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SHIP PROPULSION.

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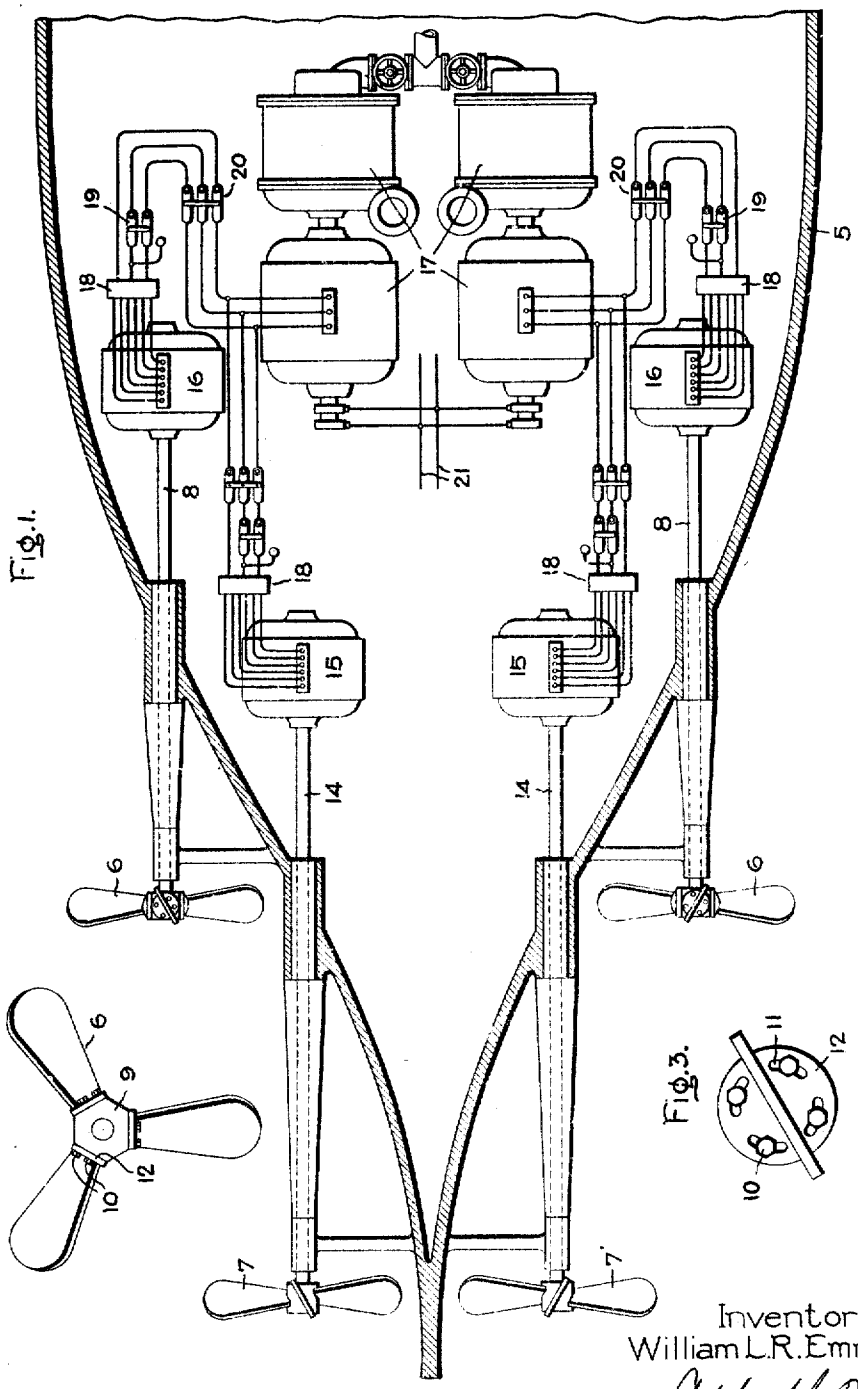


Fig. 1.

Fig. 2.

Fig. 3.

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SHIP PROPULSION.

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To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, 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 in particular to the propulsion of ships by electric motors. The object of the invention is to improve the propulsion of ships having propellers located in different positions and driven at substantially the same speed.

