Dec. 31, 1957 R. L. SHALLENBERG 2,818,053

GOVERNING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Filed April 7, 1956 2 Sheets-Sheet 1

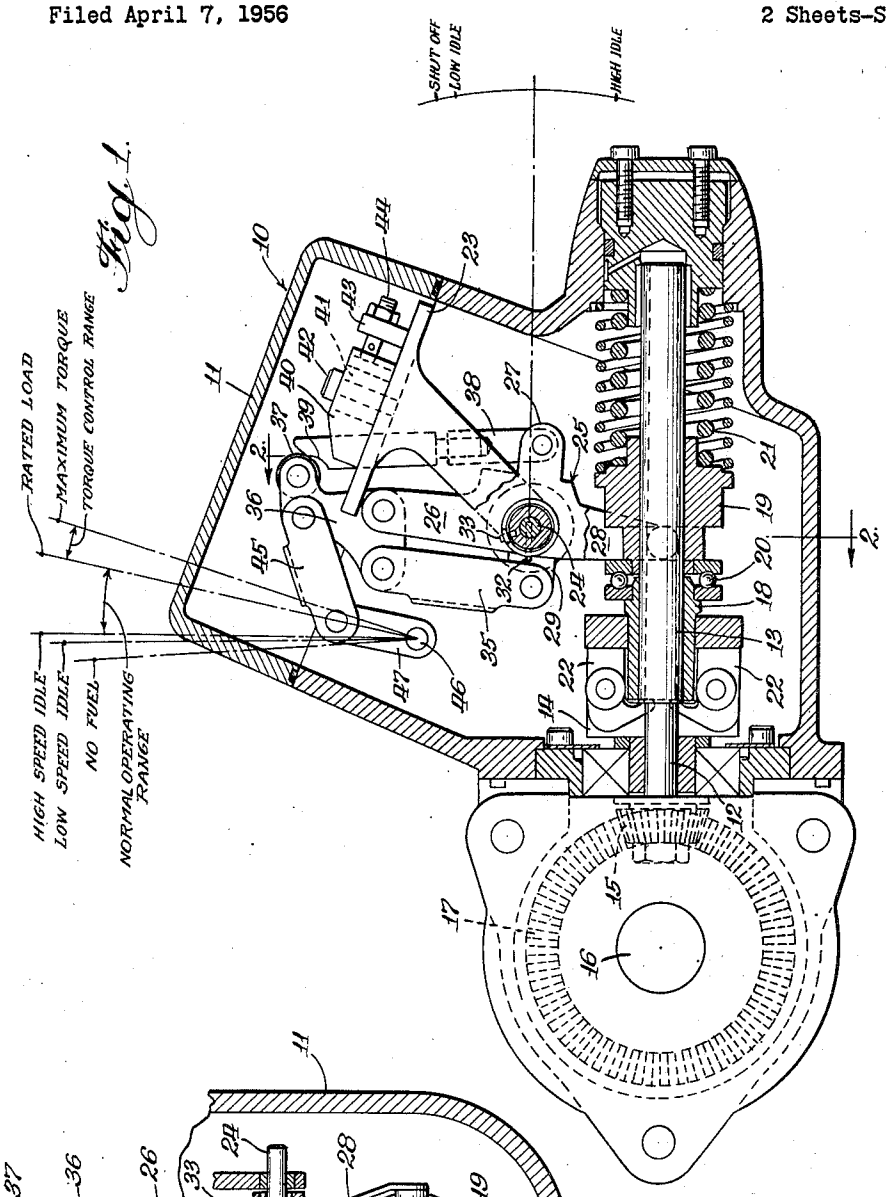


Fig. 1.

