

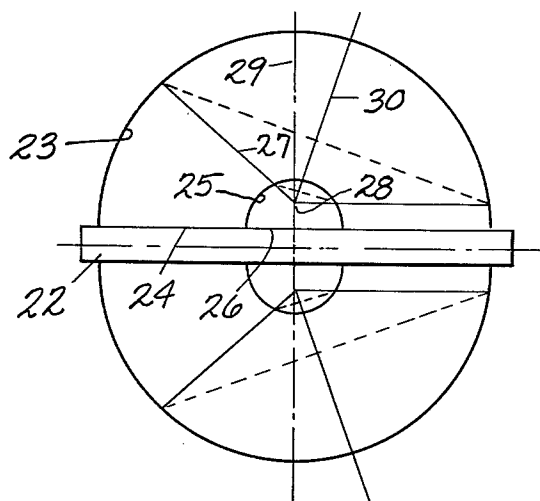
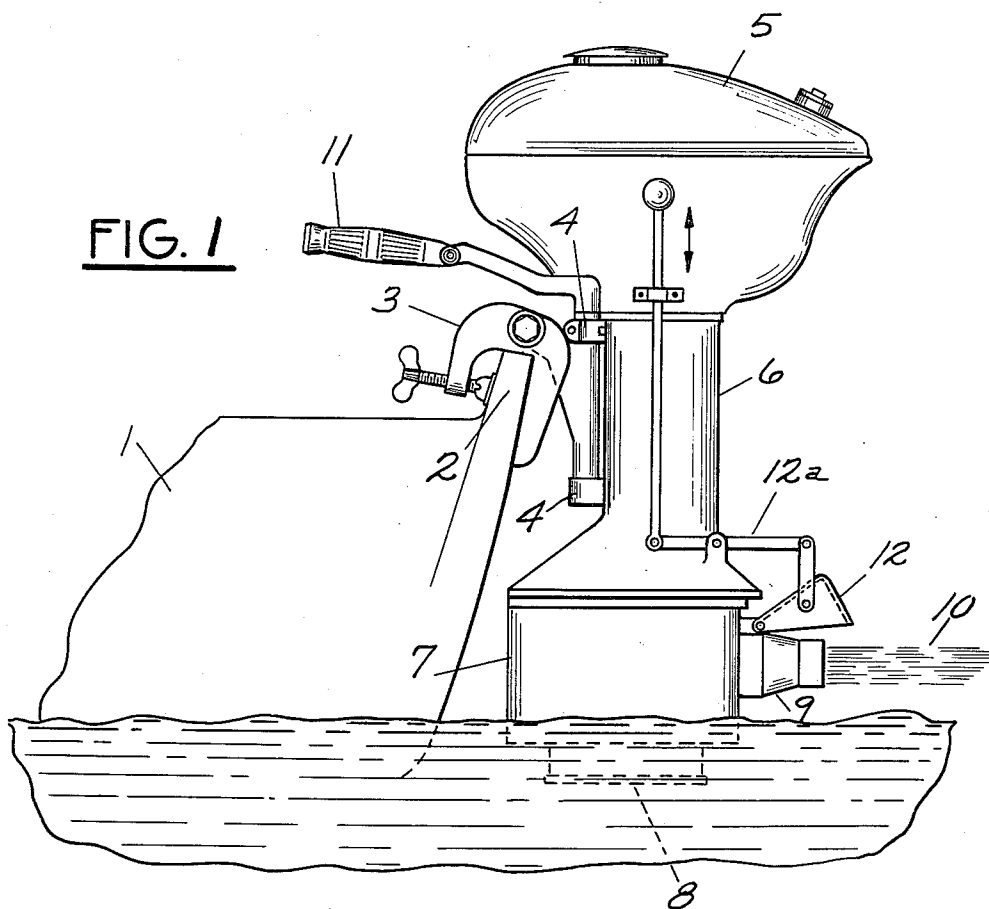
Sept. 18, 1962

