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METHOD FOR GASIFYING, IGNITING, AND CONTROLLING THE COMBUSTION OF FUEL.

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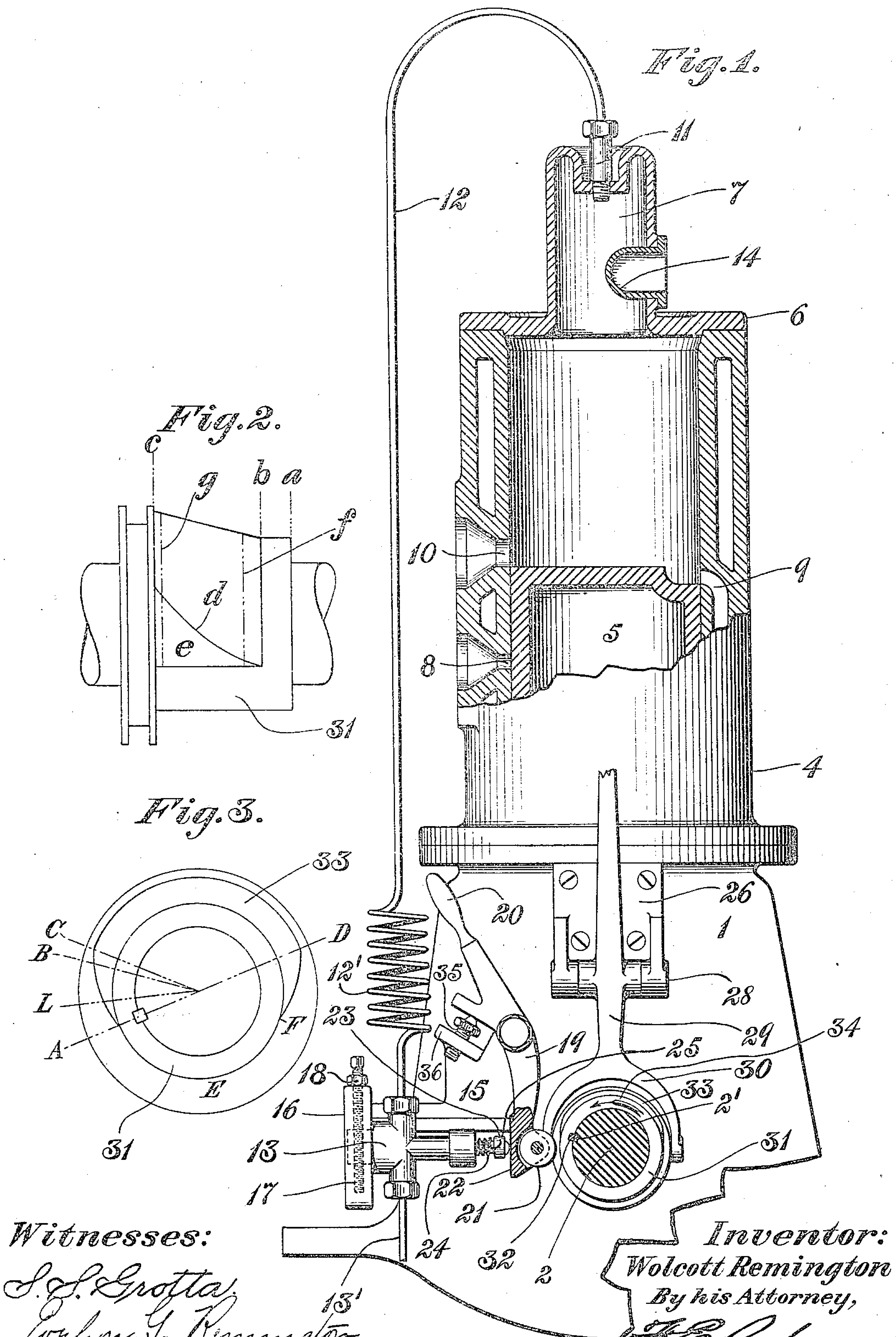

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METHOD FOR GASIFYING, IGNITING, AND CONTROLLING THE COMBUSTION OF FUEL.

951,093. Specification of Letters Patent. Patented Mar. 1, 1910.

