June 19, 1962 T. F. CRAMER ETAL 3,039,480

HYDRAULIC ENGINE SPEED GOVERNOR

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FIG. 1.

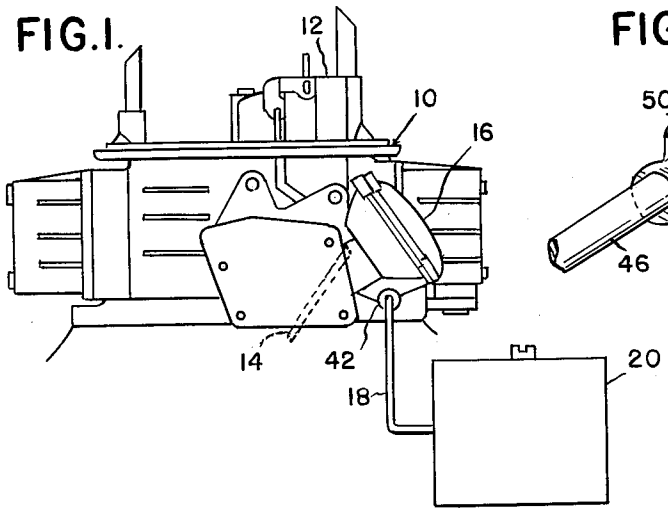


FIG. 3.

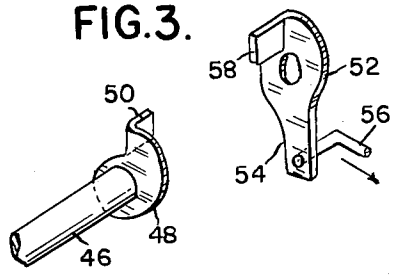


FIG. 2.

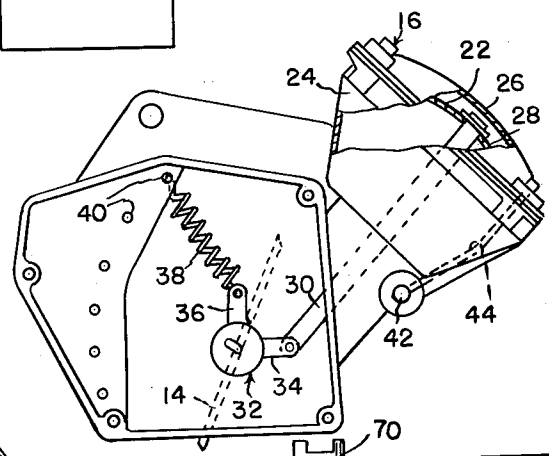
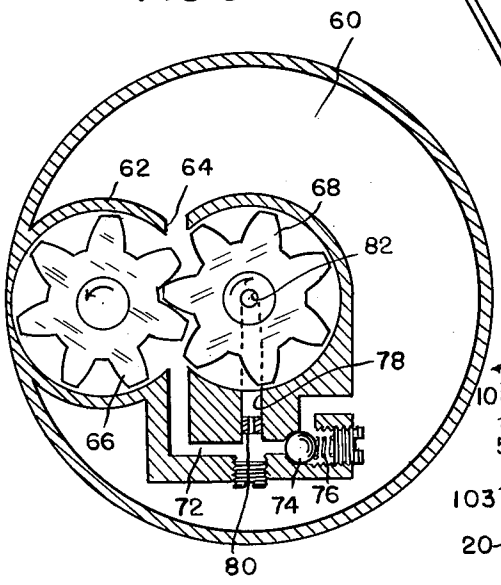


FIG. 5.