R. S. NEELY
OUTBOARD MOTOR

3,054,375

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3 Sheets-Sheet 1



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3 Sheets-Sheet 2

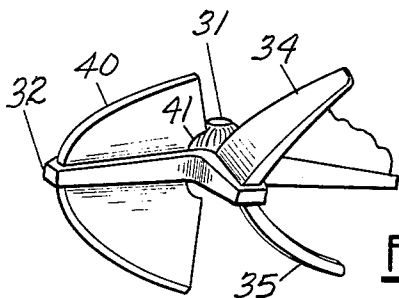
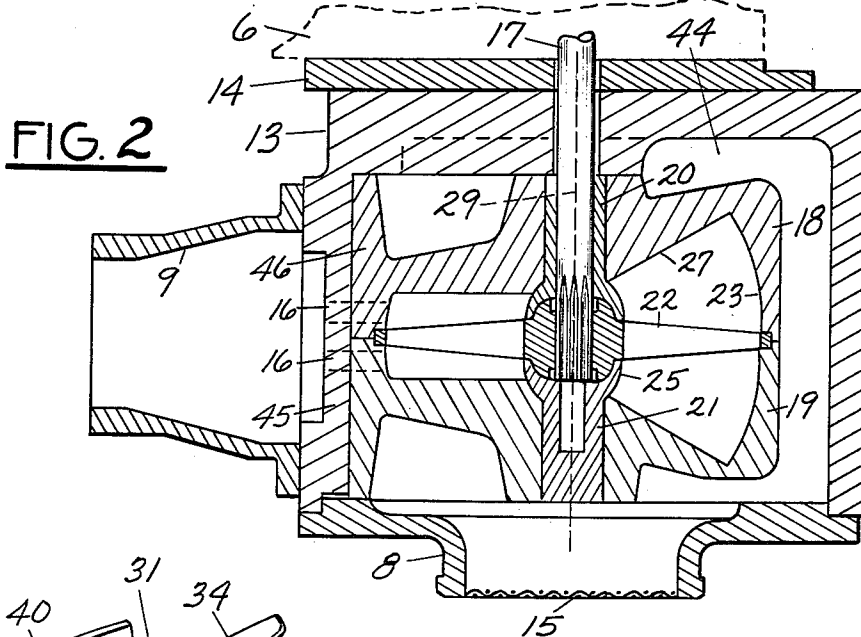
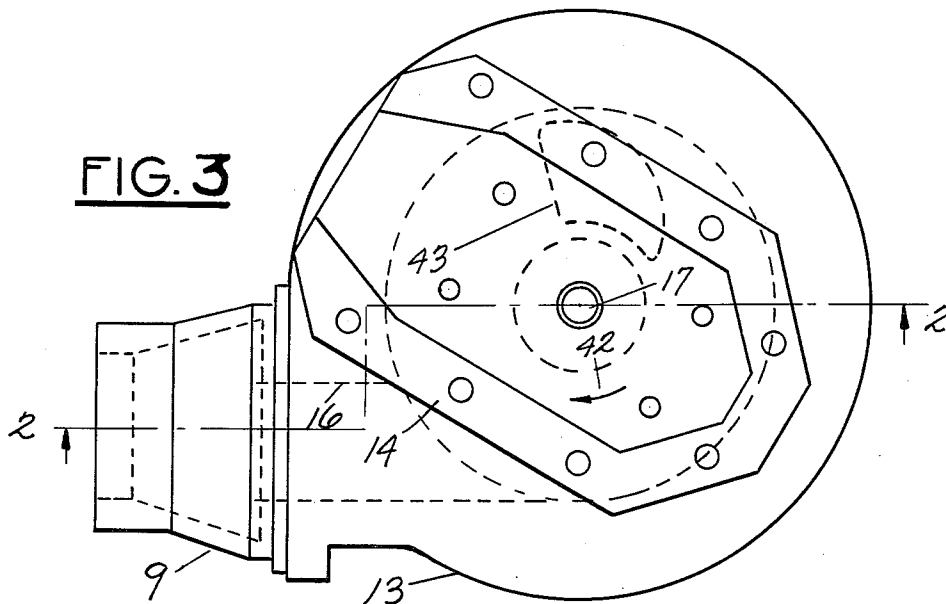


