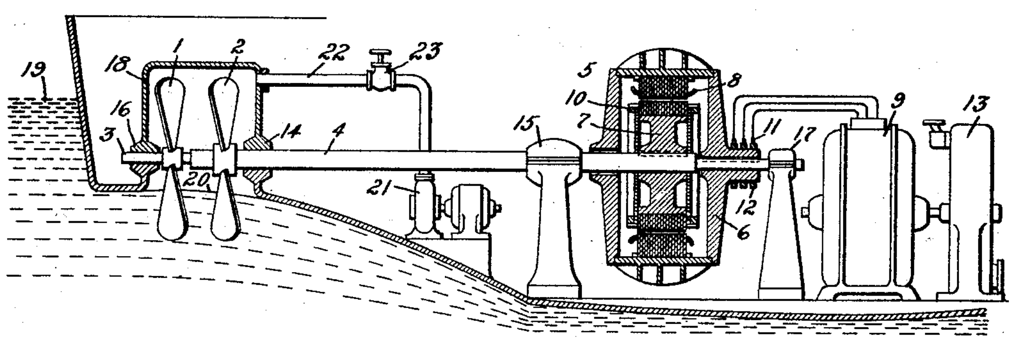
April 21, 1925. 1,534,725

C. MACMILLAN

SHIP PROPULSION

Filed May 28, 1923



Inventor:
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UNITED STATES PATENT OFFICE.

CAMPBELL MACMILLAN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SHIP PROPULSION.

Application filed May 28, 1923. Serial No. 641,847.

To all whom it may concern:

Be it known, that I, CAMPBELL MACMILLAN, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Ship Propulsion, of which the following is a specification.

My invention relates to ship propulsion and more particularly to systems of ship propulsion wherein vane-wheels driven by electric motors or other suitable driving means are utilized in propelling the ship.

A vane-wheel is like the ordinary screw propeller in that it consists of a plurality of blades or vanes fixed to a boss or hub structure mounted on its driving shaft, but differs therefrom in having its axis of rotation at some distance above the surface of the water. This arrangement makes possible certain economies by which the operation of the equipment as a whole may be greatly improved over that possible in the case of the submerged screw propeller which must have its hub limited in size and form to suit the requirements of minimum hydraulic resistance compatible with blades sufficiently strong as cantilevers and must furthermore bear the burden of propelling its supporting structure through the water. The hub structure of the vane-wheel is out of contact with the water and may therefore be designed solely with reference to considerations of its utility as a support for the blades which may then be constructed to produce maximum hydraulic efficiency. The vane-wheel may consist of two or more vanes attached to arms fixed to the hub structure and having the desired helical pitch, the diameter of the wheel being such that only the vanes are immersed in the water when propelling the ship. It thus affords marked advantages with regard to lubrication of the bearings, inspection and repairs. In prior equipments, however, all these advantages have been in a measure counterbalanced by the handicap that the blade immersion must be maintained substantially uniform. One object of my invention is to provide means for regulating the blade immersion thereby adapting the vane-wheel to use in rough water. An other difficulty encountered in the operation of vane-wheel equipments has been the requirement for low speed necessitated by the comparatively large diameter of the wheel. Since one of the factors affecting its efficiency is the frictional loss of the blades which in turn depends on peripheral or linear speed, a larger diameter necessarily involves slower rotation. The propulsion machinery required to produce low speed is essentially heavier than that necessary where high rotational speeds are permissible. A further object of my invention is to provide electric propulsive means which shall be both light in weight and efficient in operation.

My invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring now to the drawing there is shown in the single figure thereof a vane-wheel equipment constructed in accordance with my invention. The drawing shows vane-wheels 1 and 2 mounted on co-axial shafts 3 and 4 respectively arranged to be rotated in opposite directions by means of a motor 5 provided with a rotatable primary 6 mechanically fixed to the shaft 3 and a rotatable secondary member 7 arranged to rotate with the shaft 4. The motor 5 is illustrated as of the induction type and is provided with a primary winding 8 to which current may be supplied from a generator 9 through suitable connections, brushes 11 and slip rings 12, a prime mover 13 being provided for driving the generator 9. The secondary winding 10 of the motor 5 is shown as a squirrel cage but may be any other desired type. Suitable bearings 14 and 15 are provided for the shaft 4 and similar bearings 16 and 17 are provided for the shaft 3. The secondary member 7 is fixed to the shaft 4, and the primary member 6 is fixed to the shaft 3 at its right and at its left end is arranged to revolve about the shaft 4.

