

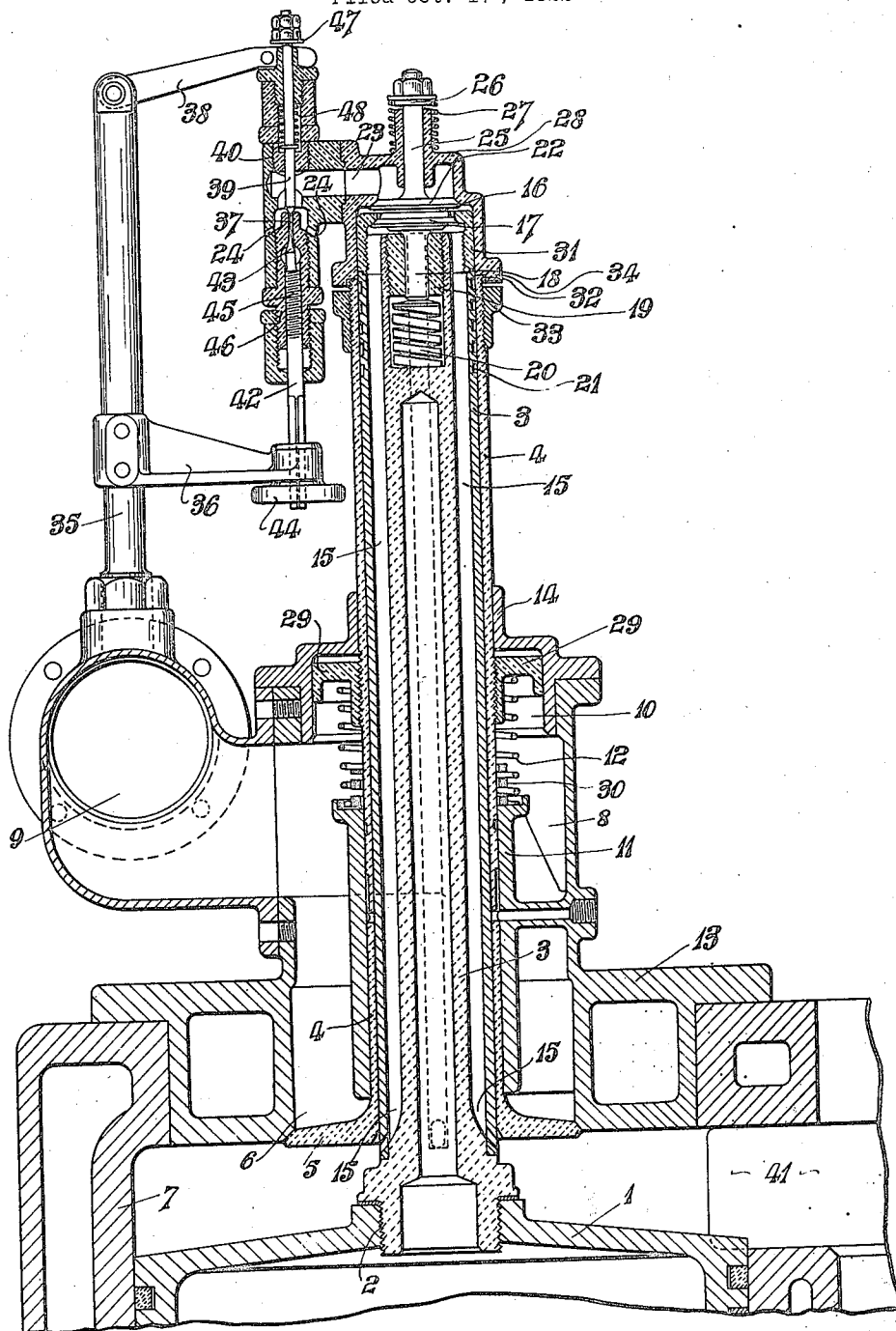
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W. F. THOMAS

INTERNAL COMBUSTION ENGINE

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

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To all whom it may concern:

Be it known that I, WALTER FREDERICK THOMAS, a subject of the King of Great Britain and Ireland, residing at Alma Cottage, St. Helens, Isle of Wight, England, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines and has for its main object the adaptation of the construction described in the specification of my prior British Patent No. 10,769 of 1913 to four stroke cycle engines.

According to the present invention a four stroke cycle internal combustion engine comprises an auxiliary pump piston moving coincidentally with a main working piston and adapted to compress alternately a charge of fuel and air and a charge of pure air for the purpose of delivering an explosive charge into a charge of air already compressed by the main piston and of scavenging the working cylinder during the concluding stroke of each cycle. According to the preferred form of construction the auxiliary pump piston comprises a rod connected to the main working piston and working in a hollow stem having at its base the main induction valve adapted to be opened against spring pressure by the main piston during the first stroke of each cycle. The auxiliary piston may be formed with longitudinal ports through which the compressed charges of air and fuel and of pure air pass to the working cylinder, such ports being controlled by a fluid pressure operated valve in the piston head.

