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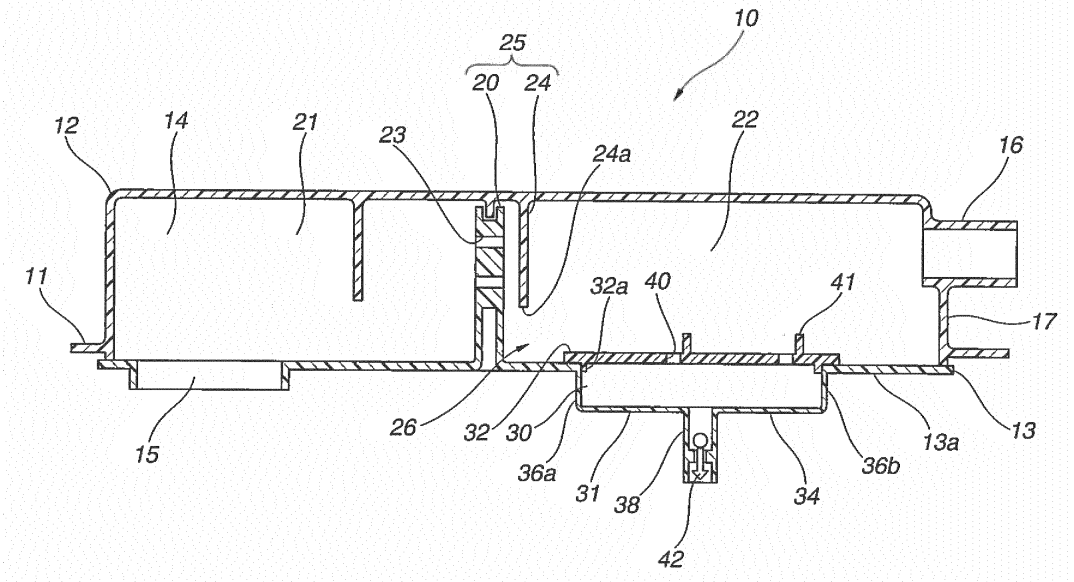
(54) OIL MIST SEPARATOR

(57) An oil mist separator includes: an inlet chamber including a blowby gas inlet; an outlet chamber including a blowby gas outlet, and a bottom wall; an oil mist separation section disposed between the inlet chamber and the outlet chamber; an oil recovering chamber which includes an oil recovering chamber bottom wall located below the bottom wall of the outlet chamber, and which is defined between the bottom wall of the outlet chamber, and the oil recovering chamber bottom wall; an oil communication hole which is opened in the bottom wall of the outlet chamber, and which connects the oil recovering chamber and the outlet chamber; a drain pipe which protrudes in a downward direction from a bottom surface of the oil recovering chamber; and a check valve which is provided at a tip end opening of the drain pipe.

FIG.1



EP 3 034 823 A1

Description

BACKGROUND OF THE INVENTION

[0001] This invention relates to an oil mist separator.

[0002] For example, in an internal combustion engine for a vehicle, as is well known, a blowby gas including unburnt component which is leaked from a combustion chamber into a crank case is introduced to an intake system of the engine, and burned. The blowby gas passing through the inside of the crank case includes oil mist. Accordingly, for preventing the oil from flowing into the intake system of the engine, there is provided, for example, an oil mist separator disposed within a cylinder head cover, and arranged to separate and remove the oil mist within the blowby gas. For example, a patent document 1 (Japanese Patent Application Publication No. 8-158853) discloses an oil mist separator including an oil mist separator section including an impact plate extending within a separator chamber in an upward direction, and an impact plate extending within the separator chamber in a downward direction. With this, this oil mist separator curves a flow of the blowby gas so as to separate the oil mist from the blowby gas. Furthermore, a patent document 2 (Japanese Patent Application Publication No. 2009-121281) discloses an oil mist separator including a separation wall which is provided within a separation chamber, and a plurality of passage holes which are opened in the separation wall for further promoting the separation and the removal of the oil mist. In this oil mist separator, the blowby gas passes through these passage holes, so that the flow speed of the blowby gas is increased. Then, the blowby gas is impeded on the impact plate on a downstream side of the separation wall so as to separate and remove the oil mist.

