

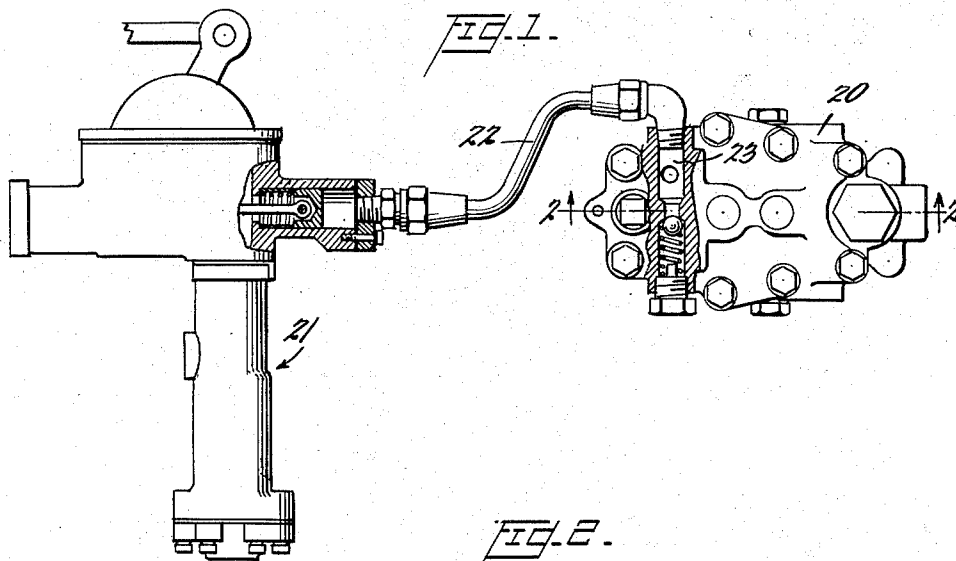
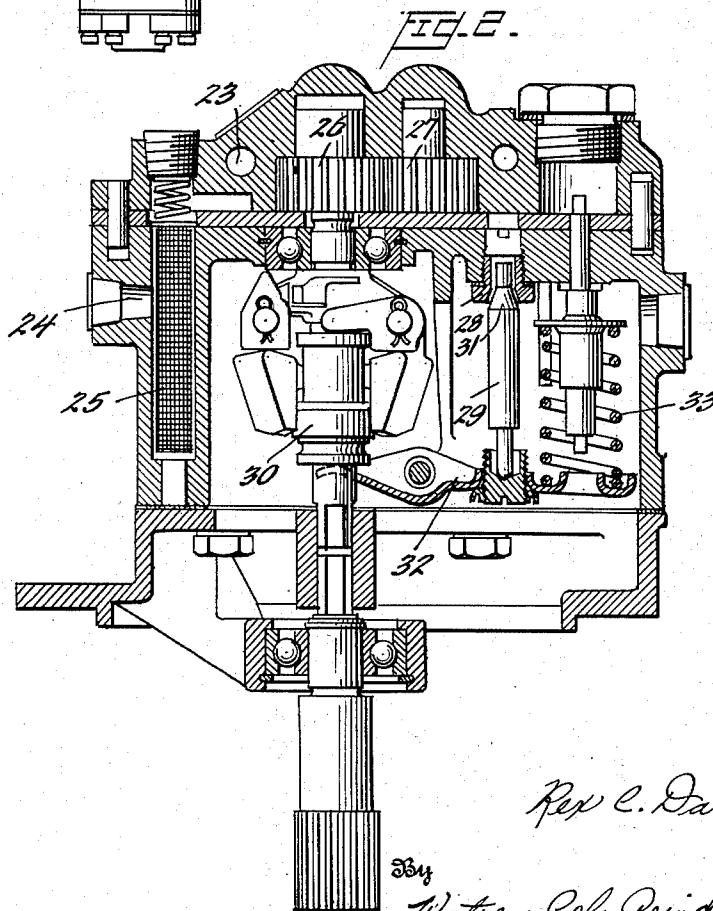
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R. C. DARNELL
HYDRAULIC SPEED GOVERNOR

