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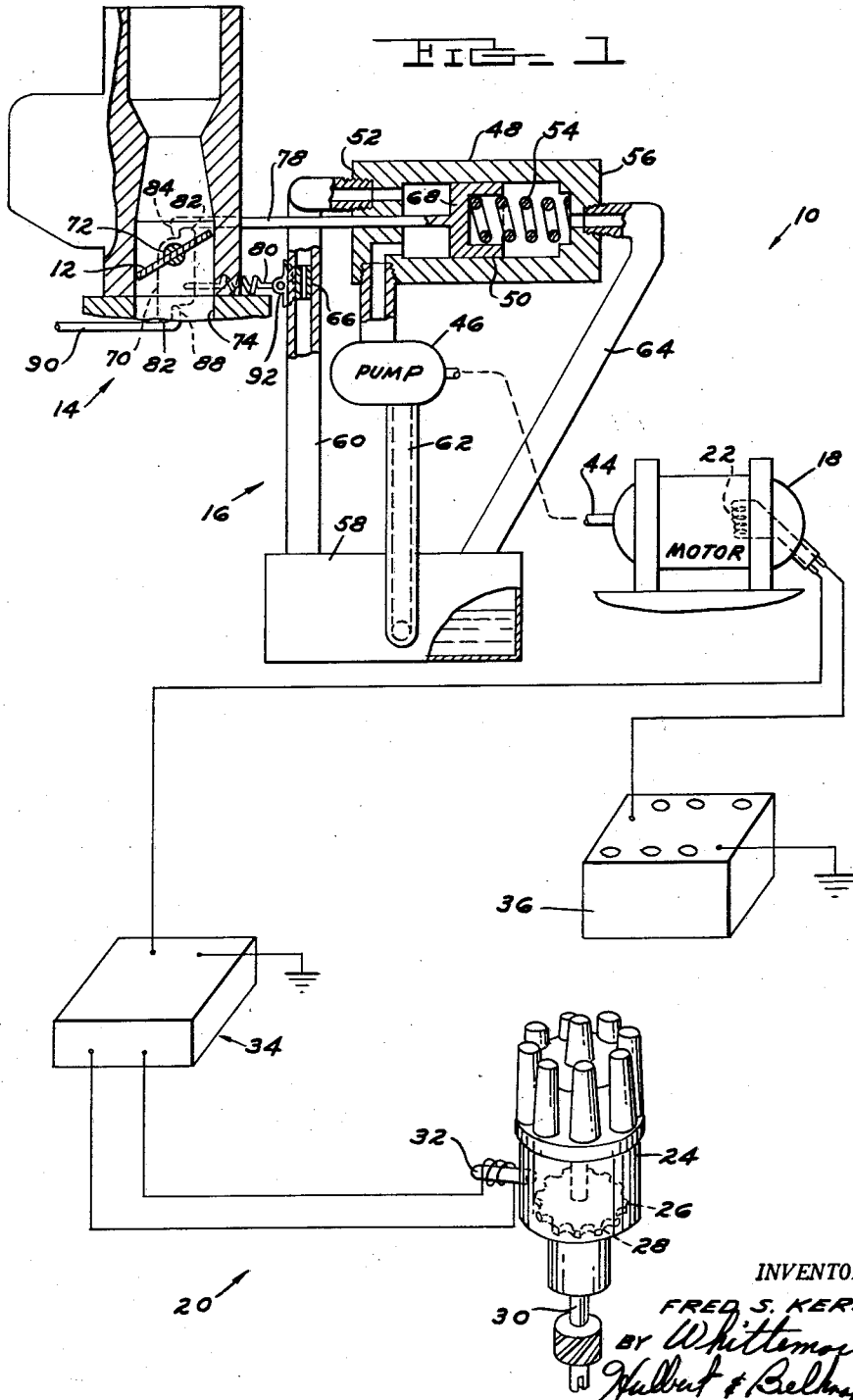
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ENGINE SPEED GOVERNOR

