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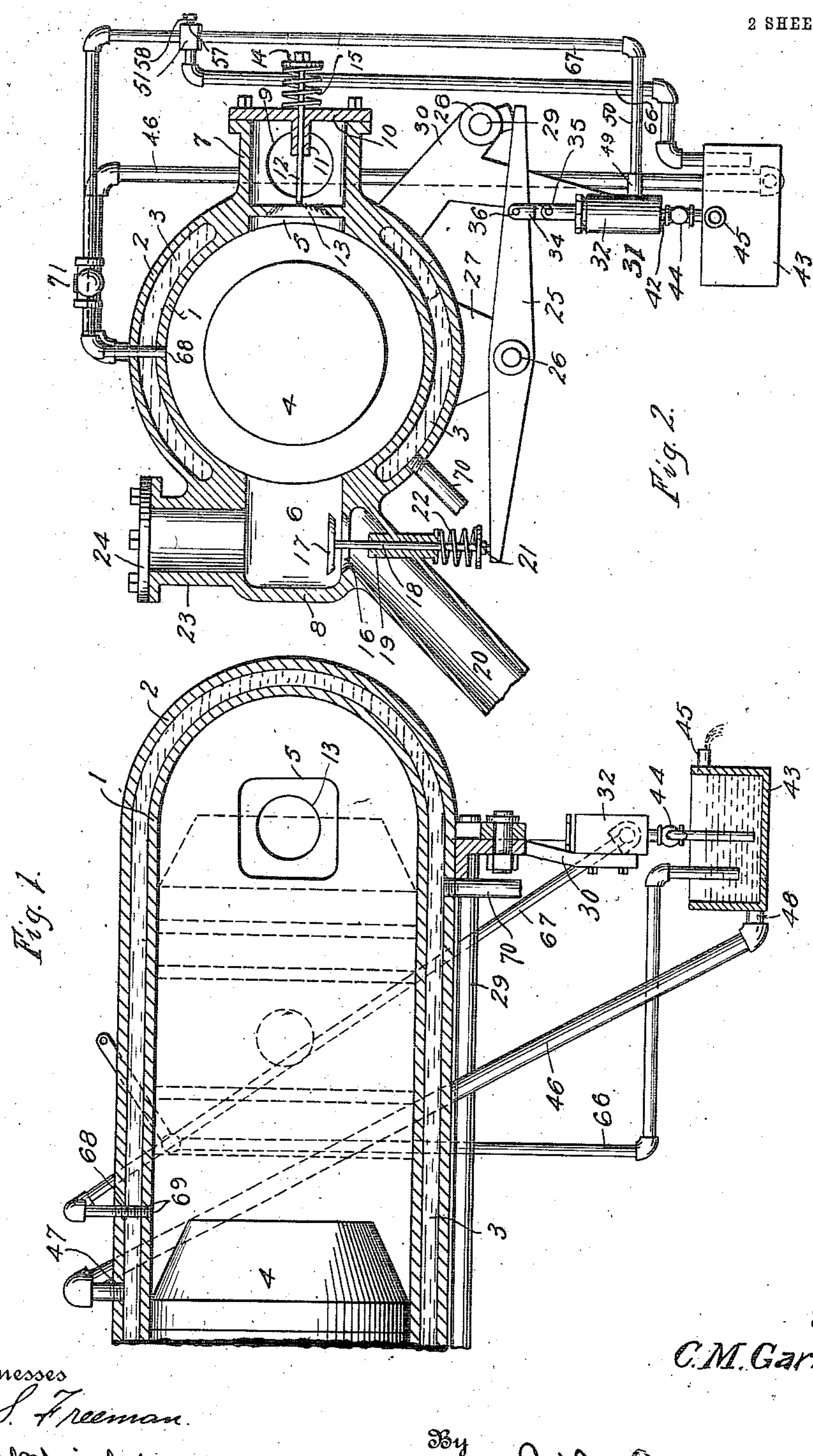
INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 5, 1910.

995,530. Patented June 20, 1911.