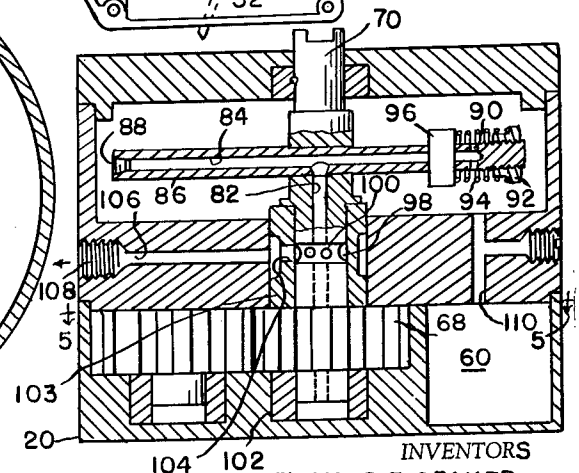


FIG. 4.

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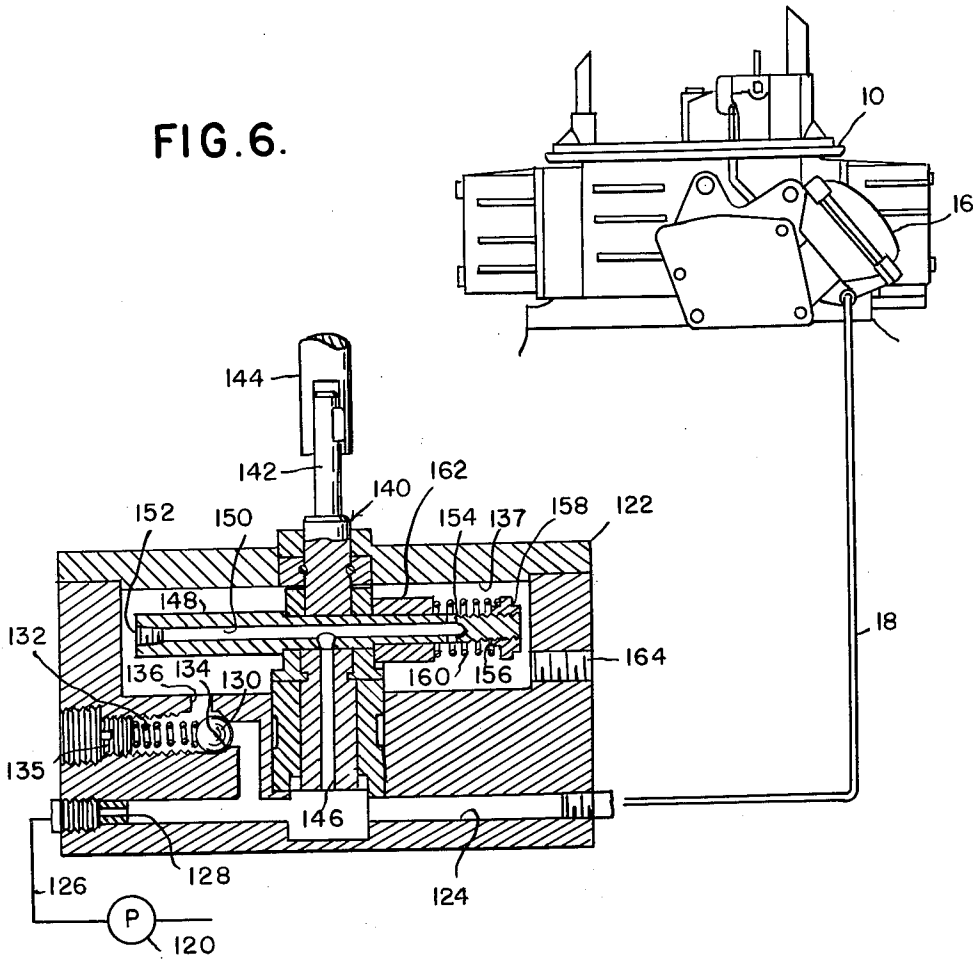
FIG. 6.



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HYDRAULIC ENGINE SPEED GOVERNOR

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The present invention relates to a hydraulic engine speed governor with integral relief means, and/or an integral pump and reservoir.

It is an object of the present invention to provide an engine governor including an integral pump and reservoir, said pump including a rotary member, and a speed responsive control valve associated with said rotary member.