FIG. 7

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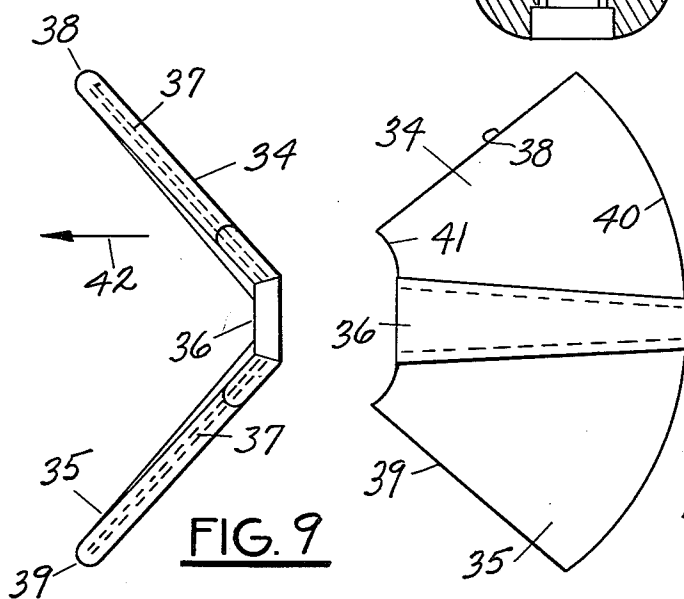
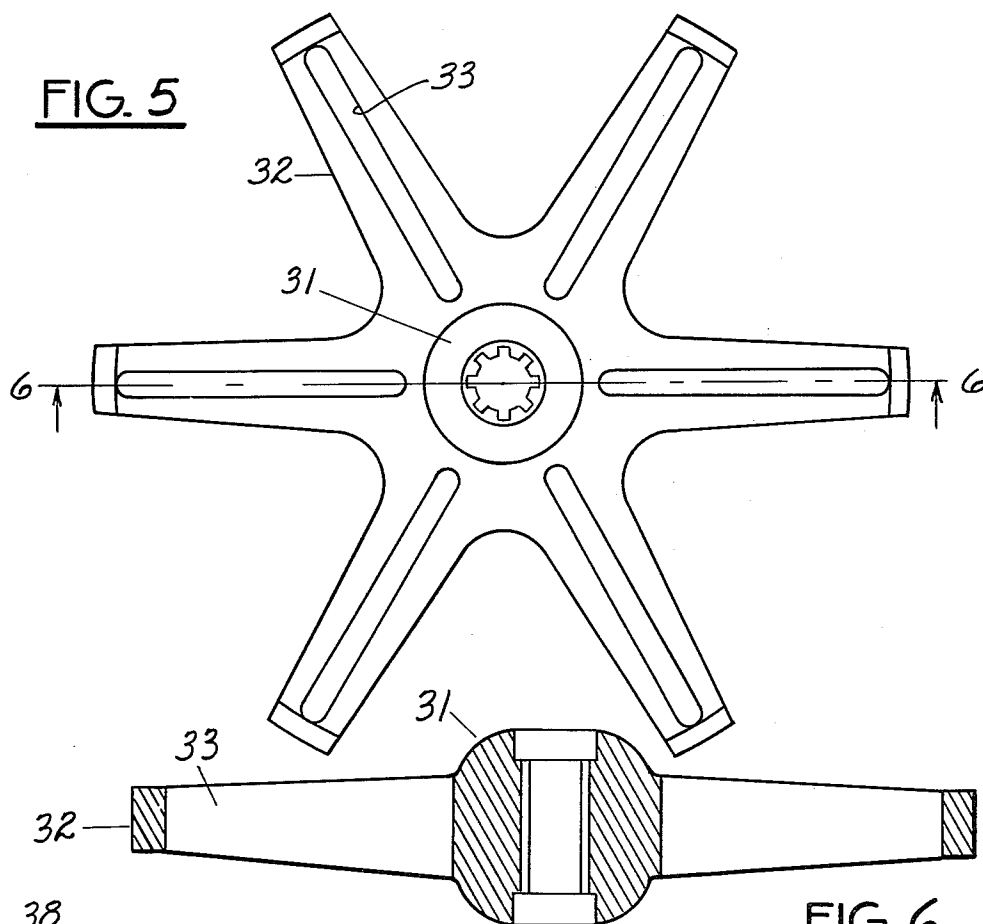
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OUTBOARD MOTOR

