Jan. 23, 1945. F. LOMAX 2,367,879

PROPELLER

Filed Dec. 21, 1943 2 Sheets-Sheet 1

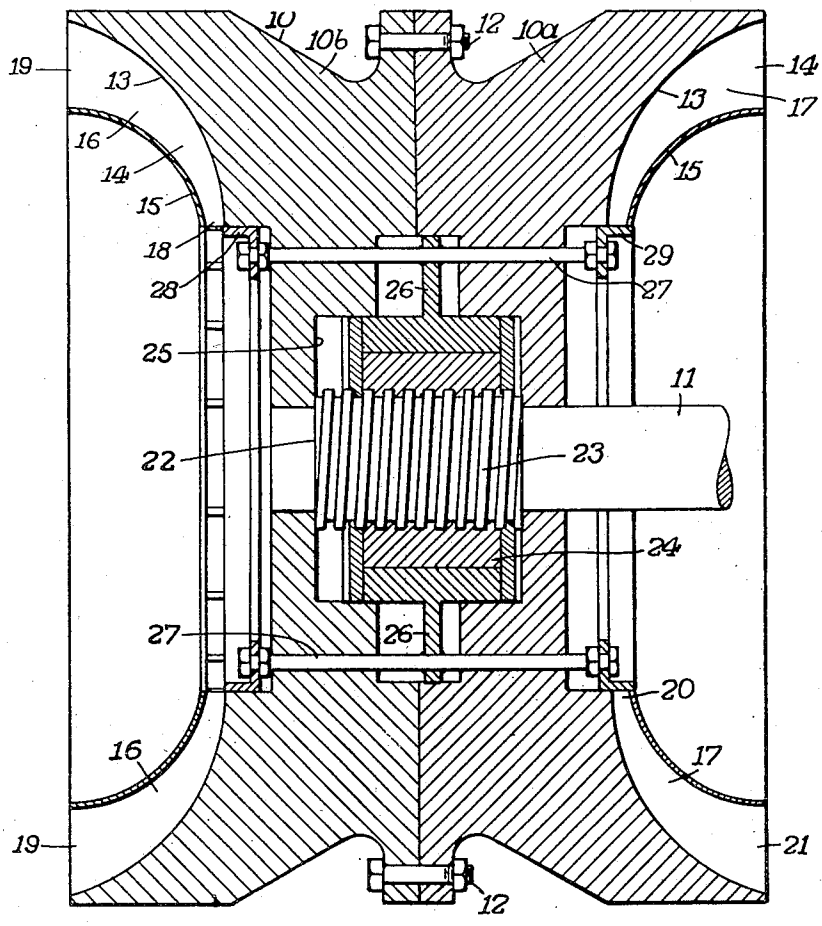


Fig. 1.

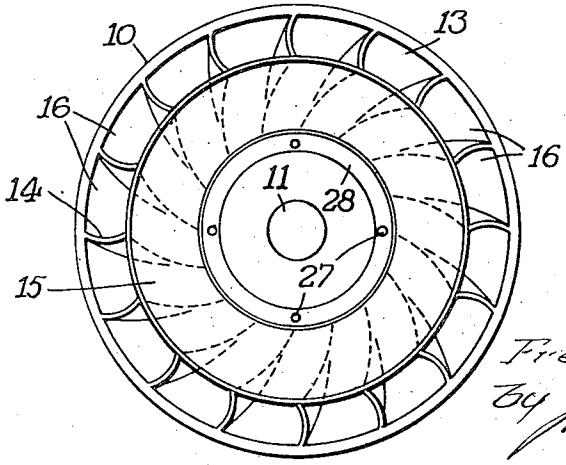


Fig. 2.

