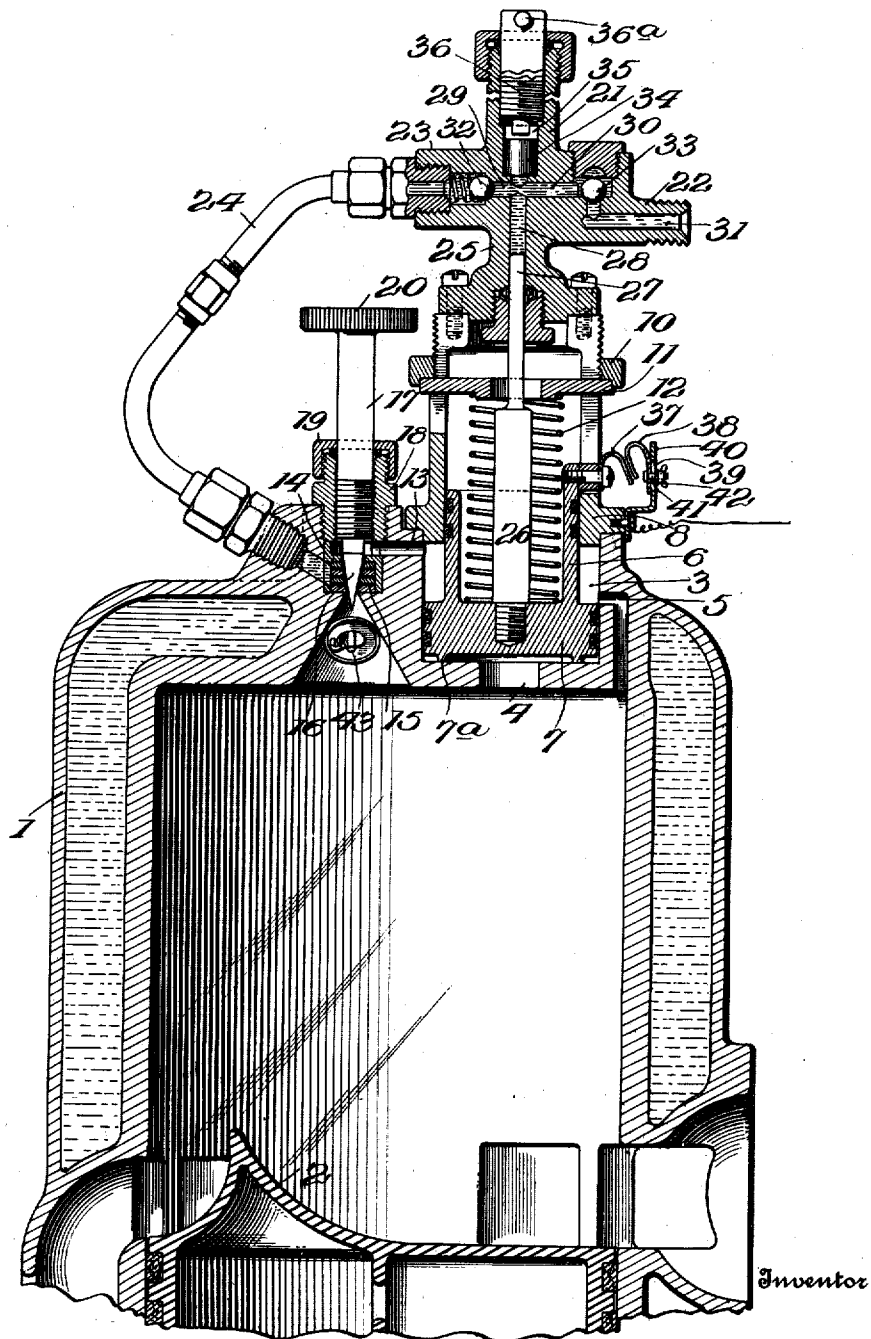


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ATTACHMENT FOR INTERNAL COMBUSTION ENGINES.
APPLICATION FILED APR. 13, 1918.