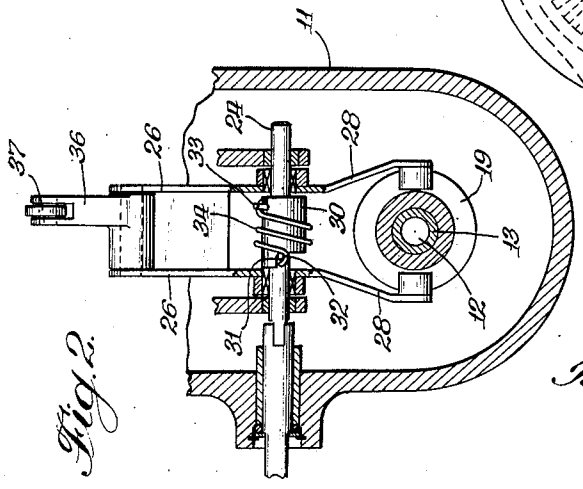


Fig. 2.

INVENTOR.
Robert L. Shallenberg
BY
Paul O. Pippel
Atty

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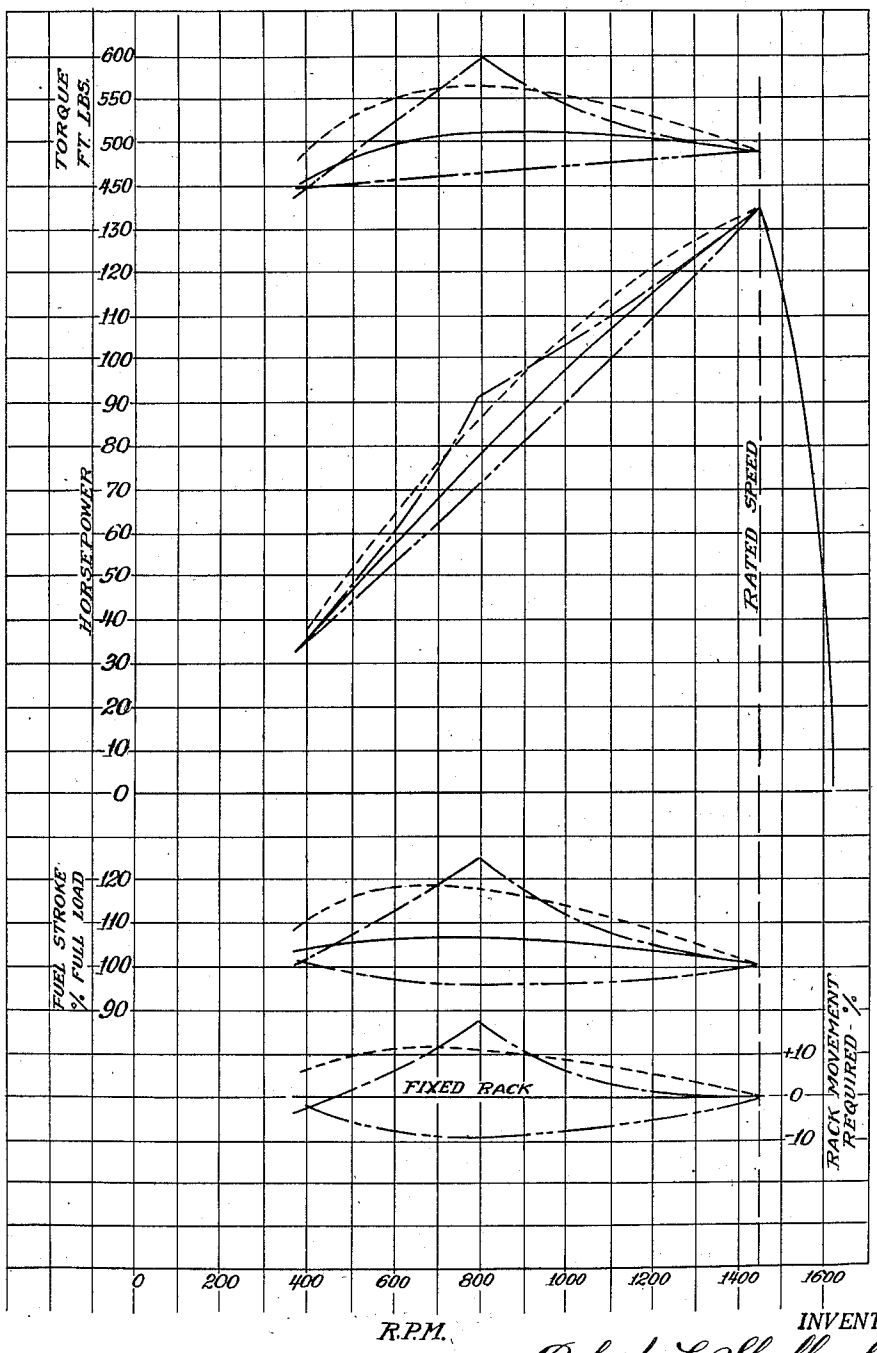


