Aug. 11, 1964 H. J. EATON 3,143,857

COMBINED FORWARD AND REVERSE STEERING DEVICE FOR JET PROPELLED AQUATIC VEHICLES

Filed May 2, 1960 2 Sheets-Sheet 1

Fig. 1

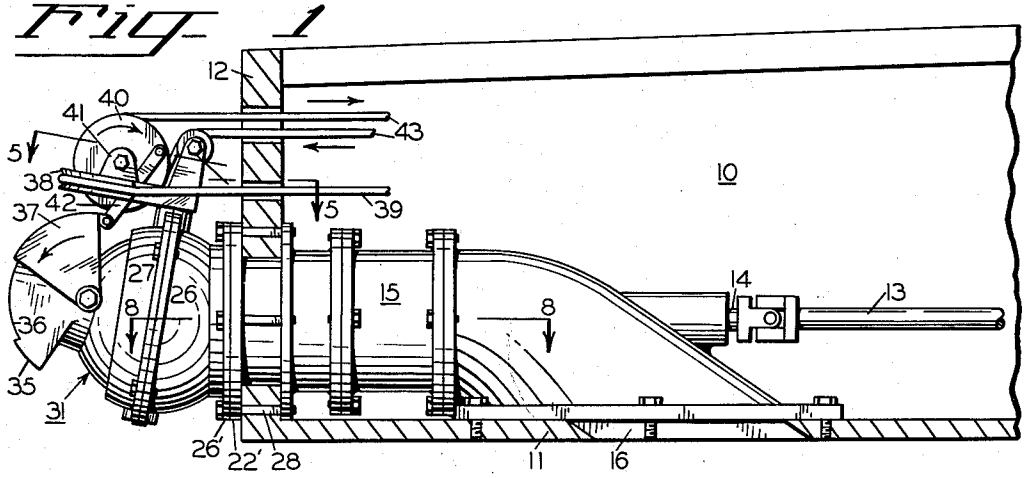
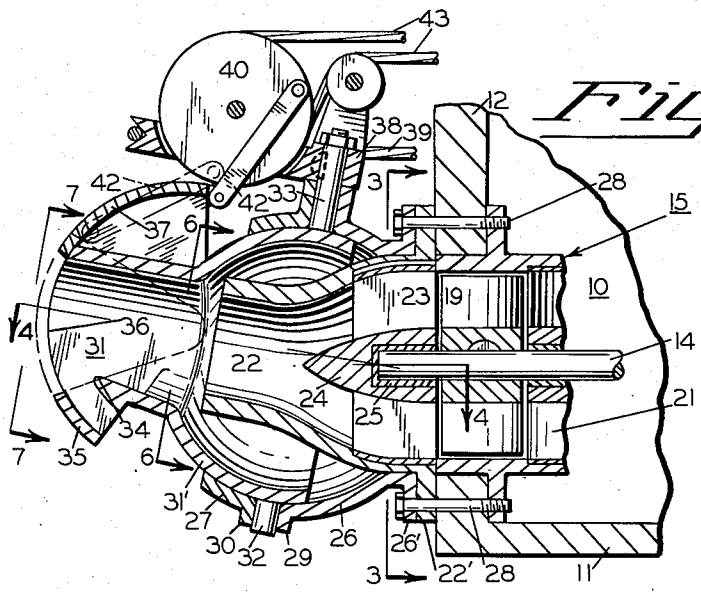


