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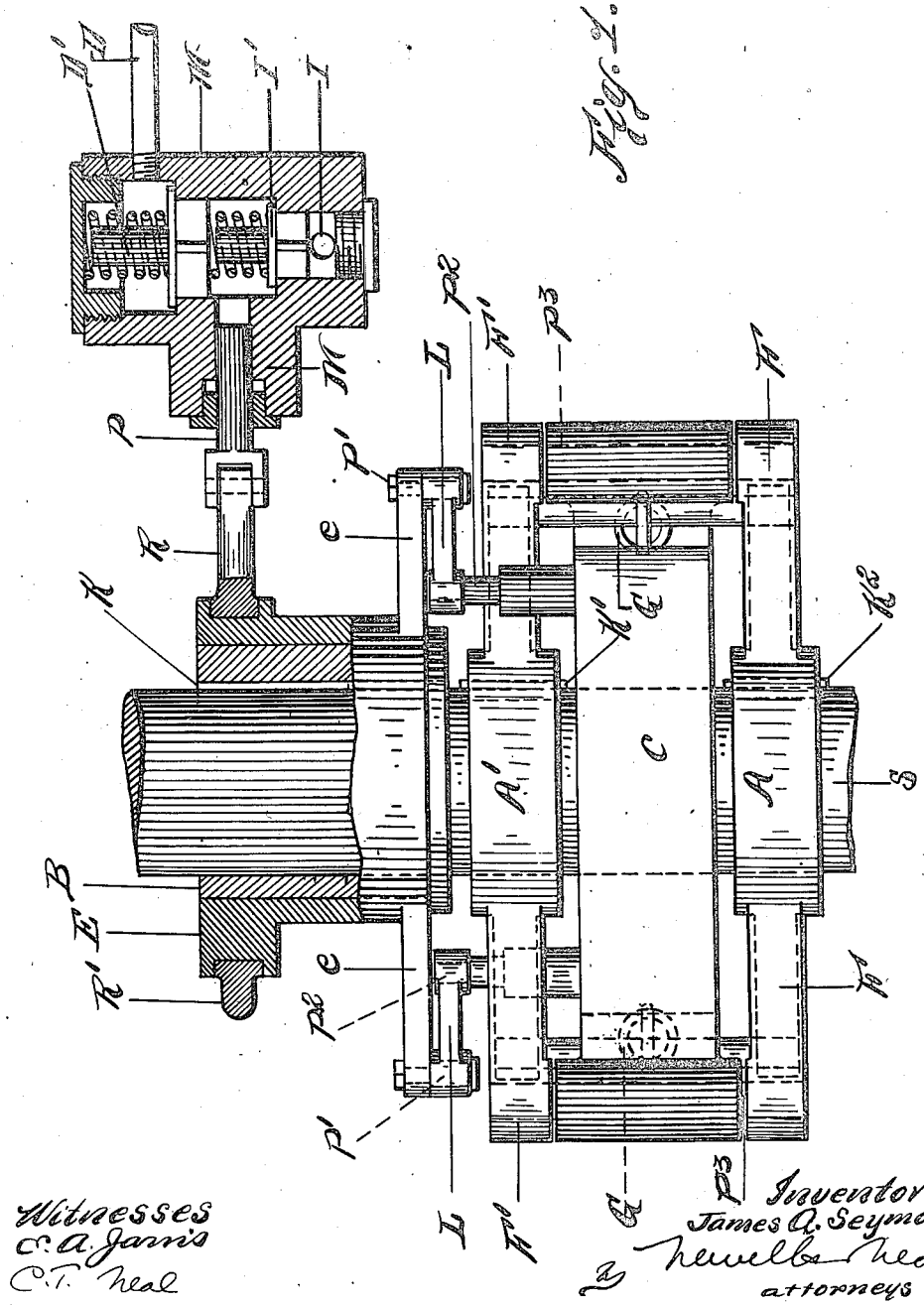
VARIABLE DELIVERY FUEL PUMP FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED SEPT. 30, 1914.

1,222,148.

Patented Apr. 10, 1917.

