

Description

This invention relates generally to an internal combustion engine, to a heat plug and more particularly to a piston having a barrier means for preventing unburned fuel from impinging against the cylinder bore.

The low supply of petroleum based fuels in many countries has revived the interest for the development of alternative fuels or extenders for replacing or supplementing petroleum based fuels. The use of vegetable oils or blends of vegetable oils in diesel fuel appear promising for diesel engines. In particular, a large amount of test data has been accumulated burning various soybean oil/diesel fuel blends in various diesel engine configurations. The engines showing the most promise with the least modifications are those having precombustion chambers. Acceptable performance and durability have been achieved with four valve engines having centrally located precombustion chambers. However, it was found that two valve engines having a precombustion chamber located non-symmetric or offset with respect to the main combustion chamber, e.g. as disclosed in Figure 1 of US-A-2734491, were susceptible to increased wear to the piston rings and the cylinder bore. Such high piston ring and cylinder bore wear has been attributed to fuel impingement on the cylinder bore due to the poorer atomization and slower burning characteristics of the vegetable oil. The partially burned fuel impinging against the cylinder bore results in high dilution of the lubricating film and heavy deposits on the piston rings and cylinder bore which lead to ring sticking, corrosion and wear.

In order to burn vegetable oil or blends of vegetable oil and petroleum based fuel effectively, it became apparent that modifications to some of the engine components would be necessary. One of the considerations in modifying the engine is that such modifications should not unduly hinder the burning of straight petroleum based diesel fuel.

FR-A-1308400 discloses an internal combustion engine having a main combustion chamber partially defined by a cylinder bore, a piston defining a movable wall of the main combustion chamber, a heat plug connected to the piston and having one side facing away from the piston, and a precombustion chamber having a throat through which, in use, a stream of combustible fuel and air is directed into the main combustion chamber and toward the heat plug for impacting thereagainst. Such an engine is hereinafter referred to as of the kind described. However the heat plug and precombustion chamber are located centrally with respect to the centres of the piston and main combustion chamber. The piston is provided, around the heat plug with a cavity for confining the burning gases in a jet-like pattern to promote complete mixing. There is no appreciation of the need to inhibit partially burned fuel from impinging on the cylinder bore, particularly

when the impact point on the heat plug is offset from the centre of the piston and hence close to a portion of the cylinder bore.

According to one aspect of the invention, an engine of the kind described is characterised in that the heat plug and precombustion chamber are located offset with respect to the centres of the piston and main combustion chamber; and in that there is a barrier connected to the heat plug and extending outwardly from one side of the heat plug, the barrier being positioned between the impact point and a portion of the cylinder bore nearest to the impact point for preventing unburned fuel from being deflected against the portion of the cylinder bore nearest to the impact point.

According to a second aspect of the invention, a heat plug which is arranged to be fitted to a piston of an internal combustion engine having a main combustion chamber partially defined by a cylinder bore and a precombustion chamber in communication with the main combustion chamber through a throat, and which has one side provided with means for connecting the heat plug to the piston, and an opposite side which is arranged to be impacted by fuel directed into the main chamber through the throat; is characterized in that the heat plug has a barrier connected to and extending outwardly from the opposite side, whereby when the heat plug and precombustion chamber are located offset with respect to the centres of the piston and main combustion chamber, with the barrier positioned between the impact point of the fuel on the heat plug and the portion of the cylinder bore nearest to the impact point, unburned fuel is, in use, prevented from being deflected against the portion of the cylinder bore nearest to the impact point.

According to a third aspect of the invention, a piston for use in an engine having a main combustion chamber partially defined by a cylinder bore in which the piston is adapted to reciprocate and a precombustion chamber having throat through which, in use, a stream of combustible fuel and air is directed into the main combustion chamber for impacting against a heat plug is fitted to the piston; is characterised in that the heat plug is fitted to the piston at a location offset from the centre of the piston and has an outwardly extending barrier connected to the heat plug and positioned in the path of unburned fuel deflected, in use, from the impact point on the heat plug towards a portion of the cylinder bore nearest to the impact point.

