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[56]

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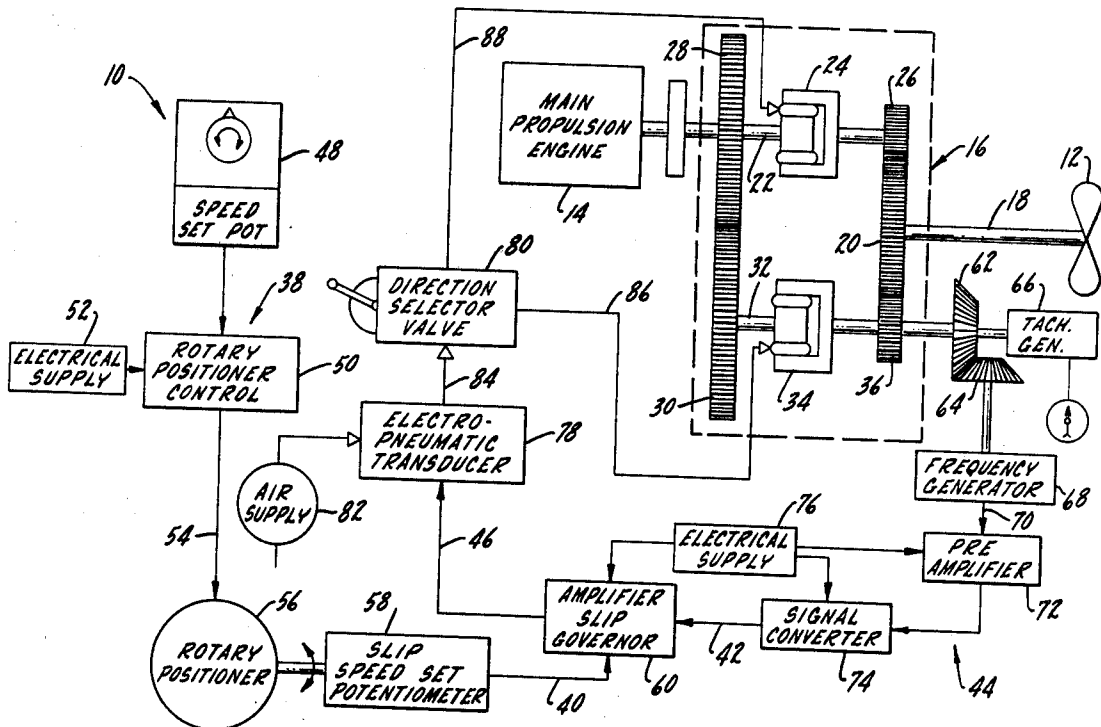
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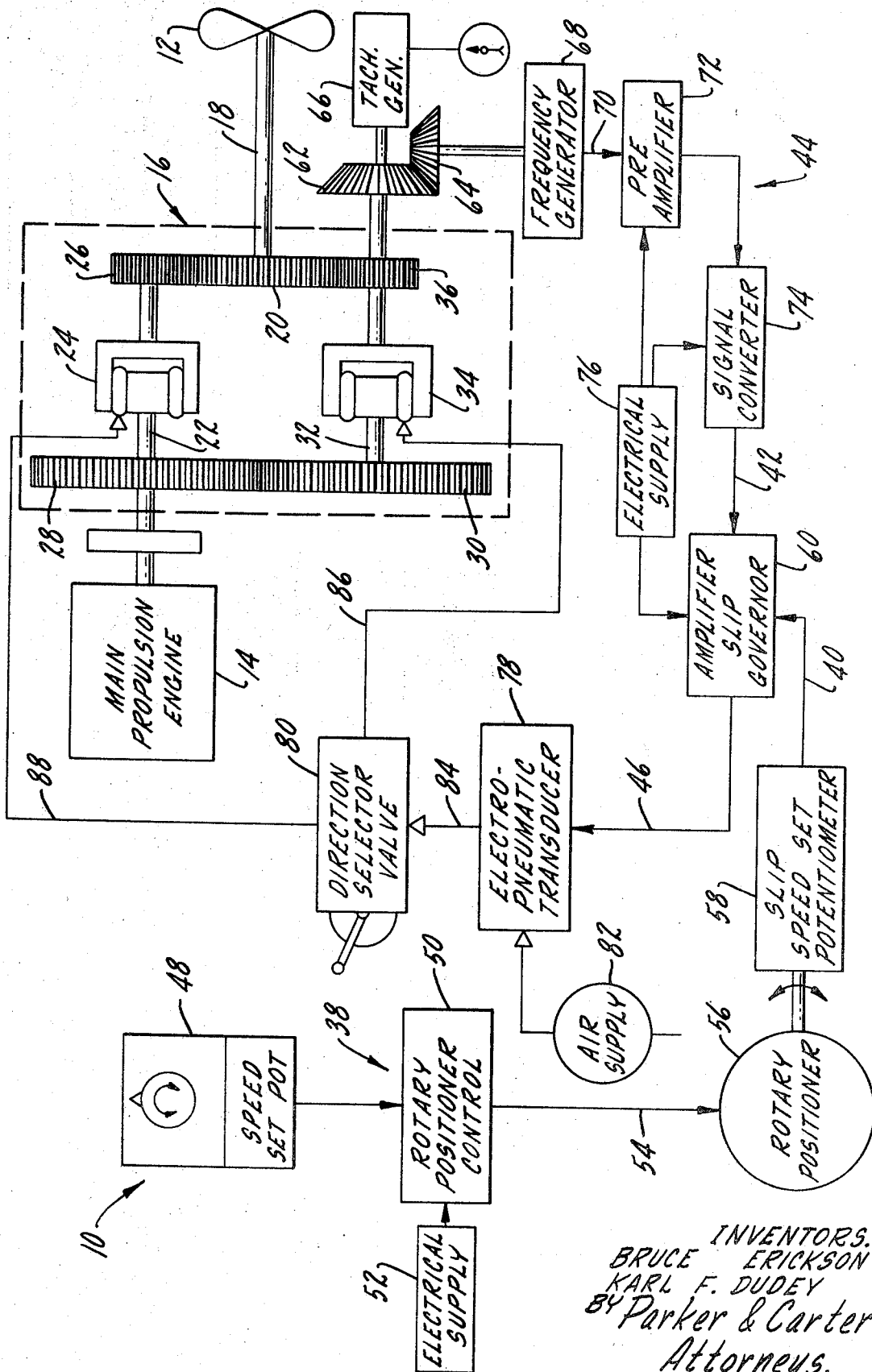
[54] ELECTRIC SPEED CONTROL FOR FLUID OPERATED MARINE CLUTCHES