Reference will now be made to the accompanying drawing which illustrates by way of example a partial sectional elevation of an engine constructed according to the invention.

The engine illustrated comprises a main working piston 1 connected as by screw threads 2 to an auxiliary pump piston 3 working in a cylinder formed as a hollow tubular stem 4. The lower end of the stem 4 is formed with an induction valve member 5 normally closing an air inlet 6 to the working cylinder 7, such air inlet being at the base of a chamber 8 surrounding the stem 4. The chamber 8 is open always to a main air induction pipe 9 and at its upper end is formed with a dashpot cylinder 10 in which is disposed a piston 29 secured to the stem 4. Be-

tween the piston 10 and a guide 11 for the stem 4 secured to or formed integral with the walls of chamber 8 is interposed a spring 12 acting normally to maintain valve 5 closed. It is also preferred to employ a buffer spring 30 to act as a cushion for the piston 29 on the downward movements of the latter. The chamber 8 may be formed integral with the cylinder head 13, the dash pot cylinder 10 being formed as a separate unit secured into the upper end of the said chamber and the cylinder head is formed with a sleeve 14 to act as a guide for the stem 4.

The auxiliary pump piston 3 is in the form of a rod having longitudinal passages or ports 15 formed therethrough which connect the working cylinder 17 with a chamber 16 in the head of piston 3, such chamber being closed normally by a valve 17 having a stem 18 passing through a removable guide member 19 and being engaged at its lower end by a spring 20 acting normally to maintain the valve 17 closed. The piston 3 is provided with rings 21 of usual form to engage the inner walls of the tubular stem 4 which thus constitutes the auxiliary pump cylinder. The upper end of stem 4 is closed by a secondary induction valve 22 controlling the mouth of a passage 23 the outer end of which is always open to atmosphere through ports 24 and which also serves as the fuel inlet as hereinafter described. The valve 22 has a stem 25 having a collar 26 at its outer end against which bears a spring 27 normally maintaining the valve against its seating in the fixed head 28, in which the upper end of the piston 3 slides. The seating for the valve 17 is formed at the upper end of a sleeve 31 detachably secured to and movable with the piston 3.

The head 28 is formed around the inner edge of its lower face with a groove 32 in which the upper end of the hollow stem 4 is adapted to seat whilst the outer edge of the head 28 is formed with a flanged portion 34. Secured to the stem 4 near its upper end is a collar 33 adapted to be connected rigidly to the flange 34 by bolts or the like.

On the main air induction pipe 9 or on any other convenient fixed support is mounted a standard 35 having a bracket 36 adjustably secured thereto through which passes a spindle 42 the upper end of which is formed as a needle valve 43 by which a fuel inlet 37 is

adjusted in area. The lower end of spindle 42 is of square cross section in order to be engaged by a corresponding aperture in a nut 44 rotatably mounted in the bracket 36.

5 The screw threaded engagement at 45 of the needle valve 43 with its surrounding sleeve 46 causes the valve to be raised or lowered when the nut 44 is rotated.

The upper end of the standard 35 carries 10 pivotally a fuel inlet valve operating lever 38 which engages beneath a collar 47 secured near the upper end of a valve spindle 39 mounted in a casing 40 (of which the sleeve 46 forms a part) and normally urged in a 15 direction to close the fuel inlet passage 37 by a spring 48. The passage 37 communicates with an extension of passage 23 formed in the casing 40 and the latter is rigidly connected to the head 28 so that both move with 20 the hollow stem 4 when the main air induction valve 5 is opened as hereinafter described.

The main working cylinder 7 is provided with an exhaust port 41 having a valve (not 25 shown) operated in any usual and convenient manner.

The cycle of operations in an engine having the construction above described is as follows:—

30 On the down or outward stroke of the main piston 1, a charge of air is drawn into the working cylinder 7 through the induction valve 5 which opens owing to the combined effect of the suction produced by the 35 descent of piston 1 unbalancing the valve due to the constant atmospheric pressure in chamber 8 and the friction of the piston rings 21 which tend to draw the hollow stem downwards with the auxiliary piston 3 as the latter moves.

40 As the hollow stem 4 moves downwardly the head 28 and casing 40 move with it owing to the connections between flange 34 and collar 33. The lever 38 is thus caused to move through a short arc during the conclusion 45 of which movement the shape of the upper edge of the lever which bears against the under surface of collar 46 lifts the valve off its seat and allows fuel to enter the passage 50 23 in which a mixture is formed owing to induction of air through ports 24. As the mixture of fuel and air is forming the suction produced by the descent of the auxiliary piston 3 causes the secondary valve 22 to 55 open and admit the mixed charge of air and atomized liquid fuel which fills the auxiliary pump cylinder 4 above its descending piston 3.

