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Ableitner et al.

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[54] **HYDRAULIC VALVE-PLAY COMPENSATING ELEMENT FOR INTERNAL COMBUSTION ENGINES**

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[52] **U.S. Cl.** **123/90.46;** 123/90.35; 123/90.55; 123/90.56

[51] **Int. Cl.²** **F01L 1/18**

[58] **Field of Search** 123/90.56, 90.57, 90.58, 123/90.59, 90.55, 90.35, 90.46, 90.33

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[57] **ABSTRACT**

A hydraulic valve-play compensating element for internal combustion engines with two elements longitudinally displaceable relative to one another which enclose a pressure space that is separated by way of a check valve from a supply space connected to the oil circulatory system of the internal combustion engine; the supply space is thereby interconnected into the oil circulatory system to permit an oil flow through the same while means are also provided in the supply space upstream of the check valve for defoaming the oil flow.

36 Claims, 5 Drawing Figures

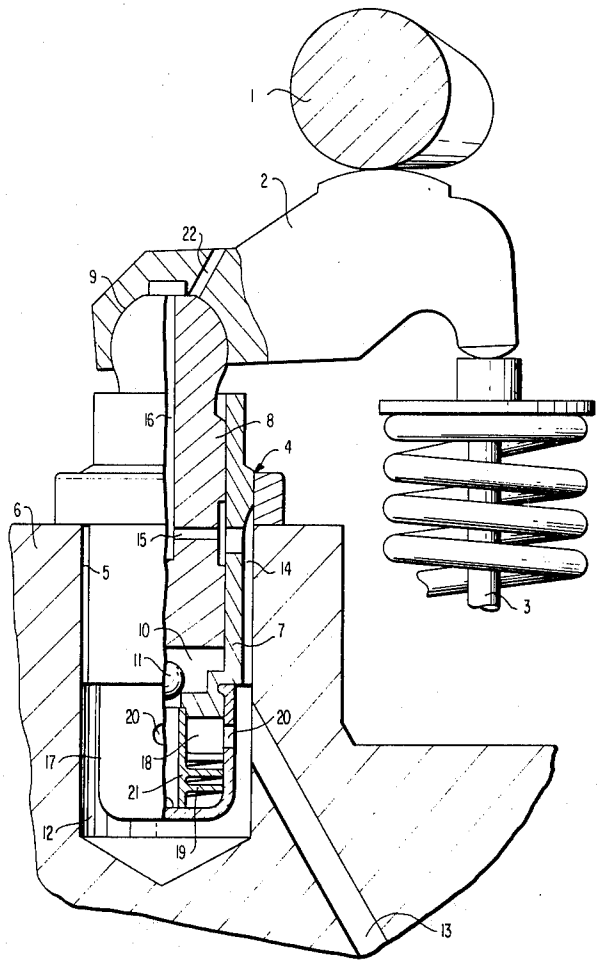
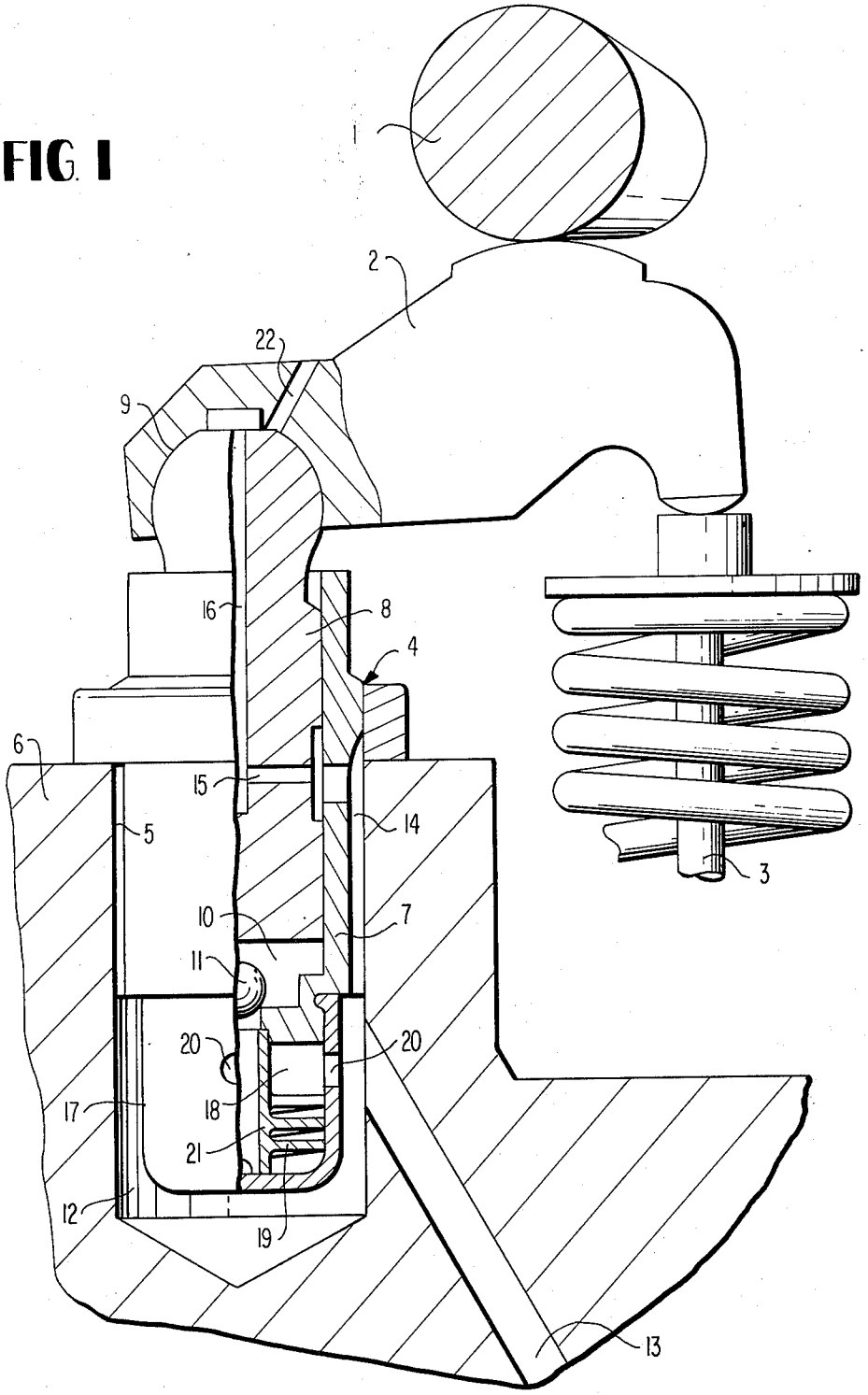


