

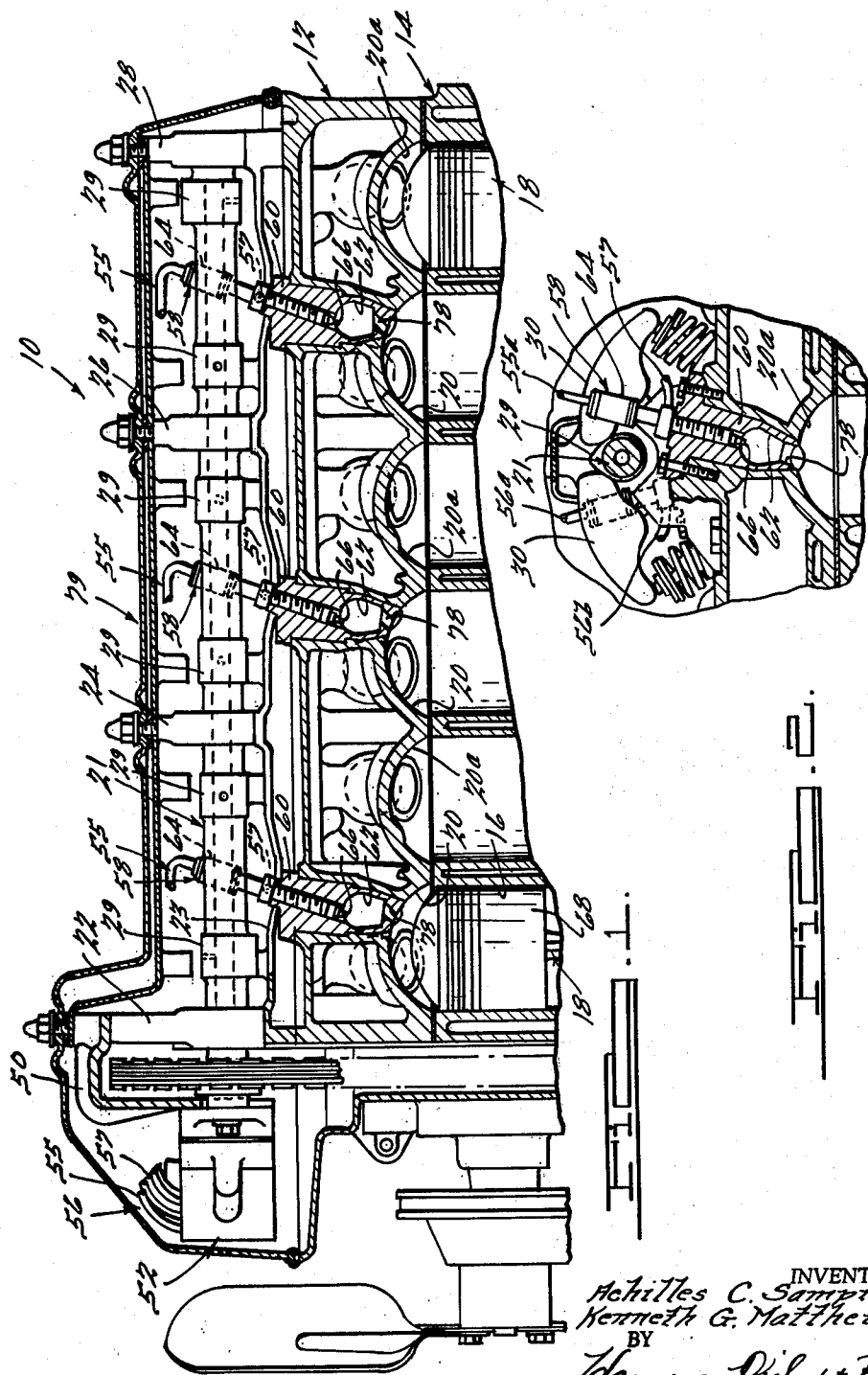
March 23, 1965

A. C. SAMPIETRO ET AL
DIESEL CYLINDER HEAD

3,174,467

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4 Sheets-Sheet 1



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FIG. 3.