2,525,653

Filed March 26, 1948

4 Sheets-Sheet 1



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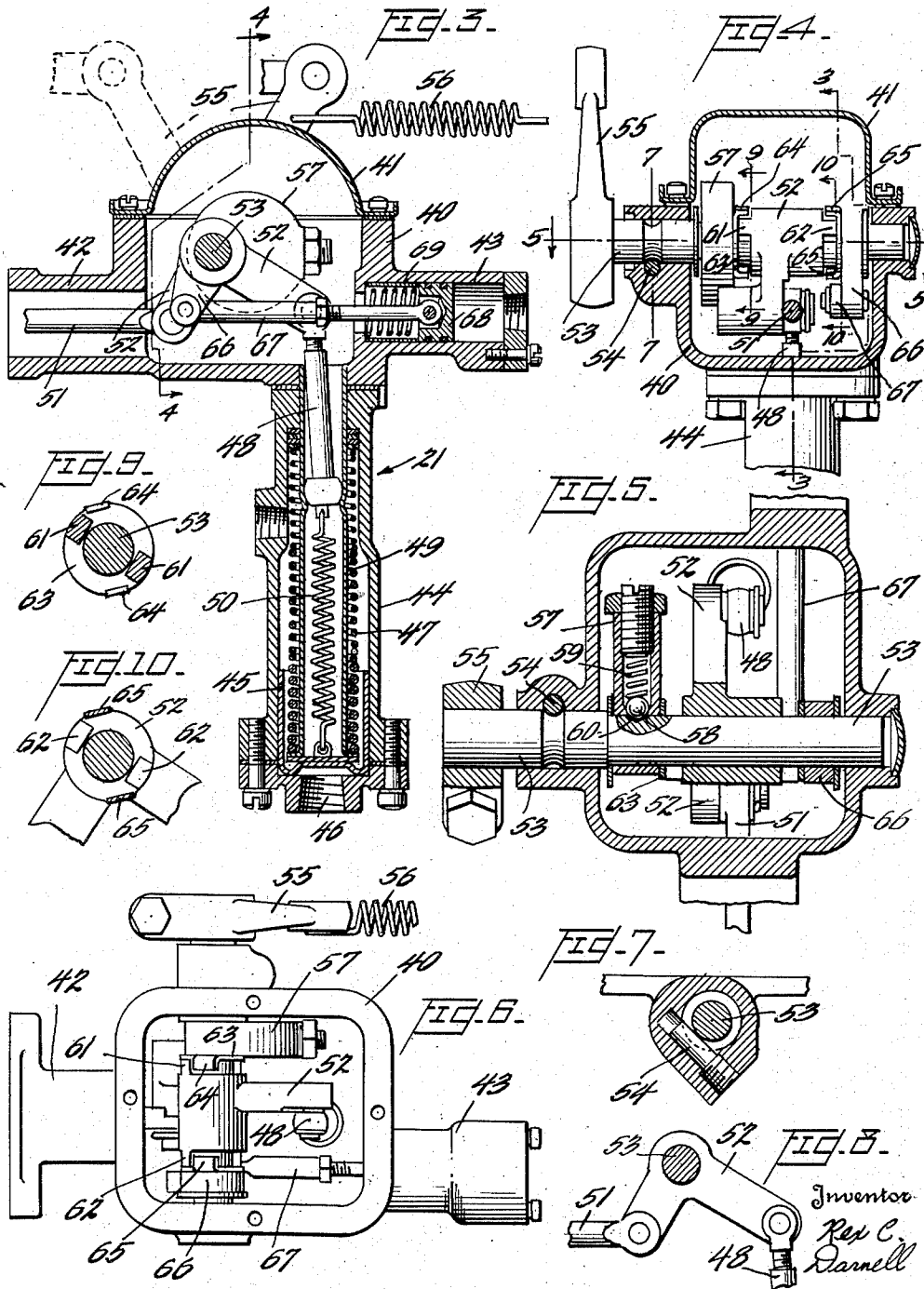
