

[54] **ROTARY PISTON COMBUSTION ENGINE**

[75] Inventors: **Walter Froede; Gottlieb Wilmers; Anton Dekitsch**, all of Neckarsulm, Germany

[73] Assignees: **Audi Nsu Auto Union Aktiengesellschaft**, Neckarsulm; **Wankel GmbH**, Lindau/Bodensee, both of Germany

[22] Filed: **Mar. 1, 1972**

[21] Appl. No.: **230,557**

[30] **Foreign Application Priority Data**

Mar. 4, 1971 Germany..... P 21 10 333.3

[52] U.S. Cl..... **123/196 R**, 123/8.01, 418/100

[51] Int. Cl..... **F01m 9/02**

[58] Field of Search..... 123/8.01, 196 R; 184/6.16; 418/96, 100

[56] **References Cited**

**UNITED STATES PATENTS**

3,140,700 7/1964 Nallinger..... 123/196 R

**FOREIGN PATENTS OR APPLICATIONS**

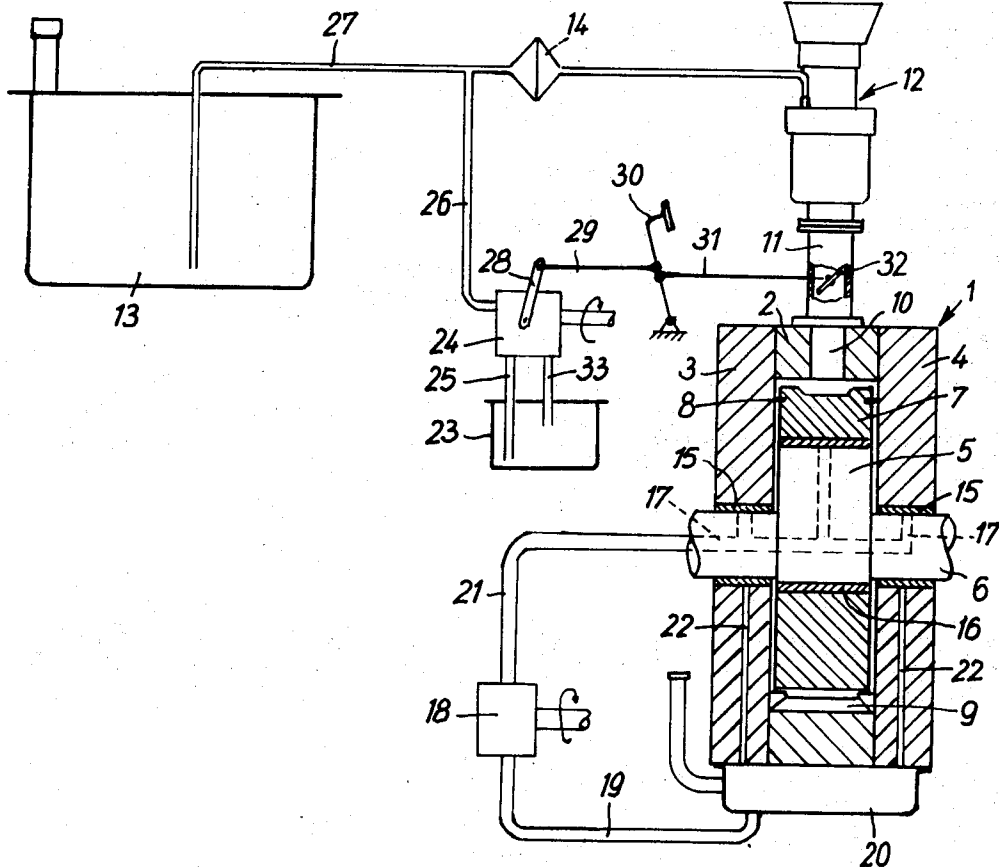
369,451	7/1963	Switzerland.....	418/100
706,503	5/1941	Germany .....	184/6.16
517,189	1/1940	Great Britain.....	184/6.16
406,051	2/1934	Great Britain.....	418/100
1,146,699	9/1960	Germany .....	123/8.01

*Primary Examiner*—Manuel A. Antonakas  
*Attorney*—David S. Kane et al.

