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COMPLETE SPECIFICATION.

Improvements in or relating to Internal Combustion Engines.

We, ALFRED GORDON SMITH (trading as SOUTHERN PRODUCTS), of Saltdean Vale, Saltdean, Brighton, Sussex, and ARTHUR ALEXANDER SIDNEY, of same address, both British Subjects, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

10 This invention relates to internal combustion engines of the kind in which the upper end or ends of the cylinder or cylinders, that is the end or ends remote from the crank shaft, is or are, provided with an extension which is described herein as an ante chamber.

15 It is an object of the invention to provide an improved construction of internal combustion engine of this kind.

20 According to the invention an internal combustion engine of the kind described is provided having an open-ended ante chamber of cylindrical form opening directly into the cylinder, a cylindrical closure member to fit within said ante chamber to provide a closure, and clamping means engaging within the walls of said ante chamber to retain said closure member rigidly in a desired position within the ante chamber.

30 By utilising this construction together with different closure members the shape or size of the ante chamber may be varied as desired. Thus, when it is desired to decrease the volume of the ante chamber and increase the compression ratio of the engine, a reducing member can be inserted into the chamber to occupy a portion of its volume and thereby reduce the effective volume thereof. Such a reduction member may be secured to or form part of the closure member, or it may be a separate part located in position in the ante chamber by the closure member or a retaining member. When it is desired to increase the volume of the ante chamber a closure member may be used which is formed with a cavity communicating with the ante chamber, and thereby serving to increase the effective volume of the ante chamber. Where it is desired to provide an ante chamber of particular internal shape a closure member having such an internal shape may be inserted into the ante chamber.

45 The closure member may also embody a fuel injection nozzle where this is desired.

50 When closure members are to be inserted into the ante chamber they will generally be formed with an external configuration to fit closely within the ante chamber. They may be retained in place either by screw threadably engaging the ante chamber either internally, or externally, or they may be held in place by an external retaining member similarly engaging the ante chamber or else being bolted or otherwise secured to the part of the cylinder head surrounding the ante chamber. A closure member which is a sliding fit within the ante chamber may be prevented from moving into the cylinder by an annular inward projection at the end of the ante chamber adjacent to the cylinder.

55 In order that the invention may be clearly understood some embodiments will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which :—

60 Figure 1 is a section of the upper part of a diesel engine cylinder provided with an ante chamber according to the invention.

65 Figure 2 is a similar view of an engine provided with a different form of ante chamber.

70 In the drawings a cylinder 1 is provided with a piston, and connecting rod assembly 2 and a cylinder head 3. The piston is shown at its top dead centre position, and

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the space 4 represents the compression space in the cylinder at this position.

The cylinder head is formed with an extension 5 providing a cylindrical ante chamber 6 the axis of which is parallel to the cylinder axis and the end remote from the cylinder is open. This open end is closed by a closure member consisting of an annular member 7 fitting within the open end of the ante chamber, and a fuel injector nozzle represented by 8 fitted within the aperture of the member 7. The injection nozzle 8 is formed with a flange 9 which is apertured to receive a pair of studs 11 and to be clamped rigidly in position relative to the ante chamber by the nuts 12. A shoulder 13 upon the injection nozzle engages the upper surface of the member 7 to retain this also in rigid engagement with the ante chamber.

In Figure 2 the annular member 7 has been replaced by a different closure member 14. This is again retained in position by the same means as described with reference to Figure 1, but is provided with a shaped combustion space 15 communicating with the head space in the cylinder at 16. The size and shape of the member 14 is such that the volume of the ante chamber is considerably reduced, and the compression ratio of the engine thereby increased compared to the engine of Figure 1.

In Figure 2 there is also shown an annular ring 17 projecting inwardly at the end of the ante chamber adjacent to the cylinder to provide a seating to prevent closure members moving from the ante chamber into the cylinder. This allows closure members to be used which are not provided with the annular flange 18 to engage the outermost face of the ante chamber.

Thus the closure members may be of many and various sizes, and forms, and may be retained in position by any suitable means. They may incorporate a fuel injector nozzle where this is desired. The ante chamber may also be disposed at an angle to the axis of the cylinder, and may be either offset with respect to the cylinder axis as shown in the drawings or coaxially therewith.

It would also be appreciated that the closure member may be arranged to be movable into and out of the ante chamber to provide an engine in which the compression ratio may be varied.

The invention is applicable to all kinds of internal combustion engines, whether diesel, semi-diesel, or petrol, or compression, or spark ignition.

#### WHAT WE CLAIM IS :—

1. An internal combustion engine of the kind described having an open-ended ante chamber of cylindrical form opening directly into the cylinder, a cylindrical closure member to fit within said ante chamber to provide a closure, and clamping means engaging within the walls of said ante chamber to retain said closure member rigidly in a desired position within the ante chamber.