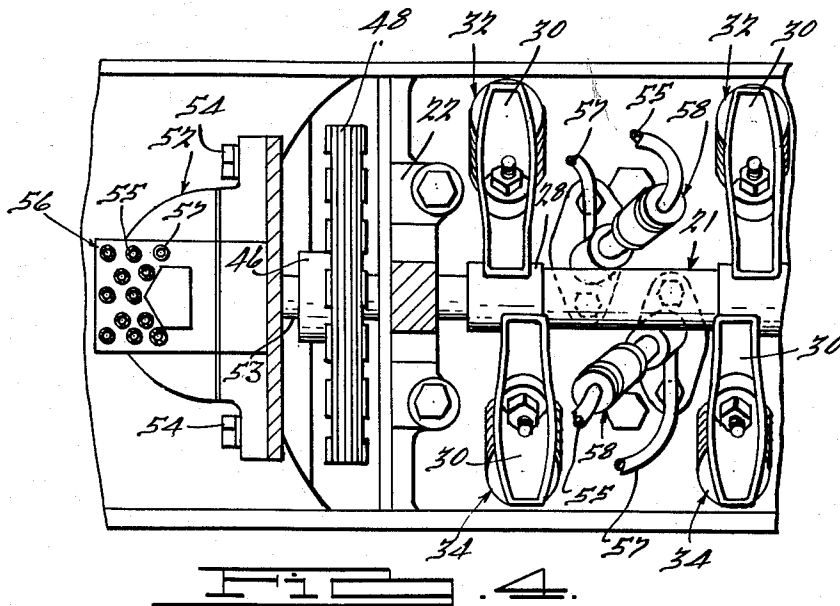
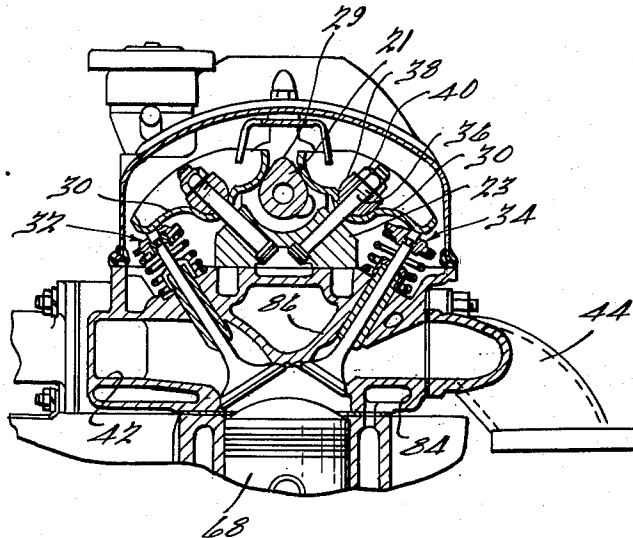


FIG. 4.

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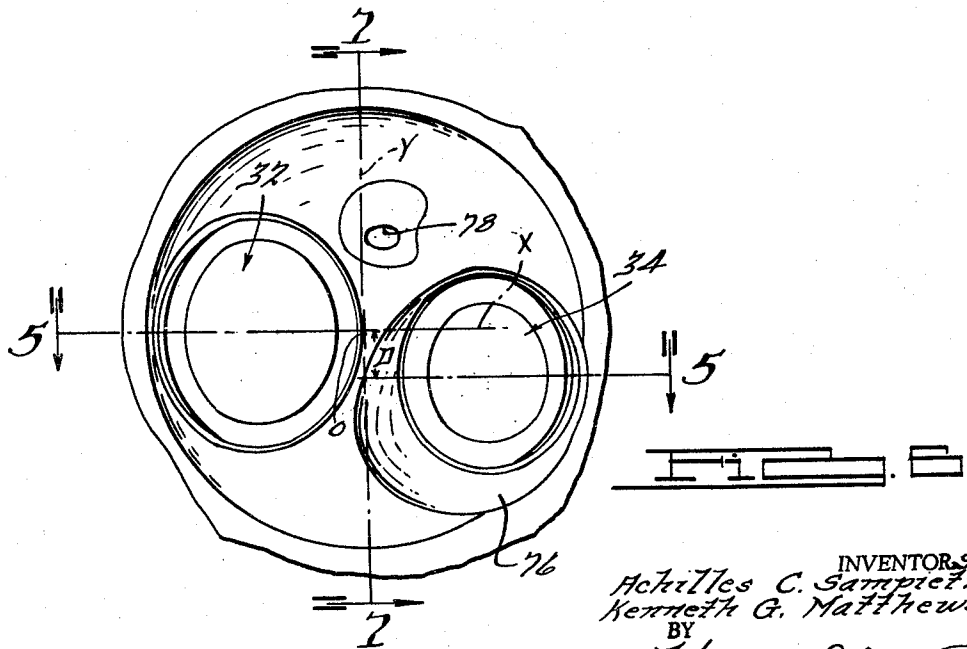
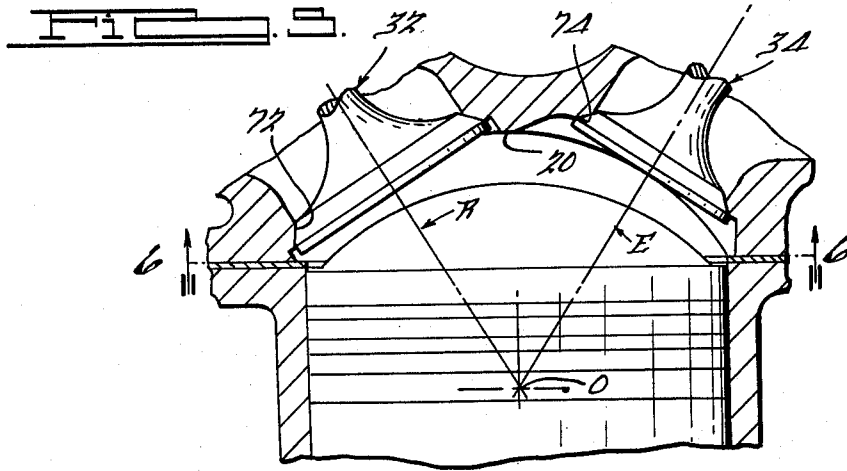
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4 Sheets-Sheet 3