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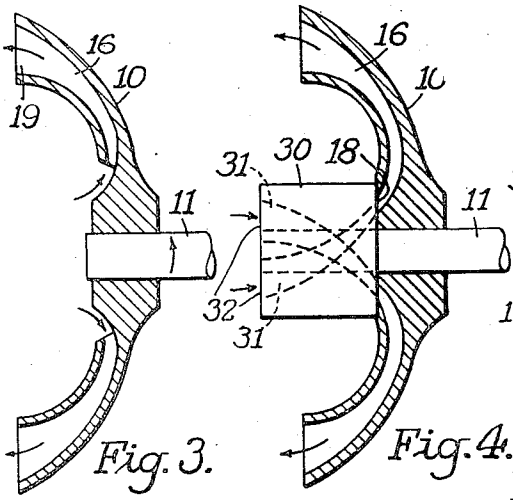


Fig. 3. Fig. 4.

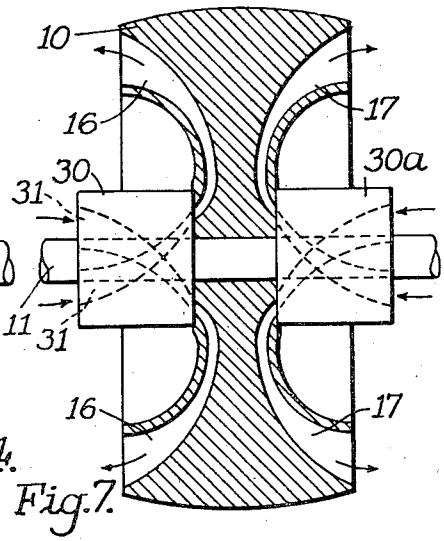


Fig. 7.

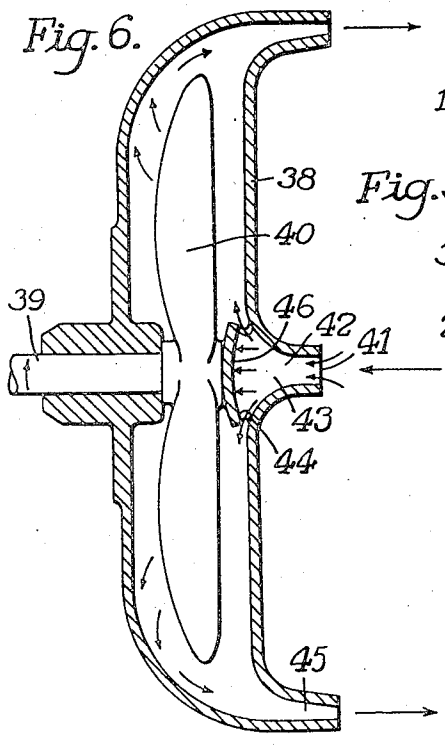


Fig. 6.

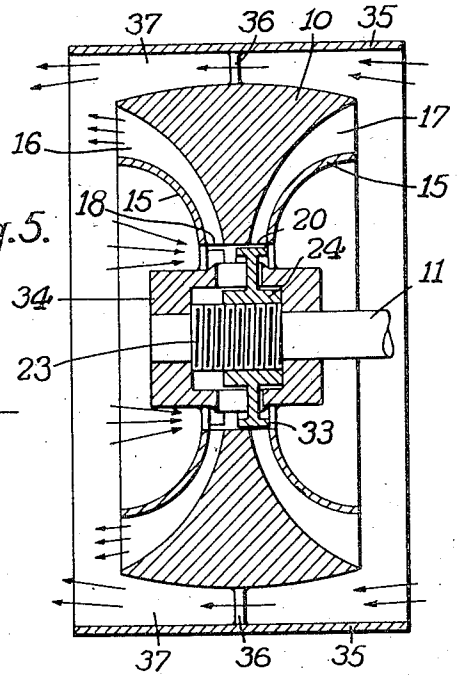


Fig. 5.

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UNITED STATES PATENT OFFICE

2,367,879

PROPELLER

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Application December 21, 1943, Serial No. 515,131
In Great Britain September 15, 1942

6 Claims. (Cl. 170—135)

This invention relates to improvements in propellers and propulsive arrangements for ships and like surface or submersible watercraft or like bodies, aeroplanes or like craft, and also to propulsive arrangements wherein supplementary power is required to be developed for suitable purposes.

