

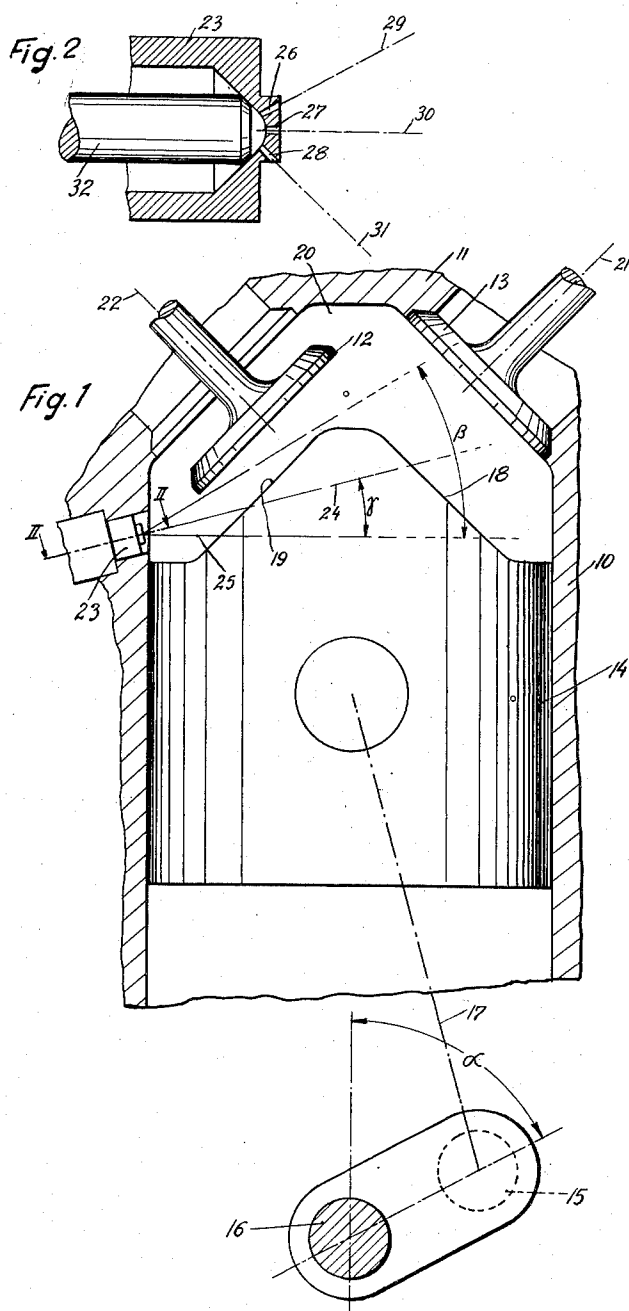
Jan. 29, 1957

KARL-HEINZ R. GÖSCHEL ET AL

2,779,320

INTERNAL COMBUSTION ENGINE

Filed April 18, 1955



Inventors
 KARL-HEINZ R. GÖSCHEL
 AND HANS R. GROZINGER
 BY *Dietze and Craig*
 ATTORNEYS.

1

2,779,320

INTERNAL COMBUSTION ENGINE

Karl-Heinz R. Göschel, Stuttgart-Unterturkheim, and
Hans R. Grözinger, Plochingen (Neckar), Germany,
assignors to Daimler-Benz Aktiengesellschaft, Stuttgart-
Unterturkheim, Germany

Application April 18, 1955, Serial No. 502,136

Claims priority, application Germany April 17, 1954

6 Claims. (Cl. 123—32)

Our invention relates to an internal combustion engine and, more particularly, to a piston engine of the type in which liquid fuel is injected into the cylinder during the suction stroke of the piston to form a combustible mixture for susquent compression by the piston.

It is the object of our invention to so shape and organize the elements of the internal combustion engine that the fuel will impinge against the hot piston head and if desired, against the outlet valve to thereby cool the piston and the valve by action of the cooling effect inherent in the vaporization of the fuel.

It is another object of our invention to so inject the fuel during the suction stroke that by impinging against suitable faces of elevated temperature the fuel will be atomized and vaporized effectively.

It is a further object of our invention to inject a fuel jet in a manner causing it by reflection from the piston to concentrate the fuel in the upper part of the combustion space in which it will be immediately engaged by the stream of air entering through the inlet valve substantially transversely to the direction of movement of the fuel jet to thereby ensure intimate mixture of the air sucked in the cylinder with the fuel injected into the same.