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To all whom it may concern:

Be it known that I, WOLCOTT REMINGTON, a citizen of the United States, residing at Stamford, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Methods for Gasifying, Igniting, and Controlling the Combustion of Fuel, of which the following is a specification.

This invention relates to an improved method of gasifying and burning fuel in what are known as "internal-combustion" engines, and although limited to the use of no particular kind of fuel said invention is adapted to produce a perfect result with any of the heavy mineral oils.

In one method of vaporizing and igniting fuel known to me oil is first vaporized by contact with a hot surface, the vapor is then mixed with air and compressed, and the mixture is finally ignited either by an electric spark or by engagement with a highly-heated surface. In this method there is more or less cracking of the oil, and it is broken up into its elements sufficiently to cause separation of the carbon, which is always detrimental. Furthermore, the compression before combustion takes place is limited to five or six atmospheres, as at about that point the mixture will fire from the heat generated by its compression. In another method air alone is compressed to such a degree that its temperature is above the igniting point of the fuel, and then said fuel is injected, combustion taking place when it comes into contact with the highly-compressed air. In this method mechanical difficulties and heavy expense are incurred in manufacturing an engine in which this extremely high compression can be maintained, and such engine when operated by this method can not be reduced in speed much below normal, for if it were the walls of the cylinder would absorb so much of the heat of compression that the temperature of the air at the time of injection of the fuel would not be high enough to ignite it. Again, in this method none but the first particles of fuel which enter the cylinder at each injection come directly into contact with pure air, and as said particles are immediately ignited on contact with the air, the succeeding particles must necessarily pass through the products of combustion and, therefore, imperfect combustion takes place.

After a series of experiments I have discovered that perfect combustion of the oil or other fuel may be obtained by compressing air, or air and water-vapor, to such a degree that its temperature is above that necessary for vaporizing the fuel, but below the temperature at which the fuel ignites, and then injecting the fuel into the compressed-air in such a manner that it passes through the same, is vaporized thereby, and then comes into contact with a heated surface remote from the point of injection, the temperature of which surface is sufficiently high to ignite it.

When this method is employed with internal-combustion engines air is first compressed by the piston into a chamber in communication with the cylinder of the engine to such a degree that its temperature is above the temperature necessary for boiling or vaporizing the fuel, but below the temperature at which the fuel ignites, as above stated. After this operation has taken place, and at or just before the start of the working-stroke of the piston, fuel is injected into the volume of compressed air in said chamber, and passing through the same is first vaporized, then comes into contact with the heated-surface described, and is ignited at a point remote from the point of injection. It will, therefore, be seen that all particles of fuel come directly into contact with clean compressed-air of a temperature high enough to cause their vaporization, and that when the first particles of the now vaporized fuel pass through the compressed-air and reach the heated surface they are ignited thereby, and that all succeeding particles are ignited as they enter the flame produced by the combustion of the preceding particles. Consequently, the flame of combustion will start at the heated-surface, and will burn back to the point of injection.

In engines built on this system considerable variation in speed is permissible, as the ignition of the fuel is caused by the heated-surface described when its particles percolate through the volume of compressed-air and come into contact with said heated surface. It will thus be seen that the temperature of the heat of combustion will keep above the igniting point of the fuel independent of the heat generated by the compression of the air, and that, inasmuch as the fuel is vaporized at a point much below the temperature required for its ignition, the heat lost in radiation will not materially affect the vaporization of the fuel. As only a small portion of the fuel enters the chamber leading to the cylinder of the engine before ignition takes place there will be but a slight rise in pressure, after this the rate of combustion and the pressure will be entirely controlled by the amount of supply of the fuel. After cut-off has taken place the work is, of course, done by the expansion of the heated gases. Should the load be increased the maximum pressure in the cylinders does not increase, as it simply continues for a longer portion of the stroke, and, conversely, with a decrease of load the maximum pressure will continue for a shorter portion of the stroke.