[57] **ABSTRACT**

A rotary piston combustion engine including a housing made up of a shell with multiarcuate inner surface and side parts. A polygonal piston is rotatably mounted on the eccentric of an eccentric shaft in the housing. The piston is provided with sealing parts to slide along the inner housing surfaces and to seal off adjacent working chambers from each other. Finally, means are provided for introducing a basic additive into the working chambers at least during the phase when the engine is running hot.

**11 Claims, 5 Drawing Figures**



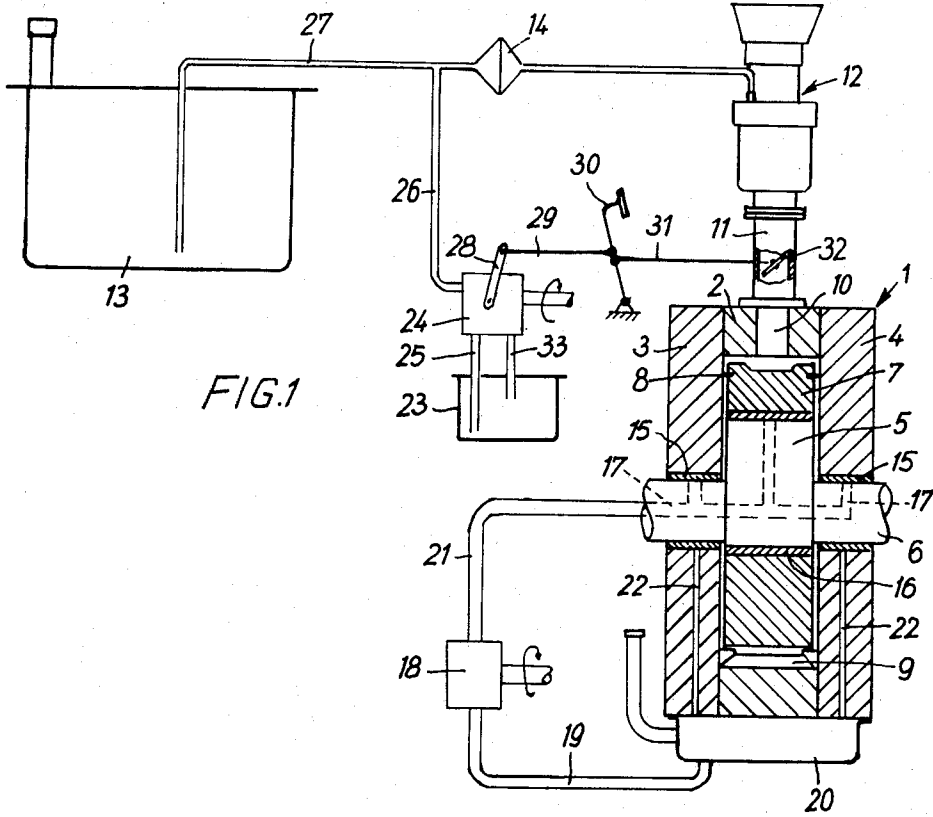


FIG. 1

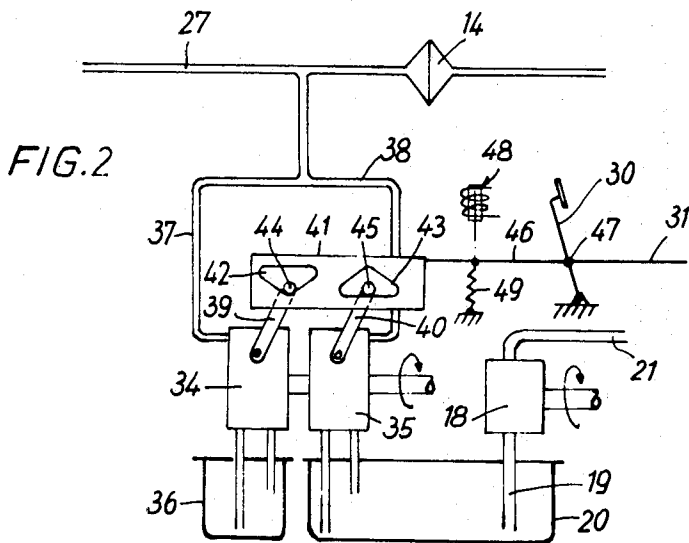


FIG. 2

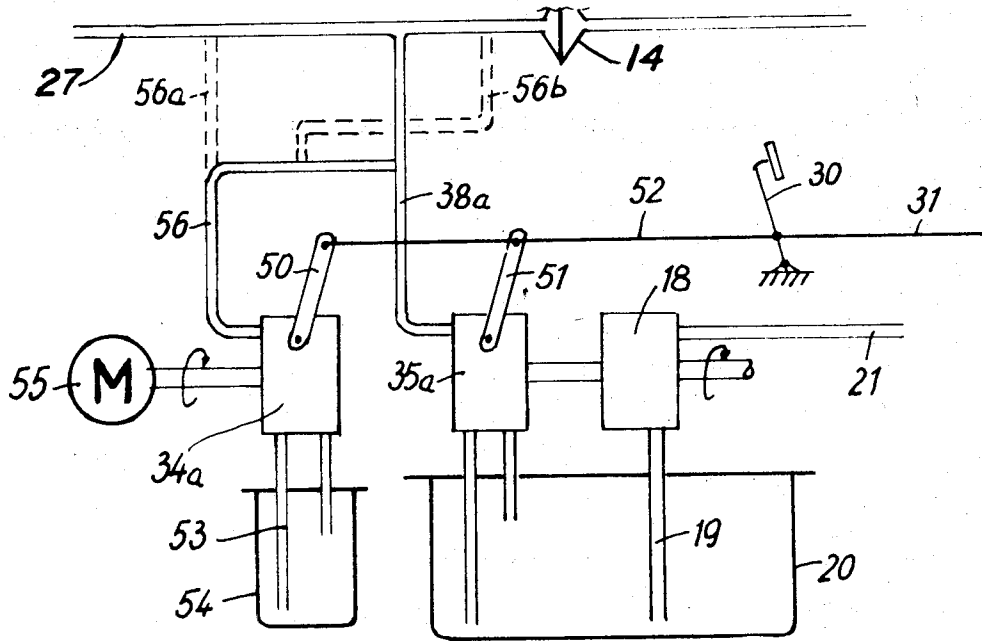
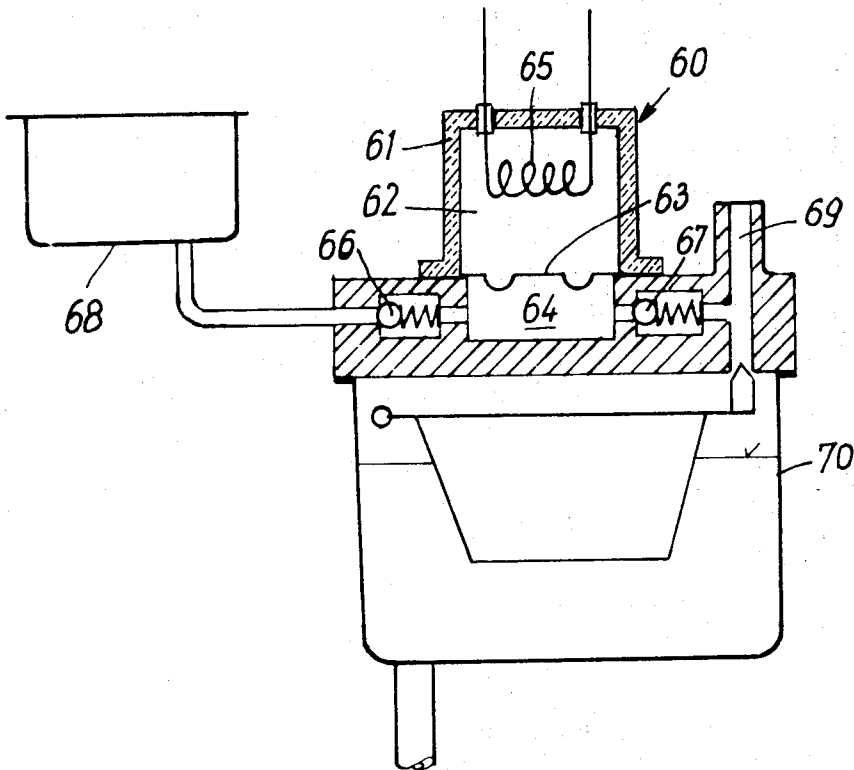


