

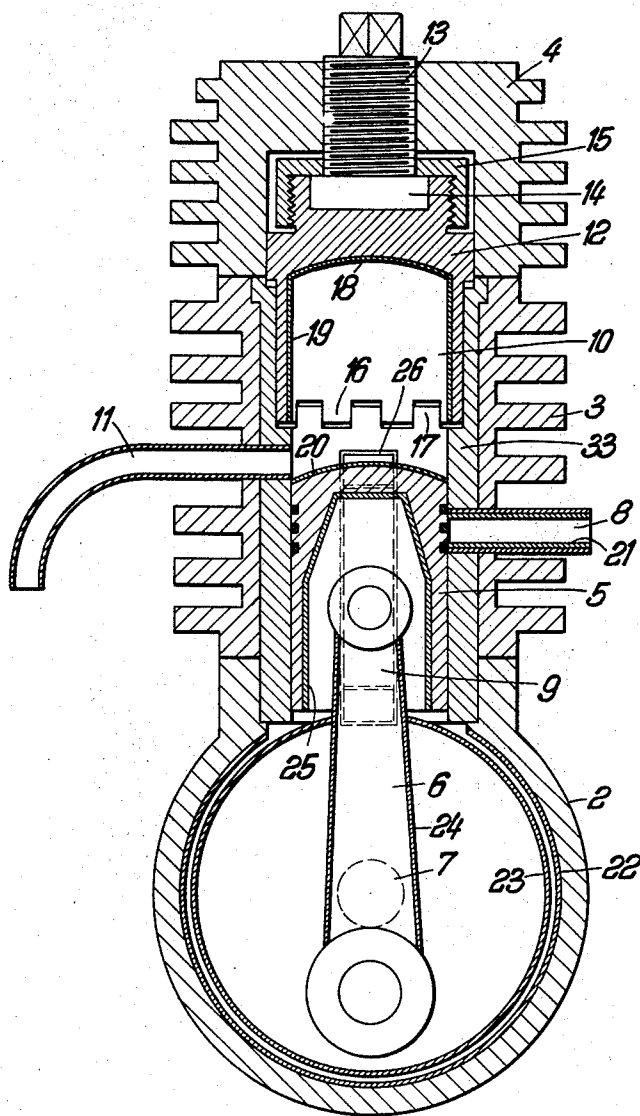
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F. PHILIPP

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INTERNAL-COMBUSTION ENGINE WITH ADJUSTABLE COMBUSTION CHAMBER

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Inventor:

FRANZ PHILIPP

BY

Karl F. Ross
AGENT

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INTERNAL-COMBUSTION ENGINE WITH ADJUSTABLE COMBUSTION CHAMBER

Franz Philipp, Berlin-Spandau, Germany

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2 Claims. (Cl. 123—48)

The invention relates to a two-stroke internal-combustion engine with an adjustable combustion chamber, which may be used for stationary service as well as for driving a vehicle and is adapted to operate on a light liquid fuel or a heavy oil.

One of the main features of the invention resides in the provision of a stepped piston axially divided by an internal shoulder into a narrower and a wider compartment, the difference in the inner width of the two compartments being compensated by a tubular insert or counter-piston which is slidably received in the narrower compartment and is provided with crenellations mating with complementary crenellations in the aforesaid shoulder whereby a reciprocating piston within the cylinder is smoothly guided while the effective cylinder volume may be varied. This enables a ready adaptation of the compression chamber within the cylinder to different fuels without requiring any relocation of the inlet and outlet passages for the working fluid which may be conveniently connected with the wider cylinder compartment. With such arrangement the cylinder head is perfectly tight before and after the explosion stroke, that is to say at the times of maximum pressures, so that no escape or loss of gases is possible as happens with other axially adjustable counter-pistons serving as cylinder heads. The clearance provided by the crenellations between the movable insert and the fixed part of the cylinder also serves to accommodate the residues from the fuel oils which lubricate and seal the hollow counter-piston. When heavy fuel oil is used, the engine can be started with the compression chamber adjusted to its smallest volume, e.g. for a compression of about 30 atmospheres, and shortly after the start of the engine the compression is decreased by retracting the hollow counter-piston and expanding the interior of the cylinder. An ignition device is not needed.

Advantageously, the bottom of the counter-piston (or insert) is plated with a catalytic layer of platinum, palladium or the like, while the cylinder wall of this insert is provided with a plating of nickel, rhodium or iridium; the bottom of the operating piston facing the combustion chamber is plated with copper, as are the gas passages, the crank case, the crank, the connecting rod, and the bore of the working piston. By virtue of the catalytic action of these platings, a heavy-fuel/air mixture passing from the carburetor and from there to the cylinder is split up into different light oils. Thus, shortly after the engine starts it may continue to operate by a self-igniting process at a comparatively low precompression of, say, 14 atmospheres or less, and the counter-piston may be retracted so as to enlarge the compression chamber. The engine, working without spark plugs or the like, operates almost as quietly as a conventional gasoline engine.

In the sole figure of the accompanying drawing a combustion engine according to the invention is illustrated in longitudinal section.