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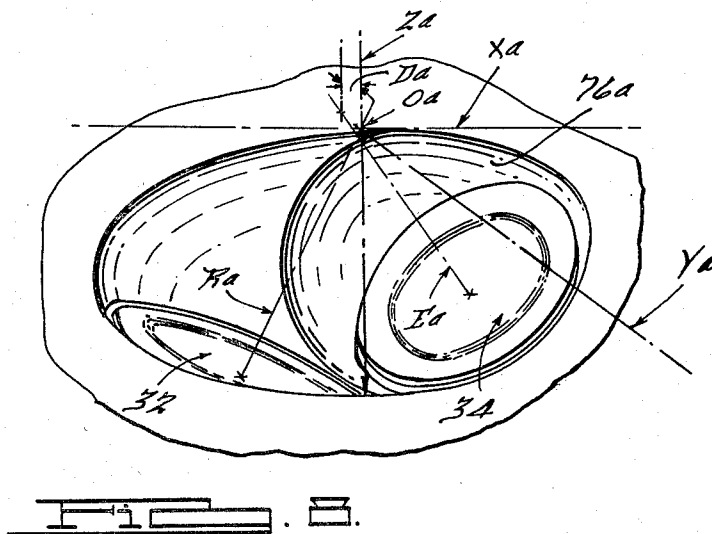
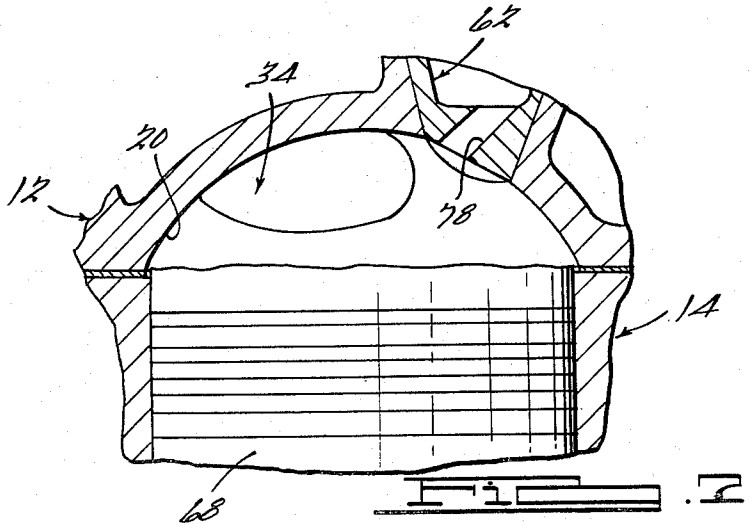
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4 Sheets-Sheet 4



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DIESEL CYLINDER HEAD

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Filed Apr. 23, 1962, Ser. No. 189,515
22 Claims. (Cl. 123—32)

This invention relates to diesel engines and more specifically to a diesel engine of an overhead camshaft construction.

By providing a diesel engine with an overhead camshaft and by driving the fuel injector pump for that diesel engine directly from the overhead camshaft, the fuel lines from the injector pump to the individual injectors can be of a minimum length; therefore, it is an object of this invention to provide a diesel engine of an overhead camshaft design in which the fuel injector pump is driven by the camshaft.

By utilizing a diesel engine having an overhead camshaft and by driving the fuel injection pump therefrom, all of the fuel lines and the injector pump can be encased within the valve cover thereby providing both a more compact assembly and a construction in which the individual fuel lines are protected from damage in the event the engine is to be removed and/or repaired. Therefore, it is another object of this invention to provide a diesel engine having an overhead camshaft which drives the fuel injector pump which construction facilitates the location of all the fuel lines to the injectors plus the injector pump within the valve cover.

Tests have indicated that one of the most efficient types of combustion chambers in the cylinder head is the hemispherically shaped combustion chamber; therefore, it is another object of this invention to provide a diesel engine having a cylinder head with a hemispherically-shaped combustion chamber.

It has been the practice in diesel engine construction to provide a combustion pocket in the head of the piston in which the fuel-air mixture can be concentrated and efficiently ignited. With this type of construction, however, cooling problems result since the only cooling to the piston head is through the oil in the crankcase. It is an object of this invention to provide a diesel engine construction in which a combustion pocket is formed in the cylinder head, which pocket is readily accessible to cooling from the cooling system; it is a further object of this invention to provide a diesel engine having a simplified construction in which the combustion pocket is coincident with the exhaust valve seat in the cylinder head.

It is desirable that the fuel-air mixture in the combustion chamber be subjected to a swirling effect when forced into the combustion pocket to thereby provide for an effective mixture of the fuel and air prior to combustion; therefore, it is another object of the invention to provide a combustion pocket causing swirling of fuel-air mixture in the combustion chamber cylinder.

It is another object of this invention to provide an injector assembly for each combustion chamber in the cylinder head for directing fuel such as to aid the swirling within the combustion pocket to thereby enhance the effectiveness of the mixture of the fuel with the air.

It is desirable that a short fuel ignition path be provided from the nozzle of each fuel injector to the combustion pocket; therefore, it is an object of this invention to provide a diesel engine construction having a short fuel ignition path from the nozzle of each fuel injector to the combustion pocket.