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Patented Apr. 26, 1921.



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ATTACHMENT FOR INTERNAL-COMBUSTION ENGINES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY B. HIGGINS, Jr., a citizen of the United States of America, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Attachments for Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines and has special reference to improvements designed to more effectually atomize the fuel therefor, and to more reliably insure the delivery of the vaporized fuel to the cylinders of the engine at predetermined times with reference to the instants of ignition and the moments of the compression of air charges therein. My invention is designed primarily for the benefit of two-cycle internal combustion engines, but nevertheless, is well adapted for use with internal combustion engines of other types, notably with those of the four-cycle type. As will be made clear hereinafter, the invention is well adapted for use on any internal combustion engine, whatever its type, so long as it is of a kind which compresses either its charge of explosive mixture, or a charge of fresh air, as distinguished from engines of the kind which are operated by pre-compressed charges from other sources.

In carrying out my invention I utilize the compression of air or gas in the working cylinder to operate the apparatus to both atomize and inject the fuel, and in practice I employ, with the mechanism essential to that end, other means which are adjustable and by which I am able to vary and fix the time of fuel injection and the instant of the ignition of the pre-compressed charge.

In the accomplishment of the objects of this invention, I preferably employ a supplemental cylinder which is in communication with the main or working cylinder of the engine, and with an atomizer leading into the explosion chamber adjacent the spark plug or other ignition device. The supplemental cylinder is provided with a plunger adapted for actuation by the compression in the working cylinder, to compress a charge of air or other aeri-form promoter of combustion, and to thereby discharge it to the atomizer. Additional means are provided whereby the reciprocations of the plunger will operate to deliver liquid fuel to the atomizer, which fuel will effect a

mixture with the air therein, and be discharged therefrom to the combustion chamber.

My invention will be readily understood 60 on reference to the accompanying drawing in which I have diagrammatically represented the invention in the complete form which I deem best.

The drawing, which forms a part of this specification, is a sectional elevation of the upper portion of the working cylinder of an internal combustion engine equipped with my invention.

Referring specifically to the drawing, 1 indicates the working cylinder of an internal combustion engine, here shown as of the two-cycle type, and 2 the piston thereof. A smaller cylinder 3 is externally provided upon the top of the cylinder 1, and is in communication with the interior of said cylinder 1 through the ports 4 and 5. A plunger 6, having an enlarged head 7, is located and adapted for reciprocation within the cylinder 3, the plunger 6 being guided in its reciprocation by a cylindrical casing 8 mounted upon the top of the cylinder 3. The upper portion of the casing 8 is screw-threaded, and carries a screw-threaded ring 10, bearing upon a thrust washer 11. Between the thrust washer 11 and the plunger head 7 is carried a coiled spring 12 which always exerts a downward thrust upon the plunger head 7. Adjacent the top of the cylinder 3 and in communication therewith through the port 13, is an atomizing chamber 14, carrying a plurality of separated disks 15, said disks being preferably provided with graduated central perforations forming an inverted frusto-conically shaped port or passage leading into the combustion chamber of the working cylinder of the engine. Through this port extends a conically-shaped end 16 of a pin-valve 17. The upper portion of the chamber 14 is internally screw-threaded to receive an externally and internally screw-threaded tubular member 18, the upper portion of said member 18 being provided with a packing gland 19.

The lower portion of the pin-valve 17, just above end 16, is externally screw-threaded for engagement with the internal threads of the member 18, whereby end 16 may be raised or lowered with respect to the port formed in the disks, by the proper manipulation of the thumb piece 20.

Upon the top of the cylindrical casing 8

is mounted a fuel pump 21, provided with a connection 22 leading to the fuel source and a branch 23 to which is connected a pipe or duct 24 leading to the atomizing chamber 14.