FIG. 3

FIG. 4



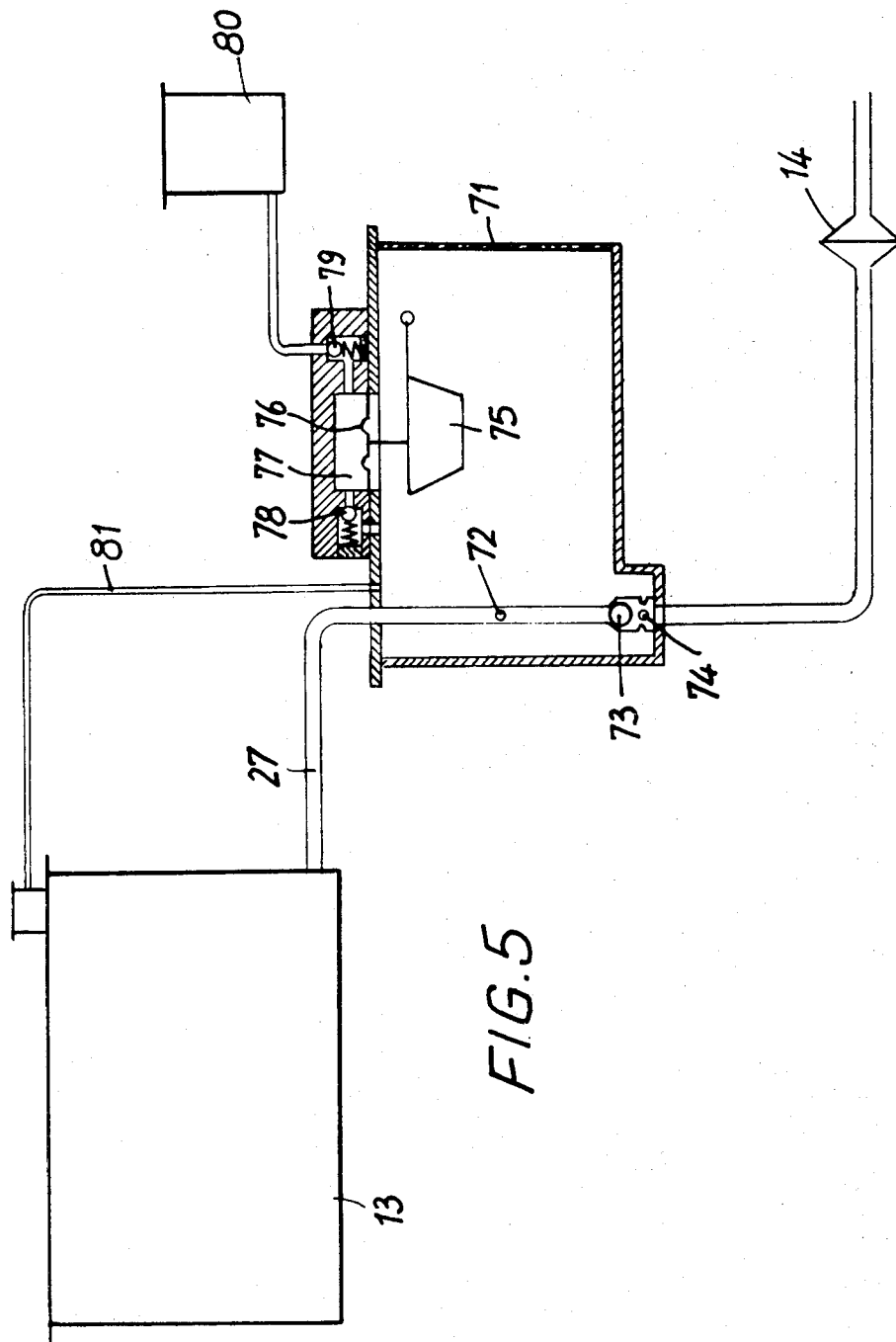


FIG. 5

## ROTARY PISTON COMBUSTION ENGINE

### BACKGROUND OF THE INVENTION

The invention relates to a rotary piston combustion engine having a housing consisting of a shell with multi-arcuate inner surface and side parts. A polygonal piston is rotatably mounted on the eccentric of an eccentric shaft in the housing. The piston is provided with sealing parts which slide along the inner housing surfaces and seal off adjacent working chambers from each other.