2. An internal combustion engine according to Claim 1 wherein alternative plug-shaped closure members of different length may be secured in the ante chamber by the clamping means thereby to change the engine compression ratio.

3. An internal combustion engine according to Claim 1 or 2 wherein the face of the closure member adjacent the cylinder is shaped to constitute a part of the wall of a combustion chamber of a desired shape.

4. An internal combustion engine according to Claim 1, 2 or 3, wherein the closure member carries a fuel injection nozzle.

5. An internal combustion engine according to any of the preceding claims wherein the ante chamber is formed with an annular seat in the wall thereof to engage the closure member to restrict the degree of movement of this towards the cylinder.

6. An internal combustion engine according to any of the preceding claims wherein the closure member is movable longitudinally of the ante chamber and may be secured by the clamping means at any adjusted position.

7. An internal combustion engine according to any of the preceding claims wherein the axis of the ante chamber is parallel to the axis of the cylinder.

8. An internal combustion engine of the kind described substantially as hereinbefore specifically described with reference to Figures 1 or 2 of the accompanying drawings.

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#### PROVISIONAL SPECIFICATION.

#### Improvements in or relating to Internal Combustion Engines.

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British Subjects, do hereby declare this invention to be described in the following statement :—

The present invention relates to internal 110

combustion engines of the type in which the cylinder or cylinders of the engine is or are provided with a combustion chamber commonly known as an ante-chamber and has for an object to provide an improved internal combustion engine of the type referred to.

According to the invention, the ante-chamber of an internal combustion engine of the type referred to is constructed in such manner as to permit the volume of the chamber to be adjusted to vary the compression therein and also to permit the shape of the combustion space within the chamber to be varied.

To this end the said ante-chamber is provided with an opening adapted removably to receive a closure member therefor. The said opening is made such that when it is desired to decrease the volume of the ante-chamber a reduction member can be inserted into the chamber to occupy a portion of the chamber and thereby reduce the effective volume thereof, the said reduction member preferably being secured to and forming part of the closure member. When it is desired to increase the volume of the chamber, a closure member is employed which is provided with a cavity communicating with the said opening thereby increasing the effective volume of the ante-chamber.

In this manner the volume of the ante-chamber can be decreased or increased respectively by inserting therein through the said opening a reduction member of appropriate size or by securing over the said opening a closure member having a cavity of the required volume.

The aforementioned reduction member may be in the form of an apertured plug so that by employing plugs of different sizes the effective volume of the chamber is varied or the member may comprise a sleeve or liner adapted to engage the wall of the chamber, the internal surface of the sleeve or liner being shaped so as to give a combustion space of a desired configuration so that by using sleeves or liners of different internal shapes, the shape of the combustion space and the volume thereof can be varied. The said plug or liner may be formed integral with a releasable closure member for the said opening or the plug or liner may be engaged between the releasable closure member and suitable stop means such as a shoulder formed on the interior wall of the chamber.

In one construction of diesel engine according to the invention, the ante-chamber is cylindrical in shape and is formed by a bore extending through the cylinder head parallel

to the cylinder axis and disposed adjacent the wall of the cylinder. The chamber thus opens at its inner end into the compression end of the cylinder and is open at its outer end. The said outer end is closed by a closure member releasably secured thereto by bolts and adapted to support the injector so that the injector is in communication with the interior of the chamber. The said closure member may be constituted by the injector itself or the closure member may be provided with an annular projection surrounding the nozzle of the injector and engaging the internal surface of the chamber and extending inwardly thereof to constitute an apertured plug occupying a portion of the volume of the chamber. Alternatively, the closure member may be provided with a cavity communicating with the said opening and thereby constituting an extension of the ante-chamber. It will be apparent that the volume of the ante-chamber can be adjusted to a desired volume by employing a closure member having an annular projection of the requisite length or by a closure member having a cavity of appropriate size.

In addition the said closure member may be adapted to engage the internal wall of the chamber and to extend substantially the entire length thereof, a cavity extending from the inner end of the projection to the nozzle of the injector, and shaped to provide a combustion space of a desired configuration. In this manner the closure member provides a liner for the chamber and by changing a closure member having a cavity of one shape, for a closure member having a cavity of another shape, the configuration of the combustion space can be varied.

Instead of the liner being formed integral with the closure member, it may be a separate member and the chamber provided with an annular shoulder adapted to engage the inner end of the liner so that the separate liner is gripped between the closure member and the shoulder.

It will be understood that the invention is not limited to the above described construction. For example, the ante-chamber may be disposed at an angle inclined to the longitudinal axis of the cylinder or the ante-chamber may extend lengthwise across the end of the cylinder.

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