July 3, 1956 G. E. FRANZ 2,753,006

BLADE WHEEL PROPELLER

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FIG. 1.

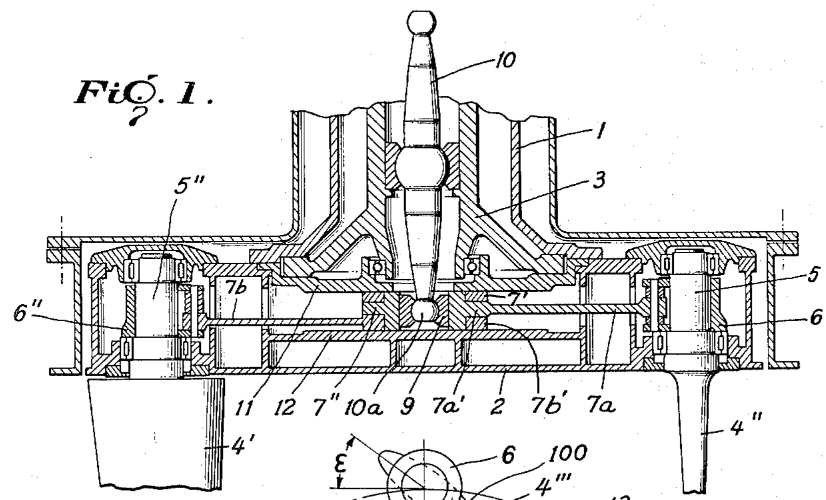
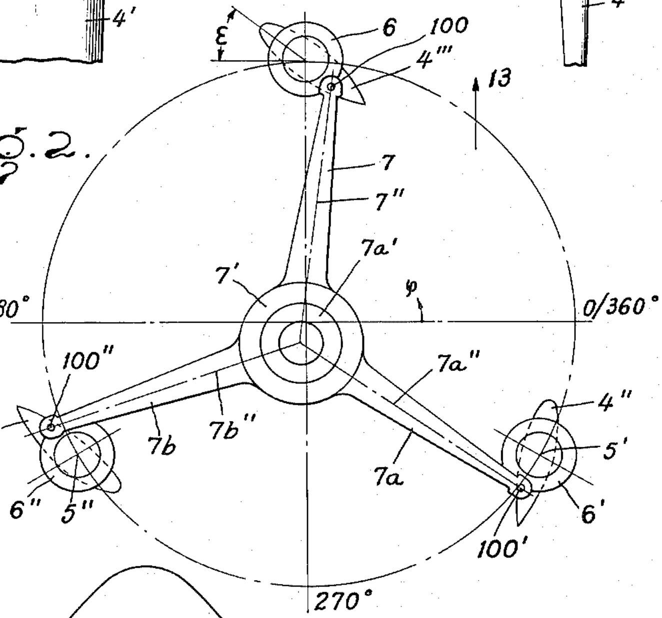


FIG. 2.



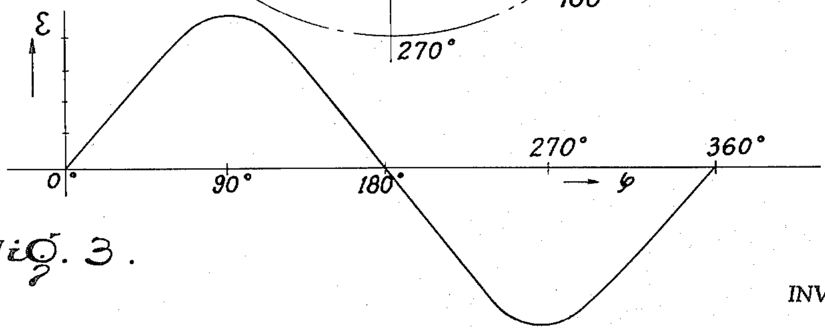


FIG. 3.