Fig. 3

INVENTOR.

Robert L. Shallenberg

BY

Paul O. Pippel

Atty.

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GOVERNING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Robert L. Shallenberg, Westchester, Ill., assignor to International Harvester Company, a corporation of New Jersey

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5 Claims. (Cl. 123—140)

This invention relates to internal combustion engines and is primarily concerned with a governing mechanism for diesel engines.

An object of the invention is to provide a throttle control in a governing mechanism which is easy to operate.

Another object of the invention is to provide a throttle control and a governor control in a governing mechanism which are independent yet actuate the same control shaft for the fuel injection pump so that there may be a direct increase or decrease of fuel by operation of the throttle resulting in no delay in the change of fuel.

A further object of the invention is to provide a governing mechanism allowing full delivery of fuel to be reached at any throttle setting between one half and full.

The foregoing and other objects of the invention will be apparent from the construction and arrangement illustrated in the accompanying drawings wherein:

Figure 1 is a longitudinal sectional view through a governing mechanism for a combined fuel injection pump and injection nozzle of a diesel engine,

Figure 2 is a cross sectional view through the governing mechanism taken on the line 2—2 of Figure 1, and

Figure 3 is a graph showing the torque control characteristics obtained by the governing mechanism.

The invention proposes a governing mechanism for diesel engines. A housing is provided and a shaft is rotatably mounted in the housing and is operatively connected to the crankshaft of the engine. A sleeve is rotatably and slidably mounted on the shaft and another sleeve is slidably mounted on the same shaft and bearings are disposed between the sleeves so that the first named sleeve may rotate relative to the second named sleeve. Resilient means bears against the second named sleeve and the housing and a pair of opposed weights are pivotally mounted on the shaft and engage the first named sleeve. A throttle shaft is arranged transversely of and spaced from the first named shaft and is rotatably supported in the housing. A member is rotatably mounted on the second named shaft and is in pivotal engagement with the second named sleeve. A link is rotatably mounted on the second named shaft and a resilient restraining mechanism is mounted on the link and the second named shaft and allows the link to be rotated in only one direction on the shaft. Another link is pivotally connected to the first named link and a cam follower is pivotally connected to the second named link and the member and a cam is pivotally connected to the member and the cam follower engages the cam. Another link is pivotally connected to the follower and another shaft is arranged in spaced parallel relation with the second named shaft and is rotatably mounted in the housing and is operatively connected to a fuel injection pump. Another link is pivotally connected to the third named link and is fixedly secured on the third named shaft. This arrangement has the advantages of providing a throttle control which is easy to operate and has a throttle control and a governor control which are independent so that there may be a direct increase or decrease of fuel by operation of the throttle resulting in no delay in the change of fuel and allows full delivery of fuel to be reached at any throttle setting between one half and full.

