

United States Patent

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[56] **References Cited**

UNITED STATES PATENTS

2,213,611	9/1940	Ronning	115/35
2,917,019	12/1959	Krueger	115/35
3,187,704	6/1965	Shatto et al.	114/144

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[54] **WATER PROPELLER DRIVE FOR AMPHIBIOUS VEHICLES**
4 Claims, 6 Drawing Figs.

[52] U.S. Cl. **115/35,**
114/144 B

[51] Int. Cl. **B63h 25/42**

[50] Field of Search **114/144 B;**
115/35, 12

ABSTRACT: Water propeller drive for amphibious vehicles with pairs of bow and stern propellers each associated with a corner of the vehicle body and arranged in bights of the body that are adapted to the current conditions, with steering means for adjusting the directional effect of the four propellers that permit steering of all propellers or a selected number of them optionally by means of one or two operating devices for which purpose suitable coupling and uncoupling means are provided in the steering transmission components.

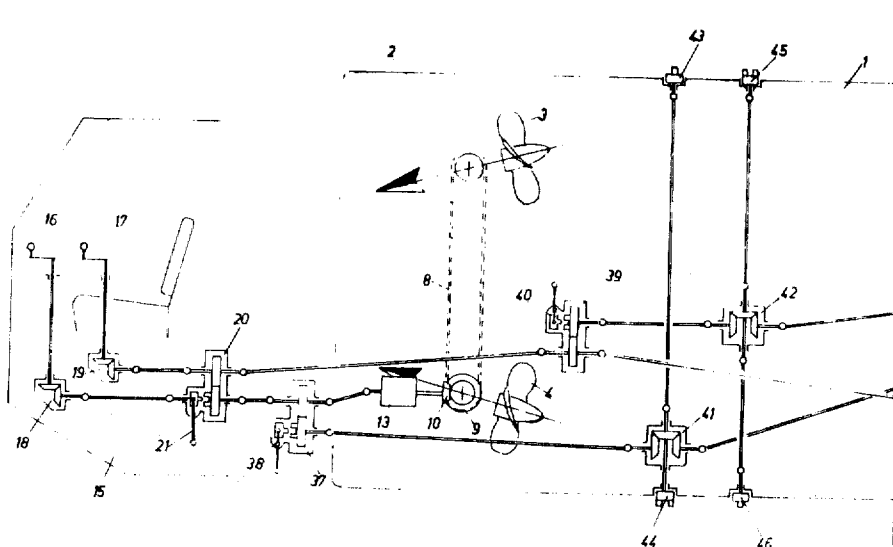
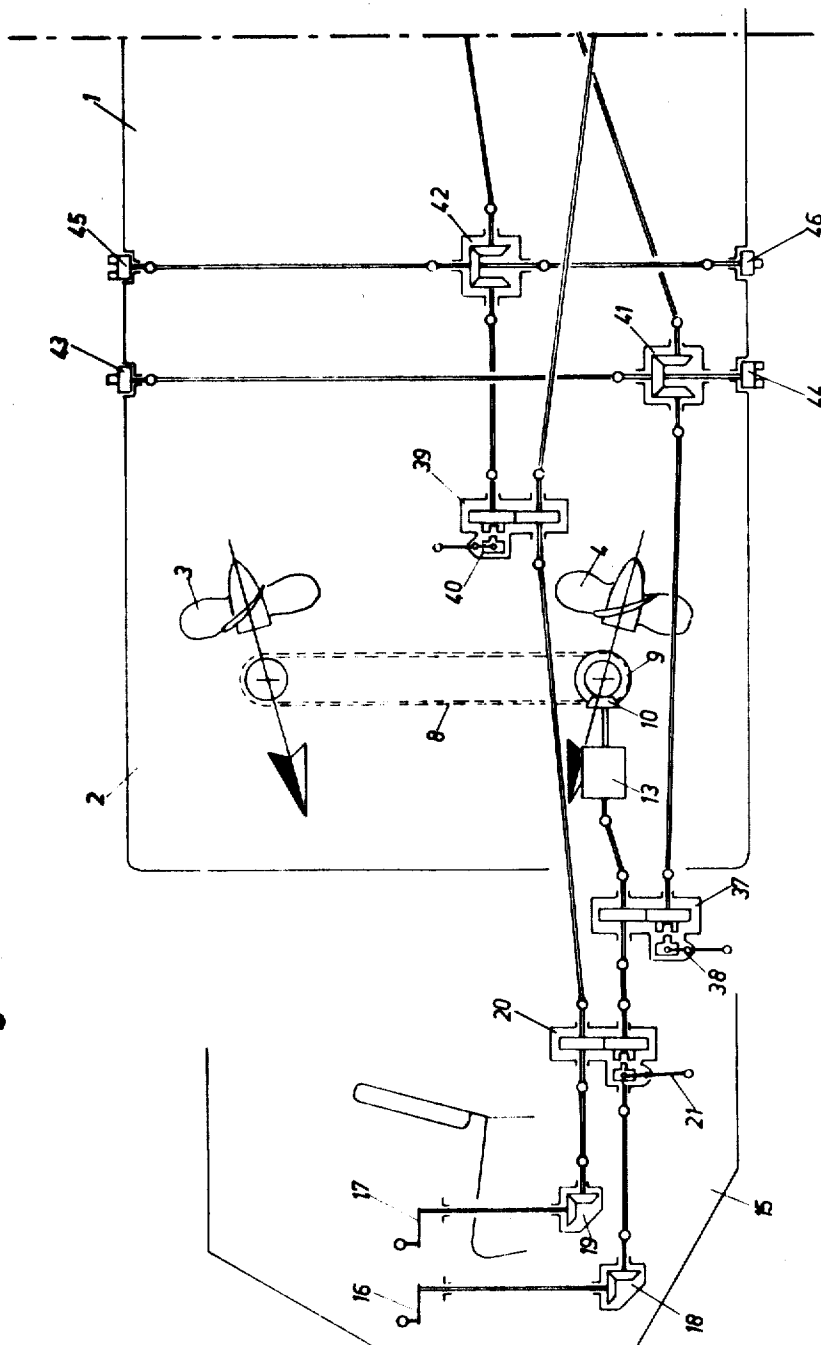