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BLADE WHEEL PROPELLER

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3 Claims. (Cl. 170—151)

The present invention relates to ship propellers and, more particularly, to blade wheel propellers. As is well known, the blades of blade wheel propellers—cycloidal propellers—are during their rotation about the propeller axis controlled according to certain laws by a blade drive mechanism, mostly called kinematics. While in operation, the blades carry out an oscillating movement about their tangential position, the amplitude of which may be influenced by the speed lever or speed stick whereas the phase of said oscillating movement can be influenced by the steering wheel.

As blade drive mechanism for high speed cycloidal propellers, the so-called connecting rod kinematics have proved successful. With this construction, also called sliding link kinematics, the blades are coupled by means of a blade lever, a connecting rod, and a slide rod with annular control center which in the zero position of said blades is located centrally and which is rotatably connected with the propeller in any convenient manner. The said slide rod is guided in a slide member—cross head—which is rotatably journalled in the propeller wheel.

In addition to the above, also a number of further kinematics have been suggested. As far as they have been built, they have at least in part proved successful as to design. However, they could not get adopted by the ship building industry over the materially simpler connecting rod kinematics. On the other hand, even with the proven connecting rod kinematics, the blade wheel propeller has not been adopted to the extent it would deserve in view of its excellent maneuverability and its simple operation. This is due primarily to the fact that it is materially higher in price than the screw propeller drive.

In an effort to develop a kinematics as simple and as low in cost as possible, already two decades ago, the construction of a simple sine-kinematics has been suggested and discussed. Preliminary research tests, however, have yielded so poor a degree of efficiency of sine-kinematics that experts in this art have abstained from further tests and have dismissed the sine-kinematics as completely impractical. Also, in the meantime occasionally advanced suggestions concerning the sine-kinematics have produced no success inasmuch as these suggestions were expected merely to confirm the results of the above mentioned research tests.

More recently it was believed that an explanation of the impracticability of the sine-kinematics had been found. It had been found that with a blade wheel propeller a great angle of attack or blade angle can be selected without having to fear that a separation of the flow or cavitation will occur. However, it was believed that a sinusoidal blade angle graph in the first range of the front wheel half—ascending branch of the sine curve—and in the oppositely located last range of the rear wheel half—descending branch of the sine graph—would automatically cause too fast a rise or drop of the approach flow angle and thus would produce cavitations and losses in efficiency. This explanation further strengthened the

heretofore prevailing opinion concerning the impracticability of the sine-kinematics.

It is, therefore, an object of the present invention to provide a blade wheel cycloidal propeller with sine-kinematics which will overcome the above mentioned drawbacks.

It is another object of this invention so to simplify the sine-kinematics for use in connection with blade wheel cycloidal propellers that such a construction will not only be able to compete with screw propellers but will have distinct advantages over the latter in connection with certain types of ships or vessels.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings in which:

Fig. 1 diagrammatically illustrates a cross section through a propeller according to the invention.

Fig. 2 represents a top view of the blade drive linkage.

Fig. 3 is a graph concerning the blade angle in connection with the propeller according to the present invention.

General arrangement

Recent tests have revealed that the heretofore prevailing opinions concerning the sine-kinematics with blade wheel cycloidal propellers represent an unjustified prejudice, and that with sine-kinematics very favorable results can be obtained provided that the blade wheel driving mechanism yields a sinusoidal blade angle graph which for all practical purposes is the same for each and every blade of the same blade wheel. The blade angle epsilon plotted over the circumferential angle phi, should therefore, yield a sine curve, and this sine curve should for each blade of one and the same blade wheel be practically the same and equal the sine of the circumferential angle phi. This condition is met by a blade wheel propeller according to the invention which is characterized in that the inner end of each coupling or connecting rod of one and the same blade wheel ends in an annular member or portion and that all of said annular members or portions are superimposed upon each other and are arranged concentrically with regard to each other and with regard to the lower end portion of the control member regardless of the control position of said control member. According to a specific embodiment of the invention the control member is designed as control stick having a lower ball shaped end. This ball shaped end forms the control center and has pivotally connected thereto the inner ends of all coupling rods which in their turn are connected to the blade levers. The arrangement is such that the respective longitudinal axis of each of said connecting rod means intersects the axis of said control means in all positions of said control means whereby substantially the same sinusoidal blade angle curve is obtained for each of said blades.

