Feb. 13, 1962 O. HARTMANN 3,020,898

DIESEL ENGINE

Filed Dec. 30, 1958

Fig. 1

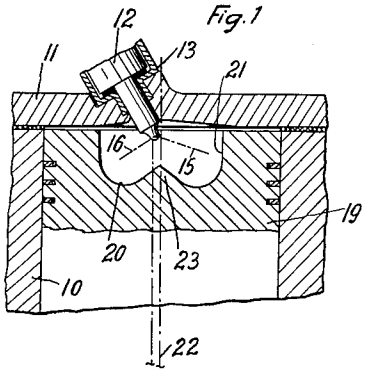


Fig. 2

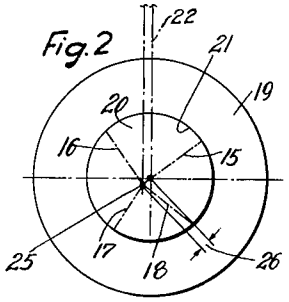


Fig. 3

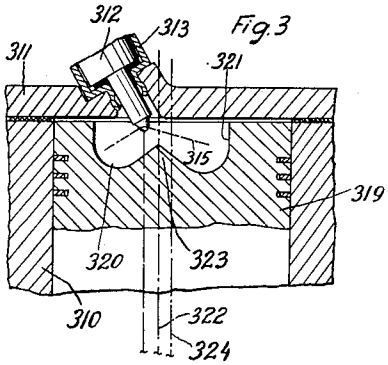


Fig. 4

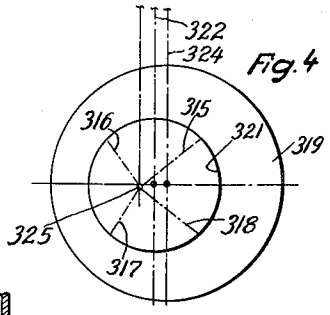


Fig. 5

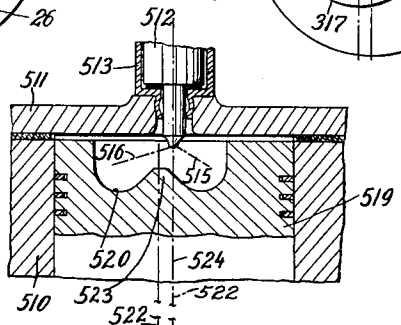
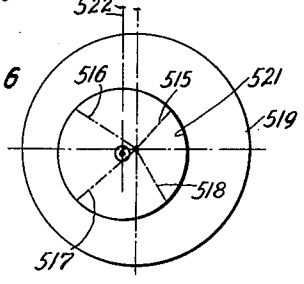


Fig. 6



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DIESEL ENGINE

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10 Claims. (Cl. 123—32)

My invention relates to a diesel engine in which a plurality of fuel jets is injected into the combustion space formed by a recess provided in the top of the piston.

It is the object of my invention to provide an improved diesel engine of this type in which in any condition of operation of the engine at least one of the fuel jets has a length most suitable for the air currents prevailing in the combustion space and for the quantity of air therein under such conditions, thus insuring that the combustion of this jet reacts favorably on the combustion of the fuel of the other jets.

It is another object of my invention to provide a diesel engine of the type described hereinabove in which owing to the different lengths of the fuel jets at least one of the jets will be of considerable length, and, therefore, will easily ignite when the engine is started in cold condition, the easy ignition being due to the fact that the fuel globules injected into the combustion space will travel a considerable distance in the combustion air before hitting the cold wall of the combustion space.

My invention is of particular utility for a diesel engine in which four valves are mounted in the cylinder head around the centrally located fuel injector mounted as close to the axis of the cylinder as possible.

Finally, it is an object of my invention to provide an improved diesel engine of the type indicated hereinabove in which the combustion space has a shape insuring that the lengths of the different jets though different are considerable even where the volume of the combustion space is limited.

Further objects of my invention will appear from a detailed description of the various embodiments of my invention with reference to the accompanying drawings following hereinafter. It is to be understood, however, that my invention is in no way limited to the details of such embodiments but is capable of numerous modifications within the scope of the appended claims and that the terms and phrases used in such detailed description have been chosen for the purpose of explaining rather than that of restricting or limiting my invention.

In the drawings

FIG. 1 is a diagrammatic longitudinal section taken through the top of the cylinder, the fuel injector mounted therein and the piston,

FIG. 2 is a plan view of the top of the piston,

FIG. 3 is a sectional view similar to that of FIG. 1 of a modified embodiment of my invention,

FIG. 4 is a plan view of the top of the piston shown in FIG. 3,

FIG. 5 is a view similar to that of FIG. 1 of another embodiment of my invention, and

FIG. 6 is a plan view of the top of the piston shown in FIG. 5.

