

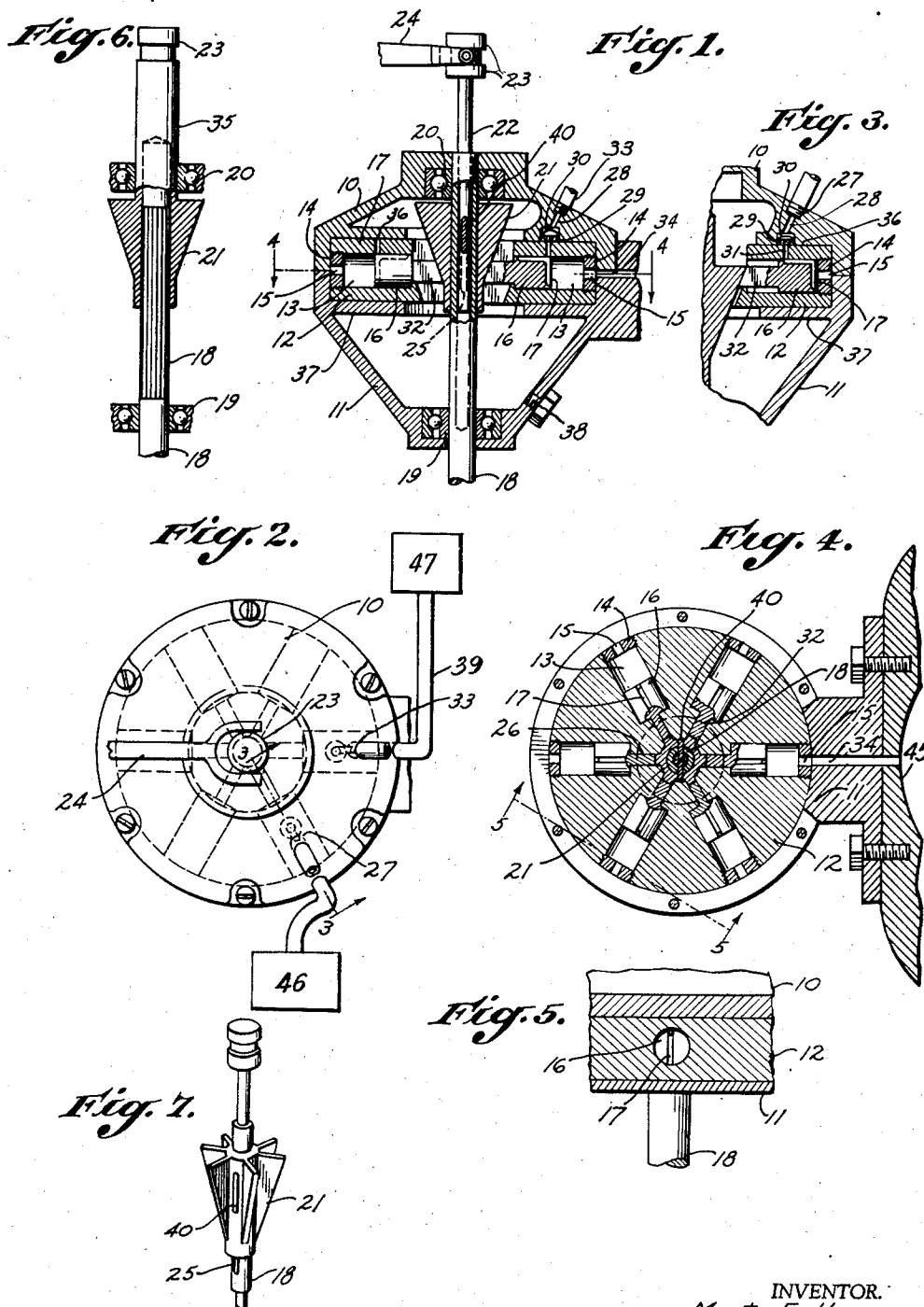
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DIESEL ENGINE INJECTOR

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DIESEL ENGINE INJECTOR

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My invention relates generally to fuel injectors for internal combustion engines, and more particularly to injectors for engines of the Diesel, semi-Diesel, and similar types.

The major object of my invention is to provide an injector which delivers an accurately measured amount of fuel to the combustion chamber of an internal combustion engine.

Another object of my invention is to provide simple and easily operable means for varying the amount of fuel so delivered.

Still another object of my invention is to perform these functions without the use of high speed mechanism and with apparatus which is small and easily attached to the engine.