As shown in the drawing, said pump member 21 is also provided with a downwardly extending member 25. The members 22, 23 and 25 are all longitudinally channeled, and are in communication with each other.

Centrally connected to the upper face of the plunger head is a rigid stem 26, which extends upwardly through the coiled spring 12, the upper end 27 of said stem alining with and entering the channel in the member 25, and constituting a working plunger therefor. It will be noted that the pump member, as a whole, is provided with what may be termed four fuel passages 28, 29, 30 and 31, as clearly shown. These passages are all interconnected, the flow of fuel, under the impulse of the pump, being governed by ball valves 32 and 33. Suitable packing members are of course provided to prevent leakage.

The output of the pump is controlled by displacement plunger 34 adapted for free reciprocation in a cylinder 35, the upward movement of said plunger being limited by a regulating screw 36, having a thumb-piece 36^a at the top, whereby the screw may be raised or lowered at will. In the movement of the plunger 27, the liquid in the channels 28, 29 and 30 will impart movement to the plunger 34, causing it to rise or fall as the plunger 27 moves upwardly or downwardly. It is obvious that the screw 36 might be moved away from the plunger 34 and the column of liquid fuel might therefore be caused to merely reciprocate within the channels, since not enough pressure would be developed to open the valves 32 and 33. As the stroke of the plunger 34 is shortened, however, by manipulation of the screw 36, the plunger 34 cannot displace as much fuel as is pumped in by the plunger 27, past the valve 33, and hence the difference between these volumes is pumped past the valve 32 to the atomizing chamber 14.

If the screw 36 is turned to its lowest position, the plunger 34 remains stationary, and the pump is delivering the full charge of fuel to the atomizing chamber, under each upward reciprocation of the plunger 27.

Connected to the plunger 6 is a downwardly and outwardly extending contact member 37 adapted, during the upward movement of the plunger 6, to engage a downwardly and inwardly extending adjustable contact member 38, fixed to the casing of the motor by a suitable slotted bracket 40, provided with a vertical slot 39. A bolt 41, provided with a winged nut 42, holds the contact to the bracket, whereby the desired adjustment may be effected, as will be clearly

understood. The contact member 37 is wired to the spark plug 43, and the contact 38 is wired to the electrical source. Since the plug 43 is also wired to the electrical source, it is obvious that when the contacts 37 and 38 engage, the circuit will be closed and a spark produced by the plug 43. It will be understood that the casing 8 is slotted to admit of the vertical movement of the rivet or other member which secures the contact 37 to the plunger 6.

The lower face of the head 7 is provided with an integral annular ring 7^a, of a diameter substantially less than that of the plunger head. When the head is at the limit of its downward stroke, the ring 7^a engages the bottom of the cylinder 3, a suitable packing or shock absorbing element being provided upon the bottom of said cylinder, if found desirable.

In the operation of my device, the parts being in the position shown in the drawing, it will be clear that the rise of the piston 2 will compress the air in the cylinder 1, and that this pressure will be communicated to both the upper and the lower faces of the head 7, through the ports 4 and 5. The ring 7^a of such proportion, however, that there is a larger area of the head 7 exposed on the lower face than on the upper. Consequently, at a certain point in the upward movement of the piston 2, the compression in the cylinder 1 will become effective to cause an upward movement of the plunger head 7. Once the ring 7^a has left its seat, the whole lower face of the head is exposed to the pressure caused by the rising piston 2. The result will be that the plunger 6 will be caused to very rapidly move upwardly, which movement will cut off the port 5 and cause a sudden compression of the hot air or gas which has entered the cylinder 3, and it will be noted that the only point of egress for this compressed hot air is by way of the duct 13 which leads to the atomizing chamber 14. The air rushes through said duct and annular passage and between the perforations in the disks 15 and the pin-valve 16 into the combustion chamber, carrying with it the fuel particles which have been delivered to the atomizing chamber, through the instrumentalities to be described.

