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AIR COMPRESSION FOR SELF-IGNITION ENGINES

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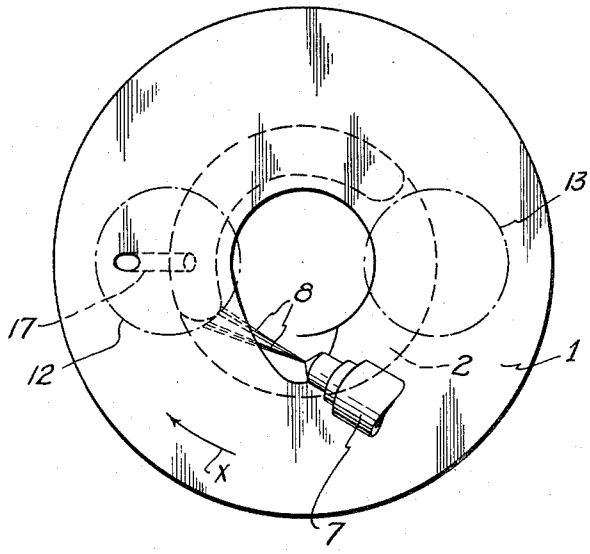


Fig. 1

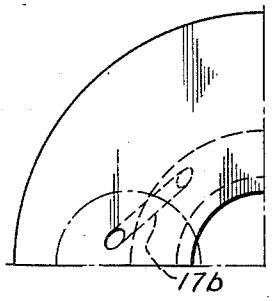


Fig. 1b

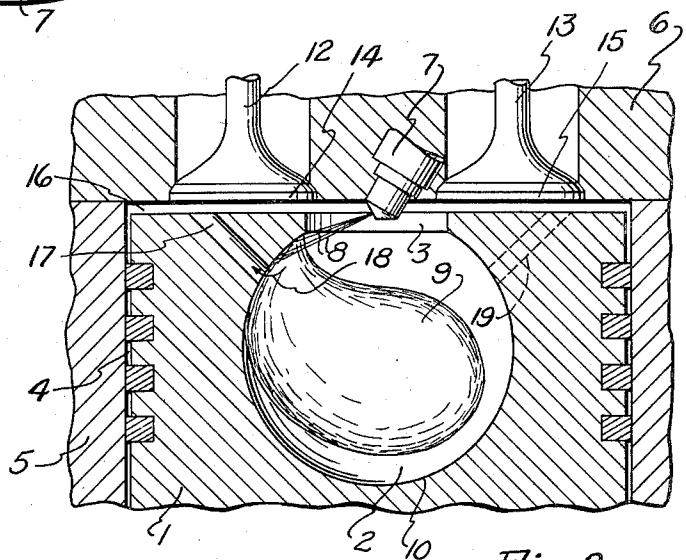


Fig. 2

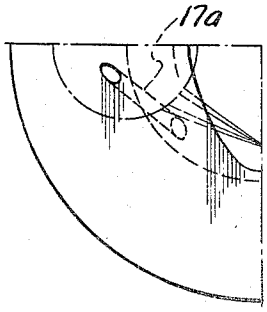


Fig. 1a

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AIR COMPRESSION FOR SELF-IGNITION ENGINES

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5 Claims. (Cl. 123—32)

This invention relates to the air compression in self-ignition internal combustion engines. In particular, the invention is directed to the means for compressing the combustion air in an engine as disclosed in application 480,432, filed Jan. 7, 1955, now Patent 2,907,308, issued Oct. 6, 1959. In this engine, the major portion of the injected fuel, but not more than 98% thereof, is applied as a film on the wall of the combustion chamber over as large a surface as possible. The remaining approximate 2% of fuel is atomized in the combustion air and is self-ignited. The combustion air is swirled over the film of fuel to vaporize the same, with these vapors in turn being ignited by the self-ignited atomized fuel.

In such an engine, combustion air is present in the combustion chamber and also in the compression space of the cylinder wherein the air is at a lower pressure during the period of combustion than the gas pressure within the combustion chamber. The low pressure area or areas are principally at the pockets in which the valves are seated. By reason of the lower pressure, the air, especially that in the valve pockets, is either not, or just slightly, exposed to the fuel mixture formed in the combustion chamber and the following combustion process. An unsatisfactory condition therefor exists because these low pressure spaces can contain as much as about 20% of the total volume of the combustion air. This means that of the total combustion air some 20% either does not enter into the combustion process or is inefficiently used therein.

The objects of this invention are to produce a structure and process for avoiding the above disadvantages and to utilize effectively the combustion air contained in the low compression space.

In general, the objects are obtained by forming a channel or passageway connecting the combustion chamber and the low pressure area in the cylinder, such channel being directed especially toward the valve pockets.

During the combustion process or burning of the gas in the combustion chamber, a current of gas is formed in the channel directed toward the cylinder space for a low pressure area. This gas current carries a part of the fuel from the combustion chamber and delivers it to the low pressure area. The fuel thereupon mixes with the low pressure air and will thereupon burn. Consequently, the low pressure air, and particularly the air in the valve pockets, takes part in the fuel combustion process.

For example, it is known to form channels between a combustion chamber in a piston and direct them toward the valve pockets. But in such a construction, these channels are not for the purpose of those of this invention. These prior art channels are for the purpose of assisting in the scavenging of the exhaust gases from the cylinder, whereas the channels of the present invention are for transferring fuel from the combustion chamber to the valve pockets in order to utilize the low pressure air for purposes of combustion.