Other objects, features, and advantages of the present invention will become apparent from the subsequent de-

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scription and the appended claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fragmentary side elevational view with some parts broken away with some parts shown in section of a diesel engine embodying the features of this invention;

FIGURE 2 is a fragmentary, partially sectioned, front elevational view of a portion of the diesel engine shown in FIGURE 1 depicting the relationship between a fuel injector, combustion chamber, cylinder, the camshaft and rocker arm assemblies of the diesel engine shown in FIGURE 1;

FIGURE 3 is a fragmentary, partially sectioned, front elevational view of the diesel engine in FIGURE 1 depicting the relationship between the camshaft, the intake and exhaust valves, the combustion chamber and the rocker arm assembly of the diesel engine of FIGURE 1;

FIGURE 4 is a fragmentary, partially sectioned, plan view of a portion of the diesel engine shown in FIGURE 1 depicting the relationship between the rocker arms actuating the intake and exhaust valves, the overhead camshaft, the fuel injectors and the fuel injector pump of the diesel engine of FIGURE 1;

FIGURE 5 is a blown up, fragmentary, partially sectioned, front elevational view depicting the relationship between the intake and exhaust valves, the combustion chamber and the piston of one cylinder of the diesel engine shown in FIGURE 1 and taken substantially along the line 5—5 in FIGURE 6;

FIGURE 6 is a bottom sectional view of a combustion chamber of the cylinder head of the diesel engine shown in FIGURE 1 taken substantially along the line 6—6 in FIGURE 5;

FIGURE 7 is a fragmentary sectional view of the combustion chamber in the cylinder head and a piston of the diesel engine of FIGURE 1 taken substantially along the line 7—7 in FIGURE 6, and

FIGURE 8 is a pictorial representation of one of the hemispherical combustion chambers of the cylinder head of the diesel shown in FIGURE 1 and depicts the relationship between the intake and exhaust valves and the combustion pocket.

While the features of this invention have been shown as embodied for use in an overhead valve, in-line 6-cylinder engine, it is to be understood that the features of this invention are not necessarily restricted to that specific type.

Looking now to FIGURE 1, an in-line 6-cylinder diesel engine 10 is generally shown to be comprised of a cylinder head assembly 12 and an engine block assembly 14 secured together by bolts or other conventional means. The engine block 14 has six in-line cylinders 16 each for receiving one of six piston assemblies 18. The cylinder head 12 is formed with six combustion chambers 20, 20a each of which is arranged in alignment with one of the cylinders 16. The chambers 20 are the first, third and fifth ones in the cylinder head 12 (left to right in FIGURE 1) and differ from the chambers 20a which are the second, fourth and sixth ones, in a manner to be described. The combustion chambers 20, 20a are of a contour defined by a spherical zone bounded by one plane. While in the specific embodiment shown the combustion chambers 20, 20a define less than half of a sphere, for the sake of convenience these shall be referred to as hemispherical combustion chambers.

A camshaft 21 is centrally mounted on a camshaft bracket 23 disposed on the upper portion of the cylinder head 12 for rotation within a plurality of axially spaced bearing block members 22, 24, 26 and 28 and has disposed thereon at spaced intervals a plurality of cam members 29. Looking now to FIGURES 2, 3 and 4, each of the

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lobes or cam members 29 is associated with a pair of stamped, cast or otherwise formed rocker arm members 30, pairs of which are disposed on opposite sides of the camshaft 21 for actuating an intake valve assembly 32 and an exhaust valve assembly 34 for each of the combustion chambers 20, 20a. The intake and exhaust valve assemblies 32 and 34, respectively, are disposed overhead relative to chambers 20, 20a and are comprised of the usual valve members, valve spring, etc. the details of which are well known in the art and which do not constitute a part of this invention. Each of the rocker arms 30 is pivotally secured to a stud 36 for pivotal movement about a partially spherically shaped sleeve member 38 which is secured to and positionally adjustable along the stud 36 by means of a nut 40 which is in engagement with a threaded end of the stud 36. An intake manifold 42 communicates each of the intake valve assemblies 32 while an exhaust manifold 44 communicates each of the exhaust valve assemblies 34.

Secured to the front end of the camshaft 21 is a sprocket member 46 which is engageable with a timing chain 48 which is in turn driven by the crankshaft (not shown); the timing can be set in a conventional manner to provide the proper sequence of operation of the plurality of rocker arms 30, and hence of the plurality of intake and exhaust assemblies 32 and 34, respectively, relative to the position of the associated one of the piston assemblies 18.

A bracket 50 (FIGURE 1) secured to the front bearing block 22 extends over and around the sprocket 46 and timing chain 48 and has secured thereto a fuel injection pump member 52 by means of a pair of bolts 54. The camshaft 21 terminates in a forward portion 53 which is engageable with a member within the fuel injector pump 52 such that rotation of camshaft 21 causes pump 52 to pump fuel sequentially through each of a plurality of fuel lines 56. These lines 56 are connected to the pump 52 in pairs with one (55) of each pair being an input line and the other (57) a return line. The fuel injector pump 52 is of a construction well known in the art and its specific features do not constitute a part of this invention. Thus fuel from the pump 52 is fed to the several pairs of lines composed of an input line 55 and a return line 57 in a preselected sequence and time to be in accordance with the rotation of the camshaft 21. Thus the transmission of fuel to the lines 56 can be placed in a selected relationship to the actuation of the various intake and exhaust valve assemblies 32, 34 and hence in relationship to the position of each of the piston assemblies 18. Note that in the preferred embodiment the pump 52 is substantially in axial alignment with the camshaft 21; this allows the fuel lines 56 to be of a minimum length thus providing for a compact assembly.