It is a further object of the present invention to provide a hydraulic engine speed control system including speed responsive valve means for controlling the application of hydraulic pressure to a throttle control motor, and an integral relief valve associated therewith.

It is a further object of the present invention to provide in a speed control system for an internal combustion engine including a hydraulic motor for actuating the throttle of the engine, a speed responsive valve for controlling the application of hydraulic pressure to the motor, and a relief valve associated with said speed responsive valve for limiting the pressure applied to the motor.

It is a further object of the present invention to provide in a system for controlling the speed of an internal combustion engine, a combined reservoir, pump, speed responsive valve and relief valve unit for developing actuating pressure in hydraulic fluid, the relief valve limiting the maximum pressure deliverable by said unit, and the speed responsive valve controlling the delivery of the pressure controlled hydraulic fluid to a hydraulic motor.

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

FIGURE 1 is an elevational view showing the connection of the combined reservoir, pump and speed responsive valve to a throttle control motor mounted on the carburetor of an internal combustion engine.

FIGURE 2 is an enlarged view partly broken away of the hydraulic motor and its connection to the engine throttle.

FIGURE 3 is an exploded view showing the connection between a manual control device and the automatic speed control device of the present invention applied to the throttle shaft.

FIGURE 4 is a vertical sectional view through the combined pump, reservoir and speed responsive valve unit.

FIGURE 5 is a sectional view on the line 5—5, FIGURE 4.

FIGURE 6 is a view similar to FIGURE 1 showing a modified speed responsive control valve associated with the throttle actuating motor, the valve unit being shown in section.

Referring first to FIGURES 1–5 there is shown the speed control system for an internal combustion engine which includes a carburetor **10** having primary and secondary barrels, the inlet to the primary barrel being indicated at **12**, this barrel having a throttle therein the position of which is more or less diagrammatically indicated at **14**. Connected to the throttle **14** by mechanism subsequently to be described is a hydraulic motor **16** connected by an external conduit or passage **18** to a unit **20**, details of which will be subsequently described.

Referring now more specifically to FIGURE 2 there is shown the motor **16** with a portion thereof broken away to reveal a flexible diaphragm **22** therein clamped between a housing portion **24** and a removable domed cover **26**. Intermediate the diaphragm **22** and the domed cover **26** is an expansible actuating chamber **28**. The flexible diaphragm **22** is connected by an actuating rod **30** to a bell crank **32** having an actuating arm **34** to which one end of the rod **30** is connected. The bell crank includes a second arm **36** connected to a tension spring **38**, the opposite end of the spring being connected to one of a plurality of spring support pins **40**.

The motor **16** has a connection **42** communicating by an internal conduit **44** with the actuating chamber **28** and, as seen in FIGURE 1, the fitting **42** receives one end of the external passage or conduit **18**.

Upon admission of hydraulic fluid under pressure to the chamber **28**, the chamber expands moving the flexible diaphragm **22** downwardly as seen in FIGURE 2, thus imparting clockwise rotation to the throttle **14** which results in closing movement thereof.

The throttle **14** which is thus controlled by the motor **16** is the same throttle as controlled by the usual accelerator pedal. The manual and automatic control of the throttle are coordinated by structure shown in FIGURE 3. In this figure the throttle shaft is indicated at **46** and it will be understood that the throttle plate **14** is fixedly secured to the shaft **46**. Also fixedly secured to the shaft **46** is a member **48** having an offset abutment ear **50** carried thereby. Rotatably mounted on the throttle shaft **46** is a lever **52** having an arm **54** connected by a link **56** to the usual accelerator pedal. The arrangement is such that upon downward movement of the accelerator pedal to open the throttle, the link **56** moves in the direction of the arrow shown in FIGURE 3. The lever **52** includes an offset ear **58** adapted in assembly to lie to the rear of the ear **50** as seen in FIGURE 3 and thus to limit counterclockwise motion of the ear **50**, the member **48**, and hence the throttle shaft **46** and throttle plate **14**. It will be recalled that the tension spring **38** applies a constant counterclockwise or opening bias to the throttle shaft **46**.

