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(71) Applicant (for all designated States except US): **TVS MOTOR COMPANY LIMITED** [IN/IN]; Haddows Road, 24 (Old # 8), JAYALAKSHMI ESTATE, Chennai 600 006 (IN).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PATTABIRAMAN, Venugopalan** [IN/IN]; Haddows Road, 24 (Old # 8), JAYALAKSHMI ESTATE, Chennai 600 006 (IN). **HARNE, Vinay Chandrakant** [IN/IN]; Haddows Road, 24 (Old # 8) JAYALAKSHMI ESTATE, Chennai 600 006 (IN).

(74) Agents: **VARADHACHARI, Lakshmikumaran** et al.; B-6/10, Safdarjung Enclave, New Delhi 110 029 (IN).

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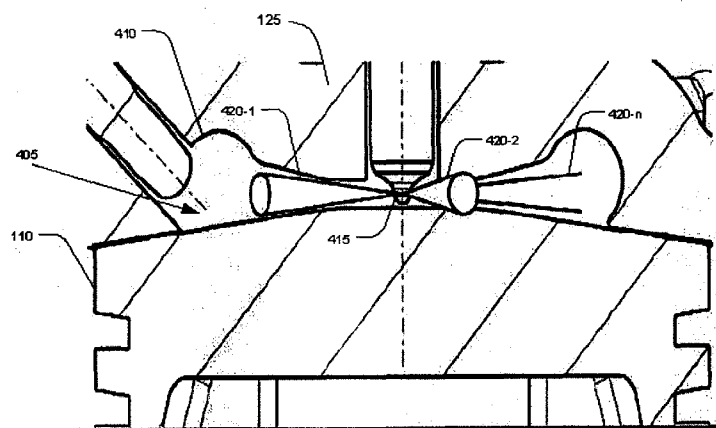


Fig.4

(57) Abstract: The subject matter described herein is directed to a cylinder head assembly (115) for a compression-ignition engine (100). The cylinder head assembly (115) includes a cylinder head (125) having a combustion bowl (410). A combustion chamber (405) is formed between the combustion bowl (410) and a piston (110) movably disposed inside a cylinder (105). The cylinder head assembly (115) also includes an injector (135) mounted on the cylinder head (125) to inject fuel in the combustion chamber (405). Further, a plurality of orifices are arranged radially on the injector (135) such that the injected fuel has a substantially disc shaped spray-pattern (520).



CYLINDER HEAD ASSEMBLY

TECHNICAL FIELD

The subject matter described herein, in general, relates to an internal combustion engine and in particular relates, to a cylinder head assembly for the internal combustion engine.

BACKGROUND

Conventionally, in an internal combustion (IC) engine, a cylinder head is bolted to a top end of a cylinder. The cylinder head, and a combustion bowl provided in a piston crown, define a combustion chamber therebetween. In compression-ignition engines in order to achieve a desirable air-fuel mixing and efficient combustion, fuel is injected either in a pre-combustion chamber or directly in the combustion chamber. The injected fuel must be vaporized and mixed with compressed air for efficient combustion.

The fuel is generally injected into the combustion chamber at a few degrees of crankshaft angle before the top dead centre (TDC). However, due to a continuous reciprocating motion of a piston, the fuel may be injected outside the combustion bowl and impinged onto the piston or a cylinder wall. Such impingement of the fuel may also occur due to incomplete vaporization and mixing of the fuel with air. This results in the formation of a fuel film on the piston or the cylinder wall, a phenomenon known as wall wetting. The formation of fuel film can lead to incomplete combustion, which in turn causes increased fuel consumption and dilution of lubricating oil. Further, the wall wetting also results in higher level of hydrocarbon (HC), and carbon monoxide (CO) emissions.

Moreover, the influence of the fuel impingement or wall wetting is often observed in small bore direct injection (DI) engines, where a short distance between the injector and the piston makes impingement more likely. In addition, owing to the space constraint and compactness requirement in such IC engines, proper positioning and mounting of the injector and coolant passages is also required.

SUMMARY

The subject matter described herein is directed to a cylinder head assembly for a compression-ignition engine. The compression-ignition engine includes a piston movably disposed inside a cylinder. The cylinder head assembly includes a cylinder head having a combustion bowl, and an injector. The combustion bowl and the piston define a combustion chamber therebetween. In one embodiment, the injector is placed substantially vertically on an opening corresponding to a centre of the cylinder head. The injector injects fuel into the combustion chamber from a plurality of orifices. The plurality of orifices are arranged such that the injected fuel has a substantially disc shaped spray-pattern.

Such a cylinder head assembly substantially reduces undesirable wall wetting phenomenon thereby providing efficient combustion and enhancing fuel economy. The cylinder head assembly also helps in providing consistent environment for fuel injection in the combustion chamber over a wide operating range that demands varying injection timings and injection duration. Additionally, the described cylinder head assembly aids for a fuel efficient and a compact engine.

These and other features, aspects, and advantages of the present subject matter will become better understood with reference to the following description and appended claims. This Summary is provided to introduce a selection of concepts in a simplified form. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

BRIEF DESCRIPTION OF DRAWINGS

The above and other features, aspects, and advantages of the subject matter will become better understood with regard to the following description, appended claims, and accompanying drawings where:

Fig. 1 illustrates a cross sectional view of an exemplary compression-ignition engine, according to an embodiment of the present subject matter.

Fig. 2a, **Fig.2b**, and **Fig. 2c** illustrate an exemplary cylinder head assembly of the compression-ignition of **Fig. 1**, according to an embodiment of the present subject matter.

