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 FUEL DISTRIBUTING AND CONTROLLING MECHANISM FOR INTERNAL COMBUSTION ENGINES.
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 2 SHEETS—SHEET 1.

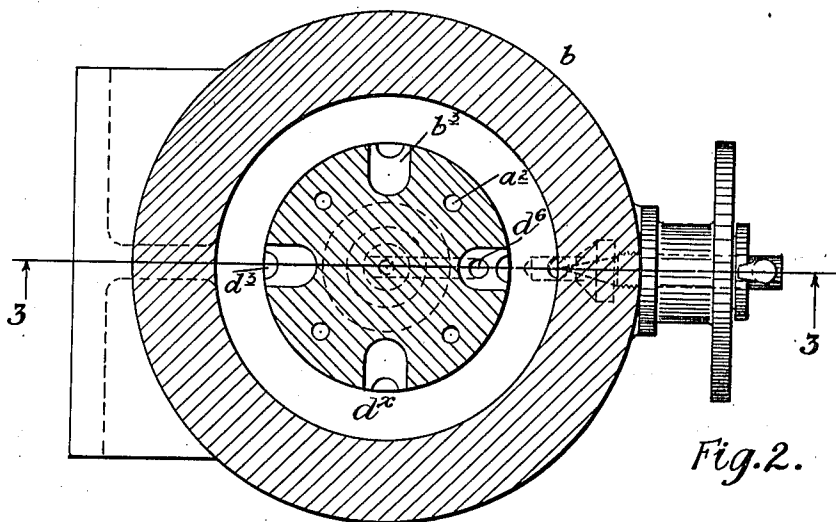


Fig. 2.