Filed April 11, 1960

2 Sheets-Sheet 1



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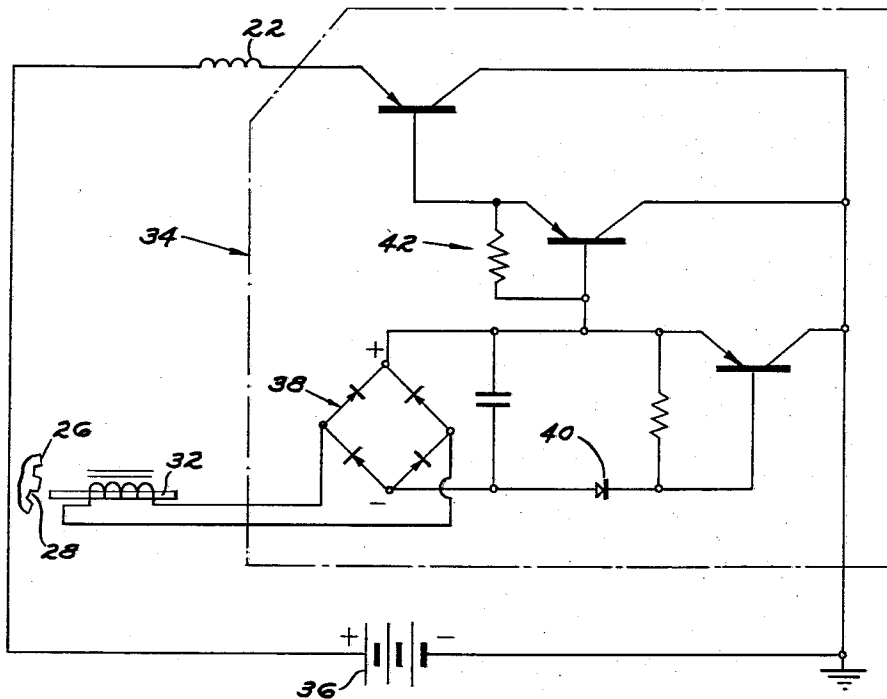
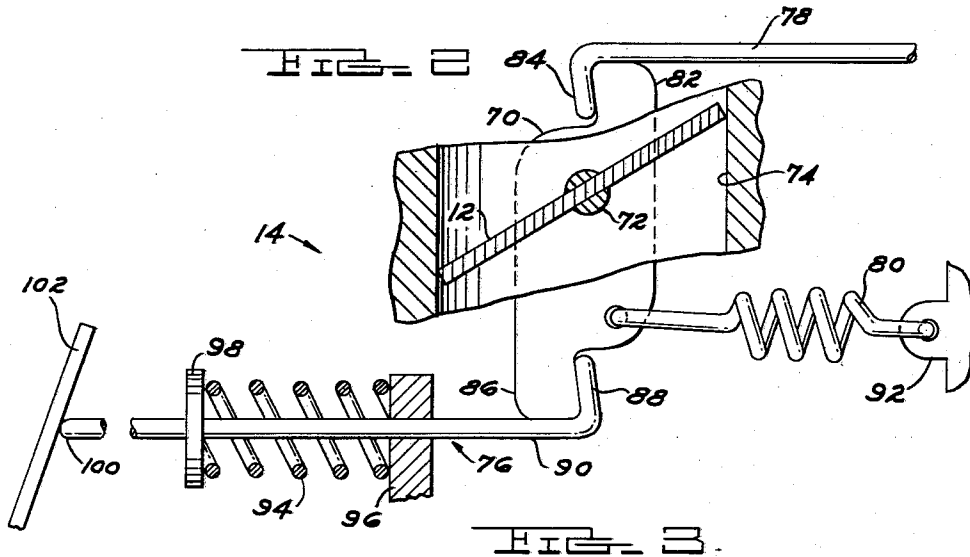
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ENGINE SPEED GOVERNOR

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15 Claims. (Cl. 123—102)

The invention relates generally to engine speed governors and refers more specifically to hydraulic means for governing the speed of an engine which hydraulic means is actuated in accordance with engine speed by electronic speed sensing means.

In the past electronic and electro-mechanical engine speed governors have been known. Such governors have however been relatively complicated and expensive. In addition often such governors require electrical apparatus to be positioned directly on the engine or immediately adjacent thereto whereby the electrical apparatus is subject to vibrations, oil and dirt generally present in conjunction with engines. Such conditions necessitate frequent repair of the governors, the electrical part of which is less well understood and is often improperly performed by the usual mechanic.

It is therefore one of the purposes of the present invention to provide an engine speed governor having hydraulic control means actuated in accordance with engine speed.

