Jan. 29, 1957 KARL-HEINZ R. GÖSCHEL 2,779,319

INTERNAL COMBUSTION ENGINE

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Fig. 2

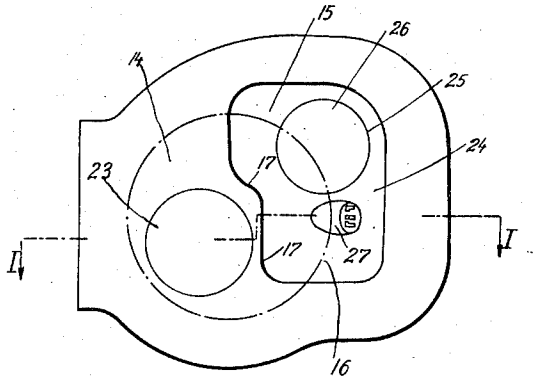
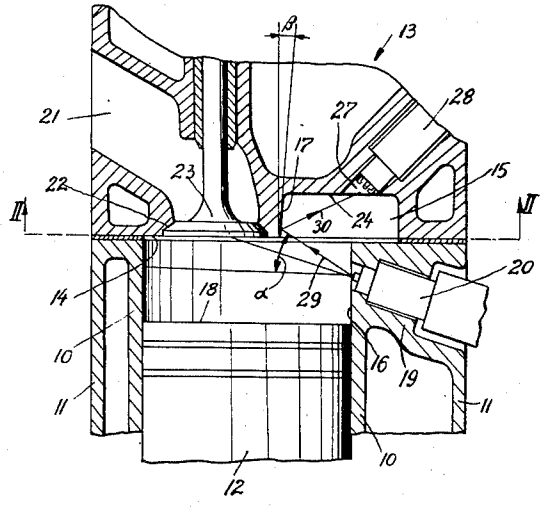



Fig. 1




Inventor
KARL-HEINZ R. GÖSCHEL
BY Dicke and Craig.
ATTORNEYS.

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# INTERNAL COMBUSTION ENGINE

Karl-Heinz R. Göschel, Stuttgart-Unterturkheim, Germany, assignor to Daimler-Benz Aktiengesellschaft, Stuttgart-Unterturkheim, Germany

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5 Claims. (Cl. 123—32)

My invention relates to an internal combustion engine of the type in which air sucked into the cylinder is mixed with liquid fuel injected into the air charge, the mixture being substantially compressed and ignited, preferably by a spark plug.

It is the object of my invention to so shape the compression space and to so coordinate the same to the fuel injection nozzle and the spark plug as to ensure the presence of a readily ignitable air-fuel-mixture in the vicinity of the spark plug irrespective of the condition of operation of the engine to thereby facilitate the ignition of the air-fuel charge.

It is a further object of my invention to so coordinate and organize the elements of the engine that the major portion of the fuel injected will be intimately mixed with the combustion air independently of the generation of an easily ignitable mixture in the vicinity of the spark plug.

Further objects of my invention are to so shape and correlate the combustion space, the fuel injection nozzle and the spark plug as to permit a particularly high compression ratio without risking undesirable knocking.

Further objects of my invention will appear from a detailed description following hereinafter of a preferred embodiment of my invention shown in the accompanying drawing by way of example. I wish it to be clearly understood, however, that such detailed description serves the purpose of illustrating the invention rather than that of restricting or limiting the same. In the drawing:

Fig. 1 is an axial section taken through the cylinder and the cylinder head of an engine, a part of the cylinder head and of the cylinder being broken away, the section being taken along the broken line I—I shown in Fig. 2.

Fig. 2 is a bottom view of the cylinder head, such view being in the direction of the arrows II—II of Fig. 1.

The novel internal combustion engine comprises a cylinder **10** which may be provided with a conventional cooling jacket **11**, a piston **12** reciprocably guided therein, and a cylinder head **13** which has a bottom face **14** extending transversely to the axis of the cylinder **10** and confining the compression space therein.

For the purposes of the present invention a recess **15** is provided in the face **14**. This recess extends laterally beyond the periphery **16** of the internal wall of the cylinder and constitutes an extension of the compression space. As will appear from Figs. 1 and 2, the lateral recess **15** has a side wall **17** which adjoins the face **14** and extends across the end face **18** of piston **12** beyond the peripheral circular boundary **16** of the cylinder space. A boss **19** integral with the inner wall of cylinder **10** and with the outer jacket **11** is provided with a bore terminating in the internal cylinder space. A fuel injection nozzle **20** is inserted in such bore. Preferably, the nozzle does not project from the bore into the internal space of the cylinder so that the nozzle may be overridden by the piston **12**. Shortly after the piston, upon



commencement of the suction stroke, has uncovered the nozzle **20**, a conventional intermittently operating fuel pump, not shown, supplies fuel under pressure to the fuel injection nozzle causing the same to issue a jet of fuel into the cylinder towards face **14**.

As will appear from Fig. 2, the cylinder head **13** is formed with an air inlet passageway **21** and with a valve seat **22** at the inner end thereof. A poppet valve **23** cooperating with the valve seat **22** is mounted in the cylinder head **13**. The recess **15** has a substantially flat bottom or inner face **24** which extends parallel to the bottom face **14** and, in the embodiment shown, is provided with an outlet port **25** for the exhaust gases, such outlet port being controlled by a conventional poppet valve **26**.