[0003] As shown in the patent documents 1 and 2, the oil separated by these oil mist separation sections is discharged from the oil mist separator through a drain pipe provided at the bottom wall of the oil mist separator, and returned into the inside of the internal combustion engine. On the other hand, the blowby gas from which the oil mist is removed is discharged from the oil mist separator to the intake system.

SUMMARY OF THE INVENTION

[0004] In general, in a case where a separation performance (property) of the oil mist separation section is improved, a pressure loss generated in the oil mist separation section is increased. For example, in a case where passage sectional areas of the passage holes provided of the separation wall are decreased, the pressure loss between the upstream side and the downstream side of the separation wall becomes large. The pressure of the downstream side portion of the oil mist separator which is positioned on the downstream side of the separation wall is lowered by this pressure loss. With this, the pressure difference between the oil mist separator downstream side portion and the inside of the internal combustion engine becomes large. The blowby gas flows through an opening of a tip end of the drain pipe into the oil mist separator downstream side portion by this pressure difference. With this, the oil within the drain pipe may flow into the oil mist separator. It is possible to prevent the reverse flow of the oil by lengthening the length of the drain pipe. However, when the drain pipe is lengthened, the drain pipe is interfered with components of the internal combustion engine which are positioned below the head cover. Accordingly, this is not preferable.

[0005] It is, therefore, an object of the present invention to provide an oil mist separator devised to solve the above mentioned problem, and to prevent the backflow of the separated oil into the oil mist separator chamber..

[0006] According to one aspect of the present invention, an oil mist separator comprises: an inlet chamber including a blowby gas inlet; an outlet chamber including a blowby gas outlet, and a bottom wall; an oil mist separation section disposed between the inlet chamber and the outlet chamber; an oil recovering chamber which includes an oil recovering chamber bottom wall located below the bottom wall of the outlet chamber, and which is defined between the bottom wall of the outlet chamber, and the oil recovering chamber bottom wall; an oil communication hole which is opened in the bottom wall of the outlet chamber, and which connects the oil recovering chamber and the outlet chamber; a drain pipe which protrudes in a downward direction from a bottom surface of the oil recovering chamber; and a check valve which is provided at a tip end opening of the drain pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a sectional view taken along a longitudinal direction of an oil mist separator according to the present invention.

FIG. 2 is a bottom view of the oil mist separator of the FIG. 1.

FIG. 3 is a sectional view showing the oil mist separator according to a first embodiment of the present invention.

FIG. 4 is a sectional view which shows a main part of the oil mist separator, and which is taken along a section line A-A of FIG. 3.

FIG. 5 is a sectional view which shows the main part of the oil mist separator, and which is taken along a section line B-B of FIG. 3.

FIG. 6 is a sectional view showing an oil mist separator according to a second embodiment of the present invention.

FIG. 7 is a sectional view which shows a main part of the oil mist separator of FIG. 6, and which is taken along a section line C-C of FIG. 6.

FIG. 8 is a sectional view which shows the main part of the oil mist separator of FIG. 6, and which is taken

along a section line D-D of FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

[0008] Hereinafter, embodiments according to the present invention are illustrated in detail based on FIG. 1 to FIG. 5.

[0009] FIG. 1 is a sectional view taken along a longitudinal direction of an oil mist separator 10. FIG. 2 is a bottom view of the oil mist separator 10. Constituting members within the oil mist separator 10 are shown by broken lines. As shown in FIG. 1, the oil mist separator 10 includes a housing member 12 which includes an opened lower surface (lower surface opening), and which has an elongated passage shape; and a separator cover 13 which is mounted to the housing member 12 so as to cover the lower surface opening of the housing member 12. The housing 12 is integrally formed (molded) with a ceiling surface of a cylinder head cover 11 made from a synthetic resin, as a part of the cylinder head cover 11. The separator cover 13 made from the synthetic resin is formed (molded) as a member different from the housing member 12. The separator cover 13 is mounted to the housing member 12, that is, the cylinder head cover 11. Besides, in this embodiment, the housing member 12 is integrally formed as the part of the cylinder head cover 11. However, the housing member 12 may be formed as a member different form the cylinder head cover 11.