Fig. 1



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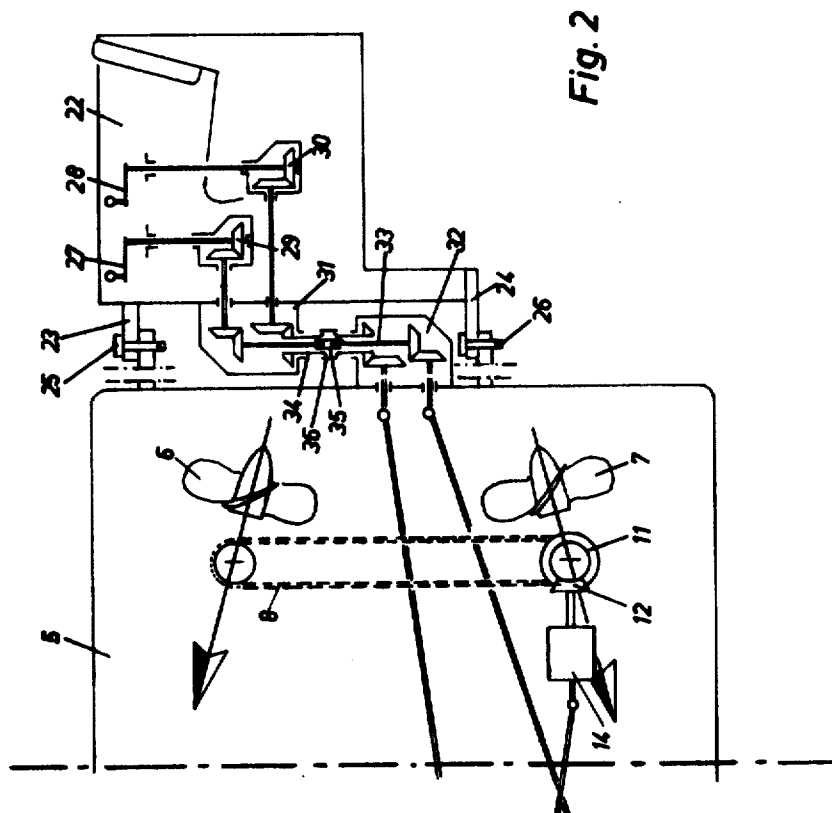