Another object is to provide hydraulic engine speed governing means actuated in accordance with an electrical signal developed in accordance with engine speed.

More specifically it is an object to provide hydraulic engine speed governing means including a hydraulic cylinder and piston, said piston having a piston rod movable to govern engine speed, and means for pumping hydraulic fluid through the hydraulic cylinder to cause movement of the piston in accordance with engine speed.

Still more specifically it is an object to provide engine speed governing means comprising a hydraulic cylinder and piston, means associated with said piston for governing the engine speed in accordance with the position of said piston, and means for pumping hydraulic fluid through the cylinder at a rate depending on the magnitude of an electrical signal developed in accordance with engine speed to cause movement of the piston to a predetermined governing position.

Another object is to provide an engine speed governor as set forth above wherein the means associated with the piston for governing the engine speed in accordance with the position of the piston comprises a control plate secured to the engine throttle valve which is spring biased to move the throttle valve into an open position and a piston rod secured to the piston and engageable with the control plate to limit movement of the throttle valve toward the open position under influence of the spring.

Another object is to provide an engine speed governor as set forth above wherein the means for pumping hydraulic fluid through said cylinder comprises a hydraulic fluid supply reservoir, a conduit extending between the reservoir and one end of the cylinder having a fluid pump interposed between the reservoir and cylinder and a conduit extending between the reservoir and the same end of the cylinder having a restriction therein.

Another object is to provide an engine speed governor as set forth above wherein the hydraulic pump is actuated by an electric motor, the speed of which is controlled in accordance with engine speed by electronic engine speed sensing means.

Another object is to provide an engine speed governor as set forth above wherein the control plate comprises a substantially flat plate rigidly fixed to one end of a rod pivotally mounting the throttle valve which plate is pro-

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vided at opposite ends thereof with portions adapted to engage a manual throttle control and the piston rod respectively and which plate is biased in a direction to cause the throttle to open with both the manual throttle control and piston rod being positioned to restrict the pivoting of the plate and therefore the opening of the throttle valve.

Another object is to provide an engine speed governor as set forth above which is simple in structure, economical to manufacture and efficient in use.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is a partly schematic and partly diagrammatic illustration of an engine speed governor according to the invention.

FIGURE 2 is an enlarged view of a portion of FIGURE 1 illustrating the details of the throttle valve control means.

FIGURE 3 is a schematic diagram of the electronic portion of the engine speed governor shown in FIGURE 1.

With specific reference to the figures a particular embodiment of the present invention will now be disclosed.

As shown best in FIGURE 1 the invention is a governor generally indicated 10 which is particularly adapted for use with an engine (not shown) having a throttle valve 12. The governor comprises the valve control means generally indicated 14, pump means generally indicated 16, electric motor 18 and electronic engine speed sensing means 20.

In accordance with the invention the electronic speed sensing means 20 is operable to develop an electric signal proportional to engine speed after the speed of the engine reaches a predetermined value. The speed of the electric motor is controlled in accordance with the electric signal developed by the electronic means 20. The pump means 16 is actuated in accordance with the speed of the electric motor 18 to position the valve control means 14 to limit movement of the throttle valve 12 whereby engine speed is governed.

The electronic means 20 as indicated above is operable to develop an electric signal in coil 22 which is proportional to engine speed after the engine has reached a predetermined speed. A detail description of the electronic means 20 is fully set forth in copending application Serial No. 764,144, now Patent No. 3,049,110, and therefore will be considered herein only to the extent necessary to the disclosure of the present invention.

As shown in FIGURE 1 the distributor 24 of the engine which it is desired to govern is provided with a rotating member 26 having angularly spaced recesses 28 around the circumference thereof which is secured to the distributor shaft 30 for rotation therewith. A magnetic pick-up probe 32 is positioned adjacent member 26 and is operable to produce an alternating current, the magnitude of which is proportional to the speed of rotation of the member 26. The alternating current developed by the probe 32 is rectified and after reaching a predetermined value is amplified by electronic means generally indicated 34. The direct current electric signal thus produced is a function of engine speed and is fed through coil 22 in electric motor 18 to produce regulation of the speed of the motor 18 in accordance with engine speed after the engine speed has reached a predetermined value. The battery 36 is operable in conjunction with the electronic means 34 to produce the required electric signal which is proportional to engine speed.