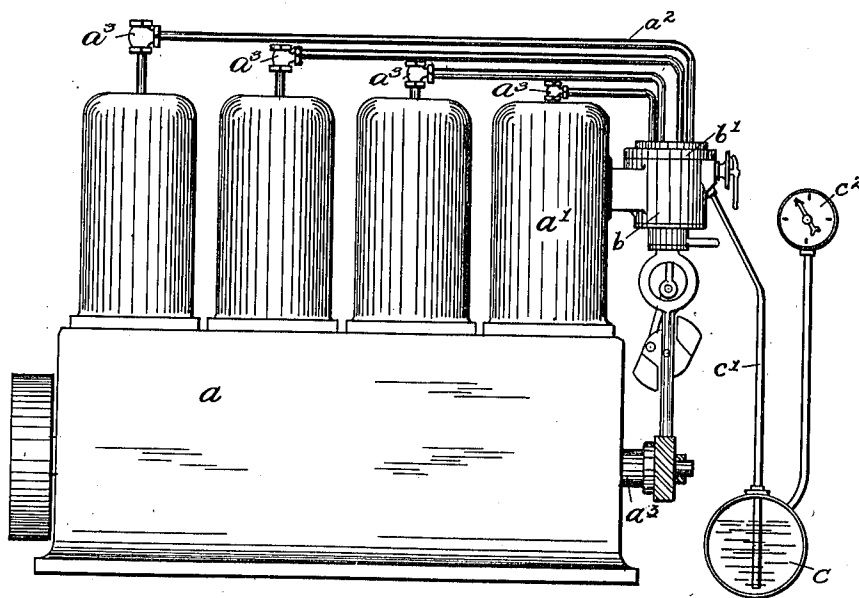
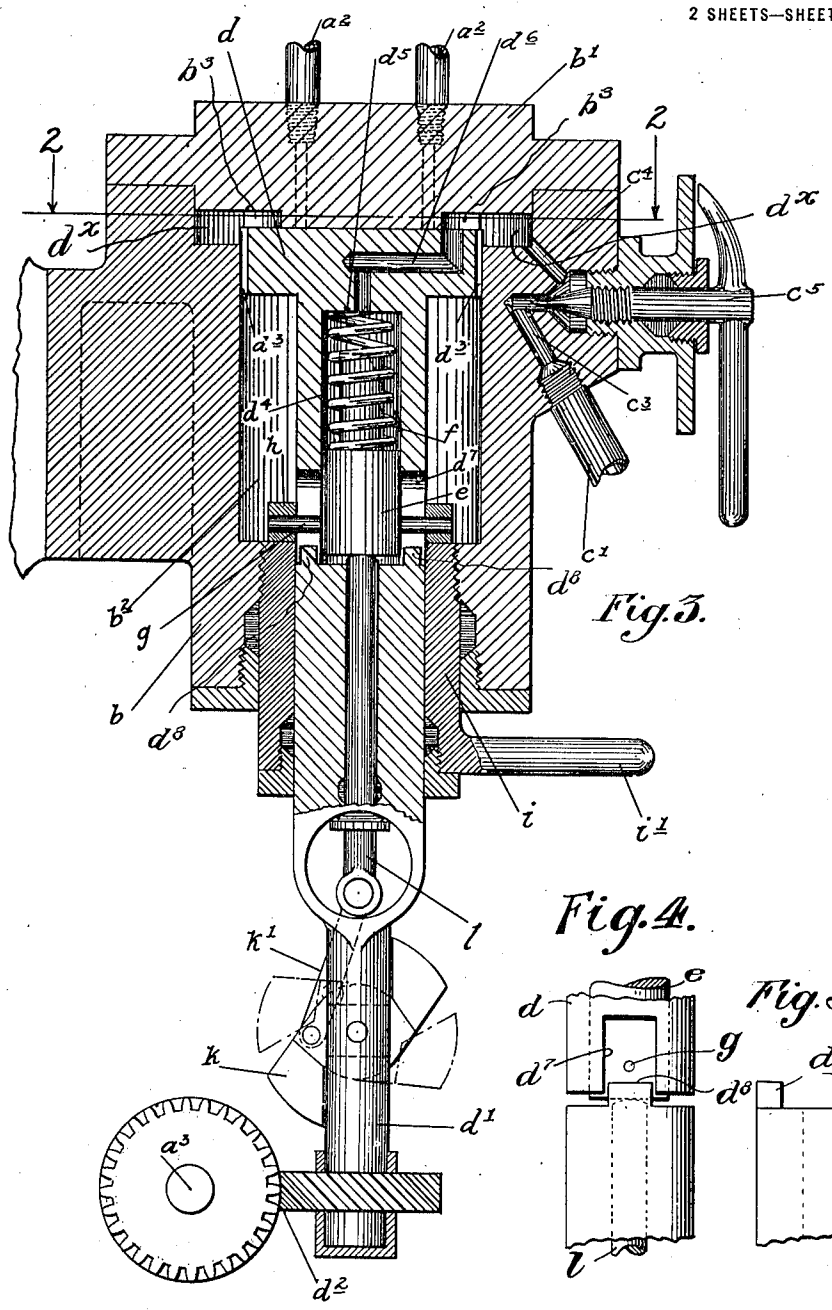


Fig. 1.

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FUEL DISTRIBUTING AND CONTROLLING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

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To all whom it may concern:

Be it known that I, CARL W. WEISS, a citizen of the United States, residing in the borough of Brooklyn of the city of New York, in the State of New York, have invented certain new and useful Improvements in Fuel-Distributing and Controlling Mechanism for Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to devices for controlling the inflow of fuel to internal combustion engines and is particularly concerned with the application of devices of such character to multi-cylinder engines of the direct oil injection or Diesel constant combustion type.

In accordance with the present invention it is sought to provide a system which is simple in construction, invariable in operation, sensitive even at the highest speeds, sufficiently flexible under some conditions to obviate the need of a governor and readily susceptible of control, either manually or automatically, for minute changes in the fuel injections. It is particularly the object of the invention to provide a fuel distributing and controlling mechanism which shall be efficient and satisfactory in all other respects, and shall also be capable of discharging at each operation a measured quantity of oil capable of regulation by hand and shall further be capable of interrupting the flow of fuel oil whenever the engine stops, and in which there shall be no direct connection between the oil reservoir and any cylinder. The details of the invention will appear fully in connection with the following description of the accompanying drawings, in which—

Figure 1 is a view in side elevation showing schematically the application of the improved mechanism to a four cylinder oil engine.