The purpose of this invention is to provide a large amount of propulsive effort by means of a propeller, which is so arranged that a vacuum or suction is induced in the body of the propeller by the rotative motion and/or centrifugal action of the propeller in combination with the water, air, or like fluid, in which it is operating; also to utilise the force or pressure of the inflow of water, air, or the like, to the propeller, which is induced by the vacuum or suction created in and by the operation of the propeller, as an additional source of propulsive power, or effort, for the purpose of forcing or pushing the craft through the water, air, or the like, in the direction of travel. Additional propulsive effort can also be derived from the improved propeller by arranging the outflow, or discharge, of water, air, or the like, from the propeller to abut against the water, air, or the like, adjacent to or forming part of the inflow of fluid drawn into the propeller by reason of the vacuum or suction created therein, and thereby utilising the greater density or pressure of the surrounding water, air, or the like, created by the inflow as an abutment for the fluid ejected by the propeller.

According to the invention a fluid pressure propeller or impeller comprises a body having one or more inlet passages at or adjacent the axis of the body and a plurality of axially directed outlet openings for fluid disposed around its periphery, means being provided to create a current of fluid rearwards through the outlet openings to produce a driving thrust upon the body in an axial direction.

There is further provided according to the invention a fluid pressure propeller or impeller comprising a rotatable body formed with a plurality of spirally arranged tubular fluid passages each curved as seen in radial section and being formed with an inlet opening at that end nearer the axis of the body and with an outlet opening at its outer end, which outlet opening is directed substantially parallel with the axis of the body.

The invention is illustrated by way of example in the accompanying diagrammatic drawings, in which:

Figure 1 is a longitudinal sectional elevation of one form of propelling device intended primarily for use with liquid as the working medium;

Figure 2 is an end elevation corresponding to Figure 1;

Figure 3 is a longitudinal sectional view of a simplified form of propeller; and

Figures 4, 5, 6 and 7 are similar views of modified arrangements.

The preferred form of propeller as shown in Figures 1 and 2 comprises a body 10 which is arranged to be rotated about its axis by a propeller shaft 11. For convenience in manufacture the body 10 is formed in two portions, 10*a* and 10*b*, which are clamped together by bolts 12. The parts 10*a* and 10*b* are somewhat saucer-shaped and each has a curved annular surface 13, from which spirally arranged fins 14 project inwards. An annular cover 15 of somewhat semi-spherical shape is secured against the edges of the fins 14, thus providing a series of spirally arranged passages 16 at the rear of the body 10 and a similar set of passages 17 at the front of said body. Each passage has, at that end nearer the axis of the propeller shaft 11, an inlet opening 18 facing radially inwards. From this inlet opening the passage smoothly increases in cross-sectional area and is curved so that the opposite end of the passage constitutes an outlet opening 19 facing rearwards in a direction substantially parallel with the axis of the propeller shaft 11. In a similar manner the passages 17 each have inlet openings 20 and outlet openings 21.

The body 10 is free to rotate upon the propeller shaft 11, but is located in an axial direction by an enlargement 22 formed with a relatively coarse pitch screw thread 23, upon which latter is mounted a nut member 24. The nut member has a limited freedom to move axially within a cavity 25 formed in the body 10, so that when the propeller shaft 11 is driven in either direction the action of the screw thread 23 causes the nut member 24 to move axially to its appropriate extreme position, whereupon the parts become frictionally locked and the drive is transmitted from the propeller shaft 11 to the body 10. Projections 26 upon the nut member 24 are secured to rods 27 slidable in the body 10, the end parts of said rods being secured to annular valve members 28 and 29 adapted to control the inlet openings 18 and 20 respectively. When the propeller shaft 11 is rotated in the direction appropriate to forward movement of the ship to which the propeller is fitted, the nut member 24 is urged to the position shown in Figure 1, thus causing the valve member 29 to close the inlet

openings 20, while at the same time the valve member 28 is moved clear of the inlet openings 18; thus the passages 16 are operative and the passages 17 inoperative. When the ship reverses, the propeller shaft 11 is driven in the opposite direction, thus causing the nut member 24 to move over to the left-hand side of the cavity 25 so that the valve member 29 uncovers the inlet openings 20 of the passages 17 and at the same time the valve member 28 closes the passages 16. The passages 17 are arranged spirally in the opposite sense to the passages 16, so that the propeller then drives the ship rearwards, and this preferred form is preferably fitted with what I term jet propulsive rotors as depicted in Figure 7.

