May 18, 1926. 1,585,377

J. H. CROMWELL

INTERNAL COMBUSTION ENGINE

Filed August 30, 1921

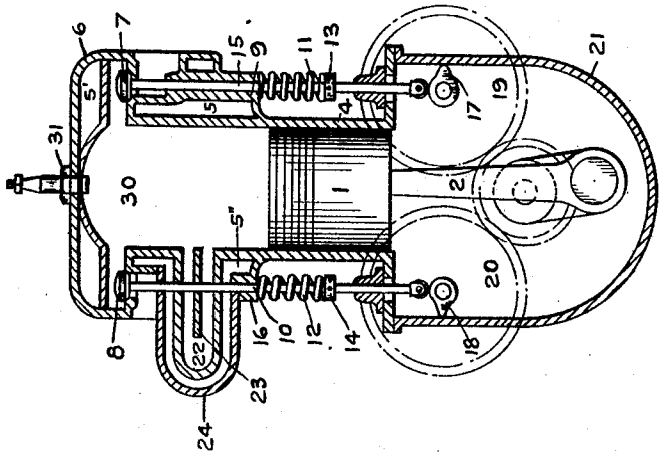


Fig-2

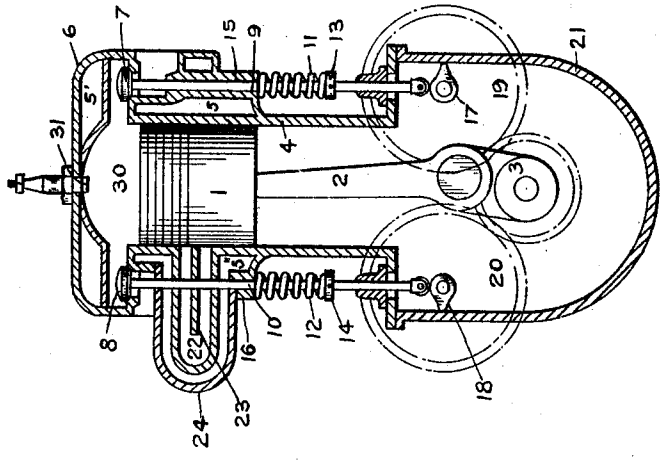


Fig-1

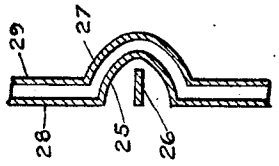


Fig-3

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Patented May 18, 1926. 1,585,377

UNITED STATES PATENT OFFICE.

JOHN HOWARD CROMWELL, OF LARCHMONT, NEW YORK.

INTERNAL-COMBUSTION ENGINE.

Application filed August 30, 1921. Serial No. 496,836.

The improvements relate to internal combustion engines, in which a charge of hydrocarbon vapor mixed with air is exploded by means of an electric spark or otherwise, for the purpose of generating power to propel vehicles, or for other purposes. In engines of this character there is usually a cylinder into which the gaseous fuel is inducted, and a piston reciprocating therein and alternately compressing the fuel and being in turn forced outwardly by the explosion, to produce the power stroke.

It has long been well recognized that a large percentage of the fuel used in engines of this character is not converted into power, and that various atmospheric and other conditions so affect the operation of the engine and the carbureter that the device is less efficient and more wasteful of fuel at certain times than at others. To remedy these defects various means have been devised, most of them having to do with the mixing and supplying of the gaseous fuel, the maintenance of favorable temperatures, and the ignition, but without even approximating an ideal percentage of efficiency. A very large percentage of the fuel is exhausted in the form of C O, or carbonic oxide, a combustible gas, and in addition to the wastage of fuel, various undesirable results, such as the contamination of the atmosphere and the fouling of the engine are produced.

I have discovered a means whereby the wastage of fuel can be avoided to a very material extent, and an increase of power and decrease in the undesirable results due to incomplete consumption of the fuel effected; and the present improvements relate to such means. It will be understood however that while the method of operation and the mechanical means employed must conform to certain requirements, in order to attain the result, the improvements are not limited to the particular details of construction and operation herein illustrated and described, and that the language of the appended claims is not to be restricted to the illustrative embodiment herein shown, but is intended to cover equivalent methods and means.