3 Claims, 1 Drawing Fig.

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ABSTRACT: A marine engine control system having slip clutches controlling propeller output speed. A manual speed set which may be remotely mounted produces a signal which is compared with a propeller output signal to provide a control signal for varying clutch slippage to achieve the selective output speed. The control signal operates a transducer connected with a direction selector valve for varying slippage in either the ahead or astern clutches.





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ELECTRIC SPEED CONTROL FOR FLUID OPERATED MARINE CLUTCHES

SUMMARY OF THE INVENTION

This invention relates to a control system for marine propulsion and more particularly relates to a marine propulsion control system in which incremental propeller speed adjustment in both the ahead and astern directions is obtained through slip clutches utilizing an input control signal and a propeller feedback signal.

Marine propulsion systems commonly utilize reduction and reversing gear arrangements for vessel speed and direction control. It is common practice to limit the speed range of the marine engine from rated speed down to approximately 50 percent of rated speed. It is undesirable to go below the lower limit in speed because of torsional critical vibrations within the engine and propeller shafting. However, it is often necessary during maneuvering such as in docking to apply small amounts of power to the propeller along with frequent reversing. Although it is possible to provide a variable pitch propeller for these operations, a fixed pitch propeller is much more desirable from the standpoint of a marked reduction in the initial cost of the system.

Although it is known to provide slip clutches in marine propulsion units, previous systems have not provided a simple, efficient, inexpensive and reliable control circuit providing incremental propeller speed control utilizing propeller feedback signals and manual speed set signals. Moreover, previous control systems of the type described have not provided a simple control circuit in which incremental propeller speed can be easily controlled at an operator's station remote from the remaining parts of the propulsion system, such as in the case of very long ore carrying vessels.

