SHIP STEERING SYSTEM

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

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SHIP STEERING SYSTEM

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ABSTRACT OF THE DISCLOSURE

A ship steering system which includes tunnels extending transversely through a ship's hull at the bow or stern or both in which is mounted a reversing or reversible pitch propeller in order to pump water selectively through the tunnel to exert a steering force on the hull and including vanes or screens which can be extended outwardly from and withdrawn into the hull located behind the ends of the tunnel or tunnels in the direction of movement of the ship in order to exert a turning force on the hull and also to direct water selectively into the tunnel during the forward or rearward movement of the ship to enable control of the steering of the ship either at low or high speeds.

This invention relates to improvements in steering systems for ships of the type including a reversible or reversible pitch propeller mounted in a tunnel extending transversely through a ship's hull and more particularly to a system of the type described which is capable of efficient operation and at substantially all ship speeds.

Steering systems generally of the type referred to above are known and have been disclosed in a number of patents, including, for example, the Jardino U. S. Patent No. 3,002,486, dated October 3, 1961. Steering systems of this type are usually installed in the fore-part or bow section of the ship but they may also be used in the aft or stern part of the ship or both in the bow and stern portions of the ship. The prior systems improve the maneuverability of the ship at low ship speeds but it is recognized that their effect diminishes greatly as the ship's speed increases. Attempts have been made to improve the action of such steering systems at higher speeds by providing pivoted valves or vanes in the transverse tunnel by means of which the jet of water ejected from the tunnel can be given a desired direction and in order to improve the flow of the water to the propeller. These expedients have not been of substantial value.

In accordance with the present invention, means are provided whereby an improved flow of water through the steering tunnel and improved yaw control are obtained by introducing into the steering action components of force resulting from the movements of the ship. And more particularly, in accordance with the present invention, in addition to reversible or reversible pitch propeller in the transverse tunnel, screens or vanes are mounted in the hull of the ship, these vanes being extendible and retractable so that the force of the water against the vanes or screens during the movement of the ship exerts forces tending to turn or yaw the ship and at the same time to direct water more efficiently through the tunnel so that operation of the propeller and the action of the jet of water is substantially improved. When the steering system is in use or vanes adjacent the ends of the tunnel is projected from the hull side in a plane which is substantially transverse to the direction which the ship moves and in a position directly behind one open end of the tunnel in relation to the direction which the ship is moving at the time. When the steering tunnel is located in the fore-part of the ship, the screen or vane on the port-side of the ship is projected to aid in steering the ship towards port when the ship is running ahead. By the same token, the starboard screen is projected to aid in the steering of the ship toward starboard when the ship is moving forward. When the steering gear is located in the aft part of the ship, the starboard screen is projected to steer the ship towards port when the ship is running ahead and the port-screen is projected to steer the ship towards starboard. Various combinations of screens and tunnels may be provided in the ship in order to provide for steering when the ship is proceeding forward or astern and in this way, the maneuverability of the ship is greatly increased throughout a wide range of operating speeds thereby facilitating the maneuvering of the ship while docking and also when running at higher speeds.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which FIG. 1 is a schematic illustration of a steering system of the conventional transverse tunnel and propeller type illustrating the pressures or combinations and forces existing when the ship is running ahead during a port yaw;

FIG. 2 illustrates schematically a steering system embodying the present invention and showing the conditions of flow and pressure existing when the ship is running ahead during a port yaw;

FIG. 3 is a schematic illustration of a ship provided with two steering systems embodying the present invention, one located in the fore-part and one in the aft part of the ship and showing the conditions of flow and pressure existing when the ship is running ahead during a port yaw;

FIG. 4 illustrates schematically the ship disclosed in FIG. 3 running astern during a port yaw;

FIG. 5 is a horizontal cross-sectional view of a portion of a ship's hull including a retractable steering screen or vane embodying the present invention;

FIG. 6 is a partial sectional and elevational view of the screen illustrated in FIG. 5;

FIG. 7 is a side elevational view of a portion of a ship's hull illustrating one end of the tunnel and a typical steering screen or vane associated therewith;

FIG. 8 is a side elevational view of a portion of a ship's hull illustrating a modified form of tunnel and steering screen or vane associated therewith;

FIG. 9 is a plan and partial sectional view of a portion of a ship's hull including a modified form of steering vane or screen embodying the present invention;

FIG. 10 is a side elevational view of a portion of a ship's hull showing the tunnel opening and a steering vane or screen of the type shown in FIG. 9;

FIG. 11 is a horizontal sectional view of a portion of a ship's hull illustrating a further modification of the steering screen or vane embodying the present invention;

FIG. 12 is a view in horizontal cross-section through a ship's hull showing the steering system with the screens or vanes disposed in the position assumed during a port yaw while the ship is running ahead; and

FIG. 13 is a horizontal sectional view through a portion of the ship's hull illustrating the position of the steering vane when the steering system is about to be set into operation.