FIG. 1



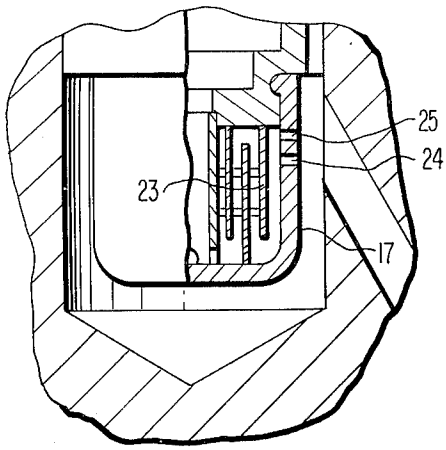


FIG. 2

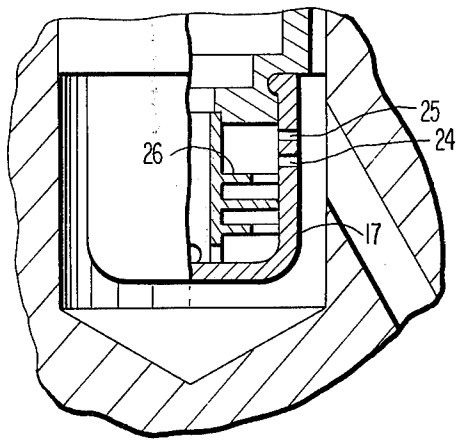


FIG. 3

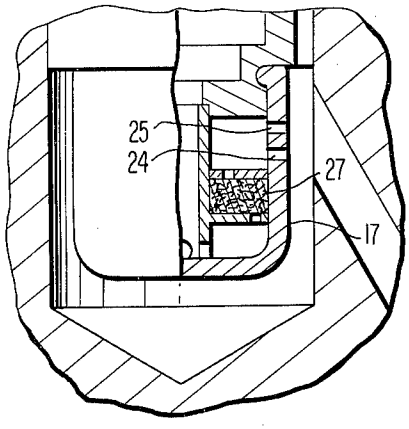


FIG. 4

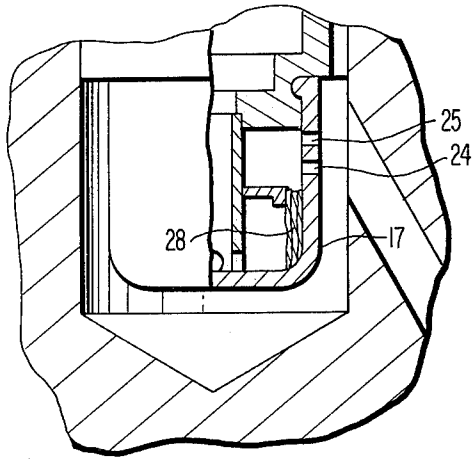


FIG. 5

HYDRAULIC VALVE-PLAY COMPENSATING ELEMENT FOR INTERNAL COMBUSTION ENGINES

The present invention relates to a hydraulic valve-play compensating element for internal combustion engines, which includes two parts longitudinally displaceable relative to one another, which enclose therebetween a pressure space, separated by a check valve from a supply space which is connected with the lubricating oil circulatory system of the internal combustion engine.

Valve-play compensating elements, in which the supply space is connected directly with the lubricating oil circulatory system of the internal combustion engine by way of a tap line, have not found acceptance to date in practice because it was not possible with tolerable expenditures to so defoam the lubricating oil foamed by the admixture of air, that only air-free oil reaches the pressure space. Tests to achieve a removal of air bubbles by a connection of the pressure space with the supply space by way of leakage oil bores or by a connection of the pressure space with temporarily free and throttled leakage oil bores leading out of the element, did not lead to a success when these arrangements were provided in elements for fast-running internal combustion engines.

The present invention is therefore concerned with the task to so construct a hydraulic valve-play compensating element with direct connection to the lubricating oil circulatory system that also at high rotational speeds of the internal combustion engine, a good defoaming with rapid removal of the air components takes place.

The underlying problems are solved according to the present invention in that the supply space is in communication in through-flow relation with the lubricating oil circulatory system and in that means are provided in the supply space upstream of the check valve which defoam the oil flow.

A safe defoaming with reliable removal of the separated-out air components can be realized by the present invention, which is not influenced by high rotational speeds of the internal combustion engine so that the valve actuation can operate clearance-free also in this rotational speed range with the requisite hydraulic hardness in the valve-play compensating element.

In one advantageous embodiment of the subject matter of the present invention, the means for defoaming may be arranged in a structurally and functionally favorable manner within a separate space which is in communication both with the inlet of the check valve as also with the supply space and is arranged within the supply space separated therefrom.

This separate space may be connected with the supply space by one or several bores at a location which is disposed with the installed element at or in proximity to the upper end of the separate space.

The means for defoaming may consist in a simple manner of a helix having a slight pitch which slows down the oil stream.

However, the means for defoaming may also be constructed as labyrinth and finally they may also consist of a filter.

Accordingly, it is an object of the present invention to provide a hydraulic valve play compensating element for internal combustion engines which avoids by

simple means the aforementioned shortcomings and drawbacks encountered in the prior art.

Another object of the present invention resides in a hydraulic valve play compensating element for internal combustion engines which is very reliable in operation, yet involves readily acceptable expenditures for the defoaming of the air.

A further object of the present invention resides in a hydraulic valve play compensating element for internal combustion engines which assures a reliable defoaming of the lubricating air by extremely simple means as well as a reliable removal of the air bubbles under all operating conditions.