Fig. 2



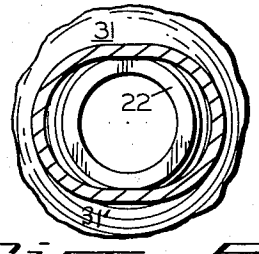


Fig. 6

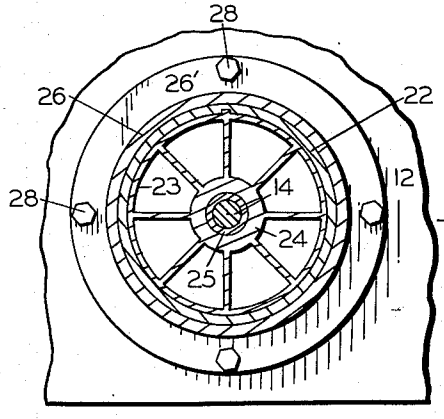


Fig. 3

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Fig. 9

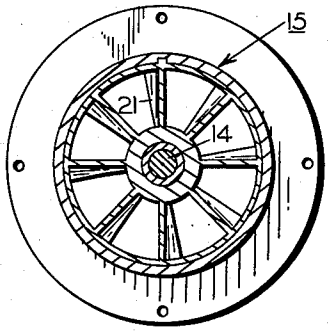


Fig. 5

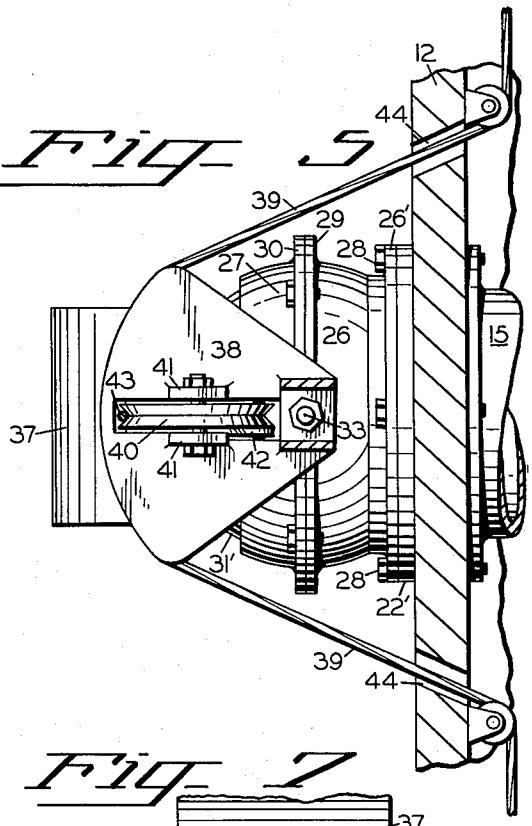


Fig. 4

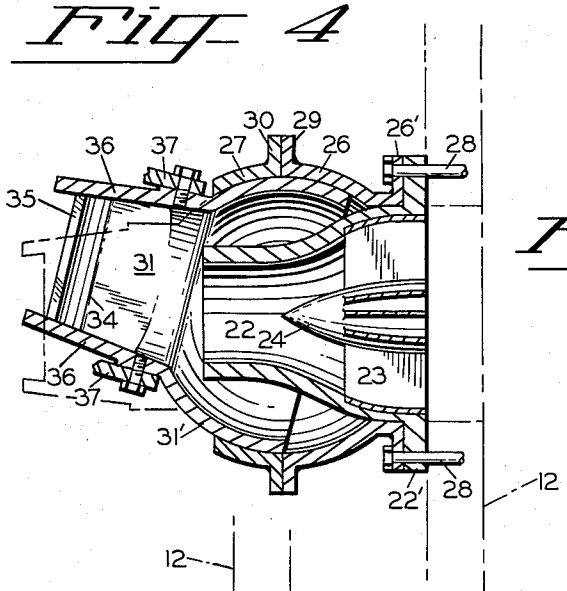


Fig. 7

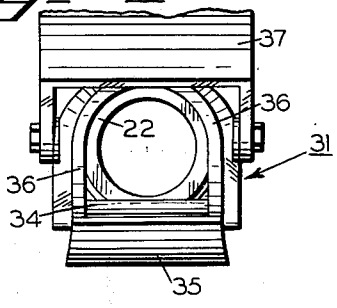
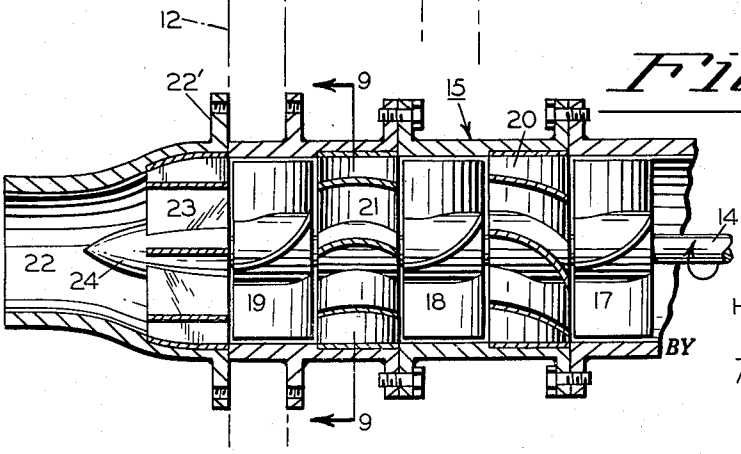


