MULTI-CYLINDER INJECTION INTERNAL COMBUSTION ENGINE

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Abstract

A multi-cylinder injection-type internal combustion engine in which idling air is conducted to the cylinders in bypassing both the control valve adjusting the quantity of air in the suction manifold as also the individual suction pipes leading from the suction manifold to the individual cylinders; with the use of a by-pass vent line for venting the crankcase, which terminates in the suction line system, the by-pass vent line is connected to the idling air line system either in or upstream of the point of distribution to the individual idling air pipes connected with the individual suction pipes near the connection of the latter with the individual cylinders.

17 Claims, 2 Drawing Figures
MULTI-CYLINDER INJECTION INTERNAL COMBUSTION ENGINE

The present invention relates to a multi-cylinder injection internal combustion engine in which the idling air is conducted to the cylinders in by-passing relationship both with respect to the throttle valve adjusting the air quantity in the suction manifold as also to the individual suction pipes leading to a respective cylinder and fed from the suction manifold.

The aim of the present invention essentially consists in providing, in the multi-cylinder injection-type internal combustion engine of this type, as disclosed in the German Offenlegungsschrift 1,526,647, a venting of the crankcase by feeding back the vent gases by way of the suction system into the combustion spaces of the cylinders, in which the danger of soiling of the suction lines is far-reaching avoided. This soiling danger occurs in the prior art carburetor internal combustion engine as disclosed in the U.S. Pat. No. 3,241,535, in which the vented particles are introduced into the suction manifold either upstream or downstream near the throttle valve depending on the load condition of the engine.

The underlying problems are solved according to the present invention in that with the use of a by-pass for the vent gases of the crankcase, known as such in connection with carburetor internal combustion engines and terminating in such engines in the suction line system downstream of the throttle valve determining the air quantity, the by-pass line is connected to the idling air system in or upstream of the branching point of the individual idling air pipes.

The considerable advantage of the present invention, attained in addition to the aimed-at object, resides in that with a strongly disrupted or clefted suction system, for example, with a V-arrangement of the cylinders, sections of the suction manifold may be lower—for example, in the V-space—that the cylinder connections or the manifold connections of the individual suction pipes without the possibility that liquid components of the venting gases may separate out and collect in these lower sections. The individual idling air pipes conducting the vented gases according to the present invention terminate in the suction channels in direct proximity to the cylinders so that the suction line system remains substantially free of vented gases. A further advantage of the present invention resides in that the vented gases are distributed very uniformly over all the cylinders.

With the known injection-type internal combustion engines, from which the present invention departs, the distribution of the enriched starting mixture to the individual cylinders takes place by way of a separate distributor device interconnected into the idling air system. Advantageously, the by-pass line for the vent gases is connected with the distributor device.

Accordingly, it is an object of the present invention to provide a multi-cylinder injection-type internal combustion engine which avoids by simple means the aforementioned shortcomings and drawbacks encountered in the prior art.

Another object of the present invention resides in a multi-cylinder injection internal combustion engine in which the danger of contamination and dirtying of the suction lines is far-reaching avoided.

A further object of the present invention resides in a multi-cylinder injection-type internal combustion engine of the type described above in which sections of the suction manifold can be disposed lower than the cylinder connections or the manifold connection of the individual suction pipes without the danger that liquid components of vent gases may collect in the form of a sump at the bottom of the suction manifold.

Another object of the present invention resides in a multicylinder injection-type internal combustion engine with a venting system for the crankcase in which the vented gases are conducted from the crankcase back to the individual cylinders with a relatively uniform distribution over all the cylinders of the engine.

These and other objects, features and advantages of the present invention will become more apparent 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:

FIG. 1 is a schematic partial cross-sectional view through an injection-type internal combustion engine with a V-arrangement of the cylinder rows; and

FIG. 2 is a schematic showing of the idling air system of the engine of FIG. 1.

Referring now to the drawing wherein like reference numerals are used throughout the two views to designate like parts, and more particularly to FIG. 1, the two cylinder rows disposed in the shape of a V with respect to each other, are generally designated therein by reference numerals 10 and 11 while the V space enclosed between the same is generally designated by reference numeral 12. For purposes of achieving a relatively flat construction of the engine, i.e., an engine of low height, the suction manifold 13 is arranged deep within the V-space 12 so that the suction air filter 14 connected upstream of the suction manifold 13 protrudes only slightly above the cylinder rows 10 and 11. The individual suction pipes 17 and 18 leading to the individual cylinder heads 15 and 16 of the cylinder rows 10 and 11 are constructed as tuned pipes and terminate in the suction manifold 13. A valve connection 19 is mounted on the suction manifold 13, which carries the filter 14 and in which the throttle valve 20 controlling the rate of air flow in the suction manifold 13 is rotatably supported.