Structural arrangement

Referring now to the drawings in detail and Fig. 1 thereof in particular, the arrangement shown therein comprises a hollow shaft 1 through the intervention of which the wheel 2 of the propeller is rotated. The wheel 2 is in a manner known per se carried by a part 3 which extends into the hollow shaft 1 and pertains to a stationary casing (not shown in the drawing). The blade 4′, 4″ and 4‴ are rotatably journalled in the wheel 2. Respectively slipped over the blade pivots 5, 5′, 5″ are blade levers 6, 6′, 6″ having pivotally connected thereto at 100, 100′, 100″ coupling or connecting rods 7, 7*a* and 7*b* respectively. The inner end of each of said coupling rods 7, 7*a*, 7*b* ends in an annular portion 7′, 7*a*′, and 7*b*′, respectively. Said annular portions are arranged concentrically with regard to each other and concentrically extend around the ball box 9 at the lower ball-shaped end 10a of the control stick 10. As will be clear from the drawings, the coupling rods 7, 7a, 7b are arranged at different levels located above each other. The inner end 7a' of the intermediate coupling rod 7a is designed as a bushing of a height which equals the distance between the upper surface of annular portion 7' and the bottom surface of annular portion 7b'. It will also be noted from the drawing that the annular portion 7a' includes an annular section 7'' separating the annular portions 7' and 7b' from each other. Furthermore, the annular portions of the coupling rods are slidably mounted between the upper wall 11 of the wheel 2 and an intermediate wall 12.

For purposes of simplification of the drawing, Fig. 1 shows the two blades 4' and 4'' of Fig. 2 as if they were located in the same plane.

Fig. 2 shows the two blades with their control system in a position for full speed ahead, the traveling direction being indicated by the arrow 13. As will be seen from Fig. 2, also when the center of ball 10a by actuation of stick 10 has been moved into an eccentric position with regard to the center of the circle on which the tilting axes of the blades 4', 4'' and 4''' are located, the center of the ball 10a and the center of the annular portions 7', 7a' and 7b' still remain located on one and the same line. This may also be expressed in a different way namely regardless of the control position of the control stick 10, the central axes 7'', 7a'' and 7b'' pass through the same line which in Fig. 2 is represented as an intersecting point of the projection of the axes 7'', 7a'' and 7b''.

Fig. 3 shows the blade angle epsilon plotted over the circumferential angle phi and also shows the sine graph obtained thereby. This sine graph is the same for each and all of the blades 4', 4'' and 4'''.

Tests carried out with a propeller having a sine kinematics according to the present invention have proved that such a propeller is particularly advantageous when used as a propeller with a medium or high loading factor, in other words, as propeller for slowly travelling, relatively heavy vessels, such as tug boats, floating cranes, or the like. For these purposes, the blade wheel propeller according to the present invention may be further simplified by reducing the number of blades as far as possible so that the propeller is equipped only with three wide blades. It has been found that a small number of blades is particularly admissible for slowly running propellers whereas, with propellers driven at high speed and used for fast ships, cavitation will occur when using less than four or five blades.

A blade wheel propeller according to the present invention is therefore fundamentally simpler than any other known designs. The blade drive rod system for each blade comprises in addition to the blade lever only one coupling rod which is centrally pivotally connected to a common control pivot which may in a manner known per se be operable by the control stick 10. The blade levers 6 and the coupling rods 7, 7a and 7b with the exception of their inner annular portions may respectively all be of the same design. Furthermore, a carrier device for the control center for a synchronous or isochronous carrying along of the control center by means of the wheel body is superfluous according to the present invention. The factor that only three blades are required for a reliable operation of the propeller, materially contributes to a simplification and a reduction in cost of the propeller.