The electronic means 34 for rectifying and amplifying the signal produced by probe 32 after it has reached a

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predetermined value is shown in more detail in FIGURE 3. As shown in FIGURE 3 electronic means 34 includes rectifier 38 for rectifying the alternating signal produced by probe 32, Zener diode 40 for preventing amplification of the rectified signal until the signal reaches a predetermined value, and a three-stage transistorized amplifier generally indicated 42 operable in conjunction with battery 36 to amplify the rectified signal which is proportional to engine speed and pass the amplified signal through the coil 22 of electric motor 18.

As shown in FIGURE 1 the output shaft 44 of the electric motor 18 is connected in driving relation to the hydraulic fluid pump 46 of the pump means 16. The electric motor 18 is constructed to produce an output speed of shaft 44 proportional to the electric signal in coil 22. Since several means by which this may be accomplished are well known in the art the details of the electric motor 18 will not be included herein.

Pumping means 16 comprises the hydraulic cylinder 48, piston 50 positioned for reciprocation within the cylinder 48 and biased toward the end 52 of the cylinder 48 by the spring 54 acting between the end 56 of the cylinder 48 and the piston 50. Pumping means 16 further includes a hydraulic fluid reservoir 58, hydraulic fluid pump 46 and three hydraulic fluid conduits 60, 62 and 64.

Hydraulic fluid conduit 62 extends between the reservoir 58 and the cylinder 48. Hydraulic pump 46 is located in hydraulic fluid conduit 62 and is operable to pump hydraulic fluid from reservoir 58 into cylinder 48.

Hydraulic fluid conduit 60 also extends between end 52 of cylinder 48 and reservoir 58. The conduit 60 has a restriction 66 therein such that fluid pumped into cylinder 48 will create a fluid pressure on surface 68 of piston 50 to force piston 50 to the right in FIGURE 1 in opposition to the bias of spring 54. The piston 50 is however allowed to move to the left as shown in FIGURE 1 due to the bias of spring 54 when the speed of the pump 46 is lowered due to the passing of hydraulic fluid pumped into the cylinder 48 through restriction 66 and conduit 60 back to reservoir 58.

Conduit 64 extends between the reservoir 58 and the end 56 of the cylinder 48. Conduit 64 is provided to permit hydraulic fluid which may leak into the end 56 of the cylinder to return to the reservoir 58 as will be understood by those in the art.

Thus in operation the pump 46 is driven at a speed proportional to the speed of the electric motor 18 to create a fluid pressure in cylinder 48 on surface 68 of piston 50 to move the piston 50 to a predetermined position in opposition to the bias of spring 54 due to the restriction 66 in the return conduit 60. The position of the piston 50 is determined by the speed of operation of the pump 46. When the operating speed of the pump 46 raises or lowers, the piston 50 is thus caused to move to the right or left respectively in FIGURE 1.

The valve control means 14 as shown best in FIGURE 2 comprises a control plate 70 secured to one end of a rotatable rod 72 mounting throttle valve 12 in the intake passage 74 of the engine to be governed. The valve control means further includes the manual throttle control means generally indicated 76, the piston rod 78 secured to piston 50 and spring bias means 80.

As illustrated the control plate 70 includes a portion 82 at one end thereof engageable with the hooked end 84 of the piston rod 78 and the portion 86 at the other end thereof engageable with the hooked end 88 of the rod 90 of the manual throttle control means 76. The control plate is biased for rotation in a counterclockwise direction as shown in FIGURE 2 by a spring means 80 connected between a fixed abutment 92 and the control plate 70 as shown.

In operation the rod 90 of the manual throttle control 76 may be moved to the right in FIGURE 2 in opposition to spring 94 acting between abutments 96 and 98 by

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means of pressure on the end 100 thereof which, for example, may be applied by foot pedal 102. Without the piston rod 78 the control plate 70 would be allowed to rotate counterclockwise on movement of the rod 90 to the right whereby the throttle valve 12 would be opened and the speed of the engine increased. The opening of the throttle valve 12 and thus the speed of the engine may be limited to a predetermined value however by positioning of the piston rod 78 which engages the control plate 82 in a predetermined position thereof to prevent further opening of the throttle valve 12.

Thus in over-all operation of the engine speed governor disclosed as the rod 90 of the manual throttle control 76 is moved to the right the throttle valve 12 will be opened due to bias of the spring 80 and the engine associated therewith will pick up speed.

