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MIXTURE-COMPRESSING ROTARY PISTON INTERNAL COMBUSTION ENGINE

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FIG.1

— PRIOR ART —

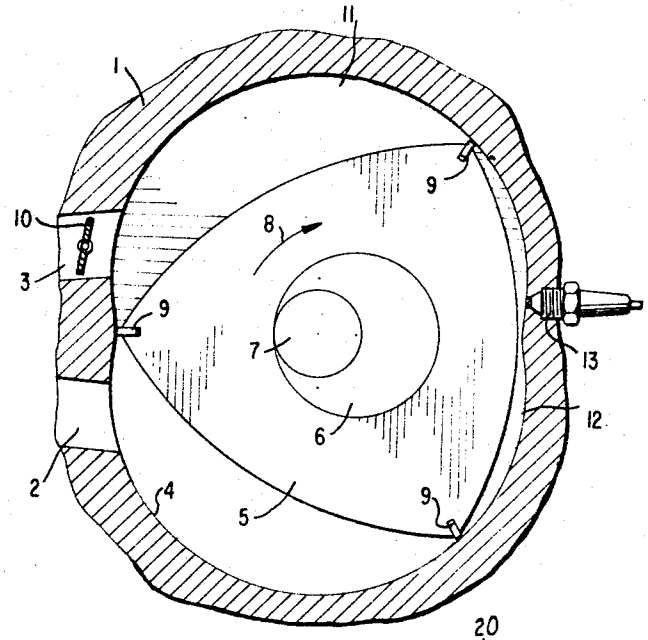
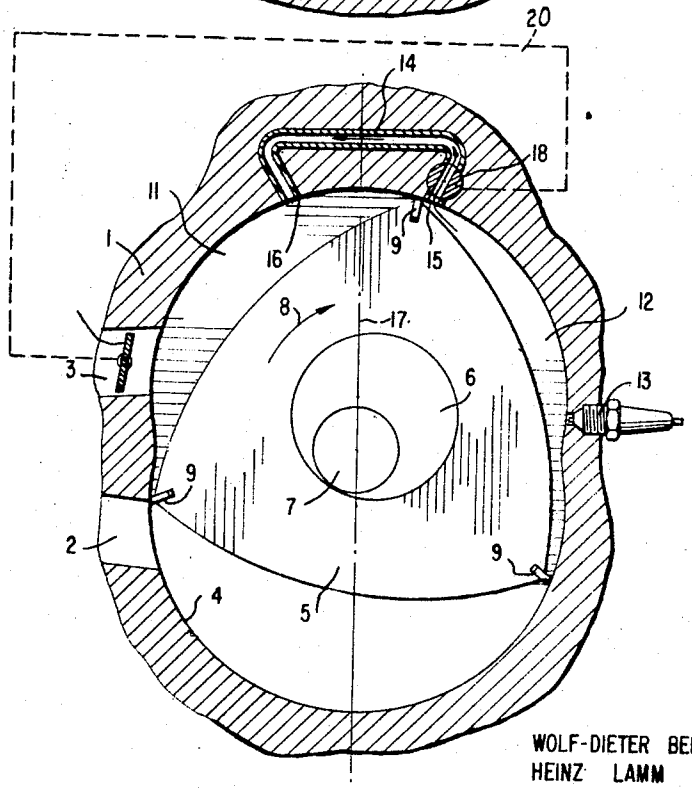


FIG.2



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MIXTURE-COMPRESSING ROTARY PISTON INTERNAL COMBUSTION ENGINE

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16 Claims

ABSTRACT OF THE DISCLOSURE

A mixture-compressing rotary piston internal combustion engine, especially of trochoidal construction, having a polygonal piston rotatable relative to the housing on the eccentric of an eccentric shaft, the eccentric shaft itself being rotatably supported in the lateral housing parts and the housing case being provided with an inlet channel and an outlet channel valved by the piston corners of the polygonal piston, and which includes an overflow channel arranged in the housing case within that area in which, during the passage of a piston corner, a pressure drop exists between the compression chamber and the suction chamber in the direction toward the suction chamber; a control member, for example, a throttling member, is arranged in this overflow channel which is open during idling speed and partial loads but is closed during the remaining operation. The control member may be appropriately connected with the throttle valve arranged in the inlet channel. Additionally, the orifices of the overflow channel may be arranged approximately at the same distance from the major axis of the housing case while the spacing between the orifices may correspond approximately to a duration of overflow of 90 to 130° of eccentric shaft angle.

