Nov. 16, 1943. O. C. NORTON 2,334,688

INTERNAL COMBUSTION ENGINE AND STARTING MEANS THEREFOR

Filed Nov. 21, 1941 2 Sheets-Sheet 1

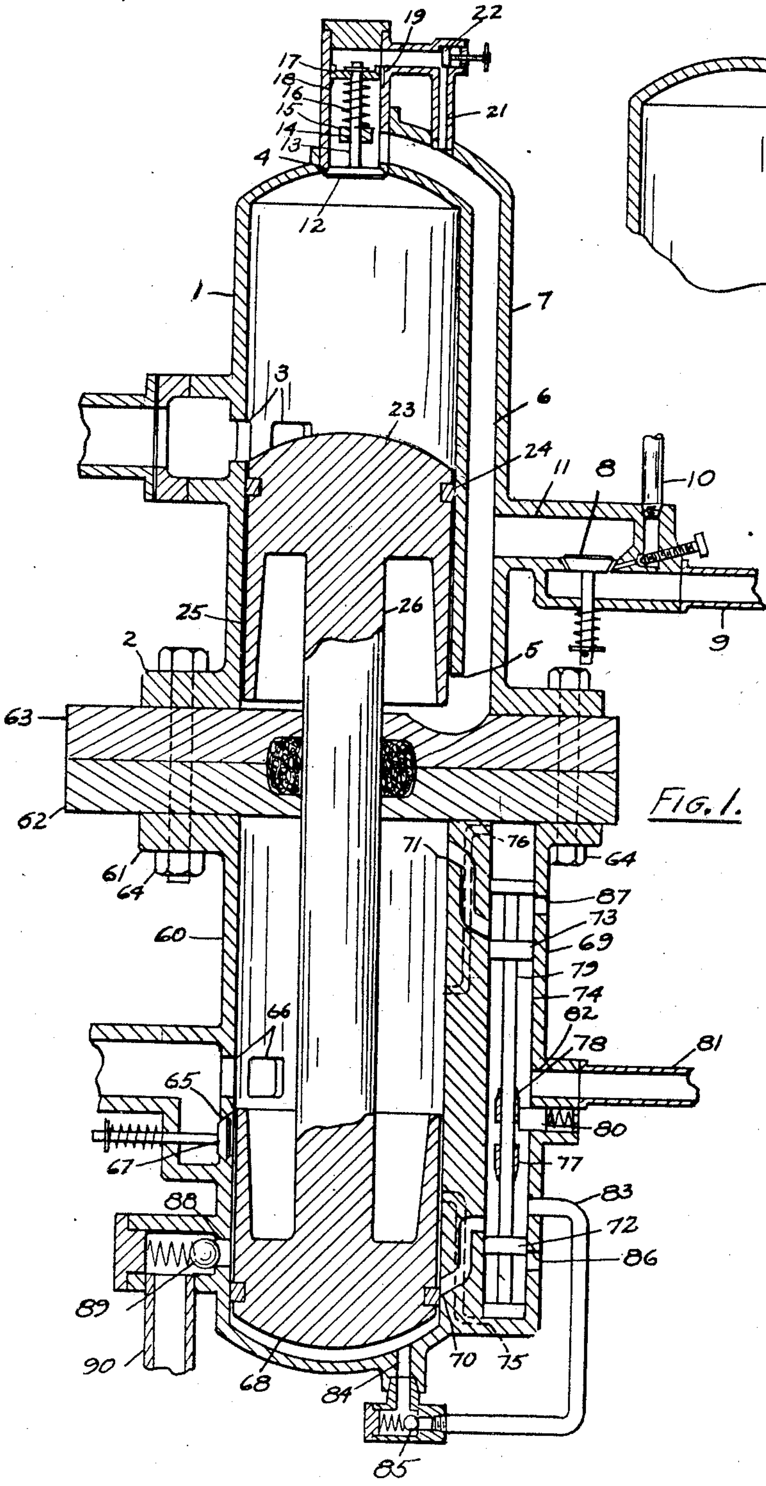

FIG. 1.