In such engines, the sealing parts and the housing walls cooperating with them are subjected to severe stress. Long life can therefore be achieved only if wear on these parts is reduced as far as possible. To keep down wear on the inner housing surfaces, especially the inner shell surface, these surfaces are often provided with an abrasion resistant facing. It has been found that in the working chambers, and especially in the so-called "cold" arc, in particular during the starting operation until the normal operating temperature is reached, an acid condensate forms that attacks the facing of the inner housing surfaces and interferes with the formation of a lubricating film. The result is considerable wear on the sealing parts and their bearing surfaces.

### SUMMARY OF THE INVENTION

The object of the invention is to reduce wear on the sealing parts and their bearing surface. This is accomplished by providing means of introducing a basic additive into the working chambers, at least while the engine is running hot. In this manner, the acid condensate is neutralized by the basic additive, so that the aforementioned damage to the inner housing surfaces and attendant severe wear on the sealing parts do not occur. The basic additive may be a constituent of the oil intended for lubricating the sealing parts. In that case, separate lubricating oil tanks are required for the bearing lubricant and the sealing parts lubricant. Alternatively, however, the additive may be a constituent of the fuel.

A lubricant blended with basic additives for the sealing parts should preferably, as stated, be employed only during the phase when the engine is running hot, since the additive causes increased ash production. Therefore, to lubricate the sealing parts, it is expedient to provide a tank of blended oil and a second tank of bearing lubricant, with two oil proportionating pumps delivering out of these tanks, and so controlled that the pump delivering blended oil functions only during the phase when the engine is running hot and the other pump only in the other phases of operation. For this purpose, first one and then the other pump can be set to zero delivery. The change-over, for example depending on operating temperature, may be made by the actuation of the starter flaps or by a time switch.

Instead of using a lubricant blended with basic additive during the hot phase, the basic additive may alternatively be added by itself to the lubricant. This can be done by means of a separately driven proportionating pump the drive of which is disconnected when the desired operating temperature is reached. The additive may alternatively be added directly to the fuel or else to the fuel-oil mixture or fuel-oil-air mixture. Finally, the additive may be introduced directly into the working chambers, as is known per se in the case of lubricating oil.

### BRIEF DESCRIPTION OF THE DRAWINGS

Further details and features of the invention will appear from the following description in conjunction with the drawings, in which some embodiments of the invention are represented by way of example:

FIG. 1 shows a schematic representation of a rotary piston combustion engine with its lubricating system;

FIG. 2 shows a modification of the lubricating system represented in FIG. 1;

FIG. 3 shows a modification of the lubricating system represented in FIG. 2;

FIG. 4 shows a sectional view of the float tank of a carburetor; and

FIG. 5 shows a means for adding the additive to the fuel required for the hot phase of operation of the combustion engine.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, a rotary piston combustion engine 1 whose housing is made up of shell 2 with multiarcuate inner surface and sides 3 and 4. A polygonal piston 7 is rotatably mounted on an eccentric 5 of an eccentric shaft 6 in the housing. The piston 7 is provided with axial seals 8 and radial seals 9 sliding along the inner housing surfaces and sealing off adjacent working chambers from each other. In shell 2 are arranged an inlet passage 10 and an outlet passage and a spark plug (not shown). The outlet passage and the spark plug are provided in any conventional and well known manner. The inlet passage 10 communicates by way of a suction pipe 11 with a carburetor 12 to which fuel is supplied from a fuel tank 13 by a fuel pump 14.

The bearings 15 of the eccentric shaft 6 and the piston bearing 16 are supplied with lubricating oil through passages 17 in the eccentric shaft 6 and eccentric 5. For this purpose, a lubricant pump 18 is provided, driven by the eccentric shaft 6, taking in oil by way of line 19 from oil well 20 and forcing it through feed line 21 into passages 17. From the bearings 15, the lubricant returns through passages 22 in the side parts 3 and 4 to the well 20. The oil used to lubricate bearings 15 and 16 may serve at the same time, in known manner, to cool the piston 7.

To lubricate the sealing parts 8 and 9, a special lubricant is added to the fuel and introduced with it into the working chambers. The special lubricant, which contains basic additives, is contained in a separate tank 23 from which it is drawn by an oil proportionating pump 24 driven by the eccentric shaft 6 by way of line 25 and forced through line 26 into the fuel line 27 above the fuel feed pump 14. The control lever 28 of pump 24 is connected by a linkage 29 to the gas pedal 30, which in turn is connected by a linkage 31 to the throttling flap 32 in the intake pipe 11. The pump 24 delivers an excess, and the surplus lubricant delivered is returned by way of line 33 to tank 23. Depending on the setting of the gas pedal 30, a larger or smaller quantity of lubricant is added to the fuel by the proportionating pump 24. The feeding of the lubricant into the fuel ahead of the fuel feed pump 14 results in an effective mingling of the fuel with the oil in the feed pump 14. The connection between pumps 18 and 24 and shaft 6 for drive purposes is accomplished in any well known and conventional manner.