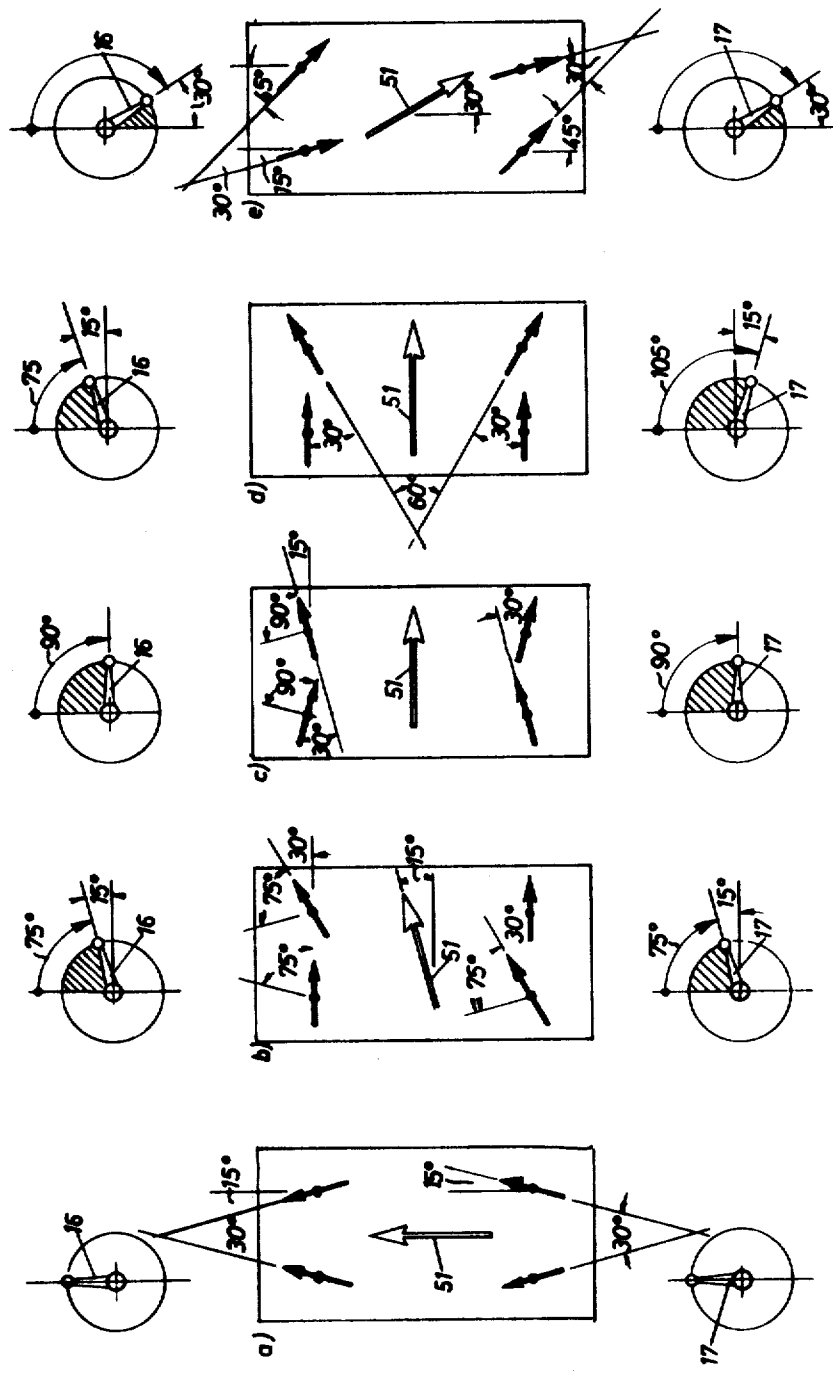
Fig. 2

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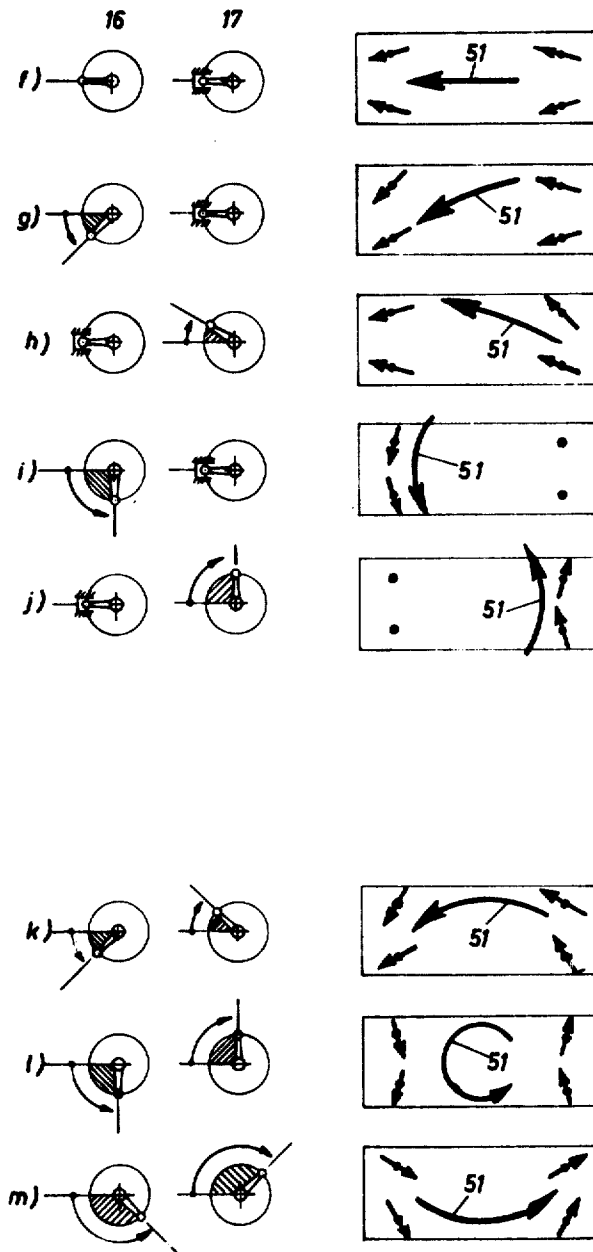
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Fig. 3