[0010] The oil mist separator 10 extends in an elongated shape, for example, in a direction perpendicular to cylinder rows (a widthwise direction of the engine). A separator chamber 14 is defined between the housing member 12 and the separator cover 13. The separator chamber 14 has an elongated shape, and a rectangular section. A blow by gas inlet 15 is positioned at one end portion of the separator chamber 14 in the longitudinal direction. A blow by gas outlet 16 is positioned at the other end portion of the separator chamber 14 in the longitudinal direction. Accordingly, the blowby gas basically flows within the separator chamber 14 along the longitudinal direction of the separator chamber 14. Besides, the separator chamber 14 is formed along a surface which is substantially perpendicular to a central axial line of the cylinder of the internal combustion engine. However, the separator chamber 14 may be formed to be inclined with respect to the cylinder central line in consideration that the internal combustion engine is mounted to the vehicle in an inclined posture.

[0011] As shown in FIG. 2, the blowby gas inlet 15 is constituted as a rectangular opening formed in the separator cover 15. That is, in this embodiment, the blowby gas inlet 15 is opened in the bottom surface of the separator chamber 14. The separator chamber 14 is connected through the blowby gas inlet 15 to the inside of the engine. Moreover, in this embodiment, the blowby gas outlet 16 is provided in an end wall 17 of the housing member 12 on the downstream side. Besides, in this embodiment, "upstream" and "downstream" represents an upstream and a downstream with respect to the flow of the blowby gas in a case where special notices are not described.

[0012] As shown in FIG. 2, a plate-shaped separation wall 20 is provided in an middle portion of the separator chamber 14 in the longitudinal direction. The separation wall 20 is perpendicular to the longitudinal direction of the separator chamber 14. As in the example shown in the drawings, this separation wall 20 is integrally formed (molded) with the separator cover 13. This separation wall 20 extends in the upward direction to have a height to reach the ceiling of the housing member 12. Besides, the separation wall 20 may be integrally formed (molded) with the housing member 12, that is, the cylinder head cover 11. This separation wall 20 includes a plurality of passage holes 23 which serve as throttling for increasing the flow speed of the blowby gas.

[0013] There is an impact plate 24 which is disposed on the downstream side of the separation wall 20 adjacent to the separation wall 20. The impact plate 24 extends in the downward direction from the ceiling surface of the housing member 12 in parallel to the separation wall 20 to have a predetermined height position. The impact plate 24 confronts the separation wall 20 with a predetermined (appropriate) clearance. There is an opening portion 26 which is opened in the form of an slit shape between a lower end 24a of the impact plate 24, and the bottom surface of the separator chamber 14. There is provided an oil recovering (collecting) chamber 30 (described later) which is positioned on the downstream side of this opening portion 26.

[0014] In this embodiment, the impact plate 24 and the separation wall 20 constitute an oil mist separation (dividing) section 25 arranged to separate (divide) the oil mist from the blowby gas including the oil mist. This oil mist separation section 25 divides the separator chamber 14 into an inlet chamber 21 which is on the blowby gas inlet 15's side, and an outlet chamber 22 which is on the blowby gas outlet 16's side.

[0015] Next, a structure of the outlet chamber 22 is illustrated with reference to FIG. 3 to FIG. 5. The oil recovering chamber 30 is formed on a lower side of the outlet chamber 22. This oil recovering chamber 30 includes a recessed portion 31 which is formed by partially recessing, in the downward direction, a part of the separator cover 13 constituting the bottom surface of the outlet chamber 22; and a cover (lid) portion 32 which has a substantially rectangular shape, and which is mounted to the separator cover 13 to cover an upper surface opening 31a of the recessed portion 31.

[0016] The recessed portion 31 is recessed in a rectangular box shape which occupies a substantially central portion of the outlet chamber 22 in the longitudinal direction. The recessed portion 31 includes a bottom wall 34 which is substantially parallel to the separator cover bottom surface 13a; a pair of side walls 35a and 35b each of which extends in a vertical direction to be perpendicular to this bottom wall 34, and which extends in parallel to

the side walls 18 (FIG. 2) of the housing member 12; and a pair of end portion walls 36a and 36b which extends in the vertical direction to be perpendicular to the bottom wall 34, and which extend in parallel with the end wall 17 of the housing member 12. As shown in FIG. 2 and FIG. 5, the recessed portion 31 extends over substantially entire width of the outlet chamber 22. Moreover, the recessed portion 31 has a flat shape in which a depth from the upper opening portion 31a to the bottom wall 34 is smaller than a length between the end walls 36a and 36b, and a width between the side walls 35a and 35b. A drain pipe 38 is provided at a substantially central portion of the bottom wall 34.