In the drawings, 10 generally designates a governing

mechanism for a diesel engine having a housing 11. A shaft 12 is disposed in the housing 11 and a sleeve 13 is disposed on the shaft and has one end rotatably mounted on bearings in the housing and its other end terminates at a considerable distance from the other end of the shaft. A structure 14 is rotatably mounted in bearings in the housing 11 and is also fixedly secured on the shaft 12. The shaft 12 has a bevel gear 15 fixed thereon and a shaft 16 is disposed at right angles to the shaft 12 and has a bevel gear 17 fixed thereon which meshes with bevel gear 15. The shaft 16 is operatively connected to the crankshaft of the engine. A sleeve 18 is rotatably and slidably mounted on the sleeve 13 and a sleeve 19 is slidably mounted on the sleeve 13 and circular grooves are provided in sleeves 18 and 19 and ball bearings 20 are disposed in the grooves so that sleeve 18 may rotate with respect to sleeve 19. A pair of governor springs 21 surround shaft 12 and sleeve 13 and bear against sleeve 19 and the housing. The springs 21 urge sleeves 18 and 19 toward the geared end of shaft 12. A pair of opposed weights 22 are pivotally mounted on the structure 14 and are adapted to engage the sleeve 18. A support 23 is disposed in the housing 11 and fixedly secured thereto and this support has spaced depending legs. A shaft 24 is arranged transversely of and spaced above the shaft 12 and is rotatably mounted in the legs of the support 23. The shaft 24 is operatively connected to a manually operated throttle. A member 25 has a pair of spaced parallel arms 26 and a pair of spaced parallel arms 27 are arranged at substantially a right angle with respect to the arms 26 and a pair of spaced parallel arms 28 are disposed opposite arms 26 and are arranged at substantially a right angle with respect to the arms 27. The member 25 is rotatably mounted on the shaft 24 at the location of the intersection of the arms 26, 27 and 28. The arms 28 of member 25 have integral lugs on their free ends which engage the sleeve 19 so that there is a pivotal connection between the arms and the sleeve. A link 29 has a hub 30 on one end and the hub is rotatably mounted on shaft 24. The hub 30 has a recess therein affording a wall 31 extending longitudinally of the hub and a pin 32 is fixed in shaft 24 and engages the wall of the recess and another pin 33 is fixed in the hub and a coil spring 34 surrounds the hub and its ends are hooked around the pins. The hub 30 and pins 32 and 33 and spring 34 form a resilient restraining mechanism for link 29 which allows rotation of the link in one direction only and rotation of the link in said one direction is allowed only when a predetermined loading is exceeded. A link 35 has one end pivotally connected to the other end of link 29. A cam follower 36 has the portion contiguous with one edge pivotally connected to the other end of the link 35 and this portion is also pivotally connected to the free ends of arms 26 of member 25. A roller 37 is carried by the follower 36 and is located in the portion contiguous with the opposite edge of the follower. An element 38 has one end pivotally connected to the free ends of the arms 27 of member 25 and has a cam 39 on its other end. The element 38 is formed of two parts so that its length may be adjusted. The support 23 has a slot therein through which the element 38 projects and a slide 40 has a longitudinally extending slot 41 therein and has its end engaging element 38 bifurcated and a screw 42 is disposed in the slot 41 and is in engagement with a threaded opening in the support. A block 43 is fixed to support 23 and has a threaded opening therein and an externally threaded element 44 is in engagement with the block. Upon loosening of the screw 42 slide 41 can be moved by turning element 44 to rotate element 38 about its pivot so that the cam 39 can be adjusted with respect to the follower 36. A link 45 has one end pivotally connected to the last named portion of the follower 36 and a shaft 46 is arranged in spaced parallel

relation with respect to the shaft 24 and is rotatably mounted in the housing 11 and is operatively connected to the output control of a fuel injection pump of a combined fuel injection pump and injection nozzle. A link 47 has one end pivotally connected to the other end of the link 45 and has its other end fixedly secured on the shaft 46.