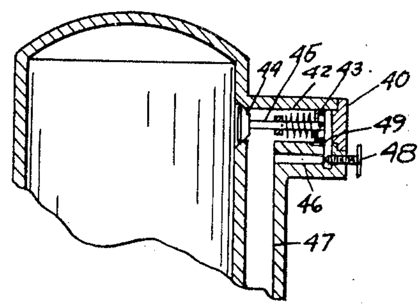

FIG. 2.

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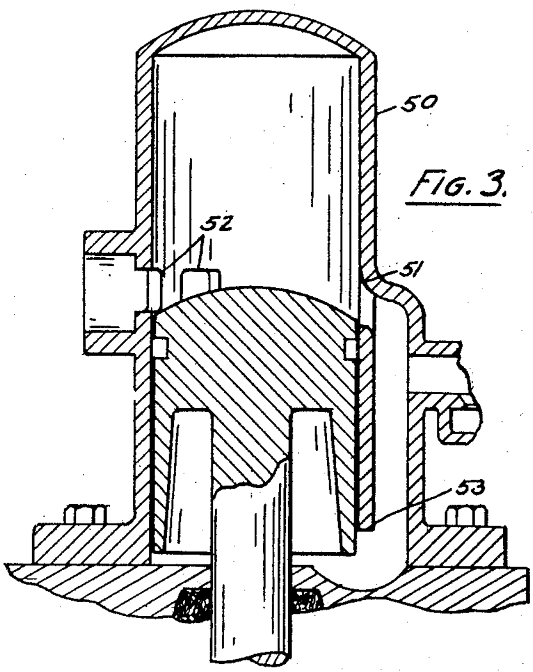

FIG. 3.

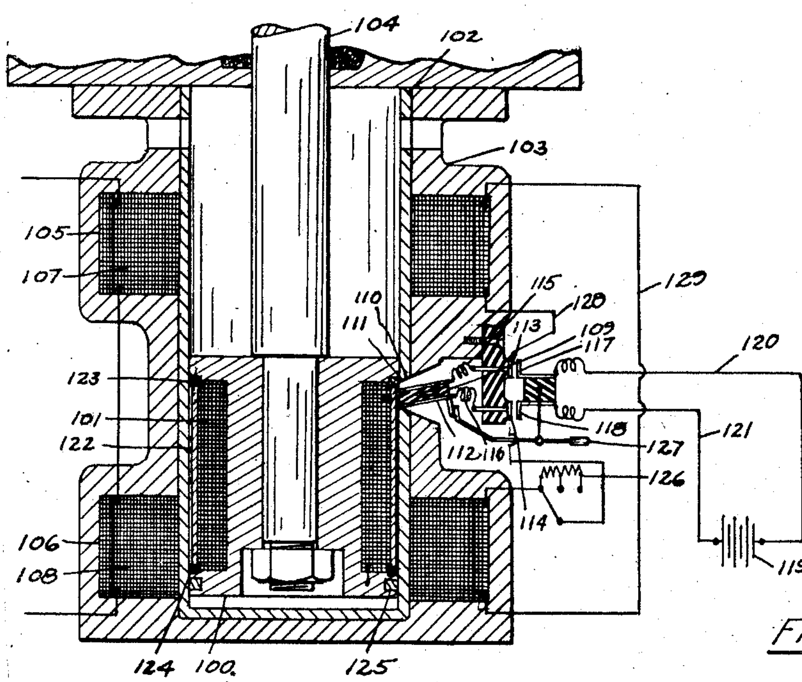

FIG. 4.

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UNITED STATES PATENT OFFICE

2,334,688

INTERNAL COMBUSTION ENGINE AND STARTING MEANS THEREFOR

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Application November 21, 1941, Serial No. 419,862

8 Claims. (Cl. 230—56)

This invention relates generally to internal combustion engines and more particularly to compression ignition, internal combustion engines.

All devices of this character made according to the teachings of the prior art and with which I am familiar have had high frictional and inertia losses because of bearings, crank shafts and other mechanical connections which caused high frictional and inertia losses. These prior engines required a particular type of fuel for efficient operation. These prior engines could not be operated efficiently at part load. In the multi-cylinder types of prior engines, mechanical connections required precision machining operations, and the mechanical connections necessary made frictional and inertia losses very high.