2 SHEETS—SHEET 1.



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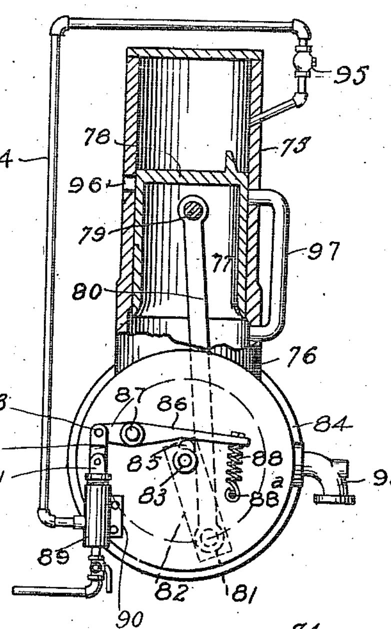

Fig. 4.

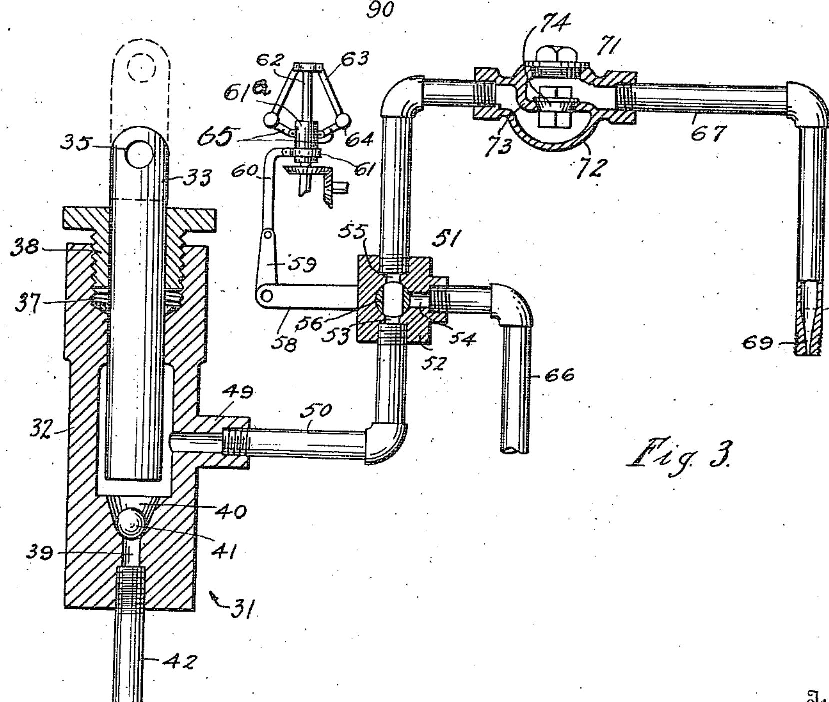

Fig. 3.

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

995,530. Specification of Letters Patent. Patented June 20, 1911.

Application filed July 5, 1910. Serial No. 570,346.

To all whom it may concern:

Be it known that I, Claude M. Garland, a citizen of the United States, residing at Urbana, in the county of Champaign and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines.

An important object of this invention is to provide an internal combustion engine, with means for injecting a cooling medium within the cylinder of the same, so that the inner walls of said cylinder and other surfaces exposed to the heat of combustion of the fuel, may be reduced in temperature during the exhaust strokes, sufficiently to allow of a high compression of the charge of fuel and air within the same, before such charge is ignited.

An important object of this invention is to provide an engine of the character described, which is simple in construction, cheap to manufacture, positive in its operation, of high efficiency, developing a high power for a given size of cylinder and using a small amount of cooling water.

It is well known that the explosive pressure of a charge of fuel and air, when ignited in the cylinder of an engine, is dependent upon the pressure that such charge is subjected to, at the time of ignition. In my engine the fuel and air may be subjected to a very high degree of compression, before being ignited, whereby the operation of the engine is rendered very efficient. This high degree of compression of the fuel and air or charge, is rendered possible by the proper cooling of the inner walls of the explosion cylinder. If the inner walls of the explosion cylinder and other surfaces exposed to the heat of combustion are not properly cooled, they impart their heat to the charge, which charge, when being compressed to a high degree may be prematurely ignited. The premature ignition of the charge in the manner above stated, may result in serious accidents, and has limited to a certain degree, the high compression of the charge before being ignited. In my engine, I introduce a cooling medium such as water, into the explosion cylinder, at or just before the exhaust port is opened, whereby the water is converted into steam and the inner walls of the explosion cylinder and the exploded charge which is being exhausted, are reduced in temperature to about 300° F.