Each of the six combustion chambers 20, 20a (FIGURE 2) is provided with a fuel injector assembly 58 which is of a conventional construction having a housing member 60 with a precombustion chamber 62 formed at the end thereof which is in fluid communication with one of the combustion chambers 20, 20a and having an injector member 64 with a nozzle 66 extending through the housing 60 and into the precombustion chamber 62. As shown in the drawings each injector member 64 is threaded into the corresponding housing member 60 which in turn is bolted to the cylinder head 12. Connected to each injector member 64 of each fuel injector assembly 58 is one input fuel line 55 and the corresponding return fuel line 57. Thus fuel is sequentially injected from the fuel injector pump 52 to each fuel injector assembly 58. As already noted, the injection of fuel into the precombustion chamber 62 can be set to coincide with that one of the pistons 18 being in a predetermined positional relationship within the cylinder 16.

As previously mentioned, each combustion chamber 20, 20a in the cylinder head 12 is hemispherically shaped. In order to provide for the high compression ratios re-

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quired in diesel engines each piston assembly 18 has its corresponding piston member 68 formed with a similarly hemispherically shaped or domed top portion.

FIGURES 5, 6 and 7 depict the structure of one of the combustion chambers 20 while FIGURE 8 depicts the structure of one of the combustion chambers 20a. In the following discussion components, axes, etc. associated with chambers 20a which are similar to like components, axes, etc. associated with chamber 20 will be given identical numbers with the subscript "a" added. Each of the combustion chambers 20, 20a in the cylinder head 12 is provided with an annular seat 72, 72a, respectively, against which the intake valve of each of the intake valve assemblies 32 is seated and a second annular seat 74, 74a, respectively, against which the exhaust valve associated with each of the exhaust valve assemblies 34 is seated. The center of the annular seat 72, 72a is coincident with a radius line R, Ra (FIGURES 5 and 8) which is the radius of each of the spherically contoured combustion chambers 20, 20a. For a purpose to be seen, the center lines E, Ea (FIGURES 5 and 8) of the annular seats 74, 74a, respectively, for the exhaust valve assemblies 30 is offset and not along a radius line.

Looking specifically now to FIGURE 8, the radius line Ra and the axis Ea are shown relative to three mutually perpendicular lines defining the Xa, Ya and Za axes, respectively, which are shown to be intersecting at the center Oa of an imaginary sphere of which the combustion chamber 20a is a zone. The radius line Ra lies in the plane defined by the Xa and Za axes, which plane extends transversely of the cylinder head 12 and substantially bisects the combustion chamber 20a. The axis Ea of the annular seat 74a for the exhaust valve assembly 34 is offset from the Xa axis a distance Da along the Ya axis. The axis line Ea is skewed relative to radius line Ra and hence lies in a plane parallel to the plane defined by the Xa and Za axes.

In forming the valve seats 72, 72a and 74, 74a, a circular cutter is passed along the radius line R, Ra and along the axis E, Ea, respectively. Since the radius line R, Ra corresponds to a radius line of the imaginary sphere of which the combustion chamber 20, 20a is a zone, a uniform annular wall will be formed defining the seat 72, 72a associated with the intake valve assembly 32. However, the same is not true in the formation of the seat 74, 74a for the exhaust valve assembly 34. On moving a circular cutter along the offset axis E, Ea a pocket 76, 76a is cut in the combustion chamber 20, 20a. Thus a combustion pocket 76, 76a is formed in the vicinity of the exhaust valve and is a portion of a right circular cylinder and performs a function to be seen. Note that the amount of the combustion chamber 20, 20a removed (and hence the extent of the volume defined by the pocket 76, 76a) is dependent upon the magnitude of the distance D, Da and the size of the cutter used. The volume defined by the pocket 76, 76a is selected to provide the proper compression ratio. Note that with such a construction the valve seat 74, 74a can be machined simultaneously with the machining of the pocket 76, 76a.

As can best be seen in FIGURE 4, each injector assembly 58 for adjacent cylinders 16 and combustion chambers 20, 20a are located on opposite, transverse sides of the camshaft 21 in a side-by-side relationship. With alternate injector assemblies 58 located on opposite sides, the fuel lines 55 and 57 from the injector fuel pump 52 are more readily accommodated. In order to provide this construction, the combustion pockets 76, 76a in adjacent combustion chambers 20, 20a are formed by offsetting the distance E, Ea, oppositely from the point of origin O, Oa along the Y, Ya axis. Thus a combustion pocket 76 as shown in FIGURES 5, 6 and 7 would be as associated with the first, third and fifth combustion chambers 20 (from left to right in FIGURE 1) while the combustion pocket 76a as shown in FIGURE 8 would be as formed for the second, fourth and sixth combustion

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chambers 20a (from left to right in FIGURE 1). Note that by so locating the injector assemblies 58 and by locating the fuel injector pump 52 to be in axial alignment with and to be driven by the camshaft 21, a valve cover 79 can be disposed over the camshaft 21, pump 52, injectors 58, fuel lines 56, etc., thereby providing a compact assembly and protecting the various components from damage.

