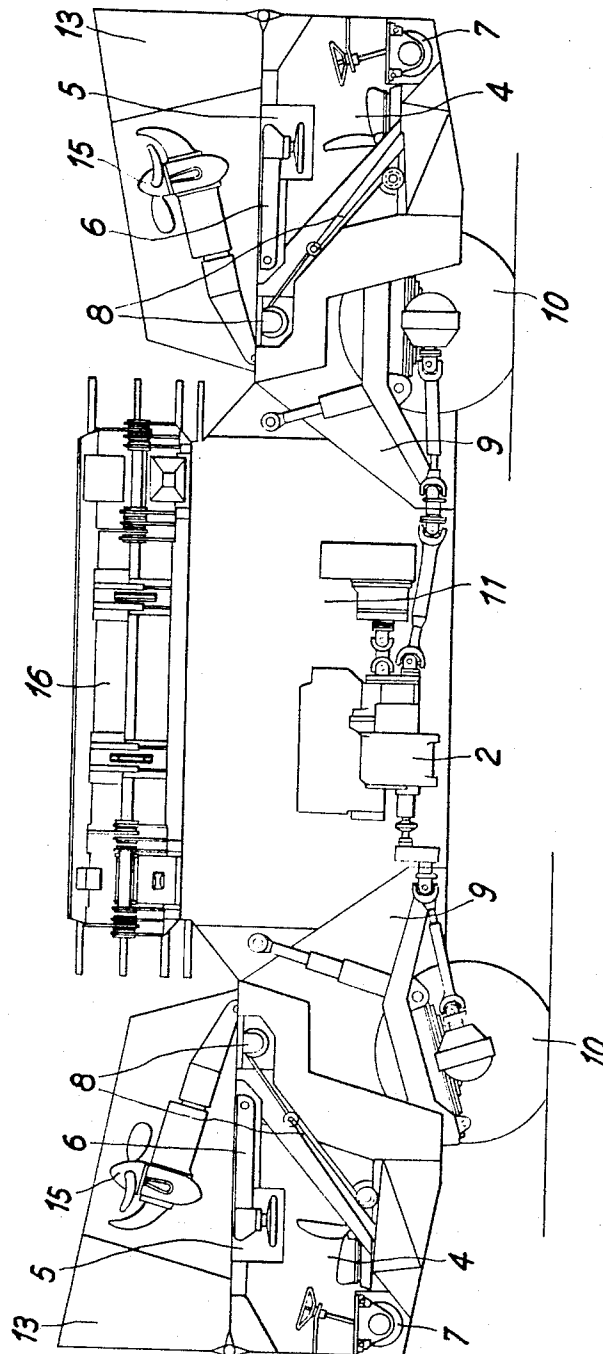
3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Filed April 5, 1967

Sheet 5 of 6

FIG.18.