Fig. 3a and **Fig. 3b** illustrate a clamping arrangement for an injector of the cylinder head assembly of **Fig. 2a**, **Fig.2b**, and **Fig. 2c**, according to an embodiment of the present subject matter.

Fig. 4 illustrates a sectional view of a combustion chamber with a piston at Top Dead Center (TDC) of a cylinder of **Fig.1**, according to an embodiment of the present subject matter.

Fig. 5 illustrates a sectional view of a cylinder head of the engine of **Fig. 1** depicting coolant passages in the cylinder head, according to an embodiment of the present subject matter.

DETAILED DESCRIPTION

The subject matter described herein is directed to a cylinder head assembly for a compression-ignition engine. The compression-ignition engine may be implemented in various applications such as vehicles, gen-sets, lawnmowers and so on. The compression-ignition engine includes a cylinder and a piston movably displaced inside the cylinder.

In one embodiment, the cylinder head assembly includes a cylinder head mounted on the cylinder. A combustion bowl provided in the cylinder head, and the piston form a combustion chamber therebetween. Since, the combustion bowl is provided in the cylinder head, the combustion bowl does not exhibit any motion and is fixed. The cylinder head assembly further includes an injector having multiple orifices. The injector is mounted on the cylinder head and delivers fuel into the combustion chamber. The multiple orifices of the injector are so arranged that they provide a substantially disc shaped spray-pattern. The disc shaped spray-pattern of the fuel and the fixed combustion bowl, prevent the fuel from impinging onto a piston head or an inner wall of the cylinder. Further, these multiple small-sized orifices provide better atomization of the fuel and aid in achieving efficient combustion. The cylinder head assembly as described herein provides good fuel economy and low emissions.

In an embodiment, the cylinder head assembly also includes an accumulator mounted on the cylinder head. The accumulator stores and maintains fuel at a high pressure, which is

delivered to the injector. The injector may be mounted on the cylinder head using a clamping arrangement.

Additionally, the cylinder head may include a plurality of coolant inlets and a plurality of metering holes to provide adequate cooling around the injector, thereby reducing carbon deposits on a tip of the injector and hence, improving durability of the injector.

Such a cylinder assembly for a compression-ignition engine results in a fuel efficient and a compact engine, thereby making the engines, suitable for use in light weight automobiles such as two-wheeled or three-wheeled vehicles.

Fig. 1 illustrates a cross sectional view of an exemplary compression-ignition engine **100**, hereinafter referred to as engine **100**, according to an embodiment of the present subject matter. Although the engine **100** has been described with respect to a two-stroke compression-ignition engine **100_1**; however, it would be appreciated that various modifications, adaptations, and alternative embodiments thereof may be made within the scope and spirit of the present invention. For example, the engine **100** can be a two-stroke compression-ignition engine **100_1** or a four-stroke compression-ignition engine **100_2**. For the purposes of explanation, the two-stroke compression-ignition engine **100_1** and the four-stroke compression-ignition engine **100_2** are jointly referred to as the engine **100**, hereinafter.

As illustrated in **Fig.1**, the engine **100** includes the cylinder **105** having a moveable piston **110**, a cylinder head assembly **115**, and a fuel pump **120**. The cylinder **105** may have a bore size of approximately 60mm to 80mm. The small bore size of the cylinder **105** makes it suitable for implementation in light weight and compact vehicles such as two-wheeled or three-wheeled vehicles. The cylinder head assembly **115** includes a cylinder head **125** mounted on the cylinder **105**. Additionally, a variety of components, such as, an accumulator **130** and an injector **135**, are mounted on the cylinder head **125**. These components may be positioned in a plurality of openings provided on the cylinder head **125**. In one embodiment, the accumulator **130** is mounted on the cylinder head **125** and stores fuel pressurized at a high pressure.

In operation, the fuel pump **120** pressurizes the fuel to a predetermined pressure, for example, pressures greater than 500 bars. The fuel pump **120** delivers the pressurized fuel to

the accumulator 130, which is in hydraulic connection with the injector 135. In other words, the pressurized fuel from the fuel pump 120 is routed to the accumulator 130 and is conveyed to the injector 135. The high working pressure of the fuel pump 120 provides a sustained and well-defined spray-pattern of the fuel. The accumulator 130 can be connected to multiple injectors for supplying fuel to multiple cylinders of an engine. Further, the injector 135 may be configured to provide short multiple injections of fuel during a single combustion cycle. The short multiple injections execute a smooth combustion process, thus reducing excess noise and vibrations. In another embodiment, in case of direct fuel injection systems, the fuel pump 120 may route the fuel directly to the injector 135 instead of first supplying it to the accumulator 130.

The injector 135 delivers the high pressure fuel into a combustion chamber (not shown in the fig.) at a pre-determined instance in a combustion cycle. As the piston 110 approaches the TDC of the cylinder 105, the space available between a top surface of the piston 110 and a bottom surface of the cylinder head 125 defines a combustion chamber, which confines a compressed air-fuel mixture. In one embodiment, the bottom surface of the cylinder head 125 forms a combustion bowl (not shown in the figure), and a nozzle 140 of the injector 135 directly injects fuel in the combustion bowl. In said embodiment, the injected fuel spray has a substantially disc-shaped pattern for efficient mixing of air with fuel. The provision of the combustion bowl in the cylinder head 125 along with the disc shaped spray-pattern of the injected fuel reduces wall wetting phenomenon. Thus, the combustion chamber design and the injector configuration, as described herein, enhance engine performance.