The diesel engine comprises a plurality of cylinders each of which is composed of a cylinder wall **10** and a cylinder head **11**. A fuel injector comprising a casing **13** and a nozzle body **12** inserted therein is mounted in a bore provided in the cylinder head **11** so that the substantially conical tip of the body **12** projects into the interior space of the cylinder. This tip is provided with a plurality of nozzles, the axes of which are indicated by the dash-dotted lines **15**, **16**, **17** and **18**. The nozzles are distributed about the axis of the fuel injector and in operation inject jets of fuel along the axial lines **15**, **16**, **17** and **18**.

The piston **19** movably mounted in the cylinder **10**, **11** has a top face provided with a recess **20** constituting the combustion space into which the fuel jets are injected. Preferably, the walls of the recess **20** are formed by a surface **21** of revolution. In the embodiment shown the cross-sectional profile taken along a plane in which the axis **22** of the surface **21** of revolution is located has substantially the shape of the Greek letter ω. Therefore, this profile has end sections extending parallel to the axis **22** and a central angular section provided with an apex pointing upwardly. Hence, the wall **21** of the recess **20** has a substantially cylindrical peripheral section connected by a rounded transitional section with the bottom face which has a central conical elevation indicated at **23**. Each of the axes **15**, **16**, **17** and **18** of the fuel injecting nozzles includes an angle of not more than 45° with a transverse plane that extends normal to the axis of the piston **19**. In the embodiment shown in FIGS. 1 and 2 the two axes **15** and **18** are inclined about 15° to such transverse plane, whereas the two axes **16** and **17** have an inclination of about 20° to such plane. In diesel engines of the type described the fuel is injected during a period in which the crank pin connected with the piston travels through an arc including the upper dead center position of the crank pin. The positions through which the piston travels during the fuel injection will be termed "fuel injecting positions" hereinafter and in the claims. Each of the axes **15**, **16**, **17** and **18** intersects the wall **21** of the combustion space at an angle of at least 45°. In the embodiment shown this angle of intersection of the axes **15** and **18** amounts to about 75°, whereas the angle of intersection of the axes **16** and **17** amounts to about 70°.

It is characteristic of my invention that these points of intersection of the axes **15**, **16**, **17** and **18** with the wall **21** of the combustion space are spaced different distances from the associated nozzles provided in the tip of the nozzle body **12**.

In the embodiment illustrated in FIG. 1 this is achieved by the disposition of the axis **22** of the combustion space at a distance from the tip of the member **12** containing the nozzles. The location of this tip is indicated at **25** in FIG. 2. It will be noted that it is spaced a distance **26** from the axis **22** of the combustion space. Moreover, it will be noted that in the embodiment of FIG. 1 the axis **22** of the combustion space **20** coincides with the axis of the piston **19**. This offers the advantage that the thermal and mechanical stresses imposed on the piston are uniform in all radial directions thereof.

The embodiment shown in FIGS. 3 and 4 is similar to that of FIG. 1. The reference numerals applied to the various elements of this embodiment are formed by the addition of **300** to the corresponding reference numerals of FIGS. 1 and 2.

Here again the tip of the nozzle located at the point **325** is spaced from the axis **322** of the combustion space **320**. The axis **324** of the piston **319**, however, is offset from both the axis **322** and the point **325** as will appear from FIG. 4 which shows, moreover, that the point **325**, the axis **322** of the combustion space and the axis **324** of the piston are located substantially in a common diametrical plane of the cylinder.

Moreover, it will appear that in both of the embodiments described hereinabove the axis of the fuel injector is inclined to the axis of the cylinder. This inclination is preferably so chosen that the axes **15**, **16**, **17** and **18**, or **315**, **316**, **317** and **318** respectively, though having different inclinations to the top face of the piston, include equal angles with the axis of the fuel injector **12**, or **312** respectively.

The embodiment of my invention illustrated in FIGS. 5 and 6 differs from that shown in FIGS. 3 and 4 primarily by the coaxial disposition of the fuel injector with the piston. In this embodiment the reference numerals have been formed by the addition of 500 to those of the corresponding elements shown in FIGS. 1 and 2. The axis 522 of the combustion space extends spaced from but parallel to the common axis 524 of the fuel injector 512, 513 and the piston 519. Moreover, the tip of the conical projection 523 provided on the bottom of the combustion space has been flattened.