May 27, 1969

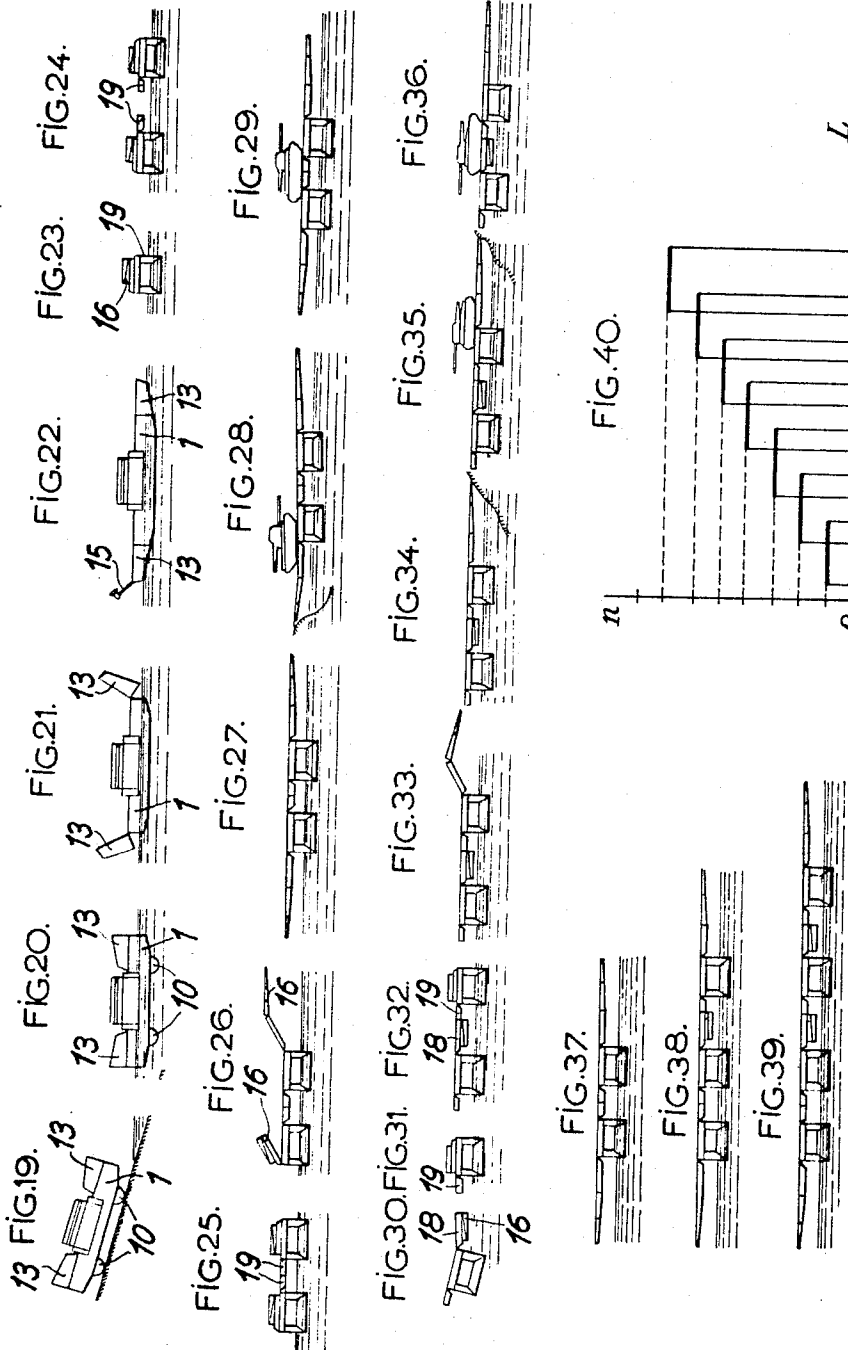
B. GRANGE ET AL

3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Filed April 5, 1967

Sheet 6 of 6



1

2

3,446,176

AMPHIBIOUS CROSSING EQUIPMENTS

Bernard Grange and Charles-Jean Long, Angers, Bernard Jugue, Puteaux, and Roger Mallet, Le-Mesnil-Saint-Denis, France, assignors to French State, represented by the Minister of Armed Forces, Ministerial Delegation for Armament, Technical Direction of Land Weapons, Technical Experiment Establishment of Angers, Paris, France

Filed Apr. 5, 1967, Ser. No. 628,707

Claims priority, application France, Oct. 5, 1966, 78,893

Int. Cl. B60f 3/00

U.S. Cl. 115—1

6 Claims

ABSTRACT OF THE DISCLOSURE

Equipment for crossing waterways comprises a series of identical amphibious vehicles each of which is completely symmetrical with reference to a transverse plane of symmetry and comprises a central water-tight cell having retractable road wheels and a driving compartment at each end and caissons articulated to opposite ends of the cell so as to fold upon top of the cell for road travel and to fold down to form extension of the cell and provide additional flotation for water navigation. Each of the caissons is provided with water propulsion means which can preferably be rotated in all directions for directional control.