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10 Claims. (Cl. 115-12)

This invention is a unit for propelling a boat by the reaction of a stream or jet of water. In a preferred form, the driving jet is obtained from a flexible bladed positive displacement rotary pump at the lower end of an outboard motor. For forward propulsion, the jet is discharged directly astern. The boat is slowed by deflecting the jet downward and is reversed by deflecting the jet forward. In both forward and reverse, the boat is steered by turning the motor.

In the drawing, FIG. 1 is an elevation of an outboard motor driven propulsion unit, FIG. 2 is a section through the pump on broken line 2-2 of FIG. 3, FIG. 3 is a top plan of the pump, FIG. 4 is a diagrammatic view of the pump cavity, FIG. 5 is a plan of the impeller spider, FIG. 6 is a section on line 6-6 of FIG. 5, FIG. 7 is a fragmentary edge view of the pump impeller, FIG. 8 is a plan view of one of the impeller blades, and FIG. 9 is an edge view of one of the impeller blades.

In the drawing, the boat 1 has a transom 2 to which is clamped a bracket 3 having a pivot 4 for an outboard motor 5. At the lower end of the power leg 6 is a rotary pump 7 having a submerged inlet 8 and a rearwardly directed nozzle 9 through which is discharged a propulsion jet 10. For forward motion at high speeds, the jet 10 discharges directly astern above the surface of the water and the reaction of the jet drives the boat forward. Steering is effected by a tiller 11 which turns the motor about the pivots 4, changing the direction of the jet reaction. A deflector 12 can be lowered by linkage 12a to intercept the jet 10 and direct the stream downward to slow the forward motion of the boat. When the deflector 12 is fully lowered, the jet 10 is reversed so that it is discharged forward and the jet reaction is transmitted to the boat to reverse its direction. The tiller 11 is effective to steer the boat in reverse in the same manner as in forward directions.

As shown in FIGS. 2 and 3, the pump has an outer casing 13 fixed to an adapter plate 14 in turn attached to the lower end of the power leg 6. The intake 8 is fixed to the underside of the outer pump housing and is provided with a screen 15. The discharge nozzle 9 is fixed to the rear side of the outer pump housing 13 and communicates with the pump cavity through passageways 16. The motor drive shaft 17 extends down through the adapter plate 14 and the top wall of the outer pump housing 13. The drive shaft may be driven directly by the motor or through a reduction gearing.

Inside the outer pump housing 13 are top and bottom inner housings 18 and 19 which define the pumping cavity. These housings may be molded of plastic. At the center of the inner housings are top and bottom bearings 20 and 21 for the shaft 17.

The pump cavity is composed of upper and lower halves which are mirror images separated by an impeller 22. As shown diagrammatically in FIG. 4, each half is composed by the volume bounded by three surfaces. The first surface is a hemisphere 23 having a base in a plane 24 normal to the plane of the paper. The second surface is a hemisphere 25 having a base in a plane 26 normal to the plane of the paper and necessarily coincident with the plane 24. The third surface is an obtuse cone 27 whose apex 28 lies within the smaller hemisphere 25 and is pointed toward the hemisphere base 26. The hemispheres 23 and 25 have a common axis 29 which is coincident with the shaft 17 and perpendicular to the bases 24, 26

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of the hemispheres. The axis 30 of the cone 27 is inclined to the common axis of the hemispheres 23, 25. In the diagrammatic view, FIG. 4, the bases 24, 26 of the hemispheres 23, 25 are coincident. In FIG. 2, the hemispheres 25 are displaced axially relative to the hemispheres 23 because the impeller hub 22 is thicker at the center than at the periphery.