With the foregoing arrangement, it will be observed that opening of the throttle by operation of the accelerator pedal is accomplished by manually producing counterclockwise rotation of the lever **52**, thus moving the ear **58** away from the ear **50**. However, under the influence of the spring **38**, the ear **50** follows the ear **58** and accordingly the throttle is opened by the spring **38** to the extent permitted by the movement of the lever **52**. On the other hand, when the motor **16** operates to close the throttle **14**, this is accompanied by movement of the ear **50** in a clockwise direction away from the ear **58**, if the lever **52** is in a position corresponding to open or partially open throttle position.

Referring now more particularly to FIGURES 4 and 5, details of the unit **20** are shown. The unit **20** comprises an integral hydraulic fluid reservoir, pump, relief valve and speed responsive control valve. More specifically, the unit comprises a reservoir portion **60** in which is located a pump casing **62** providing a pump inlet port **64**. Within the pump casing is a gear pump comprising the pump gears **66** and **68**. The pump gear **68** is fixed to a drive shaft **70** which is driven by an external driver which may be rotated at a speed corresponding to engine speed or at a speed corresponding to road speed of the vehicle. Formed within the pump casing **62** is an outlet passage **72** controlled by a pressure regulating relief valve **74** urged against its seat by an adjustable compression spring **76**. The output or delivery passage **72** of the pump communicates with a passage **78** which includes a base pressure metering orifice **80**, the passage **78** leading to and com-

municating with a vertically extending passage 82 in the shaft 70. The passage 82 as best seen in FIGURE 4, communicates at its upper end with the interior passage 84 of a spinner 86 closed at one end as indicated at 88 and having a port 90 adjacent its other end. Also adjacent the other end of the spinner 86 is an adjustable spring seat 92 on which is mounted a coil compression spring 94 which at its one end engages a centrifugal speed responsive valve element 96 adapted under the influence of centrifugal force to compress the spring 94 and move to a position in which it closes the port 90. Intermediate its ends the shaft 70 is provided with an annular groove 98 communicating through radial passages 100 with the longitudinal passage 82. The shaft is rotatable in a bushing 103 having a passage 104 communicating with a passage 106 leading to a port 108 adapted to be connected to the conduit 18 as seen in FIGURE 1.

With the construction as described, operation of the internal combustion engine to which the shaft 70 is connected results in operation of the pump including the gears 66 and 68, the gear 68 being directly driven by the shaft 70. This results in pumping hydraulic fluid from the reservoir 60 to the passage 72, excess fluid escaping through the relief valve 74 so that pressure in the passage 72 is maintained at a predetermined valve. This permits the use of a positive acting gear pump while at the same time the motor 16 and associated structure may be of relatively light construction consistent with the operation of adjusting the throttle plate 14 under relatively small hydraulic pressures.

During operation of the governor system, hydraulic fluid under the pressure as determined by cooperative action of the relief valve 74 and restriction 80, or at a lower pressure during initial operation, passes through the passages 78 and 82 into the central passage of the spinner 86. Initially, at speeds below governed speed the fluid escapes through the port or ports 90 whence it may return to the reservoir 60 through a passage 110. When however, governed speed is reached, the centrifugal valve 96 compresses the spring 94 and begins to close the port or ports 90. At this time pressure in the passage 82 commences to build up to a value which however can never exceed that controlled by the relief valve 74. The increase of pressure in the passage 82 results in an increase in pressure of the hydraulic fluid in the passage 106, conduit 18, passage 44, and hence of the hydraulic fluid in the actuating chamber 28. This increase of pressure in the chamber 28 initiates closing movement of the throttle 14 against the action of the tension spring 38.

It will be observed that the foregoing comprises a self-contained system for supplying hydraulic fluid under speed controlled pressures up to but not exceeding a predetermined safe operating maximum pressure.

