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F. R. WHITE.

GAS ENGINE.

APPLICATION FILED AUG. 30, 1905.

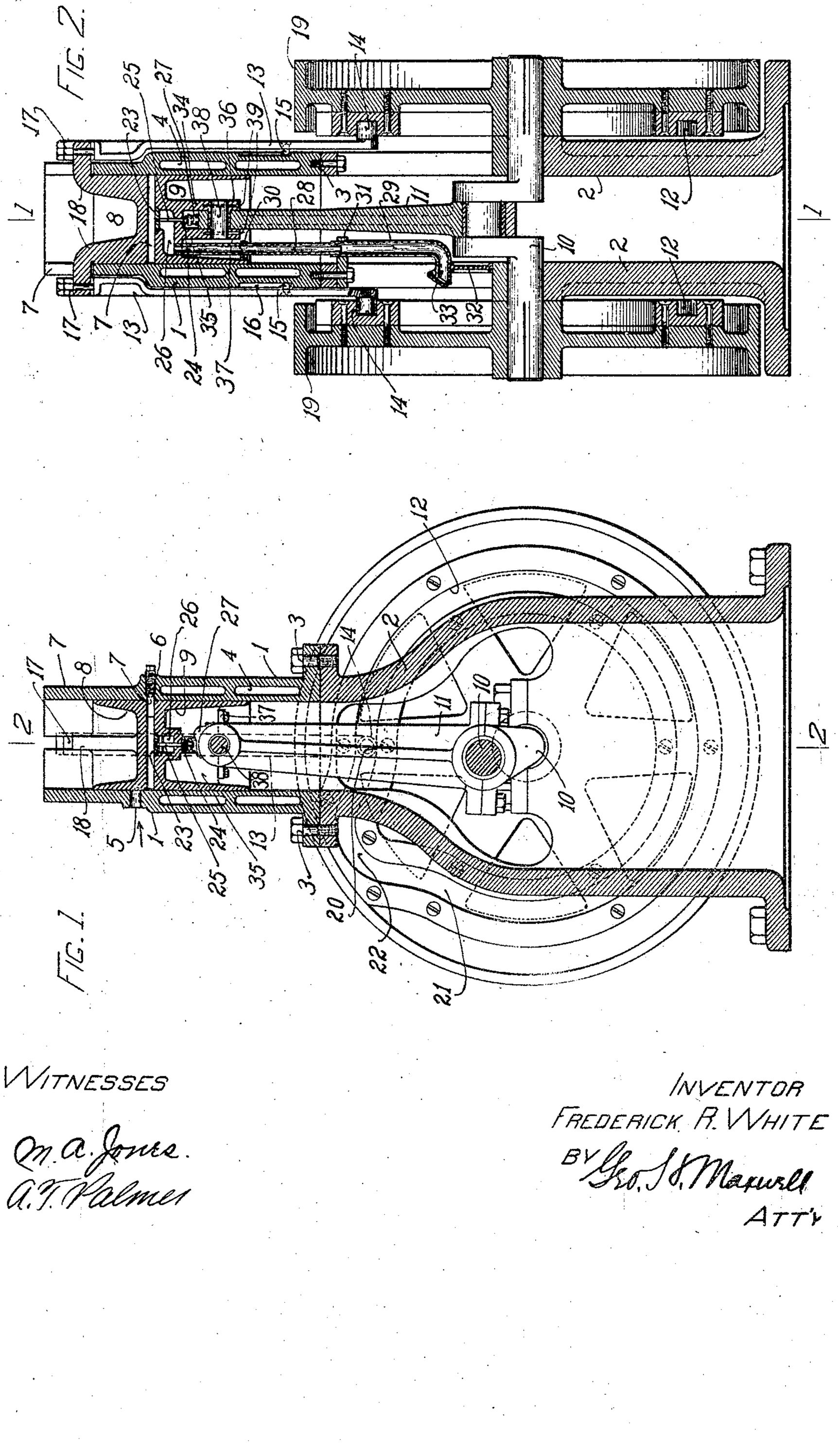

FIG. 1.

WITNESSES

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GAS-ENGINE.

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To all whom it may concern:

Be it known that I, FREDERICK R. WHITE, a citizen of the United States, residing at Lynn, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Gas-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

One of the most serious and obstinate difficulties experienced with gas engines, especially two-cycle engines, has been to properly combine or mix and press the charge of mixed gases prior to explosion or ignition, this difficulty arising mainly from inadequate compression, heretofore impossible on account of the certainty of pre-ignition, and also from the presence of more or less of the preceding dead gases which have not been entirely exhausted from the combustion chamber. Accordingly, my present invention aims to remove the aforesaid difficulty and insure the desired ignitible mixture behind the piston at and for each driving stroke thereof.

With the above object in view, I provide means for completely exhausting the dead gases after each explosion and supply an entirely fresh charge under the most effective compression. My invention is applicable to various types of engines, being herein illustrated in connection with an explosion engine employing a carbureter and spark-plug. I employ an auxiliary charging and compression piston operating dissimultaneously with the main or driving piston, the latter holding the exhaust open during the greater part of its up stroke, and I delay the up stroke of the auxiliary piston and the admission of the fresh charge until the main or driving piston has practically completed its up stroke.