Fig. 8



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United States Patent Office 3,143,857 Patented Aug. 11, 1964

3,143,857

COMBINED FORWARD AND REVERSE STEERING DEVICE FOR JET PROPELLED AQUATIC VEHICLES

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Filed May 2, 1960, Ser. No. 26,158
4 Claims. (Cl. 60—35.55)

This invention relates in general to the propulsion of boats and other amphibious crafts by the forceful discharge of a jet of water from the rear of the craft, the jet being produced by pump means located in the craft drawing in water for the jet from an intake on the bottom of the craft.

More especially the present invention relates to means by which the jet of water, constantly and forcibly discharged from the rear of a motor boat, can be employed for efficiently guiding and maneuvering the boat as well as for propelling or thrusting it forwardly.

An object of the invention is to provide improved means for discharging a jet of water in conical form from the rear of a boat for the purpose of driving the boat forwardly in the water.

Another object is to provide improved means for effectively controlling the direction in which such jet is discharged and thereby controlling the direction in which the boat is driven forwardly by the discharged jet.

A related object is to provide directing means for the discharged conical driving jet of water which will not restrict or reduce the size of the jet when the jet is directed to one side or the other in the steering of the boat.

A further object of the invention is to provide improved means whereby the forcibly discharged water may also be employed for driving the boat in reverse direction.

An additional and important object is to provide improved guiding means whereby the discharged water, when employed for driving the boat in reverse direction, can also have its direction modified so as to enable the boat to be guided when being driven in reverse, thus considerably adding to the maneuverability of the boat.

The manner in which these objects and other advantages are attained and the construction and operation of the improved maneuvering means constituting the present invention will be readily understood from the following brief description with reference to the accompanying drawings.

In the drawings:

FIG. 1 is a fragmentary longitudinal sectional elevation of the rear portion of the motor boat showing, in elevation, the improved driving and maneuvering means;

FIG. 2 is a sectional elevation, drawn to a larger scale, of the jet discharging and directing assembly, the reversing shutter being shown in full lines in its raised or normal position and in broken lines in its lowered position for causing the boat to be driven in reverse;

FIG. 3 is a section on line 3—3 of FIG. 2;

FIG. 4 is a section on line 4—4 of FIG. 2;

FIG. 5 is a section on line 5—5 of FIG. 1 but drawn to the same scale as FIGS. 2, 3 and 4;

FIG. 6 is a fragmentary section on line 6—6 of FIG. 2;

FIG. 7 is an end view of the jet-directing member taken on line 7—7 of FIG. 2;

FIG. 8 is a fragmentary section on line 8—8 of FIG. 1 but drawn to the same scale as FIGS. 2 to 7; and

FIG. 9 is a section on line 9—9 of FIG. 8 taken through one of the series of stationary directional vanes cooperating with the rotating pumping blades to produce a straight, non-rotating stream of water for the jet-discharging nozzle.

Referring first to FIG. 1, the bottom and the rear wall or transom of the boat 10 are indicated by the reference

characters 11 and 12 respectively. The motor in the boat (not shown) drives the shaft 13 to which the shaft 14 for the pump blades or propellers is attached. The pump assembly is mounted in a housing and conduit indicated in general by the reference character 15, which is preferably formed of sections bolted together and which leads from an intake opening 16 in the bottom of the boat to a circular opening in the rear wall or transom 12 of the boat. A suitable grating and screen (not shown) are mounted at the intake opening 16 to prevent rocks or other objects, which might cause damage to the pump blades, from being drawn into the conduit through the opening 16.

The particular pump assembly, which is preferably used, is shown in FIG. 8 and includes three, longitudinally spaced, pumping propellers 17, 18 and 19 which are secured to the driven pump shaft 14, and a pair of sets of stationary directional vanes 20 and 21 which are interposed between the pump propellers. This portion of the pumping assembly does not constitute part of the present invention since such pumping means in themselves are old in the art. Also it is to be understood that other pump assemblies could be substituted in place of that shown. The particular pump assembly illustrated, however, has been found to be very satisfactory and is therefore regarded as the preferred type of assembly for use with the invention.