As disclosed in FIG. 1, the hull 1 of a ship has in its bow portion a steering system of known type, such as the system disclosed in the Jardino U.S. Patent No. 3,002,584 consisting of a reversible or reversible pitch propeller 3, arranged in a tunnel 5 located transversely in relation to the longitudinal direction of the ship and having open ends 7 and 9 in the opposite sides of the hull. When the propeller is driven to pump water through the tunnel 5, a torque K1 in direction of the tunnel 5 will act upon the hull 1 to push it laterally.
When it is desired to cause the ship to yaw to port, the propeller 3 is driven to pump water to starboard, and the torque K1 is then directed towards port. When the hull 11, when it is desired to yaw to port, an increase of pressure will arise in the water alongside the port fore-part of the ship. This increase of pressure (in the figure marked +) produces forces K2 and K3, directed towards the hull 1. At the same time the pressure alongside the starboard fore-part of the ship decreases (in the figure marked –), and produces forces K4 and K5, directed away from the hull 1. Thus, in the above-described case the thrusts K2, K3, K4, and K5 on the sides of the hull 1 tend to counteract the torque K1, reducing in consequence the effect of the steering gear, especially at average and higher ship speeds.

As shown in FIG. 2 and in accordance with the invention, the hull 1 is provided with retractable screens or vanes 11 at opposite end of the tunnel (only one being shown) in addition to steering system of the type described above including a reversible or reversible pitch propeller in a transverse tunnel having open ends. One of the screens 11 is located at the aft edge of the tunnel opening 7 and is disposed in a plane substantially transverse to the longitudinal direction of the ship. As the propeller 3 is driven to pump water through the tunnel 5 towards starboard, the torque K1 produces a yaw towards port. While the ship is running ahead, the screen or vane resists the resistance of water against it, being influenced by a force K6, which through its moment arm A produces a yawing moment towards port. Just behind the screen or vane 11 the pressure in the water decreases, causing a force K7 outwardly from the port side of the fore-part of the ship, which force also provides a yawing moment towards port. The fore-part of the ship is, in addition, influenced by the forces K2, K4, and K5, as indicated in the example disclosed in FIG. 1.

While the ship is running, the screen or vane 11 operates thus in the following three ways:

(1) It improves the flow of water into the tunnel 5, with an increase in the torque K1.

(2) By its resistance in water it provides a force K6, which gives a yawing moment.

(3) By a decrease of pressure in the water along the ship side just behind the screen, it provides a force K7, which results in a yawing moment.

FIG. 3 illustrates a ship provided with no steering system according to the invention, one located in the forward part and one in the aft part of the ship. When the ship runs ahead, during a yaw towards port, the steering system in the fore-part of the ship operates as described in connection with FIG. 2.

As to the steering gear in the aft part of the ship, when its starboard screen 11 is pushed out, the steering system in the aft part of the ship will act upon the hull 1 with yawing moments caused by the torque K1 from the propeller 3, and a force K8 behind the screen 11. The screen 11, moreover, be exposed to a force K9 which by its direction in relation to the yawing centre of the ship will tend to counteract the yaw.

FIG. 4 shows a ship provided with two steering systems according to the invention, one in the fore-part and one in the aft part of the ship. The aft steering system is in this case also provided with the screens or vanes 13 which are located in a plane substantially transverse to the longitudinal direction of the ship, at the forward edge of the tunnel ends 7 and 9. When the ship is running astern during a yaw towards port, the port screen or vane 13 will be turned to working position and will in that position be acted upon by a force K10. The screen or vane 13 will also assure that the hull 1 forward of the screen 13 is influenced by a force K11. These two forces together, and the torque K1 from the propeller 3, will give a yawing moment to port.

FIGS. 5 and 6 show in principle the design and the installation in the hull 1, of a retractable screen or vane. The screen or vane 14 is in a forward of the tunnel 5' in a well W sealed off from the interior of the hull and can, by means of a servomotor 15, be projected out or retracted into the well W at an angle to the ship side so that the effect of the screen in the projected position becomes optimum. The screen 14 is suitably guided on ways 17 in the well W which absorb the forces exerted on the screen, so that these will not overload the servomotor 15. The servomotor 15 can be of any suitable type, for example, a hydraulic or pneumatic servomotor or an electric motor-driven screw.