The present invention enables vegetable oils to be used as fuel in diesel engines and for preventing unburned fuel from impinging against the cylinder bore where it would tend to form deposits and dilute the lubricating oil film on the wall with consequent corrosion and wear. This is accomplished by providing the barrier positioned between the point at which unburned fuel impacts against the heat plug and the portion of the cylinder bore nearest such impact point. The

barrier thus prevents the unburned fuel from being deflected against that portion of the cylinder bore and causes the unburned fuel to remain suspended within the burning gaseous mixture longer so that a more complete combustion occurs.

In the accompanying drawings:—

Figure 1 is a diagrammatic cross-sectional view of part of an engine constructed in accordance with the present invention;

Figure 2 is section taken on the line II—II in Figure 1;

Figure 3 is a plan view of a heat plug in accordance with the present invention; and,

Fig. 4 is a side elevational view of the heat plug of Fig. 3.

Fig. 1 shows one cylinder and the associated components of a compression ignition internal combustion engine 10. The cylinder includes a main combustion chamber 11 partially defined by a cylinder bore 12 formed within a cylinder liner 13. The cylinder liner 13 is suitably fitted within a cylinder block partially shown at 14. A piston 16 is reciprocally positioned within the cylinder bore 12 and has a surface 20 which defines a movable wall of the combustion chamber 11. A cylinder head partially shown at 17 is suitably connected to the cylinder block 14 and defines a fixed wall of the combustion chamber 11.

A precombustion chamber 18 is formed in a cylindrical member 19 which is connected to the cylinder head 17 by a screw threaded connection 21. The precombustion chamber 18 is communicated with the main combustion chamber 11 through a throat 22. The tip of an injection nozzle 23 and a glow plug 24 extend into the precombustion chamber 18 in the usual manner.

Referring also to Figs. 2—4, the piston 16 has a heat plug 26 connected thereto at a location offset from the centre of the piston and substantially in axial alignment with the throat 22 of the cylindrical member 19. The heat plug 26 has a circular portion 27 and a means 28 associated with one side 29 thereof for connecting the heat plug to the piston. The means 28 includes a stem 31 extending through a passage 32 in the piston 16 and a nut 33 threaded onto the distal end of the stem 31. The circular portion 27 has another side 34 facing away from the piston 16 and which forms a portion of the surface 20 of the piston.

A means 36 is provided for preventing unburned fuel from being deflected against a portion of the cylinder bore 12 nearest the heat plug 26. The means 36 includes an elongate semi-circular or crescent shaped barrier 37 connected to and extending outwardly from the side 34 of the circular portion 27. The barrier 37 is concentrically positioned adjacent the portion of the outer periphery of the circular portion 27 that is nearest the cylinder bore. The barrier 37 has a height "H" in the range of from about 1 to 3 millimeters above the side 34 and preferably about 1.5 millimeters. The arcuate length "A" of the barrier 37 is in the range greater than 150° and less than 360° and preferably about 180°.

Industrial Applicability

In operation, fuel is injected into the precombustion chamber 18 from the fuel injection nozzle 23 as the piston 16 approaches the top dead centre position of its compression stroke. Autoignition of the fuel is started in the precombustion chamber and a stream of partially burned fuel, air, and products of combustion is directed through the throat 22 into the main combustion chamber 11. The fuel continues to burn upon entering the main combustion chamber 11. However, some of the unburned fuel impacts against the side 34 of the heat plug 26 at a point "X" and is deflected radially outwardly in a circular pattern from the point of impact on the side 34. The fuel deflected toward the portion of the cylinder bore 12 nearest to the heat plug 26 impinges against the barrier 37 and is diverted by the barrier away from that portion of the cylinder bore. The fuel thus diverted by the barrier remains temporarily suspended within the burning gaseous mixture in the combustion chamber and is eventually burned during the combustion process.

In view of the above, it is readily apparent that the structure provides an improved piston having a barrier which causes a more complete combustion of the fuel entering the combustion chamber from the precombustion chamber. The barrier prevents unburned fuel from being deflected against a portion of the cylinder bore nearest the heat plug or the point of impact of the fuel on the piston. Such diverted fuel is then eventually burned during the combustion process. Thus, the barrier prevents unburned fuel from impinging against the cylinder bore thereby minimizing the formation of deposits and dilution of the lubricating oil film on the cylinder bore which leads to corrosion and wear.