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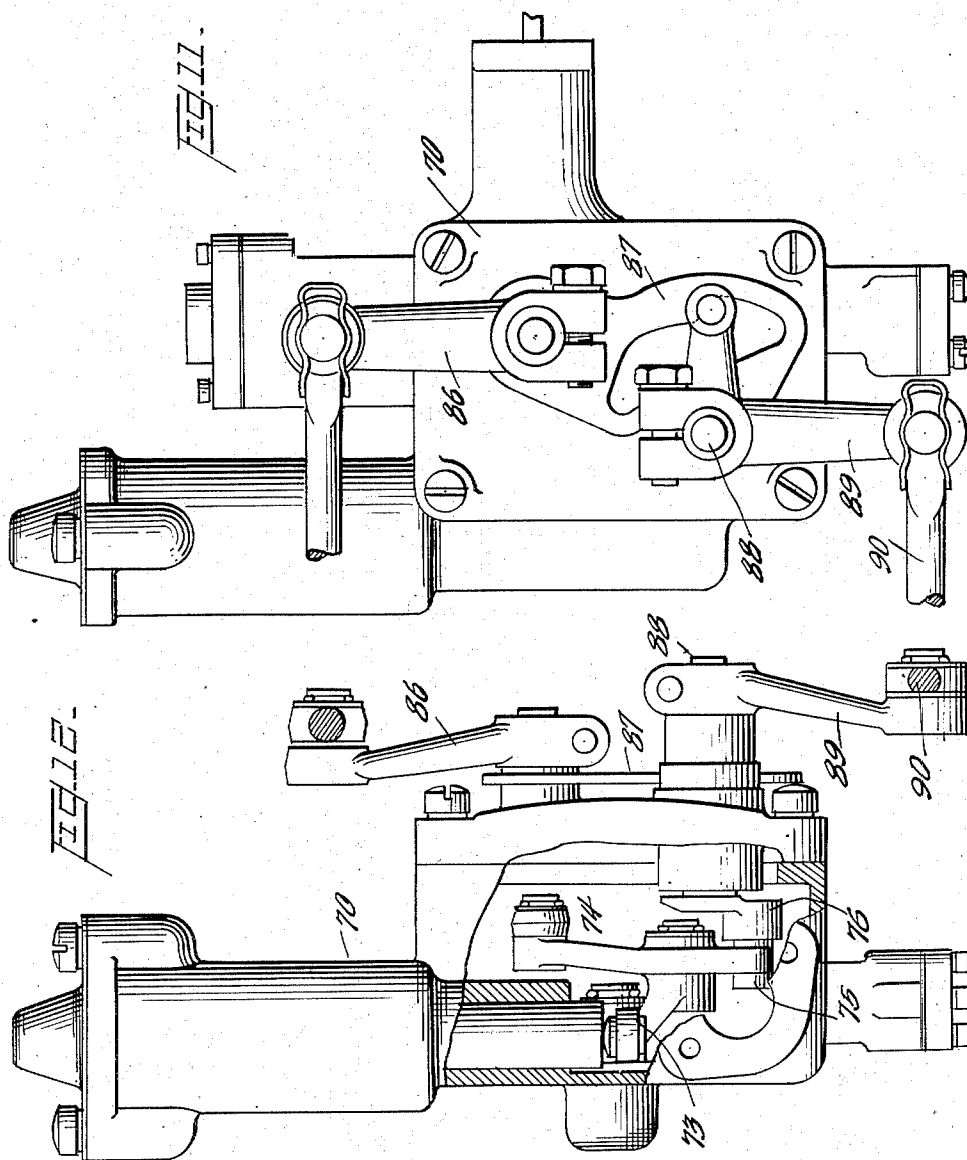
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