A by-pass line 22 conducting the vented particles out of the crankcase is connected with the control housing 21 of the cylinder row 10, serving for the bearing support of the control shaft. The by-pass line 22 terminates in a distributor device 23 of conventional construction of the air idling system generally designated by reference numeral 24 of the engine.

The air idling system 24 is constructed in principle as follows:

An air idling channel 26 is connected to the mixing chamber 25 of the distributor device 23; the idling air channel 26 is branched off from the filtered air chamber 27 of the filter 14. The injection nozzle 28 of a starting valve 29 for fuel for the purpose of producing an enriched starting mixture projects into the mixing chamber 25. Furthermore, the mixing chamber 25 is provided with a connection 30 for warming-up air. The mixing chamber 25 is in communication by way of an intermediate line 31 with two individual idling air lines 32 and 33, of which each is connected at 34 and 35, respectively, with the individual suction pipes 17 and 18 in direct proximity of the cylinder suction channels. In this manner, the vented particles are conducted, in by-passing relationship of the suction manifold 13 as well
3,742,923

as of the individual suction pipes 17 and 18, uniformly distributed to the combustion spaces of the cylinder heads 15 and 16. It is avoided above all by this arrangement according to the present invention that a sump stemming from the vented particles may form in the low suction manifold 13.

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 as to those 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 multi-cylinder injection-type internal combustion engine having a crankcase and with a suction line system including suction manifold means, control valve means controlling the quantity of air in said suction manifold means, and individual suction pipes leading from said suction manifold means to the cylinders, idling air line means supplying idling air to the cylinders in by-passing relationship to the control valve means and the suction manifold means, characterized by vent means for venting the gases of the crankcase including by-pass line means for conducting the vent gases from said crankcase to the idling air line means and means for connecting said idling air line means with the individual suction pipes.

2. An internal combustion engine according to claim 1, characterized in that said idling air line means includes a distributor means and in that said by-pass line means is connected at least upstream of said distributor means.

3. An internal combustion engine according to claim 2, characterized in that said by-pass line means is connected to said idling air line means in said distributor means.

4. An internal combustion engine according to claim 2, characterized in that said means for connecting said idling air line means includes individual idling air lines leading to respective cylinders.

5. An internal combustion engine according to claim 1, with a distributor means connected in the idling air line means for the distribution of the enriched starting mixture to the individual cylinders, characterized in that the by-pass line means is connected with the distributor means.

6. An internal combustion engine according to claim 5, characterized in that the engine is a V-type engine with two rows of cylinders disposed with respect to each other in the form of a V, and in that the suction manifold means is disposed within the space of the V.

7. An internal combustion engine according to claim 6, characterized in that at least portions of the suction manifold means are disposed lower than portions of the individual suction pipes.

8. An internal combustion engine according to claim 7, characterized in that at least portions of said suction manifold means are disposed lower than the connections of the individual suction pipes with the respective cylinders.

9. An internal combustion engine according to claim 7, characterized in that the individual suction pipes are constructed as tuned pipes.

10. An internal combustion engine according to claim 1, characterized in that the engine is a V-type engine with two rows of cylinders disposed with respect to each other in the form of a V, and in that the suction manifold means is disposed within the space of the V.

11. An internal combustion engine according to claim 10, characterized in that at least portions of the suction manifold means are disposed lower than portions of the individual suction pipes.

12. An internal combustion engine according to claim 1, characterized in that the individual suction pipes are constructed as tuned pipes.

13. An internal combustion engine according to claim 1, wherein said idling air line means is connected downstream of said suction manifold means.

14. An internal combustion engine according to claim 13, wherein said idling air line means is connected to said individual suction pipes in direct proximity to the cylinders.

15. An internal combustion engine according to claim 14, wherein said idling air line means includes a distributor means and said by-pass line means is connected at least upstream of said distributor means.

16. An internal combustion engine according to claim 15, wherein said by-pass line means is connected to said idling air line means in said distributor means.

17. An internal combustion engine according to claim 14, wherein said means for connecting said idling air line means includes individual idling air lines leading to respective cylinders.