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[54] **INTERNAL COMBUSTION ENGINE CRANKCASE**
WITH DRY-SUMP LUBRICATION
26 Claims, 4 Drawing Figs.

[52] U.S. Cl. **184/6,**
123/196

[51] Int. Cl. **F01m 1/12**

[50] Field of Search **184/6T, 6B,**
6I; 184/103; 137/21

ABSTRACT: A crankcase for an internal combustion engine, particularly with dry-sump lubrication in which the crankcase bottom part forms at least one space for the sump of the lubricant in which are arranged two or several suction places, of which at least two suction places are connected with separate suction pumps and are arranged at a place of the suction space which is a relatively lower place for a predetermined inclined position of the engine.

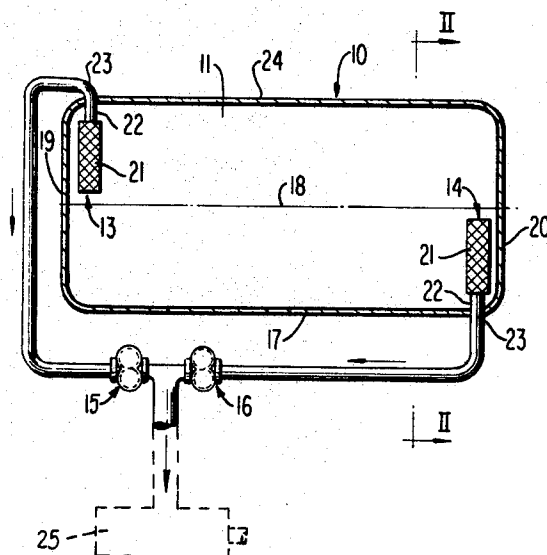


FIG 1

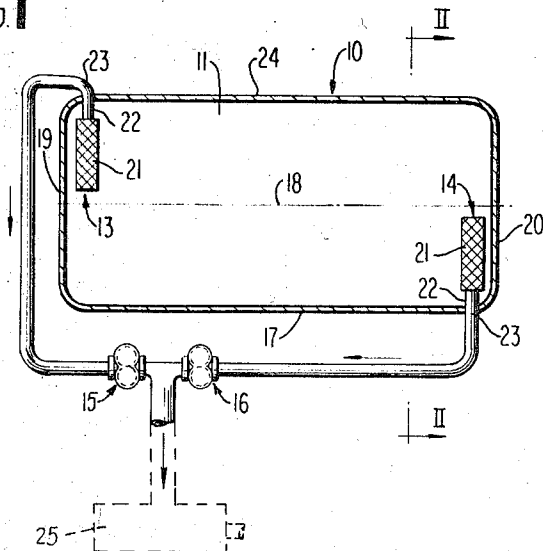


FIG 2

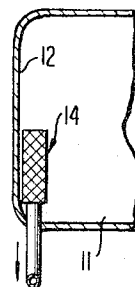


FIG 3

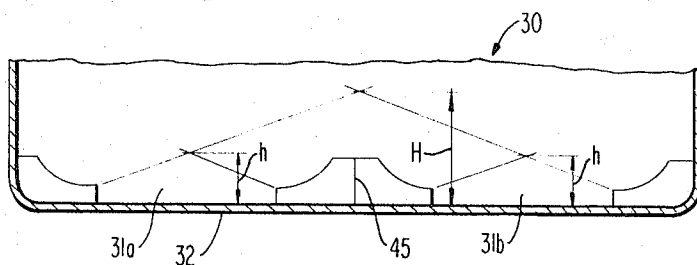
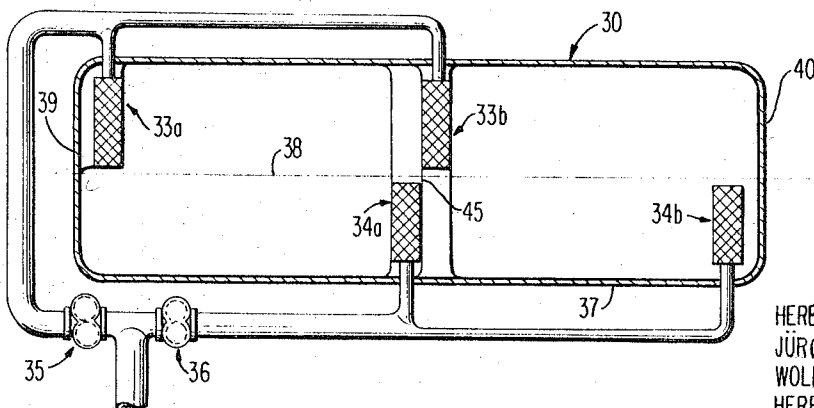


FIG 4



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INTERNAL COMBUSTION ENGINE CRANKCASE WITH DRY-SUMP LUBRICATION

The present invention relates to a crankcase for an internal combustion engine, especially with dry-sump lubrication.