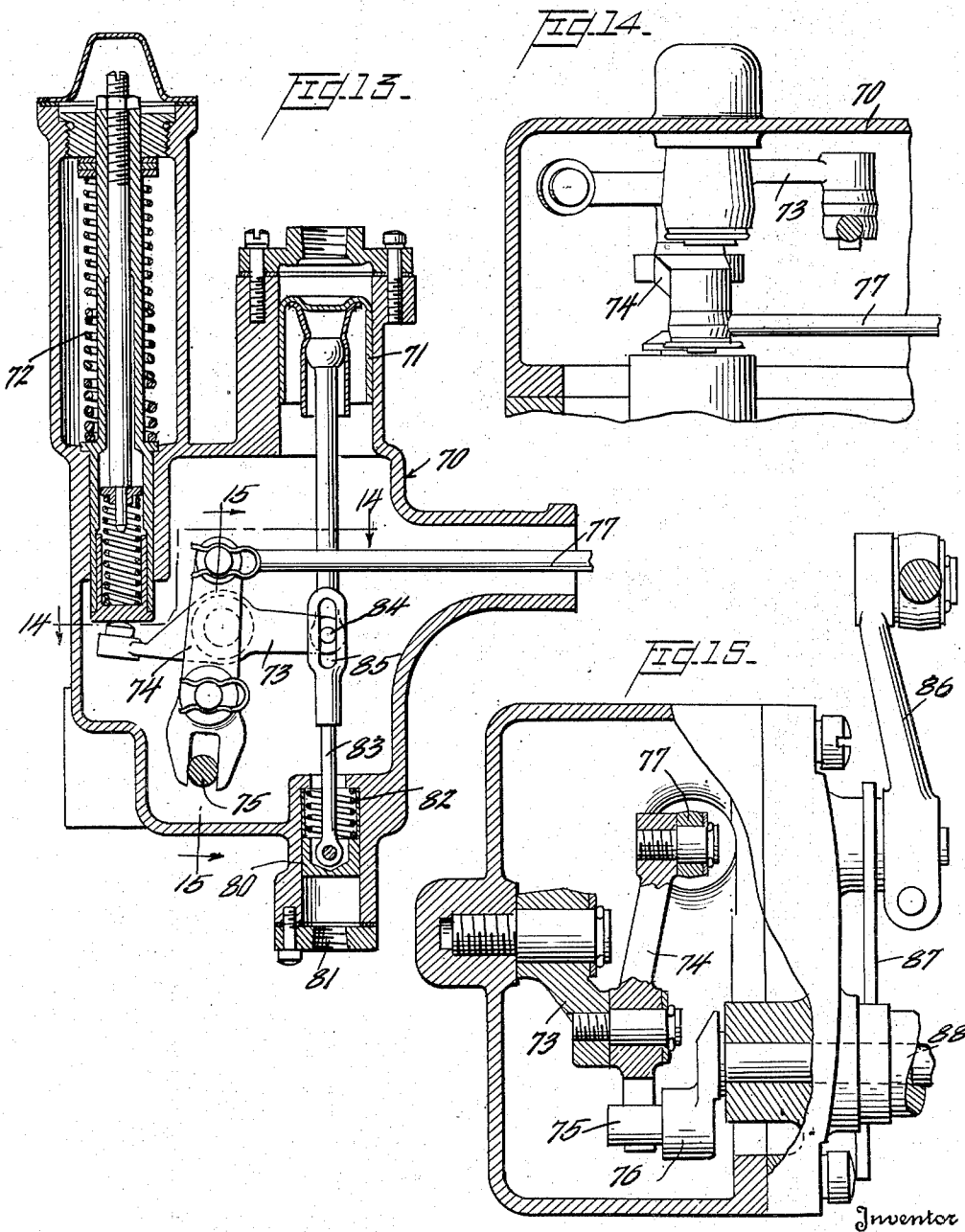
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HYDRAULIC SPEED GOVERNOR