In Figure 1 there is a curve having marks "High idle," "Low idle" and "Shut off." These marks show the various positions of shaft 24. The various positions of the link 47 are also indicated in Figure 1. These positions are "No fuel," "Low speed idle," "High speed idle," "Normal operating range," "Rated load" "Torque control range" and "Maximum torque." A feature of the governor is the non-loaded throttle. Many governors change speeds by acting directly upon the governor spring with the throttle. This requires considerable throttle effort and necessitates elaborate throttle holding devices. In applicant's invention link 29 is actuated by throttle shaft 24 through the resilient restraining mechanism which permits relative motion in one direction only and that only when a predetermined loading is exceeded. The cam follower 36 is actuated by link 35 through its connection with link 29 and pivots about the pin connecting member 25 and the follower. By the path of shaft 24, links 29 and 35, cam follower 36, link 45 and shaft 46 motion is transferred directly from the throttle to the injector control, increasing or decreasing the fuel delivery at will. The governor weights must also control the same injector shaft simultaneously and yet neither throttle or governor control may interfere with the other. The member 25 is actuated on its one extremity by the governor thrust sleeve 19 and is pivoted freely on throttle shaft 24 and carries the pin connecting it to follower 36 at its other extremity. Through the parallelogram formed by links 29 and 35, cam follower 36 and member 25, movement of the governor thrust sleeve 19 is transmitted directly through member 25 and cam follower 36 to actuate link 45 and thus control shaft 46. By this means throttle movements and governor movements are independent yet actuate the same control shaft. It follows then that when control shaft 46 is moved toward increased fuel by the throttle shaft 24, the engine will increase in speed, supplying more energy to governor weights 22 which will swing outward a given amount, moving sleeves 18 and 19 axially against the force of springs 21 and through the mechanism will move the control shaft in the direction of decreased fuel. This movement will stabilize the engine at a higher speed. Because of the balance between governor weights 22 and governor springs 21 a fixed relation exists between speed and the position of the sleeve 19. The member 25 through the arm 27 also supports the pivot pin to which is attached the element 38. If load is applied to the engine at a given throttle setting, the speed will drop and the governor mechanism will swing control shaft 46 toward increased fuel. When the maximum allowable amount of fuel is reached, further increase is prevented by roller 37 contacting cam 39. Further drop in speed results in cam follower 36 pivoting about the pin connecting it to member 25 causing link 29 to rotate with respect to shaft 24 while winding up the resilient restraining mechanism. At the same time, cam 39 is being moved by the governor thus giving an increased or decreased fuel delivery depending on the cam profile being traversed by roller 37.

In Figure 3 are shown sets of curves with "revolutions per minute" as abscissas and the left hand ordinates being "Fuel/Stroke % Full Load," "Horsepower" and "Torque Ft. Lbs." and the right hand ordinate being "Rack Movement Required—%." The solid curves in each case illustrate a possible condition arising from no torque control at all. By assuming a fuel consumption curve and knowing the approximate "fixed rack" delivery characteristic (second curve set from bottom) designated fuel per stroke the natural torque curve at the top of the sheet can be calculated. As shown, this curve would produce only a 5% torque rise and would not be satisfactory for tractor work. A possible "tractor type" torque curve is shown by the dashed line, having a 15% rise with a peak at 800 R. P. M. To achieve such a curve, the torque control mechanism would have to move the injector control in the direction of increased fuel as much as 11½% as shown in the first curve set from the bottom (also a dashed line) designated "Rack Movement Required." Note that the rate of movement is highest at high speeds, decreasing with speed and then becoming negative in direction at very low speeds. The latter would be to protect the engine and tractor from excessive torque at low speed. Another type of increased torque curve is shown by the dot-dash curves. This curve has a concave rise, peaking at 23% at 800 R. P. M., then dropping off sharply for protection. The rack movement required is also shown in dot-dash form, and shows slow rates of increase at high speeds but rapidly increasing rates at lower speeds, then changing to negative rate and dropping off to an actual negative position at low speeds. In an oil-field engine used for screwing pipe together, a decreasing torque curve might be required to prevent twisting off the pipe. Such a set of curves is illustrated in double dot-dash. This shows the torque control mechanism would be required to move the injector control toward less fuel in the manner shown. Any conceivable torque characteristic which falls within the peak output limitations of the engine can be produced. The adjustment provided by slide 40 serves to move that portion of the torque curve which is coincident in time with the period roller 37 engages cam 39 up or down intact. The adjustment of the length of element 38 serves to shift the torque curve sideways intact. A combination of these two adjustments will permit setting the torque peak to the desired amount while holding rated load at specifications.