The aim underlying the present invention essentially resides in so constructing the crankcase that the lubrication of the internal combustion engine is assured also in the operating positions of the housing deviating from the normal, horizontal position.

The mentioned aims and underlying problems are solved by the present invention in that the housing bottom part includes at least one space for lubricant sump with two or more suction places, of which at least two suction places are connected with separate suction pumps as well as are arranged each at a place of the sump space representing a lower place for a predetermined engine inclination. According to the present invention, the suction places are so arranged that at least one of the suction pumps sucks off the lubricant in the inclined operating positions of the internal combustion engine. An advantage of this arrangement resides in the fact that the housing bottom part can be constructed relatively low, i.e., flat, without a rise of the oil level in the inclined position to a nonpermissible extent.

For purposes of assuring the lubricant supply with inclined positions of the engine, in which the longitudinal axis of the crankcase is inclined, at least one suction place having its own suction pump may be arranged at each of the two space ends disposed one behind the other in the space longitudinal direction.

During mountain driving of a cross-country vehicle, the suction place provided at the rear end of the suction space would then be effective whereas, depending on the grade, the suction pump connected with the forward suction place would suck off air and therewith would be ineffectual.

In order to eliminate disturbances and failures of the engine lubrication by inclinations of the crankcase about the housing longitudinal axis, at least two suction places of a sump space may be arranged with a separate suction pump each on different sides of the longitudinal axis.

In one embodiment of a crankcase according to the present invention, one or several pairs of suction places are provided in a sump space. Each pair is connected with two suction pumps, both suction places with one pump each. Each suction place of a respective pair is arranged both at a different longitudinal end of the suction space as well as on a different side of the space longitudinal axis. In this manner, lubricant can be sucked out of the sump space with nearly all inclined positions without the necessity for more than one such pair of suction places.

With very long internal combustion engines, it is of advantage if the housing bottom part is subdivided into two sump spaces arranged one behind the other in the housing longitudinal axis. The necessary lubricant drop to the suction places is reduced thereby. According to a further feature and development of such a crankcase, suction pumps are economized in that suction places arranged on the same side of the housing longitudinal axis from both suction spaces are connected with a common suction pump. In order to avoid thereby that with an inclined housing longitudinal axis all suction pumps suck in air, the arrangement may be so made that the suction places from both sump spaces with a common suction pump are arranged at the same longitudinal ends—i.e., at the forward or rearward longitudinal end of the respective suction space.

In order that the suction places are acted upon by the lubricant over the entire suction cross section also in case of inclined positions of the engine with inclined longitudinal axis, it is appropriate if the aperture of the suction place terminating in the sump extends transversely to the housing longitudinal axis.

A particularly low construction of the crankcase is achieved if the suction pumps are arranged at the outer walls of the crankcase.

For purposes of reducing the line losses, the interior housing line section may extend transversely to the housing longitudinal axis between the suction place and the aperture in the housing wall for the passage of the line.

In order to achieve short lines within the crankcase, according to a further feature and development of the present invention, the suction places and their communicating passage apertures in the housing wall may be arranged on the same side of the housing longitudinal axis. A further advantage of this arrangement resides in that the housing line with inclined positions of the engines is located in the natural flow direction of the flowing-off lubricant. With pumps arranged at the outer walls of the crankcase relatively long line sections may also be arranged at the housing outer walls.

Accordingly, it is an object of the present invention to provide a crankcase for internal combustion engines, especially with dry sump lubrication which avoids by simple means the aforementioned shortcomings and drawbacks encountered in the prior art.

Another object of the present invention resides in a crankcase for internal combustion engines with dry sump lubrication which assures adequate lubrication of the internal combustion engine also in operating positions of the crankcase housing differing from the normal position thereof.

A further object of the present invention resides in a dry-sump lubrication for internal combustion engines which assures adequate lubrication under all operating conditions, irrespective of the position of the crankcase.

Still a further object of the present invention resides in a crankcase construction for internal combustion engines of the type described above in which the necessary drop of the lubricant to the suction places is reduced.

Still another object of the present invention resides in a crankcase for internal combustion engines, especially with dry sump lubrication which not only permits a relatively flat construction of the crankcase, important particularly for cross-country-type vehicles, but also assures that the suction cross sections are acted upon by the lubricant over the entire cross section thereof even with an inclined longitudinal axis of the crankcase housing.

