FIG. 2

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This application is a continuation-in-part of application Ser. No. 178,383, filed August 9, 1950, in the name of Sylvester Sparling. That application has been abandoned.

The present invention relates to ship-propelling apparatus and more particularly to such apparatus wherein a primary screw or jet propeller, or other propelling device, operating in a known manner, activates an impeller which in turn drives a secondary propeller to impart additional propelling effort to the ship. The invention is especially useful in its application to slow-speed ships, to which use, however, it is not restricted.

The invention provides an impeller-propeller unit acting as auxiliary propelling means wherein the entire slip stream from the primary propeller or jet propulsion means is captured and effectively used by an impeller separately carried by the ship. Furthermore, air bubbles are kept out of the slip stream within the impeller so that the slip stream delivers a heavy impact and thrust against the impeller blades. There is a secondary propeller, carried by the ship and outside the impeller. This secondary propeller turns with the rotating impeller and imparts additional propelling effort to the ship through the means which mounts it independently and directly on the ship. The independently carried impeller-propeller unit does not interfere with operation of the primary propeller, and imposes no burden thereon.

In the accompanying drawings:

Fig. 1 is a semi-diagrammatic view, partly in section, of the stern of a propeller-driven ship with one embodiment of the novel propelling apparatus applied thereto, parts being broken away and the dot-and-dash arrows showing the directions of movement of the water.

Fig. 2 is a semi-diagrammatic view in end elevation illustrating the primary propeller and the position of the shell of the impeller of the invention with respect thereto; the view being taken forward of the propeller looking aft on the line 2--2 of Fig. 1.

Fig. 3 is a view similar to Fig. 2 but showing only the impeller and primary propeller blades of the embodiment of Figs. 1 and 2; the point marked with the arrow V being shown in Fig. 1 in down position.

Fig. 4 is a detail plan view of the hub of the impeller-propeller unit of the embodiment of Figs. 1-3.

Fig. 5 is a view similar to Fig. 1, of a preferred embodiment of the invention in which there are twelve impeller blades.

Fig. 6 is a face view in elevation looking to the rear, showing the impeller-propeller arrangement of the embodiment of Fig. 5.

Fig. 7 is a developed detail view of part of the shell and blades of the unit of Figs. 5 and 6, showing a modified form.

Fig. 8 is a view similar to Fig. 7, of another form of shell and impeller blades peculiarly adapted for backing the ship.

Fig. 9 is a view similar to Fig. 6, of an improved arrangement of impeller blades in which there are eighteen blades.

Fig. 10 is a view similar to Figs. 1 and 5 of one of the novel impeller-propeller units installed on a ship driven by jet propulsion.

Fig. 11 is a view similar to part of Figs. 1 and 5 in which the main propeller shaft and the hub of the impeller-propeller unit are interfitted to prevent lateral vibration, but turn freely with relation to each other.

In the embodiment of the invention illustrated in Figs. 1-4 of the drawings there is shown the stern of a ship 10 carrying the novel ship-propelling apparatus which is the subject of the present invention. In the ship shown there is a primary propeller comprising three blades 11A, 11B and 11C fixed to a propeller shaft 12 of the ship 10 in the usual manner. The shaft is driven by any desired prime mover 22. Behind the primary propeller 11, and independently thereof, the ship carries a separate novel impeller-propeller apparatus 13 for rotation coaxially with the primary propeller. The object of the separate impeller-propeller apparatus is to capture and convert into additional propelling effort impulses from the slip stream of the primary propeller which ordinarily are wasted, and to do so with little increase in the load on the ship's engine.

As here shown, the mounting of this secondary apparatus comprises a strut 14 hanging from the overhang 15 of the stern of the ship 10. This strut carries a shaft 16 coaxial with but behind the propeller shaft 12 of the ship. These two shafts are not connected to each other. The impeller-propeller apparatus 13 is rotatably carried by the shaft 16. Although the shaft may be fixed to the strut 14 and the separate impeller-propeller apparatus 13 rotated thereon, it is preferred that the shaft be rotatably carried by the strut. Therefore, there is shown a rotatable connection between the shaft and the strut in Fig. 1, a fore-and-aft thrust bearing 17 serving to prevent axial movement of the shaft 16 with respect to the strut, and also to transfer to the strut any force exerted upon the shaft 16.