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Fig. 4



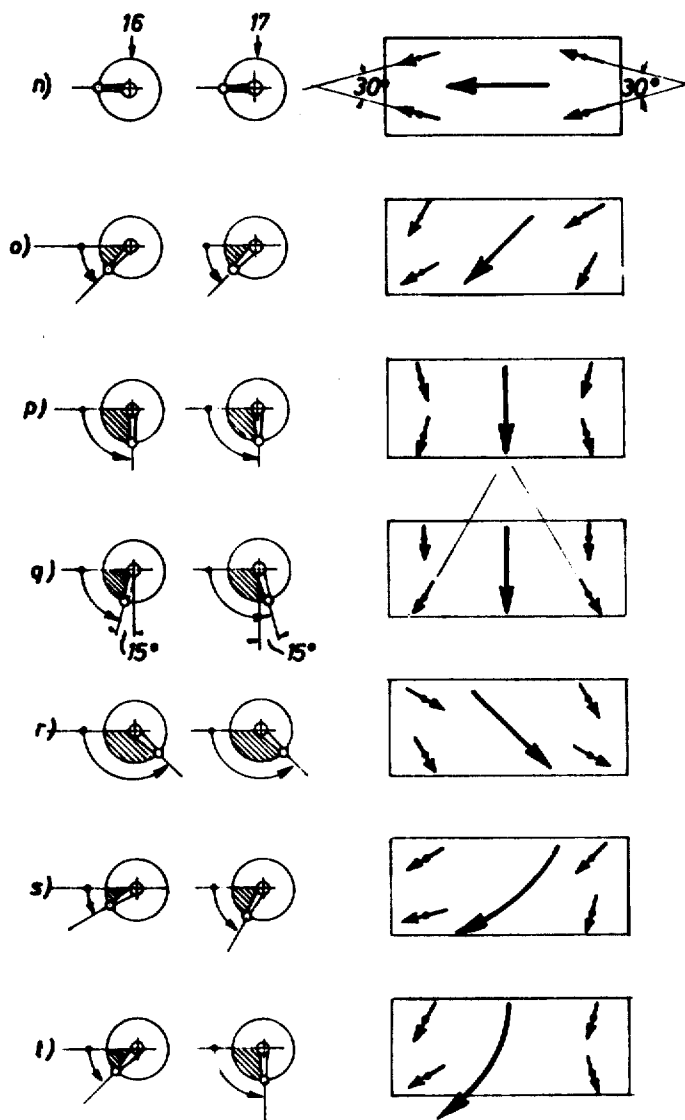
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Fig. 5



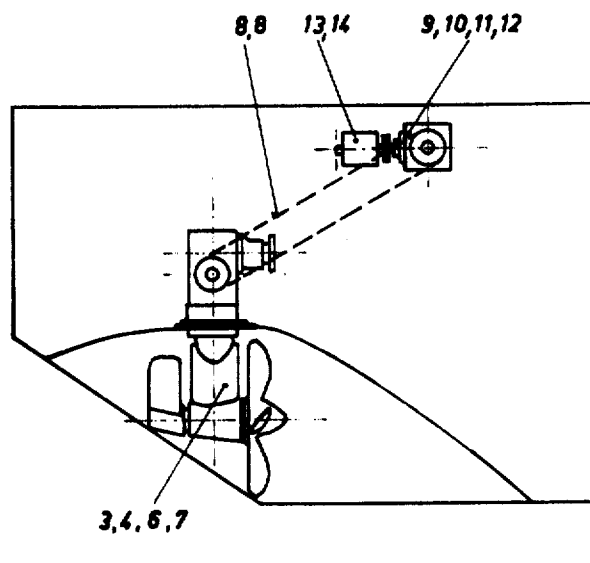
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Fig. 6



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WATER PROPELLER DRIVE FOR AMPHIBIOUS VEHICLES

BACKGROUND OF THE INVENTION

The invention is concerned with the construction of the water propeller drive for amphibious vehicles. More in particular the invention is intended to solve the numerous problems which are posed by the propeller drive of amphibious vehicles when subjected to the different tasks discussed below.

