Oct. 2, 1962 R. A. MacFARLAND 3,056,457

VARIABLE PITCH PROPELLER

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FIG. 1

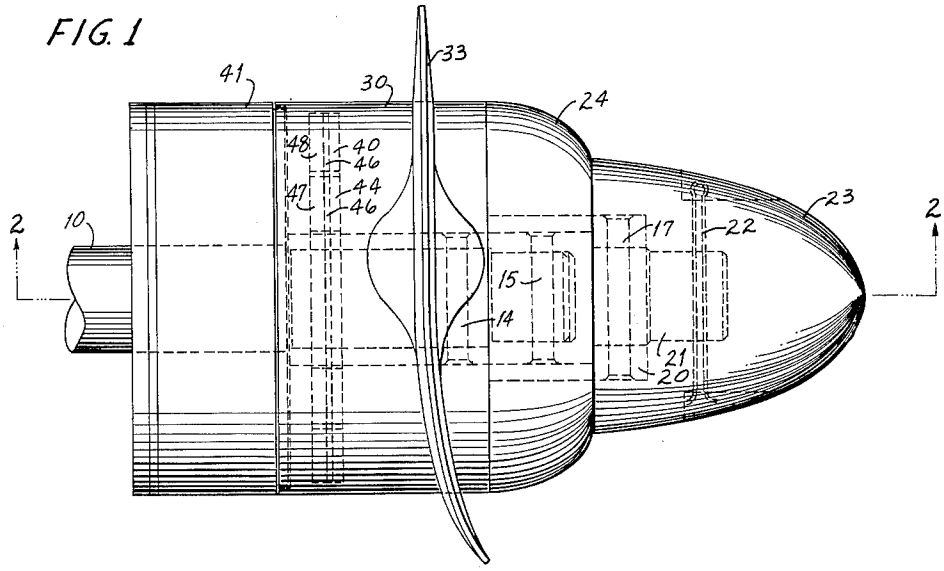
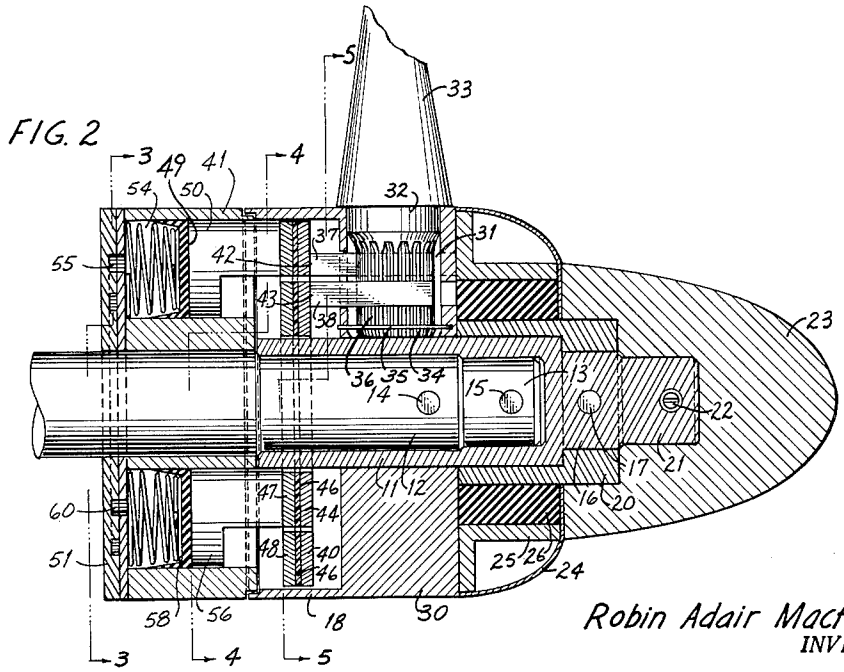


