March 6, 1934. K. J. E. HESSELMAN 1,949,470

INTERNAL COMBUSTION ENGINE

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Fig. 1.

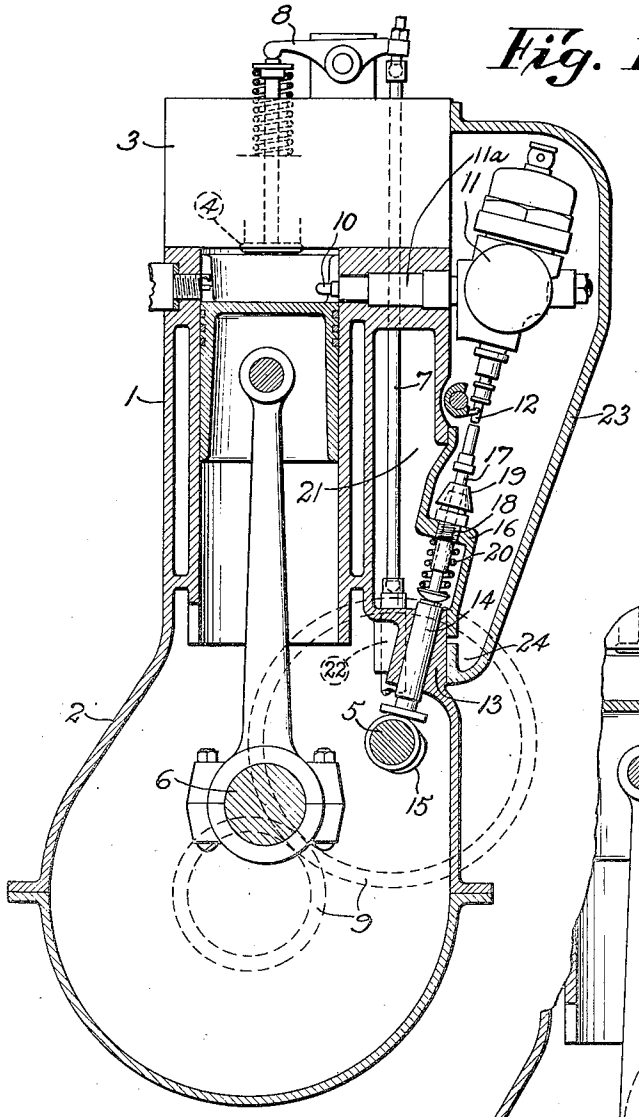
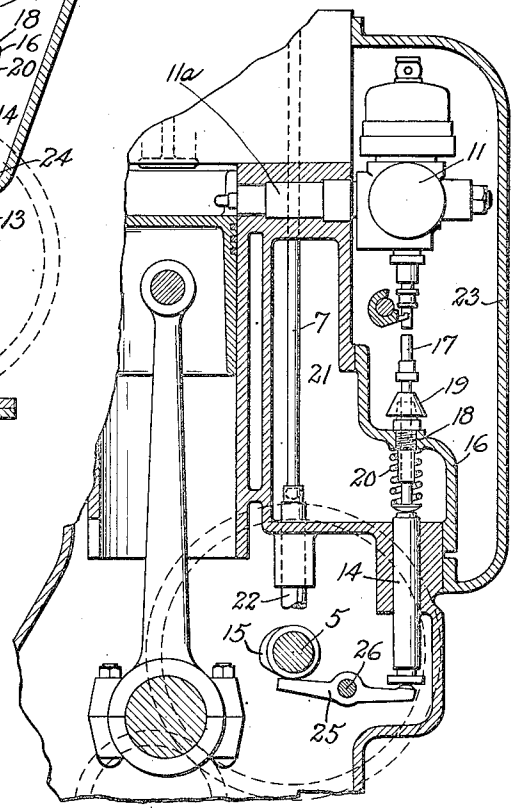


Fig. 2.



INVENTOR

Knut Jonas Elias Hesselman

BY

ATTORNEY

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INTERNAL COMBUSTION ENGINE

Knut Jonas Elias Hesselman, Saltsjo-Storangen, Sweden

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18 Claims. (Cl. 123—139)

The present invention relates to internal combustion engines and has particular reference to engines of the type in which liquid fuel is injected directly into the engine cylinders from a fuel pump or pumps. More specifically the invention relates to internal combustion engines of the so-called solid injection type in which a separate fuel pump is employed for each of the engine cylinders.

In motors of this character the suitable location of the fuel pumps presents a relatively serious problem, particularly in the case of comparatively small motors.

Because of the necessity for keeping fuel oil leaking from the pump or pumps from mingling with the engine lubricating oil and also because of space limitations, it has heretofore been necessary in the case of small or medium sized motors to operate the fuel pump or pumps from a separate driving shaft, which adds complication to the engine and usually results in an increase in its dimensions.