Moreover, the cylinder head is provided with an inclined bore **27** terminating in the bottom face **24** of the recess **15** adjacent to the port **25**. The bore **27** accommodates a conventional spark plug **28**.

As will appear from Fig. 1, the fuel injection nozzle **20** is provided with one or more nozzle openings which are so shaped as to issue a conical jet having a cone angle $\alpha$ towards the inlet valve **23**, the extreme upper portion of the jet indicated by the arrow **29** impinging against the side wall **17** which is preferably slightly inclined to the axial direction of the cylinder by an angle $\beta$. This angle is preferably so chosen that the fuel jet reflected by the side wall **17** in the direction of arrow **30** will be directed towards the spark plug **28**. Moreover, it will appear that the inclination of the spark plug **28** is so chosen that the axis of the same is disposed substantially in the direction of arrow **30**.

From the foregoing description it will appear that my invention relates to a mixture-compressing internal combustion engine in which the cylinder space is partly confined by a surface, such as **14**, extending substantially perpendicularly to the cylinder axis and partly extends beyond the plane of said surface in form of a chamber extended beyond the cylinder periphery and adjoining directly the cylinder space proper. According to a preferred feature of my invention, an injection nozzle issuing the fuel into the cylinder space proper on the side thereof on which the chamber extends beyond the cylinder periphery, such as **16**, injects at least part of the fuel against the wall **17** adjoining the surface **14**, the wall **17** being so inclined as to reflect the fuel in the direction of the spark plug disposed in the chamber.

In this manner the side wall **17** serves the dual purpose of forming the chamber **15** and of supplying the direct vicinity of the spark plug with a readily ignitable fuel mixture thereby ensuring reliable ignition of the engine irrespective of its condition of operation.

Preferably, the inlet valve is disposed within the surface **14** confining the cylinder space, and the nozzle is so disposed as to inject the fuel into the stream of air entering the cylinder through the passageway **21**. As a result, the extreme portion of the injected spray only, such as the portion indicated by arrow **29**, will be reflected by the side wall **17** toward the spark plug. In this manner it will be ensured that the major portion of the fuel will be intimately mixed with the combustion air entering the cylinder through the inlet passageway **21** and that, independently of this operation, a readily ignitable fuel mixture will be always produced in the vicinity of the spark plug.

An extremely simple arrangement will be attained by so disposing the spark plug and the fuel inpection nozzle that the axes thereof are substantially disposed in a common radial plane of the cylinder. Preferably, the axis of the spark plug coincides substantially with the direction of travel of the fuel reflected from the side wall **17** as indicated by arrow **30**. Moreover, I prefer to dispose

the outlet valve 26 in the chamber formed by recess 15 thus ensuring a dual advantageous effect. First, the hot outlet valve will be located in the vicinity of the spark plug which results in highly favorable anti-knocking properties of the engine; secondly, the fuel portion reflected from the side wall 17 towards the spark plug 28 will travel through a highly heated region whereby the fuel will be effectively conditioned for ignition.

While the invention has been described in connection with a preferred embodiment 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 general, 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 appended claims.

What I claim is:

1. An internal combustion engine comprising a cylinder, a piston reciprocably guided therein, a cylinder head having a face extending transversely to the axis of and confining the compression space of said cylinder, a recess being provided in said face extending laterally beyond the periphery of said cylinder and constituting an extension of said compression space, said lateral recess having a side wall adjoining said face and extending across the end face of said piston, a fuel injection nozzle mounted in the wall of said cylinder adjacent to said recess in opposed relationship to said side wall to spray a jet of fuel into said cylinder and against said side wall, and a spark plug mounted in said recess at a position where it will be met by fuel reflected from said side wall.

2. An internal combustion engine as claimed in claim 1 in which said cylinder head is formed with an air inlet passageway terminating in said face and with a valve seat at the inner end of said passageway, a poppet valve cooperating with said valve seat being mounted in said cylinder head, said fuel injection nozzle being adapted to spray a jet of fuel in a direction towards said poppet valve, the extreme portions of said jet impinging against said side wall for reflection to said spark plug.

3. The combination claimed in claim 1 in which the axis of said spark plug and the axis of said fuel injection nozzle are substantially contained in a common radial plane of said cylinder.

4. The combination claimed in claim 1 in which the axis of said spark plug and the axis of said fuel injection nozzle are substantially contained in a common radial plane of said cylinder, the axis of said spark plug extending substantially in the direction of travel of said fuel reflected from said side wall.

5. An internal combustion engine comprising a cylinder, a piston reciprocably guided therein, a cylinder head having a face extending transversely to the axis of and confining the compression space of the cylinder and having a recess in said face extending laterally beyond the periphery of said cylinder and constituting an extension of said compression space, said lateral recess having a side wall adjoining said face and extending across the end face of said piston, said face of said cylinder head being provided with an air inlet port and the inner face of said recess being provided with an outlet port for the exhaust gases, an inlet valve controlling said inlet port, an outlet valve controlling said outlet port, a fuel injection nozzle mounted in the wall of said cylinder adjacent to said recess in opposed relationship to said side wall to spray a jet of fuel into said cylinder towards said inlet valve and against said side wall, and a spark plug mounted in said recess adjacent to said outlet valve.

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