It is accordingly an object of my invention to overcome the above and other defects in internal combustion engines, and it is more particuarly an object of my invention to provide a compression ignition, internal combustion engine which is simple in construction, efficient in operation, economical in manufacture and economical in cost.

Another object of my invention is to provide a compression ignition type of internal combustion engine in which the air charge is constant and the fuel charge is variable.

Another object of my invention is to provide a uniflow pressure gas-type engine in which inertia forces are utilized to permit and provide compression sufficient to prevent initial condensation or cooling and which adjusts itself automatically to various back-pressures without the use of outside valves, clearance pockets, etc.

Another object of my invention is to provide a compression ignition type of internal combustion engine in which the energy of each stroke is accumulated so as to lengthen the stroke and raise the compression pressure high enough to assure ignition with a lower gas pressure.

Another object of my invention is to provide a prime mover which may be built in multi-cylinder types and which can be balanced by connecting the intakes to a common opening without mechanical connection.

Another object of my invention is to provide a compression ignition type of internal combustion engine having no clearance losses.

Another object of my invention is to provide accumulative energy action in starting.

Another object of my invention is to provide a compression ignition type of internal combustion engine in which the output is governed by the length of the stroke of the piston.

Another object of my invention is to provide a compression ignition type of internal combustion engine having a high-temperature pressure range because of the absence of excess air or fuel at partial loads.

Other objects of my invention will become evident from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a vertical section taken through my novel compression ignition type internal combustion engine and my novel fluid compressor directly connected thereto.

Fig. 2 is a fragmentary cross-sectional view of the upper end of a modified form of my novel invention.

Fig. 3 is a vertical cross-sectional view of another modified form of my novel invention.

Fig. 4 is a vertical cross-sectional view of an electrical starting and generating system for use with my novel invention.

Referring now to the drawings, Fig. 1 shows a cylinder 1 having a flange 2 and exhaust openings 3 and an admission port 4 in the head-end of the cylinder 1. The lower end of the cylinder 1 is open at 5 to receive a fuel mixture from a fuel line 6 enclosed in a casing 7. The fuel line 6 leads upwardly to the head-end of the cylinder 1 to the admission port 4. A spring-urged valve 8 admits air from the air line 9 and fuel from the valved fuel line 10 to the passage 11 and fuel line 6. A carburetor or any other suitable means may be used to mix the air and fuel. A valve 12 having a stem 13 movable in an aperture 14 in the cross-member 15 is urged to a closed position by spring 16. A piston member 17 mounted on the opposite end of the stem 13 to the valve 12 moves in a bore 18. Groove 19 in the side of the bore 18 permits passage of the gas mixture when the valve 12 is in a closed position as shown in Fig. 1.

A separate line 21 leading from the fuel line 6 leads to the top side of the piston member 18 attached to one end of the valve stem 13. This provides a predetermined amount of pressure on the top side of the piston member 18 thereby maintaining the valve 12 in an open or a closed position in accordance with predetermined conditions. A valve 22 in the passage 21 increases or decreases the pressure on the top side of the piston member 18, thereby maintaining the valve in an open or a closed position according to predetermined conditions. A piston 23 having a piston ring 24 and along skirt 25 is mounted on a piston rod 26. The piston 23 only uncovers the exhaust port 3 on the downward stroke.