These and other objects of my invention will be apparent from the following description of a preferred form thereof, and from the accompanying drawing, in which:

Fig. 1 is a view of the injector, partly in section and partly cut away, showing the device as cut away along its axis,

Fig. 2 is a plan view of the injector, showing the location of the air and fuel inlets,

Fig. 3 is a detail section taken at 3—3 in Fig. 2, showing the fuel inlet and the fuel passage cut into the piston,

Fig. 4 is a plan view taken at 4—4 in Fig. 1 showing a portion of the combustion chamber of the engine, this being omitted in other views for the sake of clarity,

Fig. 5 is a view taken at 5—5 in Fig. 4, showing the shape of the piston,

Fig. 6 is a view of an optional form of piston positioner, showing location of bearings, and

Fig. 7 is a perspective view of the preferred form of piston positioner.

Referring now to the drawing, and particularly to Fig. 1 thereof, the numerals 10 and 11 indicate the upper and lower sections, respectively, of a separable circular housing, said sections being provided with annular-shaped bearing plates 36 and 37 which are parallel to each other. A rotor, preferably in the form of a cylinder block 12, is mounted on a shaft 18 in said housing and rotates between said bearing plates 36 and 37. The cylinder block 12 is circular in shape and of such dimension that its peripheral face make sealing contact with the central section of the inner wall of said housing. In the block 12 are one or more radially positioned cylinders 13, each cylinder sealed at its outer end by suitable means, such as a plug 14 having an orifice 15. In each cylinder is a piston 16 provided with a channel 17 cut across its outer face

and preferably also along its side wall. The drive shaft 18 rotates in bearings 19 and 20, and is connected by any suitable means to the engine (not shown) with which the injector is associated. Suitable piston positioning means is disposed at the center of the block 12 and in the preferred form of my invention takes the form of a fluted wedge member 21, axially slidable along the shaft 18 under the control of the operator, and adapted to rotate with the drive shaft. In this form of my invention, I prefer to make the upper portion of the drive shaft 18 hollow and insert a spindle 22 therein, said spindle being provided with suitable means, such as a double collar 23 and its engaging member 24, for moving the spindle axially to any desired position within the shaft. An elongated key-way 25 is provided in the shaft 18, and the fluted wedge member 21 is keyed to the spindle 22 by a key 40 in a manner such that it may slide along the shaft 18 as the spindle is moved axially, while revolving with the shaft. Radial grooves 26 are cut into the rotating cylinder block 12 adjacent its axis, so that the flutes of the wedge member 21 fit therein and cause the cylinder block 12 to rotate with the shaft 18.

In my preferred form, the housing 10 is provided with a fuel inlet 27 and connection thereto, said inlet leading through a passage 28 to suitable sealing means in the bearing plate 36, such as a pierced block 29 which bears against the rotating cylinder block 12, the pierced block being held against the latter by resilient means, such as a flat spring 30. Each cylinder 13 is provided with a hole 31 adapted to register with the opening in the pierced block 29 when the cylinder reaches the correct angular position, so that a continuous passageway for the fuel from inlet 27 into the cylinder 13 is then provided. The previously mentioned groove 17 connects with the hole 31, so that even when the piston is in its outermost position, a flow of fuel into the cylinder through groove 17 is assured.

The position of the piston 16 in the cylinder 13, and hence the amount of fuel admitted to the cylinder, is determined by the position of the fluted wedge member 21. Each flute of the latter in its corresponding groove 26 bears against a tail-like projection 32 on each piston, forcing the latter outwardly or permitting it to return nearer to the axis of the cylinder block, depending upon the axial position of the wedge with respect to the shaft 18. By thus providing a positive contact relationship between the piston positioning means and the pistons, I secure ex-

tremely accurate metering of the fuel injected into the combustion chamber of the associated engine.

The housing 10 is also provided with an air inlet 33, constructed similarly to the fuel inlet 27. In the housing, and aligned with the cylinder plug orifice 15, is an orifice 34 leading into the combustion chamber of the engine to which fuel is to be delivered. The air inlet 33 is located so as to admit air into the injector cylinder 13 while the latter is in the proper position to discharge the resulting fuel and air mixture into the combustion chamber 45 through the orifice 34. In one adaptation of my invention, the fuel is forced into the engine combustion chamber at about 5° before its piston's dead center and continues until the said piston is 25° to 30° past dead center. In the six cylinder injector shown, fuel is admitted into the injector cylinder approximately 60° before it reaches the point of discharge.

A drain plug 38 may be located in the lower portion of the housing 11 to permit draining of any fuel that may have accumulated therein, and a bracket 39, or similar means may be provided to facilitate fastening the injector to the engine. Any air under pressure remaining in the cylinder after the fuel has been ejected, escapes between the rotor 12 and the housing 11, as will any air remaining in the cylinder when the fuel is injected, the air escaping through small spaces normally being present through irregularities in the machining of the surfaces. While the rotor 12 makes substantially sealing fit with the housing 11, these irregularities are nevertheless always present, and hence the air under pressure in the cylinder is permitted to escape, and a slight amount of fuel will leak out of the cylinder, necessitating the use of the drain plug 38.