My invention may be accomplished by a variety of mechanisms and in the preferred form as herein shown in the drawing, Figure 1 is a central, vertical sectional view of one embodiment of my invention, taken on the line 1—1, Fig. 2; and Fig. 2 is a central, vertical sectional view thereof taken on the line 2, 2, Fig. 1.

It will be understood that in the accompanying drawings I have illustrated merely one of many types of engine to which my invention is adapted, a vertical cylinder 1 being shown as bolted to a stand or frame 2 at 3, preferably being provided with water coolers 4. This cylinder 1 has a gas-inlet 5 leading from a usual carbureter and valve mechanism, not shown, for supplying the proper explosive mixture to the cylinder, and an igniter 6 of any preferred construction. The cylinder is extended at its upper end, as indicated at 7, to constitute a combustion chamber, and is provided with an upper auxiliary or compression piston 8 above the usual lower driving piston 9, the latter being connected to the crank shaft 10 by any usual or preferred means, as by a connecting rod 11, and the auxiliary piston 8 being operated by any suitable means as by a path-cam 12 and opposite rods 13 each having a cam-roll 14 at its lower end and held to proper vertical reciprocation by a stud 15 traveling in a guide 16 on the cylinder 1, and at its upper end being strongly secured at 17 to arms 18 projecting from the auxiliary charging and compression piston 8.

The path-cam 12 is herein shown as provided on the inner face of the heavy pulley 19 which also acts as the fly wheel of the engine, being keyed to the crank shaft 10, and in order to give the exceedingly quick movement to the auxiliary piston which is desirable, as already stated, said path cam is concentric from the point 20 around to the right Fig. 1 to the point 21 and is offset for the short distance between 21 and 20, as indicated at 22, the incline of said offset portion being as steep as is permissible without interfering with the desired high speed and effectiveness of the engine, thereby reducing to a minimum the period required for receiving and compressing the explosive charge behind the main piston.

By observing Fig. 1 it will be seen that the crank of the crank shaft is set at an angle just ahead of the point 20 or foot of the compressing incline of the offset 22, so that as the cam rolls 14 reach the apex of the offset portion 22 of the cam, raising the auxiliary piston to its extreme outward position, thereby having drawn in the full charge, the crank is just reaching its upper dead-center position and the main piston is accordingly near its extreme return position. During the short instant while the crank is passing the dead center and reaching its slightly forward position, as shown in Fig. 1, the cam rolls 14 are caused to descend the steep compressing incline from 22 to 20, thereby swiftly moving downward the auxiliary piston on its compression stroke, and just as it reaches the point of full compression, as shown in the drawings, the explosion takes place. This may be either by spontaneous ignition, if desired, or by means of the igniter 6 in usual manner, according to the type of engine.

When the piston 9 has completed its driving stroke or downward movement and the crank passes the lower dead center, the exhaust of the exploded gases takes place. For this purpose, I provide an exhaust valve 23 of any suitable kind, held closed by a spring 24 engaging its headed stem 25 which projects through the exhaust passage 26 in position to be engaged by a cam 27 on the upper end of the connecting rod 11 set at an angle slightly to the right of the vertical, as clearly shown in Fig. 1, so as to engage the valve stem 25 the moment that the downward stroke of the piston is completed and the latter begins the return stroke.

Viewing Fig. 2, it will be seen that the exhaust passage 26 terminates in elescoping tubes 28, 29, the former being shown as held vertically by a strap 30 to move with the piston 9; and the latter being held truly ver-

tical by straps or brackets 31, 32 on the frame and provided with a check valve 33 closing the discharge end thereof, so that the moment the piston begins its return movement, the exhaust valve 23 is automatically raised by the cam 27 and the included gases are forcibly driven out through the tubes 28, 29. The headed stem 25, spring 24 and cam 27 operate in a recess provided between opposite transverse webs or bridge-pieces 34, 35 in the under side of the piston 9 against whose lower sides journal straps 36, 37 are secured for retaining the pin 38 of the pitman or connecting rod 11 which is held against longitudinal movement by screws 39.

In all the above details of mechanism, it will be understood that, unless otherwise specified in the claims, I am not limited thereto, as many changes and substitutions may be resorted to within my invention.

In operation, the parts having reached the position shown in the drawings, ready for the explosion, the explosion thereupon takes place and the piston 9 is driven downward, the crank continuing forward toward the left, Fig. 1, and the compression piston 8 remaining in unchanged position, the cam rolls 14 traveling in the concentric portion of the path-cam 12. As the main piston 9 reaches its lowermost position and begins its upward stroke, the shifting of the crank to the right past the lower dead point causes the cam 27 to open the exhaust valve 23 (or whatever other means may be employed for opening the exhaust), whereupon, the dead or burned gases are forcibly discharged through the passage 26, 28, 29. The exhaust valve remains open for nearly the entire cycle until the piston 9 has been substantially raised, thereby fully expelling the exploded gases, and just as the piston 9 is reaching its uppermost position, the quick-acting offset cam-path instantly raises the compression piston 8 and as suddenly lowers it again, this movement taking place while the main piston 9 is practically stationary during the swinging of the crank from right to left past the dead center, the exhaust valve 23 being automatically closed at the beginning of the compressing movement. The result is that the charge of fresh explosive mixture is drawn in and compressed at the critical moment when the dead gases have been exhausted and yet so quickly that the full driving effect of the piston and charge is secured with maximum efficiency.

