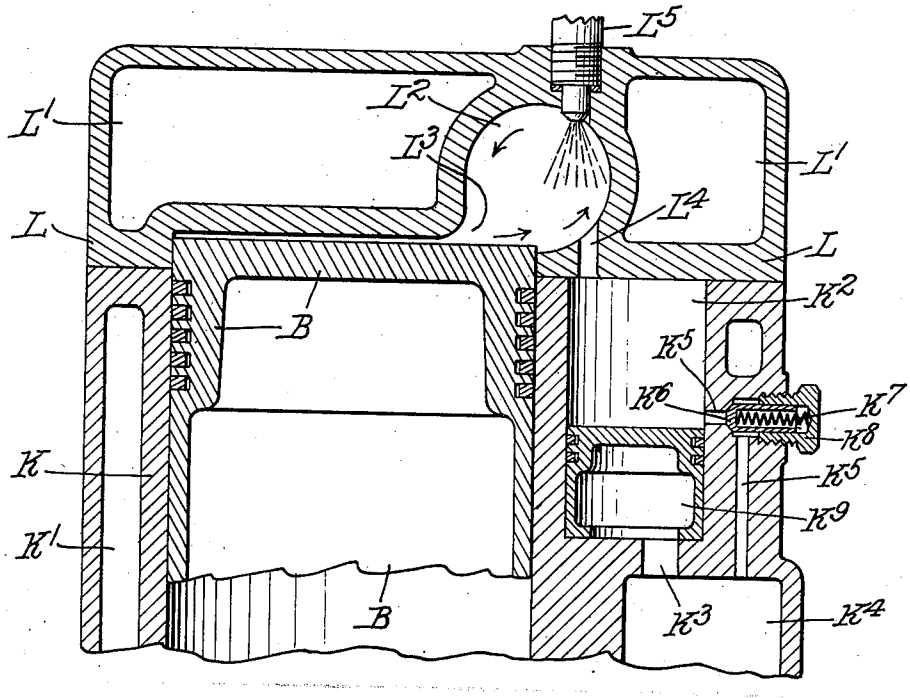
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VARIABLE VOLUME INTERNAL COMBUSTION ENGINE

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VARIABLE VOLUME INTERNAL COMBUSTION ENGINE

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11 Claims. (Cl. 123—78)

This invention relates to an internal combustion engine.

It has for one object to provide means for accomplishing adequate fuel mixture. Another object is to provide means for creating turbulence. Another object is to provide an automatic means for checking or preventing detonation. Another object is to provide means for preventing or compensating for excessive cylinder pressures.

Other objects will appear from time to time in the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawing, wherein—

The single figure is a sectional view showing a construction in which fluid pressure is utilized for returning the auxiliary piston.

In the invention as shown there is a cylinder K, which has a cooling jacket K^1, and the piston B is provided to reciprocate within the cylinder. Formed preferably as a part of the cylinder casting, although not necessarily so, is an auxiliary cylindrical chamber K^2 which communicates by means of a passage K^3 with a fluid pressure storage chamber K^4 which is closed at its bottom to provide a closed chamber into which fluid may come and from which it can escape only to the auxiliary cylinder K^2. A second passage K^5 leads from the cylindrical chamber K^2 to the chamber K^4 and has positioned within it a valve member K^6 which is normally held closed by a yieldable spring K^7. The valve member K^6 is hollow and the spring K^7 may lie within it and bear at one end upon the head of the valve member. At its other end the spring K^7 bears upon an adjusting member K^8 which is threadedly engaged in an appropriate socket in the casting and surrounds the valve member. The compression of the spring may be varied by adjusting the member K^8 in and out and thus the point at which the valve K^6 will yield outwardly in response to pressure within the cylinder K^2 to permit flow through the passage K^5 is variable. K^9 is a piston mounted within the cylinder K^2 for reciprocation therein.

The reference character designates a cylinder head which may have a cooling jacket L^1 and has formed within it a rounded and preferably generally spherical combustion chamber L^2 which communicates with the upper end of the main cylinder K by a relatively open throat L^3. It communicates also with the auxiliary cylinder K^2 by a preferably more restricted passage or throat L^4. L^5 is a fuel valve arranged in any suitable manner or position, to discharge fuel into the combustion chamber L^2.