The primary object of the present invention is to provide a novel arrangement by means of which the minimum space is required for the fuel pumping means and by means of which the necessity for a special pump driving shaft is eliminated. A further object of the invention is to provide means whereby the engine fuel pump or pumps may be driven from the cam shaft employed to operate the engine valves.

A still further object of the invention is to provide a cam shaft driven pump arrangement in which the possibility of fuel oil leakage to the lubricated parts of the engine is eliminated. The more specific nature of the invention together with other detailed objects thereof will appear more clearly upon consideration of the following description of suitable means for carrying the invention into effect when taken in conjunction with the accompanying drawing forming a part of this specification.

In the drawing:

Fig. 1 is a transverse section through the center line of the cylinder of an engine to which the invention has been applied; and

Fig. 2 is a fragmentary section similar to Fig. 1 and illustrating another form of construction.

Turning now to the drawing, Fig. 1 illustrates a typical four-stroke cycle engine of the valve-in-head type, reference character 1 indicating the cylinder which may have formed integrally therewith the upper half of a crank case 2. Obviously, the crank case 2 may be a separate element. In the cylinder head 3 the inlet and exhaust valves are mounted side by side in the usual manner, one of these valves being indicated at 4. The cylinder valves are actuated through the medium of cam shaft 5, push rods 7 and rocker arms 8. Shaft 5 is located in the crank case in the usual manner and is driven at half crank shaft speed from the crank shaft 6. The cam shaft drive may be of any suitable type and is indicated in the drawing diagrammatically by the timing gears 9. A fuel injection nozzle 10 is located in the upper part of the cylinder, this nozzle being supplied with fuel by pump 11 of the plunger type, the plunger 12 extending downwardly from the lower part of the pump housing. The injection nozzle 10 is advantageously carried directly on an arm 11a of the pump, which arm projects into a suitable bore in the side wall of the cylinder and which also may advantageously act as a guide member for centering the pump in proper relation with respect to the cylinder. As will be noted from the figure, the axis of the pump plunger is obliquely inclined so that its projection passes through the cam shaft 5. Pump plunger 12 is actuated from the cam shaft 5 by means of a tappet 14 seated in a suitable bore passing through a thickened portion 13 of the crank case. Alternatively, if cylinder 1 and crank case 2 are separate elements, the guide for tappet 14 may be formed in the lower part of the cylinder casting. The bore in which tappet 14 is located is of sufficient length so that it not only forms a guide for the tappet, but also acts somewhat in the nature of a stuffing box. Tappet 14 is actuated by means of a special cam 15, which is carried by shaft 5 in addition to the usual valve operating cams, the latter not appearing in the figure. As will be evident from the figure, the tappet 14 extends inwardly over the cam shaft in the space adjacent valve push rods 7. A cover plate 16 adapted to be secured to the side wall of the cylinder and having a lateral offset therein provides a bearing for guiding an intermediate push rod 17 in line between the upper end of tappet 14 and the lower end of plunger 12. The bearing for rod 17 is advantageously formed by a bushing 18 screwed or otherwise secured in the offset part of plate 16 and passing therethrough. Bushing 18 provides a relatively long guide for the rod 17, which serves to prevent leakage of oil from the pump around rod 17 to the inner side of the plate 16. In addition to the seal formed by the bearing surface of bushing 18, a conically shaped cap or shield 19 is preferably secured to rod 17 above the upper end of bushing 18, this shield

serving to cover the upper end of the bushing so as to carry any drip of oil leaking from the pump past the upper end of the bushing. A spring 20 inserted between a collar on the lower end of rod 17 and the offset in plate 16 acts to hold the rod in contact with tappet 14 and to maintain the tappet in contact with the surface of cam 15. The plate 16 provides a partition separating the pump from the chamber 21 into which the valve tappets 22 extend and which also houses the valve push rods 7.

It will be seen that the above described arrangement will act to effectively prevent oil leakage from the pump to either chamber 21 or to the interior of the crank case.

The pump assembly is housed by a removable cover 23 which at the bottom forms a well or sump 24 for the collection of oil which may leak from the fuel pump. Obviously, if desired, this sump may be provided with a suitable drain.

Turning now to Fig. 2, a modified arrangement is shown in which the pump 11 is arranged vertically to one side of the cylinder and the pump tappet 14 is driven from the cam shaft 5 through the medium of a rocker arm 25 housed within the crank case and mounted upon a fixed pivot 26. In other respects, this modification is similar to that described in connection with Fig. 1.

From the above description it will be apparent that the present invention provides a simple and compact arrangement for the fuel pump which enables it to be driven with the least complicated mechanism and which furthermore provides an assembly enabling the parts of the pump and pump drive to be readily inspected. Removal of the cover 23 gives access to the pump for adjustment and the readily accessible plate 16 is also easily removable with the pump operating rod assembly to render accessible the lower ends of the valve-operating push rods and the valve tappets.