[0017] As shown in FIG. 3, the cover portion 32 is made from the synthetic resin which is identical to the synthetic resin of the separator cover 13. The cover portion 32 is a member different from the separator cover 13. The cover portion 32 is mounted so that an outer periphery of the cover portion 32 is overlapped with an opening edge of the upper surface opening 31a of the recessed portion 31. With this the cover portion 32 constitutes a part of the bottom wall of the outlet chamber 22. In this embodiment, the cover portion 32 includes retaining portions 32a which protrude from the bottom surface of the cover portion 32. These retaining portions 32a are engaged with the upper surface opening 31a of the recessed portion 31, so that the cover portion 32 is mounted to the separator cover 13. Besides, the present invention is not limited to this. The cover portion 32 may be welded, seized, adhered on the separator cover 13.

[0018] As shown in FIG. 5, the cover portion 32 includes four oil communication holes 40a-40d each of which has a circular shape, and each of which connects the outlet chamber 22 and the recessed portion 31. Moreover, the cover portion 32 includes four ribs 41 which protrude to introduce the separated oil to the oil communication holes 40.

[0019] Sizes and positions of the oil communication holes 40a-40d are set so as to smoothly flow (introduce) the separated oil to the inside of the recessed portion 31. In this embodiment, in the oil communication holes 40a-40d, two oil communication holes 40a and 40b are positioned on the upstream side of the drain pipe 38. Two oil communication holes 40c and 40d are positioned on the downstream side of the drain pipe 38. Moreover, two oil communication holes 40a and 40c are positioned on one side (an upper side of the drawing) of a central line of the longitudinal direction of the separator chamber 14. Two oil communication holes 40b and 40d are positioned on the other side (a lower side of the drawing) of the central line of the longitudinal direction of the separator chamber 14.

[0020] Furthermore, the shapes and the positons of the ribs 41 are set so as to smoothly introduce the oil flowing toward the downward side to the oil communication holes 40. In this embodiment, each of the ribs 41 includes an upstream side portion 41a extending in a liner shape in a obliquely direction; and a downstream side portion 41b which is curbed to partially surround an outer circumference of a downstream side portion of one of the oil communication holes 40.

[0021] As shown in FIG. 3 and FIG. 4, the drain pipe 38 is integrally formed (molded) with the separator cover 13, that is, the bottom wall 34. The drain pipe 38 extends in a cylindrical shape from the bottom wall 34 in the downward direction. A check valve 42 is provided at a lower end of this drain pipe 38. The check valve 42 is arranged to be opened and closed by a pressure difference between the oil mist separator 10 (the outlet chamber 22) and the inside of the engine, and the weight of the stored oil.

[0022] In the thus-constructed oil mist separator 10, the blowby gas flowing within the separator chamber 14 from the blowby gas inlet 15 to the blowby gas outlet 16 becomes a high speed by the throttled (decreased) passage area of the passage holes 23 of the separation wall 20, and then impedes the impact plate 24. With this, the oil mist is separated from the blowby gas. The oil mist is adhered to the impact plate 24. The oil mist is gradually developed into large droplet. The droplet drops from the lower end 24a of the impact plate 24. This flows through the opening portion 26 along the bottom wall of the outlet chamber 22 toward the downstream side. In this case, the oi is guided by the ribs 41 on the cover portion 32, and aggregated to the oil communication holes 40. Then, the oil drops from the oil communication holes 40. The oil is aggregated into the oil recovering chamber 30.

[0023] In this case, at the high load of the internal combustion engine such as the acceleration of the vehicle, the amount of the blowby gas passing through the oil mist separation section 25 becomes much. Accordingly, the pressure loss due to the oil mist separation section 25 becomes large. Consequently, the pressure difference between the inlet chamber 21 and the outlet chamber 22, that is, the pressure difference between the inside of the engine and the outlet chamber 22 becomes large. The check valve 42 is moved in the upward direction by this pressure difference, so that a valve tip end portion 42a closes the oil discharge hole 38a of the drain pipe 38. Accordingly, the oil within the oil recovering chamber 30 is not discharged through the drain pipe 38. The oil is temporarily stored (remained) in the oil recovering chamber 30. On the other hand, the blowby gas from which the oil mist is removed is discharged from the oil mist separator 10 through the blowby gas outlet 16. Then, when the driving condition is varied so that the internal combustion engine becomes the low load such as the idling state, the amount of the blowby gas passing through the oil mist separation section 25 becomes less, the pressure loss due to the oil mist separation section 25 is decreased. Accordingly, the pressure difference between the inlet chamber 21 and the outlet chamber 22, that is, the pressure difference between the inside of the engine and the outlet chamber 22 becomes small. Consequently, the check valve 42 is moved in the downward direction by the weight of the oil so as to open the oil