By using the piston with the barrier, alternative fuels such as vegetable oil and blends of vegetable oil and petroleum based fuel can be burned with negligible effect on the performance and durability of the engine. Moreover, the barrier will hinder the use of straight petroleum base fuel.

Claims

1. An internal combustion engine having a main combustion chamber (11) partially defined by a cylinder bore (12), a piston (16) defining a movable wall of the main combustion chamber, a heat plug (26) connected to the piston and having one side (34) facing away from the piston, and a precombustion chamber (18) having a throat (22) through which, in use, a stream of combustible fuel and air is directed into the main combustion chamber (11) and toward the heat plug (26) for impacting thereagainst; characterised in that the heat plug and precombustion chamber are located offset with respect to the centres of the piston and main combustion chamber; and in that there is a barrier (37) connected to the heat plug (26) and extending outwardly from one side (34) of the heat plug, the barrier being positioned between the impact point and a portion of the

barrier thus prevents the unburned fuel from being deflected against that portion of the cylinder bore and causes the unburned fuel to remain suspended within the burning gaseous mixture longer so that a more complete combustion occurs.

In the accompanying drawings:—

Figure 1 is a diagrammatic cross-sectional view of part of an engine constructed in accordance with the present invention;

Figure 2 is section taken on the line II—II in Figure 1;

Figure 3 is a plan view of a heat plug in accordance with the present invention; and,

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A precombustion chamber 18 is formed in a cylindrical member 19 which is connected to the cylinder head 17 by a screw threaded connection 21. The precombustion chamber 18 is communicated with the main combustion chamber 11 through a throat 22. The tip of an injection nozzle 23 and a glow plug 24 extend into the precombustion chamber 18 in the usual manner.

Referring also to Figs. 2—4, the piston 16 has a heat plug 26 connected thereto at a location offset from the centre of the piston and substantially in axial alignment with the throat 22 of the cylindrical member 19. The heat plug 26 has a circular portion 27 and a means 28 associated with one side 29 thereof for connecting the heat plug to the piston. The means 28 includes a stem 31 extending through a passage 32 in the piston 16 and a nut 33 threaded onto the distal end of the stem 31. The circular portion 27 has another side 34 facing away from the piston 16 and which forms a portion of the surface 20 of the piston.

A means 36 is provided for preventing unburned fuel from being deflected against a portion of the cylinder bore 12 nearest the heat plug 26. The means 36 includes an elongate semi-circular or crescent shaped barrier 37 connected to and extending outwardly from the side 34 of the circular portion 27. The barrier 37 is concentrically positioned adjacent the portion of the outer periphery of the circular portion 27 that is nearest the cylinder bore. The barrier 37 has a height "H" in the range of from about 1 to 3 millimeters above the side 34 and preferably about 1.5 millimeters. The arcuate length "A" of the barrier 37 is in the range greater than 150° and less than 360° and preferably about 180°.

Industrial Applicability

In operation, fuel is injected into the precombustion chamber 18 from the fuel injection nozzle 23 as the piston 16 approaches the top dead centre position of its compression stroke. Autoignition of the fuel is started in the precombustion chamber and a stream of partially burned fuel, air, and products of combustion is directed through the throat 22 into the main combustion chamber 11. The fuel continues to burn upon entering the main combustion chamber 11. However, some of the unburned fuel impacts against the side 34 of the heat plug 26 at a point "X" and is deflected radially outwardly in a circular pattern from the point of impact on the side 34. The fuel deflected toward the portion of the cylinder bore 12 nearest to the heat plug 26 impinges against the barrier 37 and is diverted by the barrier away from that portion of the cylinder bore. The fuel thus diverted by the barrier remains temporarily suspended within the burning gaseous mixture in the combustion chamber and is eventually burned during the combustion process.

In view of the above, it is readily apparent that the structure provides an improved piston having a barrier which causes a more complete combustion of the fuel entering the combustion chamber from the precombustion chamber. The barrier prevents unburned fuel from being deflected against a portion of the cylinder bore nearest the heat plug or the point of impact of the fuel on the piston. Such diverted fuel is then eventually burned during the combustion process. Thus, the barrier prevents unburned fuel from impinging against the cylinder bore thereby minimizing the formation of deposits and dilution of the lubricating oil film on the cylinder bore which leads to corrosion and wear.