On the inward and second stroke of the 60 main piston 1 both induction valves 5 and 22 close owing to the compression respectively of the charge of air in the main cylinder 7 and of the fuel mixture in auxiliary cylinder 4. The relative dimensions of the 65 spaces in the two cylinders which contain the

compressed charges are such that towards the end of the compression stroke the pressure in the auxiliary pump cylinder 4 becomes greater than that in the main working cylinder 7. Consequently the pressure acting 70 above the valve 17 becomes such as to cause this valve to open and before the limit of the second stroke is reached the compressed charge of fuel and air is forced through the passages 15 and into the charge of air com- 75 pressed in the working cylinder. Immediately upon the conclusion of this stroke ignition is timed to occur and may be effected by any desired method, preferably by that described in the specification of Patent No. 80 26,700 of 1911 granted to Walter Frederick Thomas.

The third stroke of the cycle is the working stroke in which the pistons 1 and 3 again 85 move outwards under the influence of the high pressure caused by ignition, combustion and expansion of the working charge. During this stroke the main induction valve 5 remains stationary owing to the working 90 pressure in the main cylinder 7. Consequently the stem 4, head 28 and casing 40 remain stationary and the fuel inlet valve 39 closed and the auxiliary pump piston 3 moving with the main piston draws in a charge 95 of fresh air only through the secondary induction valve 22. As the main piston 1 nears the end of this stroke, the valve controlling the exhaust port 41 opens enabling the products of the combustion to pass out to atmosphere. 100

During the next inward stroke (the fourth 105 of the cycle) the exhaust valve continues open whilst the charge of air induced during the working stroke in the auxiliary pump cylinder 4 is compressed until near the end of the stroke it is at a pressure sufficient to cause the valve 17 to open and allow the 110 compressed charge of air to pass through the ports 15 to the working cylinder to assist in scavenging the latter of products of combustion.

The parts are then in the position shown in the drawing and on the next outward stroke induction of an air charge takes place 115 in the main working cylinder and the cycle of operations described is repeated.

Various modifications may be made in the construction and arrangements of the engine described above. For example, instead of fixing and working the auxiliary air and fuel 120 pump in the stem of the main induction valve, the latter may be situated in a pocket and the auxiliary pump in the cover of the working cylinder. Further, a separate pump cylinder and piston could be employed and 125 operated by an auxiliary crank shaft geared to the main shaft and timed to work in unison with the working piston.

I claim:—

1. In a four stroke cycle internal com- 130

bustion engine, a working cylinder having valve controlled air inlet and exhaust ports, a working piston mounted to reciprocate in said cylinder, an auxiliary pump cylinder, an auxiliary pump piston mounted to reciprocate in said pump cylinder, means for reciprocating said pump piston coincidently with said working piston comprising a means for introducing alternately a charge of fuel and air and a charge of pure air into said pump cylinder, and means for transferring said charges of fuel and air and pure air when compressed to said working cylinder.

2. A four stroke cycle internal combustion engine, according to claim 1, wherein said auxiliary pump piston and means for reciprocating the same comprise a rod connected to said working piston, said auxiliary pump cylinder consisting of a hollow stem having at its lower end an induction valve seated in said air inlet port and mounted to open against spring pressure under suction produced by said working piston.

3. A four stroke cycle internal combustion engine according to claim 1, wherein said auxiliary pump piston and means for reciprocating the same comprise a rod connected to said working piston, the means for transferring the charges of fuel and air and pure air into the working cylinder comprising longitudinal ports formed in said rod and a pressure controlled valve carried

in said rod and controlling the passage of fluid through said longitudinal ports.

4. A four stroke cycle internal combustion engine according to claim 1, wherein said auxiliary pump cylinder has a head, the means for introducing alternately a charge of fuel and air and a charge of pure air into the pump cylinder including an induction valve carried in said head and mounted to open against spring pressure under suction produced by the pump piston.

5. In a four stroke cycle internal combustion engine, a working cylinder having valve controlled air inlet and exhaust ports, a working piston arranged to reciprocate in said cylinder, an auxiliary pump cylinder having a head provided with an induction valve mounted to open by suction against spring pressure, an auxiliary pump piston in said pump cylinder, means to operate said pump piston coincidently with said working piston, said means comprising a rod connected to said working piston, said rod having longitudinal fuel and air and pure air ports and a pressure controlled valve controlling the passage of fluid through said ports, and constituting means for transferring charges of fuel and air and pure air when compressed to said working cylinder.

In witness whereof I affix my signature.

WALTER FREDERICK THOMAS.