The pump assembly discharges into a jet nozzle 22 which is mounted on the outside of the transom 12 of the boat in registration with the rear end of the housing or conduit 15. A casting 23 containing an end set of stationary, radially extending, directional vanes is secured in the base of the nozzle 22 and is formed with a hub 24 (see also FIGS. 2 and 3). This hub has a recess in which is mounted a bearing 25 for the end of the pump shaft 14, and the hub 24 is preferably extended and given a torpedo shape as shown in FIG. 2. The purpose of the sets of stationary directional vanes 20 and 21, and especially of the final stationary radial vanes in the casting 23, is to cause a straight non-rotating stream of water to be delivered to the nozzle 22.

It will be noted from FIG. 2 that the axis of the discharging end of the nozzle 22 is shown as having an upward slope with respect to the pump shaft 14 and the bottom 11 of the boat. The reason for this is that the bottom of the boat, of the type indicated, will not remain horizontal when the boat is driven through the water but will slope upwardly and forwardly as the bow of the boat rides over the surface of the water. It has been found, with the boat driving means of the present invention, that the most efficiency is obtained when the driving jet of water is substantially horizontal or parallel with the water surface.

Referring now to FIGS. 1, 2 and 4, a housing consisting of two companion members 26 and 27, which are bolted together, extends about the nozzle 22 spaced from the nozzle. The inner member 26 has an annular flange 26' which extends around over the annular flange 22' of the nozzle 22, and both flanges are secured to the transom 12 of the boat by suitable bolts 28. The two companion members 26 and 27 have registering adjacent annular flanges 29 and 30 respectively and are secured together by bolts extending through these flanges. It will be noted that these companion members form an open housing constituting a substantial portion of a hollow sphere. Also it will be noted from FIGS. 1 and 2 that the adjacent flanges 29 and 30 extend in a plane which is perpendicular to the axis of the discharging end of the nozzle 22.

A jet-directing member 31 has an inner portion 31' which is also in the shape of a spherical segment and is so mounted in the housing formed by the members 26

and **27** as to have this portion concentric with the housing. This inner portion **31'** of the jet-directing member is also formed with a pair of diametrically opposite, external, radially extending, pivot shafts **32** and **33** (FIG. 2), and the adjacent flanges **29** and **30** of the surrounding housing have mating-offset portions which provide channels in which these two pivot shafts are rotatably mounted. Thus the jet-directing member **31** is rotatable to a limited extent on an axis perpendicular to the axis of the discharging end of the nozzle **22**, and consequently, when the axis of the nozzle **22** is substantially horizontal with the boat in operation, the jet-directing member can be moved to a limited extent laterally in a substantially horizontal plane.

It will be noted from FIG. 6 that the jet-directing member **31** is somewhat elliptical in cross section where the partially spherical portion **31'** joins the outer end portion, and that the major axis in this elliptical cross section part is horizontal. The purpose of this is to avoid any appreciable interference with the jet from the nozzle **22** when the jet-directing member **31** is turned to one side or the other. This elliptical directing member has in effect a built in angle of 15° on each side which not only prevents steering tube interference with jet stream but also increases sensitivity in introducing change of angle of impingement on the jet stream during turning. Furthermore the inner diameter at the rear or outer end of member **31** is still greater than the inner diameter at the discharging end of the nozzle **22**. Consequently no restriction of the discharged jet takes place. Thus, even when the jet from the nozzle **22** is directed to one side or the other by the member **31**, as required for the steering of the boat, there is no reduction in the size of the jet. This is one of the important features of the present invention since it remedies a defect found in some other jet assemblies for driving and steering boats.