A simplified form of propeller is shown in Figure 3 and is intended primarily for operation in only one direction. The body 10 is in the form of a single saucer-shape member in which the passages 16 are formed conveniently by casting or the like. The inlet openings through which the liquid enters the passages 16 is again indicated at 18, and the outlet openings directed axially rearwards at 19.

The arrangement shown in Figure 4 is substantially the same as Figure 3, except that it is fitted with what I term a propulsive jet rotor, this comprising a cylindrical impeller block 30, which is fitted to the propeller shaft 11 and is formed with a circular series of somewhat helical passages, two of which are indicated in dotted lines at 31. The impeller block 30 butts against the body 10, and the passages 16 in said body are extended inwards and are curved rearwards so that their inlet openings 18 come into register each with the corresponding passage 31 in the impeller block 30. The inlet openings in the passages 31 of the impeller block are indicated at 32; these face rearwards and are arranged to be rather larger in cross-sectional area than the corresponding inlet openings 18. This can be fitted with inlet port opening and closing arrangements, if so desired.

The device shown in Figure 5 is arranged to be reversible in the same manner as the construction of Figures 1 and 2, the propeller shaft 11 being arranged to move the nut member 24. In this case said nut member actuates a single valve member 33, which latter is in the form of a short tube slidable across either set of inlet openings 18 and 20. The parts 15 of the body 10 are continued inwards to the hub portion 34 of the propeller, suitable apertures being formed in said members 15 to allow fluid to pass into the passages 16 or 17, depending upon the position of the nut member 24. The external surface of the body 10 is somewhat barrel-shaped and it is surrounded by a tubular shroud member 35 secured in position by radial spokes 36. This provides an annular space 37, which is reduced in width at its middle so as to produce a Venturi action as the liquid flows between the body 10 and the shroud 35. Alternatively the shroud may be composed of tubes or ducts arranged in a spiral or helical manner.

The device shown in Figure 6 is intended more especially for use with air as the working fluid, and comprises a body 38 in the form of a fixed hollow casing into which passes a rotatable shaft 39 fitted with a bladed propeller 40. At the centre of the casing 38 an inlet opening 41 is provided and leads through an axial passage 42 into a chamber 43 having openings 44 enabling air to pass to the propeller 40. The air is emitted at high velocity through tapering outlet passages 45 which are directed parallel with the axis of the device. The chamber 43 is fitted with a baffle plate 46 against which the incoming air entering through the opening 41 can impinge. This is preferably fitted with a jet propulsive rotor at the inlet port.

Figure 7 depicts an arrangement which is substantially the same as Figure 4, except that it is adapted to operate during rotation of the propeller shaft 11 in either direction, the action being then substantially the same as the device shown in Figures 1 and 2. As well as the impeller block 30 secured to the rear of the body 10 a second impeller block 30a is attached to what is normally the front of the body 10 for use more particularly when the ship is being driven backwards.

The improved device operates according to a new principle in propeller construction, i. e. a vacuum propeller. This improved propeller is primarily designed to operate or function in the form wherein, what I term, a jet propulsion rotor, or rotors, is attached to or combined with and forms part of this vacuum propeller and in which the propulsion jets of this rotor form the inlet port or ports of the propeller. The purpose of this improved propeller is to function as a means of additional or supplementary effort acting in conjunction with the usual screw or like propeller of a ship, or like craft, and is mounted on the same propeller shaft as the usual screw propeller, the shaft being extended or otherwise arranged for this purpose. Similarly, in the case of aircraft the usual airscrew shaft is extended or arranged, to mount this vacuum propeller in addition to the usual airscrew. Arrangements for mounting the improved propeller on the shaft are so adjusted that as little interference as possible with the normal operation of the usual screw propeller, or airscrew, is occasioned.