Accordingly, it is an object of the invention to provide an improved marine engine control system in which propeller speed may be controlled over a wide range while maintaining relatively high engine speed.

Another object is to provide a marine engine control system in which propeller speed is controlled through slip clutches with a control signal obtained by comparing propeller output speed with a speed set input variable.

Another important object is to provide a marine engine control system utilizing slip clutches in which an electrical control circuit may be remotely mounted to provide an input signal which combines with a propeller output signal to produce a control signal operating a transducer controlling clutch slippage.

Another important object is to provide a marine engine control system having ahead and astern propeller speed gears controlled by a pair of slip clutches connected with a direction selector valve which in turn passes a controlled slip signal responsive to the difference between desired and feedback signals.

These and other objects of the present invention will become apparent to those skilled in the art when the following specification is read in conjunction with the accompanying drawing.

THE DRAWING

The single drawing is a schematic diagram of a marine engine control system incorporating features of the invention.

DETAILED DESCRIPTION

Referring to the drawing the marine engine control system of the invention indicated generally at 10 controls the speed of propeller 12 at a rate which may be adjusted over a wide range. Main propulsion engine 14 drives the propeller through a reduction gear and clutch assembly 16 and propeller shaft 18.

Gear and clutch assembly 16 may comprise any type of gearing to transmit torque between the engine and propeller. In the preferred embodiment gear 20 keyed to shaft 18 is connected to drive the propeller for ahead and astern operation

through a pair of gear sets and clutch assemblies. Shaft 22 driven from the engine output shaft is connected with slip clutch 24 to drive pinion 26 meshing with propeller gear 20. This provides the ahead gear set and clutch arrangement, depending on the direction of rotation of the engine output shaft. The astern gear and clutch arrangement may include gear set 28 and 30 which drive shaft 32, slip clutch 34, and pinion gear 36 meshing with gear 20.

The slip clutches 24 and 34 are of a conventional construction and are adapted to undergo a controlled slippage of the clutch elements responsive to a controlled pressure below lockup pressure. The output speed of the clutch may thus be varied between freewheeling and lockup conditions while engine speed is maintained relatively constant. One type of clutch which may be utilized for this purpose is a slip clutch operated pneumatically and which comprises one or more inflatable members responding to input air pressure to vary the pressure between interleaved friction plates of the clutch. However, it is understood that the invention is not limited to the particular type of clutch utilized.

Control system 10 includes a manual set point system 38 producing a selectively variable input control signal at 40. This is compared with a feedback signal at 42 produced from feedback system 44. Input signal 40 and feedback signal 42 are compared to produce a control signal 46 for controlling the slippage of the clutches.

Set point system 38 comprises a manual speed set device 48 which may be located at a position remote from the propulsion system and other control system components. This is advantageous in situations where the pilot is at a great distance from the main control system, as in the case of very long ore carrying vessels. Manual speed set 48 is conventional and may comprise a speed set potentiometer manually adjustable and electrically connected with a rotary positioner control 50. Control 50 is powered by electrical supply 52 and operates to provide an electric signal 54 responsive to speed set 48 to power rotary positioner 56 which in turn adjusts the slip speed set potentiometer 58. The setting of potentiometer 58 provides an electrical input signal 40 to the amplifier slip governor device 60.

Feedback system 44 comprises a bevel gear set 62, 64 driven from pinion gear 36 of the gear mechanism 16. A tachometer generator 66 provides an indication of propeller output speed. Frequency generator 68 driven from gear 64 provides an electrical output signal 70 proportional to propeller speed. The frequency generator is conventional and may comprise an inductive pickup type rotary speed measuring device. This system is not damaged by higher speeds resulting when the propeller shaft is operating at full speed, which could otherwise be destructive to mechanical governing drive systems. The output 70 from generator 68 is fed to a preamplifier 72 and then to a signal converter 74 producing electrical feedback signal 42 responsive to propeller speed. Electrical supply 76 provides electrical power for the operation of governor 60, preamplifier 72, and signal converter 74. A conventional tachometer generator, not shown, may be utilized in place of frequency generator 68, preamplifier 72, and signal converter 74 to produce feedback signal 42.