2 SHEETS—SHEET 1.



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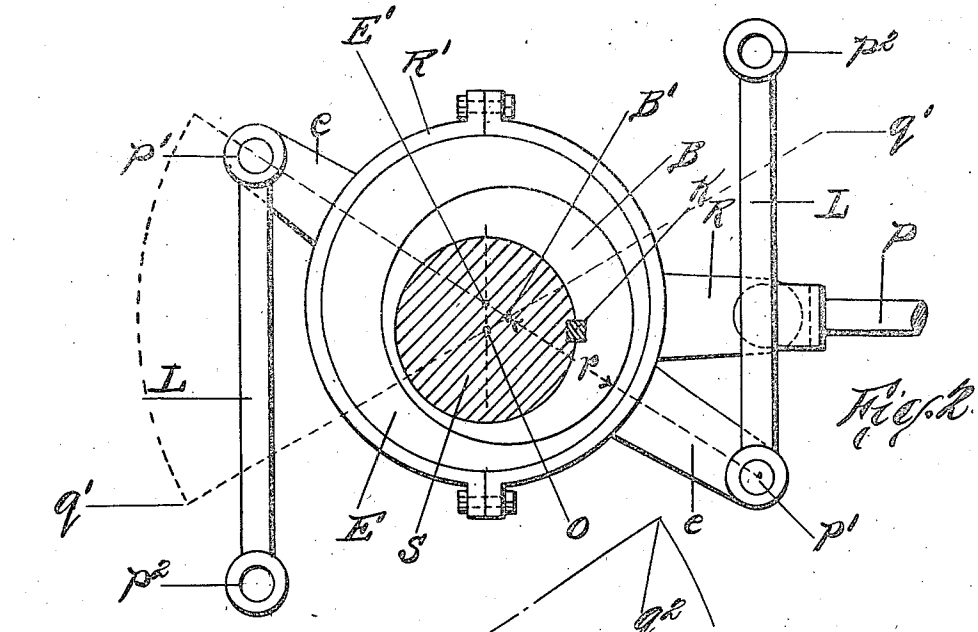


Fig. 2.

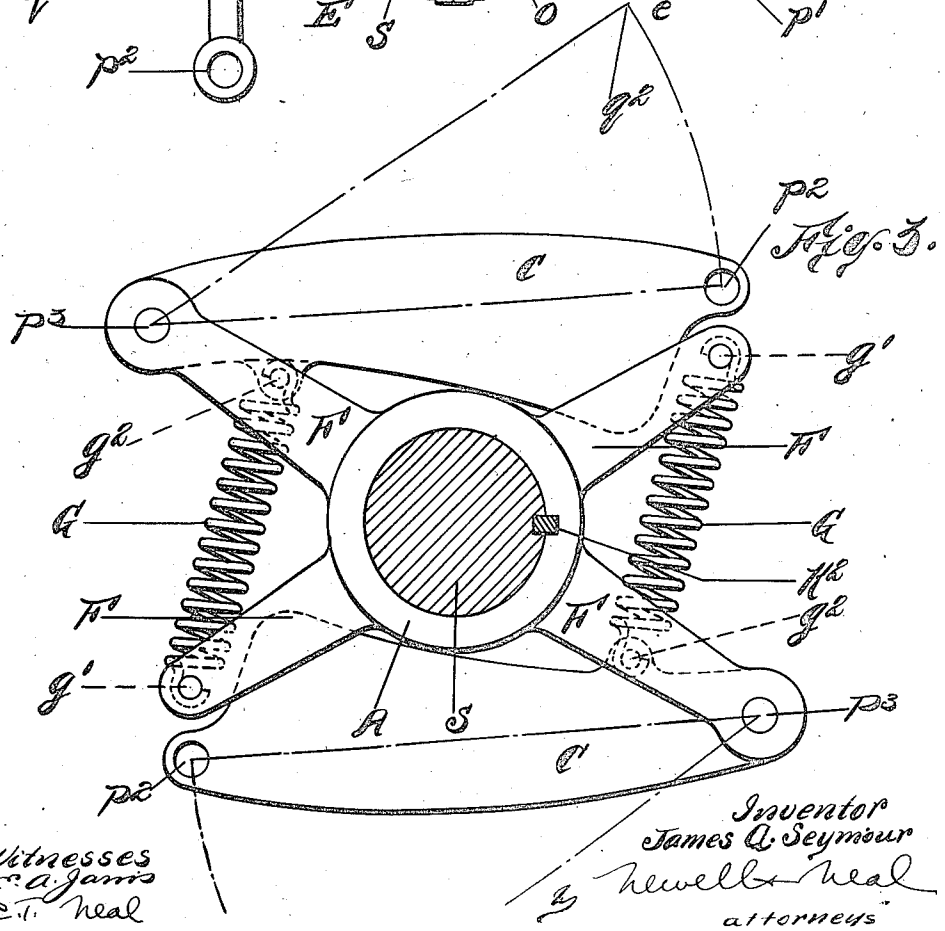


Fig. 3.

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UNITED STATES PATENT OFFICE.