By using the piston with the barrier, alternative fuels such as vegetable oil and blends of vegetable oil and petroleum based fuel can be burned with negligible effect on the performance and durability of the engine. Moreover, the barrier will hinder the use of straight petroleum base fuel.

Claims

1. An internal combustion engine having a main combustion chamber (11) partially defined by a cylinder bore (12), a piston (16) defining a movable wall of the main combustion chamber, a heat plug (26) connected to the piston and having one side (34) facing away from the piston, and a precombustion chamber (18) having a throat (22) through which, in use, a stream of combustible fuel and air is directed into the main combustion chamber (11) and toward the heat plug (26) for impacting thereagainst; characterised in that the heat plug and precombustion chamber are located offset with respect to the centres of the piston and main combustion chamber; and in that there is a barrier (37) connected to the heat plug (26) and extending outwardly from one side (34) of the heat plug, the barrier being positioned between the impact point and a portion of the



(13)

cylinder bore nearest to the impact point for preventing unburned fuel from being deflected against the portion of the cylinder bore (12) nearest to the impact point.

2. An engine according to claim 1, wherein the barrier (37) is crescent shaped and has an arcuate length greater than 150° but less than 360°.

3. An engine according to claim 2, wherein the barrier (37) has an arcuate length of substantially 180°.

4. An engine according to any one of the preceding claims, wherein the barrier (37) has a height in the range of from 1 to 3 millimeters.

5. An engine according to claim 4, wherein the barrier (37) has a height of substantially 1.5 millimeters.

6. A heat plug (26) which is arranged to be fitted to a piston (16) of an internal combustion engine, according to one of the claims 1—5, having a main combustion chamber (11) partially defined by a cylinder bore (12) and a precombustion chamber (18) in communication with the main combustion chamber through a throat (22), and which has one side (29) provided with means (28) for connecting the heat plug to the piston, and an opposite side (34) which is arranged to be impacted by fuel directed into the main chamber through the throat; characterised in that the heat plug has a barrier (37) connected to and extending outwardly from the opposite side (34), whereby when the heat plug and precombustion chamber are located offset with respect to the centres of the piston and main combustion chamber, with the barrier positioned between the impact point of the fuel on the heat plug and the portion of the cylinder bore nearest to the impact point, unburned fuel is, in use, prevented from being deflected against the portion of the cylinder bore nearest to the impact point.

7. A heat plug according to claim 6, wherein the barrier (37) is crescent shaped and has an arcuate length of substantially 180° and a height of substantially 1.5 millimeters.

8. A piston (16) for use in an engine, according to one of the claims 1—5, having a main combustion chamber (11) partially defined by a cylinder bore (12) in which the piston is adapted to reciprocate and a precombustion chamber (18) having throat (22) through which, in use, a stream of combustible fuel and air is directed into the main combustion chamber (11) for impacting against a heat plug (26) which is fitted to the piston, characterised in that the heat plug (26) is fitted to the piston at a location offset from the centre of the piston and has an outwardly extending barrier (37) connected to the heat plug (26) and positioned in the path of unburned fuel deflected, in use, from the impact point on the heat plug towards a portion of the cylinder bore (12) nearest to the impact point.

9. A piston according to claim 8, wherein the barrier (37) has a crescent shape and an arcuate length greater than 150° but less than 360°.

10. A piston according to claim 9, wherein the barrier (37) has an arcuate length of substantially 180°.

Patentansprüche

1. Verbrennungsmaschine mit einer Hauptverbrennungskammer (11) teilweise definiert durch eine Zylinderbohrung (12), einem Kolben (16), der eine bewegliche Wand der Hauptverbrennungskammer definiert, einem Heizstift (26), verbunden mit dem Kolben und mit einer vom Kolben wegweisenden Seite (34), und mit einer Vorverbrennungskammer (18) mit einem Hals (22), durch den im Gebrauch ein Strom aus verbrennbarem Kraftstoff und Luft in die Hauptverbrennungskammer (11) und zum Heizstift (26) zum Auftreffen darauf geleitet wird, dadurch gekennzeichnet, daß der Heizstift und die Vorverbrennungskammer, versetzt bezüglich der Zentren des Kolbens und der Hauptverbrennungskammer angeordnet sind, und daß eine Barriere (37) mit dem Heizstift (26) verbunden ist und sich von einer Seite (34) des Heizstifts nach außen erstreckt, wobei die Barriere zwischen dem Auftreffpunkt und einem Teil der Zylinderbohrung nächst dem Auftreffpunkt angeordnet ist, um zu verhindern, daß nicht verbrannter Kraftstoff gegen den Teil der Zylinderbohrung (12) am nächsten zum Auftreffpunkt abgelenkt wird.

