1,564,215

Dec. 8, 1925.

G. F. DILLIG

INJECTOR

Original Filed May 9, 1918

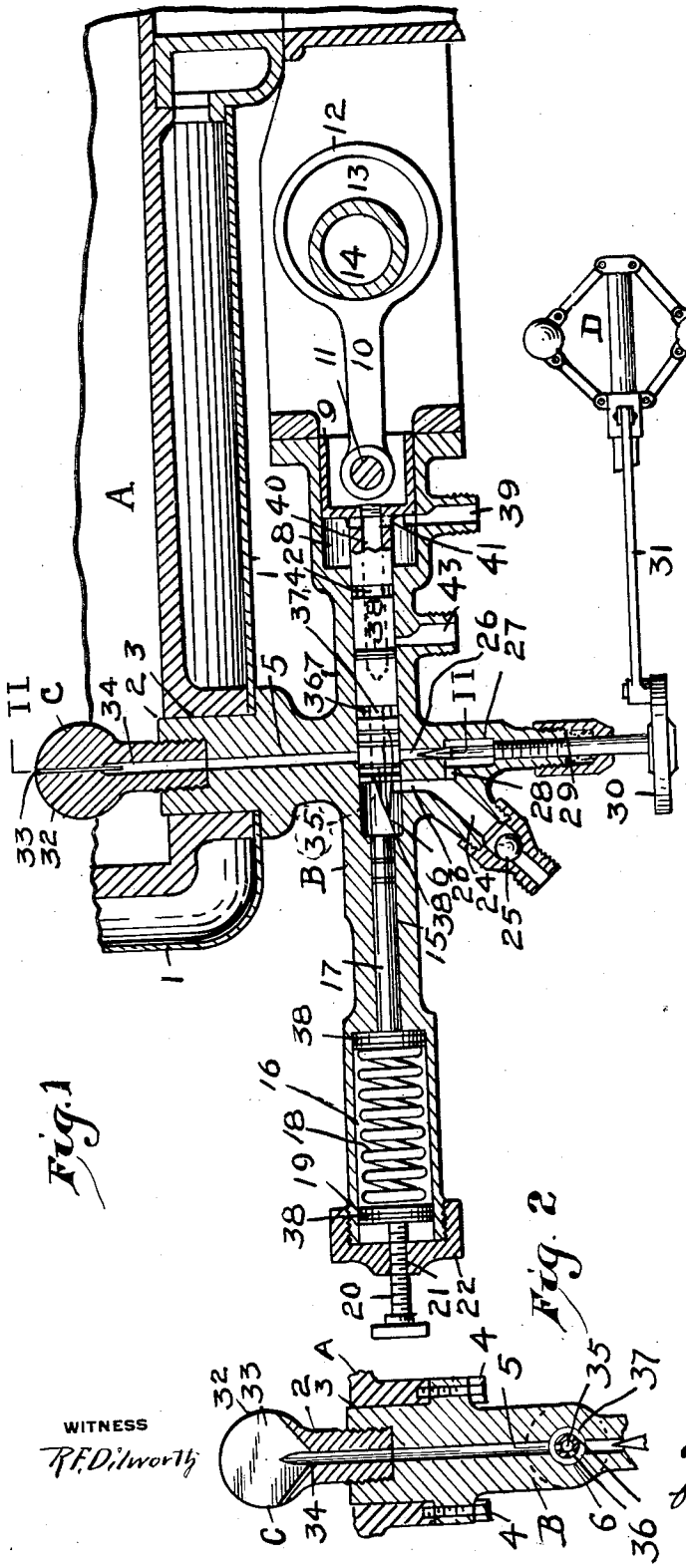


Fig. 1

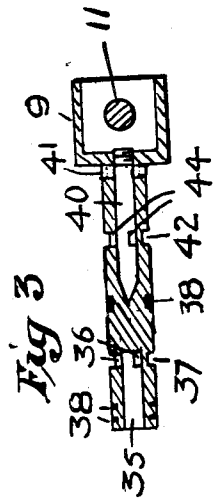


Fig. 3

Fig. 2

WITNESS

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UNITED STATES PATENT OFFICE.

GEORGE F. DILLIG, OF PITTSBURGH, PENNSYLVANIA.

INJECTOR.

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To all whom it may concern:

Be it known that I, GEORGE F. DILLIG, a citizen of the United States, and residing in the city of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented or discovered new and useful Improvements in Injectors, of which the following is a specification.

My invention consists in a new and improved injector for liquids.

More particularly, my injector is intended for the introduction of oil or other liquid fuel into the firing chamber of an internal combustion engine wherein the air and fuel are separately introduced.

Generally speaking, my improved injector comprises a chamber into which the fuel or other liquid is admitted at proper intervals, means operated by the engine, or other power element, for placing the quantity of admitted liquid under pressure, and means for permitting such pressure to discharge such liquid into the firing or other chamber at the proper intervals.