An orifice 78 (FIGURES 1, 2 and 7) communicates each of the precombustion chambers 62 with a corresponding combustion chamber 20, 20a and is inclined at an angle such that the fuel is injected into the combustion pocket 76, 76a to further enhance the swirling effect. This swirling or turbulence causes a better mixture of fuel and air and hence results in a more efficient combustion of the fuel. By locating the combustion pocket 76 by the exhaust valve the temperature of the fuel-air mixture therein is raised, thereby enhancing combustion. As can best be seen in FIGURE 6, by offsetting the exhaust valve seat 76 the injector orifice 78 can be approximately centrally located with respect to the combustion chamber 20; this allows for a shorter, more uniform flame travel to all parts of the chamber 20, hence providing for a more efficient combustion of fuel. Of course, the same result is obtained in chambers 20a.

The principle of operation of a diesel engine as previously described is conventional and will be described only briefly here with reference to one of the combustion chambers 20, 20a. Upon a first stroke downward of the piston assembly 18, the intake valve assembly 32 as actuated by its corresponding rocker arm member 30 unseats the intake valve from the seat 72 and clean air is drawn into the combustion chamber 20 and into the corresponding cylinder 16 from the intake manifold 42. Upon the upward stroke of the piston assembly 18 the air inside the combustion chamber 20 is compressed; likewise, compression takes place of the air in the precombustion chamber 62, since that is connected directly to the combustion chamber 20 via the orifice 78. As the air is being compressed, a turbulence or swirling of the air in the pocket 76 occurs because of the discontinuity created by the pocket 76 over the surface of the combustion chamber 20. At a preselected time on the upstroke of the piston assembly 18, fuel is injected from the fuel injector pump 52 via the input line 55 into the injector 64 and into the precombustion chamber 62 via the nozzle 66. Excess fuel, of course, is returned to the pump 52 via the return line 57. The fuel is injected as a spray into the precombustion chamber 62 where ignition initially takes place as a result of the high temperature of the gas therein due to its compression, as previously described. The mixture in the precombustion chamber 62 is partially ignited and immediately expands and flows into the combustion chamber 20 and specifically into the combustion pocket 76 towards which it is directed via the orifice 78. The partially ignited mixture directed into the combustion pocket 76 causes further swirling and turbulence; of course, the flame initiated in the precombustion chamber 62 also travels into the pocket 76 igniting the mixture therein; the flame from the precombustion chamber 62 likewise propagates throughout the remainder of the combustion chamber 20 igniting the mixture therein. Upon ignition of the fuel within the combustion chamber 20, the expanding gases cause the piston assembly 18 to be moved downwardly again. On the next stroke of the piston assembly 18 upwardly, the exhaust valve of the assembly 34 unseats from the valve seat 74 thereby allowing the exhaust gases to be purged from the combustion chamber 20 and into the atmosphere via the exhaust manifold 44. The same cycle of operation, of course, is sequentially occurring in the rest of the cylinders of the diesel engine 10. For cold starting, a glow plug or other type apparatus well known in the art could be utilized to initially provide ignition of the fuel.

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Note that by forming the combustion pocket 76 within the walls of the combustion chamber 20 and the cylinder head 12, cooling can be provided to this portion via the water cooling system and specifically via the chambers 84, 86 (FIGURE 3); this allows for a higher output for same sized engines without danger of damage. For example, in the diesel engine as shown in the figures a turbo supercharger could be attached providing for an increase in horse power output without necessitating a change in construction other than the installation of the supercharging equipment. In the preferred embodiment air alone is inducted through the intake manifold 42; if desired, by modification well known in the art, a lean fuel-air mixture could be inducted instead.

Thus a diesel engine design has been provided in which a hemispherical combustion chamber and overhead camshaft are utilized to provide a compact engine having the numerous advantages described above.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a diesel engine the combination comprising a cylinder head having a plurality of combustion chambers, a camshaft rotatably secured overhead to said cylinder head, intake means individual to each of said combustion chambers and secured to said cylinder head and being actuable responsively to rotation of said camshaft for communicating said combustion chambers with a gas to be drawn therein, exhaust means individual to each of said combustion chambers and secured to said cylinder head and being actuable responsively to rotation of said camshaft for communicating said combustion chambers to the atmosphere, a fuel injector pump secured to one end of said camshaft and being actuable responsively to rotation of said camshaft for pumping fuel under pressure, and injector means for conducting fuel from said fuel injector pump to each of said combustion chambers.

2. In a diesel engine the combination comprising a cylinder head having a plurality of combustion chambers, a camshaft rotatably secured overhead to said cylinder head having a plurality of axially spaced cam members disposed thereon, intake means individual to each of said combustion chambers and secured in overhead relationship to said cylinder head and being actuable by said cam member responsively to rotation of said camshaft for communicating said combustion chambers with a gas to be drawn therein, exhaust means individual to each of said combustion chambers and secured in overhead relationship to said cylinder head and being actuable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers to the atmosphere, a fuel injector pump secured in substantial axial alignment to one end of said camshaft and being actuable responsively to rotation of said camshaft for pumping fuel under pressure, and injector means for conducting fuel from said fuel injector pump to each of said combustion chambers.