2. Maschine nach Anspruch 1, wobei die Barriere (37) halbmondförmig ist und eine Bogenlänge größer als 150° aber weniger als 360° besitzt.

3. Maschine nach Anspruch 2, wobei die Barriere (37) eine Bogenlänge von im wesentlichen 180° besitzt.

4. Maschine nach einem der vorhergehenden Ansprüche, wobei die Barriere (37) eine Höhe im Bereich von 1 bis 3 mm aufweist.

5. Maschine nach Anspruch 4, wobei die Barriere (37) eine Höhe von im wesentlichen 1,5 mm besitzt.

6. Heizstift (26), angeordnet zur Einpassung in einem Kolben (16) einer Verbrennungsmaschine nach einem der Ansprüche 1—5 mit einer Hauptverbrennungskammer (11), partiell definiert durch eine Zylinderbohrung (12) und mit einer Vorverbrennungskammer (18) in Verbindung mit der Hauptverbrennungskammer durch einem Hals (22) und wobei sie eine Seite (29), ausgestattet mit Mitteln (28) zur Verbindung des Heizstiftes mit dem Kolben aufweist, und eine entgegengesetzte Seite (34), die derart angeordnet ist, daß Brennstoff auf sie auftrifft, der in die Hauptkammer durch den Hals geleitet wird, dadurch gekennzeichnet, daß der Heizstift eine Barriere (37) aufweist, und zwar verbunden mit und sich nach außen erstreckend von der entgegengesetzten Seite (34), wodurch dann, wenn der Heizstift und die Vorverbrennungskammer, versetzt bezüglich der Mitten des Kolbens und der Hauptverbrennungskammer angeordnet sind, bei zwischen Auftreffpunkt des Kraftstoffs auf den Heizstift und den Teil der Zylinderbohrung am nächsten zum Auftreffpunkt angeordneter Barriere, nicht verbrannter Kraftstoff im Gebrauch daran gehindert wird, gegen den Teil der Zylinderbohrung am nächsten zum Auftreffpunkt abgelenkt zu werden.

7. Heizstift nach Anspruch 6, wobei die Barriere (37) halbmondförmig ist und eine Bogenlänge von im wesentlichen 180° und eine Höhe von im



wesentlichen 1,5 mm aufweist.

8. Kolben (16) zur Verwendung in einer Maschine nach einem der Ansprüche 1 bis 5 mit einer Hauptverbrennungskammer (11) partiell definiert durch eine Zylinderbohrung (12), in der der Kolben sich hin- und her-bewegen kann, und mit einer Verbrennungskammer (18) mit einem Hals (22), durch den im Gebrauch ein Strom aus verbrennbarem Kraftstoff und Luft in die Hauptverbrennungskammer (11) geleitet wird, um auf einen Heizstift (26) aufzutreffen, der an den Kolben angepaßt ist, dadurch gekennzeichnet, daß der Heizstift (26) an den Kolben an einer Stelle eingepaßt ist, die gegenüber der Mitte des Kolbens versetzt ist und wobei ferner eine sich nach außen erstreckende Barriere (37) mit dem Heizstift (26) verbunden ist und in der Bahn des nicht verbrannten Kraftstoffs positioniert ist, der im Gebrauch vom Auftreffpunkt des Heizstiftes zu einem Teil der Zylinderbohrung (12) am nächsten zum Auftreffpunkt hin abgelenkt wird.

9. Kolben nach Anspruch 8, wobei die Barriere (37) eine Halbmondform besitzt und eine Bogenlänge größer als 150° aber weniger als 360°.

