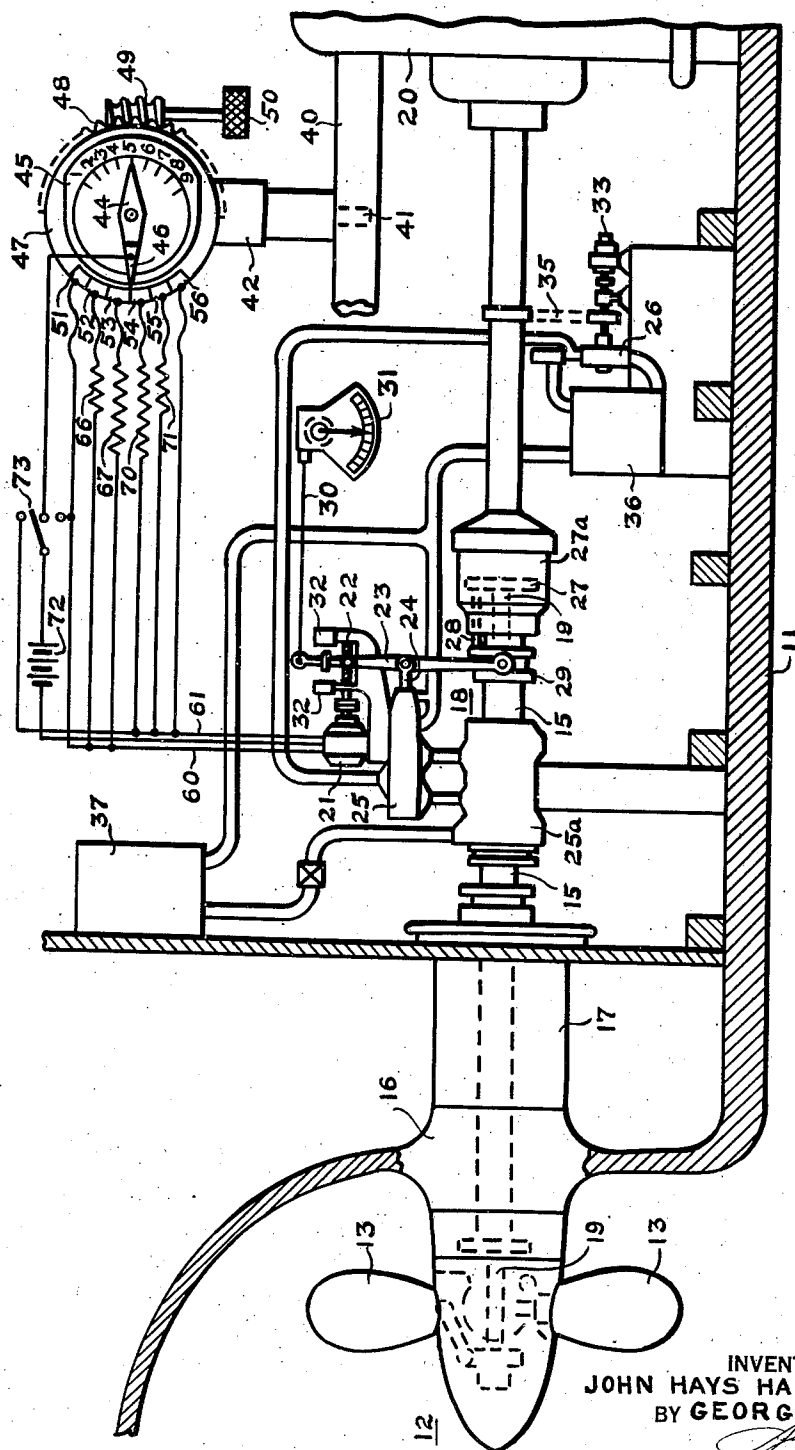


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VARIABLE PITCH PROPELLER CONTROL

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VARIABLE PITCH PROPELLER CONTROL

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This invention relates to variable pitch propeller systems and more specifically to a system for automatically varying the pitch of a propeller in accordance with a characteristic of the driving motor.