BACKGROUND OF THE INVENTION

The present invention relates to a mixture-compressing rotary piston internal combustion engine, especially of trochoidal construction, having a housing consisting of a housing case and of lateral parts, a polygonal piston in the housing which is rotatably arranged on the eccentric of an eccentric shaft supported in the lateral housing parts so as to rotate relativve to the housing and to the eccentric shaft, and provided with an inlet channel and an outlet channel in the housing whose control apertures are arranged in the cam track of the housing case and are controlled by the piston.

In practical operation of rotary piston internal combustion engines of trochoidal construction, it has been found that during idling, i.e., with closed throttle valve, the fresh gases are disposed within the area of the trailing piston corner in both the suction chamber and the compression chamber, and that under partial loads, particularly with carburetor operation, an excessively rich mixture is present in the area of the trailing pitson corners. During idling, this is due to the fact that by reason of the large overflow cross section, with a closed throttle valve, at first exhaust gases are sucked in from the exhaust and only after closure of the exhaust, fresh gases enter into the trailing part of the suction chamber. During partial loads, non-combusted fuel drops or particles collect in the trailing part of the suction chamber by reason of their larger mass. The fresh gases can be ignited only with difficulty because they reach the spark plug only when the

pressure has already decreased, and because the large combustion space surfaces effect a cooling off. An uneven operation of the internal combustion engine results during idling because the mixture does not ignite regularly. With carburetor operation, however, one has to adjust to a very rich setting in order that a mixture is present at the spark plug which is still ignitable.

SUMMARY OF THE INVENTION

The present invention aims at eliminating the aforementioned disadvantages during the operation of rotary piston internal combustion engines. The underlying problems are solved by the present invention in that an overflow channel is arranged within the housing case at a place at which during the instant of the passage or sweep by a piston corner a pressure drop exists between the compression chamber and the suction chamber in the direction toward the suction chamber, which overflow channel connects these two chambers, and in that a throttling member is arranged in this overflow channel in proximity to the compression chamber which is open during idling and at partial load and is closed as to the rest.

It is possible by the present invention with an open throttle member in the overflow channel, to press in a simple manner fresh gases from the trailing part of the compression chamber through the overflow channel into the leading part of the suction chamber. The fresh gases thereby reach a place in the top dead-center position where they are located within the area of the spark plug. At the same time, possibly present condensates are evaporated and prepared by the high velocity in the overflow channel. A readily ignitable mixture is present at the spark plug whereas exhaust gases or a lean mixture is present within the area of the trailing part of the compression chamber. The transferred fresh gases are present in the suction chamber within the leading part thereof, exhaust gases are in the center portion and sucked in fresh gases are again present in the trailing portion which, during the further rotation of the piston, are again displaced into the leading portion of the next chamber. It is possible in this manner to operate the engine with a considerably more lean mixture and to achieve under all circumstances always a completely satisfactory combustion. The exhaust gases no longer contain any non-combusted fuel particles.

The overflow channel is also of great usefulness during cold-starting of the engine because some condensated fuel always remains behind and as finally brought back by way of the overflow channel into the leading side and is not displaced, for example, into the spark plug bore. Even though some condensate is still present downstream of the ovreflow channel, this will again remain behind and is eventually transferred, this taking place for such length of time until all fuel is evaporated. During full or open throttle, the internal combustion engine behaves exactly as before because the throttle member is then closed. During full or open throttle, the fuel preparation is improved by reason of the high temperatures. The mixture distribution is more uniform as the residual gas component is smaller, i.e., suction takes place throughout the entire suction stroke. With injection of fuel, the injection can be realized in such a manner that the mixture is even leaner at the end. During full or open throttle, the throttle member in the overflow channel also has to be closed because the compression losses are then no longer acceptable.

It is known in the prior art in connection with rotary piston internal combustion engines of different construction to provide an overflow channel within the housing which connects two adjacent working chambers with each other for short periods of time when a pressure drop occurs in the direction of the trailing working chamber.

This prior art overflow channel serves the purpose to change the compression and therewith the output of the engine. For that purpose, an adjustable valve is arranged in the overflow channel by means of which the overflow channel cross section is adjustable in order to be able to push or displace back into the suction chamber a more or less large part of the compressed charge. The overflow channel is connected with the carburetor in the prior art, i.e., forms simultaneously a portion of the suction system. Furthermore, it is known with rotary piston internal combustion engines of trochoidal construction to provide overflow channels in which terminate or into which discharge fuel lines through which is supplied into the overflow channel a quantity of liquid fuel metered by an appropriate mechanism. Finally, it is also known in the prior art to provide an overflow channel in order to erect by means of overflowing air a barrier against the passage of exhaust gases into the suction space. However, the basic concept of the present invention to transport ignitable gases through the overflow channel from an unfavorable place to a favorable place, cannot be deducted from the arrangements of overflow channels as known in the prior art.