I do not limit myself to a path cam, but the latter has practical advantages, (although limiting somewhat the speed or quickness of movement of the auxiliary piston), and I have therefore shown the same as a preferable construction.

The check valve 33 operates to prevent the drawing in of any of the expelled dead gases during the initial upward movement of the auxiliary piston, while the exhaust valve is closing. At the instant the explosion takes place, the main piston 9 has slightly started on its downward movement, but on account of the rapid movement of the compression piston 8, the explosion takes place at the moment of maximum compression of the charge.

It will be understood that proper governing mechanism for throttling the intake is provided the same as usual in gas engines, the various constructional details and usual auxiliaries of gas engines being herein omitted, as they do not constitute a part of my invention.

The diameter and stroke of both the driving piston and the auxiliary or compression piston are the same, and said auxiliary piston takes in and then compresses the full cylinder volume. The charging and compression are accomplished entirely by the auxiliary piston, and the compression of the mixture is so timed that pre-ignition is impossible, because the compression is accomplished when the driving piston is ready for effecting the driving movement. Inasmuch as the parts are in the position last mentioned, at the time when the compression takes place, my mechanism secures maximum results or efficiency from the ignitible mixture. All this is accomplished at each cycle. By my invention it becomes impossible to have a pre-ignition for the reason that the gaseous mixture is not compressed to the ignition point until the driving piston has arrived at driving position. Also as the entire compressing movement of the compression piston takes place while the driving piston is substantially stationary at the end of its return stroke, said auxiliary piston is enabled to compress the mixture far beyond ignition pressure.

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

1. A gas engine having a cylinder, driving piston, and means separate from said piston for supplying a combustible gaseous charge to said cylinder behind said driving piston, said means including auxiliary means for compressing said charge behind said piston before the ignition thereof, said auxiliary means being timed to effect said compression to ignition pressure when the driving piston arrives at driving position.

2. A gas engine having a cylinder, driving piston, and means for supplying a combustible gaseous charge to said cylinder behind said piston, including a compression device separate from said driving piston for compressing said charge independently of movement on the part of said driving piston, and mechanism independent of said compression device for exhausting the burned charge.

3. A gas engine, having a cylinder, piston, and means for supplying a combustible gaseous charge to said cylinder behind said piston, combined with an auxiliary compression device for said charge, and quick-acting operating means for actuating said device after said piston has substantially completed its return movement.

4. In a gas engine, a cylinder, a driving piston therein, means operated by the movement of said piston for exhausting the burned gases, and a combined charge-introducer and charge-compressor, provided with quick-operating means for fully actuating the same during one exhaust movement of said piston.

5. A gas engine, comprising a cylinder, a driving piston therein, a combustion chamber behind said piston, a gas inlet for charging said chamber, and an auxiliary compression piston for compressing the charge behind said driving piston, while the latter is approximately stationary.

6. A gas engine, comprising a cylinder, a driving piston therein, a combustion chamber behind said piston, a gas inlet for charging said chamber, a charging and compression piston in said chamber, and quick-operating means timed to give said compression piston its compressing movement at the moment said driving piston is ready to be driven forward.

7. A gas engine, comprising a cylinder, a driving piston therein, a combustion chamber behind said piston, a gas inlet for charging said chamber, a charging and compression piston in said chamber, and means maintaining charging and said compression piston in closing engagement with said gas inlet until the driving piston has substantially completed its return stroke.

8. A gas engine, comprising a cylinder, a driving piston therein, a combustion chamber behind said piston, a gas inlet for charging said chamber, a charging and compression piston in said chamber, and quick-operating mechan-

ism, acting after the driving piston has substantially completed its return stroke, for reciprocating said charging and compression piston from and toward said driving piston, thereby drawing in and compressing the charge at the end of the driving piston's return stroke.

9. A gas engine, comprising a cylinder, a driving piston therein, a combustion chamber behind said piston, a gas inlet for charging said chamber, a charging and compression piston in said chamber normally closing said gas inlet, and quick-operating mechanism, acting after the driving piston has substantially completed its return stroke, for reciprocating said charging and compression piston from and toward said driving piston, thereby drawing in and compressing the charge at the end of the driving piston's return stroke.

10. A gas engine, comprising a cylinder, a driving piston therein, a combustion chamber behind said piston, a gas inlet for charging said chamber, a compression piston in said chamber, a normally closed exhaust passage for the escape of the burned gases, means for maintaining said passage open during the return stroke of the driving piston, and means maintaining said compression piston in its forward position until the driving piston has substantially completed its return stroke.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

FREDERICK R. WHITE.

Witnesses:

GEO. H. MAXWELL,

M. A. JONES.