In the invention as illustrated on the drawing, gaseous pressure is used for the loading medium for the auxiliary piston. Gaseous pressure is preferable to springs, as the problem of providing sufficiently stiff springs to withstand the higher ranges of combustion pressures is difficult. It will be seen that, at some suitable point in the stroke of the secondary piston, a passage is uncovered between the main combustion space, L^2, and the reservoir behind the piston K^9. This permits gas at the pressure existing at the moment to flow into the reservoir and build up some desired pressure behind the secondary piston. This is of course a cumulative process during the first few revolutions when the engine is started. This pressure is controlled by the regulating valve K^8 as well as the location and arrangement of the port K^5. As in the previous cases the force resisting outward movement of the secondary piston is so chosen in relation to the pressures in the combustion space that one of several types of movement may occur depending on the characteristics of the engine and the fuel and the resulting type of combustion. The gas pressure behind the secondary piston may be such that it will yield during the compression stroke, or during the combustion period. The receiver may be of such large volume that the pressure rise in the gas trapped in reservoir will not rise greatly even when the secondary piston has reached its outer limit of travel. In that case the piston will start to move when its restoring pressure is overbalanced and will travel to its outer limit before any great further pressure rise occurs in the main chamber. It will remain in this position until the pressures in the main chamber have dropped to a point where the restoring force can drive the piston back.

The use and operation of my invention are as follows:

The piston and cylinder design shown herewith are merely shown as typical of one possible adaptation of the invention. The invention may be used in an internal combustion engine operating on any suitable cycle. It may be used in a carbureting engine, in a Diesel engine or any type of internal combustion engine. As shown, the invention is applied to an injection engine conforming generally to the so-called Diesel type, the fuel being injected into the cylinder and burned therein, the air being supplied either with the fuel, or otherwise, to the cylinder so that the air and fuel burn within the cylinder.

It is recognized that improper burning may be due to many causes, but among them an important cause is poor mixing and poor scavenging. These are to some degree avoided by adequate mixing and by setting up turbulence within the cylinder.

The auxiliary piston K^9 may be loaded, to yield at pressures either below the maximum compression pressure or below the detonating ranges. Thus the auxiliary piston may be forced backward or outward, either by the normal burning or by the compression, and it will not return till the pressures have dropped to the equivalent point on the expansion stroke. At this time a turbulence or blast of gas will be caused by the return of the auxiliary piston. Whatever the proportion of the auxiliary cylinder and its piston and whatever the loading on the auxiliary piston, the arrangement is such that the yielding of the loading mechanism and consequently the outward movement of the piston does not occur until the desired time and it can, of course, be adjusted for a wide variety of conditions and it has the ability to store the energy of sudden pressure changes by reason of the compression of the loading mechanism so that a more effective use can be made upon the return stroke of the auxiliary piston and the original energy of the detonating pressure waves.

The term "turbulence" as used throughout the specification is not used in the strictly aerodynamic sense but in the sense which has become accepted in the engine art as referring to rapid air motion in a combustion chamber of an engine for the purpose of better mixing the fuel and air. This rapid air motion is of an orderly nature rather than truly "turbulent" in a strictly aerodynamic sense.

I claim:

1. In combination in an internal combustion engine, a working cylinder, a piston therein, means defining a separate combustion chamber having communication with the working cylinder, and an auxiliary cylinder in communication with said combustion chamber, and means movable solely in response to pressure variations in the auxiliary cylinder and combustion chamber for forcing gas from said auxiliary cylinder, into said combustion chamber, and means providing a throat between said working cylinder and said combustion chamber.

2. In combination in an internal combustion engine, a working cylinder, a piston therein, means defining a separate combustion chamber having communication with the working cylinder, and an auxiliary cylinder in communication with said combustion chamber, and means movable solely in response to pressure variations in the auxiliary cylinder and combustion chamber for forcing gas from said auxiliary cylinder into said combustion chamber, and means providing a throat between said auxiliary chamber and said combustion chamber and means providing a throat between said working cylinder and said combustion chamber.

3. In combination in an internal combustion engine, a working cylinder, a main piston therein, means defining a separate combustion chamber having communication with the working cylinder and an auxiliary cylinder in communication with said combustion chamber, and an auxiliary piston freely movable in said auxiliary chamber adapted to force gas from said auxiliary cylinder to said combustion chamber solely in response to variations in gas pressure, and means providing a throat between said auxiliary chamber and said combustion chamber and means providing a throat between said working cylinder and said combustion chamber, said main piston co-operating with the throat between the working cylinder and the combustion chamber to force air in predetermined, orderly paths into the combustion chamber.