The rise of the plunger 6 carries with it the stem 26 and therefore causes the plunger 27 to rise in the channel 28 of the pump member, which channel is at all times filled with liquid fuel. Manifestly the rise of the plunger 27 imparts a pressure upon the fuel in the channel 28, which pressure is communicated to the ball valves 32 and 33, in consequence of which, on account of the construction of the apparatus, the valve 32 is unseated, and the valve 33 is seated, in a manner which will be readily understood.

By a continued upward movement of the plunger 27, the fuel in the channels 28 and 29 will be forced past the valve 32, to the duct 24, and thence to the atomizing chamber 14, where it is taken up by the compressed air, as heretofore explained, and forced into the combustion chamber adjacent the spark plug 43, which produces the necessary spark at this time, because of the synchronous engagement of the contacts 37 and 38.

Upon downward movement of the piston 2 the pressure is released and the spring 12 tends to move the head 7 down to its seat. This movement opens the port 5 and releases the contacts 37 and 38. It also causes the plunger 27 to initially move downwardly within the cylinder 28, which movement seats the ball valve 32 and unseats the ball valve 33. A further movement of the plunger 27 will cause the fuel to be drawn past the valve 33 and into the channel 30, and the apparatus as a whole is then ready for another cycle of operation.

It is to be understood that, in the adjustability of the thrust washer 11, and the consequent variance of the pressure to be exerted by the spring 12, I have provided an effective method of timing the delivery of the vaporized fuel from the atomizing chamber to the cylinders of the engine, with reference to the instant of ignition, which is governed by the adjustable contact 38, and this is a very important feature of my invention. This adjustment may easily be made while the motor is running.

In the application of my invention to engines of the four-cycle type, it is to be understood that the thrust washer 11 must be so adjusted that the port 5 will always be closed while the exhaust valves of the working cylinders are open, or that a suitable valve must be interposed in said port so that the scavenging effect may not operate to draw fuel through ports 5.

From the foregoing it will be observed that my invention contemplates instrumentalities whereby a portion of the heated air may be taken from the working cylinders of an internal combustion engine, and additionally and suddenly placed under great compression by the ascent of the working piston, and thence conducted to an atomizing chamber; that the compression in the working cylinders, caused by the ascent of the piston also operates the fuel pump and ejects the fuel into the atomizing chamber simultaneously with the delivery of compressed air from the supplemental chamber, and that simultaneously therewith also the spark plug is caused to explode the mixture which enters adjacent thereto.

The theory upon which I base the better operation of the engine, when equipped with my apparatus, is that the combustion in the cylinder is prolonged, or made progressive,

it being obvious that the operation of the atomizer pump is not actually instantaneous, but is a relatively prolonged operation with respect to the movement of the main piston, and the time consumed in the entrance of the fuel.

Various embodiments of the invention may be suggested to those skilled in the art to which the invention pertains, but I desire to secure by Letters Patent all such embodiments as fall fairly within the scope and spirit of the appended claims.

What I claim is:

1. An attachment for internal combustion engines provided with a working cylinder and piston, a source of fuel supply, an ignition element and an atomizing element, comprising means actuated by the compression of air in the working cylinder, whereby a charge of compressed aeriform promoter of combustion and of liquid fuel are simultaneously delivered through the atomizing element to the combustion chamber, and means for timing the delivery of the compressed aeriform promoter of combustion and liquid fuel to the combustion chamber with reference to the instant of operation of the ignition element, substantially as described.
2. An attachment for internal combustion engines provided with a working cylinder and piston, a source of fuel supply and an atomizing element, of a supplemental cylinder in communication with the working cylinder, a plunger in said supplemental cylinder adapted for actuation by compression in the working cylinder, means whereby the actuation of the plunger may compress a charge of aeriform promoter of combustion received from the working cylinder and deliver it to the combustion chamber through the atomizing element, and additional means actuated by said plunger whereby a charge of liquid fuel may be delivered to the atomizing element and mixed with said compressed aeriform promoter of combustion prior to its passage to the combustion chamber, substantially as described.
3. An attachment for internal combustion engines provided with a working cylinder and piston, a source of fuel supply, an atomizing element and an ignition element, of a supplemental cylinder in communication with the working cylinder, a plunger in said supplemental cylinder adapted for actuation by compression in the working cylinder, means whereby the actuation of the plunger may compress a charge of aeriform promoter of combustion received from the working cylinder and deliver it to the combustion chamber through the atomizing element, additional means actuated by said plunger whereby a charge of liquid fuel may be simultaneously delivered to the atomizing element and mixed with said compressed aeriform promoter of combustion prior to