Amphibious vehicles must cope with the operational requirements arising on land within reasonable limits, but above all they must carry out the numerous tasks which are involved in water operation. They are deployed as single vehicles in the form of an individually operating ferry, they must be deployed as landing bridges, they must be adapted for assembly to constitute floating bridges to travel on still or flowing bodies of water, and it must also be possible to deploy them as double or multiple unit ferries for negotiating primarily flowing bodies of water. Especially the deployment in flowing bodies of water requires an extremely great measure of maneuverability.

For the different possibilities of deployment mentioned above there is a basic requisite that the vehicle can be driven forward, backwards and sideways and that it can turn in place or in situ. This applies particularly for deployment in rapidly flowing waters.

SUMMARY OF THE INVENTION

The solution of the different problems is based on the fundamental recognition, that the required maneuverability can only be obtained if the vehicle is equipped with four outboard drives, such as propellers, two of each of which are mounted in pairs in the front and in the rear on the vehicle body. In this connection it must be kept in mind that the arrangement of the four drive means is such that they do not adversely affect or interfere with one another during the different operations. Accordingly they are arranged in bights in the vehicle body that are adapted to the current conditions in all directions of travel. Furthermore, to the extent that they are provided with downwardly projecting parts, they are pivotable about a horizontal axle, in order to provide for the necessary clearance for the vehicle during travel on land.

Essentially the drive means may be rudder propellers or also Voith-Schneider drives, or as the case may be, also high or low pressure turbines having turning nozzles.

The most advantageous current conditions for forward travel are obtained when the bow propellers are disposed divergently and the stern drives convergently. On the other hand, for reverse travel the stern drives must be diverging and the bow drives or propellers converging.

During lateral travel the influence of the bow or stern drive means that are disposed side by side is particularly strong. It has been found that the most favorable degree of effectiveness of the drive means during lateral travel is obtained when the propellers that are forward in the direction of travel diverge by about $2 \times 30^\circ$ relative to one another, while the rearwardly located propellers (downstream drives) are disposed parallel to one another.

The noted divergence required for the forward drive means and the convergence of the rearward drive means indicates that the vertical pivot axes of the two bow drives as well as of the two stern drives must be coupled with one another, for which purpose one each steering means is provided for the pair of bow drive means as well as for the pair of stern drive means.

During forward or reverse travel and propulsion by all four drive means the steering movements can be effected either with the forward or with the rearward pair of drive means.

For very acute steering movements such as are required above all in flowing bodies of water and for turning of the

vehicle in situ the bow drives, as well as also the stern drives, must be utilized for steering the vehicles. For this purpose the steering devices for the two pairs of drive means must be coupled with each other in such a manner that they turn in opposite directions. For this the steering movement can be effected by one of the existing steering means and with a steering lever (single hand operation). Thus the vehicle can turn in situ while employing the full thrust of the drive means.

For true lateral driving or for oblique driving forward or in the reverse, the two pairs of drive means must permit of steering in the same sense in front and at the rear. With these steering movements the pairs of drive means in front and at the rear must be operated with two separate steering devices or units. They may not be coupled with one another.

Finally, it is necessary because, as already mentioned above for true or pure lateral driving that the upstream drives must operate divergently by about $2 \times 30^\circ = 60^\circ$ and the downstream drives must operate parallel in which connection any mutual effects must be eliminated as much as possible, to provide for a relative movement within the coupling of the steering devices of the forward and rearward drives.

It may be assumed that the vehicles which are concerned here are regularly equipped with two drive means or units. For that event a collective transmission means is provided by way of which the drives can be optionally driven by one or both driving units. Furthermore, the operation may in this connection be effected optionally with drive means acting separately upon the front and rear drives and with two separate output controls or they may be coupled together with a single output control.

The steering arrangement for the drive means must accordingly have means for steering each individual drive means, for steering the front pair of drive means and the stern pair of drive means as well as coupling means for coupling together and releasing these different steering means. Furthermore, the coupling arrangement is constructed in such a manner that in the coupled condition of the forward and the stern drives a limited relative setting is possible between them, which can be controlled manually in a manner known per se or automatically.

For steering of a plurality of vehicles coupled together, transmission means for the operation of all steering systems from one vehicle are provided.