Fig. 2 is a view in horizontal section taken through the distributor shown in Fig. 3 along the plane indicated by the line 2—2 of Fig. 3 and looking in the direction of the arrows.

Fig. 3 is a view in vertical section through the distributor taken along the plane indicated by the line 3—3 of Fig. 2 and looking in the direction of the arrows.

Figs. 4 and 5 are detail views of the cou-

pling between the distributor and its driving member.

As the description proceeds, it will be evident that the invention is not to be limited to the particular type of engine with which the improved mechanism is employed, but for the purposes of this application it has been found convenient to illustrate this mechanism in association with a four cylinder oil engine *a* of, say, the two cycle type. The distributor casing *b* may be secured conveniently to one of the cylinders *a'* and have its head *b'* connected with each of the cylinders through oil injection pipes *a''* through which the oil is led from the casing *b* to each of the cylinders through the usual cylinder check valves *a'''* in proper phase relation to the cycle of operation going on therein. The fuel oil is forced into the distributor casing *b* under pressure from a suitable reservoir *c*, as through the conduit *c'*, the reservoir or pressure tank constituting means to maintain the fuel in the casing under constant pressure. Indication of the pressure within the feed reservoir *c* may be had by means of a suitable gage *c''* applied thereto. Control of the injection of fuel into each of the cylinders through the several pipes *a''* is had by means of a suitable distributor disk *d* (hereinafter to be described) to which rotative movement is imparted from the crank shaft *a'''* of the engine through a distributor shaft *d'*, this distributor shaft being geared operatively to the crank shaft, as at *d''*, in a manner which will be evident. By this positive connection of the distributor to the crank shaft it is insured that movements of the distributor disk *d* shall always be in fixed phase relation to the cycle of operations of the engine. The disk *d* with its barrel *d''* is made as an element separate from its shaft *d'*, the two being connected operatively by the engagement of lugs *d'''* on the shaft *d'* with a slot *d'''* in the distributor. This slot and lug engagement is loose so that the distributor disk is in floating engagement with the shaft *d'* and with the cover *b'* of the oil casing.

Having described broadly the general system which is employed, reference is now to be had particularly to Figs. 2 and 3 wherein is illustrated, in detail, the improved elements by which the desired distribution and control of the fuel is insured. In the dis-

tributer casing b is formed an oil chamber b^2 in which oil is received from the pipe c' through suitable ducts c^3, c^4 , controlled by a manually operable needle valve c^5 whereby the pressure of the oil within the chamber b^2 may be regulated. The distributor disk d which bears against the inner face of the head b' of the distributor casing has formed in its periphery suitable ports d^3 for permitting the free flow of oil from the chamber d^* around the distributor head into the larger oil chamber b^2 through which the distributor shaft d' extends. In an extension of the distributor disk is formed a barrel d^4 to receive the reciprocating oil piston valve e , the upper end of the barrel being formed with a flat seat d^5 to cooperate with the corresponding flat end of the piston valve e whereby the end of the piston may act as a valve to interrupt communication between the interior of the barrel and the associated duct d^6 in the distributor disk d . Normally the piston e is held retracted by means of a spiral spring f which is operatively interposed between the distributor disk and the piston, the effect of this spring being to press the disk firmly against the inner face of the head b' of the distributor casing thereby insuring an oil-tight contact between the two and also to move the piston valve downwardly to a point where its complete displacing stroke is effected. The piston valve e has its end position or the length of its throw regulated by means of a pin g which is secured to it and rests in longitudinal slots d^7 formed in the wall of the barrel d^4 , these slots being so disposed with relation to the piston valve that while oil may not pass through them into the barrel, it may pass through them and exert its pressure on the lower end of the piston, as is required for the successful operation of the improved mechanism. The pin g engages a ring h which rests upon a vertically movable bushing i which is threaded into the lower end of the distributor casing, whereby the piston valve may be lowered with respect to its seat d^5 and its throat thereby lengthened or shortened at will. The distributor shaft d' passes through the bushing i , but the latter may move axially with relation to that shaft. This bushing has formed with it a suitable controlling handle i' by which it may be rotated in the casing b for the purpose of moving it axially and changing its relationship to the ring h .