4. In combination in an internal combustion engine, a working cylinder, a main piston therein, a separate combustion chamber having communication with the working cylinder and an auxiliary cylinder in communication with said combustion chamber, and an auxiliary piston freely movable in said auxiliary chamber adapted to force gas from said auxiliary cylinder to said combustion chamber solely in response to variations in gas pressure, and means providing a throat between said auxiliary chamber and said combustion chamber and means providing a throat between said working cylinder and said combustion chamber, said auxiliary piston co-operating with the throat between the auxiliary cylinder and the combustion chamber to force air in predetermined, orderly paths into the combustion chamber.

5. In combination in an internal combustion engine, a working cylinder, a main piston therein, means defining a separate combustion chamber having communication with the working cylinder and an auxiliary cylinder in communication with said combustion chamber, and an auxiliary piston freely movable in said auxiliary chamber adapted to force gas from said auxiliary cylinder to said combustion chamber solely in response to variations in gas pressure, and means providing a throat between said auxiliary chamber and said combustion chamber and means providing a throat between said working cylinder and said combustion chamber, said main piston co-operating with the throat between the working cylinder and the combustion chamber and said auxiliary piston co-operating with the throat between the auxiliary cylinder and the combustion chamber to force air in predetermined, orderly paths into the combustion chamber.

6. In an internal combustion engine, a main cylinder, an auxiliary cylinder, means defining a combustion chamber having substantially arcuate wall surfaces, and means providing communicating passages between the combustion chamber and the main cylinder and between the combustion chamber and the auxiliary cylinder, said passages at the point of connection with said combustion chamber being disposed respectively substantially tangent to the arcuate wall surface thereof and arranged to establish a substantially uniform path of movement for gases through said combustion chamber from said passages, and means within the said cylinders for delivering gases through said passages to the combustion chamber, said first mentioned means including a pressure responsive free piston in the auxiliary cylinder, and means for restraining said piston to move only in response to pressure variations during the high pressure period of the cycle.

7. In an internal combustion engine, means defining three vessels arranged in series, said vessels being separated by ported partitions, said vessels comprising a working cylinder, a combustion chamber, and an auxiliary cylinder, a pressure responsive member mounted for movement within the auxiliary cylinder to effect transfer of gases between the combustion chamber and said auxiliary cylinder, the ports in said

partitions defining gase nozzles for directing and controlling the flow of gas between said vessels, and means for yieldingly restraining said pressure responsive means against movement except during the high pressure period of the cycle.

8. In an internal combustion engine, a main cylinder, a piston within said cylinder, an auxiliary cylinder, means defining a combustion chamber having communication with both cylinders by gas nozzles disposed with respect to the wall surfaces of said combustion chamber to establish a substantially orderly movement of gas in a given direction through said combustion chamber when gases are discharged from either of said nozzles, a pressure responsive member movable within the auxiliary cylinder, and means defining a pressure chamber having communication with said auxiliary cylinder behind said pressure responsive member by means of a gas nozzle, and means for moving said piston and said pressure responsive means to evacuate the gaseous charges in the main cylinder and auxiliary cylinder respectively through said first mentioned nozzles into the combustion chamber.

9. In an internal combustion engine, means defining three vessels arranged in series, said vessels being separated by ported partitions, said vessels comprising a working cylinder, a combustion chamber, and an auxiliary cylinder, a pressure responsive member mounted for movement within the auxiliary cylinder to effect transfer of gases between the combustion chamber and said auxiliary cylinder, the ports in said partitions defining gas nozzles for directing and controlling the flow of gas between said vessels, and a fourth vessel separated from said auxiliary cylinder by a ported partition and defining a pressure receiver behind said pressure responsive member, whereby to yieldingly restrain said pressure responsive means against movement except during the high pressure period of the cycle.

10. In an internal combustion engine, a working cylinder, a working piston, means defining a combustion chamber disposed outside the confines of said working cylinder, said combustion chamber and said working cylinder being connected by a gas nozzle, an auxiliary cylinder disposed outside the confines of said main cylinder, and having communication only with said combustion chamber by means of a partition provided with a gas nozzle establishing communication between the combustion chamber and auxiliary chamber, and a pressure responsive member mounted in the auxiliary chamber and movable in response to variation in gas pressure only to effect transfer of gases between the combustion chamber and said auxiliary cylinder, said gas nozzles controlling and directing the passage of gas between said working chamber, combustion chamber and auxiliary cylinder in regular and orderly paths, and means for yieldingly restraining said pressure responsive member against movement except during high pressure period of the cycle.

11. The internal combustion engine described in claim 3 wherein the main piston cooperates with the throat between the working cylinder and said combustion chamber at the upper end of its stroke to change the effective area of said throat.

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