Still a further object of the present invention resides in a crankcase for internal combustion engines with dry-sump lubrication which achieves all of the aforementioned aims and objects with extraordinarily simple means while at the same time minimizing line losses.

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, two embodiments of a crankcase in accordance with the present invention, and wherein: Opp FIG. 1 is a schematic plan view of a first embodiment of a crankcase bottom part in accordance with the present invention;

FIG. 2 is a schematic partial cross-sectional view through the crankcase bottom part of FIG. 1, taken along line II-II; Opp FIG. 3 is a schematic partial longitudinal cross section through a modified embodiment of a crankcase bottom part according to the present invention; and Opp FIG. 4 is a schematic plan view of the crankcase bottom part of FIG. 3.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIGS. 1 and 2, the crankcase bottom part generally designated by reference numeral 10 illustrated in these FIGS. includes a single interior sump space 11, at the bottom 12 of which are provided two suction places generally designated by reference numerals 13 and 14. Each suction place 13 and 14 is connected with its own suction pump generally designated by reference numerals 15 and 16, respectively. The pumps 15 and 16 are secured externally at the housing sidewall 17 in a conventional manner, not illustrated in the drawing, and supply or feed the lubricating oil from the sump space 11 into an oil tank (not shown). From this oil tank, the lubricating oil is fed to the lubricating places by pressure pumps in a conventional manner.

The suction places 13 and 14 form a pair, of which each suction place 13 and 14 is arranged on a different side of the housing longitudinal axis 18 is also at a different longitudinal end 19 and 20 of the space 11, respectively. Each suction place 13 and 14 of this pair of suction places is connected with its own suction pump 15 and 16, respectively for pumping or returning the lubricating oil to a collection sump 25, which is known in conventional dry sump lubrication arrangements.

The apertures 21 of the suction places 13 and 14 terminating in the sump extend transversely to the axis 18. The inner housing channels or lines 22 between the suction places 13 and 14 and their passage apertures 23 in the housing sidewalls 24 and 17 also extend in the same transverse direction.

The crankcase bottom part generally designated by reference numeral 30 of FIGS. 3 and 4 is subdivided by a cross wall 45 at the housing bottom 32 into two suction spaces 31a and 31b disposed behind one another in the housing longitudinal axis 38. One pair each of suction places 31a, 34a and 33b, 34b is arranged in the spaces 31a and 31b, respectively. Each suction place 33a and 34a as well as 33b and 34b of a respective pair is connected with a separate suction pump generally designated by reference numerals 35 and 36. The pumps 35 and 36 are again secured externally at the housing sidewall 37 in any conventional manner. Each pair of suction places of the bottom part 30 is characterized in that the two associated suction places of the bottom part 30 is characterized in that the two associated suction places 33a and 34a or 33b are arranged both on different sides of the housing longitudinal axis 38 as also at different longitudinal ends 39 and 45 or 45 and 40 of the respective space 31a and 31b, respectively.

If the subdivision of the housing bottom part 30 by the cross wall 45 with the additional suction places 34a and 33b were missing, then an imaginary drop, indicated by H, would be necessary for the movement of the lubricating particles to the remaining suction places 33a and 34b. By the illustrated and described subdivision of the housing bottom part 30, as shown in FIG. 3, the drop H is reduced to the smaller value h. The oil sump becomes flatter as a result thereof, and the crankcase can be constructed and designed lower.

As can be seen from FIG. 4, two suction places 33a and 33b or 34a and 34b of different suction spaces 31a and 31b arranged on the same side of the axis 38 are connected to a common suction pump 35 and 36, respectively.

The suction places 33a and 33b of the pump 35 are arranged at the forward longitudinal ends 39 and 45 of the spaces 31a and 31b whereas the suction places 34a and 34b are arranged at the rear longitudinal ends 45 and 40 of the spaces 31a and 31b. It is always assured by this arrangement that with an inclination of the longitudinal axis 38, lubricant is sucked off both sump spaces 31a and 31b, and more particularly, essentially without air.

While we have shown and described two embodiments 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 crankcase for an internal combustion engine with dry sump lubrication, wherein the improvement comprises a relatively flat crankcase bottom part provided with at least one space for the lubricant sump having disposed therein at least two suction places at substantially the same level, at least two of said suction places being operatively connected with separate suction pump means for return of a lubricant to a collection sump and being each arranged at a place of the sump space constituting a lower space for a predetermined inclined position of the engine.

2. A crankcase according to claim 1, wherein at least two suction places of a respective sump space are arranged with separate suction pump means on different sides of the longitudinal axis of the space.