In addition to ship drives with medium or high load factor, the propeller according to the present invention is highly advantageous also in such instances in which, for example, with ferry boats, the degree of efficiency is rated lower than a good maneuverability of the propeller, while with regard to maintaining the purchase price as low as possible, a simple kinematics is mandatory.

It is, of course, understood that the present invention is, by no means, limited to the particular construction shown in the drawings but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. In a blade wheel ship propeller arrangement having a rotatable wheel with a plurality of blades respectively provided with shafts operable to oscillate said blades about the respective axes of said shafts, the combination of: a plurality of blade lever means respectively connected to said shafts, a plurality of connecting rod means having their outer ends respectively pivotally connected to said blade lever means, the inner ends of said connecting rod means being formed with annular portions arranged concentrically with regard to each other and superimposed upon each other, and control means concentrically surrounded by said annular portions and operable selectively to shift the said annular portions from a position concentric to said rotatable wheel into a plurality of positions eccentric thereto and vice versa, the respective longitudinal axis of each of said connecting rod means intersecting the axis of said control means in all positions of said control means whereby substantially the same sinusoidal blade angle curve is obtained for each of said blades.

2. In a blade wheel ship propeller arrangement which includes a rotatable wheel with oppositely located spaced central wall sections extending substantially perpendicular to the axis of rotation of said wheel, and in which said rotatable wheel carries a plurality of blades respectively provided with shafts operable to oscillate said blades about the respective axes of said shafts, the combination of: a plurality of blade lever means respectively connected to said shafts, a plurality of connecting rod means having their outer ends respectively pivotally connected to said blade lever means, the inner ends of said connecting rod means being formed with annular flat portions concentrically arranged with regard to each other and superimposed upon each other, said annular portions being journalled between said oppositely located spaced central wall sections of said wheel so as to allow oscillation of said annular portions relative to each other, ball box means mounted within said annular portions, and control stick means including a ball-shaped portion journalled in said ball box means and operable selectively to shift said annular portions from a position concentric to said rotatable wheel into a plurality of positions eccentric thereto and vice versa, the respective longitudinal axis of each of said connecting rod means intersecting the axis of said control means in all positions of said control means whereby substantially the same sinusoidal blade angle curve is obtained for each of said blades.

3. In a blade wheel ship propeller arrangement having a rotatable wheel with an uneven number of blades respectively provided with shafts operable to oscillate said blades about the respective axes of said shafts, the combination of: a plurality of blade lever means corresponding in number to that of said blades and respectively connected to said shafts, a plurality of connecting rod means corresponding in number to that of said blades and having their outer ends respectively pivotally connected to said blade lever means, the inner ends of said connecting rod means being formed with annular portions concentrically arranged with regard to each other and superimposed upon each other, said annular portions being supported by said wheel and being oscillatable relative thereto and relative to each other, that annular portion which has the same number of annular portions arranged above and below thereof having integral therewith a sleeve concentrically located within said other annular portions, and control means concentrically surrounded by said annular portions and operable selectively to shift all of said annular portions as a unit from a position concentric to said rotatable wheel into a plurality of positions eccentric thereto and vice versa, the respective longitudinal axis of each of said connecting rod means intersecting the axis of said control means in all positions of said

control means whereby substantially the same sinusoidal blade angle curve is obtained for each of said blades.

References Cited in the file of this patent

UNITED STATES PATENTS

2,037,069 Ehrhart ---------------- Apr. 14, 1936

2,250,772 Mueller et al. ------------ July 29, 1941
2,580,428 Heuver ---------------- Jan. 1, 1952

FOREIGN PATENTS

170,080 Germany -------------- June 15, 1951
823,108 Germany -------------- Nov. 29, 1951
1,013,747 France ---------------- Aug. 4, 1952