discharge holes 38a. The oil stored in the oil recovering chamber 30 is discharged through the drain pipe 38 into the inside of the engine. The oil recovering chamber 30 has a relatively large volume. Therefore, even when the high load state of the internal combustion engine continues during a long time period, it is possible to retain (hold) the oil so that the oil is not overflowed to the outlet chamber 22. Moreover, the oil recovering chamber 30 and the outlet chamber 22 are partitioned by the cover portion 32. Accordingly, the oil stored within the oil recovering chamber 30 is not moved into (brought into) the outlet chamber 22 by the blowby gas.

[0024] Next, an oil recovering chamber in an oil mist separator according to a second embodiment of the present invention is illustrated with reference to FIG. 6 to FIG. 8. Besides, portions which are identical to those of the first embodiment shown in FIG. 1 to FIG. 5 have the same symbols.

[0025] In the second embodiment, the oil recovering chamber 130 has a basic structure which is identical to that of the first embodiment. The oil recovering chamber 130 includes the recessed portion 31 which is integrally formed (molded) with the separator cover 13; and the cover portion 32 which is mounted to the recessed portion 31. The cover portion 32 includes the four oil communication holes 40a-40d; and the four ribs 41.

[0026] As shown in FIG. 6, two drain pipes 138a and 138b are integrally formed (molded) with the separator cover 13, that is, the bottom wall 34, on the bottom wall 34 of the recessed portion 31. The drain pipes 138a and 138b have the structure which is identical to that of the drain pipe 38 in the first embodiment. Each of the drain pipes 138a and 138b extends in the cylindrical shape from the bottom wall 34 in the downward direction. The check valve 42 is provided at each of the drain pipes 138a and 138b. The drain pipes 138a and 138b are disposed at front left and rear right two corners, or front right and rear left two corners of the rectangular recessed portion 31 when the internal combustion engine is mounted to the vehicle. Specifically, as shown in FIG. 7, the drain pipe 138a is positioned near a corner defined by the end wall 36a and the side wall 35a which are positioned on the upstream side. The drain pipe 138b is positioned near a corner defined by the end wall 36b and the side wall 35b which are positioned on the downstream side. That is, the drain pipe 138a and the drain pipe 138b are positioned in a diagonal line.

[0027] In this embodiment, even when the vehicle is inclined on the hill (slope), curve and so on, and the internal combustion engine, that is, the oil mist separator 10 is inclined in the forward or rearward direction, or in the leftward or rightward direction, the oil stored in the oil recovering chamber 130 is surely discharged from one of two drain pipes 138a and 138b in accordance with the inclination direction.

[0028] Hereinabove, the embodiments according to the present invention are illustrated. However, the present invention is not limited to the above-described embodiments. Various variations are included in the present invention.

[0029] For example, in the above-described embodiments, the separator cover 13 and the recessed portion 31 are integrally formed (molded) with each other. The cover portion 32 which is different from the separator cover 13 and the recessed portion 31 is mounted to the separator cover 13 and the recessed portion 31. However, the recessed portion 31 may be formed (molded) as a member different from the separator cover 13. The recessed portion 31 may be welded to the bottom portion of the separator cover 13. In this case, the oil communication holes 40a-40d are formed on the wall portion of the outlet chamber which is constituted by the separator cover 13 itself.

[0030] Moreover, in the embodiment, the oil mist separator 10 is provided with the oil mist separator section 25 which is constituted by the separation wall 20 including the communication holes 23, and the impact plate 24. The present invention is not limited to this. There may be provided the oil mist separation section 25 which have the other structure. Moreover, the shapes and the numbers of the oil communication holes 40 and the ribs 41 are merely one example. The shapes and the numbers of the oil communication holes 40 and the ribs 41 are not limited to those of the above-described embodiment.

[0031] Furthermore, the present invention is not limited to the oil mist separator provided within the cylinder head cover. The present invention is applicable to an oil mist separator which is disposed at other portion of the internal combustion engine.