The speed of the engine is sensed by the magnetic pick-up probe in conjunction with the rotation of member 26 secured to the distributor shaft 30 which rotation is at a speed proportional to engine speed. The signal developed by the probe 32 which is proportional to engine speed is rectified and amplified by electronic means 34 on the engine speed reaching a predetermined value. The rectified and amplified electric signal proportional to engine speed is then passed through coil 22 to regulate the speed of the electric motor 18.

Thus the pump 46 may be caused to operate at an engine speed above a predetermined engine speed. Further since the position of the piston 50 depends upon the speed of operation of the pump 46 the position of the control plate 70 at which contact is made thereby with the end 84 of piston rod 78 will also be determined by the speed of the pump 46.

Thus is the operation of the engine an equilibrium will be established between engine speed as determined by the position of the throttle valve 12 and the position of the piston rod 78 which is a function of the engine speed since the pump 46 controls the position of the piston 50 and the speed of the pump 46 is proportional to the speed of the motor 18 which is determined by the electric signal passing through coil 22 developed in accordance with engine speed.

By proper varying of the amplification of the signals fed to the electric motor 18 the position of the throttle valve when the control plate engages the end 84 of rod 78 may be varied to correspond to the engine speed at which it is desired to govern the engine.

The drawings and the foregoing specification constitute a description of the improved engine speed governor in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. An engine speed governor comprising hydraulic control means associated with the engine operable on actuation to limit the speed of the engine in accordance with the degree of actuation of the hydraulic control means, said hydraulic control means including a hydraulic cylinder, a piston movable within said cylinder, valve control means associated with said piston for limiting the speed of the engine in accordance with the position of said piston in said cylinder and pump means for positioning said piston in said cylinder in accordance with the speed of operation thereof, said governor further comprising electronic means associated with said pump means and sensitive to engine speed operable to actuate said pump means at a speed proportional to engine speed.

2. Structure as claimed in claim 1 wherein the engine includes a movable throttle valve and said valve control means comprises a control plate secured to the throttle valve for movement therewith, spring means biasing the control plate in a direction to open the throttle valve, and a piston rod secured to said piston for movement therewith positioned to engage said control plate to limit move-

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ment thereof due to said spring means in accordance with the position of said piston.

3. Structure as claimed in claim 1 wherein said pump means includes a hydraulic fluid reservoir, a first fluid conduit extending between said fluid reservoir and one end of said cylinder, a second fluid conduit having a restriction therein extending between said one end of said cylinder and said reservoir, a hydraulic fluid pump operable to pump hydraulic fluid to said cylinder through said first conduit and resilient means within said cylinder operable to urge the piston toward one end of the cylinder.

4. An engine speed governor comprising hydraulic control means associated with the engine operable on actuation to limit the speed of the engine in accordance with the degree of actuation of the hydraulic control means, said hydraulic control means including a hydraulic cylinder, a piston movable within said cylinder, valve control means associated with said piston for limiting the speed of the engine in accordance with the position of said piston in said cylinder and pump means for positioning said piston in said cylinder in accordance with the speed of said engine, said governor further comprising electronic means including an electric motor operable to actuate said pump means at a speed proportional to the magnitude of a signal developed in accordance with engine speed, and electronic means for developing a signal the magnitude of which is variable in accordance with engine speed after a predetermined speed is attained by the engine.

5. An engine speed governor for an engine having a speed control member movable to regulate the speed of the engine, comprising electronic means operable to develop an electric signal proportional to the speed of the engine, an electric motor operably associated with said electronic means, the speed of which is controlled in accordance with said electric signal, control means including a governing member positionable to limit movement of said speed control member, and hydraulic means including a pump connected to said motor intermediate said electric motor and control means operable to position said governing member in accordance with the speed of the electric motor.

6. An engine speed governor for an engine having a speed control member movable to regulate the speed of the engine, comprising electronic means operable to develop an electric signal proportional to the speed of the engine, an electric motor operably associated with said electronic means, the speed of which is controlled in accordance with said electric signal, control means including a governing member positionable to limit movement of said speed control member in a direction whereby engine speed is increased, and hydraulic means including a pump connected to said motor intermediate said electric motor and control means operable to position said governing member in accordance with the speed of the electric motor.

