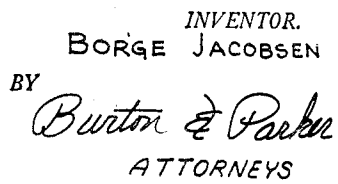


Filed May 1, 1948

TWO-CYCLE CRANKCASE COMPRESSION ENGINE

2 SHEETS--SHEET 1



Feb. 19, 1952

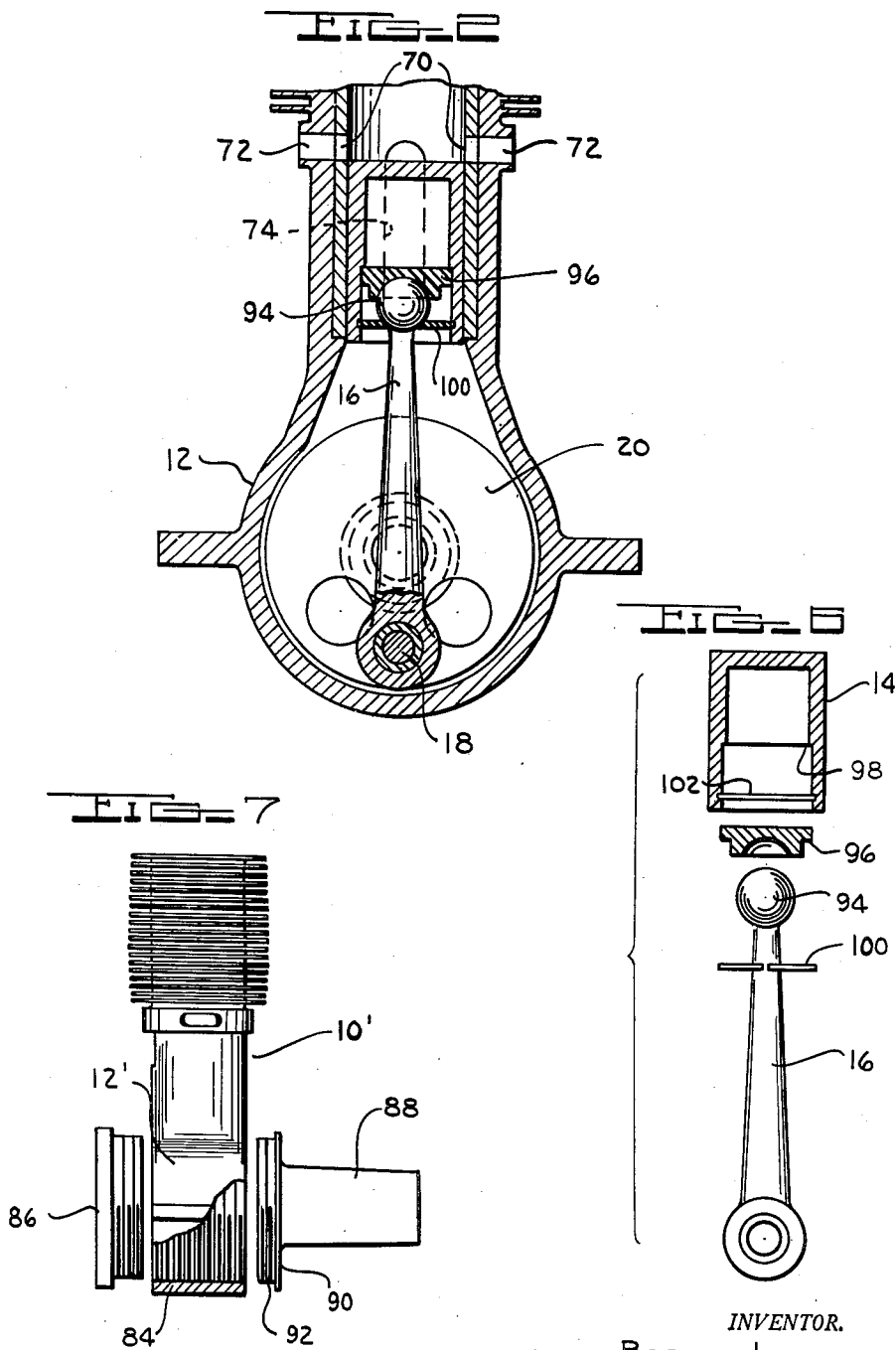
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TWO-CYCLE CRANKCASE COMPRESSION ENGINE

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2 SHEETS--SHEET 2



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TWO-CYCLE CRANKCASE COMPRESSION
ENGINE

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7 Claims. (Cl. 123—73)

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This invention relates to internal combustion engines and particularly to a two-cycle compression self-ignition engine.