From what has been stated it will be seen that the particles of food are injected into the volume of compressed-air in the chamber at a point, for instance, above the heated surface, and that as such compressed-air is of sufficient temperature to vaporize the fuel, a mixture of fuel-vapor, and compressed-air results while the feed-supply is continued. and that the entrained particles of vapor finally reach the heated-surface by which they are ignited. The combustion of these first particles will cause that of the following particles, the propagation of the flame thus started extending toward the point of injection, but being so retarded by the force of injection of the fuel that it will only reach the said point of injection as the last particles of the charge enter the chamber. As the path of the combustion or flame is at all times surrounded by pure air and no particles of the fuel are permitted to come into contact with the walls of the chamber and only to a very limited extent with the heated bulb, the result of the combustion is very clean or complete instead of the usual residuum caused by the separating of the fuel into its elements upon contact with the heated walls of the combustion chamber. Thus complete combustion takes place, and after the cut-off the expansion of the gases causes the working-stroke of the piston. Owing to this fact no tarry or foreign residuum due to imperfect combustion of the fuel is left in the cylinder to clog the piston thereof.

While shown in the drawings applied to a two-cycle internal-combustion engine it is distinctly to be understood that the invention is not limited in this respect; nor is it necessarily limited to internal-combustion engines, for complete combustion of all particles of the fuel will take place when the method is employed in other relations.

While intended particularly as a method of producing complete combustion of the heavier grades of mineral oils (for instance kerosene and its analogues) it is distinctly to be understood that the invention is not limited to any special kind of fuel, for such fuel may be solid, liquid, or gaseous if desired, the solid fuels being introduced, of course, in a pulverulent condition.

In the accompanying drawings, one form of apparatus viz.—a two-cycle internal combustion engine is shown, and in said drawings Figure 1 is an end view partially in section of an internal-combustion engine which may be of any desired construction. Figs. 2 and 3 are detail views of the feed-controlling cam.

Like characters designate similar parts throughout the several views.

Referring to the drawings, the numeral 1 designates the frame of the engine, said frame being of any approved type, and 2 the crank-shaft carrying the usual fly-wheel not shown, the inertia of which causes the return of the piston and the compression of air in the chamber above the cylinder to a point sufficient to generate heat necessary to vaporize the fuel, but not to ignite the same.

Bolted to the frame or base 1 is a cylinder 4 in which works a piston 5, and in the exemplification given secured to the top of said cylinder is a head 6 having a chamber 7 in which air is compressed by the piston in the manner just stated. In the cylinder are inlet-ports 8 and 9, through which fresh air is drawn by the piston, and an exhaust-port 10 to permit the escape of the products of combustion. Passing through the top of the chamber 7 is a nozzle 11 through which fuel is admitted, said device being, when hydrocarbon fuel is employed, a spray-nozzle, and communicating with this nozzle is a pipe 12 leading to an oil-pump 13. Projecting from the inner wall of chamber 7 adjacent to its lower end is a hollow steel hemisphere 14, which will be heated externally by a torch in starting the engine, and is subsequently kept hot enough to ignite the fuel by the internal heat of the chamber.

Designated by 15 is a bracket bolted to the frame or base 1, and having an extension 16. On this extension the pump 13 is mounted and is capable of vertical adjustment by means of a screw 17 secured by a lock-nut 18. To the bracket 15 is pivoted a lever 19 having a handle 20 at its upper end and carrying an anti-friction roller 21 at its lower end. Adjacent said roller the lever is provided with a flattened surface 22 against which bears the end of the piston rod 23 of the pump 13. Surrounding said piston-rod is a helical spring 24 located between a collar 25 of the rod and the end of the pump.

A pipe 13′ leads from the pump to the source of oil-supply.