The water in which a ship's propeller moves is generally more or less influenced by currents created by the passage of the ship itself, and such water-movements may affect the propeller in one way or another. The movement of the water caused by the passage of the ship may be termed wake-factor, and it will be evident to those skilled in the art that the wake-factor may be different at different places about the ship. Let us assume for the purposes of explanation that the wake-factor opposes the normal "ahead" rotation of the propellers, then the actual work done by a propeller for a particular speed of the ship includes not only the work which the propeller would have to do in still water to produce the same speed of the ship, but includes in addition the work which the propeller is called upon to perform in overcoming the effect of the wake-factor to which the propeller is subjected. When a ship is driven by two propellers on the same side of the ship, the inboard propeller may be affected by a different wake-factor than the out-board propeller, and consequently, if the two propellers are of the same size and pitch, they must be driven at different speeds if each is to do the same amount of work, and if the propellers are driven at substantially the same speed one will do a relatively greater amount of work than the other. Thus, where similar propellers are used on screws in different positions on the same side of a ship and are driven at substantially the same speed, a difference in wake-factor to which the propellers are subjected will cause an unequal distribution of load between the two propellers, which is undesirable because the best efficiency is generally obtained with an equal load division between the propellers. My present invention comprises in its broadest aspect the provision of means for equalizing the effects of different wake-factors on two or more propellers driven at substantially the same speed. In the particular embodiment of the invention which I shall hereinafter specifically describe the propellers are given slightly different propeller-pitches in order to equalize the effects of the different wake-factors to which the propellers are subjected.

My present invention is of particular advantage in systems of electric ship propulsion where each propeller shaft or screw is driven by an independent electric motor or motors. In propelling ships, particularly those of large size, by electric motors, it is desirable to use alternating currents since the motors and the generators for alternating currents are simpler than those for direct currents, and also since alternating current generators can be conveniently designed for large capacities and high speeds and are therefore well adapted for use with high speed steam turbines. Alternating current motors of the simplest type, such as polyphase induction motors, require no commutators and can be constructed and wound in such a manner that they will stand the roughest usage with a minimum of trouble and expense for maintenance. Such alternating current motors, however, are best adapted to operate at speeds synchronous or nearly synchronous with the speed of the generator, and thus where two or more propeller-driving motors are operated from the same generator, the speed of the motors, under the most economic conditions, must be substantially the same. Where similar propellers are thus driven by electric motors of substantially the same speed, a difference in the wake-factor to which the propellers are subjected will cause an unequal distribution of load between the propeller-driving motors, which is undesirable not only on account of the poorer efficiency resulting from the unequal load division between the propellers, but also because it is desirable to have the motors of the same size so that they may be interchangeable, and the best efficiency of such motors is obtained when the load is equally distributed between them. My present invention as applied to such a system consists in providing means, as for

example, by giving the propellers different pitches, for equalizing the effects on the propellers of the different wake-factors to which they may be subjected.

The features of my invention which I believe to be novel and patentable are definitely indicated in the claims appended hereto. The invention will be better understood from the following description taken in connection with the accompanying drawings, in which Figure 1 diagrammatically represents a system of ship propulsion embodying the invention, and Figs. 2 and 3 illustrate a propeller construction by means of which the objects of the invention may be conveniently secured.

In Fig. 1 of the drawings the hull of the ship is designated at 5. Two propellers 6 and 7 are located on each side of the ship. The propellers 6 and 7 are located at places where the movements of the water caused by the passage of the ship are different. It will be understood by those skilled in the art that the particular water-movement to which any propeller is subjected depends upon the shape of the ship and the position of the propeller with respect to the ship. For the purposes of explanation I will consider the probable water-movements to which the propellers 6 and 7 may be subjected. An inward surge of water takes place at the stern as the ship advances, and this water-movement is relatively greater at the relatively narrower parts of the ship's stern, so that the propellers 7 encounter a greater water-movement or wake-factor than the propellers 6. Let us assume that the conditions are such that this movement of the water caused by the passage of the ship opposes the "ahead" rotation of the propellers, in which case the propellers 7 encounter greater opposition from wake-factor than do the propellers 6, and, accordingly, the propellers 7 are called upon to perform a relatively greater amount of work than are the propellers 6. Under such conditions, if the propellers 6 are given a greater pitch than the propellers 7 the effects of the movements of the water caused by the passage of the ship can be equalized, and the propellers can each be driven at the same speed.