An important object of the invention is to provide an improved internal combustion engine embodying characteristics of diesel type of engines and operating without spark ignition and fuel injection. Another important object of the invention is to provide an engine of this character which is constructed in a novel manner for highly efficient operation and for extremely high speeds and high horse power ratio as compared to the weight thereof. A further important object of the invention is to provide an improved type of diesel engine particularly adapted for use on miniature or model aircraft and which is designed and constructed in a novel manner for economical manufacture with at least the cylinder and the crank case forming integral parts thereof.

In carrying out the invention the engine is constructed with the cylinder and crank case cast integrally together and in one form of the invention the supporting hub of the crank shaft is cast integrally with these parts. Received within this cylinder is a novel sleeve in which the piston reciprocates having inlet and exhaust ports cooperating in a novel manner with the piston to improve the carburation of the device and the discharge of the burned gases therefrom. An important feature of the invention is the provision in such a sleeve liner of an elongated opening or slot which cooperates with the interior of the crank case to form a fuel delivery passage. Another important feature of the invention is the form of connection between the piston and the crank shaft connecting rod consisting of a few easily assembled and disassembled parts and which provides universal movement of the piston relative to the rod including the rotation of the former in the cylinder during the operation of the engine. A still further important feature of the invention is the relationship of the exhaust ports to the piston whereby at the top of the stroke of the latter the exhaust ports are at least partially opened to admit air from the outside for mixture with the fuel delivered to the crank case.

Various other objects, advantages and meritorious features of the invention will become more fully apparent from the following specification, appended claims and accompanying drawings wherein:

Fig. 1 is a vertical sectional view through an engine embodying the features of the invention,

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Fig. 2 is a vertical sectional view through the engine of Fig. 1 taken along line 2—2 thereof,

Fig. 3 is a perspective view of one form of cylinder liner employed in the engine,

Fig. 4 is a perspective view of another type of cylinder liner adapted for use in the engine,

Fig. 5 is a fragmentary vertical sectional view showing the mounting of the sleeve of Fig. 4 in an engine of this character,

Fig. 6 is an exploded view illustrating the parts of the piston and connecting pin in their order of assembly, and

Fig. 7 is a side elevation, partly in section, of a modified form of engine body having a removable propellor hub portion.

The engine comprises a cylinder 10 opening into communication at its lower end with a crank case 12. Slidably reciprocally mounted in the cylinder 10 is a piston 14. The latter is connected by means of a rod 16 to a crank pin 18 eccentrically mounted on a crank 20.

The front wall of the crank case is formed with a forwardly projecting cylinder portion or hub 22 through which projects and is rotatably mounted a crank shaft 24. On the forward projecting end of the crank shaft 24 is a removable nut 26 employed for clamping a propellor between the same and a washer member 28. Encircling the crank shaft 24 in the hub 22 is an antifrictional sleeve bearing 30.

The crank case 12 is formed with an opening in its rear wall opposite to the hub 22 to permit the insertion and removal of the piston 14 and its associated parts and the insertion and removal of the crank shaft 24. This opening is normally closed by a circular plug 32 which is externally threaded for threaded engagement in the opening.