The impeller has a metal spider shown in FIGS. 5 and 6 having a hub 31 at the center keyed to the shaft 17 and radially projecting arms 32 with slots 33.

The impeller blades shown in FIGS. 7, 8 and 9 have top and bottom inclined sections 34 and 35 joined by a flat vertical section 36 which mates with one of the slots 33 in the impeller spider. Metal reinforcing members 37 may be imbedded in the top and bottom sections 34 and 35. All sections of the blades are of substantially constant thickness. The blades are molded in the position illustrated in FIG. 9 so that the maximum separation between the tips 38, 39 of the blades is slightly greater than the maximum spacing between the conical surfaces 27 in the cavity. The outer peripheral edge 40 of the blades has the same radius as the spherical surface 23. The inner peripheral edge 41 of the blades has the same radius as the spherical surfaces 25. When the blades are assembled into the slots 33 in the impeller, the edges 40 and 41 of the blades have a sliding fit with the spherical surfaces 23, 25 of the pump cavity. The tips 38, 39 of the blades are inclined toward the direction of rotation indicated by arrow 42. The tips 38, 39 ride on the conical surfaces 27 of the pump cavity which vary gradually in axial separation between a minimum and a maximum as indicated in FIG. 4. The greatest axial separation of the conical surfaces 27 is such that the elasticity of the rubber keeps the blades in contact with these surfaces. As the impeller is rotated, the blades are flexed in a gradual manner until reaching the point of minimum axial separation. The flexing of the blades is of a cantilever nature with the base of the cantilever located at the surface of the impeller web. From another aspect, the base of the cantilever corresponds substantially to the bases of the hemispherical surfaces 23 and 25 so that in all deflected positions, the clearance between the surfaces 40 and 41 on the blades and the surfaces 23 and 25 on the pump cavity does not change. Contact between the tips 38, 39 of the blades and the conical surfaces 27 of the pump cavity is maintained in part by the elasticity of the blades but primarily by the water pressure acting over the front surfaces of the blades. The water pressure tries to spread the blades apart thereby forcing the tips of the blades into contact with the conical surfaces 27 of the housing. The contact between the tips of the blades and the housing is proportional to the water pressure which is in turn proportional to the speed of the impeller. The contact is best when the water pressure within the pump is highest, an ideal situation for positive displacement pumps.

As the pump impeller rotates and the blades are deflected axially, the space between adjacent pairs of blades is compelled to vary from a minimum to a maximum by the conical surfaces 27. To produce a pumping action, upper and lower inlet passages 43 are located in the end walls of the housing parts 18 and 19 in a region in which the volume between adjacent blades is increasing and upper and lower outlet passages 46 are located in a region in which the space between adjacent blades is decreasing. As the impeller rotates, liquid is drawn into the inlet passages 43 and is forced out through the outlet passages 46. Both the inlet and outlet passages are mirror images of each other. The inlet passages to the pumping cavity communicate with the space 44 around the inner and outer housing parts 18, 19. The outlet passages 46 extend tangentially through walls 45 and 46 to the nozzle 9. As is apparent from FIG. 2, the outlet passages

16 are located on the spherical surfaces 23 between the conical surfaces 27 and the impeller arms 32. There are no corners on which the blades may catch.