Another feature of this governor is a provision allowing full delivery of fuel to be reached at any throttle setting between one half and full. It will be noted from the discussion above that under torque control action, link 29 was forced to rotate against the resilient restraining mechanism by the action of roller 37 and member 25. This movement of link 29 is toward decreased throttle and amounts to one half throttle when peak torque is reached. Thus, any throttle position of one half or greater will permit the same peak torque to be achieved. However, any throttle setting less than one half will prohibit reaching peak torque fuel and will thus prevent the engine from being subjected to full load operation at extremely low speeds.

By having a throttle control which does not act upon the governor spring the throttle control is easy to operate. Since the throttle control and governor control are independent yet actuate the same control shaft for the fuel injection pump there may be a direct increase or decrease of fuel by operation of the throttle resulting in no delay in the change of fuel. In prior governers where the throttle acted upon the governor spring movement of the throttle was transmitted to the governor and the governor brought about the change of fuel. In these old arrangements there was considerable delay before the governor brought about the change of fuel. With applicant's throttle control there is no delay in the change of fuel.

What is claimed is:

1. A governing mechanism for an internal combustion engine comprising a housing, a first shaft rotatably mounted in the housing and operatively connected to a crankshaft of the engine, a first sleeve rotatably and slidably mounted on the first shaft, a second sleeve slidably mounted on the first shaft, bearings between the first and second sleeves so that the first sleeve may rotate relative to the second sleeve, resilient means bearing against the second sleeve and the housing, a pair of opposed weights pivotally mounted on the first shaft and engaging the first sleeve, a second shaft arranged transversely of and spaced

from the first shaft and rotatably supported in the housing, a member rotatably mounted on the second shaft and pivotally connected to the second sleeve, a first link rotatably mounted on the second shaft, a resilient restraining mechanism mounted on the first link and the second shaft and allowing the link to be rotated in only one direction on the shaft, a second link pivotally connected to the first link, a follower pivotally connected to the second link and pivotally connected to the member, a cam pivotally connected to the member, the follower engaging the cam, a third link pivotally connected to the follower, a third shaft arranged in spaced parallel relation with respect to the second shaft and rotatably mounted in the housing and operatively connected to the output control of a fuel injection pump, and a fourth link pivotally connected to the third link and fixedly secured on the third shaft.

2. A governing mechanism for an internal combustion engine comprising a housing, a first shaft rotatably mounted in the housing and operatively connected to a crankshaft of the engine, a first sleeve rotatably and slidably mounted on the first shaft, a second sleeve slidably mounted on the first shaft, bearings between the first and second sleeves so that the first sleeve may rotate relative to the second sleeve, resilient means bearing against the second sleeve and the housing, a pair of opposed weights pivotally mounted on the first shaft and engaging the first sleeve, a second shaft arranged transversely of and spaced from the first shaft and rotatably supported in the housing, a member rotatably mounted on the second shaft and pivotally connected to the second sleeve, a resilient restraining mechanism comprising a hub rotatably mounted on the second shaft and a wall on the hub extending longitudinally thereof and a pin fixed to the shaft and engaging the wall and a pin fixed to the hub and a coil spring on the hub engaging the pins, a first link fixedly secured to the hub, the resilient restraining mechanism allowing the first link to be rotated in only one direction on the second shaft, a second link pivotally connected to the first link, a follower pivotally connected to the second link and pivotally connected to the member, a cam pivotally connected to the member, the follower engaging the cam, a third link pivotally connected to the follower, a third shaft arranged in spaced parallel relation with respect to the second shaft and rotatably mounted in the housing and operatively connected to the output control of a fuel injection pump, and a fourth link pivotally connected to the third link and fixedly secured on the third shaft.