While the invention has been shown as applied to one specific form of engine, it may obviously be applied to other forms of engines, as for example, L-head engines in which the chamber 21 serves to house the stems of the engine valves and also the valve springs. Further, the arrangements herein described and illustrated may be modified without departing from the spirit or scope of the invention which is to be understood as limited only by the scope of the appended claims.

What I claim is:

1. In an internal combustion engine having a cylinder, a crank case, a crank shaft, a valve for the cylinder and mechanism including a cam shaft located in the crank case to one side of the crank shaft for actuating said valve, in combination, a fuel pump located adjacent to and laterally of the combustion chamber end of said cylinder, said pump comprising a reciprocable plunger located so that the projection of the longitudinal axis of the plunger passes through said cam shaft, mechanism actuated by said cam shaft for operating said plunger, and partition means for separating the pump from the valve actuating mechanism, the mechanism for actuating said plunger comprising a part reciprocably mounted in said partition means.

2. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder and mechanism including a cam shaft and adjacent parts enclosed in said crank case for actuating said valve, in combination, a fuel pump mounted at the side of the cylinder adjacent to the combustion chamber end thereof, mechanism actuated by said cam shaft for operating said pump, a partition between the pump and the valve actuating mechanism and separating the same to prevent leakage of fuel from the pump to the valve actuating mechanism, said partition being removable laterally of the cylinder and a removable cover plate for said pump providing a space for the collection of fuel leaking from the pump.

3. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case and mechanism including a cam shaft located in the crank case for actuating said valve, in combination, a fuel pump mounted at the side of the cylinder, a pump tappet, a partition situated generally parallel to the cam shaft for separating the pump from said mechanism and said tappet, said partition being removable laterally of the cylinder, and a pump actuating rod operatively supported by said partition and passing therethrough, said rod acting to transmit motion from said tappet to said pump.

4. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case and mechanism including a cam shaft located in the crank case for actuating said valve, in combination, a fuel pump mounted at the side of the cylinder, a pump tappet actuated by said cam shaft, a plate secured to the cylinder and forming a partition situated generally parallel to the cam shaft for separating the pump from said mechanism and said tappet, said partition being removable laterally of the cylinder, means forming a guide passage extending through said plate, a pump operating rod projecting through said passage for transmitting motion from the tappet to the pump, and a shield on the projecting portion of said rod for preventing leakage of fuel from the pump through the partition.

5. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case and mechanism including a cam shaft located in the crank case for actuating said valve, in combination, a fuel pump mounted at the side of the cylinder, a pump tappet actuated by said cam shaft, a plate secured to the cylinder and forming a partition situated generally parallel to the cam shaft for separating the pump from said mechanism and said tappet, said plate having a lateral offset therein, means forming a guide passage extending through the offset in said plate, a pump operating rod projecting through said guide passage for transmitting motion from the tappet to the pump, and a shield on the projecting portion of said rod.

6. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder and valve operating mechanism including a cam shaft located in said crank case, in combination, a fuel pump located at one side of the cylinder adjacent to the combustion chamber end thereof, said pump comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, mechanism including a rocker arm actuated by said cam shaft for operating said pump, and means forming a partition lying generally parallel to said cam shaft for separating the fuel pump from said valve actuating mechanism, said pump operating mechanism comprising a reciprocable member actuated by said rocker arm and passing through said partition.

7. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder and valve operating mechanism including a cam

shaft located in said crank case, and a reciprocable element passing through said crank case, in combination, a fuel pump located at one side of the cylinder and having a plunger reciprocable in a direction generally longitudinal of the cylinder, a tappet passing through said crank case to one side of said cam shaft, a rocker arm for transmitting movement from the cam shaft to the tappet, a partition for separating the pump from the valve actuating mechanism, and means passing through said partition for transmitting motion from said tappet to the pump plunger.

8. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder, a member having a plurality of cam surfaces thereon rotatably mounted in the crank case and valve operating mechanism actuated by said member, in combination, a fuel pump mounted at one side of the cylinder adjacent to the combustion chamber end thereof, said pump comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, mechanism actuated by said member for operating the pump plunger, and means for enclosing the valve operating mechanism to prevent fuel leakage from the pump from reaching said valve actuating mechanism.

9. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case, a member having a plurality of cam surfaces thereon rotatably mounted in the crank case, valve operating mechanism actuated by said member and means for enclosing the portion of said mechanism adjacent to said crank case, in combination, a fuel pump mounted at one side of said cylinder adjacent to the combustion chamber end thereof and comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, said pump being situated entirely outside of the enclosure provided for the valve operating mechanism, and mechanism actuated by said member for operating the pump plunger, said mechanism comprising a part reciprocably mounted in said crank case and adapted to transmit motion to the exterior thereof.

10. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case, a member having a plurality of cam surfaces thereon rotatably mounted in the crank case, and valve operating mechanism actuated by said member, in combination, a fuel pump mounted at one side of the cylinder adjacent to the combustion chamber end thereof, said pump comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, mechanism actuated by said member for operating the pump plunger, and means for preventing fuel leakage from the pump from reaching said valve actuating mechanism and said crank case.

11. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case, a member having a plurality of cam surfaces thereon rotatably mounted in the crank case, a plurality of reciprocably mounted elements for transmitting motion from said cam surfaces to the exterior of the crank case, and valve operating mechanism actuated by one of said elements, in combination, a fuel pump mounted at one side of the cylinder adjacent to the combustion chamber end thereof, said pump comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, mechanism actuated by another of said elements for operating the pump plunger, and means for enclosing said reciprocable elements to prevent leakage of fuel from the pump thereto, said means being situated between said pump and said valve operating mechanism.

12. In an internal combustion engine having a cylinder, a valve for the cylinder, a crank case, a member having a plurality of cam surfaces thereon rotatably mounted in the crank case, valve operating mechanism actuated by said member, and means for enclosing the portions of said mechanism adjacent to said crank case, in combination, a fuel pump mounted at the side of said cylinder adjacent to the combustion chamber end thereof and comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, and mechanism actuated by said member for operating the pump plunger, said mechanism comprising a part reciprocably mounted in and projecting through the means enclosing said valve operating mechanism.

13. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder, a member having a plurality of cam surfaces thereon rotatably mounted in the crank case, walls forming a closed space at the side of the cylinder, and valve operating mechanism actuated by said member and projecting into said space, in combination, a fuel pump at the side of the cylinder adjacent to the combustion chamber end thereof and comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, and pump operating mechanism actuated by said member and passing through one of said walls.

14. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder, a member having a plurality of cam surfaces thereon rotatably mounted in a crank case, walls forming a closed space at the side of the cylinder, and valve operating mechanism actuated by said member and projecting into said space, in combination, a fuel pump at the side of the cylinder adjacent to the combustion chamber end thereof and comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, pump operating mechanism actuated by said member and passing through one of said walls, and means for preventing leakage of fuel from the pump around said last named mechanism and through said wall.

15. In an internal combustion engine having a cylinder, a crank case, a valve for the cylinder, a cam shaft in said crank case and a recess at the side of the cylinder adapted to house valve operating mechanism actuated by said cam shaft, in combination, a removable partition forming a closure for said recess, a fuel pump mounted at the side of the cylinder adjacent to the combustion chamber end thereof and comprising a plunger reciprocable in a direction generally longitudinal of the cylinder, and pump operating mechanism actuated by said cam shaft and passing through said removable partition.

16. In an internal combustion engine having a cylinder, valves for the cylinder, a crank shaft, a cam shaft driven by the crank shaft, and push rods actuated from said cam shaft for operating the valves, in combination, a fuel injection pump having a body comprising an arm mounted in the side of the cylinder adjacent to the combustion end thereof and a barrel portion extending longitudinally of the cylinder, said barrel portion being adjacent to said push rods, a plunger in said barrel portion, means for actuating said plunger from said cam shaft and partitioning means for separating said pump from said push rods and said cam shaft.

17. In an internal combustion engine having a cylinder, valves for the cylinder, a crank shaft, a cam shaft driven by the crank shaft and push rods actuated from said cam shaft for operating the valves, in combination, a fuel injection pump having a body comprising an arm mounted in the side of the cylinder adjacent to the combustion end thereof and a barrel portion extending longitudinally of the cylinder, said barrel portion being adjacent to said push rods, a plunger in said barrel portion, the axial projection of said plunger passing through said cam shaft, a partition for separating the pump from said push rods and said cam shaft, said partition being removable laterally of the cylinder and a pump actuating rod for transmitting motion from said cam shaft to said plunger, said rod being reciprocably mounted in said partition.

18. In an internal combustion engine having a cylinder, valves for the cylinder, a crank shaft, a cam shaft driven by the crank shaft and push rods actuated from said cam shaft for operating the valves, in combination, a fuel injection pump having a body comprising an arm mounted in the side of the cylinder adjacent to the combustion end thereof and a barrel portion extending longitudinally of the cylinder, said barrel portion being adjacent to said push rods, a plunger in said barrel portion, the axial projection of said plunger passing through said cam shaft, a partition for separating the pump from said push rods and said cam shaft, said partition being removable laterally of the cylinder, a pump actuating rod for transmitting motion from said cam shaft to said plunger, said rod being reciprocably mounted in said partition and a shield on said rod externally of said partition for preventing flow of fuel through the partition around said rod.

KNUT JONAS ELIAS HESSELMAN.