Fig. 2a, Fig.2b, and Fig. 2c illustrate the cylinder head assembly 115 of Fig. 1, according to an embodiment of the present subject matter. The high pressure fuel from the fuel pump 120 is routed to the accumulator 130 through a first fuel pipe (not shown in the figures). The first fuel pipe connects the fuel pump 120 to an inlet 205 of the accumulator 130. The accumulator 130 acts as a reservoir for the high pressure fuel and ensures that the same is available to the injector 135, as and when required. From the accumulator 130, the fuel is supplied to the injector 135 by way of a second fuel pipe 210 which leads from an outlet 215 of the accumulator 130 to the injector 135.

The accumulator 130 may have a tubular construction and is mounted onto the cylinder head 125 by a plurality of bolts 220. However, the accumulator 130 can also be mounted on the cylinder 105. The accumulator 130 is mounted on the periphery of the cylinder head 125 such that a longitudinal axis of the accumulator 130 is substantially parallel to a longitudinal axis of the vehicle. In other words, the accumulator 130 extends substantially parallel to the length of the vehicle. Such a mounting of the accumulator 130 allows the injector 135 to be in a proximity of the combustion chamber that helps to maintain a substantially constant pressure of the fuel inside the second fuel pipe 210 and minimizes the lag in delivering the pressurized fuel. Further, such a mounting of the accumulator 130 does not limit the space available on the cylinder head 125. Additionally, the mounting of the accumulator 130 facilitates easy assembly of connections from the fuel pump to the accumulator 130, and from the accumulator 130 to the injector 135. Further, the described mounting arrangement for the accumulator 130 allows a precise fitting of the accumulator 130 and a reliable positioning of a pressure sensor 225 and a pressure regulator valve 230, thus considerably protecting the accumulator 130, the pressure regulator valve 230, and the pressure sensor 225 from vibrations and other dynamics of the vehicle.

The pressure sensor 225 senses the fuel pressure inside the accumulator 130 and provides a sensed value of pressure to an electronic control unit (ECU) of the vehicle. The ECU, in turn, regulates the pressure regulator valve 230 to maintain a constant high pressure inside the accumulator 130 at all operating conditions of the engine 100. For example, if the ECU determines that the sensed fuel pressure is higher than a threshold pressure range, the pressure regulator valve 230 is opened to drain out surplus fuel from the accumulator 130 to a fuel tank. Due to the return of the surplus fuel from the accumulator 130, the fuel pressure inside the accumulator 130 is relieved and a substantially constant pressure is maintained. Thus, the pressure sensor 225 and the pressure regulator valve 230 maintain a substantially constant fuel pressure inside the accumulator 130 and provide easy venting of fuel in case the fuel pressure goes higher than the threshold pressure range, thereby making it safe for use in two-wheeled or three-wheeled vehicles.

As mentioned previously, the high pressure fuel from the accumulator 130 is hydraulically connected to the injector 135. In one embodiment, the injector 135 is positioned

in an opening substantially corresponding to the centre of the cylinder head 125 using a clamping arrangement 235. The clamping arrangement 235 holds the injector 135 in a substantially vertical position and will be discussed in detail in Fig.3a and Fig.3b. Various other components, such as a glow plug 240, engine coolant temperature (ECT) sensor 245, and a coolant outlet 250 can also be provided in the various openings provided on the cylinder head 125 to constitute the cylinder head assembly 115. The glow plug 240 facilitates heating of the air-fuel mixture to enable starting of the engine 100 in low temperature conditions. The ECT sensor 245 provides coolant temperature information to the ECU.

Further, the cylinder head assembly 115 is detachably attached to the cylinder 105 by cylinder head bolts 255, thus providing ease in de-mounting the cylinder head assembly 115 for servicing purposes.

Fig. 3a and Fig. 3b illustrate the clamping arrangement 235 for the injector 135, according to an embodiment of the present subject matter.

As illustrated in Fig.3a and 3b, the injector 135 is mounted vertically on the cylinder head 125, such that the injector 135 is aligned approximately with the center of the cylinder head 125. The clamping arrangement 235 facilitates an appropriate mounting of the injector 135 on the cylinder head 125. For the purpose, the clamping arrangement 235 is mounted on the cylinder head 125 such that a longitudinal axis of the clamping arrangement 235 is oriented substantially parallel to a longitudinal axis of the injector 135. The clamping arrangement 235 includes a clamping bracket 305 having two extensions for firmly holding the injector 135 in position onto the cylinder head 125. The two extensions are clamped at the wings of the injector 135 to provide a firm grip. Further, the contact between the injector 135 and the clamping bracket 305 can be a line contact. A support stud 310 is provided at an end of the clamping bracket 305 and a clamping stud 315 is provided alongside the support stud 310. The clamping stud 315 and the support stud 310 are screwed in the respective opening provided on the cylinder head 125. Further, the clamping stud 315 can be disposed at about the mid-point of the clamping bracket 305.

As aforementioned, to have a substantially vertical positioning of the injector 135 during all operating conditions of the engine, the clamping bracket 305 grips the wings of the

injector 135. Conventionally, to accommodate variations in height of the injector 135, the injector 135 is capable of being moved along its longitudinal axis. However, with such a provision, the clamping bracket 305 may not clamp the entire span of the wings. This may result in the loosening of the grip of the clamping bracket 305 when the vibrations of the engine occur.

For the purpose, the clamping stud 315 and the clamping bracket 305 are interfaced using a spherical joint having a nut 325 and a washer 330 such as a rounded washer. The nut 325 and the washer 330 are used for tightening the joint between the clamping stud 315 and the clamping bracket 305. The tightening of the nut 325 ensures a steady position of the injector 135 in the cylinder head 125 during the operation of the engine.