3. A governing mechanism for an internal combustion engine comprising a housing, a first shaft rotatably mounted in the housing and operatively connected to a crankshaft of the engine, a first sleeve rotatably and slidably mounted on the first shaft, a second sleeve slidably mounted on the first shaft, bearings between the first and second sleeves so that the first sleeve may rotate relative to the second sleeve, resilient means bearing against the second sleeve and the housing, a pair of opposed weights pivotally mounted on the first shaft and engaging the first sleeve, a second shaft arranged transversely of and spaced from the first shaft and rotatably supported in the housing, a member rotatably mounted on the second shaft and pivotally connected to the second sleeve, a first link rotatably mounted on the second shaft, a resilient restraining mechanism mounted on the first link and the second shaft and allowing the link to be rotated in only one direction on the shaft, a second link pivotally connected to the first link, a follower pivotally connected to the second link and pivotally connected to the member, a cam pivotally connected to the member, the follower engaging the cam, a third link pivotally connected to the follower, a third shaft arranged in spaced parallel relation with respect to the second shaft and rotatably mounted in the housing and operatively conected to the output control of a fuel injection pump, and a fourth link pivotally connected to the third link and fixedly secured on the third shaft.

4. A governing mechanism for an internal combustion engine comprising a housing, a first shaft rotatably mounted in the housing and operatively connected to a crankshaft of the engine, a first sleeve rotatably and slidably mounted on the first shaft, a second sleeve slidably mounted on the first shaft, bearings between the first and second sleeves so that the first sleeve may rotate relative to the second sleeve, resilient means surrounding the first shaft and bearing against the second sleeve and the housing, a pair of opposed weights pivotally mounted on the first shaft and engaging the first sleeve, a second shaft arranged transversely of and spaced from the first shaft and rotatably supported in the housing, a member rotatably mounted on the second shaft and pivotally connected to the second sleeve, a first link rotatably mounted on the second shaft, a resilient restraining mechanism mounted on the first link and the second shaft and allowing the link to be rotated in only one direction on the shaft, a second link pivotally connected to the first link, a follower pivotally connected to the second link and pivotally connected to the member, a roller carried by the follower, an element pivotally connected to the member and having a cam thereon, the roller engaging the cam, a third link pivotally connected to the follower, a third shaft arranged in spaced parallel relation with respect to the second shaft and rotatably mounted in the housing and operatively connected to the output control of a fuel injection pump, and a fourth link pivotally connected to the third link and fixedly secured on the third shaft.

5. A governing mechanism for diesel engines comprising a housing, a first shaft rotatably mounted in the housing and operatively connected to a crankshaft of the engine, a first sleeve rotatably and slidably mounted on the first shaft, a second sleeve slidably mounted on the first shaft, bearings between the first and second sleeves so that the first sleeve may rotate relative to the second sleeve, resilient means surrounding the first shaft and bearing against the second sleeve and the housing, a pair of opposed weights pivotally mounted on the first shaft and engaging the first sleeve, a second shaft arranged transversely of and spaced from the first shaft and rotatably supported in the housing, a member having a first arm and a second arm arranged at substantially a right angle with respect to the first arm and a third arm disposed opposite the first arm and arranged at substantially a right angle with respect to the second arm and the member being rotatably mounted on the second shaft at the location of the intersection of the arms and the third arm having its free end pivotally connected to the second sleeve, a first link having one end rotatably mounted on the second shaft, a resilient restraining mechanism mounted on the first link and the second shaft and allowing the link to be rotated in only one direction on the shaft, a second link having one end pivotally connected to the other end of the first link, a follower pivotally connected to the other end of the second link and pivotally connected to the free end of the first arm of the member, a roller carried by the follower, an element having one end pivotally connected to the free end of the second arm of the member and having a cam on its other end, the roller engaging the cam, a third link having one end pivotally connected to the follower, a third shaft arranged in spaced parallel relation with respect to the second shaft and rotatably mounted in the housing and operatively connected to the output control of a fuel injection pump, and a fourth link having one end pivotally connected to the other end of the third link and having its other end fixedly secured on the third shaft.

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