Still a further object of the present invention resides in a hydraulic valve play compensating element for internal combustion engines which is capable of operating also at high rotational speeds without jeopardizing the defoaming of the lubricating oil.

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 drawings which shows, for purposes of illustration only, several embodiments in accordance with the present invention, and wherein:

FIG. 1 is a partial cross-sectional view through a valve actuating mechanism for an internal combustion engine equipped with a valve-play compensating element having a helix for defoaming the oil in accordance with the present invention;

FIGS. 2 and 3 are partial cross-sectional views illustrating modified embodiments of a valve-play compensating element equipped with a labyrinth for defoaming the oil in accordance with the present invention; and

FIGS. 4 and 5 are partial cross-sectional views through valve-play compensating elements with filters for defoaming the lubricating oil in accordance with the present invention.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIG. 1, the valve actuating mechanism for an internal combustion engine includes a cam shaft 1, a rocker arm 2, a valve 3, of which only the valve stem is shown, and a hydraulic valve-play compensating element generally designated by reference numeral 4. The valve-play compensating element 4 is arranged in a bore 5 of the cylinder head 6 of the internal combustion engine and includes two parts 7 and 8. The part 7 is constructed cylinder-like and is fixedly arranged at the cylinder head 6 by conventional means. The part 8 is constructed piston-like and is longitudinally displaceably supported in the part 7. The upper end of the valve-play compensating part 8 serves as bearing support 9 for the rocker arm 2. The two parts 7 and 8 enclose therebetween a pressure space 10 which is connected by way of a check valve 11 with a supply space 12 disposed below the part 7. The supply space 12 is in communication in through-flow relationship with the lubricating oil circulatory system of the internal combustion engine in that it is connected, on the one hand, by way of a bore 13 with a main oil channel supplying lubricating oil and by way of a channel 14 and bores 15 and 16 with the bearing 9 to be lubricated. In other words, the connection according to the present invention is so realized that lubricating oil flows through the space 12 in the course of its flow path from bore 13 into bores 15 and 16 by way of channel 14. An essentially cylindrical member

17 connected with the part 7 forms on the inside of the supply space 12 a separate space 18 disposed upstream of the inlet of the check valve 11; a helix 19 with slight pitch is arranged in the separated space 18 in such a manner that oil flowing-in out of the supply space 12 is slowly conducted downwardly by the helix 19 whereby a defoaming takes place, and then reaches the check valve 11 by way of a central tubular member or pipe 21. Air separated out of the lubricating oil within the space 18 is sucked by the lubricating oil stream into the supply space 12 through the bores 20 and together with the lubricating oil stream reaches the bearing 9 by way of the channel 14 and by way of the bores 15 and 16, where the air is able to leave the bearing 9 by way of the bore 22. Lubricating oil discharged out of the bore 22 serves for the lubrication of the other parts of the valve actuating mechanism, such as the contact surface of the cam shaft 1 on the rocker arm 2.

As to the rest, the operation of the valve-play compensating element is conventional so that a further detailed description thereof is dispensed with herein.

A labyrinth 23 may also be arranged in the member 17, as shown in FIG. 2, in lieu of a helix, whereby the lubricating oil has to flow through the labyrinth 23 in the axial direction. As FIG. 2 further illustrates, in lieu of bores 20 (FIG. 1), bores 24 and 25 disposed one behind the other in the axial direction may be provided, of which the bores 24 serve for the supply of lubricating oil and the bores 25 for the discharge of separated-out air.

FIG. 3 illustrates a labyrinth 26 in the member 17 of the mechanism which consists of annular disks disposed one above the other with respectively offset passage bores.

According to FIG. 4, a steel-wool filter 27 is arranged in the member 17 whereas according to FIG. 5, also a paper filter 28 can be used for the same purpose.

While we have shown and described several 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 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.