its passage to the combustion chamber, and adjustable means for timing the delivery of the mixture to said combustion chamber, with respect to the instant of ignition, substantially as described.

4. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with the atomizing element and provided with a plunger having a head thereon, ports for the ingress of compressed air from the working cylinder above and below said head, whereby inward movement of the head under the influence of pressure from the working cylinder may additionally compress air above the head and deliver it to the atomizing element, and means for causing the said compression in the working cylinder to impart first a gradual and then a sudden inward movement to said head, substantially as described.

5. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with the atomizing element and provided with a plunger having a head thereon, ports for the ingress of compressed air from the working cylinder above and below said head, whereby inward movement of the head under the influence of pressure from the working cylinder may additionally compress air above the head and deliver it to the atomizing element, and means for causing the said compression in the working cylinder to impart first a gradual and then a sudden inward movement to said head, said means comprising an annular ring provided on the lower face of the head, the diameter of the said ring being less than the diameter of the head, substantially as described.

6. An attachment for internal combustion engines provided with a working cylinder and piston, an atomizing element and a source of liquid fuel, comprising a supplemental cylinder communicating with the atomizing element and provided with a plunger having a head, a port connecting said cylinders below the head and a duct connecting said cylinders above the head, whereby compressed air from the working cylinder may enter the supplemental cylinder above the head, and said head may be moved inwardly by the compression in the working cylinder to additionally compress the air in the supplemental cylinder and deliver it through the atomizing element to the combustion chamber, and a pump connected to said fuel source and to said plunger, whereby reciprocation of the plunger may deliver a charge of fuel through said atomizing element to said combustion chamber simultaneously with delivery of the compressed air, substantially as described.

7. An attachment for internal combustion engines provided with a working cylinder and piston, an atomizing element and a source of liquid fuel, comprising a supplemental cylinder in communication with the working cylinder, said supplemental cylinder being provided with a plunger adapted for reciprocation by the compression in the working cylinder, the supplemental cylinder above the plunger being in communication with said atomizing element, whereby reciprocation of the head may inject compressed air through the atomizing element to the combustion chamber, a pump connected to said fuel source, a member fixed to said plunger and connected to said pump, whereby reciprocation of the plunger may deliver a charge of fuel through said atomizing element to said combustion chamber, simultaneously with the delivery of compressed air thereto, and means carried by said plunger whereby the ignition elements are caused to operate at the instant of the delivery of said fuel and air to the combustion chamber from the atomizing element, substantially as described.

8. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with the atomizing element and provided with a plunger having a head adapted to seat on the bottom of said supplemental cylinder, ports establishing communication between said supplemental and working cylinders, one of said ports opening above and one below said plunger head, whereby the rise of the plunger in the working cylinder may cause a charge of heated compressed air to enter the supplemental cylinder above the head, and may thereafter raise the plunger to additionally compress the charge thereabove and eject it to the atomizing element, substantially as described.

9. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with the atomizing element and provided with a plunger having a head adapted to seat on the bottom of said supplemental cylinder, ports establishing communication between said supplemental and working cylinders, one of said ports opening above and one below said plunger head, whereby the rise of the plunger in the working cylinder may cause a charge of heated compressed air to enter the supplemental cylinder above the head, and may thereafter raise the plunger to additionally compress the charge thereabove and eject it to the atomizing element, and means connected to the plunger for simultaneously delivering a charge of liquid fuel to said atomizing element, substantially as described.

10. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with the atomizing element, a plunger adapted for reciprocation in said supplemental cylinder and having a head adapted to seat on the bottom wall thereof, a port leading from the working cylinder to the bottom face of said head, and a port similarly leading to the top face thereof, whereby the compression in the working cylinder may be communicated to both faces of the plunger, and means on said plunger whereby said compression may cause it to first rise slowly to close the upper port, and then rise quickly to compress the air thereabove and eject it to the atomizing element, substantially as described.

11. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with said atomizing element and provided with a plunger having a head adapted to seat on the bottom thereof, ports leading from said working cylinder to the top and bottom faces of said head, whereby both faces are subject to the compression in the working cylinder, the exposed area of the bottom face being greater than that of the top face, and means whereby upon the initial upward movement of the plunger a still larger area of the bottom face thereof is exposed to the compression, whereby said plunger is caused to rise suddenly and additionally compress the air thereabove and eject it to the atomizing element, substantially as described.

12. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with said atomizing element and provided with a plunger having a head adapted to seat on the bottom thereof, ports leading from said working cylinder to the top and bottom faces of said head, whereby both faces are subject to the compression in the working cylinder, the exposed area of the bottom face being greater than that of the top face, means whereby upon the initial upward movement of the plunger a still larger area of the bottom face thereof is exposed to the compression, whereby said plunger is caused to rise suddenly and additionally compress the air thereabove and eject it to the atomizing element, and means connected to said plunger whereby a charge of liquid fuel is simultaneously delivered to said atomizing element, substantially as described.

13. A device of the character described comprising, in combination with the working cylinder, piston and combustion chamber

of an internal combustion engine, an atomizing element, pneumatically operable means outside of said cylinder for additionally compressing an aeriform promoter of combustion received therefrom, said means operating to simultaneously deliver said compressed aeriform promoter of combustion and a charge of fuel under pressure through said atomizing element to the combustion chamber, and adjustable means for governing the instant of delivery of the compressed aeriform promoter of combustion and fuel through the atomizing element, substantially as described.

14. An attachment for internal combustion engines provided with a working cylinder and piston and an atomizing element, comprising a supplemental cylinder communicating with said atomizing element, a plunger adapted for reciprocation in said supplemental cylinder, and having a head adapted to seat on the bottom wall thereof, a spring member governing the actuation of said plunger, ports leading from the working cylinder to the top and bottom faces of said head, whereby a charge of compressed air from the working cylinder may enter the supplemental cylinder above the head and be additionally compressed and thereafter ejected to the atomizing element by a rise of the plunger, and means for adjusting the tension of said spring member to vary the instant of rise of the plunger, substantially as described.

15. An attachment for internal combustion engines provided with a working cylinder and piston, an ignition element, and an atomizer leading to the combustion chamber, comprising a supplemental cylinder communicating with the atomizer, a plunger adapted for reciprocation in said supplemental cylinder and having a head adapted to seat on the bottom wall thereof, ports leading from the working cylinder above and below said head, whereby a charge of compressed air from the working cylinder may enter the supplemental cylinder above the head, and the compression in the working cylinder may cause a reciprocation of the plunger to compress the air thereabove, and eject it through the atomizer to the combustion chamber, means carried by the plunger for actuating the ignition element, and adjustable means co-acting with said last named means for timing the actuation of the sparking element with respect to the instant of ejection of the compressed air through the atomizer to the combustion chamber, substantially as described.

In testimony whereof I affix my signature. 125

HENRY B. HIGGINS, Jr.

Witnesses to signature:

CHARLES L. WALTER,
NELLIE J. SCULLY.