3. A crankcase for an internal combustion engine with dry-sump lubrication, wherein the improvement comprises a relatively flat crankcase bottom part provided with at least one space for the lubricant sump having at least two suction places at substantially the same level, at least two of said suction places being operatively connected with separate suction pump means, and being each arranged at a place of the sump space constituting a lower space for a predetermined inclined position of the engine, wherein at least two suction places of a respective sump are arranged with separate suction pump means on different sides of the longitudinal axis of the space, characterized by at least one pair of suction places in each sump space, each pair being operatively connected with two suction pump means, one suction pump means for each suction place, and each suction place of a respective pair being arranged at a different longitudinal end of the sump space and on a different side of the space longitudinal axis.

4. A crankcase according to claim 3, wherein the housing bottom part is subdivided into two sump spaces arranged one behind the other in the longitudinal axis of the housing.

5. A crankcase according to claim 4, wherein the suction places arranged on the same side of the housing longitudinal axis from both sump spaces are operatively connected with a common suction pump means.

6. A crankcase according to claim 5, wherein the suction places from both sump spaces operatively connected with a common suction pump means are arranged at the same longitudinal ends.

7. A crankcase according to claim 6, wherein the last-mentioned suction places of both sump spaces connected with a common suction pump means are arranged at a respective one of the forward and rearward longitudinal ends of the corresponding space.

8. A crankcase according to claim 6, wherein each suction place is provided with an aperture terminating in the sump which extends transversely to the housing longitudinal axis.

9. A crankcase according to claim 8, wherein the suction pump means are arranged at the outer wall of the crankcase.

10. A crankcase according to claim 9, further comprising inner housing line means between a respective suction place and the corresponding passage opening in the housing wall and extending substantially transversely to the housing longitudinal axis.

11. A crankcase according to claim 10, wherein the suction place and its communicating passage aperture in the housing wall are arranged on the same side of the housing longitudinal axis.

12. A crankcase for an internal combustion engine with dry-sump lubrication, wherein the improvement comprises a relatively flat crankcase bottom part provided with at least one space for the lubricant sump having at least two suction places at substantially the same level, at least two of said suction places being operatively connected with separate suction pump means and being each arranged at a place of the sump space constituting a lower space for a predetermined inclined position of the engine, characterized by at least one pair of suction places in each sump space, each pair being operatively connected with two suction pump means, one suction pump means for each suction place, and each suction place of a respective pair being arranged at a different longitudinal end of the sump space and on a different side of the space longitudinal axis.

13. A crankcase according to claim 12, wherein the housing bottom part is subdivided into two sump spaces arranged one behind the other in the longitudinal axis of the housing.

14. A crankcase according to claim 13, wherein the suction places arranged on the same side of the housing longitudinal axis from both sump spaces are operatively connected with a common suction pump means.

15. A crankcase according to claim 14, wherein the suction places from both sump spaces operatively connected with a common suction pump means are arranged at the same longitudinal ends.

16. A crankcase according to claim 12, wherein each suction place is provided with an aperture terminating in the sump which extends transversely to the housing longitudinal axis.

17. A crankcase according to claim 1, wherein the suction pump means are arranged at the outer wall of the crankcase.

18. A crankcase according to claim 16, further comprising inner housing line means between a respective suction place and the corresponding passage opening in the housing wall and extending substantially transversely to the housing longitudinal axis.

19. A crankcase according to claim 18, wherein the suction place and its communicating passage aperture in the housing wall are arranged on the same side of the housing longitudinal axis.

20. A crankcase according to claim 1, wherein the housing bottom part is subdivided into two sump spaces arranged one behind the other in the longitudinal axis of the housing.

21. A crankcase according to claim 20, wherein the suction places arranged on the same side of the housing longitudinal axis from both sump spaces are operatively connected with a common suction pump means.

22. A crankcase according to claim 20, wherein the suction places from both sump spaces operatively connected with a common suction pump means are arranged at the same longitudinal ends.

23. A crankcase according to claim 22, wherein the last-mentioned suction places of both sump spaces connected with a common suction pump means are arranged at a respective one of the forward and rearward longitudinal ends of the corresponding space.

24. A crankcase according to claim 1, wherein each suction place is provided with an aperture terminating in the sump which extends transversely to the housing longitudinal axis.

25. A crankcase according to claim 1, further comprising inner housing line means between a respective suction place and the corresponding passage opening in the housing wall and extending substantially transversely to the housing longitudinal axis.

26. A crankcase according to claim 25, wherein the suction place and its communicating passage aperture in the housing wall are arranged on the same side of the housing longitudinal axis.

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