3. In an in-line diesel engine the combination comprising a cylinder head having a plurality of combustion chambers, a camshaft rotatably secured overhead to said cylinder head and having a plurality of axially spaced cam members disposed thereon, intake means individual to each of said combustion chambers and secured to said cylinder head and being actuable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers with a gas to be drawn therein, exhaust means individual to each of said combustion chambers and secured to said cylinder head and being actuable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers to the atmosphere, a fuel injector pump se-

cured to one end of said camshaft and being actuable responsively to rotation of said camshaft for pumping fuel under pressure, and injector means for conducting fuel from said fuel injector pump to each of said combustion chambers, said injector means including a plurality of injector assemblies each individual to one of said combustion chambers for injecting fuel therein with adjacent ones of successive pairs of said injector assemblies disposed on opposite, transverse sides of said camshaft in a substantially side-by-side relationship and further including a plurality of fuel lines connecting each of said injector assemblies to said injector pump.

4. In an in-line diesel engine the combination comprising a cylinder head having a plurality of combustion chambers, a camshaft rotatably secured overhead to said cylinder head and having a plurality of axially spaced cam members disposed thereon, intake means individual to each of said combustion chambers and including an intake valve assembly secured in overhead relationship to said cylinder head and being actuable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers with a gas to be drawn therein, exhaust means individual to each of said combustion chambers and including an exhaust valve assembly secured in overhead relationship to said cylinder head and being actuable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers to the atmosphere, a fuel injector pump secured in substantial axial alignment to one end of said camshaft and being actuable responsively to rotation of said camshaft for pumping fuel under pressure, injector means for conducting fuel from said fuel injector pump to each of said combustion chambers, said injector means including a plurality of injector members each individual to one of said combustion chambers for injecting fuel therein and a plurality of fuel lines connecting each of said injector members to said injector pump, and a cover member secured to said cylinder head and substantially enveloping said camshaft, each said intake valve assembly, each said exhaust valve assembly, said injector pump, and said injector means.

5. In a diesel engine the combination comprising a cylinder head having a plurality of combustion chambers each having an intake and an exhaust valve seat therein, each of said combustion chambers at least partially defined by a peripheral, recessed surface in said cylinder head, a combustion pocket formed integrally with each of said combustion chambers at one of said intake and exhaust valve seats and defined by a portion of said recessed surface further recessed from substantially the remainder thereof and being openly, unrestrictedly in communication with said each of said combustion chambers, and means operative with each of said combustion chambers for injecting fuel therein and including passage means oriented for directing substantially all of the injected fuel in a direction into each said combustion pocket.

6. In a diesel engine the combination comprising a cylinder head having a plurality of combustion chambers each defining a zone of a sphere and each having an intake and an exhaust valve seat therein, each of said combustion chambers at least partially defined by a peripheral, recessed surface in said cylinder head, a combustion pocket formed integrally with each of said combustion chambers at said exhaust valve seat and defined by a portion of said recessed surface further recessed from substantially the remainder thereof and being openly unrestrictedly in communication with said each of said combustion chambers, and means operative with each of said combustion chambers for injecting fuel therein and including passage means oriented for directing substantially all of the injected fuel in a direction into each said combustion pocket.

7. In a diesel engine the combination comprising a cylinder head having a plurality of combustion chambers therein, each of said combustion chambers at least partially defined by a peripheral, recessed surface in said

cylinder head, a combustion pocket formed integrally with each of said combustion chambers and defined by a portion of said recessed surface further recessed from substantially the remainder thereof and being openly, unrestrictedly in communication with said each of said combustion chambers, a plurality of fuel injector assemblies each in fluid communication with and individual to one of said combustion chambers injecting fuel therein, each of said fuel injectors having an orifice positioned to direct fuel into that one of said combustion pockets with which it is individual.

8. The diesel engine of claim 7 in which said each of said fuel injector assemblies includes a precombustion chamber with said orifice communicating said precombustion chamber to said combustion chambers.

9. In a diesel engine the combination comprising a longitudinally extending cylinder head having a plurality of spherically contoured combustion chambers therein, each of said combustion chambers at least partially defined by a peripheral recessed surface in said cylinder head, each of said combustion chambers having an intake and an exhaust valve seat with the axes of said intake and said exhaust valve seat being longitudinally offset from each other, a combustion pocket formed integrally with each of said combustion chambers at one of said intake and said exhaust valve seats and defined by a portion of said recessed surface further recessed from substantially the remainder thereof and being openly, unrestrictedly in communication with said each of said combustion chambers, and means operative with each of said combustion chambers for injecting fuel therein and including passage means oriented for directing substantially all of the injected fuel in a direction in each said combustion pocket.

10. The diesel engine of claim 9 with the surface defining said combustion pocket being a portion of a right circular cylinder having its axis coincident with the axis of said one of said intake and said exhaust valve seats at which said combustion pocket is formed.

11. In a diesel engine the combination comprising a cylinder head having a plurality of spherically contoured combustion chambers therein, each of said combustion chambers having an intake and an exhaust valve seat with the axis of one of said intake and exhaust valve seats being in a plane transversely bisecting said each of said combustion chambers and with the axis of the other of said intake and said exhaust valve seats being in a transverse plane longitudinally offset from the transverse plane of said axis of said one of said intake and exhaust valve seats a combustion pocket formed integrally with each of said combustion chambers at said other of said intake and said exhaust valve seats and means operative with each of said combustion chambers for injecting fuel therein and including passage means oriented for directing substantially all of the injected fuel in a direction into each said combustion pocket.

12. The diesel engine of claim 11 with said one of said intake and exhaust valve seats being said intake valve seat and with said other of said intake and exhaust valve seats being said exhaust valve seat.