The ordinary or usual propeller is thus allowed to perform and develop its normal function and effort as transmitted by the propeller shaft, whilst the rotative effort required to operate this improved propeller through the propeller shaft will be small because of the rotative effort developed by means of the jet propulsive rotor forming part of this improved propeller. Actuated by the vacuum, formed within the body of this improved propeller, created by the comparatively greater outflow capacity than the inflow capacity, the jet propulsive rotor of this propeller transforms the inflow of fluid, which is drawn through the spiral or curved propulsion jets of the rotor by the vacuum created in the propeller body, into rotative effort by reason of the jet discharge of this rotor creating a clockwise movement of the rotor, when the fluid is discharged in an anti-clockwise direction, and so provides practically all the rotative or mechanical effort required for the operation of this improved propeller, except of course, when starting up, and thus leaves the normal power or effort developed by the power unit of the ship or the like, and transmitted through the propeller shaft to be utilised by the usual screw propeller, or the like.

Contingent, therefore, upon the small amount of effort required from the propeller shaft, this improved propeller provides a source of additional, or supplementary, propulsive effort for the purpose of forcing or pushing a ship, aircraft, or the like, through water or air as the case may be.

The manner in which this improved propeller is formed enables it to develop propulsive effort in different ways, the first by reason of the out-

flow which is discharged against the surrounding water or air in a backwards direction opposed to the direction in which the craft, or the like, is travelling, the second way is by means of utilising the inflow as a means of forcing or pushing the craft through the water, or air, in the direction of travel by reason of the concentrated central inflow through the jets or ports of the propulsion rotor, the inflow being drawn through the jets by the vacuum created in the propeller, and consequently, causing a concentrated or jet form inflow which creates a thrust forcing the craft in the direction of travel, the volume of inflow being the same as the volume of outflow. The third way of aiding the propulsive effort is by discharging the outflow from this propeller against the inflow to this propeller, or against the water or air adjacent to such inflow, which by reason of its direction of travel creates a more suitable abutment than the open or surrounding water or air.

It will be understood that the arrangements which have been described are given merely by way of example and that numerous modifications may be made.

The invention can be used on aircraft to utilise the slip stream as a means of propulsion by having the improved propellers, such as is shown in Figure 6, mounted on the tailplane or on a suitable member, or for towed or other gliders and the like, the rotative effort required by the propeller being provided by a ring of jets forming a rotative propulsive rotor arranged around or adjacent to a vaccum propeller of the improved type, or other suitable propeller if desired, a train of gears, or chain drive being used to transmit rotative effort to the propeller shaft, whilst the jet propulsive rotor is loosely mounted on the propeller shaft or the like with supporting spiders.

Propellers of the improved type may be formed with a number of inner and outer casings having blades, or vanes, arranged in the separate cavities formed between the separate or various casings, the central inflow or inlet port in this instance being common to all the cavities and each casing acting as both inner and outer casing, each having the central inlet port except the last or final casing, which would not be provided with the central inlet port.

In propellers of these types the blades or vanes may be of any suitable shape, form, or type, and the outflow, or discharge, port or ports may be formed as jets, if so desired, or in any suitable form, and arranged to discharge the water, or the like, in any suitable manner or direction. The propeller may be so arranged that the blades only rotate whilst the inner and outer casings are arranged as non-rotating members, whilst the inner and outer casings may be formed as part of or by the structure of the ship or like craft, if so desired.

A propeller of this type suitable for aircraft, or the like, is formed with inner and outer casings, and the inner casing is provided with the central inlet port or ports, whilst the blades or vanes are arranged in the cavity formed between the inner and outer casings of the propeller.