In operation, the piston **23** is initially moved by external starting means as will hereafter be described. When the piston **23** is moved upwardly from its lowermost position, a mixture of fuel and air is drawn into the fuel line **6** and through the opening **5** in the lower end of the cylinder **1**. Upon the downward stroke, the mixture drawn in through the port **5** into the lower end of the cylinder **1** is compressed and forced through the fuel line **6** and through the admission port **4** in the head-end of the cylinder **1**. The pressure of the mixture moves the valve **12** against the force of the spring **16**, thereby opening the admission port **4** for the admission of the mixture to the upper end of the cylinder **1**. The valve **12** remains open until the piston **23** moves upwardly to some point in its stroke when part of the mixture in the upper part of the cylinder **1** is forced out through the admission port **4** until the valve **12** is closed, enough charge being retained to carry the given load. This charge in the upper part of the cylinder **1** is then compressed until it reaches the ignition temperature when it explodes and forces the piston downwardly. The air and fuel charge are both variable. When the engine is operating, the mixture entering the admission port **4** displaces the burned gases which pass out through the exhaust port **3**. By adjustment of the valve **22** in the passage **21** leading to the top side of the piston member **17**, the pressure on the top side of the piston member **17** is increased or decreased thereby closing the valve **12** at different points in the stroke of the piston **23**. The power output is therefore varied by means of valve **22**.

Fig. 2 shows a scavenging cyclinder **40** similar to that shown in Fig. 1 with the exception that it is mounted on the side of the cylinder rather than on the end thereof. By mounting the scavenging cylinder **40** on the side of the main cylinder **41**, there is a space provided in the upper end of the main cylinder **41** to cushion the head of the main piston. The scavenging cylinder **40** has a bore **42**, a piston member **43**, a valve **44**, and a valve stem **45** connecting the valve **44** and piston member **43**. A separate passage **46** leading from the fuel line **47** permits the gas mixture under pressure on the top side of the piston member **43** to control the opening and closing of the valve **44**. A valve **48** in the passage **46** controls the pressure on the top side of the piston member **43**. A groove **49** in the side of the bqre **42** permits passage of gases when the valve **44** is in a closed position. The operation of this scavenging cylinder is the same as the scavenging cylinder shown in Fig. 1.

Fig. 3 shows a construction of my novel compression-ignition type of engine in its simplest form. The cylinder **50** has an admission port **51** and an exhaust port **52** intermediate the ends thereof and an opening **53** for gases in the lower end thereof. With no scavenging valve, as in Figs. 1 and 2, this type of construction would merely operate as a two-cycle internal combustion engine except that it would be of the compression-ignition type. When my novel engine is operated without the scavenging valve, as shown in Fig. 3, the quantity of air admitted is constant and the fuel admitted is controlled to carry any given load. In the constructions shown in Fig. 1, the output of the engine may be controlled by means of the operation of the valve **22** which controls the back-pressure on the piston member **17** attached to the spring-urged valve **12** which opens and closes the admission port **4** in the head of the cylinder, thereby admitting a greater or lesser amount of fuel mixture to the upper end of the cylinder by controlling the opening and closing of the valve **12**.

Disposed in opposed relation to my novel engine and prime mover is a fluid compressor comprising a cylinder **60** having a flange **61** attached to a flange **62** and secured to the top flange **63** and the flange **2** of the cylinder **1** by bolts **64**. The cylinder **60** has admission ports **65** and **66** for air, the lower port **65** having a spring-urged valve **67** seated therein for controlling the initial admission of air to said cylinder on the upstroke of the piston **68**. A piston valve casing **69** is disposed on the side of the cylinder **60** and has admission ports **70** and **71** leading to opposite ends of the cylinder **60**. The piston valve casing **69** has oppositely-disposed pistons **72** and **73** which reciprocate in the bore **74**. Air passages **75** and **76** are disposed on opposite ends of the piston valve bore **74** and lead to an intermediate point in the side wall of the cylinder **60**. Stop members **77** and **78** are mounted on the piston valve rod **79** for engagement with a spring-urged reciprocating locking member **80**. An air supply line **81** for a source of air under pressure leads to an opening **82** in the side of the piston valve casing **69**. Another air line **83** leads from the piston valve casing **69** to a port opening **84** in the bottom portion of the cylinder **60** for initially moving the piston **68**. A check valve **85** is disposed in the air line **83**. Exhaust openings **86** and **87** are disposed in opposite ends of the piston valve casing **69**. A discharge opening **88** having a check valve **89** disposed therein leads to a discharge line **90** for discharging compressed air from the cylinder **60**.