In Fig. 6 is shown an optional method of providing means for sliding the fluted wedge member 21 along the shaft 18. In this form of my invention, the shaft 18 is grooved at its extremity to admit splines or keys on the wedge member 21, which in this case is a continuation of a hollow shaft 35, which fits over the drive shaft 18 and rotates with it by reason of said splines. At the outer extremity of the hollow shaft 35 is a collar arrangement 23 similar to that already described, and adapted to move the fluted wedge member 21 along the shaft 18 while it is rotating to thus vary the quantity of fuel injected into the engine combustion chamber.

The operation of the injector is as follows: With the fluted wedge member 21 at the desired throttle setting and the injector pistons 16 in their corresponding positions, fuel is introduced through the fuel inlet 27 at a suitable pressure as for instance from 50 to 150 pounds per square inch from a supply 46 through the hole 31 and channel 17 into the injector cylinder 13. The pressure at which the fuel is admitted is sufficient to move the injector piston 16 back until it is stopped by the wedge member 21 if the piston has been moved out by centrifugal force or other means. The channel 17 cut into the wall and face of the piston 16 permits the fuel to enter the injector cylinder even if the injector piston is in its outermost position, as it may be when idling at closed throttle position. As the rotating cylinder block 12 revolves, the hole 31 is closed and the fuel-filled cylinder 13 passes to the point where its hole 31 registers with air inlet 33, where compressed air under relatively high pressure, such as from 2000 to 4000 pounds per square inch, from a supply 47 is admitted to the injector cyl-

inder, creating extreme turbulence therein. At this point, the cylinder plug orifice 15 passes the combustion chamber orifice 34, and the fuel in a completely atomized state is injected into the combustion chamber of the engine by the compressed air. The flow of air through the cylinder 13 preferably continues for a sufficient length of time to scavenge the cylinder and said orifices.

As will be seen, the injector of my invention, while running at a relatively slow speed, can nevertheless properly supply an accurately measured amount of fuel to a high speed engine; and in the injector illustrated, the speed of the injector drive shaft would be but one-sixth of the engine speed of a two-stroke-cycle engine, and one-twelfth the engine speed of a four-stroke-cycle engine.

It is to be understood of course that the values given herein are for purposes of illustration only, and that other values may be used as required by the particular engine and fuel.

The device illustrated and described herein is the preferred form of my invention, and it is to be understood that modifications may be made which are included within the spirit of the invention, as for example cutting away portions of the cylinder block to decrease weight, making the rotor of cylindrical shells held together by bands and rings, or modifying the piston positioning means to meet certain requirements of use.

I claim as my invention:

1. A fuel injector for internal combustion engines which includes: a housing; a rotor mounted on a shaft within said housing and provided with a generally radially disposed cylinder and a free piston therein; means for limiting the inward travel of said piston within said cylinder; means for injecting fuel under pressure into said cylinder; and means for forcibly ejecting said fuel from said cylinder.
2. A device as described in claim 1 in which the means for limiting the inward travel of said piston comprises a wedge-shaped member slidably carried on the shaft of said rotor.
3. A device as described in claim 1 in which said piston is substantially cylindrical in shape and has a groove cut across its outer face.
4. A device as described in claim 1 in which the means for limiting the inward travel of said piston comprises a wedge-shaped member slidably carried on the shaft of said rotor, and in which said piston has a groove cut across its outer face and along its side wall.
5. A fuel injector for internal combustion engines which includes: a housing; a rotor mounted on a shaft in said housing and provided with a generally radially disposed cylinder and piston therein; adjustable means for limiting the inward travel of said piston within said cylinder; means for injecting fuel into said cylinder; and means for blowing said fuel from said cylinder.
6. A device as described in claim 5 in which the means for limiting the inward travel of said piston comprises a wedge-shaped member slidably carried on said rotor shaft.
7. A device as described in claim 5 in which said piston is substantially cylindrical in shape with a groove cut across its outer face.
8. A device as described in claim 5 in which the means for limiting the inward travel of said piston comprises a wedge-shaped member slidably carried on the rotor shaft, and in which said piston has a groove cut across its outer face and along its side wall.
9. A device as described in claim 5 in which

the rotor shaft is hollow and the means for limiting the inward movement of said piston comprises a wedge-shaped member slidably carried on said hollow shaft, said shaft having an elongated key-way therein and a spindle in the center thereof, said spindle having a key passing through said key-way and into said wedge-shaped member.