According to another feature of this invention, the channels extend from the area of the point of contact of the fuel jet upon the wall of the combustion chamber. This ensures with considerable certainty that a sufficient amount of fuel is transferred to the areas of low pressure air. If the cylinder compression space has several zones in which a lower air pressure exists than the pressure in the combustion chamber, a separate channel can be directed to each area. For example, in an engine having four valves for each cylinder, a separate channel can be directed toward each of the four valve pockets.

The means by which the objects of the invention are obtained are disclosed more fully with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a piston head with the position of the low pressure pockets adjacent the valve seats and the fuel nozzle being schematically indicated;

Figure 1*a* is a fragmentary view of Figure 1 showing a modification in the location of the channel;

Figure 1*b* is a view similar to Figure 1 of a further modification; and

Figure 2 is a cross-sectional view through a portion of the cylinder and cylinder head showing the piston of Figure 1 in the cylinder.

As shown in Figures 1 and 2, the piston **1** contains a combustion chamber **2** formed as a body of rotation as, for example, a sphere. This combusition chamber has a cylindrical neck portion **3** extending through the surface of the piston head and communicating with the cylinder space **4** within cylinder **5**. Obliquely mounted in cylinder head **6** is a fuel injection nozzle from which fuel is injected through neck **3** of the chamber **2**. The injected fuel is in the form of several concentrated jets **8** of short length which are directed at a sharp angle toward the wall of chamber **2** in order to form a film **9** on the wall. By so doing, up to 98% of the fuel is deposited as a film on the wall. The remaining approximate 2% of the fuel which is at a maximum that which gives a just noticeable ignition noise during running of the engine is atomized immediately in the combustion air. Such atomizing is achieved either by suitably deflecting a part of the fuel jets or by means of a specially directed jet in the combustion chamber, the latter not being shown. The compression ratio in the cylinder is fixed so that the atomized air is certain to be self-ignited, but the fuel on the combustion chamber wall does not ignite. The combustion air is swirled as it enters the cylinder as indicated by the arrow *x* in the same direction as the fuel jets **8**. This air vaporizes the fuel from the film **9** on the chamber wall. Ignition and the following combustion thus proceed according to the engine in aforesaid application No. 480,432.

Beneath valves **12** and **13** and especially in the valve pockets **14** and **15**, a volume of air **16** exists at the top dead center position of piston **1**. During the combustion of the fuel in chamber **2**, the volume of air **16** is at a lower pressure than the pressure in the combustion chamber. To include the low pressure air in the combustion process, a passageway or channel **17** is provided in piston **1**. This channel extends from the area of the contact of fuel jets **8** on the chamber wall to the top surface of the piston and thus forms a communication between the combustion chamber and the air volume **16** in the area of valve pocket **14**. Because of the pressure difference between the gas in chamber **2** and the air volume **16**, a gas flow of current as indicated by arrow **18** takes place in channel **17** while the combustion or burning of the gas proceeds in chamber **2**. The direction of this current **18** is from the combustion chamber outwardly toward air volume **16**. This current carries a part of the fuel from chamber **2**. This fuel reaches air volume **16** to form an air-fuel mixture therewith which will burn. Thus the residual air volume **16** is brought into and takes

part in the combustion process. The quantity of fuel carried into air volume **16** is determined by the current **18** which in turn is determined by the size and position of channel **17**. As determined by the quantity of fuel required in air volume **16**, the direction of channel **17** can be radial with respect to Figure 2 as shown in Figures 1 and 2, in the same direction of the air swirl *x* as shown by the channel **17***a* of Figure 1*a*, or against the air swirl *x* as shown by the channel **17***b* of Figure 1*b*.

Furthermore, the channel **19**, Figure 2, similar to channel **17**, is provided for forming communication with the air pocket **15** beneath valve **13**.

The channels of this invention are also used to fix the volume of the air distributed portion of the injected fuel. This is done by making the size of the channels either larger or smaller, and/or by directing them in the same direction or a direction opposite to the air swirl.

Having now described the means by which the objects of the invention are obtained, I claim:

1. In an internal combustion engine having a cylinder, a cylinder head, intake and exhaust valves in said head and forming low pressure areas in said cylinder, a piston movable in said cylinder to compress the combustion air, a combustion chamber in said piston and opened through the top surface of said piston, means for forming an unidirectional air swirl in said chamber from the compressed combustion air, and a fuel nozzle positioned to inject the major portion of the fuel against the wall of said chamber to form a film thereon, the improvement comprising a channel extending from said combustion chamber through the upper surface of said piston and directed toward a valve for transferring fuel vaporized in said chamber to a lower pressure area in said cylinder adjacent said valve.

2. In an engine as in claim 1, said channel extending from the impact area of the fuel jet with the wall of said chamber.

3. In an engine as in claim 1, further comprising a separate channel directed to each of the valves in said cylinder head.

4. A method of burning fuel in an internal combustion engine having a cylinder, and a combustion space associated therewith, comprising imparting a swirling motion in one direction to the intake air durng the compression stroke, injecting a stream of fuel into said space near top dead center of the compression stroke in substantially the same direction as said air swirl and with the major portion of the fuel being deposited on the wall of the combustion space as a non-vaporized film and a minor portion of the fuel atomized in said air swirl, igniting said minor portion of the fuel at approximately the top dead center of the compression stroke, continuing the air swirl in the same direction during the power stroke while progressively vaporizing and burning the fuel from said film, and simultaneous with said vaporizing transferring a portion of the vaporized fuel from the high combustion gas pressure area of said chamber to a lower pressure air area in said cylinder.

5. A method as in claim 4, said transferring of vaporized fuel being from a combustion chamber in a piston to a low pressure air pocket adjacent a valve for said cylinder.

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