The engine carries a fuel tank or reservoir 34 which is supportingly suspended below a horizontal fuel delivery conduit 36. The forward end of the conduit 36 is threaded for detachable connection to the rear side of the cylinder 10 and in alignment a fuel inlet port 38 in the cylinder wall. Thus, fuel from the tank 34 may flow into the conduit 36 and thus by way of the port 38 into the cylinder and crank case in a manner to be more fully described hereinafter. Suspended in the fuel tank is a tube 40 coupled at its upper end to an elongated tubular member 42 which projects above the tank and extends diametrically through the conduit 36. The member 42 is provided with a shoulder 44 which bears upon the conduit 36 for supporting engagement therewith. A passage 46 admits fuel from

the tube 40 and delivers the same to a relatively small laterally opening discharge port 48 opening into the interior of the conduit 36. An adjustable needle valve 50 is mounted in the member 42 and controls the amount of fuel permitted to be discharged from the port 48. Fixed to the needle valve 50 is an encircling sleeve 52 which is threadedly connected to the member 42 in order that upon rotation of the needle valve it will rise and fall relative to the discharge port 48 and vary the opening thereof.

The engine is preferably constructed so that the three major parts thereof, the cylinder 10, the crank case 12, and the crank shaft hub 22 are formed in one piece and integrally connected together. This is accomplished in one casting operation thereby economizing on the manufacturing costs and providing a fine functional design.

An important feature of the invention is the provision of a sleeve or liner 54 for the cylinder 10 which extends slightly less than the length of the cylinder, being seated at its lower end upon a shoulder 56 adjacent to the crank case and terminating short of the upper end of the cylinder as shown in Fig. 1. The piston 14 slidably fits the sleeve and is capable of reciprocating and rotational movement therein. The sleeve and piston are preferably hardened, honed and lapped for tight slidable fit.

Immediately beyond the upper end of the sleeve 54, the cylinder wall is internally threaded as at 58 for threadedly receiving a body or cylinder closure member 60. The latter is axially bored and the bore is internally threaded to receive an externally threaded stem 62. The upper end of the stem projects beyond the body and is provided with a laterally extending arm 64 for turning the same.

To vary the compression ratio, the upper end of the cylinder is provided with a longitudinal adjustable member capable of bodily movement toward the piston upon rotational movement of the stem 62 in one direction. This member is in the form of a cup 66, the side walls of which slidably fit the sleeve 54 and the bottom of which is engaged by the lower end of the threaded stem. It is obvious that upon rotation of the handle 64 in one direction, the stem will advance into the cylinder and force the cup shaped member 66 toward the piston. The member 66 is loosely fitted in the cylinder and normally is held against the lower end of the stem 62 by the compression built up within the cylinder. The assembly for adjusting the compression ratio is extremely simple consisting in all of three parts, namely, the stem 62 and its arm, the body 60, and the cup shaped member 66. To prevent complete withdrawal of the stem from the engine, the former is provided with a snap ring or other suitable means 68 on the lower end thereof which limits the extent of outward threaded adjustment of the same.

The sleeve 54 forms the chamber in which the piston reciprocates. The chamber is scavenged by two exhaust ports located on opposite sides of the cylinder. The sleeve 54 as shown in Fig. 4 is provided with two circularly aligned arcuate slots 70-70 on diametrically opposite sides thereof which align with ports 72-72 in the wall of the cylinder for forming the exhaust ports of the engine. The piston is of such a length that in its lowermost position shown in full line in Fig. 1, the upper end thereof extends substantially flush with the lower edges of the two ex-

haust slots or ports 70-70 of the sleeve. The piston's length is also so related to the stroke of the engine that in its uppermost position in dotted outline of Fig. 1, the lower end of the skirt of the piston clears the bottom edges of the ports 70-70 and partially opens these ports for the admission of fresh air into the cylinder. Thus, the piston in its lowermost position will permit the exhaust of the burned gases during the operation of the engine, and at its uppermost position will permit the introduction of fresh air into the cylinder below the piston.

The fuel inlet port 38 is so related to the piston and its stroke that when the piston is approaching or reaches its uppermost position its skirt will clear the port and permit the introduction of fuel into cylinder and crank case below the piston. When the piston returns from its uppermost position it cuts off the port 38 and thereafter compresses the fuel mixture in the bottom portion of the cylinder and in the crank case.