The impeller-propeller apparatus 13 is carried upon the shaft 16 by means of an impeller hub.
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In the drawings, merely for the sake of illustration, is shown the shaft 16 rotatable in the strut and the hub tight upon the shaft.

The impeller of the impeller-propeller apparatus 13 comprises blades 19 centrally fixed to the hub 18 and extending outwardly therefrom in generally radial directions. Six such impeller blades 1A, 1B, 1C, 1D, 1E, and 1F are shown in Fig. 3 of the drawings. More blades may be used. A cylindrical casing, cylinder or shell 20 is carried by the outer ends of the impeller blades coaxial with the impeller hub 18. In order that the impeller may receive substantially the entire slip stream of the primary propeller 11, the cylindrical shell 20 is disposed with its forward end surrounding the rear part of the primary propeller (see Fig. 1). Thus the back, i.e., rear or suction edges of the primary propeller blades are inclosed by the cylindrical shell. The diameter of the shell is such that it closely surrounds the outermost edges of the primary propeller (see Fig. 2). On the other hand, the axial extent of the cylindrical shell 20 is such that the forward or suction edges of the primary propeller blades are in open water, and there is no interference with the effective operation of the primary propeller. The cylindrical shell accordingly receives and confines therein substantially the entire slip stream, and its axial extent rearwardly of the primary propeller causes the impeller blades to react fully to the energy of the slip stream. The primary propeller and the impeller-propeller apparatus 13 both turn in the same direction as indicated by the long arrows in Figs. 2 and 3. Looking aft, they turn counterclockwise.

The impeller blades 19 are carefully designed and arranged to turn the impeller-propeller apparatus 13 with greatest efficiency. It is found advantageous to position the impeller blades as closely as possible to the pumping edges and the outermost ends of the primary propeller blades. Accordingly, the forward edges of the impeller blades 19 are formed to follow the contour of the pumping edges of the primary propeller blades, and are positioned as closely thereto as is consistent with necessary operating clearance (see Fig. 1). Because of this construction the slip stream from the primary propeller 11 is prevented from moving ineffectively within the impeller.

Furthermore, the impeller blades 19 are formed and fixed in position to extend rearwardly of the impeller from their forward edges for about two-thirds of their length in planes parallel to the axis of the impeller hub 18. The rear one-third of each impeller blade is curved out of such substantially longitudinal direction, as indicated in Fig. 1. In this figure impeller blade 19B is 30° above horizontal leaning toward the observer and impeller blade 19C is 30° below horizontal facing toward the observer. It has been found that the action of the slip stream upon blades so formed and disposed gives more effective thrust upon the blades than is the case where flat blades having more excessive pitch are used.

With the impeller and its blades constructed and arranged as described, efficient action of the slip stream to rotate the impeller-propeller apparatus is assured. Substantially the entire slip stream is received within the impeller. The lateral and centrifugal components of the slip stream, impinge upon the forward parts of the impeller blades to give initial turning impulses thereto (see the pairs of dot-and-dash arrows on blade 19B in Fig. 1). The angle of impingement is about 70°-80°, as indicated by the pair of arrows. As the initial turning energy of the slip stream is converted into turning movement of the impeller-propeller apparatus, the water of the slip stream is directed rearwardly by the impeller blades 18 (see the single dot-and-dash arrow on blade 18B and the dash arrow hidden by blade 18C). As this rearwardly moving water comes into contact with the curved rear one-third of the impeller blades, it gives a second turning impulse to the impeller-propeller apparatus. Finally, a third thrust is given as the rearwardly moving water of the slip stream is deflected off of the ends of the impeller blades and leaves the impeller.

In order that rotation of the impeller-propeller apparatus may impart the additional propelling effort to the ship through the strut 14, a secondary propeller is carried by the impeller externally thereof to complete the apparatus. Thus, as the impeller is rotated by the slip stream, the secondary propeller turns with the impeller and exerts a thrust against the clear water outside of the impeller. The reaction of the water to this thrust is carried through the impeller and the shaft 18 to the strut 14. Instead of employing a single continuous secondary propeller blade, it is found convenient to provide separate secondary propeller blades, and three such blades 21A, 21B and 21C are shown in Figs. 1 and 3 of the drawings.