The difference in pitch of the propellers 6 and 7 can be provided for in the original design of the propellers, through foreknowledge of the conditions in hand, or can be obtained after the trials of the ship by constructing certain of the propellers with removable blades, the pitch angle of which can be adjusted. In practice I believe it will generally be found advisable to determine by experiment the wake-factor to which each propeller is subjected. By constructing certain of the propellers with adjustable blades it will then be possible to obtain the proper relative propeller-pitches in order to equalize the effects on the propellers of the different wake-factors to which they are subjected. In accordance with this feature of my invention the propellers 6 have adjustable blades, as will be better understood by reference to Figs. 2 and 3 of the drawings. The propeller shafts 8 carry at their external ends hexagonal hubs 9. The propeller blades are secured to alternate faces of the hexagonal hub 9 by means of bolts 10 which extend through slots 11 in the base 12.

The propellers 7 are mounted at the outer ends of propeller shafts or screws 14, and these shafts are direct-coupled to electric motors 15. The propeller shafts 8 are similarly direct-coupled to electric motors 16. Turbo-generators 17 are adapted to furnish electric energy to the motors 15 and 16. The starboard motors 15 and 16 receive energy from one of the turbo-generators 17, while the port motors 15 and 16 receive energy from the other turbo-generator 17. I have illustrated polyphase alternating current generators of the rotating field type. The propeller-driving motors are preferably induction motors of the pole-changing type, and to this end I have diagrammatically illustrated pole-changing switches 18 in conjunction with each motor. Each motor is further provided with a reversing switch 19 and a disconnecting switch 20. The rotating fields of the generators are adapted to be excited from any suitable direct current source, such as represented at 21 in the drawings.

The propeller-driving induction motors 15 and 16 operate at substantially the same speed. If the propellers 6 and 7 are located at places where the movements of the water caused by the passage of the ship are different and have the same propeller-pitch, the motors 15 and 16 will be unevenly loaded, that is to say one motor will carry a relatively greater load than the other. As previously pointed out, it is desirable to have all of the propeller-driving motors 15 and 16 alike, so that they may be interchanged, and an uneven distribution of load between such similar propeller-driving motors is objectionable, particularly when the motors are operating at or near their rated capacity. When the propellers 6 and 7 are given different pitches in accordance with my present invention, the effects of the different wake-factors to which the propellers are subjected are equalized, whereby the propellers do substantially the same amount of work and the motors carry substantially equal loads, and hence both the propellers and motors operate under the most efficient conditions.

I have herein shown and described a particular embodiment of my invention for the purpose of explaining its principle and illustrating its applications, but numerous modifications and other applications will

present themselves to those skilled in the art. I, therefore, wish to cover by the following claims all modifications within the spirit of the invention.

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

1. The combination in a system of ship propulsion of a plurality of propellers on each side of the ship, the propellers on the same side of the ship being located at places where the movements of the water caused by the passage of the ship are different, means for driving all of the propellers at substantially the same speed, and means for equalizing the loads on the propellers.

2. The combination in a system of ship propulsion of a plurality of propellers on each side of the ship, the propellers on the same side of the ship being located at places where the movements of the water caused by the passage of the ship are different, individual means for driving the propellers at substantially the same speed, and means for equalizing the loads on the driving means.

3. A system of ship propulsion comprising a plurality of propellers on each side of the ship, the propellers on the same side of the ship being located at places where the movements of the water caused by the passage of the ship are different, and means for driving said propellers at substantially the same speed, said propellers having relatively different proportions for equalizing the effects on the propellers of the different water-movements to which the propellers are subjected whereby the propellers operate at substantially the same speed and perform substantially equal amounts of work.

4. A system of ship propulsion comprising a plurality of propellers on each side of the ship, the propellers on the same side of the ship being located at places where the movements of the water caused by the passage of the ship are different, and means for driving all of said propellers at substantially the same speed, the propellers on the same side of the ship having different pitches for equalizing the effects on the propellers of the different water-movements to which the propellers are subjected whereby all of these propellers are equally loaded and may be efficiently driven at substantially the same speed.

5. The combination in a system of ship propulsion of a plurality of propellers on each side of the ship, the propellers on the same side of the ship being located at places where the movements of the water caused by the passage of the ship are different, means for driving all of the propellers at substantially the same speed, and means for adjusting the blades of certain of the propellers so as to equalize the effects on the propellers of the different water movements to which the propellers are subjected, whereby all of these propellers are substantially equally loaded and may be efficiently driven at substantially the same speed.

In witness whereof, I have hereunto set my hand this 22nd day of December, 1915.

WILLIAM L. R. EMMET.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."