This propeller may also be formed with a number of airscrews encased between the inner and outer casings of the propeller, or by a number of bladed or vaned wheels, or other suitable arrangement, the inner casing being provided or formed with the central inlet or inflow port or ports, whilst the outer casing would have the outer edge extended or shaped to enclose the tips of the enclosed airscrew, bladed wheels, or the like, and to form the outlet port together with the outer edge of the inner casing, the circular or like outlet port thus formed ejecting the air or the like in a backward or other suitable direction. This outlet port may be suitably extended and shaped to enable the outflow to abut against the adjacent air, forming part of the intake or inflow to the inlet port of the propeller, if so desired. The outlet port or ports formed by the outer edges of the outer and inner casings of the propeller may be arranged in the form of one or more jets or the like, and these may be arranged to eject or discharge in any suitable direction, or in such a manner that added impetus is given to the rotary motion of the propeller.

The outer and inner casings of the propeller may be attached to and suspended from the engine mounting or otherwise suitably attached to the aircraft or the like, or if so desired the inner and outer casings may form part of, or be formed by, the structure or other member of the craft. Alternatively the whole propeller unit or parts thereof may be arranged to rotate, whilst the blades, vanes, or the like, may be fixed or attached to the outer and inner casings, or to the inner or outer casings of the propeller, and the propeller may be built in any suitable sections or arrangement. If so desired propellers of this type may be formed as dual direction propellers by providing means for closing the outlet and inlet ports normally used and arranging the outer casing with ports which may be opened as required for both inlet port and for an outlet port.

Where additional propulsive effort is required, a propeller of this type for use with aircraft is provided with a jet propulsion rotor of the type wherein a rotor having a number of propulsion jets arranged in a spiral, curved, or like manner, is used as the central inlet port or ports and is attached to the central port of the inner casing of the propeller, the inner casing and jet rotor being rotatable and mounted on the propeller shaft, the intake air, or the like, being drawn or forced through the propulsion jets of the jet rotor by the vacuum or suction created in the cavity of the propeller, whilst the outlet ports may be formed as propulsive jets arranged to discharge in any suitable manner.

A jet propulsion craft suitable for use in water, air, or the like, incorporating the principle whereby the inflow or propulsive fluid and/or the fluid adjacent to such inflow is used as the abutment against which the outflow or discharged propulsive fluid is ejected, may be formed where the craft is propelled by means of the intake and ejection of the water, air, or the like, in which the craft is suspended or borne.

This is formed by incorporating a suitable power unit within the craft for the purpose of causing an inflow of water, air, or the like, either into the craft itself, or the power unit therein, or to an attached unit such as a suitable propeller, jet ejector, or like suitable arrangement, and subsequently ejecting such air, water, or the like, against the inflow and/or fluid adjacent thereto. The inflow port or ports and the outflow or ejection port or ports would preferably be adjacent to each other for the purpose of obtaining the greatest propulsive effort by the ejection of fluid against the inflow or adjacent fluid.

In another form the jet propelled craft is

arranged with an air or water duct, funnel, or the like, or a number of these, passing either through, forming part of, or otherwise attached to the craft, the duct or ducts being open at each end to enable the air, or water, to pass through from one end to the other when the craft is in motion. This air or water duct would be provided with a number of ports, or the like, along its length, whilst the duct is shrouded, or enclosed, along part or the whole of its length by an outer sheath, tube, or the like, forming a surrounding chamber or chambers closed at the front end and open at the rear, this chamber being of relatively small size. This arrangement provides an additional means of propulsion by causing a stream of air or water to flow down and through the opened duct by reason of the motion of the craft passing through the air or water as it travels by the normal means of propulsion. The stream of air or water thus forced through the duct and flowing past the ports or the like provided in the duct causes a suction or partial vacuum at each of these ports and so extracts a quantity of air or water through each such port from the surrounding chamber formed by the outer sheath or the like, and so increases the total outflow of air, water, or the like. This outer chamber, or chambers, is thus continuously evacuated and replenished of air, or water, as the case may be, by this means from the open end of this chamber at the rear by reason of the suction or vacuum created in the outer chamber at the exhaust ports of the duct, and so creating an inflow at the open end of the outer chamber. Alternatively the air, water, or like, duct, open at each end, may be arranged as the outer member and the chamber, or chambers, formed with a closed front end, as the inner member and this inner member or chamber would be provided with ports leading into the air or water duct.

