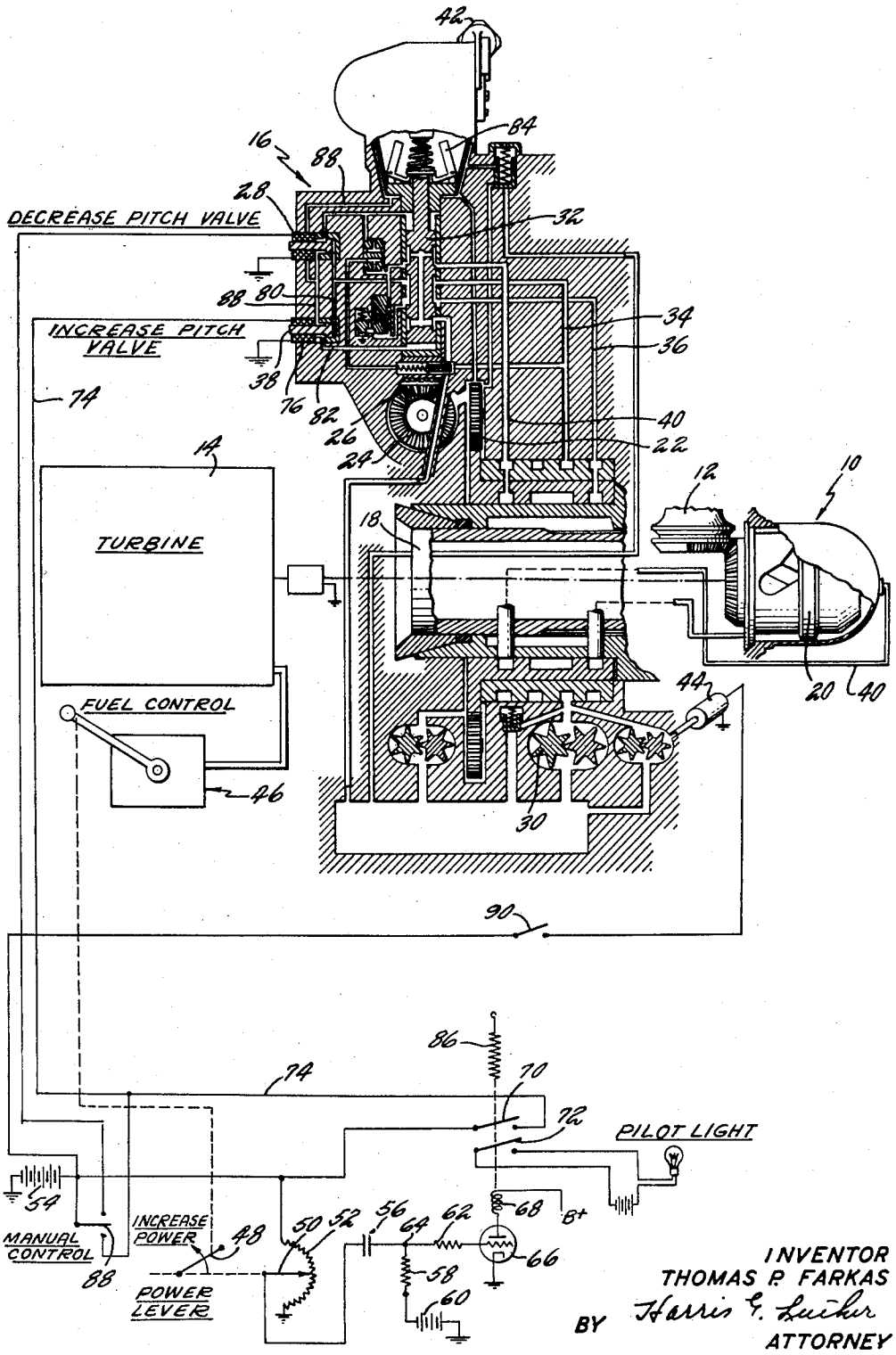
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PROPELLER CONTROL ANTICIPATOR

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PROPELLER CONTROL ANTICIPATOR

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This invention relates to a propeller control and particularly to throttle actuated means temporarily controlling propeller pitch in anticipation of a change in engine power.

An object of the invention is a simple electrical mechanism for temporarily disabling a hydraulic governor for a hydraulically actuated propeller and directing fluid at a predetermined rate to said propeller.

A further object is throttle actuated electronic mechanism temporarily closing a switch to actuate a valve and force the propeller pilot valve to one extreme of its movement for controlling the flow of fluid to a hydraulic propeller pitch changing mechanism.

A still further object is an electronic device utilizing the potential of a portion of an R.C. circuit, the potential across which is being changed, as the timing mechanism for temporarily actuating a governor disabling and fluid controlling switch.