In order to eliminate loss of energy through air bubbles and to secure the most power from the water in the slip stream from the primary propeller, means is provided for removing air bubbles from the slip stream within the impeller. For this purpose the forward end of the impeller hub 18 is made of the same diameter as the after end of the primary propeller hub, and it is positioned as closely adjacent thereto as possible. The diameter of the impeller hub 18 is increased rearwardly thereof to give the hub a cone formation (see Fig. 4). As a result of forming and positioning the impeller hub as described, the water passing through the impeller is compacted by the removal of air bubbles therefrom.

As a result of the invention, substantially the entire slip stream from the primary propeller is captured and its energy is effectively used by the impeller. The impeller-propeller apparatus is carried entirely separate from the primary propeller. It applies the energy which it receives from the slip stream to the ship separately from the main propeller and main propeller shaft. The impeller-propeller apparatus does not interfere with effective operation of the primary propeller; and no direct burden is imposed upon the primary propeller by the impeller-propeller apparatus. But slight increase in power is required of the ship's engine due to restriction of the slip stream by the impeller. By practical test it is found that the present invention makes it possible for the primary propeller to attain 100% of rated shaft horse power. Adding thereto 40% from the slip stream gives a total of 140% rated shaft horse power.

In many cases it is desirable to extend the cylindrical shell forward to the point where the shell ends opposite the forward or suction edges of the primary propeller. Such a shell 23 is shown in the preferred embodiment of Fig. 5. The increase in length shown is about 10% and
starts from the center line of the primary propeller blades.

In Fig. 6 is shown the use of twelve impeller blades 24 instead of six. It will be noted that the width of the blades is shown somewhat reduced.

There are also shown six secondary propeller blades 25, each of which is shorter than the secondary propeller blades 21A, B, C, of Fig. 3.

The number of impeller blades can be increased still further to twenty, as shown in Fig. 9. It is shown in Fig. 3 that there are thirteen impeller blades. In this embodiment two kinds of blades are shown. There are six blades 19A, B, C, D, E, F, like those shown in Fig. 3. Interlaced between these are short intermediate blades 26. These intermediate blades are attached to the cylindrical shell 23 of the impeller-propeller unit and extend radially inward half the distance to the hub of the unit. Two such intermediate blades are shown between each two regular blades. These intermediate blades are shown half the width of the regular ones. This arrangement eases the passage of the water through the impeller. In this embodiment three secondary propeller blades 35 are shown, as in the embodiment of Figs. 1-5.

It has been found that on many ships the operation of the primary propeller pulls the water aft past the propeller faster than new water can come in to replace it. As a result of this pumping action of the blades there is a partial vacuum immediately aft of the primary propeller. In Figs. 6, 7 and 8 are shown means by which this vacuum is partially neutralized. These means consist of vacuum relief vents or holes 21 in the cylindrical shell of the impeller-propeller unit. These holes are located in a position immediately aft or immediately forward of the center of the primary blades, the hole preferably being longer circumferentially than it is lengthwise of the shell. In Fig. 7 each hole is shown circumferentially as long as half the distance between the two propeller blades, assuming that there are six impeller blades in the impeller-propeller unit. The width of each hole is about 1/8 of the length in the examples shown in the drawings.

Another feature of the invention relates to the shaping of the impeller blades. As will be realized from the description heretofore given, it is very important in the present construction that both radial and axial components of movement of the slip stream be dealt with. It has been found not only that the slip stream is composed of two elements of energy, one lateral and the other working straight aft (and advantage of both components has been taken in the present invention), but also that the shape of the impeller blades can be varied slightly to give greater efficiency according to the kind of work for which the ship is built. In Fig. 4 are shown impeller blades which are curved at the rear end, and it has been found that this is the most efficient type of blade for long-range or coastwise sailing where a vessel is moved to and from the dock by tugs rather than by its main propelling equipment. On the other hand, in smaller vessels, such as, for example, harbor craft, where considerable maneuverability is desired, obtained from the main propelling equipment, it is found that the curved type of impeller blades is not as efficient when the engines are reversed as are the constructions shown in Figs. 7 and 8. In these figures the after ends of the blades are composed of either a single flat section 28, as shown in Fig. 8, or a plurality of smaller successive flat sections 29, as shown in Fig. 7. By thus having the after section of each blade composed of one or more sections of flat plate, increased efficiency, nearly equal to that obtained by the unbroken curve shown in Fig. 4, is obtained when the propeller is rotating in the reverse direction.