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VARIABLE-DELIVERY FUEL-PUMP FOR INTERNAL-COMBUSTION ENGINES.

1,222,148. Specification of Letters Patent. Patented Apr. 10, 1917.

Application filed September 30, 1914. Serial No. 864,222.

To all whom it may concern:

Be it known that I, JAMES A. SEYMOUR, a citizen of the United States, residing at Auburn, New York, have invented certain new and useful Improvements in Variable-Delivery Fuel-Pumps for Internal-Combustion Engines, of which the following is a clear, full, and exact description.

This invention relates to a method of controlling the speed of internal combustion engines using liquid fuel by means of a variable delivery fuel pump for feeding said fuel in variable quantities to such engines, the speed of the engine being automatically regulated by a centrifugal governor controlling by suitable mechanism the amount of oil actually fed to the engine at each stroke of the fuel feed pump.

In internal combustion engines of this character, the oil or liquid fuel is usually introduced into the combustion chamber from an atomizing chamber containing air under pressure sometimes as high as 1000 pounds or more per square inch, and the fuel delivery pump of the present invention is designed to work against this high pressure.

The principal object of my invention is to avoid the complicated mechanisms of other existing systems, and permit the use of a shaft governor, a movable eccentric actuating the pump plunger, and a simple, direct connecting mechanism between governor and movable eccentric, arranged so that the eccentricity of the eccentric, and consequently stroke of pump plunger, is directly controlled by the action of the governor, the governor, movable eccentric, and connecting mechanism all being compactly mounted together upon the governor shaft and revolving with it.

In my invention I employ in connection with the other features just mentioned a connecting train of mechanism between the governor and the eccentric driving the fuel pump plunger of such a character that forces may be efficiently transmitted from the governor to the eccentric for controlling the stroke of the latter, but that this train of mechanism will not transmit forces backward from the pump plunger to the governor weights, or at least do it so inefficiently that the effective disturbing effect upon the action of the governor, due to the heavy reaction on the pump plunger, will be so diminished that it will not substantially interfere with the proper action of the governor.

Various other advantages and uses of my invention will become apparent from the following specification and from the drawings which show the preferred embodiment thereof.

In the drawings, Figure 1 is a portion of the governor shaft showing partly in elevation and partly in section the complete mechanism as it would appear during normal operation with the governor weights intermediate their extreme positions;

Fig. 2 is a detail plan of the driving mechanism for the pump;

Fig. 3 is a detail plan of the governor, said Figs. 2 and 3 showing the position of the parts when the centrifugal weights are in their innermost position which they occupy when the engine is at rest.

Referring more particularly to the drawings, S is the governor shaft for the engine and has mounted thereon the usual form of centrifugal shaft governor. The governor shaft may be the main shaft of the engine, or some shaft driven at such a fixed speed ratio to it, that fuel will always be fed to the atomizer the same integral number of times per working cycle. This governor comprises the frame A, A^1 fixed to the shaft by keys K^1, K^2, and having outwardly extending arms F and F^1 for supporting one or more centrifugal weights C. The weights C, C are pivoted between the arms F and F^1 on cross-rods P^3, P^3, as shown in Figs. 1 and 3, and springs G, G, connected at one end to the weights C, C at g^2, g^2 and at the other end to the fixed frame at g^1, g^1, normally oppose the tendency of the centrifugal weights to fly out away from the shaft by reason of their centrifugal force.

The pump consists of the usual casing M having pump plunger P working through suitable packing in a pump chamber thereof and arranged to draw in oil through inlet I and inlet valve I^1 and deliver through outlet valve D^1 and outlet pipe D, for being fed into the engine.

The pump is preferably driven directly from the governor shaft by the following arrangement: Keyed upon the shaft S by key K is a fixed eccentric B; and revolubly mounted on this fixed eccentric B as a bearing, is a movable eccentric E. The movable eccentric E is connected by the usual eccentric strap R^1 and strap rod R to the pump plunger P for reciprocating the same. Referring to Fig. 2, the center of the movable

eccentric E is at E^1; the center of the fixed eccentric B is at B^1, and the center of the shaft S is at O, and it will be obvious that the throw of the pump plunger P is determined by the distance between E^1 and O. Since eccentric E is movable on eccentric B, the center E^1 may be revolved about the center B^1 to vary its distance from the center O and thus vary the throw of the eccentric E.