From the foregoing it will be noted that the unit or device 20 includes first means in the form of a rotary pump operatively connected to the shaft 70 for establishing fluid pressure within the unit, second means in the form of the pressure relief valve 74 for preventing fluid pressure within the unit from exceeding a predetermined maximum at any time, and speed responsive means operatively connected to the shaft effective to prevent an increase of pressure within the unit below a predetermined shaft or governed speed. Below governed speed no substantial pressure is built up and accordingly, the operating parts are driven under minimum load conditions.

Referring now to FIGURE 6 there is shown a similar system, corresponding parts of which are identified by the same reference characters and hence will not be separately described. This system differs from that shown in FIGURES 1–5 in that the source of hydraulic fluid under pressure is an external operating pump 120 which may if desired be the pump for supplying lubricating oil to the engine. In this case the combined speed responsive and pressure regulating valve unit is indicated at 122. The unit 122 is provided with an internal passage 124 to one end of which is connected an external passage or conduit 126 leading to the pump 120. A base pressure metering orifice 128 is provided through which the hydraulic fluid flows to enter the passage 124. The opposite end of the passage 124 is connected by the external passage or conduit 18 to the motor 16 as previously disclosed.

Inasmuch as the pressure of fluid supplied by the pump 120 may be substantially greater than necessary for the operations to be performed by the motor 16 it is desirable to provide a means for limiting maximum pressure of hydraulic fluid supplied to the motor. This means comprises a pressure relief valve in the form of a ball valve 130 urged by a compression spring 132 against a valve seat 134. The spring is maintained under a predetermined pressure by an adjustable spring seat 135 and when the predetermined pressure is exceeded fluid pressure moves the ball 130 off its seat and permits fluid to exhaust as for example to a sump, reservoir or the crankcase of the engine through a passage 136 which communicates with a chamber 137 in the unit.

Extending into the interior of the unit is a rotary drive shaft 140 having an exterior portion 142 coupled to an external driver 144. The driver 144 may be driven at a speed directly proportional to engine speed or directly proportional to road speed of the vehicle.

The inner end of the shaft 140 is provided with a longitudinally extending passage 146 which communicates with the passage 124. Intermediate the ends of the shaft 140 there is provided a transverse opening communicating with the passage 146 which receives an elongated spinner 148 illustrated as comprising a pair of diametrically opposite extending arms. The spinner 148 has a longitudinally extending passage 150 provided therein closed at one end by a plug 152. Adjacent the other end of the spinner the passage 150 communicates with a transverse passage 154 forming valve ports. The last mentioned end of the spinner is threaded as indicated at 156 and receives an adjustable nut 158, constituting a seat for a compression spring 160. Slidable on the spinner 148 is a sleeve valve 162 urged to the left as seen in FIGURE 6 by the compression spring but movable radially outwardly under the influence of centrifugal force. Thus, at a predetermined rotational speed of the shaft 140, the sleeve valve 162 commences to close the valve ports 154.

During operation of the engine of which the carburetor 10 is a part, below the predetermined speed (either engine speed or road speed) hydraulic fluid such as oil under the pressure delivered by the pump 120 enters the passage 124 through the base pressure metering orifice 128. At this time the sleeve valve 162 is in an open position permitting the hydraulic fluid to flow through the passages 146 and 150, the port 154, to the chamber 137 in the unit, from which it flows through a suitable fitting received in the threaded opening 164 to exhaust, such for example as the crankcase of the engine. However, as soon as the speed of the shaft 142 arrives at the lower limit of governed speed, the sleeve valve 162 starts to close the valve ports 154 and accordingly pressure within the unit builds up to a point as determined by the strength of the spring 132. This pressure is transmitted to the motor 16 through the conduit 18.

It will be appreciated that the embodiment of the invention illustrated in FIGURE 6 is substantially the same as that illustrated in FIGURES 1–5 except that in the embodiment of FIGURE 6 the fluid pressure is supplied to the unit by an external pump.

In the embodiment of the invention illustrated in FIGURES 1–5 the hydraulic fluid actuating the motor 16 is contained in a closed system including only the motor 16, the unit 20 and the conduit extending therebetween. The unit includes its own reservoir or sump.

