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IMPELLER

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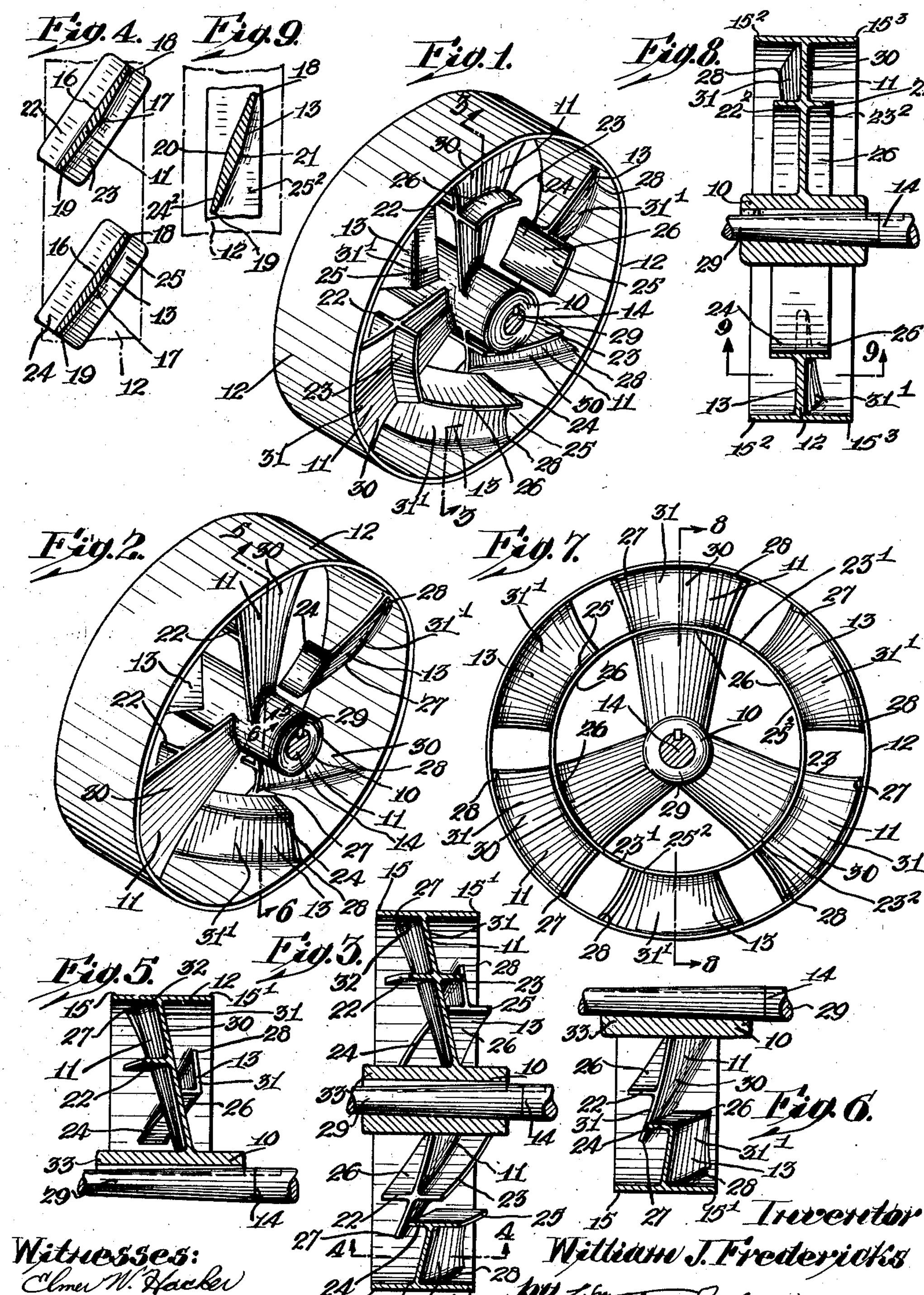

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IMPELLER

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The present invention novel in design, construction, action and effect relates to impellers and is believed to have its widest and best application to power driven impellers for operating different kinds of watercraft such as ships and boats, but is intended for any use to which it may be adapted.