At the outer end of the jet-directing member **31** the underside of this member is cut back for a short distance and formed with a turned under wall, as shown at **34** in FIGS. 2 and 4. A directing baffle **35** is located below this opening, the purpose of which will be presently apparent. Each of the rear edges at the sides of the outer end of the member **31** is curved, as shown at **36** in FIG. 2 in order to enable a shutter **37**, formed with a curved outer wall, to swing down closely but freely over the outer end of the member **31**. The shutter **37** has a pair of side pieces which are pivotally mounted on the member **31**, the two pivotal mountings being in transverse horizontal alignment and the line determined by these two mountings constitutes the center line for the curvature of the outer wall of the shutter **37** and also the center of curvature of the curved rear side edges on the member **31**. The bottom wall of the baffle **35** also has substantially the same curvature as the outer wall of the shutter **37**.

The shutter **37** is normally in the raised position shown in FIG. 1 and shown in full lines in FIG. 2, and thus entirely out of the path of the jet when the boat is being driven forwardly. However, when the boat is required to be driven in reverse direction, the lowering of the shutter to the broken line position shown in FIG. 2, blocks the normal path of the jet and forces the water from the jet to be discharged downwardly and forwardly through the cutaway portion **34** in the bottom of the member **31** and over the baffle **35**. The lowered shutter **37** rests against the top of the baffle **35** and the wall of the shutter and the bottom wall of the baffle then form a continuous curved guideway for reversing the jet.

A steering quadrant **38** (FIGS. 1, 2 and 5) is secured to the top pivot shaft **33** of the jet-directing member **31**. A steering cable **39**, secured to this quadrant, passes through openings **44** in the transom **12** of the boat and is then led past suitable guide pulleys on opposite sides of the boat respectively to the steering wheel or other steering control (not shown) located in the boat.

A shutter-operating pulley **40** is pivotally mounted on a shaft supported in a pair of brackets **41** (FIGS. 1 and 5) mounted on the steering quadrant **38** and extending upwardly from the quadrant on opposite sides of a slot provided in the steering quadrant for the pulley **40**. A link **42** (FIGS. 1 and 2), having one end pivotally connected to the pulley **40** and the other end pivotally connected to the shutter **37**, causes the shutter to be lowered or raised by the partial rotation of the pulley (thus clockwise, as viewed in FIG. 2, for lowering the shutter, and counter-clockwise for returning the shutter to normal raised position). A cable **43**, secured to the pulley **40** and directed over suitable guide means, is attached to a reversing control in the boat (not shown) and enables the shutter **37** to be lowered whenever the boat is to be driven in reverse and to be raised whenever the boat is driven in the normal forward direction.

Since the reversing shutter **37** is mounted on the member **31** and since the steering quadrant **38** for the entire member **31** carries a control pulley for the shutter, the turning of the member **31** to one side or the other through the steering mechanism of the boat can take place either when the shutter **37** is in the raised position or when it is in the lowered position. Consequently with this device it is possible to guide or steer the boat when the boat is being driven in reverse direction as well as when it is being driven forwardly. This is an important feature of the invention since the ability to guide the boat when driven in reverse direction adds considerably to its maneuverability, particularly in the case of light speed boats, for which the present invention is especially adaptable.

Minor modifications might be made in the different parts of the mechanism herein described without departing from the principle of the invention. However, the particular construction and mounting of the jet-directing member with respect to the jet nozzle, and the arrangement of the reversing shutter on the jet-directing member as illustrated, have proved very satisfactory and accordingly are considered as the preferred arrangement and construction for the carrying out of the invention.

I claim:

1. In a ship propulsion mechanism including a water conduit having an outlet through the rear wall of the ship and an inlet located in the ship forwardly of the rear wall with pumping means in the conduit for producing a rapid flow of water therethrough, the combination of a jet-forming nozzle on the outside of the rear wall of the ship over the conduit outlet, said nozzle terminating in a discharging tip, a jet-directing member, said member having a forward portion extending around and spaced from the outside of said nozzle tip and a rear portion having a channel, the front entrance to said channel spaced rearwardly beyond said nozzle tip for receiving and directing the jet from said nozzle, a shutter pivotally mounted on the rear end of said rear portion of said member to swing up and down over the rear end of said channel, means for operating said shutter, the bottom of said channel having an opening at the rear discharging end of said channel, a nozzle on the bottom side of the rear portion of said member leading downwardly and forwardly from said bottom opening in said channel, whereby, when said shutter is in lowered position, the jet from said nozzle received in said channel will be forced to pass through said opening and thereby produce a force for rearward propulsion of the ship, pivotal mounting means for said jet-directing member supporting said member for limited lateral swing with respect to said nozzle while maintaining the axis of said channel of said jet-directing member in the same plane with the axis of said nozzle tip, and steering means connected with said jet-directing member controlling the directional position of said channel with respect to said nozzle, whereby said steering means will serve to steer the ship during forward travel when said shutter is in raised position, and during rearward travel when said shutter is lowered.