What we claim is:

1. A hydraulic valve play compensating element for an internal combustion engine, the compensating element includes two members longitudinally displaceable relative to one another, which members enclose therebetween a pressure space separated by a check valve means from a supply space, characterized in that a lubricating oil circulatory system is provided, the supply space is operatively connected with the lubricating oil circulatory system, a separate oil receiving space communicating with said check valve means is provided in said supply space, bore means are provided for communicating said supply space with said separate oil receiving space, and in that a defoaming means is arranged in said separate oil receiving space for defoaming the oil flowing into said pressure space.

2. A hydraulic valve play compensating element according to claim 1, characterized in that the supply space is in communication with the lubricating oil circulatory system in such a manner that a flow of the lubricating oil takes place through the supply space in the course of the lubrication of other parts of an internal combustion engine.

3. A hydraulic valve play compensating element according to claim 2, characterized in that said parts are parts of the valve actuating mechanism.

4. A hydraulic valve play compensating element according to claim 1, characterized in that the defoaming means include a filter means.

5. A hydraulic valve play compensating element according to claim 1, characterized in that said separate oil receiving space is defined by a substantially cylindrical member disposed in said supply space, said defoaming means including a labyrinth means arranged in said cylindrical member whereby the oil flow in said cylindrical member is substantially in the axial direction thereof.

6. A hydraulic valve play compensating element according to claim 5, characterized in that a further bore means is provided for discharging separated air from said separate oil receiving space.

7. A hydraulic valve play compensating element according to claim 1, characterized in that said separate oil receiving space is defined by a substantially cylindrical member disposed in said supply space, said defoaming means including a labyrinth means arranged in said cylindrical member, said labyrinth means comprising at least two annular disc members disposed one above the other in said cylindrical member having offset passage bores to direct the flow from said supply space to said check valve means.

8. A hydraulic valve play compensating element according to claim 7, characterized in that a further bore means is provided for discharging separated air from said separate oil receiving space.

9. A hydraulic valve play compensating element according to claim 7, characterized in that two annular discs are provided having offset passage bores, and in that a filter element is disposed between said two annular discs.

10. A hydraulic valve play compensating element according to claim 9, characterized in that a further bore means is provided for discharging separated air from said separate oil receiving space.

11. A hydraulic valve play compensating element according to claim 10, characterized in that said filter element is a steelwool filter.

12. A hydraulic valve play compensating element according to claim 1, characterized in that said separate oil receiving space is defined by a substantially cylindrical member disposed in said supply space, said defoaming means including an annular disc element arranged in said cylindrical member, said disc element including a peripheral edge portion spaced from an internal wall of said cylindrical member to define a passage means, and in that a filter element is disposed in said passage means.

13. A hydraulic valve play compensating element according to claim 12, characterized in that a further bore means is provided for discharging separated air from said separate oil receiving space.

14. A hydraulic valve play compensating element according to claim 13, characterized in that said filter element is a paper filter.

15. A hydraulic valve play compensating element for internal combustion engines, which element includes two members longitudinally displaceable relative to one another, which members enclose therebetween a

pressure space separated by way of a check valve means from a supply space, characterized in that a lubricating oil circulatory system is provided, the supply space is operatively connected with the lubricating oil circulatory system, means are provided in the supply space upstream of the check valve means for defoaming the oil flow, the defoaming means are arranged in a separate space which is in communication both with the inlet of the check valve means as also with the supply space, said separate space is arranged within the supply space, though separated therefrom, and in that the separate space is connected with the supply space by at least one bore means at a location which is disposed at least in proximity to the upper end of the separate space.

16. A hydraulic valve play compensating element according to claim **6,** characterized in that said separate space is connected with the supply space by way of several bore means.

17. A hydraulic valve play compensating element according to claim **6,** characterized in that said location is disposed at the upper end of said separate space.

18. A hydraulic valve play compensating element according to claim **6,** characterized in that said defoaming means includes a helix with slight pitch which slows down the oil flow.

19. A hydraulic valve play compensating element according to claim **6,** characterized in that the defoaming means include a labyrinth means.

20. A hydraulic valve play compensating element according to claim **6,** characterized in that the defoaming means include a filter means.

21. A hydraulic valve play compensating element according to claim **6,** characterized in that the supply space is in communication with the lubricating oil circulatory system in such a manner that a flow of lubricating oil takes place through the supply space in the course of the lubrication of other parts of an internal combustion engine.