In Fig. 11 has been shown an embodiment in which there is a rearwardly projecting stub 36 on the rear ends of the primary propeller shaft. This fits freely into a hole in the front end of the impeller hub 18'. The two parts turn freely with relation to each other and there is no driving action between them. The purpose of this free interfitting is to prevent relative lateral vibration of the parts.

It will be obvious that ships propelled by jet propulsion rather than by the ordinary bladed propeller can also benefit greatly from the present invention, and in Fig. 10 the present invention is shown embodied in a jet-propelled ship. In this figure the after end of a jet motor 20 is shown at the left, with the arrows indicating the direction of movement of the fluid when the ship is going forward. Just aft of the rear end of the motor, closely adjacent thereto, is one of the novel impeller-propeller units carried on a bracket 31 bolted on the stern overhang 22 of the ship. The cylindrical shell 33 in the unit is shown as of the same diameter as the opening at the rear of the jet motor, and there are impeller blades 34 and secondary blades 35 of the same general nature as those previously described. It will be seen that the invention is equally applicable to screw propellers, jet propellers and other similar propelling devices or equipment.

It is desired to claim not only ship-propelling equipment or apparatus which includes the novel impeller-propeller unit, but also the unit by itself, since it may be possible in many instances to build and sell the propeller-impeller unit separately.

What is claimed is:

1. Ship-propelling apparatus comprising primary propelling means at the rear of the ship and an impeller-propeller unit carried by the ship separately from and behind the primary propelling means, said unit comprising in combination a cylindrical shell coaxial with the primary means of a diameter such that it surrounds the outermost edges of the primary propelling means and adapted to confine substantially the entire slip stream received from the primary means, impellers including blades located inside the shell, and secondary propelling means carried externally thereof in water outside the slip stream; thereby imparting additional propelling effort to the ship as the unit is rotated by the slip stream.

2. Ship-propelling apparatus according to claim 1 in which the impellers lie radially inside the shell in a direction longitudinal thereof but are curved away from the direction of rotation of the unit at their ends remote from the propeller, whereby the energy of both axial and longitudinal components of force in the slip stream are translated into rotation of the secondary blades in water outside the slip stream.

3. Ship-propelling apparatus according to claim 1 in which the forward edges of the impeller blades are fixed at an angle of substantially 70° to 80° to the direction of the slip stream.

4. Ship-propelling apparatus according to claim 1 in which some of the impeller blades ex-
tend only part way from the shell to the center, thereby easing the passage of the water through the impeller.

5. Ship-propelling apparatus according to claim 1 in which the impeller blades lie radially inside the shell in a direction substantially longitudinal thereof so as to receive the rotary component of force from the slipstream at an angle which will cause rotation of the unit and the rear ends of the impeller blades are curved out of such substantially longitudinal direction to catch the longitudinal components of force in the slip stream so as to also cause rotation of the unit, thereby imparting additional propelling effort to the ship through the secondary propelling means in the water outside the slip stream.

6. In ship-propelling apparatus a propeller shaft, a primary propeller on the shaft, and a cylindrical impeller carried by the ship separated from and behind the primary propeller and shaft in coaxial relation therewith of a diameter such that it surrounds the outermost edges of the primary propeller and adapted to receive substantially the entire slip stream from the primary propeller, in combination with a secondary propeller carried by the impeller externally thereof in water outside the slip stream for imparting additional propelling effort to the ship as the impeller rotates.

7. Ship-propelling apparatus comprising a propeller shaft and a primary propeller on the shaft, in combination with an impeller-propeller unit carried by the ship separately from and behind the primary propeller and coaxial therewith of a diameter such that it surrounds the outermost edges of the primary propeller and said unit having a cylindrical shell adapted to confine substantially the entire slip stream received from the primary propeller and extending forward to the forward edge of the primary blades, impellers inside the shell lying radially in a direction longitudinal of the shell with their ends remote from the propeller curved out of such substantially longitudinal direction and adapted to take energy from both axial and longitudinal components of force in the slip stream, and secondary propelling means carried externally of the shell in water outside the slip stream, whereby additional propelling effort is imparted to the ship as the unit is rotated by the slip stream.