As the jets issuing from the tip of the injector along the axes 15, 16, 17 and 18, or 315, 316, 317 and 318, or 515, 516, 517 and 518 respectively, have different lengths, the probability is increased that no matter what the conditions of operation, such as temperature, pressure, inflammability of the fuel, rate of rotation of the air charge in the combustion space, etc. might be, one of the different jets will have the most favorable length for ignition. The ignition of one of the jets, however, will spread to the other jets immediately, thus insuring a successful ignition, even under unfavorable circumstances. Moreover, it will be seen that in FIGS. 1 and 2 the two jets coinciding with the axial lines 15 and 18, or 315 and 318 respectively, have a considerable length. Therefore, the fuel globules of which this jet is composed will more easily ignite, when the temperature of the piston is low as in a cold start. Preferably, I equip my novel diesel engine with suitable means which will cause the air charge compressed in the combustion space 20 or 320 or 520 to rotate about the axis 22, or 322 or 522 respectively. As such means are well known in the art, they need not be described.

The provision of the conical elevation 23 or 323 or 523 affords the advantage that the combustion space of a given volume will have an increased diameter, thus increasing the length of the fuel jets which is particularly desirable for facilitating a cold start of the engine.

While each of the nozzle members 12, 312 and 512 have four nozzles, any other desired number of nozzles may be chosen.

While the invention has been described in connection with a number of preferred embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in genreal, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as fall within the scope of the invention or the limits of the apepnded claims.

What I claim is:

1. In a diesel engine the combination comprising a cylinder, a piston movable therein through fuel injecting positions, said piston being provided with a recess constituting a combustion space, the top face of said piston surrounding said recess constituting an uninterrupted plane surface, the boundary wall of said recess being essentially formed by a surface of revolution, a fuel injector carried by said cylinder and provided with a plurality of nozzles, the axis of each of said nozzles including an angle of not more than 45° with a transverse plane of said piston and intersecting said wall of the combustion space when said piston is in said fuel injecting positions at an angle of at least 45°, the points of intersection of the axes of said nozzles with said wall being spaced different distances from the associated nozzles, the axis of said surface of revolution being spaced from the axis of said cylinder, said latter axis extending between said nozzles.

2. In a diesel engine the combination comprising a cylinder and a cylinder head, a piston movable in said cylinder through fuel injection positions, said piston being provided with a recess constituting a combustion space, the top face of said piston surrounding said recess constituting an uninterrupted plane surface, the boundary wall of said recess being essentially formed by a surface of revolution, a fuel injector disposed in said cylinder head and provided with a plurality of nozzle orifices, the position of said injector in relation to the axis of said combustion space and the direction of the center lines of said orifices being arranged such that the distances between the injector and the intersections of at least three of said center lines with said boundary wall are different.

3. The combination claimed in claim 2 in which said surface of revolution has an axis extending in the same direction as the axis of said cylinder.

4. The combination claimed in claim 2 in which the axis of said surface of revolution is spaced from said injector.

5. The combination claimed in claim 2 in which said recess is provided in the top of said piston, the bottom of said recess being provided with a centrally disposed projection, said projection viewed in a plan view of the top of said piston being offset laterally from said injector.

6. In a diesel engine, the combination comprising a cylinder, a piston movable therein through fuel injecting positions, a recess in the top face of said piston constituting a combustion space and having a wall forming a body of revolution, the top face of said piston surrounding said recess constituting an uninterrupted plane surface, the axis of said body extending in the same direction as the axis of said piston and being spaced from the axis of said piston, a fuel injector carried by said cylinder and provided with a plurality of nozzle orifices, the axis of said cylinder extending between said orifices, the axis of each of said orifices intersecting said wall when said piston is in said fuel injecting positions, the points of intersection of at least three of the axes of said orifices with said wall being spaced different distances from said injector, the bottom of said recess being provided with a centrally disposed projection offset from said fuel injector when viewed in a plan view of the top face of said piston.

7. The combination as claimed in claim 2, wherein the axis of said fuel injector is disposed essentially coaxially with the axis of said cylinder.

8. A combination according to claim 2, wherein the center lines of said orifices are equally spaced around said fuel injector.

9. A combination according to claim 2, wherein the axis of said surface of revolution is spaced from the axis of said piston and from the axis of said injector.

10. A combination according to claim 2, herein the axis of said injector is essentially coaxial with the cylinder axis.

References Cited in the file of this patent

UNITED STATES PATENTS

2,720,870	Grob	Oct. 18, 1955
2,837,068	Lang	June 3, 1958
2,851,019	Fleming et al.	Sept. 9, 1958