It has been found that the temperature of the exhaust gases of an internal combustion engine, especially of the Diesel type, varies approximately directly as the shaft horsepower transmitted to the propeller. It is thus possible to maintain a constant power output by maintaining a constant exhaust temperature.

The invention accordingly provides, in one embodiment, exhaust temperature indicating means, operated by the temperature of the exhaust gases of the driving engine to control the means for varying the pitch of the propeller blades in such a way that the power absorbed by the propeller is varied so as to maintain a constant temperature of the exhaust gases.

In turbine and electric propulsion other variables which have a definite relationship with the transmitted horsepower may be utilized for maintaining this power constant under varying conditions of wind and weather.

The invention further provides means for varying the rate of change of pitch of the propeller blades in accordance with the rate of change of condition, thus causing the device to operate efficiently and effectively regardless of the extent of change required.

An object of the invention is to provide a novel and improved device of the type above indicated which is suited to commercial use on marine vessels and aircraft.

Other objects will become apparent as the nature of the invention is more fully disclosed. The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be more particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization, may be better understood by referring to the following description taken in connection with the accompanying drawing forming a part thereof, in which the single figure illustrates diagrammatically the system as applied to the driving mechanism of a marine vessel.

In the following description and in the claims parts will be identified by specific names for convenience, but they are intended to be as generic

in their application to similar parts as the art will permit.

Referring to the accompanying drawing, the hull of a marine vessel is indicated at 11. This vessel is shown as driven by means of a propeller 12 which is provided with adjustable blades 13. The propeller 12 is attached to the end of a hollow shaft 15 which passes through an outboard bearing 16 and a thrust bearing 17. The shaft 15 is driven by a prime mover 20 which may be of any desired type but is preferably of the Diesel type and is provided with a governor, not shown, for maintaining a constant speed of rotation.

The blades 13 are connected to a variable pitch mechanism 18 which may be of any well known and standard construction such as that manufactured by the Escher-Wyss Company of Zurich, Switzerland, the details of which form no part of the present invention and are accordingly not specifically set forth herein. This mechanism, in general, comprises a rod 19 slidable longitudinally within the shaft 15 and connected to control the pitch of the blades 13. The rod 19 is actuated by a piston 27 in a fluid pressure cylinder 27a. Fluid for actuating the piston 27 is supplied by a pump 26 through a control valve 25 and a distribution valve 25a which communicates with the cylinder 27a through ducts, not shown, in the shaft 15.

A motor 21 rotates a worm 22 which operates to move the upper end of a floating lever 23, which, in turn, is pivoted to the end of a valve rod 24 which controls the valve 25. The piston 27 is connected by a rod 28 to a collar 29 which is slidably mounted on the shaft 15 and engages the lower end of the lever 23 so that the position of this end of the lever corresponds to the pitch of the blades 13.

The upper end of the lever 23 is connected by a wire 30 to an indicator 31 which shows the pitch at which the blades 13 are set. Stops 32 are provided for limiting the maximum and minimum pitch of the blades 13. The fluid pump 26 is driven either by a motor 33 or a belt 35 from the shaft 15. A reservoir 36 and a supply tank 37 are provided for the necessary fluid.

It is to be understood that other pitch control devices may be employed in place of that referred to above, for varying the pitch of the propeller blades 13 in response to actuation of the motor 21. A particular type is shown for purposes of illustration only.

The prime mover 20, which is preferably of the Diesel engine type, is provided with the usual exhaust pipe 40 in which is mounted a tempera-

ture responsive device 41 which forms a part of a temperature indicator 42. The temperature indicator 42 is provided with a pointer 44 which registers with a scale 45 graduated, for example, in hundreds of degrees. It is to be understood that other types of direct or remote control exhaust temperature indicating devices may be used if desired.