Hitherto constructed or designed amphibious crossing equipments are characterized by many drawbacks, some of which are listed hereinafter:

The group of equipments constituting a crossing system consists of several types of vehicles or crafts, whereby these equipments are extremely expensive, complicated and vulnerable.

A long period is necessary before these equipments can be put into actual service, due either to the various operations required before they are set afloat, or to the operations to be performed for fitting ramps or spans, or assembling the crafts or vehicles with one another.

The length of the ramps used with the equipments are not sufficient, so that the access to certain shores is subordinate to a preliminary grading or preparation of these shores. The track width provided by these equipments is not sufficient and the hourly quantity of equipments set ready for actual service is not efficient. The bulky shape of the bottoms, hulls or like bodies of the floating supports produces a considerable drag, thus reducing to abnormally low values the speed on water or requiring an abnormally high specific power rating. The manoeuvrability on water is inadequate, thus making maneuvering under load difficult and dangerous, notably in case of violent currents.

The draught of the floating supports is abnormally high and the equipment cannot float and therefore be assembled on relatively shallow bodies of water or moderately sloped banks or shores.

The longitudinal inertia of the floating surface of the floating supports is too low, thus developing in a continuous system a lack of transverse stability preventing the use of a bridge thus constructed in case of violent currents.

It is the chief object of the present invention to provide an improved amphibious crossing equipment intended for use by armed forces and designed with a view to avoid the drawbacks broadly set forth hereinabove which characterize known equipments.

To this end, this crossing equipment is characterized by the provision of a self-powered unit equipped

with two land driving cabs and two navigation cockpits.

This unit can be used either in a continuous crossing system or in a discontinuous crossing system, without requiring any appreciable modification for changing from one mode of operation to another. It can be used in either direction and therefore does not require any backing of the vehicles during the crossing from one shore to the other.

The time necessary for putting the equipment into service is relatively short, under both continuous or discontinuous conditions, due to the following characteristic features:

No preliminary work is required on the shore or bank of the body of water to be crossed.

Each vehicle comprises autonomously all the elements necessary for constituting a raft or a bridge, including the approach-ramps and exit-ramps.

The two-way road characteristic of the separate and nautical vehicle intended for a raft made of a plurality of vehicles is such that, notably in the case of a raft, turning manoeuvres on a river or like stream can be avoided.

The approach ramps are so designed that any preliminary work on the shores can be dispensed with, and the considerable track width available for the passage of crossing vehicles affords a high vehicle output per hour.

The elongated shape of the hull increases the transverse stability of the floats used in a continuous system and reduces on the other hand to a substantial degree the drag produced by each vehicle.

The displacements in shallow bodies of water are permitted by partially lifting the water propelling units, and in this case three-fourths of the propellers are immersed, thus affording a sufficient manoeuvrability on water.

In order to afford a clearer understanding of this invention and of the manner in which the same may be carried out in practice, reference will now be made to the accompanying drawings illustrating diagrammatically by way of example typical forms of embodiment of the present invention. In the drawings:

FIGURE 1 is a lateral elevational view of the vehicle in its land position with reduced ground clearance;

FIGURE 2 is a side elevational view showing the opposite side of the vehicle with a greater ground clearance;

FIGURE 3 is a top plan view corresponding to FIGURES 1 and 2;

FIGURES 4 and 5 are end views corresponding respectively to FIGURES 1 and 2;

FIGURE 6 is a side elevational view of the same vehicle in its navigation position;

FIGURE 7 is an end view of the same vehicle;

FIGURE 8 is a plan view thereof;

FIGURE 9 is a side elevational view showing the same vehicle as seen from the opposite side with respect to FIGURE 6;

FIGURE 10 is an end view corresponding to FIGURE 9;

FIGURE 11 shows in a manner similar to FIGURE 9 the vehicle position required for navigating on shallow waters;

FIGURES 12 and 13 show on a smaller scale, respectively in plan view and end view, a raft consisting of two vehicles assembled side by side;

FIGURES 14 and 15 show similarly a raft consisting of a different assembly of the same vehicles;