In initially starting my novel prime mover, fluid under pressure is admitted through the port **82** to the bore **74** in the piston valve casing **69**. The air pressure moves the reciprocating plunger member **80** against the force of the spring thereby releasing the piston rod **79** for movement in the piston bore **74**. The air under pressure passes through the air line **83** past the check valve **85** to the bottom of the cylinder **60** forcing the piston **68** upwardly past the admission port **71**. Fluid under pressure is admitted to the cylinder **60** through the admission port **71** until the piston passes port **76** when the air passes through port **76** to move the pistons **72** and **73** in the bore **74** to uncover the admission port **70** in the opposite end of the cylinder **60**, thereby providing fluid under pressure for reversing the pistons **72** and **73**. After the piston moves downwardly past the port **75**, the fluid passes through port **75** to force the pistons **72** and **73** to their original position shown in Fig. 1, thereby opening the opposite admission port **70**. When the piston **68** travels past the port **71**, the air trapped in the lower part of the cylinder **60** is compressed, the compressed air stopping and returning the piston **68** in such a manner as to accumulate the energy of each stroke to raise the pressure of the fluid in the lower part of the cylinder **60** as well as the fuel mixture in the upper part of the cylinder in the prime mover to the ignition point of the mixture. When explosions take place in the upper part of the cylinder in the prime mover in regular sequence, the air under pressure is released, allowing the piston rod **79** to center itself where it is locked by plunger **80**, thus closing both admission ports **70** and **71**. When compressing fluid in the cylinder **60**, the charge is drawn from a fluid source first through the valved admission port 65 and then through the open admission port 66 upon the passing of these ports by the piston 68 on its upward stroke. This fluid is compressed on the downward stroke, part of it being discharged through a discharge opening 88 to a receiver (not shown), and part of the fluid remaining in the cylinder 60 being further compressed in the bottom of the cylinder 60 to cushion the momentum of the piston 68 and return it on its upward stroke.

Fig. 4 shows an electrical starting and generating system for use with my novel compression-ignition type engine. A piston 100 having windings 101 reciprocates in a non-conducting sleeve 102 disposed in casing 103. The piston 100 is connected to a non-conducting piston rod 104 common to the piston rods in my novel compression-ignition type engine. Two sets of windinggs 105 and 106 and 107 and 108 surround each end of the sleeve 102. A brush 109 extends through aperture 110 in the sleeve 102 to change the flow of current in the windings 101. The brush 109 is made of insulating material and has contact members 111 and 112 disposed on opposite sides thereof connected to contact members 113 and 114 through flexible leads 115 and 116. Switch contacts 117 and 118 are connected to a battery 119 through wires 120 and 121. A cylindrical contact member 122 surrounds the windings 101 on the piston 100 for engagement with the brush 109. Non-conducting rings 123 and 124 are disposed on each end of the cylindrical contact member 122. A piston ring 125 is disposed on the bottom end of the piston 100 to cushion the piston 100 on its downward movement in the sleeve 102. A rheostat 126 is provided to control the voltage in the coils 107 and 108. A handle 127 serves to move the contact members 117 and 118 into engagement with the contact members 113 and 114 and also holds the brush contacts 111 and 112 in a secure position after tilting (not shown).

In starting my novel compression-ignition type engine, the contact members 117 and 118 in circuit with the battery 119 are placed into engagement with the contact members 113 and 114. This closes a circuit from the contact members 113 and 114 through the exciting coils 105 and 106 as follows: contact member 113, wire 128, coil 105, wire 129, coil 106, rheostat 126, contact member 114, contact member 118, wire 121, battery 119, wire 120, contact member 117, back to the contact member 113. The coil 101 surrounding the piston 100 is also energized with a circuit starting at the contact member 113 as follows: contact member 113, flexible wire 115, contact member 111, cylindrical contact member 122, coil 101, cylindrical contact member 122, contact member 112, flexible wire 116, contact member 114, and through the battery circuit as previously described.

The flux created by the exciting coils 105 and 106 will draw the piston 100 upwardly in the sleeve when the polarity thereof is changed by the tilting of the brush 109 to bring the contact member 112 of the brush 109 into engagement with the cylindrical contact member 122 on the piston 100. The piston 100 will then be alternately moved upwardly and downwardly acting as a solenoid. After my novel engine is started, the starting circuit is broken and the brush 109 held stationary for generating alternating current.