8. Ship-propelling apparatus according to claim 1 in which there is a hub in the propeller-impeller unit to carry the shell, and in which the impeller blades lie radially inside the shell in a direction longitudinal thereof but curved at their ends remote from the propeller, whereby the energy of both axial and longitudinal components of force in the slip stream are translated into rotation of the secondary blades in water outside the slip stream; the diameter of the hub increasing rearwardly so as to give the hub a cone formation to remove air bubbles from the slip stream within the impeller.

9. Ship-propelling apparatus comprising a propeller shaft, a primary propeller fixed to the propeller shaft, impeller-propeller apparatus carried by the ship separately from, located for rotation behind and coaxial with, the primary propeller shaft, said impeller-propeller apparatus comprising a hub, in combination with a cylindrical impeller carried by the hub and of such diameter and so disposed that its end nearest the primary propeller surrounds the rear part of the primary propeller to receive therein substantially the entire slip stream from the primary propeller, and blades fixed within and forming part of the impeller for reacting under the force of the slip stream to rotate the impeller; and secondary propeller blades carried by the impeller externally thereof in water outside the slip stream for imparting additional propelling effort to the ship as the impeller rotates; the diameter of the hub increasing rearwardly thereof to give the hub a cone formation to remove air bubbles from the slip stream within the impeller.

10. Ship-propelling apparatus comprising a propeller shaft, and a primary propeller fixed on the propeller shaft, an impeller-propeller apparatus carried by the ship separately from, located for rotation behind and coaxial with, the primary propeller shaft, said impeller-propeller apparatus comprising a hub in combination with a hollow cylinder coaxially fixed to the hub and carried thereby and of such diameter and so disposed that its end nearest the primary propeller surrounds the rear part of the ship's primary propeller to receive therein substantially the entire slip stream from the primary propeller, impeller blades fixed within the cylinder for reacting under the force of the slip stream to rotate the blades and cylinder, and secondary propeller blades carried by said cylinder externally thereof for imparting additional propelling effort to the ship as the impeller rotates; the diameter of the hub increasing rearwardly thereof to give the hub a cone formation to remove air bubbles from the slip stream within the impeller.

11. Ship-propelling apparatus comprising a propeller shaft, a primary propeller fixed to the shaft, a secondary shaft independent from the primary shaft but located behind and coaxial therewith, a hub fixed to the secondary shaft and disposed with one of its ends closely adjacent to the hub of the primary propeller, and a plurality of impeller blades around the hub extending radially therefrom and also in a direction longitudinal thereof for the major part of their length but curved out of such substantially longitudinal direction at their ends remote from the propeller; and a cylindrical shell carried by the outer edges of the impeller blades of a diameter at least as great as the primary propeller, surrounding the hub coaxially therewith and extending along the hub for a distance greater than the width of the primary blades and for the full length of the impeller blades, the forward end of the shell surrounding a part of said primary propeller; in combination with secondary propeller blades carried by the shell externally thereof; whereby the cylinder confines the slip stream from said primary propeller, and the impeller blades receive the slip stream and both the rotary and longitudinal components are translated into rotation of the secondary blades in water outside the slip stream.

12. Ship-propelling apparatus comprising a propeller shaft, a primary propeller fixed to the shaft, a strut carried by the hull of the ship rearwardly of the primary propeller, a separate shaft rotatably carried by the strut behind the propeller shaft but coaxial therewith; a hub fixed to the separate shaft and disposed with one of its ends closely adjacent to the hub of the primary propeller, and a plurality of impeller blades fixed to the hub and extending outwardly thereof, in combination with a cylindrical shell carried by the outer edges of the impeller blades surround-
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ing the hub coaxial therewith; the forward end of the shell surrounding a part of the primary propeller and the forward edges of the impeller blades following the contour of the after edges of the blades of the primary propeller and being spaced therefrom with a minimum practical clearance; the hub being coned to expand rearwardly within the shell to remove air bubbles within the shell, and a plurality of secondary propeller blades carried by the shell externally thereof; whereby the shell confines the slip stream from the primary propeller, the impeller blades receive the slip stream from the primary propeller to rotate the shell and the secondary propeller blades apply additional propelling force to the ship through said strut.

13. Ship-propelling apparatus according to claim 1 in which vacuum vents are provided around the circumference of the shell at a point just aft of the back edge of the primary propelling means.