FIGURE 16 shows in perspective view and on a larger scale the configuration of one of the elements of the vehicle for coupling same with a corresponding element, shown in FIGURE 17, of a similar vehicle;

FIGURE 18 shows on a relatively large scale and in

fragmentary longitudinal section the series of vehicles in road driving condition;

FIGURES 19 to 22 show diagrammatically on a smaller scale and in transverse views various steps of the launching of an amphibious vehicle;

FIGURE 23 illustrates the same vehicle afloat, as seen from one end;

FIGURES 24 to 27 show in end views the coupling of two vehicles for constituting a raft provided with two opposite ramps;

FIGURES 28 and 29 show the use of this raft for transferring a load from one shore to another;

FIGURES 30 to 34 illustrate the combination of two vehicles to constitute a raft having only one ramp;

FIGURES 35 and 36 illustrate the use of the raft of FIGURE 34 for transferring a load from one shore to another;

FIGURES 37 to 39 show the method of constituting a raft consisting of three or four vehicles from a two-vehicle raft of the type shown in FIGURE 27, by the addition of successive vehicles;

FIGURE 40 is a diagram corresponding on a smaller scale to the diagrams of FIGURES 37 to 39, to show the number of vehicles to be used for crossing a given body of water.

The amphibious vehicle providing a two-way track according to this invention comprises:

A body 1 constituting the main structure of the vehicle and the main portion of the hull. This body 1 comprises as shown in FIGURE 18 a central compartment 11 enclosing a reversing driving mechanism 2, two end compartments 4 for driving the vehicle on land, recesses 5 for receiving the collapsed nautical or navigational control cockpits 6, towing accessories 7 and mooring accessories 8. Recesses 9 for receiving the raised and retracted trains of wheels 10 in the navigation position are provided between the central compartment 11 and the end compartments 4.

Two identical caissons 13 constitute in the navigation position the endmost portions of the hull. In the navigation position these two caissons 13 constitute to this end extensions of the body 1 by acting as fore-peaks. They are folded against the body 1 in the land or road position, for example, by means of hydraulic actuators and comprise recesses 14 adapted to receive the propelling units 15.

A ramp 16 is folded in the road or land position on the body 1 between the two fore-peaks 13, above the central compartment 11. This ramp 16 consists of a plurality of hingedly interconnected elements of which a main element 18 is pivoted to the body 1. These elements in their spread condition constitute the ramp in the service position; the main element 18 and the other elements folded thereon constitute a span element 17 used in the intermediate section of a raft or bridge.

A connecting element 19, constituting a span element and adapted to be assembled either with the corresponding connecting element 19 of another vehicle or with the main element of the ramp 16 of another vehicle, is folded in the road or land position as shown in FIGURE 1 and stowed in a recess 20 provided to this end in the lateral wall 21 of body 1.

This vehicle is characterized by the following features:

The general design and disposal of the main component elements of the vehicle afford a transverse plane of symmetry extending at right angles to the longitudinal median plane of the body;

The possibilities of displacing the vehicle in translation and of steering same on land, on and off the road or on water, are the same in either direction;

The vehicle is equipped with two driving cabs 4, two nautical control cockpits 6, two trains of wheels 10, two identical power units 15 and a reversing driving mechanism 2 permitting the same operation in either direction;

A two-way platform may be obtained by combining two vehicles assembled through their connecting elements

19 (see FIGURES 12 and 13) or through the connecting element 19 of one vehicle and the main element 18 of the ramp of the other vehicle (FIGURES 14 and 15);

An amphibious bridge may be constructed by associating a raft as shown in FIGURE 34 and a number of additional vehicles sufficient to cover the complete width of the body of water to be crossed. The couplings required therefor are made between the main element 18 of ramps 16 of one of the vehicles and the connecting element 19 of the next vehicle;

For a given over-all width on the road, the equipment is characterized by a relatively streamlined hull. This arrangement ensures a reduced drag of the raft and a low specific drag of the bridge, in conjunction with a very satisfactory transverse stability;