10. A device as described in claim 5 in which the means for limiting the inward travel of said piston includes a wedge-shaped member on a hollow shaft slidably mounted on said rotor shaft, said slidable shaft being provided with splines or keys which engage with corresponding key-ways on said rotor shaft causing both shafts to rotate as one.

11. A fuel injector for internal combustion engines which includes: a housing; a rotating block having a cylinder therein, mounted in said housing; a shaft driving said block by means of a member having wedge-shaped flutes and axially slidable thereon; a piston within said cylinder, said piston having a groove cut across its outer face and along its side wall; means for axially moving said wedge-shaped member to vary the limit of the inward motion of said piston; a plug in the outer end of said cylinder provided with an orifice; means for filling the remaining space between said piston and said plug in said cylinder with fuel; and compressed air means for then ejecting said fuel through a suitable outlet in said housing.

12. A fuel injector for internal combustion engines which includes: a housing; a rotor in said housing provided with a plurality of cylinders and pistons therein; adjustable means for limiting the inward travel of said pistons within said cylinders; means for injecting fuel under pressure into said cylinders, and means for forcibly ejecting said fuel from said cylinders directly into the combustion chamber of said engine.

13. A device as defined in claim 12 in which the means for limiting the inward travel of said pistons is a fluted wedge-shaped member slidably carried on the injector shaft.

14. A fuel injector for internal combustion engines which includes: a housing; a rotor mounted on a shaft in said housing and provided with a generally radially disposed cylinder and piston therein; adjustable means for limiting the inward travel of said piston within said cylinder; means for admitting fuel under pressure into said cylinder; and means for admitting air under pressure into said cylinder whereby said fuel is discharged therefrom.

15. A fuel injector for internal combustion engines which includes: a housing; a rotor mounted on a shaft in said housing and provided with a generally radially disposed cylinder; a piston within said cylinder having a groove cut across its outer face and along its side wall; adjustable means for limiting the inward travel of said piston within said cylinder, said means comprising a wedge-shaped member slidably carried on the rotor shaft; means for admitting fuel under pressure into said cylinder; and means for admitting air under pressure into said cylinder whereby said fuel is discharged therefrom.

16. A fuel injector for internal combustion engines which includes: a housing; a rotor in said housing with a cylinder and a free piston therein; adjustable means for limiting the inward travel of said piston within said cylinder; a fuel inlet in said housing leading to the rotor and radially equidistant from the rotor axis with a passageway in said rotor leading to said cylinder; an air inlet in said housing angularly displaced from said fuel inlet but also at the same distance radially from the rotor axis; and an outlet in said housing adapted to be connected to a cylinder of said internal combustion engine, said air inlet and said outlet being disposed so that when said injector cylinder is connected to said inlet, it is also connected to said outlet.

17. A fuel injector for internal combustion engines which includes: a housing having a pair of parallel annular bearing plates; a rotor having a substantially radially disposed cylinder therein, mounted in said housing between said bearing plates; a piston within said cylinder, said piston having a substantially cylindrical shape with a groove cut across its outer face and along its side wall; a shaft driving said rotor by means of a fluted wedge-shaped member axially slidable thereon and adjustable to limit the inward travel of said piston; a plug in the outer end of said cylinder provided with an orifice; a fuel inlet in said housing connectable to said cylinder whereby the space between said piston and said plug may be filled with fuel; a compressed air inlet located in said housing and connectable to said cylinder; and an outlet in said housing adapted to be connected to a cylinder of said internal combustion engine, said air inlet and said outlet being disposed so that when said injector cylinder is connected to said inlet it is also connected to said outlet.

18. A fuel injector for internal combustion engines which includes: a housing having a pair of parallel annular bearing plates and having the portion of its inner wall between said bearing plates substantially cylindrical in shape; a rotor having a plurality of substantially radially positioned cylinders and mounted with a substantially sealing fit in said housing between said bearing plates; a shaft driving said rotor by means of a fluted wedge-shaped piston-travel-limiting member axially slidable thereon; a piston within each of said cylinders, each piston being provided with a tail-like projection adapted to bear against said piston-travel-limiting member so as to limit the inward travel of said piston; a plug in the outer end of each cylinder provided with an orifice; a fuel inlet in said housing connectable through resiliently mounted sealing means to each cylinder successively whereby the space between said piston and said plug may be filled with fuel; a compressed air inlet angularly-disposed from said fuel inlet, located in said housing, and connectable to each cylinder successively; and an outlet in said housing adapted to be connected to a cylinder of said internal combustion engine, said air inlet and said outlet being disposed so that when said injector cylinder is connected to said inlet it is also connected to said outlet.

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