2. In a ship propulsion mechanism including a water conduit having an outlet through the rear wall of the ship and an inlet located in the ship forwardly of the rear wall with pumping means in the conduit for producing a rapid flow of water therethrough, the combination of a jet-forming nozzle on the outside of the rear wall of the ship over the conduit outlet, said nozzle terminating in a discharging tip, a jet-directing member, said member having a forward portion extending around and spaced from the outside of said nozzle and a rear portion having a channel, the front entrance to said channel spaced rearwardly beyond said nozzle tip for receiving and directing the jet from said nozzle, a shutter pivotally mounted on the rear end of said rear portion of said member to swing up and down over the discharging end of said channel, means for operating said shutter, the bottom of said channel having an opening at the rear discharging end of said channel, a flow-directing element connected with said opening and forming a downwardly and forwardly facing discharge nozzle with the lower external surface of the rear end of said rear portion of said member causing the discharge of water through said opening to be directed downwardly and forwardly, whereby, when said shutter is in lowered position, the jet from said nozzle received in said channel will be forced to pass through said opening and thereby produce a force for rearward propulsion of the ship, a stationary housing secured on the outside of the rear wall of the ship about said nozzle, said forward portion of said jet-directing member pivotally mounted in said housing and enabling said member to have limited lateral swing with respect to said housing and nozzle, and steering means connected with said jet-directing member controlling the directional position of said channel with respect to said nozzle, whereby said steering means will serve to steer the ship during forward travel when said shutter is in raised position, and during rearward travel when said shutter is lowered.

3. In a ship propulsion mechanism including a water conduit having an outlet through the rear wall of the ship and an inlet located in the ship forwardly of the rear wall with pumping means in the conduit for producing a rapid flow of water therethrough, the combination of a jet-forming nozzle on the outside of the rear wall of the ship over the conduit outlet, said nozzle terminating in a discharging tip, the axis of said nozzle tip inclined upwardly with respect to the center line of said conduit outlet, a jet-directing member, said member having a tubular channel of varying internal diameter spaced beyond said nozzle tip for receiving and directing the jet from said nozzle, the minimum internal diameter of said channel being slightly greater than the inside diameter of said nozzle tip, a shutter pivotally mounted on said

member to swing up and down over the discharging end of said channel, means for operating said shutter, the bottom of said channel having an opening near the discharging end of said channel, a flow-directing element connected with said opening and forming a downwardly and forwardly facing discharge nozzle with the lower external surface of said member causing the discharge of water through said opening to be directed downwardly and forwardly, whereby when said shutter is in lowered position, the jet from said nozzle received in said channel will be forced to pass through said opening and thereby produce a force for rearward propulsion of the ship, a stationary housing forming part of a hollow sphere secured on the outside of the rear wall of the ship about said nozzle, said jet-directing member having a forward mounting portion located in said housing and forming part of a hollow sphere concentric with said housing, means securing said forward mounting portion of said jet-directing member in said housing for limited lateral swing with respect to said nozzle, and steering means connected with said forward mounting portion of said jet-directing member for controlling the directional position of said channel with respect to said nozzle, whereby said steering means will serve to steer the ship during forward travel when said shutter is in raised position and during rearward travel when said shutter is lowered.

4. In a directional control device for a fluid propulsive jet emerging from a converging nozzle, the combination comprising a support sleeve mounted for pivotal movement at the exit of said converging nozzle on a substantially vertical axis, means for positioning said support sleeve whereby to control the direction of thrust from said converging nozzle, deflector means movably mounted on said support sleeve, said deflector means being movable from a forward position to a reverse position, said deflector means being so configured that in the reverse position the said deflector means directs the flow propulsive jet downwardly and in the direction opposite to that from which the said jet emerges from said nozzle, and means for moving said deflector means independently of said support sleeve to reverse the thrust force of said fluid propulsive jet by said deflector means while maintaining control of the direction of thrust by means of said support sleeve.

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