A still further object is mechanism including an R.C. circuit utilizing a changing potential produced by a throttle actuated potentiometer to provide a temporary bias on an electron tube to control the actuation of switching mechanism.

Other and further objects will be apparent from the following specification and the attached drawing in which:

The single figure shows a wiring diagram of the invention applied to a hydraulic governor controlling an hydraulically actuated controllable pitch propeller.

In the operation of turbine driven propellers, it has been found that opening the throttle or increasing the fuel flow to a turbine driving a speed-governor-controlled controllable-pitch propeller may result in an increase in turbine speed which will reach such proportions before the governor is able to sense the speed change and produce sufficient blade change to start a turbine speed reduction, that the turbine may reach dangerous overspeed conditions. Furthermore, the rate of pitch change induced by the governor is proportional to the speed error so that small speed changes will produce only a small rate of pitch change.

In order to avoid this overspeeding upon the opening of the throttle, applicant has devised an anticipating mechanism actuated by the turbine throttle movement which will start an increase in propeller pitch upon opening movements of the throttle without waiting for a sufficient change in turbine speed to affect the governor and increase the propeller pitch. The anticipating mechanism is used to temporarily disable the governor and at the same time supply fluid to the propeller pitch changing mechanism at a predetermined rate so that the propeller pitch is increased an amount determined by the rate and the duration of the throttle opening movement.

The anticipating mechanism is shown as applied to a governor of the type shown in Anderson Patent 2,653,668, and Farkas application Ser. No. 314,593, filed October 14, 1952, now U.S. Patent 2,840,169 applied to a propeller of the type as shown in Forman Patent 2,477,858 to which reference may be made for further details of the governor and propeller.

In the structure selected for illustrating the invention, a propeller shown generally at **10** having a plurality of blades, one of which is shown at **12** is driven by an engine **14** which is preferably a turbine. A hydraulic governor indicated generally at **16** is driven by gears **22, 24, 26** from the propeller shaft **18** and directs fluid to one side or the other of piston **20** to control the pitch of the blades **12**. This governor is provided with a decrease pitch valve **28** which is electrically controlled to direct fluid from the main pump **30** to the top of pilot valve **32** to force the pilot valve downward to direct fluid from pump **30** through channel **34** to valve **32** and thence through line **36** to the inboard side of piston **20** to decrease the propeller pitch. The governor is also provided with an increase pitch valve **38** which can direct fluid from the pump **30** to the underside of pilot valve **32**, thus forcing the pilot valve upward to thereby direct fluid from pump **30** to channel **34**, pilot valve **32**, channel **40** to the outboard side of piston **20** to increase the propeller pitch. Reference may be made to the above-identified patents and application for further details of this propeller and governor. This governor is provided with a control indicated generally at **42** by which the governor speeder spring may be set in the usual manner to select the speed at which the propeller will be governed. The governor is provided with a feathering pump shown generally at **44** which may be energized to supply pitch changing fluid when the propeller is stationary. This fluid may be directed by the decrease pitch valve and the increase pitch valve in the same manner as the fluid from pump **30** in order to change the propeller blade pitch. The engine **14** is provided with a fuel control shown generally at **46** which is controlled by means of a power lever **48**.

The above-described mechanism will provide a propeller and engine combination in which the engine speed is maintained substantially constant by the governor controlled propeller in positive pitch positions and the fuel control may be varied to increase or decrease the engine power.

Attached to the power lever **48** for movement therewith, is the wiper **50** of the potentiometer **52** connected across a fixed source of voltage **54** in such a way that movement of the power lever **48** to increase the power will provide a more positive voltage in the wiper arm **50**. Wiper arm **50** is connected by means of a condenser **56**, a resistor **58** and a biasing voltage **60** with ground and thus completing the circuit through the potentiometer back to the source of potential **54**. A resistor **62** connects the junction **64** between condenser **56** and resistor **58** with the grid of a triode **66**. The plate circuit of the triode **66** energizes a solenoid **68** to actuate a pair of switches **70, 72** when the grid of the tube **66** is provided with sufficient positive potential to render the tube conductive. Closing of the switch **70** will complete a circuit from the potential source **54** through line **74** to the increase pitch valve solenoid **76** to move the valve toward the left as viewed in the figure to conduct fluid from the pressure line **34** from the pump **30** to line **80** to valve chamber of valve **38** and line **82** to the underside of valve **32**. Introduction of the pressure fluid under the pilot valve **32** will overcome the effect of the governor flyweights **84**, thus disabling the governor and lifting the valve **32** to a predetermined position and connect pressure line **34** with the line **40** leading to the front side of the piston **20** to move the pitch changing piston and increase the propeller pitch. The rate at which the propeller pitch can increase is determined by the capacity of the pump **30**, and the size of the line to which the fluid is pumped.