The support stud 310 includes a tapered portion for receiving a mating ball 335 provided at the end of the clamping bracket 305, other than the one which holds the injector 135. The mating ball 335 can swivel about a point A to move the clamping bracket 305 in a first direction 340. The movement of the clamping bracket 305 in the first direction 340 results in the movement of the injector 135 along its longitudinal axis. Thus, the swiveling of the mating ball 335 facilitates accommodation of vertical dimensional variations or height variations of the injector 135. Also, the washer 330 can swivel about a point B to rotate clockwise or anti-clockwise as illustrated by a second direction 345. Once the desired position of the injector 135 is achieved, the injector 135 is secured in that position by tightening the nut 325. Furthermore, the clearance between the clamping bracket 305 and the clamping stud 315 facilitates accommodation of height variations of the injector 135.

The height variations can be due to various manufacturing tolerances of the injector 135, nozzle seating height on the cylinder head 125 and other tolerances which may stack up resulting in height variations. Further, such a configuration of the clamping arrangement also facilitates in varying the protrusion of a tip (not shown in the figure) of the nozzle 140, extending inside the combustion bowl, for optimized performance, fuel efficiency, and emissions. In addition to height variations, the washer 330 also allows for accommodation of location variations, i.e., variations due to mis-alignment between clamping bracket 305 and the clamping stud 315.

Thus, the clamping arrangement 235 can accommodate various injectors irrespective of their sizes and the size of a washer underneath. The clamping arrangement 235 also provides flexibility for easy dis-mounting of the injector 135 for servicing. The clamping arrangement 235, having an elongated structure along the length of the injector 135, serves as a compact arrangement for precise mounting of the injector 135.

Fig.4 illustrates a sectional view of the combustion chamber 405 with the piston 110 at the TDC, according to an embodiment of the present subject matter. According to an aspect of the present subject matter, the injector 135 injects fuel in the combustion bowl 410 provided in the cylinder head 125. The combustion bowl 410 can be in the shape of a toroidal ring. **Fig.4** also depicts spray characteristics of the fuel injected in the combustion chamber 405. The combustion chamber 405 has quiescent characteristics and the air-fuel mixture has a radial squish flow at the TDC. Owing to such a configuration of the combustion chamber 405, the motion of the air prior to combustion has a little swirl or tumble. Such a motion of the air facilitates the mixing of air and fuel.

In operation, an upward movement of the piston 110 progressively compresses the air in the cylinder 105. When the piston 110 approaches the TDC, the compressed air is pushed into the combustion bowl 410. Owing to the toroidal ring configuration of the combustion bowl 410, the air-fuel mixture formed on the injection of fuel, follows a toroidal flow path. The toroidal shape of the combustion bowl 410 provides good turbulence of air in the combustion chamber 405, which in turn helps in achieving efficient combustion. Additionally, such a shape also facilitates efficient ejection of the exhaust gases from the cylinder 105. Further, such a configuration of the cylinder head 125 eliminates the need for a swirl chamber and a pre-combustion chamber provided in the conventional compression-ignition engines.

In one implementation, a tip 415 of the nozzle 140 is provided with multiple orifices (not shown in the figure) to inject fuel into the combustion chamber 405. The multiple orifices are arranged around a circumference of the tip 415. The high pressure fuel expelled from the orifices forms spray cones 420-1, 420-2,, 420-n, collectively referred to as the spray cones 420. Owing to the pressure of the fuel and the described configuration of the orifices on the tip 415, the spray-pattern of the injected fuel is substantially disc shaped i.e. the spray-pattern formed by the spray cones 420 takes the form of a flat disc (shown in **Fig.5**). The

spray-pattern has a conic angle of about 160° to 180° as compared to the conventional conic angle ranging from about 140° to 150° .

In one implementation, the tip 415 is provided with seven or more orifices having low pass-through flow. In said implementation, about 10 mm^3 or less of fuel is injected into the combustion chamber 405 per combustion cycle as against conventional 15 mm^3 of fuel per combustion cycle. The orifices have a small cross-section to facilitate better atomization of the high pressure fuel received from the accumulator 130. The atomized high pressure fuel spray injected from the orifices is assisted by the radial squish flow of the air at the TDC resulting in the toroidal flow path of the air-fuel mixture into the combustion chamber 405. However, it will be appreciated that depending on the size of an engine, the number and the size of the orifices can be increased or decreased accordingly.

The provision of the combustion bowl 410 along with the wide conic angle of the spray-pattern of the fuel ensures precise spacing of the fuel spray between the cylinder wall and the piston 110. Such a provision considerably prevents impingement of the fuel on the cylinder walls and the piston 110, thereby resulting in optimum utilization of the injected fuel. Further, both the toroidal ring shape of the combustion bowl 410 and the finely atomized fuel from the injector 135 vertically clamped at the centre of the cylinder head 125, enable efficient vaporization and mixing of the fuel for effective combustion.

In conventional engines, the fuel is injected when a combustion bowl, provided on the piston crown, is in proximity of the TDC. However in the described subject matter the combustion bowl 410 is fixed and therefore, a probability of the fuel being injected into the combustion chamber 405 increases. Additionally, the fixed combustion bowl 410 provides flexibility of injection timing and injection duration. Further, the disc-shaped spray-pattern of fuel and the described configuration of the combustion chamber 405 help in achieving required power output with low emissions and improved engine performance.

Fig. 5 illustrates a sectional view of the cylinder head 125 of the engine 100 of Fig. 2, according to an embodiment of the present subject matter. As illustrated, the cylinder head 125 includes a plurality coolant inlets 505-1,, 505-n, collectively referred to as coolant inlets 505, and a plurality of metering holes 510-1,, 510-n, collectively referred to as

metering holes 510. In one embodiment, the cross section of the metering holes 510 is sized smaller as compared to the coolant inlets 505.