A purpose of the invention is to improve the operating efficiency of a screw impeller and responsive steering of a ship by reducing the radial diversion and dissipation of water particularly from the hub to the rim of the impeller and directing this water rearward and against a rudder which lies in the wake of the impeller.

A further purpose is to confine the radial movement of water through the assistance of the impeller blades both along the lengths of the blades and between the blades so that the water as a body upon which the impeller works will have as little unchecked radial movement as possible.

A further purpose is to provide an impeller with retaining and directional vanes for confining and limiting radial movement of the water both on the front face and on the rear face of the impeller.

A further purpose is to cast an integral impeller with vanes at and inwardly of the blade ends and generally arcuate and longitudinal of the impeller axis.

A further purpose is to distribute the thrust through a plurality of impeller blades, suitably consisting of main and intermediate blades, to greatly reduce the vibration and convert the thrust into work or propelling force.

A further purpose is to reduce or eliminate fluttering of the blades.

A further purpose is to provide additional impeller blades supported by means of a baffle joining with the main impeller blades and controlling and directing the discharge of the water at the interior of the impeller, the baffle being preferably applicable both on the front and the rear faces of the impeller.

A further purpose is to provide the front of an impeller with blade vanes generally arcuate and longitudinal of the impeller axis.

A further purpose is to mount a circumferential longitudinally-extending rim upon the ends of one set of impeller blades and to carry an intermediate set of blades upon the interior of the rim, providing the blades of one or both sets with vanes generally arcuate and longitudinal of the impeller axis and on the rear and/or front of the blades.

A further purpose is to cone the blades of an impeller with respect to the impeller axis where the boat is intended mainly to move in one direction, so that the blade ends are axially offset, preferably rearwardly offset, from the hub ends of the blades, and desirably to extend the rim axially beyond the coned ends of the blades.

A further purpose, in boats operating mainly in one direction, is to concave the impeller taken as an entirety on the face away from the boat, so as to reduce radial throw of the water and cause the impeller to work more upon a "solid" body of water, drawing and discharging inlet water more at the circumference and less along the impeller shaft than would be the case without the concaving.

A further purpose is to employ coned blades whose rearward faces are plane.

Further purposes appear in the specification and in the claims.

I have elected to show one main form only of my invention, with minor modifications thereof, selecting however, several forms only, with slight modifications, that are practical and efficient in operation and which well illustrate the principles involved.

Figures 1 and 2 are perspective views showing somewhat different embodiments of the invention. In these views the observer is looking into the front or shaft face of the impeller.

Figure 3 is a section of Figure 1 taken upon the line 3—3 thereof.

Figure 4 is a section of Figure 3 on the line 4—4 thereof.

Figure 5 is a section of Figure 2 on the line 5—5 thereof.

Figure 6 is a section of Figure 2 on the line 6—6 thereof.

Figure 7 is a front elevation of a modified form.

Figure 8 is a section of Figure 7 on the line 8—8 thereof.

Figure 9 is a view corresponding to Figure 4, but showing a modification; also

Figure 9 is a section on the line 9—9 of Figure 8.

Like numerals refer to like parts in all figures.

Describing in illustration and not in limitation and referring to the drawing:—

Many prior art screw impellers or propellers for operating watercraft, whether large or small, have caused considerable radial outward flow of water from the hub to beyond the extreme outer diameter with consequent great lateral disturbance of the water. This represents a loss of efficiency, as much of the energy serving to throw the water radially outward is lost. This also produces near the impeller blades a churning and

eddying body of water of lower inertia rather than a relatively stationary or "solid" body of water of higher inertia on which the impeller must act. Furthermore, the responsive steering of the ship is slower and less efficient because some water from the impeller of the type referred to, instead of flowing sternward and adjacent to the rudder, which is directly aft of and normally behind or in the wake of the impeller, is to an appreciable extent diverted laterally due to the internal and external outward flow.

A corrective step has been made in the prior art to reduce this action by providing the impeller with a rim, surrounding the blades, and serving to reduce lateral or radial dispersion of the water. The blades act as a spider to support the rim. The rim has the further advantage of reducing the hazard of fouling from stray lines, tackle, or floating objects, as well as submerged ones.