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The drawing shows a cylinder 3 made of aluminum, provided with cooling ribs and with a sleeve 33 made of steel or iron, as by a centrifugal-casting process; sleeve 33 is screwed onto a crank case 2. A cylinder head 4 is similarly fastened to the cylinder 3. A piston 5 drives a connecting rod 6 impelling a crank shaft 7. A gas conduit 8 leads to the crank case 2 whence the usual passages 9 extend to the combustion chamber 10, connected by an exhaust conduit 11 with an exhaust box.

A hollow counter-piston 12 is arranged for axial movement in the sleeve 33 and the cylinder head 4. The counter-piston 12 is adjustable in height by means of a screw 13, bearing upon it through a collar 14 and threadedly engaging cylinder head 4, by means of a screw driver or any other suitable tool. The collar 14 is rotatably secured to the counter-piston 12 with a screw cap 15.

The hollow counter-piston 12 terminates slightly above the exhaust pipe 11 and is formed at its lower edge with crenellations 16 co-operating with complementary toothed formations 17 which are provided at the junction of the upper, large-diameter part with the lower, small-diameter part of the cylindrical sleeve 33. The counter-piston 12 has a bore corresponding to the diameter of the lower sleeve portion 33 so that the operating piston 5 on its upward stroke can enter into the interior 10 of this counter-piston. The inner edges of the teeth 16 and 17 are slightly beveled so as to minimize the impact of the piston rings upon these edges. In operation, oil residues settle within the empty spaces between the crenellations 16 and 17, thereby lubricating the sleeve 33 as well as the hollow counter-piston and sealing the latter against the fixed part of the cylinder.

All surfaces of the gas conduits, the crank case, the bore of the piston, and the combustion chamber which are in contact with the fuel oil are plated with catalytic linings, preferably with different catalysts, so that in operation a heavy-fuel-oil mixture is split into lighter hydrocarbons and carbon monoxide whereby the compression necessary for self-ignition can be decreased, shortly after starting and warm-up of the engine, by the upward retraction of counter-piston 12 as described above. The catalytic plating 18 of the bottom of the roof of the counter-piston consists e.g. of platinum, palladium, rhodium or the like, the plating 19 of the cylinder wall of the counter-piston being of nickel, rhodium or iridium, and the plating 20 of the bottom of the operating piston at the side of the combustion chamber consisting of copper or the like. The gas conduit 8 and the passage 9, the crank case 2, the crank 7, the connecting rod 6, and the bore of the operating piston 5 are preferably copper-plated, as indicated at 21, 22, 23, 24, 25 and 26. If smooth coatings are not essential and the surfaces are easily accessible, plating can be effected partly by spraying. Otherwise, as in the case of the hollow counter-piston 12, the catalytic plating is advantageously applied by electrodeposition. The layers 18 and 20 as well as others, if desired, can also be applied by galvanization or by welding.

For starting the engine, the compression chamber 10 of the cylinder is shortened by screwing down the piston 12, whereupon fuel is admitted to the cylinder. The gas passes through conduit 8, case 2 and passage 9, arriving in the combustion chamber 10 where it is ignited by a compression of, say, 30 atmospheres and from which it escapes through exhaust conduit 11. After a few revolutions, the engine and the catalysts are sufficiently hot so that the fuel is split up into lighter oils and combustible gases by the action of the catalysts. Then the precompression can be decreased to, for example, 14 atmospheres or less while the ignition process continues.

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As in a solidly closed cylinder, the ignition takes place in a gas-tight space and there are no fuel losses through leaks. Once the crenellations 16 and 17 have been cleared by the operating piston 5, the pressure of the fuel gases has decreased sufficiently so that no gases can escape through these crenellations and between the cylindrical contact surfaces of sleeve 33 and counter-piston 12. The change of pressure within the cylinder promotes, furthermore, a continuous flow of oil residues into the empty spaces between the crenellations 16 and 17 so that the plated surfaces 19 and the cylinder surfaces between the counter-piston 12 and sleeve 33 are well lubricated. The adjustability of the compression chamber does not affect the gas passages 9 and 11 because their orifices are arranged in the fixed part of the cylinder.

The catalytic platings on the surface 19, applied by electrodeposition, can be suitably smoothed and compacted by rolling after their formation.

I claim:

1. In an internal-combustion engine, in combination, a cylinder having a chamber, the wall of said chamber having a shoulder dividing the chamber into a first compartment of increased diameter and a second compartment of reduced diameter axially adjoining each other, a tubular insert slidably received in said first compartment, said insert having a wall thickness equaling the depth of said shoulder whereby its interior forms a flush continuation of said second compartment, said insert being closed

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at its end remote from said second compartment, control means for changing the effective volume of said chamber by axially displacing said insert in said first compartment, said shoulder and said insert being provided with mating crenellations interengaging over the range of displacement of said insert, and a piston reciprocable in said chamber across said crenellations, said cylinder having passages located at said second compartment for the admission and the discharge of a working fluid into and out of said chamber.

2. The combination according to claim 1 wherein said control means comprises a screw coaxially engaging said insert.

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