22. A hydraulic valve play compensating element for internal combustion engines, which element includes two members longitudinally displaceable relative to one another, which members enclose therebetween a pressure space separated by way of a check valve means from a supply space, characterized in that a lubricating oil circulatory system is provided, the supply space is operatively connected with the lubricating oil circulatory system, a separate oil receiving space in communication with the check valve means is provided in said supply space, bore means are provided for communicating said supply space with said separate oil receiving space, means are provided in said separate oil receiving space upstream of the check valve means for defoaming the oil flow, said defoaming means includes a helical member having a slight pitch in the flow direction of the oil for slowing down the oil flow from said supply space to said check valve means.

23. A hydraulic valve play compensating element for internal combustion engines, which element includes two members longitudinally displaceable relative to one another, which members enclose therebetween a pressure space separated by way of a check valve means from a supply space, characterized in that a lubricating oil system is provided, the supply space is operatively connected with the lubricating oil circulatory system, a separate oil receiving space in communication with the check valve means is provided in said supply space, bore means are provided for communicating said supply space with said separate oil receiving space, means are provided in said separate oil receiving space upstream of the check valve means for defoaming the oil flow, said defoaming means including a labyrinth means.

24. An internal combustion engine comprising: a cylinder head means, a bore provided in said cylinder head means, a hydraulic compensating means including two members longitudinally displaceable relative to one another disposed in said bore, a pressure space enclosed by said two members, a lubricating oil circulatory system for the internal combustion engine, a supply space provided in said bore operatively connected with said lubricating oil circulatory system, a check valve means for separating said pressure space from said supply space, a separate oil receiving means arranged in said supply space and communicating with said check valve means, bore means for communicating said supply space with said separate oil receiving space, and a defoaming means arranged in said separate oil receiving space for defoaming the oil flowing into said pressure space.

25. An internal combustion engine according to claim **24,** further comprising a valve actuating mechanism, and wherein means are provided for communicating said supply space with said valve actuating mechanism for lubricating said mechanism.

26. An internal combustion engine according to claim **24,** wherein said bore means is disposed at least in proximity to the upper end of said separate oil receiving space.

27. An internal combustion engine according to claim **24,** wherein said defoaming means includes a helical member arranged in said separate oil receiving space having a slight pitch in the flow direction of the oil for slowing down the oil flow from said supply space to said check valve means.

28. An internal combustion engine according to claim **24,** wherein said defoaming means includes a labyrinth means.

29. An internal combustion engine according to claim **24,** wherein said separate oil receiving space is defined by a substantially cylindrical member disposed in said supply space, said defoaming means including a labyrinth means arranged in said cylindrical member whereby the oil flow in said cylindrical member is substantially in the axial direction thereof.

30. An internal combustion engine according to claim **29,** wherein a further bore means is provided for discharging separate air from said separate oil receiving space.

31. An internal combustion engine according to claim **24,** wherein said separate oil receiving space is defined by a substantially cylindrical member disposed in said supply space, said defoaming means including a labyrinth means arranged in said cylindrical member, said labyrinth means comprising at least two annular disc members disposed one above the other in said cylindrical member having offset passage bores to direct the flow from said supply space to said check valve means.

32. An internal combustion engine according to claim **31,** wherein a further bore means is provided for discharging separated air from said separate oil receiving space.

33. An internal combustion engine according to claim 31, wherein two annular discs are provided having offset passage bores, and wherein a filter element is disposed between said two annular discs.

34. An internal combustion engine according to claim 33, wherein a further bore means is provided for discharging separated air from said separate oil receiving space.

35. An internal combustion engine according to claim 24, wherein said separate oil receiving space is defined by a substantially cylindrical member disposed in said supply space, said defoaming means including an annular disc element arranged in said cylindrical member, said disc element including a peripheral edge portion spaced from an internal wall of said cylindrical member to define a passage means, and a filter element disposed in said passage means.

36. An internal combustion engine according to claim 34, wherein a further bore means is provided for discharging separated air from said separate oil receiving space.

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