The sleeve 54 is constructed in a novel manner for forming a passage for by-passing the fuel mixture to the chamber above the piston when the latter approaches and reaches its lowermost position. The sleeve 54 as shown in Fig. 3 is provided with an elongated slotted opening 74 extending longitudinally of the sleeve. This opening as shown in Fig. 3 may terminate just short of the lower end of the sleeve and is closed by a bridging portion 78 of the sleeve wall. The slotted opening 74 extends to a height on the level with the exhaust ports 70-70 and terminates substantially on the level with the center line of these ports as shown in Figs. 1 and 2. The upper end of the slotted opening may be rounded as shown in Fig. 2 and thereby rise to a height slightly above the center line.

The inner wall of the cylinder adjacent to the lower end of the sleeve is cut away or otherwise so formed to provide a passage 76 extending around the narrow bridging element 78 which closes off the lower end of the opening 74. This passage provides communication between the crank case and the elongated opening 74 and after the piston clears the upper end of the opening in its downward stroke enables the fuel mixture compressed in the crank case to flow around the bridging element 78 and thus into the slotted opening 74 for discharge into the firing chamber. The flow of this gaseous mixture in the chamber at this instant of time will force any remainnig part of the burned gases out of the exhaust port 70-70, but before the fuel mixture can likewise escape the piston rises cutting off the upper end of the slotted opening 74 and sealing the new mixture within the chamber preparatory to firing the same. Characteristic of diesel types of engines, the upper stroke of the piston will compress the fuel mixture in the chamber until the mixture reaches the pressure and temperature at which it is self-ignitable.

A modified form of sleeve is shown in Fig. 4 wherein instead of the slot 74 terminating short of the lower end of the sleeve as in Fig. 3 it is opened out through the bottom end thereof. Such a slot is indicated at 80 in this figure and as shown in the fragmentary view in Fig. 5 the slot in assembled position communicates directly with the crank case. The advantage of this form of sleeve construction is the fact that the cylinder wall need not be cut away or otherwise formed to provide a communicating passage between the crank case and the lower end of the slot. The inner wall of the cylinder may be cut

away only slightly and in the manner indicated at 82 in Fig. 5. The disadvantage of this form of slotted passageway is the fact that it tends to weaken the sleeve and would in use in high compression engines require a thicker walled sleeve. The sleeve of Fig. 4 is otherwise similar to that shown in Fig. 3.

In the embodiment of the invention previously described, the cylinder, crank case and hub are integrally joined together in one casting operation. In Fig. 7, however, the invention is constructed in a slightly different way and in such a manner that only the crank case and the cylinder are integrally joined together in one casting operation. Referring to Fig. 7 the cylinder is indicated at 10' and the crank case at 12'. The latter is completely internally threaded from the front side to the rear side thereof as indicated by the threads 84 thereof. Received in the back opening of the crank case is a plug 86 similar to plug 32 previously described.

In the embodiment of the invention illustrated in Fig. 7, the forwardly projecting support for the crank shaft is a separate unit of tubular formation shown at 88. The rear end of this tubular member is widened out at 90 circularly on all sides and provided with external threads 92 which threadingly engage with the threads 84. Thus, in one operation it is possible to internally thread the crank case from the front side thereof to the rear side thereof and thereby provide the same threads for detachably threadingly receiving the plug element 38 and the crank shaft support 28. This manner of connecting the parts forms an economical way of manufacturing the engine and enables the parts to be readily disassembled and assembled by the user.

As previously mentioned the piston 14 is capable of universal movement relative to the connection rod 16. The form of connection for this purpose is shown in Fig. 6 and comprises a ball end 94 on the connecting rod which is engageable with a socket member 96 adapted to slidably fit the interior of the piston. As shown in Fig. 6 the piston is hollow and is internally bored to provide two wall portions of different radii. The wider wall portion is located adjacent to the lower end of the piston and at its juncture with the narrower wall portion forms a shoulder 98 against which the socket member 96 is adapted to fit in assembled position. Encircling the connecting rod 16 is a split angular shaped member 100 which as shown in Fig. 2 is adapted to be releasably snapped into an internal circular groove 102 in the wider wall portion of the piston. In completely assembled position as shown in Fig. 2 the snap ring 100 serves as a retainer holding the ball end 94 of the connecting pin in the concave recess of the socket member 96 at all times. The parts are so related that in assembled position the socket member seats against the shoulder 98 thus holding the parts from longitudinal movement in the piston but permitting the connecting rod 16 to assume various angular positions with respect to the piston during the operation of the engine and also permitting the piston to rotate freely in the sleeve as it reciprocates.