It is necessary to allow space within the rim and between the blades for water to pass from the front or shaft face to the rear or wake face of the impeller. This requirement serves to restrict the number and size of the blades, but, since, the extremities of the blades are most effective in moving the ship, partial or intermediate blades have in the prior art been mounted on the rim between the points of attachment of two main blades to the rim. This arrangement leaves ample space, inside the partial blades and between the partial blades and the main blades, for water to flow through the impeller by virtue of the movement of the ship and the pumping action when the ship is in motion, or by virtue of gravity and the pumping action when the ship is working closely or drilling.

I have discovered that considerable efficiency has been lost even in rimmed impellers with or without partial blades by radial outward flow of water between the hub and the rim or by radial outward flow initiated by the inner portions of the blades. I find that I can reduce this by means of cones or deflectors, placed on the blades between the hub and the rim, and/or placed on the partial blades preferably at their inner edges, the vanes desirably being generally arcuate or circumferential and desirably also all at the same radial position, so that the vanes will not break up nor churn the water. I find it most important to have the vanes on the rear or wake face of the impeller (where I refer to the rear or wake face I assume that the ship is proceeding forward) and they may be omitted from the front face when the impeller is intended for a ship which will develop speed mainly in one direction. But where the impeller is to be used on a ship, such as a tug, ferry, or other self-handling and self docking vessel, which must move very readily forward or backward, the vanes will desirably be on both faces of the impeller.

Where the ship is to move mainly in one direction, I find that radial outward movement of water can be further reduced by coning the blades toward the wake face, that is, with the concave face toward the wake and the convex face toward the front. By cooperation of the vanes and the coning, radial outward movement of water is controlled and efficiently utilized.

My impeller, suitably an integral casting, includes a hub 10, main impeller blades 11 of one set carried by the hub, a rim 12 at the extremities of and carried by the main blades 11 and partial impeller blades 13 supported intermediate the blades 11 on the rim interior. The impeller is keyed to a suitable solid tapered shaft 14. At the wake (small) end of the shaft the usual fastening and retaining means (such as nuts and locking mechanism) is intended to be used but has been omitted from the illustration as it is well known. Any required number of blades 11 and 13 may be used, the number depending upon the size, speed, load, demand, etc. as in ordinary practice.

The rim 12 being both restraining and directional may desirably somewhat overhang the blades at 15 on the wake face of the impeller (or on each face where the ship is intended to drive well in either direction as in Figure 8), to restrain and redirect radial outward flow of water at that point. Each main blade 11 serves as a spider leg to support the rim and attachments, and should be constructed with sufficient strength for this purpose, as well as to function as a blade.

Where the impeller is intended to drive the ship mainly in one direction, the wake face of each main and partial blade is desirably flat or plane in circumferential cross section as shown at 16 in Figure 4, the thickening for strength being at 17 on the front face with sloping of the blades to thin edges at 18 and 19.

In case the impeller is intended to drive well in one direction and fairly well in the opposite direction, the thickening will be divided between the two faces of the blades as shown at 20 and 21 in Figure 9. The pitch of the blades will preferably be "uniform", that is, set steep adjacent the hub and reducing proportionally as the distance from the hub increases, so that each part of the blade's surface revolution will synchronize and act uniformly against the water and push accordingly with its proportional impulse. The pitch must be selected as that suitable for the size, speed, load and operation conditions of the vessel. The uniform pitch tends to give a streamline construction greatly reducing churning.

Vanes 22 are shown on the wake face of each blade 11 with vanes 23, permissibly identical with vanes 22 on the front face in Figure 1. On the inner extremity of each partial blade 13 is a vane 24 on the wake face with a vane 25, permissibly identical with vane 24 on the front face, in Figure 1. The vanes 22, 23, 24 and 25 constitute circumferentially extending flanges and are positioned intermediately between the hub and the rim.

The vanes are desirably equidistant from the axis (see Figure 3) so as to cause as little churning as possible. They are also desirably curved or arcuate at 26 to conform to the circumference of a circle whose center is at the axis, and slope to points at 27 and 28.