In accordance with the present invention means is provided to control the motor 21 in response to the position of the pointer 44. In the embodiment shown a contact 46 is attached to but insulated from the pointer 44. Surrounding the scale 45 and rotatably mounted thereon is a ring 47 to which is attached a segment of a worm gear 48. Meshing with the gear 48 is a worm 49 which is rotated by means of a knurled knob 50. Mounted on but insulated from the ring 47 are a plurality of contact segments 51 to 56 which are selectively engaged by the contact 46.

The segments 51 and 56 are connected by flexible conductors to two conductors 60 and 61 which in turn are connected to the reversing windings of the motor 21. The segments 52 and 53 are connected by flexible conductors to two resistors 66 and 67 which are in turn connected to the conductor 60. The segments 54 and 55 are connected by flexible conductors to two resistors 70 and 71 which are in turn connected to the conductor 61. The common lead of the reversing windings of the motor 21 is connected through a battery 72 to the blade of a three position switch 73. The center contact of this switch is connected to the contact 46, the upper contact to the conductor 61 and the lower contact to the conductor 60.

Operation

In the operation of the form of the invention shown the pitch of the blades 13 is first set at the normal operating angle for the speed at which it is desired to operate the vessel. The setting of the propeller blades 13 is accomplished by moving the blade of the switch 73 into the upper or lower position which will cause the motor 21 to move the upper end of the lever 23 to the left or right to increase or decrease the pitch in a well known manner, the angle of pitch being indicated by the pointer of the indicator 31.

After the vessel has been brought up to the desired speed the temperature of the exhaust under this condition is indicated by the pointer 44 on the scale 45, which may for example be 500 degrees. The ring 47 is then rotated by means of the knurled knob 50 until the insulation between the segments 53 and 54 engages the contact 46. The blade of the switch 73 is then moved into engagement with the center contact.

If the forces against which the vessel is moving should increase such as due to encountering a strong head wind or running into a heavy sea, the power delivered by the engine 20 (which is of constant speed due to its governor) would increase thus causing an increase in the temperature of the exhaust gases in the exhaust pipe 40, which in turn would affect the indicator 42 causing the pointer 44 to rotate in a clockwise direction showing an increase of temperature. The contact 46 will then engage the segment 53 and a circuit will be closed from the battery 72 through the resistor 67 to the motor 21 causing it to rotate slowly in a direction to move the upper end of the lever 23 to the right for example. This will move the valve 25 to the

right which will allow fluid under pressure to pass from the pump 26 to the cylinder 27a by means of the ducts in the shaft 15. This will actuate the piston 27 which, by means of the rod 19 and the link mechanism will cause the propeller blades 13 to slowly decrease their pitch. This will cause less power to be transmitted from the engine 20, the R. P. M. being maintained constant by means of the governor, thereby decreasing the exhaust temperature until it again reaches 500 degrees, at which time the contact 46 will again rest on the insulation between the segments 53 and 54, thus stopping the motor 21.

If the conditions under which the vessel is operating should change due to a following wind or other favorable condition so that less power is supplied by the engine 20 the temperature of the exhaust would decrease and the reverse action would take place, thus causing a gradual increase in pitch of the propellers which would cause more power to be drawn from the engine 20, thus increasing the exhaust temperature until the contact 46 again rests on the insulation between the segments 53 and 54 at which time the motor 21 would stop.

If the changed conditions cause a rapid change of exhaust temperature so that the contact 46 engages either of the segments 55 or 52 then the resistor 71 or the resistor 66 will be thrown in circuit with the motor 21. As resistors 71 and 66 have less resistance than resistors 70 and 67 the motor 21 will be caused to rotate faster, thus changing the propeller pitch more rapidly to take care of the more rapidly changing conditions.