In moving the increase power lever 48 in an increase power direction, the wiper 50 is moved towards a more positive side of the potentiometer 52 to thus give a more positive potential across the condenser 56 and resistor 58 combination. The negative potential 60 in this circuit is provided to give a normally negative voltage on the grid of tube 66. Upon a rapid increase in the positive potential across condenser 56 and resistor 58, the potential at junction 64 will at first materially increase and turn positive while the condenser 56 is charging. When the junction 64 becomes positive and consequently renders the potential at the grid of tube 66 positive, tube 66 will then conduct to energize solenoid 68. After the potentiometer wiper 50 has been brought to rest or has materially slowed down, the voltage at junction 64 will become less positive as the condenser 56 becomes charged and the junction 64 will then become negative and eventually cut off conduction in the tube 66 and stop the flow of current through solenoid 68 to thus permit spring 86 to open switch 70. Opening of switch 70 will de-energize the increase pitch solenoid 76, connecting the underside of the pilot valve 32 through line 88 to drain, thus restoring control of the pilot valve 32 to the governor flyweights 84.

From the above description, it will be seen that movement of the increase power lever 48 toward an increase power position at a sufficiently fast rate will change the potential at junction 64 and the grid of tube 66 sufficiently to disable the governor and cause an increase in propeller pitch at a predetermined rate determined by the pump capacity and the restrictions of the line connecting the pump with the pitch changing mechanism. This governor disabling action is a temporary phenomenon and lasts only while the condenser 56 is being charged to a different potential. The size of the condenser 56 and resistor 58 is chosen to give a time constant which will provide an increase in pitch of the propeller sufficient to absorb substantially all of the increase in power incident to movement of the power lever 48 to an increased power position so that substantially no increase in the turbine or engine speeds will take place and control will be returned to the constant speed governor with the propeller pitch in an increased pitch position which is substantially the correct position to absorb the entire power of the turbine being delivered to the propeller without any material speed change.

This anticipating action will prevent or materially reduce any overspeeding of the turbine upon an increase in power incident to waiting for a speed change to affect the governor before the governor in turn can increase the propeller pitch sufficient to absorb the additional power and return the turbine to the selected speed.

Movement of the power lever 48 in a decrease power direction will move the potentiometer wiper 50 to reduce the potential across the condenser 56 and resistor 58 and thus tend to make the junction 64 more negative. Making the grid of the tube 66 more negative will, of course, have no effect except to put the tube 66 further into cut-off so that the propeller will remain under governor control while the power and pitch are being reduced. Any underspeeding that might occur while waiting for the governor to respond to an underspeed to reduce the propeller pitch, would not be serious.

If desired, a pilot light actuated by switch 72 can be used to advise the pilot when the governor is disabled.

Control switches 88 and 90 have been shown for manually controlling the propeller, but other means described in more detail in the above-mentioned patents and application may be used for controlling the propeller in other regimes of operation.

Although only one embodiment has been shown and described herein, it will be apparent that various changes and modifications may be made in the construction and arrangement of the various parts without departing from the scope of this novel concept.

What is desired to be obtained by Letters Patent is:

1. A control for an engine driven propeller comprising a speed responsive governor controlling the propeller pitch, a power lever controlling engine fuel flow, means actuated by said lever including a potentiometer connected across a source of D.C. voltage, a condenser and resistor connected in series and with the potentiometer wiper so as to provide a voltage across said series condenser and resistor in accordance with lever position, and provide a voltage at the junction of said condenser and resistor varying with the rate of movement of said power lever, and means, responsive to a voltage above a preselected amount at said junction, incident to the rate of movement of said power lever, operatively connected with and temporarily disabling said governor and changing the propeller pitch.

2. A control as claimed in claim 1 in which said voltage responsive means includes an electron tube and means connecting the grid of said tube with said junction; said source, potentiometer, resistor and tube arranged so that movement of said lever to increase engine power at or above a predetermined rate will activate said tube to activate said governor disabling and pitch changing means to disable said governor and increase the propeller pitch as long as said movement is at or above said rate.

3. Mechanism as claimed in claim 1 in which the governor is a contrifugal governor having a valve actuated by flyweights and controlling the flow of operating fluid to and from the propeller pitch actuating mechanism and said governor disabling and pitch increasing means includes a magnetically actuated valve for, when energized, directing fluid to a motor connected with said governor valve to move said valve to an extreme position and direct fluid to said pitch actuating mechanism to increase the propeller pitch.

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