Means are also provided for discharging the liquid at a very great pressure and velocity in the form of a laterally extended sheet of spray, mist or gas at substantially right angles to the axis of the firing chamber, so that the fuel becomes intimately mixed with the air at substantially the moment of maximum compression of the latter, thus insuring a complete ignition combination and powerful explosion of the charge.

Means are also provided which may be used either for keeping the liquid, such as oil fuel, under sufficient head to flow into the injector, or for circulating the lubricating oil through the bearings of an internal combustion engine or other mechanism in connection with which the injector is used.

In the accompanying drawings, which illustrate the principles of my invention as the same may be applied to an internal combustion engine and are not intended to limit the scope of the invention to the structure shown, Fig. 1 is a longitudinal section showing my improved injector applied to the cylinder of an internal combustion engine wherein the air is compressed and introduced into the cylinder separately from the oil or other fuel, Fig. 2 is a vertical section taken along the line II—II in Fig. 1, and Fig. 3 is a vertical section of the piston of the injector.

The following is a detailed description of my invention as the same is illustrated in the accompanying drawings.

A represents the cylinder of an internal combustion engine and 1 is the water jacket of said cylinder. B is the injector used to introduce the liquid fuel, such as oil, into said cylinder A at approximately the moment of maximum compression in the firing chamber of said cylinder.

The injector B is provided with a boss 2 which is inserted into a port 3 in the wall of the combustion chamber of the cylinder A and the injector may be attached to said cylinder, as by means of the screw bolts 4.

The boss 2 is provided with an axial passage 5 whose outer end is counterbored and threaded to receive the threaded stem of the discharge nozzle member C. The inner end of the passage 5 connects with the cylindrical chamber 6 of the differential cylinder 7 which forms the body of the injector. At one end the chamber 6 communicates with an enlarger cylinder 8, and 9 is a differential piston which works in the cylinders 6 and 8, the outer end of said piston being recessed to receive the connecting rod 10, pivotally attached to said piston by the wrist pin 11, and provided at its outer end with a strap 12 encircling the eccentric 13 mounted on the shaft 14 which is driven by the engine.

In the case of a two stroke engine, the speed of the shaft 14 is the same as that of the crank shaft or shafts.

The other end of the chamber 6 communicates with an alined bore 15 of reduced diameter which at its other end communicates with a cylindrical chamber 16, alined with said bore and of greater diameter than the chamber 6. 17 is a plunger whose stem fits the bore 15 and is of substantially equal length while its head is enlarged to the proper diameter to fit the chamber 16. 18 is a helical spring seated in the chamber 16, one end bearing against the enlarged head of the plunger 17 while its other end bears against a false cylinder head 19 fixed to the inner end of a screw 20 which is screwed into an axial threaded hole 21 in a cap 22 which is screwed onto the end of the injector to close the outer end of the chamber 16.

23 is a port through the wall chamber 6, located so as to be uncovered when the piston 9 is in its outermost position, as shown in Fig. 1, and 24 is a passage connecting said

port with a supply of oil or other liquid fuel under sufficient head or pressure to cause said liquid to flow freely through said port to fill the chamber 6 in advance of the piston 9. 25 is a check valve to prevent back flow of liquid from the chamber 6.

26 is a port through the wall of bore 6 diametrically opposed to the passage 5, and 27 is a valve chamber connected to said port and provided with a relief passage 28 leading to the oil supply passage 24. A needle valve 29 controls the passage of liquid through said port 26 into said valve chamber 27. Said needle valve may be manually adjusted, as by means of the hand wheel 30, or the stem of said valve may be connected, as by a link 31 with the speed governor D of the engine.

The discharge nozzle C is shown as having a ball head 32 provided with a discharge slot 33 which almost completely divides the ball into two hemispheres and is of narrower width than the passage 34 axial of the stem of the nozzle and communicating with the passage 5 in the boss which connects the discharge slot 33 with the injector proper. The discharge capacity of the slot 33 should approximate the supply capacity of the passage 34. Thus the charge of fuel injected through the passages 5 and 34 is discharged into the cylinder A, in a plane at right angles to the axis of the cylinder, and in the form of a fan shaped sheet of mist, spray or gas.

The inner end of the piston 9 is provided with an axial passage 35 which extends back to and is connected by radial ports 36 with a circumferential groove 37 in the piston. The groove 37 is so positioned that when the piston 9 is in its innermost position, the groove 37 registers with the passage 5 and the relief port 26. The capacity of the passage 5, the passage 35, the combined capacity of the ports 36, and that of the groove 37 are substantially equal.

The piston 9, the plunger 17 and the false cylinder head 19 are preferably provided with piston rings 38 to prevent the escape of liquid or air.

I prefer to provide the injector with compressor or pumping means which may be used either for keeping the fuel supply under the proper head or for maintaining a circulation of lubricating oil through the engine bearings, or for any other purpose for which such means may be desirable.