The air, water, or like, duct, is arranged to exhaust or eject the flow of air or water at or adjacent to the open end of the surrounding or partly surrounding chamber, so causing the ejected air, or water, to abut against the inflow of air or water entering the open end of the surrounding chamber, whilst the pressure of the inflow to this chamber provides propulsive effort.

In a further arrangement the air, water, or like, duct with the two open ends and surrounding chamber is formed with internal rotating blade wheels, vanes, turbine, or the like, mounted upon a suitable shaft, the blades or the like being rotated by the flow of air or water through the duct. This shaft carrying the bladed wheels or the like is extended at the rear of the craft, or duct, for the purpose of mounting a vacuum or other propeller or the like, thus combining the jet propulsive craft ejecting against an inflow, and the tunnel or duct flow driven propeller.

This arrangement is suitable for craft of the glider type or the like, or for the purpose of greatly increasing the bomb load, or the like, of aircraft by means of towed bombs of very heavy weights arranged in or as gliders of this type and which may be arranged with slip wings to be detached when tow ropes are released near or over the target, whilst they may be used as aerial torpedoes, or used for the purpose of towed cargo, or troop carriers.

Propellers of the types herein described may be built or arranged in or attached to any suitable type of craft, machine, or apparatus, or the like, whilst any or all of the types of propellers, craft, or arrangements, may be used in any suitable combination, or individually, or in any convenient form or method.

What I claim is:

1. A fluid handling propeller including a body, a propeller shaft for rotating the body, a fluid-flow element at each end of the body concentric with the propeller shaft, each element forming a plurality of passages radially of the body, each passage having a fluid inlet at the end adjacent the shaft and opening in a direction normal to the shaft, each of said passages having a fluid discharge outlet at the end remote from the shaft and opening in a direction in parallelism with the shaft, a control member operative with each element for opening or closing the fluid inlets of that element, means connecting the control members of the respective elements to compel simultaneous movement of said control members so that the fluid passages at one end of the body are opened while the passages at the other end are closed thereby, and means operated by the propeller shaft and attached to the connecting means for operating the control members in opposite directions incident to the respective directions of shaft rotation.

2. A fluid handling propeller including a body, a propeller shaft for rotating the body, a fluid-flow element at each end of the body concentric with the propeller shaft, each element forming a plurality of passages radially of the body, each passage having a fluid inlet at the end adjacent the shaft and opening in a direction normal to the shaft, each of said passages having a fluid discharge outlet at the end remote from the shaft and opening in a direction in parallelism with the shaft, the propeller shaft having a threaded portion within a recess in the body through which the shaft passes, a member cooperating with the threaded portion of the shaft and movable in one direction or the other axially of the shaft according to direction of shaft rotation, and means connected to and movable by said member to simultaneously open the fluid inlets of one set of passages while closing the fluid inlets of the other set of passages.

3. A construction as defined in claim 2, wherein the fluid inlets of each passage are arranged in an uninterrupted path concentric with the shaft, and wherein the means for controlling said fluid inlets comprises an annular valve member for simultaneously controlling all fluid inlets of an air-flow element.

4. A construction as defined in claim 1, wherein the passages in each fluid-flow element are of gradually increased transverse dimensions from the air inlet to the discharge outlet thereof.

5. A construction as defined in claim 1, wherein the fluid-flow elements are each formed by a depression in the end of the body, a plate overlying and spaced throughout the depression wall, and fins extending throughout the radial length of the space between the plate and depression wall and spaced apart to provide independent fluid passages.

6. A construction as defined in claim 1 wherein the control members are in the form of flat valves, and wherein the connecting means is in the form of rods extending through the body and terminally connected to the respective valves.

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