The improvements are two-fold, and comprise a method or process of igniting and consuming the gaseous fuel, as well as certain mechanism employed in the realization of the method.

The accompanying drawings illustrate an internal combustion engine, constructed to operate and operating in accordance with the present improvements, and in the said drawings Figure 1 is a vertical medial section of a cylinder and its accessories and adjacent parts of an internal combustion or explosion engine with the piston, valves, and some of the other parts in full lines, the parts being shown in their respective position at the end of the compression stroke and just before the power stroke, Fig. 2 a similar view of the same parts in their position at the end of the power stroke, and Fig. 3 a similar section of a modification.

It will be understood that the improvements may be utilized in two or four cycle engines, and in engines of any other type to which they may be applied. It will also be understood that the improvements are capable of being used with other fuel than liquid hydrocarbon provided the fuel has burning characteristics similar or analogous to those of gasoline.

1 illustrates the piston of the engine, 2 the connecting rod and 3 the crank, which forms a part of the driving shaft. 4 is the cylinder of the engine, 5, 5′, 5″, the cooling jacket, 6 the head, 7 and 8 the inlet and exhaust valves, respectively, 9 and 10 the valve tappets operating vertically in suitable sleeves in the engine casing, 11 and 12 the valve springs, 13 and 14 their collars, and 15 and 16 the outer casing of the cylinder jacket. Cams 17 and 18 operate the valves through gears indicated at 19 and 20, and the drive shaft and cranks of the engine are enclosed in an ordinary gear case 21. As these parts are the common and well-known parts of an engine of the type herein particularly referred to they need not be further described.

Extending laterally from the cylinder at a point intermediate between the extremities of the piston stroke is an auxiliary chamber 22, which may be in the form of a thimble tapped or cast in the wall of the cylinder and has its mouth, through which it communicates with the cylinder, equal to or greater than the diameter of its interior, so that it communicates freely with the cylinder for all purposes, and does not trap

any of the fuel or products of combustion. A horizontal partition 23 extends longitudinally of this auxiliary chamber from its mouth to a point nearer its inner end and spans the bore thereof from side to side, so that fluid passing through the said chamber must pass over one side of this partition around its inner end and then over the opposite side. In this manner the partition divides the auxiliary chamber into two chambers communicating interiorly, insures a circulation of gases and other fluids therein, so that it is properly charged, discharged and scavenged, and serves other purposes. Tests have demonstrated that this partition, or its equivalent, is very important to the successful and efficient operation of the present form of the improvements.

In the modification shown in Fig. 3, the auxiliary chamber 25 is relatively shallow and flares outwardly, the partition 26 extending closer to its rear wall. In this figure 28 represents the wall of the cylinder, 29 the outer wall of the cooling jacket, and 27 the portion of the said jacket wall extending over the auxiliary chamber. Various other modifications may be employed without departing from the scope of the invention. This modification, or a similar modification, is preferred for high speed engines.

The outer wall of the water jacket extends around the auxiliary chamber 22, as shown at 24, so that the auxiliary chamber has ample provision for cooling.

The position of the auxiliary chamber will depend to some extent upon the character and dimensions of the other parts, but in the illustrative embodiment it is shown in connection with an engine in which its position should be about midway between the extremities of the piston stroke. In this engine, however, it may be a little above or a little below that point and still give very satisfactory results. If desired two or more of these auxiliary chambers in line or at different points in the circumference of the cylinder may be employed, or the chamber may be of curved tubular form with two open ends at different points in the length of the cylinder. These, and other modifications will enable those skilled in the art to fully realize the advantages of the invention.

The chamber 22, as shown, has an internal diameter of about one-fourth the internal diameter of the cylinder, and its length is approximately equal to the diameter of the cylinder. A chamber of these proportions has been found to be satisfactory when located as shown, in an engine of medium compression, but in an engine of lower or high compression it is advisable to locate it nearer or farther away from the compression space as the case may be, and to vary its proportions to some extent. These matters are also influenced by the construction and character of the engine, and the best practice must therefore be determined in each new case.