In the embodiment shown by way of example in FIG. 1, the lubricant blended with basic additives for the sealing part is added throughout the entire operation of the engine. But since the acid condensate to be neutralized by the basic additives is formed primarily during the hot phase of the engine only, it is desirable to limit the use of this lubricant blended with basic additives to that phase, since such blended lubricants tend to form more ash, and to use the bearing lubricant for lubricating the sealing parts as well during the rest of the cycle. Such an arrangement is illustrated in FIG. 2, where like parts bear the same reference numerals as in FIG. 1. In this embodiment, two oil proportionating pumps 34 and 35 are provided. Pump 34 draws from tank 36, containing lubricant blended with basic additives. Pump 35 draws ordinary bearing lubricant from the oil well 20 of the engine. The feed lines 37 and 38 of the two pumps 34 and 35 again open into the fuel line 27 above the fuel feed pump 14. Both pumps 34 and 35 are driven together by the eccentric shaft 6 in a conventional and well known manner. The two control levers 39 and 40 of pumps 34 and 35 are set by the gas pedal 30 as in the previous example, but in this case by way of a slide 41. Slide 41 has two triangular slots 42 and 43 pointing opposite ways. Slot 42 cooperates with pin 44 at the end of lever 39 of pump 34. Slot 43 cooperates with pin 45 at the end of lever 40 of pump 35. Slide 41 is connected by way of linkage 46 with the gas pedal 30, and may be swung about the point of articulation 47 by solenoid 48 against the action of tension spring 49 into the position shown. In this position, pin 44 is at the apex of slot 42, so that upon movement of the gas pedal 30, the control lever 39 is shifted. The pin 45, on the other hand, is in the portion of slot 43 parallel to the direction of displacement, so that if the gas pedal 30 moves, the control lever 40 does not swing. This position of slide 41 as shown corresponds to the hot phase of the engine, in which solenoid 48 is energized for example by way of a thermostat responding to the engine temperature. When the desired operating temperature has been reached, solenoid 48 goes dead and spring 49 pulls the slide 41 downward in the drawing, whereupon the pin 44 reaches the portion of slot 42 parallel to the direction of displacement, the control lever 39 returns to its initial position, and the pin 45 is forced into the apex of the slot, so that now motion of the gas pedal 30 shifts the lever 40 of pump 35, and ordinary lubricating oil is supplied by feed line 38 to the fuel line 27.

A modification of the embodiment shown in FIG. 2 is shown in FIG. 3. As before, two oil proportionating pumps 34a and 35a are provided with their respective control levers 50 and 51 being shifted together by gas pedal 30 by way of linkage 52. Pump 35a draws bearing lubricant from oil well 20 of the engine and feeds it steadily through line 38a into the fuel line 27. The suction line 53 of pump 34a is in communication with a tank 54 which in this case contains the basic additive only. While oil proportionating pump 35a and lubricant pump 18 are driven by eccentric shaft 6 as in the preceding examples, pump 34a is driven by a separate electric motor 55. Motor 55 is switched on only during the hot phase of the engine, and the additive fed by pump 34a passes through line 56 into the feed line 38a of pump 35a. *Alternatively again, the additive may be fed directly into the fuel line 27, and this, as indicated at 56a and 56b, either ahead of or behind the opening of*

line 38a into the fuel line 27. The system shown in FIG. 3 has the advantage that the lubrication of the sealing part is effected by the bearing lubricant throughout the period of operation, and only a small additional tank 54 is required for the additive. If on some occasion the additive tank should fail to be refilled, lubrication will not thereby be interrupted during the hot phase, as would be the case if filling of tank 36 were omitted in the embodiment of FIG. 2.

To avoid an expensive additive pump, means may be provided whereby a definite quantity of additive is added to the quantity normally required for the engine in hot operation. Such a means is represented by way of example in FIG. 4. Here a heat pump 60 is employed, consisting of a heat-insulated housing 61 the interior 62 of which is shut off from the pump chamber 64 by a diaphragm 63.