FIG. 2



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FIG. 3

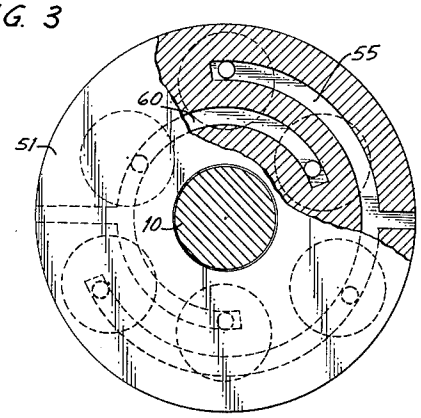


FIG. 4

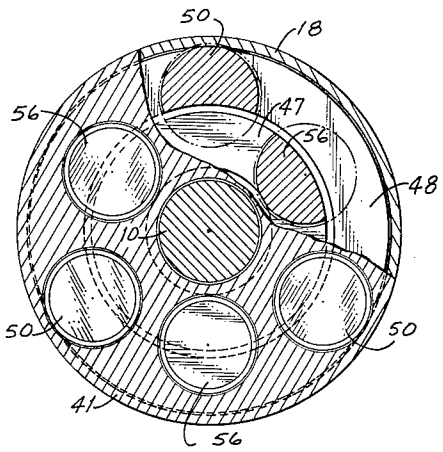
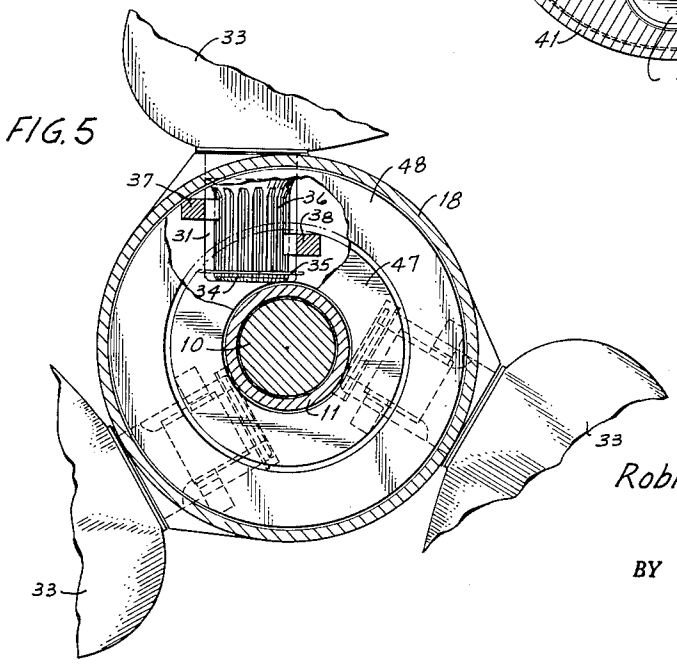


FIG. 5



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VARIABLE PITCH PROPELLER

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7 Claims. (Cl. 170—160.45)

This invention relates to variable pitch propellers. While certain aspects of the present inventive concept are broadly applicable to a wide variety of blade type propellers and impellers for liquid or gaseous blade reaction, that form of the invention here shown by way of illustration is particularly adapted for a pitch control of the blades of an outboard or inboard motor propeller. While the present construction is admirably adapted for effective and efficient use in this particular field, it will of course be understood that the principles of the invention as herein set forth are in no way limited to such an application.

In the field of outboard motor propellers in particular, considerable difficulty has been experienced in efforts to provide for adjustments of the blade tilt. In particular, there has not heretofore been provided adequate means for the variation of pitch during rotation of the propeller. Such variation during operation however is much sought after, particularly in the operation of small craft when used as tow for water skiing. In this particular instance a fast start under maximum load is desirable, calling for a minimum pitch commensurate with power capacity. After a desired speed is approximated, however, a greater pitch will be adequate and will be more efficient with respect to power consumption. These and other considerations have raised the problem of providing simple, effective and efficient remote pitch control operable during the rotation of the propeller.

In the present invention such a means is provided. The structural arrangement herein being particularly adapted to the application of outboard motor propellers. In general terms, that form of the invention herein set forth may be broadly defined as providing fluid pressure means remotely controlled for affecting the change in blade angularity while the propeller is in rotation. More specifically, the invention as here shown may be characterized as including propeller blades having geared hubs seated in the propeller hub together with fluid actuating racked pistons. The racks of the pistons engage the blade gears in the propeller hub, whereby reciprocation thereof induces a rotational blade to vary the pitch. Among the features of the invention is the provision of a single actuating means for the racks of at least one series of racks for all blades to insure uniform adjustment of all the blades simultaneously. Another important feature of the invention is the provision of a pair of opposed racks for each blade gear. Thus, as fluid pressure, preferably hydraulic, is applied in one direction to move one set of the racks under power in one direction, the opposed racks will be automatically moved in the opposite direction. This arrangement is such that the relative position of the actuating means for the racks at one side of the blade gears, automatically adjust the operating mechanism for racks on the other side of the gears to position their operating means for pressure responsive action when the blades are to be reversed from the direction of adjustment induced by pressure for the original movement.

From the foregoing, it will be seen that the objects of the present invention include that of providing a novel and improved means for adjusting angularity of propellers or impeller fluid reaction blades. More specifically, an object of the present invention includes that of providing means for adjusting the angularity of propeller or impeller blades during the rotation of the propeller or impeller. In that present form of the invention it is further an object of the invention to provide a field actuated remote

control means for altering the pitch of outboard motor propellers while the propellers are in operation. A further object of the invention is to provide a propeller pitch control by which either forward or reverse motion of the craft may be achieved from but a simple direction of drive for the propeller shaft. Numerous other objects, features and advantages of the present invention will be apparent from consideration of the following specification taken in conjunction with the accompanying drawings, in which

FIG. 1 is a side elevation of one form of the present preferred form of the invention,

FIG. 2 is a longitudinal section through that form of the invention shown in FIGURE 1, taken at right angles to the plane of the illustration of FIGURE 1. In both instances, for clarity sake, only one single blade is illustrated,

FIG. 3 is a section taken on the lines 3—3 of FIGURE 2,

FIG. 4 is a similar section taken on the lines 4—4 of FIGURE 2, and

FIG. 5 is a section taken on the lines 5—5 of FIGURE 2.