A depending bracket 26 is bolted at its upper end to the base or frame 1, and to the free end of said bracket is pivoted at 28 a controlling-lever 29. At its lower end the controlling-lever is forked at 30, and the arms of this fork are each adapted to receive the trunnions of a yoke, fitted in a groove of a cam 31. This cam is of peculiar configuration, as will be presently described, and is capable of sliding motion on the engine-shaft 2, a spline or feather 2′ of which fits in a groove 32 in the inner wall of the cam. This cam varies in height, and it is made by first working it out on a profiler to form the eccentric peripheral portion 33 extending from one end of its surface to the other. It is then turned to true cylindrical shape between the lines *a* and *b*, and then from the line *b* to the line *c* the eccentric portion will be turned on a taper of one in ten, the line *d* representing the intersection of the tapered part with the eccentric part *e* of the cam. Said cam may be adjusted along its shaft by means of the lever 29, and the key 2′ of said shaft is so located that the cam will be in position to start the pump by acting against the roller 21 of lever 19 at or just preceding the working-stroke of the piston 5. An arrow 34. Fig. 1 designates the direction in which the cam rotates, and the pump will be started and the fuel will commence to flow when the point A of the eccentric part 33 of the cam engages the roller 21, and the pump will continue to feed said fuel, the amount of supply being governed by the position of the cam along its shaft. Should the cam be held by the controlling lever so that the part *f* thereof (Fig. 2) is opposite the roller 21 of the pump-actuating lever 19 the fuel will flow through that part of the stroke of the piston 20 corresponding to the arc of rotation A—L of the cam. If any part of the cam between the lines *a* and *b* (Fig. 2) should be opposite the roller 21 the piston of the pump will not be actuated and there will be no feed of the fuel. At the point *g* of the cam, which will be opposite the roller 21 at full load, the pump will be actuated and the fuel will flow through that part of the piston-stroke corresponding to the distance between the points A—B of the cam (Fig. 3), said arc corresponding to about one tenth of the piston-stroke, although it may vary in this respect. Between the points C and D (Fig. 3) the piston-rod of the pump will be held advanced. After the roller 21 leaves the point D, the spring 21 will return the piston and its operating lever 19 to normal positions in readiness for a repetition of the operation.

Should the roller 21 be permitted to engage cam 31 through arc A E F, irregularities in the surface of said cam would produce a slight action of the pump piston thereby causing an objectionable flow and waste of oil, therefore contact of roll 21 with the low part of the cam is prevented by limiting the throw of the lever 19 by means of an adjustable stop screw 35 threaded in a projecting lug 36 of the bracket 15. By manipulation of said stop screw the distance between roll 21 and the low part of cam 31 may be varied thereby changing the relative position of the crank at the time the oil starts to enter the cylinder and also the time of ignition. The ability to obtain this variation in the time of ignition results in better economy when running the engine at different speeds, also in the use of different fuels. The lever 19 is provided with a handle 20 by means of which the pump may be operated manually if necessary.

By adjusting the pump either up or down by means of the screw 17 the stroke of its piston may be regulated, according to the location of the end of the piston-rod along the flat surface 22 of lever 19, and to enable adjustment to be made without trouble the pipe 12 is formed into a coil at 12′.

By raising the pump in the manner described the end of its piston-rod 20 is brought nearer the pivot of the swinging-lever 19, and due to the shorter arc of movement of the point of the surface 22 against which the end of the rod rests, the pump will supply a less amount of fuel, while by lowering said pump a reverse condition occurs, and there will be an increase in the supply of fuel delivered.

This application is a division of my application filed February 25th, 1908, Serial Number 417,705.

Having thus described my invention, what I claim is—

1. The method of consuming fuel which consists in first compressing air to such a degree that its temperature is above the vaporizing point of the fuel but below the temperature at which the fuel ignites, then injecting the fuel into the compressed-air, and finally igniting said fuel at a point beyond the point where it was injected.

2. The method of vaporizing, igniting and controlling the combustion of fuel in internal-combustion engines, which consists in compressing air to such a degree that its temperature is above the temperature necessary for vaporizing the fuel, but below the temperature at which the fuel ignites, then at approximately the beginning of the working-stroke of the engine injecting the fuel into the compressed-air, and, finally, igniting the now vaporized fuel at a point remote from the point of injection.

3. The method of vaporizing, igniting and controlling the combustion of fuel, which consists in first compressing air to a degree where its temperature will be above the

temperature at which the fuel vaporizes, but below the temperature at which the fuel ignites, then injecting the fuel in such a manner that it passes through the compressed-air and is vaporized, and finally bringing said fuel into contact with a heated-surface by which it is ignited.

In testimony whereof I affix my signature in presence of two witnesses.

WOLCOTT REMINGTON.

Witnesses:
GEORGE R. CLOSE,
JOSEPH G. HOUGHTON.