The movable eccentric is connected to the governor in any suitable way such as by means of outwardly projecting arms *e*, *e*, integral with the eccentric E, and rods LL, which connect pins P^1, P^1 in the outer ends of said arms *e*, *e*, with the pins P^2, P^2, at the outer free ends of the centrifugal weights C, C. In starting, after the engine has reached the critical speed at which the governor begins to act, with any further increase of speed, the centrifugal force of the weights will overcome the tension of the springs, causing the weights to swing outwardly from the shaft. This in turn will cause the arms *e*, *e*, of the movable eccentric to move toward the position of the axial line q^1, q^1 also causing the center E^1 to approach the shaft center O, thereby decreasing the length of stroke of plunger P, and consequently diminishing the amount of fuel delivery. If this increase of speed is sufficient to cause the centrifugal weights to move to their extreme outer position so that the pins P^2 P^2 assume positions q^2 q^2 (see Fig. 3), then the pins P^1 P^1 (see Fig. 2) and the arms *e*, *e*, will coincide with axial line q^1 q^1 and center E^1 of the eccentric E will coincide with the shaft center O, causing the pump plunger to have no movement, and consequently doing away with any delivery of fuel whatever. Similarly, in actual operation, when the centrifugal weights CC normally occupy some position between the two positions just described, any increase of speed will cause the centrifugal weights CC to move outwardly and thereby decrease the stroke of plunger P, and any decrease of speed will cause the centrifugal weights CC to move inwardly, and thereby increase the stroke of the plunger.

It will be noted that the movable eccentric E directly connected to the governor, is subjected to a reactive thrust or pressure from the pump plunger, and since this pump plunger works against extremely high pressures, it is essential in order to secure satisfactory operation that the parts shall be so arranged that this reactive thrust from the pump will not be sufficient to seriously disturb the effective operation of said governor in controlling the position of said movable eccentric; in other words, so that the action of the governor in controlling the speed of the engine will not become unstable or unreliable. In the present invention this is taken care of by mounting the movable eccentric E on a fixed eccentric B having a large radius *r* as compared to the distance between the centers of the two eccentrics B^1E^1 preferably when the radius *r* is several times greater than B^1E^1. The reactive thrust of pump plunger P upon the movable eccentric E tends to cause a turning moment of the eccentric E about the fixed eccentric B, which is equal to the thrust (which we shall assume to be T) times the distance B^1E^1. This turning moment of the eccentric E is more or less opposed by a counteracting moment due to the friction between the movable eccentric E and fixed eccentric B which is equal to the reactive thrust of the plunger P (T) times the coefficient of friction between the two surfaces (which we shall call *f*) times the radius (*r*) of the fixed eccentric B. Algebraically expressed, the effective turning moment of E due to the reactive thrust T is $T\ B^1E^1 - Tfr$ and there will be no tendency of the movable eccentric E to turn upon the fixed eccentric E, due to the reactive thrust T when $T\ B^1E^1 - Tfr = 0$. In practice it is not necessary nor usually desirable to have the turning moment of E about B due to the reactive thrust from the plunger P wholly negatived by the counteracting moment due to the friction between the two surfaces, but best results are found to exist when a substantial amount of this turning moment is thus counteracted by the action of friction and the remaining effective turning moment, due to the reactive thrust from the plunger, helps to overcome the friction of rest of the governor mechanism.

It is understood that various changes in details and modifications of this invention may be made without departing from the spirit of the invention as defined in the following claims.

What I claim as new is:—

1. In a variable delivery fuel pump for internal combustion engines in combination, a centrifugal shaft governor mounted upon a shaft rotating at a speed having a fixed ratio to the speed of the engine, a reciprocating pump plunger, a bearing for an eccentric carried by said governor shaft, an eccentric movably mounted on said bearing to vary its eccentricity relative to said governor shaft by causing the center of the eccentric to move in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft and operably connected to said pump plunger, connecting means from said governor for controlling the position of said movable eccentric on its bearing, the ratio of the distance between the center of said eccentric and the center of said bearing, to the radius of said bearing being such that a substan-

tial amount of the turning moment of the movable eccentric on its bearing due to the reactive thrust from said pump plunger is counteracted by the action of friction between said movable eccentric and its bearing.

2. In a variable delivery fuel pump for internal combustion engines in combination, a centrifugal shaft governor mounted upon a shaft rotating at a speed having a fixed ratio to the speed of the engine, a reciprocating pump plunger, a bearing for an eccentric carried by said governor shaft, an eccentric movably mounted on said bearing to vary its eccentricity relative to said governor shaft by causing the center of the eccentric to move in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft and operably connected to said pump plunger, connecting means from said governor mounted to rotate with said shaft for controlling the position of said movable eccentric on its bearing, the ratio of the distance between the center of said eccentric and the center of said bearing, to the radius of said bearing being such that a sufficient amount of the turning moment of the movable eccentric on its bearing due to the reactive thrust from said pump plunger is counteracted by the action of friction between said movable eccentric and its bearing to prevent the reactive thrust from said pump plunger from disturbing the effective operation of said governor.