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11 Claims. (Cl. 123—140)

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This invention relates to hydraulic governors for internal combustion engines, and more particularly to governors adapted for use in connection with Diesel engines.

Hydraulic governors for Diesel engines as a rule draw upon the engine lubricating oil supply for their hydraulic fluid, and such is the case with the type of governor here under consideration. Within the governor, the pressure of the oil is elevated by means of a pump, which is driven at a speed depending upon the engine speed, and the governing function depends upon the existence, within the governor, of such elevated fluid pressures. Accordingly, in the event of oil pressure failure, either in the engine or in the line leading from the engine to the master unit of the governor, or the line leading from the master unit to the slave unit of the governor, the governing function fails. In the case of oil pressure failure within the engine, it is essential that the engine be reduced to an idling speed in order to avoid damage to its moving parts. Also, when the governing function depends upon the existence of oil under pressure within the governor, a failure of pressure will cause the governor to permit the engine to run at excessive speeds, whether or not there is an oil pressure failure in the engine itself. Therefore, in this case also it is desirable that the engine be automatically reduced to idling speed. For example, if the engine in question is used for driving a vehicle, and the governing function is suddenly interrupted, a hazardous situation may result.

Accordingly, it is an object of the present invention to provide, in a hydraulic governor, means for automatically reducing the engine speed in the case of oil pressure failure. Such speed is conveniently the normal idling speed of the engine. Manually operable means are, of course, also provided in order to completely shut off the fuel supply, in order to stop the engine.

It is also widely believed, in the Diesel engine field, that it is advantageous to start the engine with the fuel control member or rack rod in wide open position. In order that this may be done without interference from any conflicting control, automatic means must be provided for that purpose. It is, therefore, an object of the present invention to provide a governor having automatic means for insuring that the rack rod is in wide open position when the engine is started.

A further object is the provision of a governor providing, in combination, automatic means for reducing the engine to idling speed in the event of oil pressure failure, manually operable means

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for shutting off the engine entirely, and automatic means for insuring the return of the rack rod, after such operation, to wide open position. A further object is the provision of a governor comprising a master unit driven by the governed engine, a slave unit adapted to actuate the fuel control member of the engine, pressure-responsive means in the slave unit for carrying out the governing function in response to fluid pressure generated in the master unit, and auxiliary pressure-responsive means in the slave unit and operatively connected to the fuel control member, for actuating the same to cut down the fuel supply in case of a diminution of oil pressure. A further object is the provision, in such a governor, of a lost-motion connection between the said auxiliary means and the fuel control member, whereby normal governing action can take place without hindrance.

Another object is the provision, in a governor of the type described, of a lost-motion connection between the manually operable shut-off means and the fuel control member, whereby normal governing may take place without interference from the manually operable means. A further object is the provision, in connection with said manually operable means, of means for automatically returning said means to wide open position after the engine is shut off.

Other and further objects, features and advantages will be apparent from the description which follows, read in connection with the accompanying drawings in which

Figure 1 is a view, partly in elevation and partly in section, showing a master unit and slave unit according to the present invention, and the means for transmitting fluid pressures therebetween;

Figure 2 is a vertical section on line 2—2 of Figure 1;

Figure 3 is a vertical section through the slave unit of Figure 1, on line 3—3 of Figure 4;

Figure 4 is a sectional view on line 4—4 of Figure 3;

Figure 5 is a section on line 5—5 of Figure 4;

Figure 6 is a plan view, with cover removed, of the slave unit of Figure 3;

Figure 7 is a sectional view on line 7—7 of Figure 4;

Figure 8 is a detailed view, in elevation, of one of the linkages illustrated in Figure 3;

Figures 9 and 10 are sectional views on lines 9—9 and 10—10, respectively, of Figure 4;

Figure 11 is a side elevation view of a modified form of slave unit;

Figure 12 is an end view, partly in elevation and partly in section, of the device illustrated in Figure 11;

Figure 13 is a vertical section of the device shown in Figure 11;

Figure 14 is a section on line 14—14 of Figure 13; and

Figure 15 is a section on line 15—15 of Figure 13.

In order to facilitate an understanding of the invention, reference is made to the embodiments thereof shown in the accompanying drawings and detailed descriptive language is employed. It will nevertheless be understood that no limitation of the invention is thereby intended and that various changes and alterations are contemplated such as would ordinarily occur to one skilled in the art to which the invention relates.

Referring to Figure 1 the governor of the present invention comprises a master unit 20 and a slave unit 21 connected by an oil conduit means (not shown) for the purpose of transmitting fluid pressures within the master unit to the pressure-responsive portion of the slave unit which is in control of the governing function. The general organization thus constituted is described in my copending application Serial No. 718,513, filed November 10, 1947, now abandoned, to which reference is made for details other than those hereinafter described. In the present instance, the master and slave units are also connected by a second conduit 22 which transmits fluid pressures within the master unit to the auxiliary pressure-responsive means of the slave unit, which auxiliary means is employed for the purpose of automatically reducing the engine to idling speed in case of a loss of fluid pressure, as mentioned above.