The interior 62 is filled with an expansion medium, for example wax, and contains an electric heating coil 65. The pump chamber 64 is connected by suction and pressure valves 66 and 67 to the additive tanks 68 and the fuel line 69. During the hot phase of the engine, the heating coil 65 is connected in a conventional and well known manner to a source of current, whereupon the expansion medium in the interior 62 is heated, expands, and forces the diaphragm 63 downward in the drawing, whereby the additive contained in the pump chamber 64, overcoming the valve 67, is forced into the fuel line 69 and flows with the fuel into the float tank 70 of the carburetor. When the hot phase of the engine is at an end, the supply of current to the heating coil 65 may be shut off in a conventional and well known manner, for example by way of a thermostat or a timing switch. The expansion medium in the interior 62 contracts, and the suction thereby set up in the pump chamber 64 draws in additive from the tank 68 through valve 26. At the next start, then, additive is again available in the pump chamber 64 to be fed into the fuel line 69. The same effect is of course also achieved if the heating coil 65 is disconnected from the source of current only when the engine stops. The heating capacity of coil 65 is so adjusted that additive is fed into the fuel line 69 until the uncritical motor temperature is reached. The heat pump 60 automatically allows for varying outside temperatures, since when the outside temperature is low, more additive is drawn in, and the heating time until the preassigned final temperature is reached is longer, and so additive is put in over a longer period of time. Obviously the same means can be used to feed additive into the lubricant.

The means shown in FIG. 4 may in principle be employed also to feed a lubricant blended with basic additives during the hot phase of the engine. This means, that is, would take the place of the proportionating pump 34 in the embodiment of FIG. 2.

FIG. 5 shows an arrangement in which the additive is added only to the fuel required for the hot phase of the engine. For this purpose, a holding tank 71 is arranged between the fuel tank 13 and the fuel feed pump 14, to hold the amount of fuel required for the hot phase. The fuel line 27 traverses the tank 71 and is provided with a throttling orifice 72 through which the holding tank 71 is filled with fuel while the engine is stationary. Near the bottom of tank 71, a float valve 73 and orifices 74 are provided in the fuel line 27. The tank 71 contains a float 75 connected to a pump diaphragm 76. The pump chamber 77 communicates with

the interior of the holding tank 71 on the one hand and with the additive tank 80 on the other hand by way of pressure and suction valves 78 and 79. A vent line 81 leads from the holding tank 71 to the fuel tank 13.

The mode of operation of this arrangement is as follows:

When the engine is down, the holding tank 71 gradually fills with fuel through the throttling orifice 72, the float valve 73 being closed. As the liquid level in the holding tank 72 rises, the float 75 is raised, causing the pump diaphragm 76 to execute its delivery stroke and to deliver the additive present in pump chamber 77 to the holding tank 71, where it mingles with the fuel. When the engine is put into operation, fuel is taken first from the holding tank 71, until the float valve 73 releases the supply from the fuel tank 13. As the liquid level in the holding tank 71 falls, the float 71 moves downward, so that the pump diaphragm 76 executes its suction stroke and draws additive from tank 80 into the pump chamber 77, so that additive is again available in the pump chamber 77 for the next delivery stroke.

Obviously, numerous modifications of the embodiments shown by way of example are conceivable. Thus in particular the additive may be introduced directly into the working chambers of the engine, as is known per se in the case of lubricant supply. Since the additive is required in very small quantities only, it may be expedient, for ease of proportioning, to introduce a mixture of additive and fuel or the like rather than pure additive. Such a mixture may be introduced into the working chambers directly or else into the intake pipe of the engine.

We claim:

1. A rotary piston combustion engine comprising: a housing made up of a shell with multi-arcuate inner surface and side parts and working chambers, an eccentric of an eccentric shaft, a polygonal piston rotatably mounted on the eccentric of an eccentric shaft in the housing, the piston being provided with sealing parts to slide along the inner housing surfaces and to seal off adjacent working chambers from each other, and means for introducing a basic additive into the working chambers at least during the phase when the engine is running hot, said additive including acid condensate neutralizing means therein.

2. A rotary piston combustion engine according to claim 1 wherein the basic additive is a constituent of the oil intended for lubricating the sealing parts.