Other objects and advantages of my invention will be apparent hereinafter, reference being had to the accompanying drawings forming a part of this specification, wherein,

Figure 1 is a longitudinal vertical sectional view through the cylinder of my engine, Fig. 2 is a transverse vertical section through the same, Fig. 3 is a detail sectional view through a pump constituting a portion of my invention, and showing in elevation its associated members, and Fig. 4 is a central vertical sectional view of a modified form of engine, parts thereof being shown in elevation.

Like numerals are employed to designate like parts throughout the drawings.

In the drawings, wherein a preferred embodiment of my invention is illustrated, the numeral 1 designates the explosion cylinder of a four-cycle internal combustion engine, which is surrounded as shown by a jacket 2 to form a water space 3 between the same. Within the explosion cylinder 1 is mounted a piston 4, as shown, which reciprocates within the explosion chamber in the usual manner, and is connected with a crank shaft (not shown), by any suitable means. The explosion cylinder is provided near its closed end with oppositely disposed inlet and exhaust ports 5 and 6. These ports are provided, as shown, with casings 7 and 8. The casing 7 has an opening 9 formed through one of its walls, whereby fuel and air may be fed to the explosion cylinder through the port 5. The casing 7 has one end thereof closed by means of a head 10, provided centrally thereof with an apertured boss 11, through which is slidably mounted a valve stem 12. This valve stem has a valve 13 rigidly connected to the inner end thereof, which valve is adapted to open inwardly and normally close the port 5. The valve stem 12 is provided at its outer end with a washer 14, and a compressible coil spring 15 surrounds the valve stem, as shown, and is confined between the washer and the head 10. It is thus seen that the valve is controlled by the spring 15, and that the same will be automatically unseated when a partial vacuum is created within the explosion cylinder. The casing 8 is provided with an opening 16, and the wall of this opening serves as a seat for a valve 17, which is rigidly mounted upon a vertically disposed valve stem 18. This valve stem is mounted to reciprocate through an opening formed in a boss 19, which in turn is formed upon a pipe 20. The valve stem 18 is provided at its outer end with a washer 21, which engages a compressible coil spring 22 surrounding a portion of said valve stem and confined between said washer 21 and the boss 19. The casing 8 is further provided with a cylindrical tubular portion 23, which leads into the casing 8 and which is normally closed by a head 24. The tubular portion 23 serves as means whereby access may be had to the interior of the explosion cylinder and to the valve 17.

The valve 17 is not automatic in its action, but is mechanically operated by a lever 25, which is pivoted near its center, as shown at 26, to a bracket 27 which is fixedly connected to the jacket 2 in any desired manner. It is to be understood that the spring 15 is much slighter than the spring 22, whereby the valve 13 will be unseated by a vacuum within the explosion cylinder. The lever 25 is oscillated by a cam 28, which is rigidly mounted upon one end of a rotary cam shaft 29. This cam shaft is journaled to a portion of an approximately inverted L-shaped bracket 30 which is fixedly connected with the jacket 2. The cam shaft 29 extends forwardly and longitudinally of the explosion cylinder 1 and is connected with the crank shaft (not shown), by suitable gearing (not shown), so that the cam shaft will be rotated one revolution for every two revolutions of said crank shaft. The numeral 31 designates a pump, comprising a cylindrical casing 32, which is bolted or otherwise rigidly connected with one arm of the bracket 30. A plunger 33 is mounted to reciprocate within this pump casing, and said plunger is pivotally connected with a link 34, as shown at 35, and said link is in turn pivotally connected with the lever 25, as shown at 36. The casing 32 is provided with a cylindrical internally screw threaded recess 37, to receive suitable packing for the plunger 33. A member 38 is disposed within the recess 37, as shown. The casing 32 is provided with an inlet opening 39 which has its upper end enlarged as shown at 40, to receive a ball-valve 41. A pipe 42 has communication with the opening 39 and has its free end disposed within a tank 43. This pipe is provided with a cut-off valve 44. The tank 43 is provided near its upper end with a discharge pipe 45. A discharge pipe 46 is connected to the forward end of the jacket 2, as shown at 47, and to the lower end of the tank 43, as shown at 48. The pipe 46 thus establishes communication between the space 3 and the interior of the tank 43. The pump casing 32 is provided with an apertured extension 49, within which is screw threaded one end of the pipe 50. The pipe 50 is connected with a three-way valve structure 51, comprising a body portion 52, through which is formed the three ports, 53, 54 and 55. This valve structure further comprises a valve 56, rigidly mounted upon a stem 57 which is journaled through the body portion 52 and rigidly connected with a lever 58. This lever 58 is pivotally connected with a link 59, which in turn is pivotally connected to a bar 60 having connection with an annular portion 61, which is loosely mounted within a groove formed upon the periphery of a slidable member 61ª of a centrifugal governor. This centrifugal governor comprises a rotary shaft 62, to which are pivoted arms 63 carrying the weights 64. The weights 64 are pivotally connected with the member 61ª, by means of links 65. It is to be understood that this centrifugal governor is driven by the crank shaft of the engine in the usual manner.