If the vehicle has a second operating position or platform at the stern of the vehicle in addition to the driver's cabin, transmission means are provided for actuating the steering from the driver's cabin as well as also from the stern position.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features of the invention and details of the advantages obtained thereby will become apparent from the following description of an embodiment of the subject of the application illustrated as an example in the attached drawings and also the steering possibilities and steering phases illustrated in which:

FIG. 1 shows the bow area of the vehicle where the schematically indicated driver's cabin is turned by an angle of 90° with respect to the adjacent illustration of the vehicle body;

FIG. 2 illustrates the stern area of the vehicle with a stern operating platform which is also turned through an angle of 90° with respect to the vehicle body to simplify the illustration;

FIG. 3 provides a picture concerning the steering movements for lateral travel;

FIG. 4 is a summary of the different movements of the different coordinated movements of the drive means and of the steering elements in the driver's cabin for single hand operation;

FIG. 5 is an over all view for two hand operation of the vehicle steering means for travel in water, and

FIG. 6 shows one of the drives of the vehicle that may be in the form of an outboard drive or a rudder propeller which is at the lower end of a vertical shaft, where a steering rudder may also be located.

DESCRIPTION OF THE INVENTION

The vehicle body 1 is equipped at its bow area 2 with, for example, two rudder propellers 3 and 4, as well as at its stern area 5 with two further rudder propellers 6 and 7. In lieu of the rudder propellers illustrated by way of example other steerable water drive means may be employed such as, for example, Voith-Schneider propellers or also drives having pivotable nozzles or the like.

The four drive means provided in accordance with the invention are disposed in bights of the vehicle body which are not illustrated in detail in the drawings, which are designed in accordance with the laws of the current flow lines and are furthermore constructed between any particular two adjacent drives at the bow and at the stern of the vehicle body as deflectors for the currents that occur above all with lateral travel or travel in flowing water.

The front pairs of rudder propellers 3, 4 (chosen as a drive means example) as well as also the rearward pairs of rudder propellers 6, 7 are connected by means of a solid coupling arrangement, for example, a Gall chain 8 (bush roller chain, belt chain).

The rudder propellers 3, 4 at the bow 2 of the vehicle are as illustrated arranged convergingly with the direction of the propeller effectiveness and the pair of rudder propellers 6, 7 at the stern 5 of the vehicle are arranged divergingly.

The steering means of the front pair of rudder propellers may, as illustrated be in the form of a pair of bevel gears 9 and 10 in the same manner as that of the stern pair of rudder propellers with bevel gears 11, 12. A Servomotor 13 is connected in ahead of the steering drive of the front pair of rudder propellers. It serves for amplification of forces and may act in any desired manner, hydraulically, pneumatically, or electrically. A similar Servomotor 14 is also connected in ahead of the steering drive of the rearward pair of rudder propellers.

The driver's cabin 15 that is only schematically indicated is turned through an angle of 90° for better clearness of the illustration with respect to the vehicle body 1. The driver's stand or platform of the driver's cabin is provided in addition to the known conventional operating components for the driving and steering of the vehicle with an operating device 16 for the front pair of rudder propellers 3, 4 as well as with an operating device 17 for the rearward pair of rudder propellers 6, 7 for example, in the form of rotatable cranks. The rotational movement of these rotatable cranks 16, 17 is changed in direction by way of bevel gears 18, 19. These bevel gears have connected behind them a reversing gear 20 between the two operating arrangements for the front and for the reverse pair of rudder propellers for example, in the form of a spur gear or toothed gear. This bevel gear is provided with a shifting device 21, for example a claw coupling, which permits coupling together the steering mechanisms of the front and of the rear pair of rudder propellers. The steering movements of the water drive means are effected by means of the coupling obtained by way of Servomotors 13, 14 in synchronism with the control movements of the cranks 16 and 17.

Normally the vehicles in question here are equipped beside the driver's cabin with a further operating platform 22 at the stern 5 of the vehicle. Also this operating platform as well as the driver's cabin, is shown as turned through an angle of 90° with respect to the plane of the illustrated vehicle body. This stern operating platform as indicated by the connecting members 23, 24 and the connecting bolts 25, 26 may be pivotable about a vertical mounting angle and may also be removable. Also, in the stern operating station an operating device 27 for steering the front pair of rudder propellers and an operating device 28 for steering the rear pair of rudder propellers are provided. Also here bevel gears 29, 30 for changing the direction of movement are arranged in sequence and followed by further double directional change gears 31 on the rear operating platform 22, 32 on the vehicle body 1.

The release connection between these double directional change gears is obtained by means of a shaft 33 in the train of the steering operating elements for the forward pair of rudder

propellers and a hollow shaft 34 in the train of the steering operating members for the rearward pair of rudder propellers. The shaft 33, as well as also the hollow shaft 34 are provided with releasable couplings 35, 36 respectively, between the two double directional change gears 31 and 32.

In the train of the steering means for operating the forward pair of rudder propellers 3, 4 on the one hand from the driver's cabin 15, as well as from the stern operating platform 22 a transmission 37, for example, in the form of a spur gear, is provided which is equipped furthermore with a claw coupling 38 for coupling and releasing the connection. A similar gear 39 with claw coupling 40 is provided in the train of steering operating elements for the rearward pair of rudder propellers.