7. An engine speed governor for an engine having a throttle valve operable to regulate the speed of the engine comprising, electronic means operable to develop an electric signal proportional to the speed of the engine above a predetermined speed, an electric motor operably associated with said electronic means, the speed of which is controlled in accordance with said electric signal, valve control means including a member positionable to limit movement of said throttle valve in an open direction, and pump means intermediate said electric motor and valve control means operable to position said member in accordance with the speed of the electric motor.

8. An engine speed governor for an engine having a throttle valve operable to regulate the speed of the engine comprising, electronic means operable to develop an electric signal proportional to the speed of the engine above a predetermined speed, an electric motor operably associated with said electronic means, the speed of which is controlled in accordance with said electric signal, valve

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control means including a piston rod positionable to limit movement of said throttle valve in an open direction, and hydraulic means including a pump connected to said motor intermediate said electric motor and valve control means, said pump means comprising a hydraulic cylinder, a piston reciprocal therein to which said piston rod is attached, and means for positioning said piston in said cylinder in accordance with the speed of the electric motor.

9. An engine speed governor for an engine having a throttle valve operable to regulate the speed of the engine comprising, electronic means operable to develop an electric signal proportional to the speed of the engine above a predetermined speed, an electric motor operably associated with said electronic means, the speed of which is controlled in accordance with said electric signal, valve control means including a piston rod positionable to limit movement of said throttle valve in an open direction, and hydraulic means intermediate said electric motor and valve control means, said hydraulic means comprising a hydraulic cylinder, a piston reciprocal therein to which said piston rod is attached, and means for positioning said piston in said cylinder in accordance with the speed of the electric motor, said means for positioning said piston including resilient means biasing said piston toward one end of said cylinder, a hydraulic fluid reservoir, a pair of fluid conduits extending between said one end of said cylinder and the reservoir, one of said fluid conduits having a restriction therein, and a hydraulic fluid pump in the other of said conduits for pumping fluid into said cylinder, the speed of operation of the fluid pump being controlled by the electric motor.

10. Structure as claimed in claim 9 wherein said throttle valve is mounted on a rod and is movable on rotation of said rod into open and closed positions and said valve control means also includes a control plate secured to said rod for rotation therewith, means biasing said control plate in a direction to open said throttle valve, and manually operated throttle valve control means engageable with said control plate to limit rotation thereof in a direction to open the throttle valve, said piston rod also engaging said control plate to limit rotation of said throttle valve in governing the speed of the engine.

11. An engine speed governor comprising hydraulic control means associated with the engine operable on actuation to limit the speed of the engine in accordance with the degree of actuation of the hydraulic control means, pump means for actuating said hydraulic control means in accordance with the speed of operation thereof, and electronic means connected in driving relation with said pump means and sensitive to engine speed for actuating said pump means at a speed proportional to engine speed.

12. An engine speed governor comprising hydraulic control means associated with the engine operable on actuation to limit the speed of the engine in accordance with the degree of actuation of the hydraulic control means, pump means for actuating said hydraulic control means in accordance with the speed of operation thereof, and electronic means connected in driving relation with said pump means and sensitive to engine speed for actuating said pump means at a speed proportional to engine speed only after a predetermined engine speed is attained by said engine.

13. An engine speed governor comprising hydraulic control means associated with the engine operable on actuation to limit the speed of the engine in accordance with the degree of actuation of the hydraulic control means, pump means for actuating said hydraulic control means in accordance with the speed of operation thereof, and means associated with said pump means and sensitive to engine speed operable only after a predetermined engine speed to actuate said pump means at a speed proportional to engine speed.

14. A governor comprising control means operable on

actuation to limit the speed to be governed in accordance with the degree of actuation thereof, pump means for actuating said control means in accordance with the speed of operation of the pump means, and means associated with the pump means and sensitive to the speed to be governed operable only after a predetermined speed to be governed to actuate the pump means at a speed proportional to the speed to be governed.

15. A governor comprising a speed control member movable to regulate speed, means operable to develop a signal proportional to the speed to be regulated, a variable speed motor operably associated with said signal developing means the speed of which is controlled in accordance with said signal, control means including a governing member positionable to limit movement of said speed control member, and means connected to said

motor intermediate said motor and control means operable to position said governing member in accordance with the speed of the motor.

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