3. In a variable delivery fuel pump for internal combustion engines in combination, a centrifugal shaft governor mounted upon a shaft rotating at a speed having a fixed ratio to the speed of the engine, a reciprocating pump plunger, a bearing for an eccentric carried by said governor shaft, an eccentric movably mounted on said bearing to vary its eccentricity relative to said governor shaft by causing the center of the eccentric to move in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft and operably connected to said pump plunger, the distance between the center of said eccentric and the center of said bearing being not over one-half the radius of said bearing, and connecting means from said governor for controlling the position of said movable eccentric on its bearing.

4. In a variable delivery fuel pump for internal combustion engines in combination, a centrifugal shaft governor mounted upon a shaft rotating at a speed having a fixed ratio to the speed of the engine, a reciprocating pump plunger, a fixed eccentric on said shaft serving as a bearing for a movable eccentric, said movable eccentric mounted on said fixed eccentric so as to vary its eccentricity relative to said governor shaft by causing the center of the eccentric to move in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft and being operably connected to said pump plunger, and connecting means from said governor for controlling the position of said movable eccentric on its bearing.

5. In a variable delivery fuel pump for internal combustion engines in combination, a centrifugal shaft governor comprising weighted members movably mounted upon a shaft, said shaft rotating at a speed having a fixed ratio to the speed of the engine, a reciprocating pump plunger, an eccentric fixed on said shaft serving as a bearing for a movable eccentric, said movable eccentric mounted on said fixed eccentric so that its eccentricity relative to the governor shaft may be varied by causing the center of the eccentric to move in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft, said movable eccentric being operably connected to said pump plunger and connecting means between said movable weighted members and said movable eccentric for controlling the position of said movable eccentric on its bearing.

6. In a variable delivery fuel pump for internal combustion engines in combination, a centrifugal shaft governor comprising weighted members movably mounted upon a shaft, said shaft rotating at a speed having a fixed ratio to the speed of the engine, springs for said weighted members for opposing the centrifugal force acting on said weighted members during the rotation of said governor shaft, a reciprocating pump plunger, an eccentric fixed to and surrounding said shaft to serve as a bearing for a movable eccentric, said movable eccentric mounted on said fixed eccentric so that its eccentricity relative to said governor shaft may be varied by causing the center of the eccentric to move in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft, an eccentric strap and rod operable by said movable eccentric and connected to said pump plunger for reciprocating the same and connecting means between said movable weighted members and said movable eccentric for controlling the position of said movable eccentric on said fixed eccentric.

7. In a variable delivery fuel pump for internal combustion engines, in combination, a rotating shaft, a fuel feeding pump, transmission mechanism for operating said pump from said shaft comprising two ec-

centrics carried on said shaft, one mounted upon the other, said eccentrics being relatively shiftable to move the center of the outer eccentric in an approximately radial line toward the center of the shaft from its position of maximum throw to a position substantially coinciding with the center of the shaft, and a governor controlled by the speed of said shaft for shifting said eccentrics relatively so as to vary the operation of said pump in feeding said fuel.

8. In a variable delivery fuel pump for internal combustion engines, in combination, a rotating shaft, a fuel feeding pump, transmission mechanism for operating said pump from said shaft comprising two eccentrics carried on said shaft, one mounted upon the other, said eccentrics being relatively shiftable to move the center of the outer eccentric from its position of maximum throw to a position substantially coinciding with the center of the shaft, and a governor controlled by the speed of said shaft for shifting said eccentrics relatively so as to vary the operation of said pump in feeding said fuel.

9. In a variable delivery fuel pump for internal combustion engines, in combination, a rotating shaft, a fuel feeding pump having a reciprocating plunger working against a fluid under pressure which gives a reactive thrust in the line of said plunger's reciprocatory movement, transmission mechanism for operating said pump from said shaft comprising two eccentrics carried on said shaft, one mounted upon the other, said eccentrics being relatively shiftable to move the center of the outer eccentric in an approximately radial line toward the center of the shaft from its position of maximum throw to a position coinciding with the center of the shaft, and a governor controlled by the speed of said shaft for shifting said eccentrics relatively to thus vary the operation of said pump in feeding said fuel.

Signed at Auburn, N. Y., this 21st day of September, 1914.

JAMES A. SEYMOUR.

Witnesses:
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JOHN W. CLARK.