3. A rotary piston combustion engine according to claim 1 wherein the basic additive is a constituent of the fuel.

4. A rotary piston combustion engine according to claim 1 wherein a pump with a suction line communicates with a tank containing the additive for the sealing parts and whose feed line communicates with one of a tank and portion of line containing fluid intended for introduction to the engine.

5. A rotary piston combustion engine according to claim 1 wherein addition of the basic additive is made to one of the fuel, the lubricant, the fuel-oil mixture, and the fuel-air mixture.

6. A rotary piston combustion engine according to claim 1 wherein addition of the basic additive is made to one of the fuel, the lubricant, and the fuel-air mixture.

7. A rotary piston combustion engine comprising: a housing made up of a shell with multiarcuate inner sur-

face and side parts and working chambers, an eccentric of an eccentric shaft, a polygonal piston rotatably mounted on the eccentric of an eccentric shaft in the housing, the piston being provided with sealing parts to slide along the inner housing surfaces and to seal off adjacent working chambers from each other, and means for introducing a basic additive into the working chambers at least during the phase when the engine is running hot, a tank of lubricant blended with basic additives and a second tank of bearing lubricant being provided for lubrication of the sealing parts and two oil proportionating pumps delivering from these tanks and so controlled that the pump delivering the blended lubricant delivers only during the hot phase of the engine, and the other pump only in other phases of the cycle.

8. A rotary piston combustion engine comprising: a housing made up of a shell with multiarcuate inner surface and side parts and working chambers, an eccentric of an eccentric shaft, a polygonal piston rotatably mounted on the eccentric of an eccentric shaft in the housing, the piston being provided with sealing parts to slide along the inner housing surfaces and to seal off adjacent working chambers from each other, and means for introducing a basic additive into the working chambers at least during the phase when the engine is running hot, a pump with a suction line communicates with a tank containing the additive for the sealing parts and whose feed line communicates with one of a tank and portion of line containing fluid intended for introduction to the engine, the pump being driven by an electric motor which is switched off when the desired temperature of the engine is reached.

9. A rotary piston combustion engine comprising: a housing made up of a shell with multiarcuate inner surface and side parts and working chambers, an eccentric of an eccentric shaft, a polygonal piston rotatably mounted on the eccentric of an eccentric shaft in the housing, the piston being provided with sealing parts to slide along the inner housing surfaces and to seal off adjacent working chambers from each other, and means for introducing a basic additive into the working chambers at least during the phase when the engine is running hot, a pump with a suction line communicates with a tank containing the additive for the sealing parts and whose feed line communicates with one of a tank and portion of line containing fluid intended for introduction to the engine, the pump being so constructed that it executes a delivery stroke in the hot phase of the engine and a suction stroke during the other parts of the cycle and when the engine is stationary.

10. A rotary piston combustion engine comprising: a housing made up of a shell with multiarcuate inner surface and side parts and working chambers, an eccentric of an eccentric shaft, a polygonal piston rotatably mounted on the eccentric of an eccentric shaft in the housing, the piston being provided with sealing parts to slide along the inner housing surface and to seal off adjacent working chambers from each other, and means for introducing a basic additive into the working chambers at least during the phase when the engine is running hot, a pump with a suction line communicates with a tank containing the additive for the sealing parts and whose feed line communicates with one of a tank and portion of line containing fluid intended for introduction to the engine, the pump being so constructed that it executes a delivery stroke in the hot phase of the en-

7

8

gine and a suction stroke during the other parts of the cycle and when the engine is stationary, the pump being a diaphragm pump, the delivery stroke of which is effected by an electrically heated expansion medium.

11. A rotary piston combustion engine comprising: a housing made up of a shell with multiarcuate inner surface and side parts and working chambers, an eccentric of an eccentric shaft, a polygonal piston rotatably mounted on the eccentric of an eccentric shaft in the housing, the piston being provided with sealing parts to slide along the inner housing surfaces and to seal off adjacent working chambers from each other, and means

for introducing a basic additive into the working chambers at least during the phase when the engine is running hot, a pump with a suction line communicates with a tank containing the additive for the sealing parts and whose feed line communicates with one of a tank and portion of line containing fluid intended for introduction to the engine, the pump being so constructed that it executes a suction stroke during operation of the engine and a delivery stroke when the engine is stopped, and its feed line is connected to a tank containing the fuel required for the hot phase of the engine.

\* \* \* \* \*

15

20

25

30

35

40

45

50

55

60

65