Further objects of our invention will appear from a detailed description of a preferred embodiment thereof following hereinafter, and the features of novelty will be pointed out in the claims. We wish it to be clearly understood, however, that such detailed description will serve the purpose of illustrating the invention rather than that of limiting or restricting the same. In the drawings

Fig. 1 illustrates a more or less diagrammatic axial section taken through a cylinder of the novel internal combustion engine, the crank shaft and the connecting rod being diagrammatically indicated.

Fig. 2 is a section through the fuel injection nozzle, such section being on an enlarged scale and being taken along the line II—II of Fig. 1.

The internal combustion engine comprises a cylinder 10 having a cylinder head 11 in which an inlet valve 12 and an outlet valve 13 are mounted in positions inclined to the axis of the cylinder 10. A piston 14 is reciprocally guided in the cylinder and is connected with a crank pin 15 of a crank shaft 16 in the conventional manner by a connecting rod diagrammatically indicated by the dash-dotted line 17.

The piston has inclined end faces 18 and 19 including an angle of approximately 90°. The cylinder head 11 and the piston 14 are so shaped and the valves 12 and 13 are so disposed in opposed relationship to the end faces 18, 19 that the cylinder head 11, the valves 12, 13 and the piston 14 confine a compression space 20 of inverted V-shaped cross section, such section being taken along a substantially diagrammatical axial plane containing the axes 21 and 22 of the valves. In the embodiment shown such plane coincides with that of the drawing.

Preferably, the angle included between the axes 21

2

and 22 of the valves and the angle of the V-shaped cross section are equal amounting to about 90°. However, this angle may be larger than 90°, if desired. At a point opposite to the outlet valve 13 and adjacent to the inlet valve 12, the wall of the cylinder 10 is provided with a bore in which a fuel injection nozzle 23 is inserted. From the cylinder head 11 this fuel injection nozzle is spaced a distance causing it to be uncovered by the piston 14 in the course of the first half of the suction stroke thereof. A conventional fuel injection pump, not shown, is provided which is connected with the fuel injection nozzle causing the same to inject fuel into the cylinder, the injection commencing right after the nozzle will have been uncovered by the piston 14. In Fig. 1 the elements are shown in the position they assume at the instant when the fuel injection commences. At this instant the crank of the crank shaft 16 has moved from its upper dead center position through an angle α , and the fuel injection nozzle has just been uncovered by the piston. The angle α amounts preferably to 50°. However, it may vary within wide limits, for instance from 30° to 70°. The nozzle 23 is so shaped and disposed as to be operative, right after it has been uncovered by the piston as shown, to spray the major portion of the fuel upon the inclined face 19 of the piston which is in opposed relationship to the fuel injection nozzle 23 and the inlet valve 12. The spray is preferably of conical shape having a cone angle β which amounts to from 25° to 40°, preferably to 30°. This axis 24 of the conical spray includes an angle γ with a radius 25 of the cylinder 10 passing through the nozzle 23. The angle γ amounts to from 10° to 20°, preferably to 15°. When the injection commences, the inlet valve 12 is in open condition as shown. At least a major portion of the fuel injected will impinge against the inclined face 19 of the piston. Only a minor portion of the fuel will be injected above and past the piston in a direction towards the outlet valve 13. The ratio of the amount of fuel injected against the inclined face 19 to that injected above and past the piston in a direction towards the outlet valve 13 depends on the selection of the angle β , the angle γ , and the angle α at which the fuel injection commences. The smaller the angles β and γ and the sooner the fuel injection begins after the crankshaft 16 has moved through the upper dead center position, i. e., the smaller the angle α is chosen, the larger will be the amount of fuel which impinges against the inclined face 19 of the piston. By the proper selection of the values for the variables β , γ and α it is possible to inject the fuel from the nozzle 23 in such a manner as to impinge in toto against the inclined face 19. Similarly, the amount of fuel which is injected above and past the piston in a direction towards the outlet valve 13 may be varied from zero to a predetermined value by choosing appropriate sets for these variables.