The master unit may be mounted at a convenient point on the engine, the rotating mechanism of such unit being driven from the engine and at a speed corresponding to the engine speed. The slave unit is mounted in any suitable position on the engine so as to provide convenient connection to the fuel control member of the engine which, in the case of Diesel engines, is commonly referred to as the rack rod. As described in the above-identified copending application, the master unit 20 is provided with a passage 23 which extends entirely through the unit (for right or left-hand operation), both ends being ordinarily closed by means of plugs. In the present instance the conduit 22 is connected to the passage 23 and is, therefore, filled with fluid which is subjected to the pressure existing within the master unit between the pump and the valve 28, 29, therefore the fluid pressure is somewhat greater than the fluid pressure at the slave means in control of the governing function. Ordinarily, the master unit is connected to the engine so as to receive a supply of lubricating oil, the oil entering the unit 20, for example, through the orifice 24 and passing through the filter screen 25. Within the unit 20 the pressure of the oil is elevated by means of a gear pump 26, 27 and a portion of it is forwarded to the slave unit 21, the balance of the oil being by-passed to the crank case through a valve comprising a seat 28 and valve needle 29. Movements of the latter are controlled by the rotating mechanism 30 and by the back pressure from the slave unit 21 acting upon the head 31 of the needle 29, the linear movements of the rotating mechanism being transmitted to the valve by means of pivoted rock lever 32. The

movements of the latter are resisted by a spring 33 which, in the illustrated embodiment, is shown as a simple single-rate spring, the initial pressure of which is adjustable according to the desired maximum governed speed.

The passage 23, to which the conduit 22 is connected, is located in the hydraulic circuit between the pump 26, 27 and the valve 28, 29, so that the fluid in conduit 22 is subjected at all times to the pump pressure.

The master unit illustrated in the present case is intended for use with a fixed speed engine such as might be used to drive an air compressor, a generator or similar device, but it is to be understood that the features of the present invention are applicable to all Diesel engine governors of the hydraulic type, governors for vehicles, for example, requiring different master units from that illustrated. The modification shown in Figures 11 to 15 of the present application involves a slave unit of the type which is especially adapted to vehicle motors, and the slave unit there illustrated is intended to be used with a master unit which is also suitable for vehicles, but which is not illustrated in the present case. Such a master unit is described in my co-pending application Serial No. 14,203, filed March 11, 1948.

Referring now to Figures 3 to 10, inclusive, the slave unit comprises a box-like casing 40 which is provided with a cover 41 and three generally cylindrical extensions 42, 43 and 44. The extension 44 contains the usual slave piston 45 which is subjected to the fluid pressure of the master unit, said pressure being transmitted through the orifice 46. Movements of the piston 45 are resisted by a spring series 47 as described in my application Serial No. 785,143, and the piston rod 48 is movably mounted in the tubular member 49 but is normally retained in the position illustrated by means of the tension spring 50.

The fuel control or rack rod 51 extends through the tubular portion 42 of the slave unit casing and is connected to one arm of a bell crank lever 52 (Figure 8) which is journaled within the casing 40, the opposite arm of the lever 52 being similarly connected to the upper end of the piston rod 48. The lever 52 is seen in end elevation in Figure 4. It is rotatably mounted on shaft 53 which extends entirely through the casing 40, being held against longitudinal movements by means of a set screw 54 (Figure 7). A manually operable control lever 55 is also mounted on the shaft 53, and is normally held in wide open position by means of tension spring 56.

A block 57 is rotatably mounted on the shaft 53 adjacent one end of the hub of lever 52 and contains a detent comprising a ball 58 (Figure 5) and spring 59. The ball 58 is adapted to seat, at times, in an indentation 60 formed in the shaft 53, and at other times to ride on the outer surface of said shaft. The hub of the lever 52 is provided at either end with dogs 61, 62. The block 57 is provided with a stamping or other member 63 having dogs 64, the member 63 being welded or otherwise fixedly secured to the block 57. It will be understood that the dogs 61 and 64 and their associated members together comprise the clutch or lost-motion connection illustrated in Figure 9.

The dogs 62 formed on the opposite end of the hub of lever 52 are adapted to form a part of a similar clutch or lost-motion connection (Figure 10), the complementary dogs 65 being formed on a member which is fixedly associated

with a lever 66 loosely pivoted on the shaft 53. The lever 66 is connected, by means of link 67 with a piston 68 slidably mounted in the extension 43 of the casing. The piston 68 is subjected to the master unit pump fluid pressure through the conduit 22 (Figure 1), inward movements of the piston being in turn resisted by a spring 69. It should be borne in mind that the spring 69 is stronger than the spring 50, as, on occasion, the former must overpower the latter. However, spring 69 can in turn be overpowered by springs 50 and 56, in combination, as hereinafter pointed out.