The coil 101 reciprocating with the piston 100 excites the exciting coils 105 and 106 and induces a current in the coils 107 and 108 which is drawn off through the wires 130 and 131.

It will be evident from the foregoing that I have provided a novel compression-ignition type of internal combustion engine which may utilize one of several means for initial starting thereof and which has a high efficiency, both at full and part load operation, utilizing the inertia of the moving parts in obtaining energy therefrom.

Various changes may be made in the specific embodiment of the present invention without departing from the spirit thereof or from the scope of the appended claims.

What I claim is:

1. A compression-ignition type internal combustion engine comprising a cylinder having an exhaust port intermediate the ends thereof and interconnected admission ports on both ends thereof; a source of ignitable fluid for admission to said cylinder, the compressed fluid in one end of said cylinder being admitted to said cylinder through the oppositely disposed admission port for compression and ignition therein; and a movable piston in said cylinder.

2. A compression-ignition type internal combustion engine comprising a cylinder having an intermediate exhaust port and interconnected admission ports on opposite ends thereof; a source of ignitable fluid; a piston movable in said cylinder; and a spring-urged valve in one of said admission ports for closing said port to the exhaust of fluid to be compressed, the compressed fluid in one end of said cylinder passing to said valve admission port for admission, compression and ignition; and means for initially reciprocating said piston.

3. In combination with an engine having a reciprocating piston means for initially moving said reciprocating piston and for compressing fluids comprising a cylinder having admission and exhaust ports; a piston movable with the piston of said engine; a valve casing having admission ports leading to opposite ends of said cylinder and intermediate exhaust ports; a valve for alternately opening and closing said admission and exhaust ports in said valve casing to reciprocate the piston in said cylinder; a source of fluid under pressure entering said valve casing; and means for automatically closing said admission ports when said source of fluid under pressure is shut off.

4. A means for initially moving a reciprocating piston and compressing fluid as set forth in claim 3, wherein a line from said valve casing to one end of said cylinder provides initial movement of said piston.

5. In combination with an engine having a reciprocating member, means for initially moving said reciprocating member and for compressing fluids comprising a cylinder having admission and exhaust ports; a piston movable with said reciprocating member of said engine; a valve casing having admission and exhaust ports leading to opposite ends of said cylinder for initially moving said piston; a reciprocating valve in said casing for alternately opening and closing said admission ports in said valve casing; a source of fluid under pressure for said valve casing; locking means for said reciprocating valve adapted to be opened automatically when air under pressure enters said casing to free said valve and which locks said valve automatically when said air pressure is shut off.

6. A compression-ignition type internal combustion engine comprising a cylinder having an exhaust port intermediate the ends thereof and admission ports on opposite ends of said cylinder; a casing having a passage for fluid interconnecting said admission ports; a source of ignitable fluid; a long-skirted piston uncovering said exhaust port when said piston moves in the direction of said skirt; a spring-urged valve in the admission port on the end of said cylinder opposite to the skirt on said piston, said spring-urged valve admitting ignitable fluid to said cylinder compressed in the opposite end of said cylinder; and means for varying the back pressure on said spring-urged valve to vary the amount of compressed ignitable fluid passing to said cylinder.

7. A compression-ignition type internal combustion engine comprising a cylinder having an exhaust port and interconnecting admission ports on opposite ends of said cylinder; a casing having a passage interconnecting said admission ports; a piston movable in said cylinder adapted to open said exhaust port on the power stroke thereof; a spring-urged valve in one of said admission ports; a piston member connected to said spring-urged valve; and means for exerting a predetermined back pressure on said piston member.

8. A compression-ignition type internal combustion engine, as set forth in claim 7, wherein said means for exerting a predetermined pressure on said piston member comprises a casing having an auxiliary passage leading to the back side of said piston member from the fuel passage interconnecting said admission valves, and a valve in said auxiliary passage for controlling the back pressure on said piston member.

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