For a vessel intended chiefly to operate in one direction, (as in the case of a speed racer, for example) the vanes 23 and 25 may be omitted on the forward face, as they have little function on the forward face when the vessel is being driven forward. The vanes on the wake face, such as 22 and 24 only may this appear.

Vibration of the impeller results in part from fluttering of the blades. It is always objectionable both in itself and because it represents a waste of energy. The interspersing of the intermediate blades between the main impeller blades increases the number of water contacts about the circumference without undue increase in impeller weight and more efficiently and completely con-

verts the thrust into work, i. e. into smoother propelling force.

In Figure 2 vanes or flanges appear on both faces and are connected between 22 with 23 at 22′ and 24 with 25 at 24′ to form complete and connected annular vanes 22^2, 24^2. The central portion, axially between 22^2 and 24^2 and circumferentially between the main blades and partial blades is filled in by metal at 23′ to prevent radial flow of water.

Advantage may be obtained from the vanes 22 and/or 23 on the main blades 11 without using the vanes 24 and/or 25 on the partial blades 13, and advantage may be obtained from the vanes 24 and/or 25 on the partial blades 13 without using the vanes 22 and/or 23 on the main blades 11. However, the vanes are intended to prevent or reduce radial outward flow of water from the region 29 near the hub to the region 30 near the rim, where the bulk of useful work is done, so that the water acted upon by the outer parts 31 of the main blades and the surface 31′ of the partial blades will be relatively stationary and of high inertia, and relatively free from radial outward motion. Therefore, if either the vanes 22 or 23 or the vanes 24 or 25 are omitted, the advantage of those vanes which are used will be lessened, as the water acted upon by the main blade outer areas 31 and by the partial blade areas 31′ will then be churning because of the radial water flow taking place where the vanes are omitted.

The radial outward flow appears to be greater along the main blades 11 than between them, although due to slip there is a tendency for radial flow between the blades. It therefore is considered that the vanes 24 or 25 on the partial blades 13 can be spared more readily than the vanes 22 or 23 on the main blades 11, if all are not to be used. It will also be evident that the vanes 22 and 23 will be desirable even where partial blades are not used at all. Connection of the vanes into continuous circumferential bands forms a maximum protection against radial flow. Such a band may be used on the wake face only or bands can be used upon both faces.

Where the impeller is to act almost entirely in one direction its blades both main and partial blades, (preferably) will desirably be coned toward the wake, that is, so that the wake face as outlined by the blades will be concave and the front face convex, with the extremities 32 axially offset rearwardly of the hub ends 33. This is best seen in Figure 3, where the blades 11 and 13 generally conform to cone cross sections with respect to the axis. The coning produces a radial inward component of the velocity of the water leaving the wake face of a blade 11 or 13 so that the water is reasonably confined to a stream flowing directly sternward from the impeller, without serious lateral dissipation.

Where coning is used, the rim will preferably be extended axially at 15 on the wake face but preferably will not fully overhang the vanes at 15′ on the front. See Figures 3, 5 and 6 for differing overhangs.

For a ferry, tug or other ship operating freely in both directions, coning will not ordinarily be used, the blades being transverse to the axis as shown in Figure 8, and the rim overhanging desirably on the wake and on the front faces as shown at 15^2 and 15^3 in this figure.

The vanes and the coning cooperate to prevent or reduce radial outward flow of water from the impeller. By reducing radial outward flow, disturbance of the water around the impeller, which disturbance is very wasteful of energy, is cut down and efficiency is improved. Water inside the rim is less broken up and less churned, so that there is a more "solid" body of water of higher inertia on which the blades can act, also a concentrated stream is discharged into the wake passing directly to the rudder (in the single screw type of vessel), so that quicker response to the helm is consequently obtained.

The vanes perform a vitally important function in altering the direction of and turning water toward the rear which would otherwise be thrown radially outward by the portions of the impeller within the vanes and the rim performs a similar function for water which would otherwise be thrown radially outward by portions of the impeller outside the vanes. The vanes prevent or greatly reduce disadvantageous effect from water thrown by the impeller portions inside the vanes upon water thrown by the impeller portions outside the vanes. By arcuately shaping the vanes, and positioning them on a circumference, disturbance from them will be reduced to a minimum, the gain and advantage considerably overcoming any disadvantage.