The operation of the device thus described is as follows:

The governor functions, normally, in the manner described in my application Serial No. 785,143, filed November 10, 1947, above-mentioned. That is, the oil pressure within the master unit 20 as determined by needle valve 28, 29, which is a function of the speed of the engine, is impressed upon the slave piston 45 and is in turn resisted by the action of the spring series 47. Movements of the piston 45 are transmitted to the rack rod 51 through the piston rod 48 and lever 52 which, under normal conditions, is permitted to oscillate freely on the shaft 53 without hindrance either from the manually controlled linkage or the automatic shut-down means. However, when the oil pressure within the master unit is diminished to a very low value by reason of an accident to the lubricating system or an interruption occurring within the governor, the corresponding pressure in the conduit 22 and cylinder 43 will likewise be diminished. The piston 68 will, therefore, move toward the right under the pressure of spring 69, the clutch 62, 65 will be engaged, and the rack rod 51 will move so as to adjust the fuel supply to the engine so that the latter will operate at idling speed.

The engine may then be shut down entirely by manual operation of the lever 55 toward the left in Figure 3. In the course of this movement the ball detent 58, 59 engages the indentation 60 in shaft 53, thus causing the block 57 to move with the shaft. Clutch 61, 64 then engages, bringing about a further movement of the lever 52 and rack rod 51, so that the fuel is entirely shut off, stopping the engine.

When the lever 55 is released it will move to wide open position under the urging of the spring 56. In so doing it of course rotates the shaft 53 and block 57, which is now engaged with the shaft 53 through the aforesaid ball detent. In the course of movement of the block 57, the clutch 61, 64 is engaged in the other direction, transmitting the oscillation of the block 57 to the lever 52 and rack rod 51, which thus goes automatically to wide open position. At the same time the piston 68 is moved toward the left against the pressure of spring 69, which is overpowered by springs 56 and 50, as pointed out above.

After the damage to the oil system has been repaired, and when the engine has again started, the oil pressure on the slave piston 45 (with the engine attempting to go above governed speed) will be sufficient to cause the lever 52 to assert its usual control through the rack rod 51 and at the same time, through the clutch 61, 64, to cause the block 37 to move relative to the shaft 53, thus disengaging the ball 58 from the indentation 60. Thus the entire mechanism is restored to

the same condition which it occupied at the time of the oil pressure interruption.

Referring now to Figures 11 to 15, inclusive, the slave unit there illustrated differs from that previously described in that this unit, designated generally by the reference character 70, is especially adapted for use in connection with vehicles, being of the general type described and illustrated in my copending application Serial No. 14,203, filed March 11, 1948. Movements of the slave piston 71 are resisted by the spring series 72 through the medium of lever 73, on which is also pivoted a bifurcated lever 74. A movable fulcrum is provided at the lower end of the latter by a pin 75 which may be adjusted manually through the medium of a crank 76. The rack rod 77 is pivoted at the upper end of the lever 74 and thus is subjected to the forces exerted by both manual and automatic controls through the crank 76 and the lever 73, respectively.

An auxiliary piston 80, corresponding to the piston 68 of Figure 3, is subjected to fluid pressure within the master unit through an orifice 81, such pressure being opposed by a spring 82. The piston rod 83 has a lost-motion connection with the lever 73 consisting of a pin 84 and slot 85.

When the oil pressure on the piston 80 is diminished sufficiently, the latter moves downwardly causing the lever 73 to move in a clockwise direction and the rack rod 77 to move toward the left, automatically shutting the engine down to idling speed. Manual stopping of the engine may then be accomplished through the medium of the crank 76, the lever 86 first having been oscillated, by any suitable means, so as to move the attached cam 87 to permit shut-off movement of the crank 76 through its shaft 88. Movements of the latter may be conveniently controlled through a lever 89 attached by means of a link 90 to the usual accelerator or other means under control of the vehicle operator.