What is claimed as new is:

1. In an outboard motor, a support for attachment to the transom of a boat and including means for supporting the outboard motor, said motor having a depending power leg with a vertical drive shaft, a pump housing fixed to the lower end of the power leg, an impeller in said housing rotatable about a vertical axis, a drive connection from the drive shaft to the impeller, said impeller having a hub with flexible blades cantilevered thereto on radial bases intersecting said axis, the inner and outer ends of the blades being sections of hemispheres centered on said axis and erected on said bases, said pump housing having a pump cavity with hemispherical surfaces abutting the inner and outer ends of the blades and with an end surface connecting said hemispherical surfaces and varying in axial position about said axis, and said blades having tips bearing on said end surface whereby the blades are deflected axially as the impeller is rotated.

2. The construction of claim 1 in which said end surface is a conical surface generated on an axis inclined to said vertical axis.

3. The construction of claim 1 in which the blades are inclined forward in the direction of rotation whereby the fluid pressure on the forward face of the blades holds the tips of the blades in contact with said end surface.

4. A pump comprising a pump housing, an impeller in said housing, the impeller having axially projecting flexible blades, said pump housing having a pump cavity with end walls varying gradually in axial separation from a minimum to a maximum and back to a minimum about said axis whereby the blades are compelled to deflect in a gradual manner as the impeller is rotated, and said blades being inclined toward the direction of rotation whereby the water pressure acting over the front surface of the blades forces the blades against the pump cavity.

5. A pump comprising a pump housing, an impeller rotatable in said housing, said impeller having a hub with flexible blades cantilevered thereto on radial bases intersecting said axis, the inner and outer ends of the blades being sections of hemispheres centered on said axis and erected on said bases, said pump housing having a pump cavity with hemispherical surfaces abutting the inner and outer ends of the blades and with an end surface connecting said hemispherical surfaces and varying in axial position about said axis, and said blades having tips bearing on said end surface whereby the blades are deflected axially as the impeller is rotated.

6. The construction of claim 5 in which said end surface is a conical surface generated on an axis inclined to said vertical axis.

7. The construction of claim 5 in which the blades are inclined forward in the direction of rotation whereby

the fluid pressure on the forward face of the blades holds the tips of the blades in contact with said end surface.

8. In an outboard motor, a support for attachment to the transom of a boat and including means for supporting the outboard motor, said motor having a depending power leg with a vertical drive shaft, a pump housing fixed to the lower end of the power leg, an impeller in said housing rotatable about a vertical axis, a drive connection from the drive shaft to the impeller, said impeller having a spider with radial arms with axially and radially extending slots therein, flexible blades each having an intermediate section fitting in a slot and upper and lower sections projecting above and below said slot, and said pump housing having a pump cavity with upper and lower surfaces engaging the upper and lower sections of the blades, said upper and lower surfaces of the pump cavity varying in axial separation from a minimum to a maximum about said axis whereby the blades are compelled to deflect as the impeller is rotated.

9. In an outboard motor, a support for attachment to the transom of a boat and including means for supporting the outboard motor, said motor having a depending power leg with a vertical drive shaft, a pump housing fixed to the lower end of the power leg, an impeller in said housing rotatable about a vertical axis, a drive connection from the drive shaft to the impeller, said impeller having a spider with radial arms with axially and radially extending slots therein, flexible blades each having an intermediate section fitting in a slot and upper and lower sections projecting above and below said slot, the inner and outer ends of the blades being sections of hemispheres centered on said axis and erected on said bases, said pump housing having a pump cavity with hemispherical surfaces abutting the inner and outer ends of the blades and with an end surface connecting said hemispherical surfaces and varying in axial position about said axis, and said blades having tips bearing on said end surface whereby the blades are deflected axially as the impeller is rotated.

10. A pump comprising a pump housing, an impeller rotatable in said housing, said impeller having a spider with radial arms with axially and radially extending slots therein, flexible blades each having an intermediate section fitting in a slot and upper and lower sections projecting above and below said slot, and said pump housing having a pump cavity with upper and lower surfaces engaging the upper and lower sections of the blades, said upper and lower surfaces of the pump cavity varying in axial separation from a minimum to a maximum about said axis whereby the blades are compelled to deflect as the impeller is rotated.

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