In order to economize space and adapt the equipment to electric drive I have replaced the ordinary twin wheel arrangement by oppositely rotating co-axial wheels. The necessity for either twin shafts or co-axial shafts with opposite rotation will be apparent when it is remembered that the mechanical reaction force on the bearings is a single resultant force and not a moment as in the case of submerged wheels. The effect of the latter reaction in the case of a single excessively large slow speed submerged screw would be to give the vessel a permanent list, but in the case of the vanewheel a large transverse force greatly interfering with steering would be produced. The special opportunity which occurs for the application of electric equipment depends on the use of coaxial shafts. The type of motor most suitable for driving such shafts is one having both elements capable of rotation. The relative rotational speed of the two elements would then be about twice the absolute speed of either and therefore for the transmission of any specified amount of power the weight of the active material of the motor would be reduced to but little over one half as compared with a motor having one rotating element only. No other form or propulsive machinery is so well adapted to take advantage of this requirement as the electric motor.

In order to definitely regulate the immersion of the blades I have modified the hull of the ship to form a caisson or diving bell 18 within which the wheels 1 and 2 are arranged to rotate. The lower edge of the chamber so formed is immersed below the free water level 19 and an artificial water level 20 is maintained within the chamber. The air within the chamber 18 may be automatically maintained at any suitable pressure by means of a source of compressed air 21 which is interconnected with it through a pipe 22 and valve 23. The vanewheel blades extend below the lower edge of the chamber to a depth necessary to secure the desired immersion. This immersion is approximately constant and independent of the pitching of the vessel, and may be a measure regulated by changing the pressure within the wheel chamber. With this arrangement, the stream lines of the after body above and below the artificial water-level 20 are similar but with the upper set moved relatively astern to the other. In case of very excessive pitching this structure is of further advantage in that the overhung buoyancy of the air chamber tends to reduce the pitching by providing a considerable change of buoyancy through a relatively small pitching angle.

My invention may be embodied in other forms than those shown and described as will be apparent to those skilled in the art. Thus the induction motor, for example, may be replaced by any other suitable type of motor and the arrangement of wheels may be modified as desired.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A system of ship propulsion wherein oppositely rotating vane-wheels are utilized in producing the force required to drive the ship, characterized by the fact that means are provided for producing an artificial water-level by which partial and substantially uniform immersion of the vanes is secured under all conditions of operation.

2. A system of electric ship propulsion comprising a plurality of vane-wheels, an electric motor for driving said vane-wheels in opposite directions, and means forming a chamber extending upwardly from the bottom of the ship for producing an artificial water-level by which partial and substantially uniform immersion of the vanes is maintained under all conditions of operation.

3. A system of electric ship propulsion comprising a plurality of vane-wheels, an electric motor for driving said vane-wheels in opposite directions, means forming a chamber in the hull of the ship for producing an artificial water-level by which partial and substantially uniform immersion of the vanes is maintained under all conditions of operation, and means for regulating the pressure within said chamber.

4. A system of ship propulsion comprising two co-axial vane-wheels, means for driving said vane-wheels in opposite directions, and means forming a caisson above said vane-wheels in the hull of the ship for maintaining a partial immersion of the vanes under all conditions of operation.

5. A system of electric ship propulsion comprising two co-axial vane-wheels, an electric motor for driving said wheels in opposite directions, means forming a caisson within which said vane-wheels are arranged to rotate for maintaining a partial immersion of the vanes, and means for regulating the pressure within said caisson.

In witness whereof, I have hereunto set my hand this 26th day of May, 1923.

CAMPBELL MACMILLAN.