The coolant inlets 505 and metering holes 510 are arranged circumferentially on the bottom surface 515 of the cylinder head 125 as against metering holes provided on a gasket at an interface between the cylinder 105 and the cylinder head 125 in conventional liquid-cooled engines. Such a provision of having the metering holes 510 directly on the cylinder head 125 is beneficial in cases where sealing between the cylinder head 125 and the cylinder 105 is by means other than the gasket, such as O-rings.

In operation, a coolant from a radiator (not shown in the figure) is pumped into coolant passages of the cylinder 105. The coolant from the coolant passages is discharged to the coolant inlets 505 and the metering holes 510. The flow of the coolant through inlets 505 and the metering holes 510 cools various components of the cylinder head assembly 115 such as the cylinder head 125, the injector 135, and exhaust valve(s).

As mentioned before, the tip 415 of the nozzle 140 includes multiple orifices arranged in a circumferential pattern such that the injected fuel has the disc shaped spray-pattern 520. Since the tip 415 is exposed to high temperature combustion gases, the coolant inlets 505 and metering holes 510, together facilitate effective circulation of coolant in the proximity of the nozzle 140, thereby reducing carbon deposits on the tip 415, hence improving durability of the injector 135.

Also, the provision of metering holes 510 reduces a probability of the coolant being by-passed to the coolant outlet 250. As a result, the velocity of coolant in the critical areas of the cylinder head 125 remains substantially unchanged and an effective cooling is achieved around the cylinder head 125. Upon cooling the cylinder head assembly 115, the coolant discharges through the coolant outlet 250 to the radiator. The coolant inlets 505 and the metering holes 510 lead to the coolant outlet 250.

The coolant outlet 250 is positioned such that it is at the highest point of the coolant passage. Such an arrangement, in addition to enhanced cooling of the various components, enables air bubbles to escape out of the engine 100 through the coolant outlet 250.

The previously described versions of the subject matter and its equivalent thereof have many advantages, including those which are described below. The cylinder head assembly described herein provides increased fuel efficiency and fewer emissions. Further, the cylinder head assembly provides a compact arrangement of the various components that makes it apt for use in small bore engines.

Although the subject matter has been described in considerable detail with reference to certain preferred embodiments thereof, other embodiments are possible. As such, the spirit and scope of the appended claims should not be limited to the description of the preferred embodiment contained therein.

I/we claim:

1. A cylinder head assembly (115) for a compression-ignition engine (100), the cylinder head assembly (115) comprising:

a cylinder head (125) having a combustion bowl (410), wherein a combustion chamber (405) is formed between the combustion bowl (410) and a piston (110), and wherein the combustion bowl (410) receives fuel for combustion.
2. The cylinder head assembly (115) as claimed in claim 1, wherein the combustion bowl (410) is shaped as a toroidal ring.
3. The cylinder head assembly (115) as claimed in claim 1, wherein the cylinder head assembly (115) comprises an injector (135) having a plurality of orifices, and wherein the orifices are arranged radially on the injector (135) such that the injected fuel has a substantially disc shaped spray-pattern (520).
4. The cylinder head assembly (115) as claimed in claim 1, wherein the cylinder head assembly (115) comprises an accumulator (130) mounted on the cylinder head (125).
5. The cylinder head assembly (115) as claimed in claim 1, wherein the cylinder head (125) comprises a plurality of coolant inlets (505) and a plurality of metering holes (510), and wherein the coolant inlets (505) have a cross section greater than that of the metering holes (510).
6. The cylinder head assembly (115) as claimed in claim 1, wherein the cylinder head assembly (115) comprises a clamping arrangement (235) to mount the injector (135) substantially at a centre of the cylinder head (125).
7. The cylinder head assembly (115) as claimed in claim 6, wherein the clamping arrangement (235) comprises:

a clamping bracket (305) to hold the injector (135) in a substantially vertical position;

a support stud (310) coupled to an end of the clamping bracket (305); and

a clamping stud (315) provided alongside the support stud (310).

8. The cylinder head assembly (115) as claimed in claim 7, wherein the support stud (310) comprises a taper, such that a mating ball (335) of the clamping bracket (305) rests in the taper.
9. A two-stroke compression ignition engine comprising a cylinder head assembly (115) as claimed in any of the claims 1-8.
10. A two-stroke compression-ignition engine (100_1) comprising:
 - at least one cylinder (105); and
 - at least one piston (110) movably disposed inside the cylinder (105);
 - characterized in that,
 - a cylinder head assembly (115) mounted on the cylinder(105), the cylinder head assembly (115) comprises,
 - a cylinder head (125) having a combustion bowl (410), wherein a combustion chamber (405) is defined between the combustion bowl (410) and a piston (110); and
 - an injector (135) comprises a plurality of orifices to inject fuel in the combustion bowl (410), wherein the orifices are arranged radially on the injector (135) such that the injected fuel has a substantially disc shaped spray-pattern (520).
11. The two-stroke compression-ignition engine (100_1) as claimed in claim 10, wherein the combustion bowl (410) is shaped as a toroidal ring.
12. The two-stroke compression-ignition engine (100_1) as claimed in claim 10, wherein the cylinder head assembly (115) comprises an accumulator (130) mounted on the cylinder head (125).
13. The two-stroke compression-ignition engine (100_1) as claimed in claim 10, wherein the cylinder head (125) comprises a plurality of coolant inlets (505) and a plurality of metering holes (510), and wherein the coolant inlets (505) have a cross section greater than that of the metering holes (510).