In the train of the steering operating elements for the front pair of rudder propellers there is furthermore provided a distributing gear 41, and a similar distributing gear 42 is in the train of the steering control elements for the rearward pair of rudder propellers. With these distributing gears 41, 42 are connected rapid release couplings 43, 44 and 45, 46 respectively, in the sidewalls of the vehicle body 1. By way of these rapidly releasable couplings the steering or control devices of adjacent vehicles of the same type, coupled to the vehicle can be operated from a single vehicle.

As a connection between the components of the control operating devices enumerated in detail above transmission shafts are employed which are not individually designated.

The steering operations illustrated in FIG. 3 for side travel or lateral travel which are chosen from among a multitude of possibilities begin with the illustrated setting (a) and the forward movement of the vehicle while utilizing the four drive means. The outline of the vehicle is indicated as a rectangular body. The arrow outlined in the center of this body indicates the particular direction of movement. The solid arrows in the four corners of the particular vehicle indicated show the adjustment of the drive means where the bow is at the top and the stern at the bottom. The setting of the operating control devices in the form of a crank for steering the front and the rearward drives are illustrated, as the case may be, at the top and at the bottom of the vehicle outline.

The sketch a of FIG. 3 also shows the setting of the different drives and the associated steering means for straight forward travel. It is seen that the two bow drive means are directed in converging relationship, in particular about 15° inwardly from a parallel line relative to the longitudinal axis of the vehicle. The two stern drives also diverge by about 15° outwardly from the parallel line of the longitudinal axis of the vehicle. The crank 16 of the control means provided in the driver's cabin is directed toward the front in the longitudinal direction of the vehicle, i.e., in the direction of travel, and also the crank 17 for steering the rearward drive means.

The sketch b reflects the position of the different driving and control elements for side travel where the direction of travel has superimposed upon it a small component in the direction of pure forward travel. The direction of travel is again indicated by the light arrow 51 which deviates by about 15° from the exact lateral direction.

The two steering devices or cranks 16 and 17 again indicate the direction of travel, thereby including an angle of 75° relative to forward travel direction and accordingly also, as the travel direction of the vehicle, an angle of 15° relative to the oblique direction.

With these crank positions there results the setting of the individual drive means indicated in the sketch b. The left bow drive is obliquely adjusted. It thus includes also an angle of 75° for determining the forward travel. The right bow drive defines an angle of 30° with respect to the oblique direction. Also it deviates from its position for the forward travel by 75°.

The same applies to the left and the right stern drive.

The sketch c shows a possible position of the drive means for the true or exact lateral direction of travel. The arrow 51 is exactly in transverse direction. The cranks 16 and 17 point also in transverse direction thus deviating from their position and the forward travel by 90°. **The same deviation from their**

setting for forward travel, i.e., likewise 90° , is inherent in all drives.

Another possible position of the drive means is illustrated by sketch *d* and for the control devices 16, 17 for the true lateral travel in the direction of arrow 51. Here the two control members 16, 17 are disposed at an angle of 30° symmetrically with the direction of travel, i.e. individually an angle of 15° to the direction of travel. Thus there results the setting of the drive means illustrated in sketch *d* by means of which the best degree of efficiency for lateral travel is obtained.

As a last example, the sketch *e* indicates the position of the driving means and of the steering cranks 16 and 17 for a direction of travel that is essentially rearwardly while deviating by an angle of 30° from the straight direction of rearward travel. The cranks 16 and 17 again show the direction of travel. The individual drive means are set in such a manner that the component obtains the chosen direction of travel.

FIG. 4 shows in individual sketches *f, g, h, i* and *j* steering possibilities with the single hand operation for which one of the two steering cranks is fixed in position. The sketches *k, l* and *m* again indicate the possibilities of one hand operation where both steering cranks are coupled in such a manner that they effect oppositely directed steering movements.

In all of the sketches *f* to *m* of FIG. 4 the left crank, the steering crank 16, is for the forward steering elements and the right steering crank or crank 17 for the rearward drives.

In sketch *f* the crank 17 is blocked. Only the crank 16 can be actuated, the vehicle is in conduction for straight forward travel as indicated by arrow 51. The steering is only by means of the forward drive means.

Also in the sketch *g* the crank 17 is blocked. When operating the crank 16 to the left, the travel of the vehicle in a curve as indicated by arrow 51 is obtained while the steering again is only by means of the forward drive means.

In the sketch *h* the crank 16 is blocked. Thus, only the rearward drive means are employed for steering the vehicle. As the steering crank 17 is operated in the direction of the arrow the vehicle travels in the direction of the arrow 51.