What I claim is:

1. An internal combustion engine comprising, in combination, a cylinder, a closed crank case communicating with the interior of the cylinder, a sleeve lining the inner wall of the cylinder, a piston reciprocable in said sleeve and slidably fitting the same, said sleeve provided with a fuel inlet port and an exhaust port offset

to one another axially of the sleeve, said piston adapted in its reciprocating movement to cut-off one or the other of said ports, the stroke length of the piston being so related to the ports that at the upper end of its stroke fuel is admitted through said inlet port to the underside of the piston and that at the lower end of its stroke burned gases will escape from the exhaust port, said sleeve further provided with an elongated slot extending longitudinally thereof and communicating at its lower end with the crank case and at its upper end with the chamber whereby fuel compressed within the crank case may be by-passed around the piston when it is at the lower end of its stroke and introduced into the sleeve area above the piston.

2. In a self-ignition internal combustion engine a cylinder, a sleeve lining the inner wall of the cylinder and extending for substantially the entire length thereof, a crankcase, a piston slidably reciprocating in the sleeve and forming a conjunction with the upper end of the cylinder a firing chamber, said sleeve provided with a fuel inlet port adapted when the piston is at the upper end of its stroke to communicate with the crank case and deliver a fuel mixture thereto, said sleeve further provided with an exhaust port above the level of fuel inlet port adapted to permit the escape of gases from the firing chamber when the piston reaches the lower end of its stroke, said sleeve still further provided with an elongated slot opening into communication with the crank case at the lower end thereof and opening into communication with the firing chamber when the piston is at the lower end of its stroke, and means slidably fitting the upper end of the sleeve and bodily adjustable axially thereof to vary the volume of the firing chamber.

3. In a self-ignition crank case compression internal combustion engine including a cylinder, a crank case and a reciprocable piston in the cylinder, a sleeve lining the wall of the cylinder and interposed between the same and the piston and forming in the upper end thereof above the piston a firing chamber, said sleeve provided with a fuel inlet port and an exhaust port offset with respect to one another axially of the sleeve and so related to the piston that the inlet port opens into communication with the crank case when the piston is at the upper end of its stroke and the exhaust port will permit the escape of burned gases from the chamber when the piston is at the lower end of its stroke, said sleeve further provided with an elongated opening extending longitudinally thereof adjacent to the lower end thereof and communicating at its lower end with the crank case and extending to a height slightly above the level of the piston when at the lower end of its stroke whereby a fuel mixture compressed in the crank case may be delivered to the firing chamber.

4. The invention described in claim 3 characterized by the provision of a cup-shaped member slidably fitting the upper end of the sleeve, and means for slidably bodily adjusting the member axially of the sleeve to vary the volume of the firing chamber.

5. An internal combustion engine, comprising, in combination, a cylinder and a crank case, said crank case being opened at its opposite ends and internally threaded from one end to the other end thereof, an externally threaded closure member adapted to threadedly engage the

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internal threads of the crank case and be removably secured to one end of the crank case, and a tubular housing having an externally threaded portion adapted to threadedly engage the internal threads of the crankcase and be removably secured to the opposite end of the crank case.

6. In an internal combustion engine having a crank case, said crank case opening on opposite ends thereof and being internally threaded completely therethrough from one end to the other end, a closure member having an externally threaded portion adapted to threadedly engage the internal threads of the crank case and seal one end thereof, a tubular housing for a crank shaft having an externally threaded portion adapted to threadedly engage said threads of the crank case and close the opposite end thereof, said threads of the crank case, closure member, and tubular housing being of the same diameter and pitch.

7. In an internal combustion engine having a crank case, said crank case being opened at its opposite ends and having its opposite end sections co-axially aligned and internally threaded with threads of the same pitch and diameter, a closure member having an externally

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threaded portion threadedly engaging the internal threads of one end section of the crank case, and a tubular housing for a crank shaft having an externally threaded portion on one end thereof threadedly engaging the internal threads of the opposite end section of the crank case.

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