Since opening movements of the rack rod 77 are entirely under the control of the operator through the linkages just described, it is unnecessary to provide automatic means for returning the rack rod 77 to wide open position. That is, it is customary for a vehicle operator to step on the accelerator, or similarly exercise his control of the vehicle engine when starting the latter, and he should be free to manually control the engine speed as soon as the engine is started, while in the case of a generator or an air compressor the engine speed will be fixed by the governor rather than by manual control. In this alternative form of the device, therefore, there is no mechanism corresponding to the block 57 or ball detent 58, 59, nor are there any other means for automatically returning the rack rod 77 to full open position. Otherwise, however, it will be seen that the device of Figures 11 to 15, inclusive, accomplishes the same functions, in a vehicle governor, as is accomplished by the device of Figures 3 to 10, inclusive, in a fixed speed governor.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A hydraulic governor for Diesel engines comprising a master unit driven from the engine to be governed, a slave unit adapted to actuate the fuel control member of said engine, and a fluid passage connecting said units, said slave unit comprising pressure-responsive means subjected to the pressure of the fluid in said pas-

sage and operatively connected to said member, separate pressure-responsive means operatively connected to said member for slowing the engine upon a failure of fluid pressure, means for applying the fluid pressure within said master unit to said separate means in fuel-increasing direction, and spring means resisting movement of said separate means in response to said pressure and adapted to move said separate means in fuel-decreasing direction upon a drop in said pressure.

2. A device according to claim 1, including lost-motion means in the connection between said separate means and said member.

3. A hydraulic governor for Diesel engines comprising a master unit driven from the engine to be governed, a slave unit adapted to actuate the fuel control member of said engine, and a fluid passage connecting said units, said slave unit comprising pressure-responsive means subjected to the pressure of the fluid in said passage and operatively connected to said member, separate pressure-responsive means operatively connected to said member for slowing the engine upon a failure of fluid pressure, and means subjecting said separate means to the fluid pressure within said master unit, said separate means comprising a piston adapted to be moved in fuel-increasing direction by fluid pressure, and means urging said piston in fuel-decreasing direction.

4. A hydraulic governor for Diesel engines comprising a master unit driven from the engine to be governed, a slave unit adapted to actuate the fuel control member of said engine, and a fluid passage connecting said units, said slave unit comprising pressure-responsive means subjected to the pressure of the fluid in said passage and operatively connected to said member, separate pressure-responsive means operatively connected to said member for slowing the engine upon a failure of fluid pressure, and means subjecting said separate means to the fluid pressure within said master unit, said separate means comprising a member adapted to be moved in fuel-increasing direction by fluid pressure, and resilient means urging said member in fuel-decreasing direction.

5. In combination with a device according to claim 3, a manually operable member operatively connected to said fuel control member, and lost-motion means in said connection.

6. In combination with a device according to claim 1, a manually operable member operatively connected to said fuel control member, spring means resisting fuel-decreasing movement of said manually operable member, and lost-motion means in said connection.

7. In combination with a device according to

claim 1, a manually operable member operatively connected to said fuel control member, spring means resisting fuel-decreasing movement of said manually operable member, and lost-motion means in said connection, said spring means being adapted to move said manually operable member to full fuel position when said member is released.

8. A device according to claim 1, including lost-motion means in the connection between said separate means and said member, said lost-motion means comprising a clutch adapted to transmit motion when the fluid pressure is removed from said separate means and to permit free movement of said fuel control member at other times.

9. In combination with a device according to claim 3, a manually operable member operatively connected to said fuel control member, lost-motion means in said last connection, said lost-motion means comprising a clutch adapted to transmit motion when said manually operable member is moved to fuel shut-off position and to permit free movement of said fuel control member at other times.

10. In combination with a device according to claim 3, a manually operable member operatively connected to said fuel control member, lost-motion means in said last connection, said lost-motion means comprising a clutch adapted to transmit motion when said manually operable member is moved to fuel shut-off position and to permit free movement of said fuel control member at other times, and engageable and disengageable means in said connection between said manually operable member and said fuel control member.

11. In combination with a device according to claim 3, a manually operable member operatively connected to said fuel control member, lost-motion means in said last connection, said lost-motion means comprising a clutch adapted to transmit motion when said manually operable member is moved to fuel shut-off position and to permit free movement of said fuel control member at other times, and engageable and disengageable means in said connection between said manually operable member and said fuel control member, said last means comprising a ball detent.

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The following references are of record in the file of this patent:

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