As shown in Fig. 2, the nozzle 23 may have a plurality of nozzle openings 26, 27 and 28 with the axes 29, 30 and 31 having diverging directions. The plane through the axes 29, 30 and 31 may extend, for example, parallel to the axis of the cylinder 10. From each nozzle opening a conical spray may issue, the individual sprays being disposed in adjoining relationship so as to cooperate to form a large diverging spray. A more detailed description of the injection nozzle 23 is deemed dispensable, as such fuel injection nozzles are well known in the art. It may be mentioned, however, that preferably the admission of liquid fuel under pressure to the nozzle openings 26, 27 and 28 is controlled by a needle valve 32 which is controlled by the pressure of the fuel and will open when such a pressure is increased by the fuel injection pump beyond a certain limit.

3

From the above description it will appear that our invention relates to an internal combustion engine of the type in which a fuel-air mixture is produced by injection of liquid fuel into the cylinder for subsequent compression and ignition which may be effected by a spark plug, the valves being mounted in suspended position so that the valve heads are relatively inclined and confine a combustion space which is so shaped, at least within the plane containing the valve axes 21 and 22, as to have the cross section of an inverted V. The fuel injection nozzle is disposed in the region of the cylindrical guideway for the piston 14 so as to be uncovered by the piston in the course of the first half of the suction stroke. The injection nozzle injects the fuel towards the outlet valve 13 located opposite to the nozzle 23. At the commencement of the injection period the major portion of the fuel jet impinges against the inclined face 19 of the V-shaped piston head and will be reflected by the inclined face 19. This has the advantage that the fuel, the temperature of which is lowered by the evaporation, will effectively cool the piston and the outlet valve 13. On the other hand, the fuel will be thermally and mechanically processed in an effective manner by the heat and by the impinging effect. Owing to the reflection the fuel jet impinging upon a comparatively large area of the piston will be concentrated in the upper part of the combustion space and there it will be engaged immediately upon its entry by the stream of fresh air flowing into the cylinder substantially transversely to the direction of travel of the fuel. Thus, the entering combustion air is intimately mixed with the processed fuel right from the beginning. Under certain circumstances it may be of advantage to so organize the various elements described that at the commencement of the injection period the upper portion of the injected fuel jet will be sprayed past the piston towards the outlet valve 13. In this manner, the outlet valve will be cooled directly.

The injection nozzle may issue an upwardly directed conical spray of fuel. In order to be able to distribute the fuel over as large a portion of the cylinder cross section as possible, we prefer to choose a plural-opening nozzle as shown in Fig. 2, the openings issuing conical jets which are disposed in a fan-like manner when viewed in the direction of the cylinder axis.

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

4

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 we claim is:

1. Internal combustion engine comprising a cylinder having a cylinder head, an inlet valve and an outlet valve mounted in said head in positions inclined to the axis of said cylinder, a piston reciprocably guided in the later having inclined end faces, said cylinder head and said end faces being so shaped and said valves being so disposed in opposed relationship to said end faces that said cylinder head, said valves, and said piston confine a compression space of inverted V-shaped cross section, such section being taken along a substantially diametrical axial plane containing the axes of said valves, and a fuel injection nozzle disposed in the wall of said cylinder opposite to said outlet valve and adjacent to said inlet valve and spaced from said cylinder head a distance causing it to be uncovered by said piston in the course of the first half of the suction stroke thereof, said nozzle being so shaped and disposed as to be operative, right after it has been uncovered by said piston, to spray at least the major portion of the fuel upon that one of said inclined end faces which is in opposed relationship to said fuel injection nozzle and said inlet valve.

2. The combination claimed in claim 1 in which said nozzle is so shaped and disposed as to be operative, right after it has been uncovered by said piston, to spray a substantial portion of fuel past the piston in the direction towards said outlet valve.

3. The combination claimed in claim 1 in which the angle included between the axes of said valves and the angle of said V-shaped cross section amount to about 90°.

4. The combination claimed in claim 1 in which the angle included between the axes of said valves and the angle of said V-shaped cross section amount to about 90° and in which said fuel injection nozzle is shaped to issue a conical spray having a cone angle between 25° and 40° and having an axis inclined from 10° to 20° to the radius of said cylinder passing through said nozzle.

5. The combination claimed in claim 1 additionally comprising a crank and a connecting rod for reciprocating said piston, said distance being so dimensioned that said piston will uncover said fuel injection nozzle when said crank will have moved from its upper dead center position through an angle from 30° to 70°.

6. The combination claimed in claim 1 in which said nozzle has a plurality of nozzle openings having axes extending in diverging directions.

No references cited.