The governor by which the downward movement of the piston valve e is automatically limited may be of any approved type and is illustrated herein as comprising a centrifugal member k pivoted to the distributor shaft d' and connected, as through a link k' , to a vertically reciprocating rod l journaled slidably in the distributor shaft and having

its upper free end in operative engagement with the lower end of the piston valve.

The fuel oil in the chamber d^* may flow into the barrel d^4 around the upper end of the piston valve e through suitable ports b^3 provided on the inner face of the cover b' of the distributor casing. These ports, in a four-cylinder engine, are spaced 90° apart and are placed successively in communication with the barrel d^4 through the channel d^6 by rotation of the distributor disk d . In like manner, the channel d^6 is brought successively into communication with the ends of the channels a^2 by means of which the oil is permitted to flow from the barrel d^4 , when displaced by the upward movement of the piston e , to the respective cylinders. The ends of these channels are preferably formed in the head b' of the distributor casing at equi-distant points between the inlet ports b^3 .

In normal operation the hand regulating needle valve c^5 will be opened fully so as to permit the oil in the chamber b^2 to be placed under the full pressure of the storage reservoir c . At this time the bushing i will be rotated by means of the hand lever i' until it is retracted to the fullest extent thereby allowing the piston valve e with the ring h maximum travel in their reciprocations. Where the governor is employed, as will be the case where constant speed is to be maintained under varying loads, the upper end of the governor rod l will serve to determine automatically the stroke of the piston e in a manner which will be evident. Referring to Fig. 3, if it be assumed that the channel d^6 has just been brought into communication with one of the inlet ports b^3 through rotation of the distributor disk d , oil will be forced under pressure from the oil chamber d^* through this port and the channel d^6 into the barrel d^4 . Continued rotation of the disk d will carry the channel d^6 away from this port. The disk d is always maintained in oil-tight relation with the inner face of the head d' by means of the coiled spring f so that leakage of the oil is always prevented effectively and yet the usual troublesome valves, as separate elements, are eliminated. As soon as the channel d^6 is brought into communication with the open end of the proper oil pipe a^2 , the pressure of the oil in the chamber b^2 on the lower end of the piston valve e will immediately force this piston valve forward in the barrel against the action of the spring and thereby effect a quick discharge of the displaced oil from the barrel and a concurrent injection of oil into the proper cylinder, in which the pressure at this instant is less than the pressure in chamber b^2 . Continued rotation of the disk d then brings the channel d^6 into registry with the next succeeding inlet port b^3 for a further de-

livery of oil to the barrel d^4 under the oil pressure, the piston valve e being forced downwardly and rearwardly in the barrel, at this time, under the action of the spring f . It will be observed that the barrel d^4 , by the movement of the channel d^a , is placed alternately in communication with the chamber d^x , so that the barrel may be filled with oil, and with one or another of the outlets a^2 , so that the oil may be discharged from the chamber d^4 into one or another of the cylinders a' . The operations are repeated in the manner indicated according to the number of cylinders. Manual control of the speed of the engine may be effected at any time through either the pressure regulating needle c^5 or the bushing i whereby the stroke of the piston valve may be shortened or lengthened. When the needle c^5 is moved to choke the duct c^3 the pressure in the oil chamber b^2 is lessened so that during registration of the channel d^a with any one of the inlet ports b^3 or outlet ports a^2 , for a given unit of time, less oil is delivered to the barrel d^4 or discharged therefrom according to the movement of the piston valve. If the bushing i is moved upward axially by manipulation through the handle i' the seat of the ring h is raised so that the downward stroke of the piston valve e is shortened. By this control each injection of the oil is decreased quantitatively and the speed correspondingly lessened. By conjoint use of the needle valve c^5 and the adjustable bushing i it is evident that any conditions of operation may be met readily and the most effective running conditions secured.