10. Kolben nach Anspruch 9, wobei die Barriere (37) eine Bogenlänge von im wesentlichen 180° besitzt.

Revendications

1. Moteur à combustion interne ayant une chambre de combustion principale (11) délimitée en partie par un alésage de cylindre (12), un piston (16) délimitant une paroi mobile de la chambre de combustion principale, une tête de protection contre la chaleur (26) reliée au piston et dont un côté (34) fait saillie sur le piston, et une chambre de précombustion (18) ayant un étranglement (22) par lequel, en fonctionnement, un courant de combustible et d'air est dirigé dans la chambre de combustion principale (11) et vers la tête de protection contre la chaleur (26) pour venir la frapper, caractérisé en ce que la tête de protection contre la chaleur et la chambre de précombustion sont décalées par rapport aux centres du piston et de la chambre de combustion principale; et en ce qu'il est prévu une barrière (37) reliée à la tête de protection contre la chaleur (26) et s'étendant vers l'extérieur depuis le côté (34) de la tête de protection contre la chaleur, la barrière étant positionnée entre le point d'impact et une portion de l'alésage de cylindre la plus proche de point d'impact pour empêcher le combustible non brûlé d'être dévié contre la portion de l'alésage de cylindre (12) la plus proche du point d'impact.

2. Moteur selon la revendication 1, dans lequel la barrière (37) est en forme de croissant et a une longueur suivant un arc supérieure à 150° mais inférieure à 360°.

3. Moteur selon la revendication 2, dans lequel la barrière (37) a une longueur suivant un arc de sensiblement 180°.

4. Moteur selon l'une quelconque des revendications précédentes, dans lequel la barrière (37) a une hauteur de l'ordre de 1 à 3 mm.

5. Moteur selon la revendication 4, dans lequel la barrière (37) a une hauteur de sensiblement 1,5 mm.

6. Tête de protection contre la chaleur (26) agencée pour être adaptée sur un piston (16) d'un moteur à combustion interne selon l'une quelconque des revendications 1 à 5 ayant une chambre de combustion principale (11) délimitée en partie par un alésage de cylindre (12) et une chambre de précombustion (18) en communication avec la chambre de combustion principale par un étranglement (22), et dont un côté (29) est pourvu d'un moyen (28) pour relier la tête de protection contre la chaleur au piston, et un côté opposé (34) qui est disposé pour être frappé par le combustible dirigé dans la chambre principale par l'étranglement; caractérisé en ce que la tête de protection contre la chaleur comporte une barrière (37) reliée côté opposé (34) et à partir duquel elle s'étend vers l'extérieur, de sorte que, lorsque la tête de protection contre la chaleur et la chambre de précombustion sont disposées décalées par rapport aux centres du piston et de la chambre de combustion principale, la barrière étant disposée entre le point d'impact du combustible sur la tête de protection contre la chaleur et la portion de l'alésage de cylindre la plus proche du point d'impact, le combustible non brûlé est empêché, en fonctionnement, d'être dévié contre la portion de l'alésage de cylindre la plus proche du point d'impact.

7. Tête de protection contre la chaleur selon la revendication 6, dans laquelle la barrière (37) est en forme de croissant et a une longueur suivant un arc de sensiblement 180° et une hauteur de sensiblement 1,5 mm.

8. Piston (16) utilisable dans un moteur selon l'une quelconque des revendications 1 à 5 ayant une chambre de combustion principale (11) délimitée en partie par un alésage de cylindre (12) dans lequel le piston est adapté pour effectuer un mouvement alternatif et une chambre de précombustion (18) ayant un étranglement (22) par lequel en fonctionnement, un courant de combustible et d'air est dirigé dans la chambre de combustion principale (11) pour venir frapper une tête de protection contre la chaleur (26) qui est adaptée sur le piston, caractérisé en ce que la tête de protection contre la chaleur (26) est adaptée sur le piston en un emplacement décalé par rapport au centre du piston et comprend une barrière (37) s'étendant vers l'extérieur, reliée à la tête de protection contre la chaleur (26) et disposée sur le trajet du combustible non brûlé dévié, en fonctionnement, depuis le point d'impact sur la tête de protection contre la chaleur vers une portion de l'alésage de cylindre (12) la plus proche du point d'impact.

9. Piston selon la revendication 8, dans lequel la barrière (37) a la forme d'un croissant et une longueur suivant un arc supérieure à 150° mais inférieure à 360°.

10. Piston selon la revendication 9, dans lequel la barrière (37) a une longueur suivant un arc de sensiblement 180°.