13. The diesel engine of claim 12 further including a plurality of fuel injector assemblies each in fluid communication with and individual to one of said combustion chambers for injecting fuel therein, each of said fuel injector assemblies having an orifice located approximately centrally in said one of said combustion chambers and positioned to direct fuel into that one of said combustion pockets with which it is individual.

14. The diesel engine of claim 12 with adjacent ones of successive pairs of said combustion chambers having the axes of said exhaust valve seats longitudinally offset towards each other and further including a camshaft rotatably secured overhead to said cylinder head and having a plurality of axially spaced cam members disposed thereon, intake means individual to each of said combustion chambers and secured to said cylinder head and being

actuatable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers with a gas to be drawn therein, exhaust means individual to each of said combustion chambers and secured to said cylinder head and being actuatable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers to the atmosphere, a fuel injector pump secured to one end of said camshaft and being actuatable responsively to rotation of said camshaft for pumping fuel under pressure, and injector means for conducting fuel from said fuel injector pump to each of said combustion chambers, said injector means including a plurality of injector assemblies each individual to one of said combustion chambers for injecting fuel therein with adjacent ones of successive pairs of said injector assemblies disposed on opposite, transverse sides of said camshaft in a substantially side-by-side relationship and further including a plurality of fuel lines connecting each of said injector assemblies to said injector pump.

15. The diesel engine of claim 12 with the axis of each said intake valve seat being coincident with a radius line for each of said spherically contoured combustion chambers.

16. The diesel engine of claim 15 with the surface defining said combustion pocket being a portion of a right circular cylinder having its axis coincident with the axis of said exhaust valve seat.

17. In a diesel engine the combination comprising a cylinder head having a plurality of spherically contoured combustion chambers therein, each of said combustion chambers having an intake and an exhaust valve seat with the axis of one of said intake and exhaust valve seats being in a plane transversely bisecting said each of said combustion chambers and with the axis of the other of said intake and said exhaust valve seats being in a transverse plane longitudinally offset from the transverse plane of said axis of said one of said intake and exhaust valve seats, a combustion pocket formed integrally with each of said combustion chambers at said other of said intake and said exhaust valve seats, and a plurality of fuel injector assemblies each in fluid communication with and individual to one of said combustion chambers for injecting fuel therein, each of said fuel injector assemblies having an orifice located approximately centrally in said one of said combustion chambers and positioned to direct fuel into that one of said combustion pockets with which it is individual.

18. In a diesel engine the combination comprising a cylinder head having a plurality of spherically contoured combustion chambers therein, each of said combustion chambers having an intake and an exhaust valve seat with the axis of one of said intake and exhaust valve seats being in a plane transversely bisecting said each of said combustion chambers and with the axis of the other said intake and said exhaust valve seats being in a transverse plane longitudinally offset from the transverse plane of said axis of said one of said intake and exhaust valve seats, adjacent ones of successive pairs of said combustion chambers having the axes of said other of intake and said exhaust valve seats longitudinally offset towards each other, a camshaft rotatably secured overhead to said cylinder head and having a plurality of axially spaced cam members disposed thereon, intake means individual to each of said combustion chambers and secured to said cylinder head and being actuatable by said cam members responsively to rotation of said camshaft for communicating said combustion

chambers with the gas to be drawn therein, exhaust means individual to each of said combustion chambers and secured to said cylinder head and being actuatable by said cam members responsively to rotation of said camshaft for communicating said combustion chambers to the atmosphere, a fuel injector pump secured to said camshaft and being actuatable responsively to rotation of said camshaft for pumping fuel under pressure, and injector means for conducting fuel from said fuel injector pump to each of said combustion chambers, said injector means including a plurality of injector assemblies each individual to one of said combustion chambers for injecting fuel therein with adjacent ones of successive pairs of said injectors assemblies disposed on opposite, transverse sides of said camshaft in a substantially side-by-side relationship.

19. In a diesel engine the combination comprising a cylinder head having a plurality of spherically contoured combustion chambers therein, each of said combustion chambers having an intake and exhaust valve seat with the axis of one of said intake and exhaust valve seats being in a plane transversely bisecting said each of said combustion chambers and with the axis of the other of said intake and said exhaust valve seats being in a transverse plane longitudinally offset from the transverse plane of said axis of said one of said intake and exhaust valve seats, the axis of said one of said intake and exhaust valve seats being coincident with the radius line for each of said spherically contoured combustion chambers, and a combustion pocket formed integrally with each of said combustion chambers at said other of said intake and said exhaust valve seats.

20. The diesel engine of claim 19 with the surface defining said combustion pocket being a portion of a right circular cylinder having its axis coincident with the axis of said other of said intake and said exhaust valve seats.

21. In a diesel engine the combination comprising a longitudinally extending cylinder head having a plurality of combustion chambers therein, each of said combustion chambers having an intake and an exhaust valve seat transversely spaced and longitudinally offset from each other, in successive pairs of said combustion chambers both of said combustion chambers in one of said pairs having those of said intake and exhaust valve seats on one transverse side of said cylinder head longitudinally offset towards each other.

22. The combination of claim 21 in which each of said combustion chambers has a combustion pocket formed integrally therewith at those of said intake and exhaust valve seats on said one transverse side.

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