Thus the cylinder 8 may be provided with an inlet port 39, adapted to be uncovered as the piston 9 approaches the limit of its outward movement. The piston 9 is also bored out axially to form a passage 40, and the outer end of said passage is plugged. 41 represents one or more radial ports extending through the wall of the piston near the outer end of the passage 40, said ports being so positioned as to be covered by the wall of chamber 6 when the piston assumes its innermost position. 42 is a circumferential groove in the piston 9 positioned to register with a port 43 in the wall of cylinder 6 when the piston is in its innermost position, and 44 are radial ports connecting the passage 40 with said groove 42. It will be seen that the passage 40 extends some distance beyond the groove 42. When the compressor or pump thus formed is to be used to maintain a head on the fuel oil supply, the port 39 is connected to atmosphere while the port 43 is connected to the fuel container or tank, and when the pump is to be used to maintain a circulation of lubricating oil through the engine bearings, the port 39 is connected to the return oil pipe while the port 43 is connected to the feed pipe of the circulating system.

The operation of the injector is as follows:

Coincident with the outward movement of the engine piston the outward movement of the piston 9 closes the passage 5 and the port 26, the plunger 17 is in the position shown in Fig. 1, having been previously driven inwardly by the action of the spring 18, and the port 23 is uncovered, permitting the liquid fuel to flow in past the check valve 25 and filling the chamber 6 in front of the piston and the passage 35, the ports 36 and the groove 37 of the piston. Upon the inward movement of the piston 9, coincident with the inward movement of the engine piston, the port 23 is closed, trapping the liquid in the chamber 6, and the piston moving against the substantially incompressible liquid, will result in forcing the plunger 17 back along the bore 15 to give room for the liquid before the advancing piston. This results in the compression of the spring 18, thus storing up resilient energy until, as the piston 9 reaches the innermost limit of its stroke, the groove 37 registers with the passage 5, and the spring 18 suddenly expands, thus shooting the trapped fuel with great force and velocity up through the passage 5 and the nozzle D and out into the interior of the cylinder A in the form of a fan shaped body of spray, mist or gas intersecting the interior of the firing chamber at substantially the moment of maximum compression in the cylinder A.

The enlarged or ball head of the injector becomes highly heated by the exploding charges and by the compression in the engine cylinder, so that the finely divided fuel as it is discharged through the slot 33 becomes heated and more or less gasified, thus rendering possible a more intimate intermingling of the fuel with the air and consequently a quicker ignition and complete combustion.

It is to be noted that the fuel stored energy of the helical spring or other compressible

medium working on the plunger, which is of relatively much less diameter than the chamber 6, exerts the full pressure in all directions on the liquid trapped in said chamber, the unit pressure per square inch of which is the total spray pressure divided by the area of the small diameter of the plunger, thus enabling the liquid to be shot into the engine cylinder at a pressure sufficiently greater than engine cylinder pressure to permit the fuel to be properly injected into the engine cylinder even in high speed engines. The pressure of the spring or other compressible medium may be controlled as by adjusting the false cylinder head.

The needle valve 29 may be manually adjusted so that any desired portion of the charge may be by-passed off, or the needle valve may be yoked, as shown, to the engine governor, so that when the engine exceeds the desired speed, the needle valve is automatically opened to a degree sufficient to reduce the charge and thus slow down the engine. When the predetermined speed is reached, the valve will automatically close and remain closed until excess speed is again attained.

For convenience, I have shown the resilient power obtained by the compression of a spring, whose pressure may be regulated by adjusting the compression by means of the screw 20 and false cylinder head 19. It is evident that I may omit the spring and use any compressible and elastic medium such as air in the chamber 16.

Also, the air, lubricating oil or other fluid is sucked into the chamber 8 by the outward stroke of the piston and the said fluid is driven into the bore 40 under pressure by the inward stroke of the piston, and when the groove 42 registers with the port 43, the fluid is forced out through said port. The dead end of the bore 40, beyond the groove 42, acts as a cushion, owing to the volume of air trapped therein.

What I desire to claim is:—

1. A fluid pump comprising a differential cylinder, a differential piston working in said cylinder, an inlet port for the larger cylinder bore adapted to be uncovered by the outward stroke of the piston, a discharge port for the smaller cylinder bore, and a passage in said piston adapted to connect said discharge port with the larger bore at substantially the completion of the inner stroke of the piston.

2. An injector mechanism comprising a cylinder unit, a piston working in said cylinder, means for admitting liquid into one end of said cylinder during the outward stroke of the piston, means for discharging said liquid at the completion of the inward stroke of said piston, means for admitting fluid into the opposite end of the cylinder during the outward stroke of the piston and means for discharging said fluid at substantially the completion of the inward stroke of the piston.

3. An injector consisting of a cylinder, a piston working in said cylinder, means for admitting fluid into both ends of said cylinder during the outward stroke of said piston and means for discharging fluid from both ends of said cylinder at substantially the completion of the inward stroke of the piston.

Signed at Pittsburgh, Pa., this 7th day of May, 1918.

GEORGE F. DILLIG.