According to a further feature and development of the subject matter of the present invention, the inlet cross section of the overflow channel at the compression chamber and the outlet cross section at the suction chamber may be disposed approximately equidistant from the major axis of the housing case and the distance between the two cross sections can be so selected that the duration of overflow amounts to about 90 to 130° of eccentric shaft angle.

Accordingly, it is an object of the present invention to provide a rotary piston internal combustion engine of the type described above which eliminates, by extremely simple means, the aforementioned shortcomings and drawbacks encountered with the prior art constructions.

It is another object of the present invention to provide a rotary piston internal combustion engine which assures completely satisfactory operation of the engine at idling as well as partial and full loads without requiring an excessively rich setting for proper operation at idling speeds.

A further object of the present invention resides in a mixture-compressing rotary piston internal combustion engine which assures under all operating conditions a readily ignitable fuel mixture within the area of the spark plug at the desired ignition instant.

Still a further object of the present invention resides in a rotary piston internal combustion engine of trochoidal construction which is characterized by uniform and even operation of the engine under all operating conditions.

Another object of the present invention resides in a rotary piston internal combustion engine of the type described above which also improves the operation of the engine from a point of view of fuel preparation and evaporation of any possible fuel condensate.

These and further objects, features, and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing, which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein:

FIGURE 1 is a somewhat schematic cross-sectional view through a prior art rotary piston internal combustion engine, taken at right angle to the axis of the engine; and

FIGURE 2 is a somewhat schematic transverse cross-sectional view similar to FIGURE 1, of a rotary piston internal combustion engine provided with an overflow channel in accordance with the present invention.

Referring now to the drawing wherein like reference numerals are used throughout the two views to designate like parts, and more particularly to FIGURE 1, reference numeral **1** designates therein the housing case of the internal combustion engine in which are arranged the outlet channel **2** and the inlet channel **3** adjacent the outlet channel **2**. The control apertures of both channels **2** and **3** are disposed within the cam track **4** for the piston **5** provided in the housing case **1**. The piston **5** is rotatably arranged on the eccentric **6** of the eccentric shaft **7** to rotate in the direction of arrow **8**. During its rotation, the piston **5** controls or valves with its corners, in which are arranged the sealing bars or strips **9** of conventional construction, the inlet channel **3** and the outlet channel **2**.

If, during idling rotational speeds the throttle valve **10** arranged in the inlet channel **3** is closed, then for the most part only exhaust gases are present in the suction chamber **11** and in the compression chamber **12**. Fresh gases are present only within the area of the respective trailing piston corner as indicated by the horizontal lines, which within the compression chamber **12** do not reach to within the area of the spark plug **13** at the moment of ignition. During partial load operation, and in particular, with carburetor operation, the largest portions of the suction chamber **11** and of the compression chamber **12** are filled with a lean mixture, generally not sufficient for ignition, whereas within the areas of the respective trailing piston corners are present the components of an excessively rich mixture indicated by the horizontal lines. This excessively rich mixture is ignitable only poorly because it reaches the spark plug **13** only when the pressure has already decreased so that it burns or combusts for that reason more poorly.

In order to transport or transfer the fresh gas components from the respective trailing piston corner to the corresponding leading piston corner, the overflow channel **14** is arranged in or at the housing part **1** according to FIGURE 2 at a place at which during the instant of the sweep by a piston corner a pressure drop is present between the compression chamber **12** and the suction chamber **11** in the direction toward the suction chamber. The inlet cross section **15** of the overflow channel **14** is located in the compression chamber **12** whereas the outlet cross section **16** thereof is located in the suction chamber **11**. Both cross sections **15** and **16** are located about equidistantly from the major axis **17** of the housing case **1**. Altogether the distance of the cross sections **15** and **16** amounts to about 90° to 130° of eccentric shaft angle. The throttling member **18** is arranged in proximity to the inlet cross section **15** and is so connected with the throttle valve **10** in the inlet channel **3** by linkage **20** in any conventional manner that it is open during idling and partial loads but is closed as to the remainder of operation.

The proportion of fresh gases (indicated by the horizontal lines) which is at first disposed according to FIGURES 1 and 2 within the area of the trailing piston corners, has been pressed or displaced in the internal combustion engine according to FIGURE 2, from the compression chamber **12** through the overflow channel **14** into the suction chamber **11**, and more particularly into the leading portion of the suction chamber **11** so that the fresh gases reach within the compression chamber **12** an area located directly in front of the spark plug **13** during rotation of the piston. The portion of the suction charber **11** and of the compression chamber **12**, which are without horizontal lines, are each filled with exhaust gases with a closed throttle valve **10** in the suction channel **3**. Notwithstanding these relatively large components in exhaust gases, a safe and reliable ignition is assured by the transfer of fresh gas components from the trailing to the leading piston corner in accordance with the present invention. It is possible in this manner to drive with a much leaner mixture and one obtains always a good combustion in all cases. The exhaust gases no longer contain any uncombusted components.