If the conditions change so quickly that the contact 46 engages either segment 51 or segment 56, then no resistance will be thrown in the circuit of the motor 21 and it will rotate at its maximum speed, thus changing the propeller pitch at a maximum rate. The stops 32 are provided so that the propeller pitch is prevented from exceeding certain limits beyond which it could not operate efficiently under any conditions.

By the systems above described the pitch of the propeller blades 13 is varied to cause the propeller to operate so as to maintain the exhaust temperature, and therefore the power supplied from the engine 20, constant under varied conditions. The rate of change of pitch will vary in accordance with the change of exhaust temperature so that with a gradual change of temperature there will be a slow change of propeller pitch, thus preventing violent changes of pitch which would cause undue strain on the driving mechanism, disagreeable vibrations and inefficiency of the propeller but a more abrupt change in temperature will be promptly and quickly corrected by a more rapid actuation of the pitch control means.

The invention has been specifically described as applied to a temperature responsive system actuated by the exhaust temperatures of an internal combustion engine. It is to be understood, however, that the control means may be actuated by corresponding characteristics of other power sources such as turbines or electric motors. While a specific embodiment has been set forth for purposes of illustration the invention is capable of various uses and changes and modifications may be made therein as will be apparent to a person skilled in the art.

Although only a few of the various forms in which this invention may be embodied have been shown herein, it is to be understood that

the invention is not to be limited thereto but is only to be restricted in accordance with the scope of the following claims.

What is claimed is:

1. In a system for driving a vessel, a propeller having adjustable blades, an internal combustion engine having an exhaust, driving said propeller, pitch control mechanism controlling the pitch of said blades, temperature responsive mechanism connected in heat transfer relationship to the exhaust to be actuated by and exclusively as a function of variations in the temperature of the exhaust gases from said engine, and automatic means to maintain a substantially constant exhaust temperature including a reversible control member actuated by said temperature responsive means and connected to cause said pitch control mechanism to increase the pitch of said blades in response to a decrease in exhaust temperature and vice versa.

2. In a system for driving a vessel, a propeller having adjustable blades, an internal combustion engine driving said propeller, pitch control mechanism controlling the pitch of said blades, temperature responsive mechanism connected to be actuated by and exclusively as a function of variations in the temperature of the exhaust gases from said engine, and automatic means to maintain a substantially constant exhaust temperature including a progressive reversible control member actuated by the temperature responsive means and connected to cause said pitch control mechanism to increase the pitch of said blades in response to a decrease in exhaust temperature and vice versa at a speed of operation which varies in accordance with the amplitude of change of temperature, said speed being greater when the amplitude of change in temperature is greater and vice versa, regardless of the direction of such change.

3. In a system for driving a vessel, a propeller having adjustable blades, an internal combustion

engine driving said propeller, pitch control mechanism controlling the pitch of said blades, temperature responsive mechanism connected to be actuated by and exclusively as a function of variations in the temperature of the exhaust gases from said engine, automatic means to maintain a substantially constant exhaust temperature including a reversible control member actuated by said temperature responsive means and electrical means connected to cause said reversible control member to increase the pitch of said blades in response to a decrease in exhaust temperature and vice versa.

4. In a system for driving a vessel, a propeller having adjustable blades, an internal combustion engine driving said propeller, pitch control mechanism controlling the pitch of said blades, temperature responsive mechanism connected to be actuated by and exclusively as a function of variations in the temperature of the exhaust gases from said engine, automatic means to maintain a substantially constant exhaust temperature including a reversible progressive control member having a plurality of electrical contacts and electrical means connected to said contacts to cause said pitch control mechanism to increase the pitch of said blades in response to a decrease in exhaust temperature and vice versa at a speed of operation which varies in accordance with the amplitude of change of temperature of said gases, said speed being greater when the amplitude of change is greater and vice versa, regardless of the direction of such change.

5. The system set forth in claim 1 in which the motor is an internal combustion engine of the Diesel type.

6. The system set forth in claim 1 in which the propeller is driven at a constant speed.

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