Referring in detail to the drawings, the propeller drive shaft is indicated by the numeral **10**, and may be of any of various conventional forms. The shaft here shown by way of illustration, is that of a conventional type outboard motor. Other diameters and general constructions of inboard and outboard shafts may be readily accommodated for use in the present construction by adapted drive sleeves hereinafter discussed. Since the present mechanism is capable of a complete reversal of the propeller pitch, reverse drive may be secured without the necessities for a reverse mechanism of the directional drive of the drive shaft itself.

The adapter's sleeve is indicated by the numeral **11**, and may be of such internal design with single or double diameters as to accommodate the general construction of such propeller drive shaft as may be employed. The particular shaft here shown by way of illustration, is illustrated as including a reduced portion of **12** and further reduced terminal **13**. The internal configuration of the adapter's sleeve **11** is formed to fit and accommodate such terminable portions of the shaft **10**. It will, of course, be understood that in various types of propeller shafts the internal construction of the adapter's sleeve will be modified in such manner as to properly accommodate various types of shaft ends.

Propeller shaft **10** is secured to the adapter's sleeve by staked drive pins **14** and **15**. Pin **14** extends through the reduced portion of **12** to engage the adapter's sleeve and through to engage the propeller blade shaft hub **30** for turning the hub with the shaft as hereinafter described. The pin **15** is secured to the further reduced portion **13** to engage the sleeve. Outwardly beyond the shaft end, the adapter's sleeve is provided with the reduced portion **16** accommodating a conventional shear pin **17** extending through the adapter to engage an inner hub sleeve **20**, while a further extended terminal end **21** is provided with a cotter pin **22** to engage a propeller tail cap **23**. A drive hub cover cap **24** is engaged between the tail cap **23** and an outer hub sleeve **25** which is connected and sealed by an intermediate rubber sleeve **26** of the main drive hub.

The main drive hub **18** includes the propeller blade shaft hub **30** fixed for rotation with the main drive hub and defining blade hub recesses indicated at **31** within which the blade hubs **32** of the blades **33** are seated. An inner flange **34** of the blade hubs is formed to secure the hub within the recess of **31** by shaft hub-retaining rings **35**.

Within the recess **31** each hub is provided with a splined hub or gear **36**. Recesses **31** are of such dimension as to

afford room on each side of each hub or gear **36** for toothed racks **37** and **38**. By this arrangement it will be seen that since the racks engage the splined hubs or gears on opposite sides of the axis of the blades rotation of the hubs and consequently of the blades will result from equal and opposite movement of the racks whereby to vary the blade pitch.

For movement of the outer rack shaft **37**, there is provided an outer ring **40** mounted within the main drive hub **18** formed as an extension of and rotating with the body of the blade shaft hub **30**. Against the front face of the ring **40** the rear bases **42** of the rack bars **37** rest, whereby forward movement of the plate induces forward movement of the racks **37**. Since the ring **40** rotates with the hubs and the racks no friction is encountered therebetween. For a further understanding of the operation, it is to be noted that as the racks **37** move forwardly under the influence of forward movement (to reverse the blades) the opposite racks **38** must of necessity move in the opposite rearward direction. This is made possible by the bearing of the bases **43** of the racks **38** against an inner ring **44**.

With respect to the disclosure of FIGURE 2, it will be seen that the inner and outer rings **44** and **40** are in parallelism, which indicates a neutral position for the angularity of the blades and that when rotary movement of the propeller blade hubs, and thus a change in the propeller blade pitch takes place, the inner and outer rings move with respect to each other, the one equal and opposite to the other. Behind each ring there is provided an inner friction ring **46** and behind and in contact therewith there is provided inner and outer non-rotary rings **47** and **48** respectively. For movement of the outer ring **40** there is provided an outer circular series of plungers **50**, here shown as three, mounted in the rear stationary housing **41** and which bear at the outer end against a spring pressed outer non-rotating plate **49**. The chamber **54** behind plate **49** may be served by an outer fluid passage **55**. Similarly, for operating the inner ring **44**, there is provided a series of plungers **56** bearing against an inner spring urged plate **58** which is served by an inner passage **60**.