The equipment can float, be maneuvered and assembled in relatively shallow water after partially raising the fore-peaks 13 carrying the propeller bodies 22, as shown in FIGURE 11;

The amphibious raft can be displaced in all directions by taking advantage of the maximum thrust developed by the propelling units 22, due to their great number, their relative arrangement, their driving system and the possibility of swivelling them in all directions;

The vehicle comprises both a relatively broad track 23 permitting high crossing speeds and considerable vehicle outputs per hour, and a ramp 16 of a span sufficient to reach most shores without requiring any preliminary work thereon;

Both trains of wheels 10 can be locked on the body 1 in two positions, i.e., a road position (FIGURES 1 and 4) and an off-the-road position (FIGURES 2 and 5) characterized by a greater ground clearance;

In order that the raft or bridge constituted by a plurality of coupled vehicles form a continuous girder and that the rigidity thereof be sufficient to avoid excessive immeresions when embarking loads or during their transfer, the connecting element 19 and the main element 18 of ramp 16, when assembled with each other, are each rigidly assembled with the corresponding bodies 1 through mechanical or hydraulic means;

The coupling of two adjacent vehicles by attaching their connecting elements 19 to each other, or the connecting element 19 of one vehicle to the ramp 16 of the other vehicle, is ensured by adequately arranging the ends of the connecting element 19 and of the main element 18 which will be described hereinafter with reference to FIGURES 16 and 17. In order rapidly and safely to assemble the vehicles to be coupled, these must be centered with respect to each other during their mutual approach, and to constitute a continuous girder therewith means must be provided for locking the two assembled elements at the end of their approach movements.

The above-defined centering action is obtained by means of male members 24 engageable in corresponding female recesses 25. The taper given to the side faces of these male members 24 and female recesses 25 is sufficient to facilitate the centering operation. When properly centered the two elements to be assembled are in mutual contact through their bearing faces 27. Lugs 28 coaxially engage corresponding straps 29 along the axis 30. The hydraulic lock 31 consisting of a double-rod and double-acting hydraulic actuator is secured by means of clamps 32 to the aforesaid straps 29. The locking action is obtained by causing the two rods 33 to emerge along the axis 34 of the hinged mounting of the second element 35 of ramp 16 on the main element 18. The locking action at floor level is obtained by means of hooks 36 engaging cross rods 37. A modified form of embodiment (not shown) may consist in replacing the manual or mechanical locking system comprising the hooks 36 and cross-rods 37 by a hydraulic locking system based on the same principle as the one described hereinabove, and remote-controlled by the driver or pilot.

It should be noted that as the crafts or vehicles are

identical, the only requirement to be met when coupling a plurality of them is that the various component elements of the coupling systems have a general symmetry in relation to the axis formed by the intersection of the median plane of the track with the joint plane. To permit the complete unfolding of the ramp 16 in case of its use as an end ramp, the recess 38 is provided in the second element 35 for receiving the male member 24.

The two connecting elements 19 are assembled with each other in the same manner as an element 19 is assembled with an element 18, as described hereinabove with reference to FIGURES 16 and 17.

The construction of a raft and the embarking of a vehicle are performed in the manner shown in FIGURES 15 to 29 by carrying out the following sequence of operations:

A separate amphibious vehicle is driven into the water in the road position (FIGURES 19 and 20);

Both trains of wheels 10 are retracted, and the two fore-peaks 13 are tilted down as shown in FIGURE 21 and locked to the body 1 (FIGURE 22), these two steps taking place simultaneously, if desired;

The propelling units 15 are tilted to their operative positions and locked to the fore-peaks 13 (FIGURES 22 and 23);

Two separate amphibious vehicles are moved towards each other so as to lie alongside each other (FIGURE 24), and they are subsequently coupled by means of their connecting elements 19 (FIGURE 25) which are locked with respect to their corresponding body 1;

The ramps 16 of the raft thus constructed are unfolded (FIGURE 26) and the assembly is propelled back to the embarkment shore (FIGURE 27);

The load is taken on board the raft (FIGURE 28) and ferried across the body of water to the opposite shore (FIGURE 29).