The drawings and the foregoing specification constitute a description of the improved hydraulic 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 we claim as our invention is:

1. A unitary, speed responsive device interposed between a source of fluid and the work for supplying fluid to the work at a pressure not to exceed a predetermined value comprising a substantially closed housing having a hollow interior, a substantially horizontal rigid barrier spanning the interior of said housing and dividing said housing into upper and lower compartments, means defining a fluid supply passage, a rotary tubular drive shaft vertically mounted in the interior of said housing and having one end extending outwardly from said housing beyond the top wall thereof which is adapted to be coupled to an external driver whose speed is to be sensed, said shaft including portions which extend through said upper compartment and said rigid barrier, means defining a bypass passage which connects said supply passage with a reservoir, a pressure controlling relief valve in said first bypass passage, said drive shaft including an axially extending first passage therein, which intersects said supply passage, a cross opening in the portion of said drive shaft in said upper compartment, said cross opening extending diametrically across said drive shaft, an elongated cross shaft in said upper compartment fixed in said cross opening in sealing relationship therewith, said cross shaft having a second passage therein, a first port in said cross shaft connecting said first and second passages, a second port in said cross shaft near one end thereof and opening into said upper compartment, a tubular valve slidable over said cross shaft adjacent said second port, said second port, when open, providing an effective means for preventing an increase of pressure of fluid in said supply passage below a predetermined speed, said valve being movable by centrifugal force radially of said shaft across said second port to close said second port and thereby increase the fluid pressure in said supply passage to a pressure limited by said relief valve.

2. A unitary, speed responsive device defined in claim 1 in which said one end of the cross shaft is provided with an adjustable spring seat and resilient means are provided between said seat and said valve for holding said valve away from said second port until the predetermined speed has been attained.

3. A unitary, speed responsive device defined in claim 1 in which said bypass passage is located in said barrier and connects said supply passage with said upper compartment.

4. A unitary, speed responsive device for supplying fluid at a pressure not to exceed a predetermined value, comprising a substantially closed housing having a hollow interior, a substantially horizontal rigid barrier spanning the interior of said housing and dividing said housing into upper and lower compartments, said lower compartment serving as a fluid reservoir, a pump including a pair of pumping elements mounted in said reservoir, the inlet side of said pump being in direct communication with the fluid in the reservoir, a rotary tubular drive shaft vertically mounted in the interior of said housing and having one end extending outwardly from said housing beyond the top wall thereof which is adapted to be coupled to an external driver whose speed is to be sensed, said drive shaft including portions which extend through said upper compartment and said rigid barrier and having the other end connected to one of the pumping elements of said pump for actuating said pump, a supply passage in said drive shaft and said barrier connecting the discharge side of said pump with an outlet connection in said housing, means in said lower compartment defining a bypass passage which connects the discharge side of said pump to the reservoir, a pressure controlling relief valve in said bypass passage, said drive shaft including an axially extending first passage therein which communicates with said supply passage, a cross opening in the portion of said drive shaft in said upper compartment, said cross opening extending diametrically across said drive shaft, an elongated tubular cross shaft in said upper compartment fixed in said cross opening in sealing relationship therewith, said cross shaft having a second passage therein, a first port in said cross shaft connecting said first and second passages, a second port in said cross shaft near one end thereof and opening into said upper compartment, a tubular valve slidable over said cross shaft adjacent said second port, said second port when open providing an effective means for preventing an increase of pressure of fluid in said supply passage below a predetermined speed, said valve being movable by centrifugal force radially of said cross shaft across said second port to close said second port and thereby increase the fluid in said supply passage to a pressure limited by said relief valve.

5. A unitary, speed responsive device defined in claim 4 in which a discharge passage is provided in said barrier to connect said upper compartment with said reservoir.

6. A unitary, speed responsive device defined in claim 5 in which said one end of the cross shaft is provided with an adjustable spring seat and resilient means are provided between said seat and said valve for holding said valve away from said second port until the predetermined speed has been attained.

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