A pipe 67 is suitably connected with the valve structure 51, as shown, and extends forwardly and upwardly and is provided with an end portion 68, which passes through suitable openings in the cylinder 1 and the jacket 2, as shown, to establish communication between the interior of the explosion cylinder 1 and the port 55. Special attention is called to the fact that the pipe 68 communicates with the interior of the cylinder 1 near its forward end, so that the same may deliver a cooling liquid upon or adjacent the piston head 4, when said piston head is in its forward position, as shown. The axial opening of the pipe 68 is tapered, as shown at 69, so that the liquid discharge from the same will be sprayed. The jacket 2 is provided with a supply pipe 70, by means of which fresh water may be supplied to within the space 3, and the discharge pipe 46 connected at 47 discharging this water into tank 43 at 48. The pipe 67 is controlled by a check valve 71, comprising a casing 72, a transverse section of material 73 and a valve 74. This check valve is to prevent the pressure within the explosion cylinder from being conducted back to within the pump cylinder.

In the operation of the form of my invention above described, assuming that the piston 4 is in its rearmost position and that a charge of fuel has been introduced within the cylinder and compressed by the rearward movement of the piston, said charge is now ignited and the piston driven to its most forwardly position and then the cam 28 will oscillate lever 25 to unseat the valve 17. The exploded charge may now pass through the exhaust port and the same is accordingly driven through said port 6 and pipe 20 upon the second movement of the piston, which is toward the rear of the engine. At about the same time that the exhaust port is opened or immediately before, a supply of water is injected through the pipe 67 into the cylinder 1. This injection of water is converted into steam and absorbs heat from the piston 4, the cylinder 1 and from the exploded charge. This steam is now driven from the cylinder 1 through the port 6, together with the exploded charge. Owing to the property of water to absorb heat, the exploded charge will be reduced in temperature to about 300° F., whereby the explosion cylinder 1 will not be heated above 300° F. By thus retaining the temperature of the cylinder 1 at about 300° F., the explosive charge may be highly compressed without any danger of the same being prematurely ignited. Upon the third and forward movement of the piston 4, the valve 17 having been seated, a partial vacuum is created within the explosion cylinder 1, whereby valve 13 is unseated and a new charge introduced into said explosion cylinder. Upon the fourth and rearward movement of piston 4, the valve 13 is seated and the new charge compressed. When the piston has reached its rearmost position, the charge is fired, and the same operation is repeated. It is thus seen that whenever the exhaust port is opened the pump 31 is actuated, and a cooling medium is introduced within the explosion cylinder. The temperature of the exploded charge in the cylinder 1, varies in proportion to the load placed upon the engine, so that when the load is taken off of the engine, the temperature of the exploded charge and the inner wall of the cylinder 1 is reduced. This reduction in the temperature of the charge and the cylinder 1, is compensated for by injecting a smaller amount of the water within the cylinder. The amount of water to be injected is automatically regulated by the centrifugal governor, which when the load is taken off the engine and the engine speeds up, raises the lever 58 and rotates the valve 56 so that a portion of the water pumped through the pipe 50 may be conducted through the pipe 66 and back to the tank 43. A similar action occurs when the engine slows down below the normal running speed, so that the arm 58 is depressed, allowing a portion of the water to pass through the pipe 66 to the tank 43. When the engine stops, the port 55 is closed by the above action. When the water is injected into the cylinder 1, the same passes through the tapering opening 69, whereby such water is sprayed into the cylinder, and its conversion into steam is rendered easier.