In operation the auxiliary chamber is filled with gaseous fuel when the main cylinder is filled on the intake or suction stroke, and the fuel is compressed to a greater or less extent, depending upon the particular location of the chamber, on the compression stroke, the mouth of the chamber being closed by the piston when the piston is at the end of its compression stroke, and the fuel therein being isolated from the fuel in the compression space 30. When the charge is ignited by the spark of the plug 31 the piston is forced downwardly and uncovers the mouth of the auxiliary chamber, thereby causing the ignition of the fuel in the chamber and a re-ignition thereby of the unconsumed fuel in the cylinder. It will thus be seen that there are three explosions and three power impulses for each power stroke of the piston, viz: The initial explosion on the ignition of the fuel in the compression space by the spark, the second explosion when the fuel in the chamber is ignited, and the third explosion when the unconsumed fuel in the cylinder is re-ignited by the second explosion from the chamber. On the exhaust stroke of the piston gases in the cylinder rushing past the mouth of the chamber, and the action of the piston on the gases in the chamber will cause the said gases to be drawn therefrom, so that when fresh fuel is drawn into the cylinder the chamber is filled with fresh fuel. The partition 23 in this connection performs an important function, and it will be found that the chamber does not become fouled with carbon or other by-products of combustion. It will also be found that the cylinder and its valves are cleaner; that less smoke and poisonous gas is discharged; that an increase in the power and speed of the engine with the normal supply of fuel results; and that the power and speed of an ordinary engine of the construction to which the improvements are applied may be obtained with a smaller consumption of fuel.

It will be noted that the capacity of the auxiliary chamber is greatly inferior to that of the cylinder, and while the explosive force of the fuel in the said chamber adds to the power of the piston stroke to some extent, it is the re-ignition thereby of the gases in the cylinder that effects the greatest improvement in the operation of the engine and constitutes the most important factor in the attainment of the advantageous results hereinbefore referred to, according to present observations. The cross sectional form of the chamber and its mouth may be varied and the form and arrangement of the parti-

tion therein may be changed, but the form and arrangement of these parts as illustrated have been found to produce highly efficient results.

It will be noted that the auxiliary chamber is imperforate throughout, and does not communicate with any other chamber or part, and that there are no movable parts therein. This form, or its equivalent, has been found to give most advantageous results, and is the best form of embodiment at present employed.

The term "re-igniting" in the claims refers to the operation herein described, in which the fuel is subjected to the action of a second igniting means, but it is not intended to limit the invention claimed to two or more separate ignitions of the fuel. The exact action cannot be accurately ascertained, but the term referred to seems the most apt description of the action.

What I claim is:—

1. An internal combustion engine comprising a cylinder, a piston mounted to reciprocate therein and to induct into the cylinder and compress gaseous fuel, an auxiliary chamber communicating with the cylinder intermediate the extremities of the piston stroke, a partition in said chamber, and said chamber having a passage around said partition in communication with the cylinder.

2. An internal combustion engine comprising a cylinder having an auxiliary chamber intermediate between the extremities of the piston stroke, said chamber communicating with the cylinder by means of a mouth, and such chamber being provided with a means co-operating with the piston for scavenging and refilling, without any passages or communication between the chamber and any other, and without moving parts within the chamber.

3. An internal combustion engine comprising a cylinder, a piston mounted to reciprocate therein and to induct into the cylinder and compress gaseous fuel, an auxiliary chamber communicating with the cylinder along the path of the piston stroke, said chamber having a mouth which communicates with the cylinder, and a fixed member in said chamber co-operating with the piston for causing a circulation of gases therein, said chamber being otherwise unobstructed at all times.

4. An internal combustion engine comprising a cylinder, a piston mounted to reciprocate therein and to induct into the cylinder and compress gaseous fuel, an auxiliary chamber communicating with the cylinder along the path of the piston stroke, said chamber being of relatively small diameter throughout and having a mouth which communicates with the cylinder throughout a minor part of the circumference of the cylinder, and a fixed member in said chamber cooperating with the piston for causing a circulation of gases therein, said fixed member being constructed and arranged to obstruct the free lateral movement of gases in said auxiliary chamber and to direct a portion of the fluid entering the mouth of the same over the walls thereof and a portion over the inner end thereof.

Witness my hand this 29th day of August, 1921, at the city of New York, in the county and State of New York.

JOHN HOWARD CROMWELL.