In the operation of the device, when pressure is applied to the channel **55**, to the outer series of plungers, their companion plunger **50** is pressed forwardly, moving the outer ring **40** and hence the rack **37** to turn the propeller blade hub in a reverse direction. Since in this action the opposite inner rack must, perforce, be urged rearwardly, this will move the inner ring against which they bear rearwardly and the inner plungers will move their plate rearwardly compressing its springs. If now the pressure is reversed, being admitted to the inner cylinders through the channels **60**, the inner ring will move forwardly through action of its plungers and the rack bar **38** will move reversing the direction of the pitch and causing a rearward recession of the racks **37**. Thus by selecting the application of pressure between the outer channel **55** and the inner channel **60** the pitch of the blades may be reversed by remote control and without terminating rotation of the propeller.

It will, of course, be understood that in the operation of the invention, numerous changes, modifications and the full use of equivalents may be resorted to without departing from the spirit or scope of the invention as outlined in the appended claims.

What I claim is:

1. A propeller including a hollow hub, impeller blades mounted on said hub and extending radially therefrom, splines on said blades within said hub constituting gear teeth, a pair of opposed rack bars engaging the gear teeth of each blade, remotely controllable fluid pressure operating means common to one rack bar of each blade, and a separate remotely controllable fluid pressure operating means common to the opposed rack bar of each blade.

2. A propeller including a hollow hub, impeller blades mounted on said hub and extending radially therefrom, splines on said blades within said hub constituting gear teeth, a pair of opposed rack bars engaging the gear teeth of each blade, remotely controllable fluid pressure operating means common to one rack bar of each blade, and a separate remotely controllable fluid pressure operating means common to the opposed rack bar of each blade, said fluid pressure means being operable during rotation of said blades.

3. A variable pitch propeller, including a hub, a plurality of impeller blades extending radially from said hub, gear teeth on said blades within said hub, an outer circular series of rack bars within said hub each one of which engages the gear teeth of one of said blades, fluid pressure means for simultaneously moving said outer circular series of rack bars, an inner circular series of rack bars within said hub each one of which engages the gear teeth of one of said blades on the opposite side of engagement of said teeth by said outer circular series of rack bars and independent positively acting fluid pressure means for actuating said inner series of rack bars.

4. A variable pitch propeller, including a hub, a plurality of impeller blades extending radially from said hub, gear teeth on said blades within said hub, an outer circular series of rack bars within said hub each one of which engages the gear teeth of one of said blades, fluid pressure means for simultaneously moving said outer circular series of rack bars, an inner circular series of rack bars within said hub each one of which engages the gear teeth of one of said blades on the opposite side of engagement of said teeth by said outer circular series of rack bars and independent positively acting fluid pressure means for actuating said inner series of rack bars, said means including one circular series of pistons for each series of rack bars and a common source of fluid pressure for each circular series of pistons.

5. A variable pitch propeller, including a hub, a plurality of impeller blade extending radially from said hub, gear teeth on said blades within said hub, an outer circular series of rack bars within said hub each one of which engages the gear teeth of one of said blades, a single outer operating ring engaging said outer series of rack bars, fluid pressure means for actuating said outer operating ring, an inner circular series of rack bars within said hub, each one of which engages the gear teeth of one of said blades on the opposite side of engagement of said teeth by said outer circular series of rack bars, a single inner operating ring engaging said inner series of rack bars and a separate fluid pressure means for actuating said inner operating ring.

6. A variable pitch propeller, including a hub, a plurality of impeller blades extending radially from said hub, gear teeth on said blades within said hub, an outer circular series of rack bars within said hub each one of which engages the gear teeth of one of said blades, a single outer operating ring engaging said outer series of rack bars, fluid pressure means for actuating said outer operating ring, an inner circular series of rack bars within said hub, each one of which engages the gear teeth of one of said blades on the opposite side of engagement of said teeth by said outer circular series of rack bars, a single inner operating ring engaging said inner series of rack bars and a separate fluid pressure means for actuating said inner operating ring, both of said fluid pressure means including a cylinder and piston corresponding with each rack bar actuated by each ring.

7. A variable pitch propeller, including a hub, a plurality of impeller blades extending radially from said hub, gear teeth on said blades within said hub, an outer circular series of rack bars within said hub, each one of which engages the gear teeth of one of said blades, a single outer operating ring engaging said outer series of rack bars, fluid pressure means for actuating said outer operating ring, an inner circular series of rack bars within

said hub, each one of which engages the gear teeth of one of said blades on the opposite side of engagement of said teeth by said outer circular series of rack bars, a single inner operating ring engaging said inner series of rack bars and a separate fluid pressure means for actuating said inner operating ring, both of said fluid pressure means including a cylinder and piston corresponding with each rack bar actuated by each ring, and a common source of fluid pressure for the pistons corresponding to the outer series of rack bars and a separate common source of fluid pressure for the pistons corresponding to the rack bars of the inner series.

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