14. Ship-propelling apparatus according to claim 1 in which the impellers lie radially inside the shell, the forward part being substantially in a direction longitudinal thereof but the rear end at an angle directed away from that direction in an arc of at least one-sixth of a circle.

15. Ship-propelling apparatus comprising a propeller shaft and a primary propeller fixed to the propeller shaft, in combination with a shaft carried by the ship independently of coaxial with and rearwardly of its propeller shaft, and separate impeller-propeller apparatus carried by the independent shaft for rotation by the slip stream from the ship's primary propeller; the impeller-propeller apparatus comprising a hub carried by the independent shaft, the forward end of the hub having a diameter substantially equal to the diameter of the primary propeller hub and being disposed closely adjacent thereto to reduce turbulence and partial vacuum in the slip stream, a plurality of impeller blades extending outwardly from the hub and having their inner edges fixed thereto, forming a cylindrical shell coaxial with the hub fixed to the outer edges of the impeller blades surrounding the rearward part of the ship's propeller and extending rearwardly thereof the full length of the impeller blades, the hub being coned in rearwardly expanding form within the shell to remove turbulence from the slip stream, and secondary propeller means fixed externally to the cylinder, whereby the impeller-propeller apparatus receives the slip stream from the ship's primary propeller and is rotated thereby, and whereby rotation of said impeller-propeller apparatus provides additional propelling force to the ship through the separate shaft.

16. Ship-propelling apparatus comprising a propeller shaft, a primary propeller fixed to the shaft, a separate shaft suspended from the ship independently of but coaxial with and rearwardly of its propeller shaft, and a separate impeller-propeller apparatus carried by the separate shaft for rotation by the slip stream from the ship's primary propeller, the impeller-propeller apparatus comprising a hub carried by the separate shaft, a plurality of impeller blades extending outwardly from said hub and having their inner edges fixed thereto, forming a cylindrical shell coaxial with the hub fixed to the outer edges of the impeller blades surrounding the rearward part of the ship's propeller and extending rearwardly thereof to receive the slip stream from the ship's primary propeller; the forward edges of the impeller blades following the contour of the after edges of the blades of the ship's primary propeller and being spaced therefrom with a minimum practical clearance to insure maximum contact with the impeller blades by the slip stream, the forward edges of the impeller blades being fixed at an angle of substantially 70° to 80° to the direction of the slip stream, the impeller blades extending rearwardly of the impeller propeller apparatus substantially parallel to the axis of the hub for substantially 3/5 of their length and then being curved away from the direction of the length of said impeller-propeller mechanism for substantially 2/5 of their length, and a plurality of secondary propeller blades carried by the shell externally thereof; whereby the slip stream from the ship's primary propeller rotates the impeller-propeller apparatus to provide additional propelling force to the ship through the separate shaft.

17. Ship-propelling apparatus having a propeller shaft, a primary propeller fixed to the propeller shaft, a separate shaft suspended from the ship independently of but coaxial with and rearwardly of its propeller shaft, and a separate impeller-propeller carried by the separate shaft for rotation by the slip stream from the ship's primary propeller; the impeller-propeller apparatus comprising a hub carried by the separate shaft, the forward end of the hub having a diameter substantially equal to the diameter of the primary propeller hub and being disposed closely adjacent thereto to reduce turbulence and partial vacuum in the slip stream, a plurality of impeller blades extending outwardly from the hub and having their inner edges fixed thereto, a cylindrical shell coaxial with the hub fixed to the outer edges of the impeller blades surrounding the rearward part of the ship's propeller and extending rearwardly thereof to receive the slip stream from the ship's primary propeller; the hub being coned in rearwardly expanding form within the shell to remove turbulence from the slip stream; the forward edges of said impeller blades following the contour of the after edges of the blades of the ship's primary propeller and being spaced therefrom with a minimum practical clearance to insure maximum contact with the impeller blades by the slip stream, the forward edges of the impeller blades being fixed at an angle of substantially 70° to 80° to the direction of the slip stream, the impeller blades extending rearwardly of the impeller propeller apparatus substantially parallel to the axis of the hub for substantially 3/5 of their length and then being curved away from such substantially longitudinal direction for substantially 2/5 of their length; and a plurality of secondary propeller blades carried by the shell externally thereof; whereby the slip stream from the ship's primary propeller rotates the impeller-propeller apparatus to provide additional propelling force to the ship through the separate shaft, substantially as described.

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