In the improved distributing and controlling mechanism, advantage is taken of the principle of operation described to secure greater flexibility and stability without the need of an automatic governor. As is known such flexibility is especially important in marine engines where a governor is hardly required. If it be assumed, for instance, that the governor illustrated in the accompanying drawings is omitted, then the engine is dependent for its control on the manually operable devices described. But it has been pointed out that for a given pressure in the oil chamber b^2 and a given speed of the engine, there is insured the injection of a given quantity of oil by the piston valve e during registration of the channel d^a with the appropriate oil pipe a^2 . If now, for the same pressure, the speed of the engine drops, then the speed of rotation of the disk d will drop correspondingly, the length of time in which the channel d^a remains in communication with each pipe is increased and so the piston valve e may travel a greater distance for such length of time. The result is that the engine automatically controls its own condition of operation so that any drop in speed has the

effect of initiating operation of the distributing mechanism in such manner as to bring about increased injections of oil and consequently higher speed. When the engine speeds up the converse is true.

From the description given it will be evident that the improved mechanism possesses many distinct advantages over those heretofore employed for similar purposes, in that it provides for the elimination of controlling valves for the various oil ports and makes each cylinder and its associated pipe entirely independent of every other cylinder. In the multi-pump construction, for instance, for a given flow of oil, where leakage in any one of the pumps occurs, this leakage is made good by an excessive oil feed to the other cylinders with a resulting disadvantageous operation. Again, where in known single pump systems, difficulty has been experienced at high speeds in getting the spring check valves to seat with certainty, all such difficulties are eliminated by the improved piston valve and distributor construction by the elimination of check valves and the pressure practically balanced on both sides of the displacer piston valve. Further, no element of suction is relied on for the filling of the barrel for each charge of oil, since this oil is only displaced from one side of the piston to the other under the pressure in the feed tank as the piston is moved in one direction by the spring and in the other direction by the normal oil pressure against the lower resistance in the engine cylinder. The conditions just described, too, are obtained in such manner that the feed tank is never placed in communication with any one of the cylinders but is indeed always cut off positively from such communication which is, of course, a necessary condition. The displacer piston in the distributor disk is a measuring element and does not act as a pump or oil feeder.

It will be noted as highly advantageous characteristics of the new mechanism, that the necessary feed for oil into each cylinder is effected by the differential of pressure between the pressure in the cylinder at the instant of feed and the constant pressure on the oil, that is, the plunger is driven forward to discharge a measured quantity of oil by the constant pressure of oil behind it when the pressure in the cylinder falls to such a degree that the resistance offered to the feed of oil is less than the constant pressure on the plunger; furthermore, that the plunger, at each stroke, delivers a measured quantity of oil and that by hand the stroke of the plunger can be regulated to control the quantity of oil delivered, even to the point of reducing the quantity to zero and thereby stopping the feed of fuel and the engine; again, that

there is never a direct communication between the oil reservoir and any cylinder, the oil which is to be fed to the cylinder being taken in ahead of the plunger or piston valve and then discharged, when the pressure in the cylinder falls, by the constant pressure behind the plunger; and, finally, that the flow of fuel oil to the cylinder is cut off when the movement of the plunger is stopped or when it closes the port in the forward end of its chamber.

Changes in structural details and rearrangements of the parts adapted to accomplish the described results will suggest themselves to one skilled in the art, but all such departures from the illustrated embodiment are to be deemed within the spirit of this invention, provided they fall within the scope of the appended claims.

I claim as my invention:

1. In an internal combustion engine, fuel distributing and controlling mechanism therefor, including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders and a single piston valve to control the injection of oil into said cylinders.

2. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a barrel formed with the distributor disk and a single piston valve mounted to reciprocate in said barrel under the pressure of the oil and inject oil into the respective cylinders.

3. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a single piston valve to inject oil into said cylinders, and manually controlled means to regulate the stroke of the valve.

4. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a single piston valve to

inject oil into said cylinders and a governor to regulate automatically the stroke of the valve.

5. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a single valve piston to inject oil into said cylinders, manually controlled means to regulate the stroke of the valve and a manually operable valve to regulate the pressure in the casing.

6. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections, between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a single piston valve to inject oil into said cylinders, a governor to regulate automatically the stroke of the valve and a manually operable valve to regulate the pressure in the casing.

7. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a single piston valve to inject oil into said cylinders, manually controlled means to regulate the stroke of the valve, a manually operable valve to regulate the pressure in the casing, and a governor to regulate automatically the stroke of the valve.

8. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, and a distributor shaft having formed therein a barrel, a piston valve mounted slidably in the barrel and exposed at one end to the pressure of the oil in the casing from whence the injecting force is derived and a spring to move the piston valve in the opposite direction.

9. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the cas-

ing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a single piston valve to inject oil into said cylinders, a bushing threaded in the casing and movable axially therein and means carried by the valve to engage said bushing whereby the stroke of the piston may be regulated.

10 10. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk operatively geared to the crank shaft to control the flow of oil from the casing into the respective cylinders, a barrel formed with the distributor disk, a single piston valve mounted to reciprocate in the barrel under the pressure of the oil and inject oil into the respective cylinders, a ring secured to the piston and movable therewith, and a bushing threaded in the casing and movable axially therein, the inner end of the bushing serving as a seat for the ring to regulate the valve stroke.

11. In an internal combustion engine, fuel distributing and controlling mechanism therefor including a distributor casing, connections between the casing and the cylinders, means to maintain the fuel in the casing under pressure, a distributor disk in yielding engagement with the wall of the casing and a drive shaft with which the distributor disk is in floating engagement, said shaft being geared operatively to the crank shaft, and a single pump plunger to inject oil into the cylinders.

12. In an internal combustion engine, a power cylinder, a source of fuel oil under pressure, a barrel, means to place the same at its forward end alternately in communication with the source of fuel oil and with the cylinder, a plunger in said barrel, means to move the plunger backward, and means whereby the outer end of the plunger is subject to the constant pressure of the fuel oil to drive the same forward when the resisting pressure in front of the plunger is reduced.

13. In an internal combustion engine, a power cylinder, a source of fuel oil under

pressure, a barrel, means to place the same at its forward end alternately in communication with the source of fuel oil and with the cylinder, a plunger in said barrel, a spring to move the plunger backward, and means whereby the outer end of the plunger is subject to the constant pressure of the fuel oil to drive the same forward when the resisting pressure in front of the plunger is reduced.

14. In an internal combustion engine, a power cylinder, a source of fuel oil under pressure, a barrel, means to place the same at its forward end alternately in communication with the source of fuel oil and with the cylinder, a plunger in said barrel, means to move the plunger backward, and means whereby the outer end of the plunger is subject to the constant pressure of the fuel oil to drive the same forward when the resisting pressure in front of the plunger is reduced, and means to regulate the quantity of oil delivered by the plunger.

15. In an internal combustion engine, a power cylinder, a source of fuel oil under pressure, a barrel, means to place the same at its forward end alternately in communication with the source of fuel oil and with the cylinder, a plunger in said barrel, means to move the plunger backward, means whereby the outer end of the plunger is subject to the constant pressure of the fuel oil to drive the same forward when the resisting pressure in front of the plunger is reduced, and means to regulate the stroke of the plunger.

16. In an internal combustion engine a power cylinder, a source of fuel oil under pressure, a reciprocating piston valve, a barrel having at its forward end a port, means whereby said port is connected alternately with the source of fuel oil under pressure and with the cylinder, means to move the piston valve backward, and means whereby the outer end of the piston valve is subjected to the constant pressure of the fuel oil, and the piston valve is moved forward to close the port in the barrel when the resisting pressure in front of the piston valve is reduced.

This specification signed this 21st day of November, A. D., 1916.

CARL W. WEISS.