14. The two-stroke compression-ignition engine **(100_1)** as claimed in any of the claims 10-13, wherein the cylinder **(105)** has a bore size of about 60mm to 80mm.
15. A two-wheeled vehicle comprising a compression-ignition engine **(100_1)** as claimed in any of the claims 10-13.
16. The two-wheeled vehicle as claimed in claim 15, wherein the accumulator **(130)** is mounted on the cylinder head **(125)** such that a longitudinal axis of the accumulator **(130)** is parallel to a longitudinal axis of the two-wheeled vehicle.
17. An injector for a compression ignition engine comprising:
 - a tip **(415)**; and
 - a plurality of orifices to inject fuel, with a predetermined pressure, inside a combustion chamber **(405)**, wherein the orifices are arranged radially on the tip **(415)** such that a spray-pattern **(520)** of the injected fuel has a conic angle of about 160° to 180°.

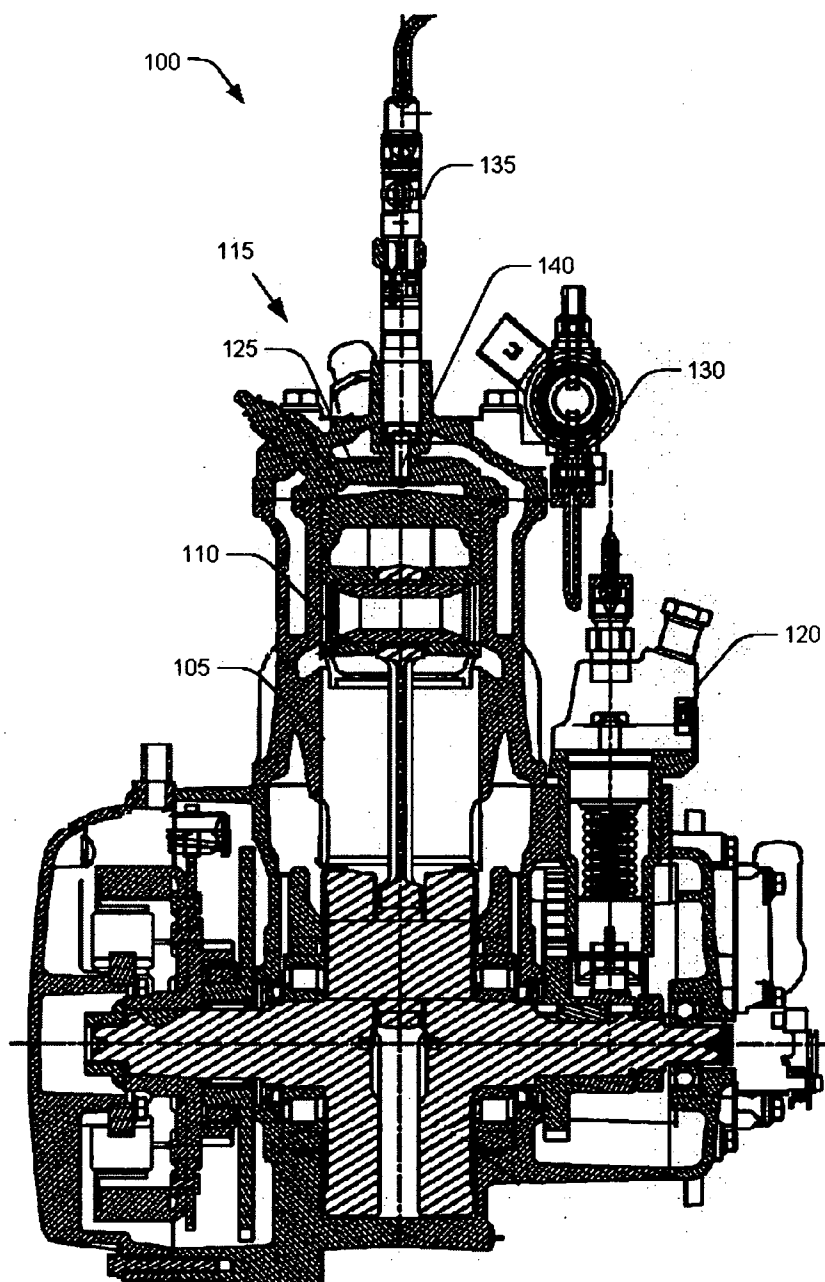


Fig.1

115

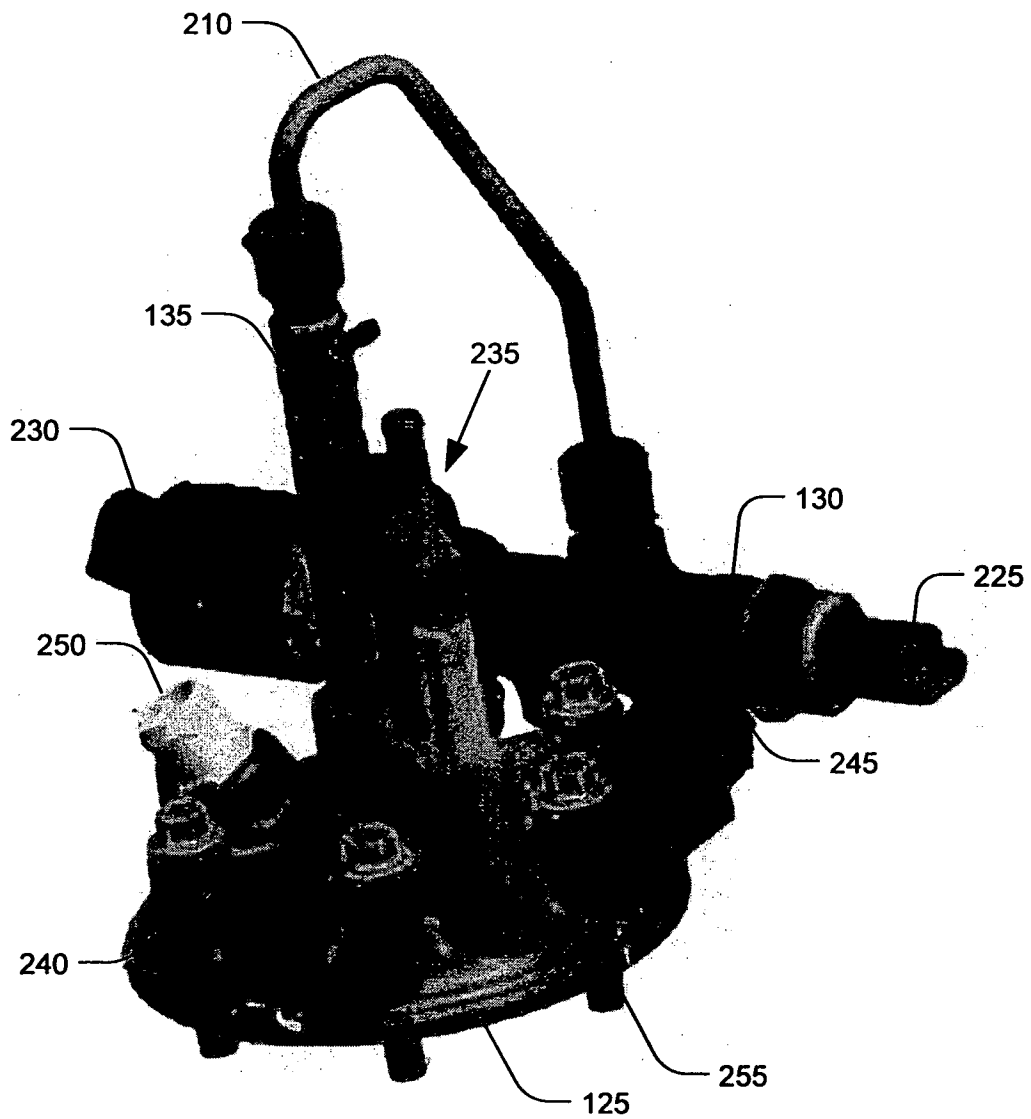


Fig.2a

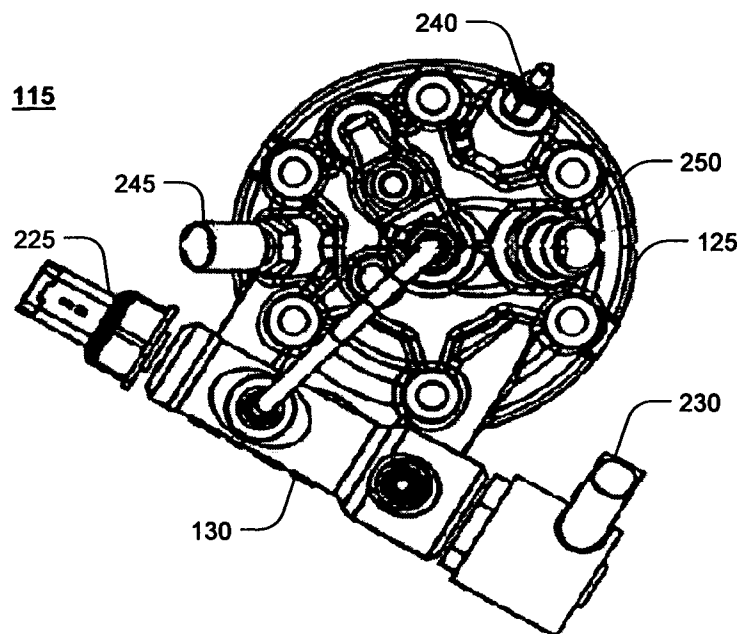


Fig.2b

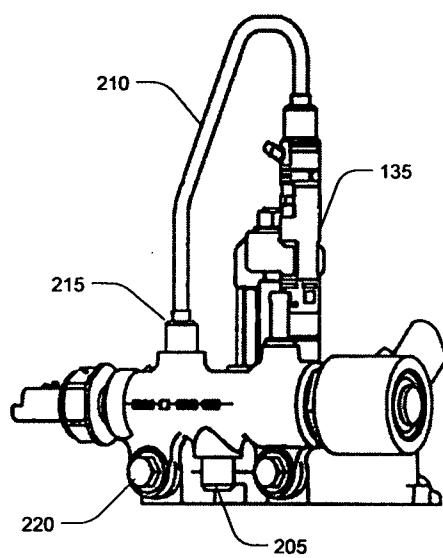


Fig.2c

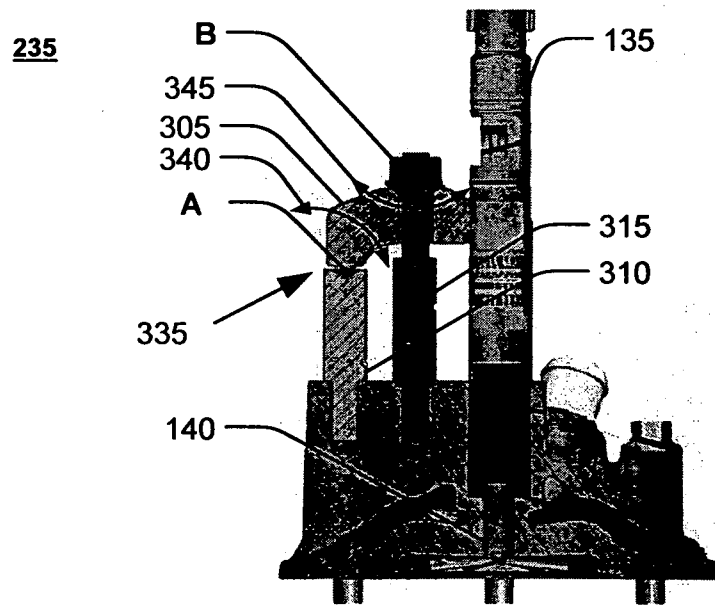


Fig.3a

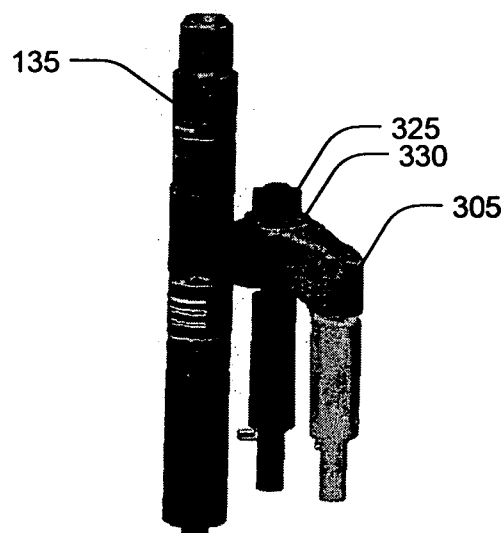
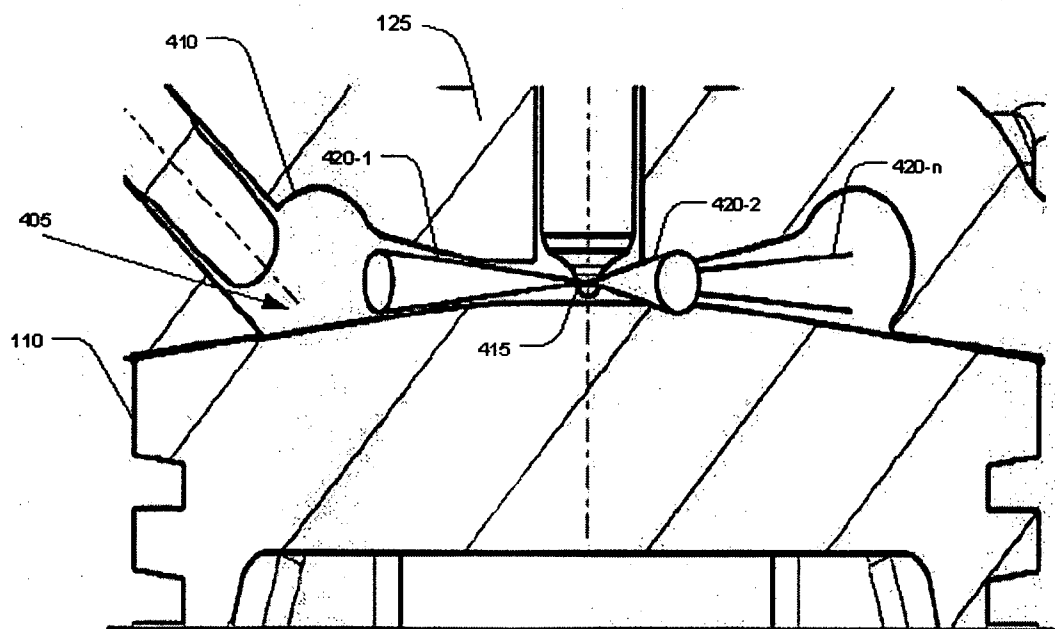


Fig.3b

**Fig.4**

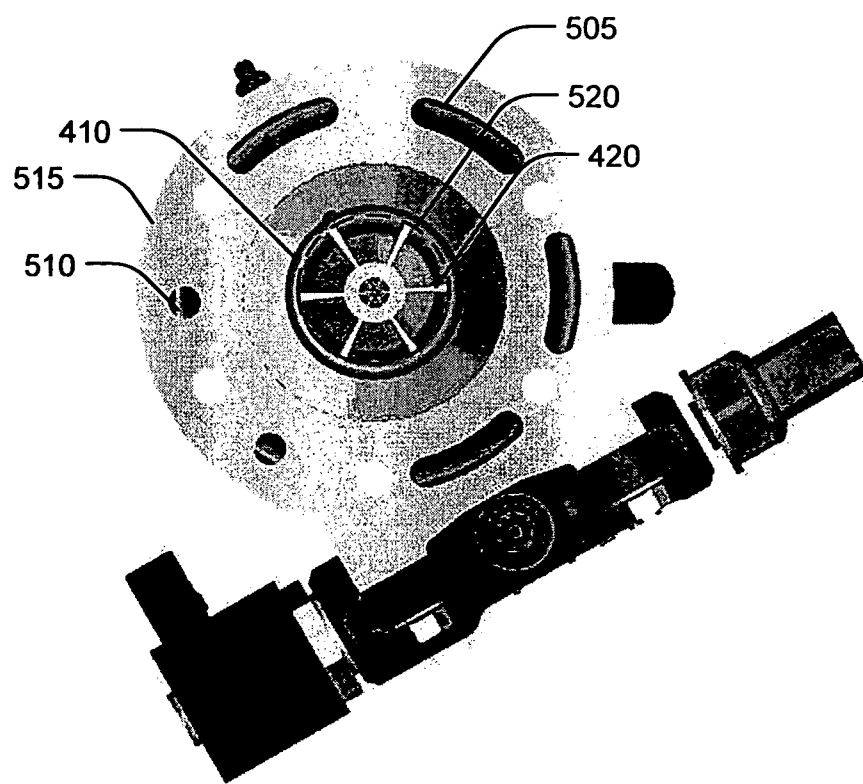


Fig.5