FIG. 7 shows a suitable shape for a screen or vane 14' for use with a tunnel 5' of elliptical cross-section. The vane 14', as illustrated, may be of semi-circular cross-section and can be mounted for projection and retraction in the manner shown in FIGS. 5 and 6.

As shown in FIG. 8, with tunnel openings 16 of rectangular cross-section, the screen or the vane 14' may be a flat plate.

FIGS. 9 and 10 show a variation of the invention where the screen or vane 18 is pivotally mounted so that it can be swung around the axis of a shaft 19 which is substantially parallel to the side of the hull. When the screen 18 is not used for steering, it is retracted into a recess 21 in the ship's hull. The screen 18 is swung out and in by means of crank arms 23 on the shaft 19, connected to hydraulic cylinders or servomotors 25. Instead of axial servomotors 25 and the crank arms 23, torque servomotors can be connected to the shaft 19 or such torque servomotor itself may form the shaft 19.

FIGS. 11, 12 and 13 show another variation of steering system according to the invention, in which pivotally mounted screens or vanes 26 can, when the steering system is not used, cover the ends of the tunnel 27 thereby reducing the resistance caused by the tunnel while the ship travels at high speed. Each screen or vane 26 is supported by shafts 27 and 29 and a crank 31 connected to the hull 1 at the aft edges of the ends of the tunnel 27. The turning movement round the shaft 28 is produced by axial servomotors 32 or torque servomotors, and the turning movement round the shaft 29 suitably by means of a torque servomotor. When the steering system is not used and the screens or vanes 26 close the ends of the tunnel, they are secured by means of suitable locking devices 33.

FIG. 11 shows the screen 26 covering the end of the tunnel 27 while the steering system is not used.

FIG. 12 shows the position of the screens 26 as the ship runs ahead to produce a yaw toward port. FIG. 13 illustrates the position of the screens 26 as the ship runs ahead with the steering gear ready for use.

With a steering gear according to the invention the control of the propellers or propellers in the tunnels, the screens and the locking devices 33 can be coordinated by means of known types of devices so that all functions of the steering system can be controlled by only one steering lever.

It will be understood that the drive means for the steering propeller may be of any suitable type such as, for example, a reversible drive connected to a fixed pitch propeller or a one-way drive for a reversible pitch propeller as disclosed in Jordom Patent No. 3,002,486.

As indicated above, steering systems of the type embodying the present invention can be located in the forward or aft portions of the ship's hull or both and the steering vanes or screens may be positioned forward and aft of each of the tunnels in order to provide enhanced maneuverability of the ship when moving either ahead or astern.

Inasmuch as the examples of the invention given hereinafore are susceptible to further variation and modification within the scope of the invention, the examples should be considered as illustrative.

I claim:

1. In a steering system for a ship having an open ended
transverse tunnel therethrough below the waterline of said ship and adjacent at least one end of said ship, a propeller in said tunnel and means to drive said propeller to force water through said tunnel in either direction, the improvement comprising a vane on said ship adjacent to and rearwardly of each end of said tunnel in the direction of movement of said ship each vane being mounted independently for movement between a retracted position on the ship and a position in which it is extended outwardly substantially transversely of the length of the ship with its outer edge spaced from the ship's hull and its major surface presented in substantially unobstructed relation to the water moving relatively toward it, thereby to sweep water and direct it into the tunnel and to alter the forces acting on the ship's hull and augment when the ship is under longitudinal way the yawing moment on the ship created by the propeller, and means for selectively projecting a portion of said vane outwardly from said ship and retracting said vane into said ship.

2. The steering system set forth in claim 1 in which said tunnel is substantially circular in cross-section and said vane is semi-circular in cross-section.

3. The steering system set forth in claim 1 in which said tunnel has substantially polygonal open ends and said vane is substantially flat.

4. The steering system set forth in claim 1 comprising ways in said ship, and means movably mounting said vanes on said ways for guiding and supporting said vanes for projection and retraction.

5. The steering system set forth in claim 1 comprising means pivotally supporting said vanes on said ship, and recesses in said ship adjacent to said open ends of said tunnel for receiving said vanes when they are retracted.

6. The steering system set forth in claim 1 comprising means pivotally supporting said vanes for projection at an angle to the direction of movement of said ship and retraction into covering relation to the ends of said tunnel.

7. The steering system set forth in claim 6 comprising means for locking said vanes in retracted covering relation to the ends of said tunnel.

8. The steering system set forth in claim 6 in which said vanes are pivotally movable to a position rearwardly of said tunnel and substantially parallel to the direction of movement of said ship.

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