FIGURES 30 to 36 illustrate an additional possibility of constructing a raft (or the abutment-pier of an amphibious bridge) permitted by the junction of the connecting member 19 of one of the amphibious vehicles with the main element 18 of the ramp 16 of the other amphibious vehicle. The great amplitude of the permissible angular movements of the ramp 16 and connecting element 19, which results from the specific arrangement of these elements, permits of performing the coupling operation without difficulty in spite of the considerable transverse slope imparted to the hull or body of the vehicle of which the ramp 16 is folded (FIGURE 30).

A raft or bridge comprising N amphibious vehicles according to this invention can be assembled from a raft of N-1 vehicles. It is only necessary to couple a separate vehicle by means of its connecting element 19 with the main element 18 of the outermost ramp 16 of the raft already assembled on the body of water. FIGURES 37 to 39 show the manner in which a raft comprising three or four vehicles can be assembled from the two-vehicle raft of FIGURE 37.

Two procedures may be adhered to for constructing a bridge, namely either forming the initial abutment-pier consisting of a two-vehicle raft and subsequently completing the bridge from said initial abutment-pier, by successively assembling separate vehicles, or constituting under shelter a plurality of rafts consisting each of a reduced number of vehicles, and subsequently assembling these rafts with each other on the crossing site.

FIGURE 40 illustrated in diagrammatic form the span or crossing possibilities of a bridge consisting of 2, 3 . . . n vehicles according to the invention. The number n of vehicles is plotted in ordinate and the corresponding width L of the body of water adapted to be spanned is shown in abscissa. Considering the great length of the end ramps with respect to the modulus of the bridge, the diagram

proves that in 50% of the cases requiring the crossing of a body of water by means of a continuous system two possibilities are available for the user: utilizing n or n+1 separate amphibious vehicles.

Although the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims,

What we claim is:

1. Crossing equipment consisting of a series of identical amphibious vehicles each of which is completely symmetrical with reference to a transverse plane of symmetry and comprises a water-tight cell, two trains of wheels for driving the vehicle on land, said wheels being retractable into said cell and being disposed partly in front of and partly behind said plane of symmetry, two driver's compartments at opposite ends of said cell for driving said vehicle on land in either direction, two caissons articulated on opposite extremities of said cell for movement between a first position in which they are folded over the cell for travel on land and a second position in which they are folded down to form fore and aft extensions of said cell and are partially immersed for navigation on water, and water propulsion means mounted in said caissons.

2. An amphibious vehicle according to claim 1, in which the water propulsion means are mounted on the caissons for rotation in all directions to provide directional control.

3. An amphibious vehicle according to claim 1, comprising a ramp of wide span comprising a main element articulated to one side of the cell and foldable over the cell in the space between said caissons and secondary elements hinged to the extremities of the preceeding element and foldable over the preceeding element between the caissons for travel, and a connecting element articulated to the opposite side of the cell in the space between the two caissons and folded down in a position along side the cell for travel.

4. An amphibious vehicle according to claim 3, in which the main element of said ramp as well as said connecting element comprise means for connection with a corresponding element of a like vehicle to connect two vehicles together.

5. An amphibious vehicle according to claim 4, in which said connecting means comprises means for aligning two elements to be connected and means for securing said elements together.

6. An amphibious vehicle according to claim 1, in which each of said caissons includes a navigational control cockpit.

References Cited

UNITED STATES PATENTS

2,981,221	4/1961	Gillois et al.	115—1
3,269,349	8/1966	Gehlen	115—1

FOREIGN PATENTS

79,401	10/1962	France.
		(Addition to No. 1,292,204)
922,145	3/1963	Great Britain.

OTHER REFERENCES

German printed application No. 1,103,793; March 1961; Scheffter.

ANDREW H. FARRELL, *Primary Examiner*.