Slip governor 60 is conventional and preferably comprises an electronic servo operational amplifier comparing input signal 40 and feedback signal 42 to produce an electrical control signal 46. Control signal 46 controls clutch slippage and therefore propeller speed through transducer 78 and direction selector valve 80.

Transducer 78 is of conventional construction and is either electropneumatic as in the preferred embodiment, or could be electrohydraulic depending on the type of clutch actuation mechanism involved. Thus, although air operated clutches are preferred, hydraulically or mechanically operated slip clutches may also be utilized. Electropneumatic transducer 78 receives air pressure from air supply 82 and directs it as a pneumatic slave signal 84 to direction selector valve 80. Signal 84 is proportionally responsive to control signal 46. Direction

selector valve 80 diverts this slave signal to either the astern conduit 86 or ahead conduit 88 according to the valve position manually selected by the pilot.

In the preferred operation of slip clutches 24, 34 full air pressure through conduits 86 and 88 provides lockup of the selected clutch so that full torque is transferred to the propeller. The pressure of slave signal 84 is reduced by transducer 78 in an amount required to slip the clutches until the speed condition selected by speed set 48 is achieved.

In operation, propulsion engine 14 will be operated at a substantially constant speed while the control system of the invention is utilized to adjust propeller output speed, as in a docking operation. Initially, input signal 40 and feedback signal 42 are balanced in slip governor 60 so that the control signal 46 is maximum. Slave signal 84 directed through selector valve 80 to a selected one of the slip clutches fully engages that clutch. To slip the selected clutch and thus vary propeller speed, speed set 48 is manually adjusted so that rotary positioner control 50, rotary positioner 56, and speed set potentiometer 58 change the balance between 42 and 40. This unbalance between the signals into governor 60 responds by reducing control signal 46 into transducer 78. Slave signal 84 is in turn reduced as it follows signal 46 so that the air pressure to the selected clutch is accordingly reduced, the clutch slips, and propeller speed drops. This drop in propeller speed is sensed by feedback circuit 44 through frequency generator 68, preamplifier 72, and signal converter 74 to vary feedback signal 42. When propeller speed drops sufficiently, feedback signal 42 will be balanced with input signal 40 so that control signal 46 and slave signal 84 level off at a constant value. After this, further adjustment of manual speed set control 48 will increase or decrease propeller speed as desired. Manipulation of selector valve 80 will operate the vessel in either the ahead or astern direction while the propeller is turning at such selected speed.

While the embodiment herein is considered to be preferred, it is understood that numerous variations and modifications

may be made by those skilled in the art and it is intended to cover in the appended claims all such variations and modifications as fall in the true spirit and scope of the invention.

We claim:

1. A control system for use with a marine engine driving a propeller including the combination of speed set means for selectively producing an input signal, means sensing propeller output speed to produce a feedback signal, a governor to produce a control signal responsive to an imbalance between said input and feedback signals, a transducer for producing a variable slave signal responsive to the control signal, two slip clutches for controlling propeller speed responsive to the slave signal, gear means operable with the slip clutches for selected ahead and astern propeller operation, and directional control means selectively operable to direct said slave signal to one of the slip clutches for said selected propeller operation, each slip clutch comprising an air operated clutch adapted to reduce propeller speed responsive to variation of the slave signal, said slave signal comprising circuit means for directing air pressure to the slip clutches, said transducer being connected with the circuit means for varying the air pressure responsive to the control signal.

2. The invention of claim 1 wherein full air pressure operates said slip clutches to transmit substantially full torque from the engine to the propeller, and said transducer proportionally reduces said air pressure for slipping the slip clutches responsive to the control signal.

3. The invention of claim 1 further characterized in that said speed set means is manually adjustable for producing an input signal comprising a selectively variable electrical signal, said feedback signal comprises an electrical signal varying in response to propeller speed, said governor produces a control signal responsive to a difference in values of said input and feedback signals, and said transducer operates to reduce said slave signal responsive to variation in said control signal.

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