Diagrams *i* and *j* illustrate two possibilities of turning the vehicle in place. According to illustration *i* the steering crank 17 for the rearward drive means is blocked and furthermore the rearward drive means are turned off. Thus the turning of the steering crank 16 through an angle of 90° causes the vehicle to turn in place in the same direction.

The same result can be obtained with the steering crank 16 for the forward drive means blocked and by turning the steering crank 17 for rearward drive means in opposite direction.

Single hand operation is also possible when both steering members are coupled in such a manner that, when operating one of the two elements they produce oppositely directed steering movements of the drive means associated with them.

In accordance with sketch *k* the steering crank 16 for the forward drive means can be turned to the right or the steering crank 17 for the rear drive means can be turned to the left in the direction of the arrows indicated. There then results a movement of the vehicle again in the direction of arrow 51 from the effect of the four drive means which also assume the particular positions indicated. Thus as shown by sketch *k* there results a movement along a small curve for which the steering is by means of all four drive means.

The sketch *l* again shows a turning maneuver in situ now by the effect of all four drive means. The steering crank 16 is turned by 90° to the left and the steering crank 17 by 90° to the right.

The sketch *m* shows the driving along a small curve rearwardly in the direction of arrow 51. The steering cranks 16 and 17 here assume the positions indicated. Also here all four drive means are employed.

FIG. 5 illustrates different possibilities of two-hand operation which permits still more sensitive steering of the vehicle while using all four drive means and whereby the same effects as in FIG. 3 are obtained, which primarily were intended for the fundamental explanation of the steering operations.

The sketch *n* shows the position of the steering elements and of the drives for the true forward movement. Sketch *o* shows the position of the steering cranks 16 and 17 and of the four drives for forward travel but laterally displaced. Sketch *p* shows the steering of the steering cranks and of the individual drives for lateral movement of the vehicle i.e., for true lateral driving at an angle of 90° with respect to forward drive. Also sketch *q* shows the lateral movement where with the positions of the drive elements indicated the best operating effect is obtained.

Sketch *r* shows the steering of the steering cranks and drive means with displacement of the vehicle laterally rearwardly. The sketch *s* shows the position of the steering cranks and the drives with laterally displaced forward travel with a curved component superimposed. As shown, the required position of the steering crank 17 which acts on the stern drives obtains a corresponding position of the stern drive means that results in the superimposed curved component. Finally, sketch *t* shows a driving component where with an addition to lateral displacement of the vehicle it is slightly turned.

Particularly the last sketches of positions for the steering elements and the drive means illustrate clearly that with two-hand drive all imaginable vehicle movements can be obtained in an exact and sensitive manner by simple operation of two hand cranks.

In the same manner also the drive means can be steered from the stern platform by way of the initially described coupling means. Finally, it is possible by the rapid coupling means to steer simultaneously from one vehicle combination, for example, of a ferry.

Having now described my invention, what I desire to protect by letters patent of the United States is set forth in the appended claims.

1. Marine drive means for amphibious vehicles comprising a vehicle body having four corner areas defining bights adapted to current flow conditions and equipped with two bow and two stern propelling means and separate coupling means between said two bow propelling means and between said two stern propelling means, steering means for moving said four propelling means into directions of travel effectiveness including at least one operating device to optionally steer any desired number of said propelling means and steering transmission means including coupling and uncoupling means intermediate said two bow and said two stern propelling means permitting independent operation of a pair of bow and a pair of stern propelling means.

2. Marine drive means in accordance with claim 1 including a horizontally disposed axle for each said propelling means.

3. Marine drive means for amphibious vehicles comprising a vehicle body having four corner areas defining bights adapted to current flow conditions and equipped with two bow and two stern propelling means and separate coupling means between said two bow propelling means and between said two stern propelling means, steering means for moving said four propelling means into directions of travel effectiveness including at least one operating device to optionally steer any desired number of said propelling means and steering transmission means including coupling and uncoupling means intermediate said two bow and said two stern propelling means permitting independent operation of a pair of bow and a pair of stern propelling means, and coupling means in the sidewalls of said vehicles associated with distributing gears connected to said steering means operative to transmit the steering movements from one vehicle to another.

4. Marine drive means for amphibious vehicles comprising a vehicle body having four corner areas defining bights adapted to current flow conditions and equipped with two bow and two stern propelling means and separate coupling means between said two bow propelling means and between said two stern propelling means, steering means for moving said four propelling means into directions of travel effectiveness including at least one operating device to optionally steer any desired number of said propelling means and steering trans-

mission means including coupling and uncoupling means intermediate said two bow and said two stern propelling means permitting independent operation of a pair of bow and a pair of stern propelling means, coupling means for connecting two bow propelling means and two stern propelling means, and

coupling means in the sidewalls of said vehicles associated with distributing gears connected to said steering means operative to transmit the steering movements from one vehicle to another.

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