Wherever I refer to the wake face of the impeller I mean that face which is toward the wake when the ship is being urged forward.

It will be evident that where the impeller, the rim and the vanes are coaxial as in my preferred construction, the vanes will exert a minimum disturbing influence.

It will be evident that the vanes upon the main blades and those upon the partial blades may be connected by webs to form continuous annular bands, as in Figure 7, whether the blades be coned or not and whether the bands be desired upon one face only or upon both faces, the bands being effective where used to close against radial water flow the space between the adjacent ends of the vanes upon the main and partial vanes respectively.

In view of my invention and disclosure, variations and modifications necessary to meet individual whim or particular need to obtain all or part of the benefits of my invention without copying the methods or structure shown will doubtless become evident to others skilled in the art and I therefore claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. An impeller for water craft having main blades and a cylindrical rim on the extremities of the blades to reduce radial outward motion of water at the wake, in combination with substantially arcuate blades which are parallel to the axis of the impeller, within the rim and located between the main blades to reduce radial outward motion of water across the wake toward the rim from points still farther inward, and to direct the wake to the rudder.

2. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes substantially arcuate and parallel to the rim axis and carried on the wake faces of the main blades.

3. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades

carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes substantially arcuate and parallel to the rim axis and carried on the forward faces of the partial blades.

4. In an impeller for water craft, a hub, a spider supported from the hub, a rim supported by the spider, partial blades supported by the rim and extending inwardly from it and vanes on the partial blades extending generally transversely to the blade face adjacent the innermost edge of the partial blade and said extension being generally parallel and arcuate to the hub axis.

5. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes coaxial with and substantially parallel to the rim axis and some carried upon the rear faces and some upon the front faces of the partial blades.

6. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes coaxial with and generally parallel to the rim, some carried upon the partial blades and some upon the main blades.

7. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades, vanes coaxial with and generally parallel to the rim axis, some carried upon the partial blades and some upon the main blades and connecting webs between the vanes on the partial blades and those on the main blades, the webs cooperating with the vanes to cut off radial water flow.

8. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes coaxial with and generally parallel to the rim axis and carried upon the main blades and also upon the partial blades, the vanes being positioned on the wake face of the main and partial blades.

9. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes coaxial with and generally parallel to the rim axis and carried some upon the main blades and some upon the partial blades, the vanes being positioned on the wake and also the front faces of the main and partial blades.

10. A plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades, vanes coaxial with and generally parallel to the rim axis and carried some upon the main blades and some upon the partial blades, the vanes being positioned on the wake and also the front face of the main and partial blades and connecting webs between the wake face vanes upon the main and upon the partial blades and between the front face vanes upon the main blades and upon the partial blades the webs cooperating with the vanes to cut off radial water flow.

11. In an impeller for water craft, a plurality of main blades, a rim uniting the outer ends of the main blades, partial blades carried by the rim and extending inwardly therefrom intermediate adjoining main blades and vanes coaxial with the rim, extending generally parallel to the rim axis and carried upon the wake faces of the main blades and also of the partial blades, the vanes upon all blades both main and partial being at approximately the same radius from the axis.

12. In an impeller for water craft, a hub, a plurality of blades extending radially from the hub and also extending toward the wake so as to concave the wake face of the impeller, a rim connecting the outer ends of the blades and vanes coaxial with the rim upon the wake faces of the blades at an intermediate point in the lengths of the blades, said vanes extending generally parallel to the impeller axis.

13. In an impeller for water craft, a hub, a plurality of blades extending radially from the hub and also extending toward the wake so as to concave the wake face of the impeller, a rim connecting the outer ends of the blades, partial blades supported by and extending inwardly and forwardly from their point of attachment to the rim and vanes coaxial with the rim and extending generally parallel to the impeller axis toward the wake from the inner ends of the partial blades.

14. In an impeller for water craft, a hub, a plurality of main blades on the hub, a rim supported by the ends of the main blades and a plurality of partial blades extending inwardly from the rim, the main and partial blades all being coned so as to present a concave face toward the wake.

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