The throttle member **18** is so connected in any appropriate conventional manner with the throttle valve **10** that wtih increasing opening of the throttle valve **10**, the throttle valve **18** is closed so that compression losses are avoided.

While we have shown and described only one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art, and we therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

We claim:

1. A mixture-compressing rotary piston internal combustion engine, especially of trochoidal construction, comprising housing means including housing case means and lateral housing parts, eccentric shaft means including eccentric means rotatably supported in said lateral housing parts, polygonal piston means rotatably mounted on the eccentric means of the eccentric shaft means within said housing means, said housing and piston means forming therebetween suction and compression chambrs, said housing case means being provided with inlet and outlet channels whose control apertures are located substantially within the cam track of the housing case means and are valved by the corners of the polygonal piston means, and overflow channel means within the housing case means located at a place, at which during the period of passage of a piston corner, a pressure drop occurs between a compression chamber and the corresponding suction chamber in the direction toward the suction chamber, and control means in said overflow channel means in proximity to the compression chamber to provide an overflow communication only during idling and partial load operation of the engine.

2. An internal combustion engine according to claim 1, wherein the inlet cross section of the overflow channel means in the compression chamber and the outlet cross section thereof in the suction chamber are disposed approximately equidistant from the major axis of the housing case means, and the distance between the two cross sections amounts to approximately an overflow duration of 90 to 130° eccentric shaft angle.

3. An internal combustion engine according to claim 2, further comprising throttle valve means in the inlet channel means, and means operatively connecting said throttle valve means with said control means to open said control means in the idling and partial load operation while closing the same during the remainder of operation.

4. An internal combustion engine according to claim 1, further comprising throttle valve means in the inlet channel means, and means operatively connecting said throttle valve means with said control means to open said control means in the idling and partial load operation while closing the same during the remainder of operation.

5. In a mixture-compressing rotary piston internal combustion engine, especially of trochoidal construction, which includes a housing consisting of a housing case provided with a cam track and of lateral parts, a polygonal piston in the housing which is rotatably arranged on the eccentric of an eccentric shaft support in the lateral housing parts so as to rotate relative to the housing and to the eccentric shaft, and an inlet and outlet channel whose control apertures are arranged in the cam track of the housing case and are controlled by the piston corners, wherein the improvement comprises overflow channel means within said housing case, said overflow channel means being so located that at the moment of the passage by a piston corner, a pressure drop occurs between a compression chamber and a suction chamber in the direction toward the latter, said overflow channel means operatively connecting said two chambers, and control means arranged in the overflow channel means in proximity to the compression chamber, said control means controlling the overflow in both directions and providing an overflow communication during idling and partial load operation.

6. The improvement according to claim 5, wherein the control means includes a throttling device.

7. The improvement according to claim 6, wherein the control means is open only during idling and partial load operation.

8. The improvement according to claim 7, wherein the inlet cross section of the overflow channel in the compression chamber and the outlet cross section thereof in the suction chamber are disposed approximately equidistant from the the major axis of the housing case.

9. The improvement according to claim 8, wherein the distance between the two inlet and outlet cross sections of the overflow channel means amounts to about 90 to 130° of eccentric shaft angle.

10. The improvement according to claim 9, wherein a throttle valve is arranged in the inlet channel, and wherein the throttling device of the control means is operatively connected with the throttle valve.

11. The improvement according to claim 10, wherein the connection between the throttle valve and the throttling device of the control means is such that with a setting of the throttle valve for idling or partial load, the throttling device of the control means is fully opened whereas the latter is closed during all other operations.

12. The improvement according to claim 5, wherein the inlet cross section of the overflow channel in the compression chamber and the outlet cross section thereof in the suction chamber are disposed approximately equidistant from the major axis of the housing case.

13. The improvement according to claim 12, wherein the distance between the two inlet and outlet cross sections of the overflow channel means amounts to about 90 to 130° of eccentric shaft angle.

14. The improvement according to claim 6, wherein a throttle valve is arranged in the inlet channel, and wherein the throttling device of the control means is operatively connected with the throttle valve.

15. The improvement according to claim 14, wherein the connection between the throttle valve and the throttling device of the control means is such that with a setting of the throttle valve for idling or partial load, the throttling device of the control means is fully opened whereas the latter is closed during all other operations.

16. The improvement according to claim 5, wherein the distance between the two inlet and outlet cross sections of the overflow channel means amounts to about 90 to 130° of eccentric shaft angle.

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