In Fig. 4 I have illustrated a slightly different form of my invention, and the same is embodied in a two-cycle internal combustion engine, comprising a cylindrical casing 75 serving as an explosion cylinder and extending downwardly to form a closed crank case 76. A hollow piston-head 77 is slidably mounted within the explosion cylinder, and provided near its head 78 with a transverse pin 79 upon which is pivotally mounted a pitman 80, having its lower end pivotally connected, as shown at 81, with a crank 82. This crank is connected with a crank shaft 83, which is journaled through the walls of the crank case 76. A fly-wheel 84 is rigidly connected with one end of the crank shaft 83, as shown. The crank shaft 83 is further provided upon its opposite end with a cam 85, which is rigidly connected with the same and disposed to oscillate a horizontally disposed lever 86, pivoted to the crank case, as shown at 87. This lever has one end thereof connected with a retractile coil spring 88, the opposite end of which is connected with the crank case, as shown at 88ª. A pump 89 is provided, which is similar in construction to the pump described in connection with Figs. 1 and 2, and therefore no detail description of this pump will be given. The pump 89 is vertically disposed, and is rigidly connected to the crank case, as shown at 90. The plunger 91 of the pump 89, is pivotally connected with a link 92, which in turn is pivoted to the lever 86, as shown at 93. A pipe 94 serves to establish communication between the pump 89 and the interior of the explosion cylinder of the engine. This pipe 94 enters the explosion cylinder at a point approximately equi-distant between the head of the cylinder and the head 78 of the piston head, when said piston head is in its lowermost position. The pipe 94 is provided with a check valve 95, which prevents the pressure within the explosion cylinder from being conducted to the pump 89. The explosion cylinder 75 is provided with an exhaust port 96, which is uncovered by the piston head before the same reaches its lowermost position. A pipe 97 establishes communication between the crank case and the explosion cylinder, said pipe enters the explosion cylinder at a point below the exhaust port. The crank case is provided with an inlet pipe 98, which is to be provided with a check valve.

The operation of a two-cycle engine is well known and the same will not be recited in detail. When the piston travels downwardly, the cam is rotated to oscillate the lever 86, whereby the pump 89 is operated and a stream of water or the like is injected into the explosion cylinder at or immediately before the exhaust 96 is uncovered. The injected water is converted into steam and lowers the temperature of the exploded charge thus keeping the inner walls of the explosion cylinder at a temperature of about

300°. F. The amount of the water to be injected into the engine may be regulated by the valve 44. In this form of my invention the centrifugal governor may be dispensed with, and the amount of the water injected within the cylinder is sufficient to properly cool the exploded charge and the walls of the cylinder 75, and other parts exposed to the heat of combustion, when the engine is operating at zero load. The increased temperature of the exploded charge when a load is placed upon the engine, is not sufficient in an engine of this type to cause any trouble.

I wish it understood that the form of my invention herewith shown and described, is to be taken as a preferred example, and that certain changes may be resorted to in the shape, size and arrangement of parts, without departing from the spirit of my invention or the scope of the subjoined claim.

Having thus fully described my invention, what I claim as new and desire to secure by Letter Patent, is:

In an internal combustion engine of the character described, a substantially horizontally arranged explosion cylinder provided with inlet and exhaust means, valves to control said means, a lever having pivotal connection intermediate its ends with said explosion cylinder, and disposed to operate one of said valves, means to operate said lever synchronously with the speed of the engine, a bracket rigidly connected with said cylinder, a pump connected with said bracket, connecting means between said pump and lever, a tank having communication with said pump, a three-way valve structure, a conduit connecting said valve structure and pump, a by-pass conduit connecting said valve structure and tank, a conduit connected with said valve structure and having its discharge end extending through the explosion cylinder for supplying a cooling medium within said cylinder at a point near the forward end of the same, a centrifugal governor to actuate said three-way valve structure, an outer casing surrounding the explosion cylinder for forming a water space therebetween, a conduit for establishing communication between said water space and tank, a conduit for supplying material within the outer casing, and a check valve connected with the third named conduit.

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

CLAUDE M. GARLAND.

Witnesses:

PAULINE A. FRECH,

HARRY FRECH.