[0032] The oil mist separator according to the present invention includes: an inlet chamber including a blowby gas inlet; an outlet chamber including a blowby gas outlet, and a bottom wall; an oil mist separation section disposed between the inlet chamber and the outlet chamber; an oil recovering chamber which includes an oil recovering chamber bottom wall located below the bottom wall of the outlet chamber, and which is defined between the bottom wall of the outlet chamber, and the oil recovering chamber bottom wall; an oil communication hole which is opened in the bottom wall of the outlet chamber, and which connects the oil recovering chamber and the outlet chamber; a drain pipe which protrudes in a downward direction from a bottom surface of the oil recovering chamber; and a check valve which is provided at a tip end opening of the drain pipe.

[0033] In this structure, the oil separated by the oil mist separation section drops to the bottom wall of the outlet chamber, and flows along this bottom wall to the downstream side. Then, this oil drops from the oil communication hole, and this oil is collected within the oil recovering chamber. In the driving state in which the blowby gas generation amount is large and the pressure difference between the outlet chamber and the inside of the engine is large, the check valve is closed. The oil is temporarily stored in the oil recovering chamber. Then, in the driving state in which the blowby gas generation

amount is small and the pressure difference between the outlet chamber and the inside of the engine is small, the oil is discharged from the drain pipe in the downward direction.

[0034] In the oil mist separator according to the present invention, the oil recovering chamber has a rectangular box shape; the oil mist separator includes two drain pipes provided to the bottom wall of the oil recovering chamber; and the two drain pipes are provided at corner portions of the oil recovering chamber, in a diagonal line of the oil recovering chamber.

[0035] In this structure, even when the vehicle and the oil mist separator is inclined in the forward and rearward directions and in the leftward and rightward directions, the oil stored in the oil recovering chamber is discharged from one of the drain pipes.

[0036] In the oil mist separator according to the present invention, the bottom wall of the outlet chamber includes a rib which protrudes from the bottom wall of the outlet chamber, and which is arranged to introduce the oil into the oil communication hole.

[0037] In this structure, the oil flowing along the bottom surface of the outlet chamber to the downstream side is smoothly guided to the oil communication hole.

[0038] In the oil mist separator according to the embodiments of the present invention, it is possible to temporarily store the separated oil within the oil recovering chamber. Accordingly, in the state in which the pressure difference generated due to the oil mist separation section is large, it is possible to prevent the backflow of the separated oil into the oil mist separation chamber.

[0039] The entire contents of Japanese Patent Application No. 2014-255667 filed December 18, 2014 are incorporated herein by reference.

[0040] Although the invention has been described above by reference to certain embodiments of the invention, the invention is not limited to the embodiments described above. Modifications and variations of the embodiments described above will occur to those skilled in the art in light of the above teachings. The scope of the invention is defined with reference to the following claims.

Claims

1. An oil mist separator comprising:

an inlet chamber including a blowby gas inlet;
an outlet chamber including a blowby gas outlet, and a bottom wall;
an oil mist separation section disposed between the inlet chamber and the outlet chamber;
an oil recovering chamber which includes an oil recovering chamber bottom wall located below the bottom wall of the outlet chamber, and which is defined between the bottom wall of the outlet chamber, and the oil recovering chamber bottom wall;
an oil communication hole which is opened in the bottom wall of the outlet chamber, and which connects the oil recovering chamber and the outlet chamber;
a drain pipe which protrudes in a downward direction from a bottom surface of the oil recovering chamber; and
a check valve which is provided at a tip end opening of the drain pipe.

2. The oil mist separator as claimed in Claim 1, wherein the oil recovering chamber has a rectangular box shape; the oil mist separator includes two drain pipes provided to the bottom wall of the oil recovering chamber; and the two drain pipes are provided at corner portions of the oil recovering chamber, in a diagonal line of the oil recovering chamber.

3. The oil mist separator as claimed in Claim 1 or 2, wherein the bottom wall of the outlet chamber includes a rib which protrudes from the bottom wall of the outlet chamber, and which is arranged to introduce the oil into the oil communication hole.

4. The oil mist separator as claimed in Claim 1, wherein the drain pipe is connected to an inside of an engine; and the check valve is arranged to be opened and closed in accordance with a pressure difference which is generated between the outlet chamber and the inside of the engine due to the oil separation section.

FIG.1

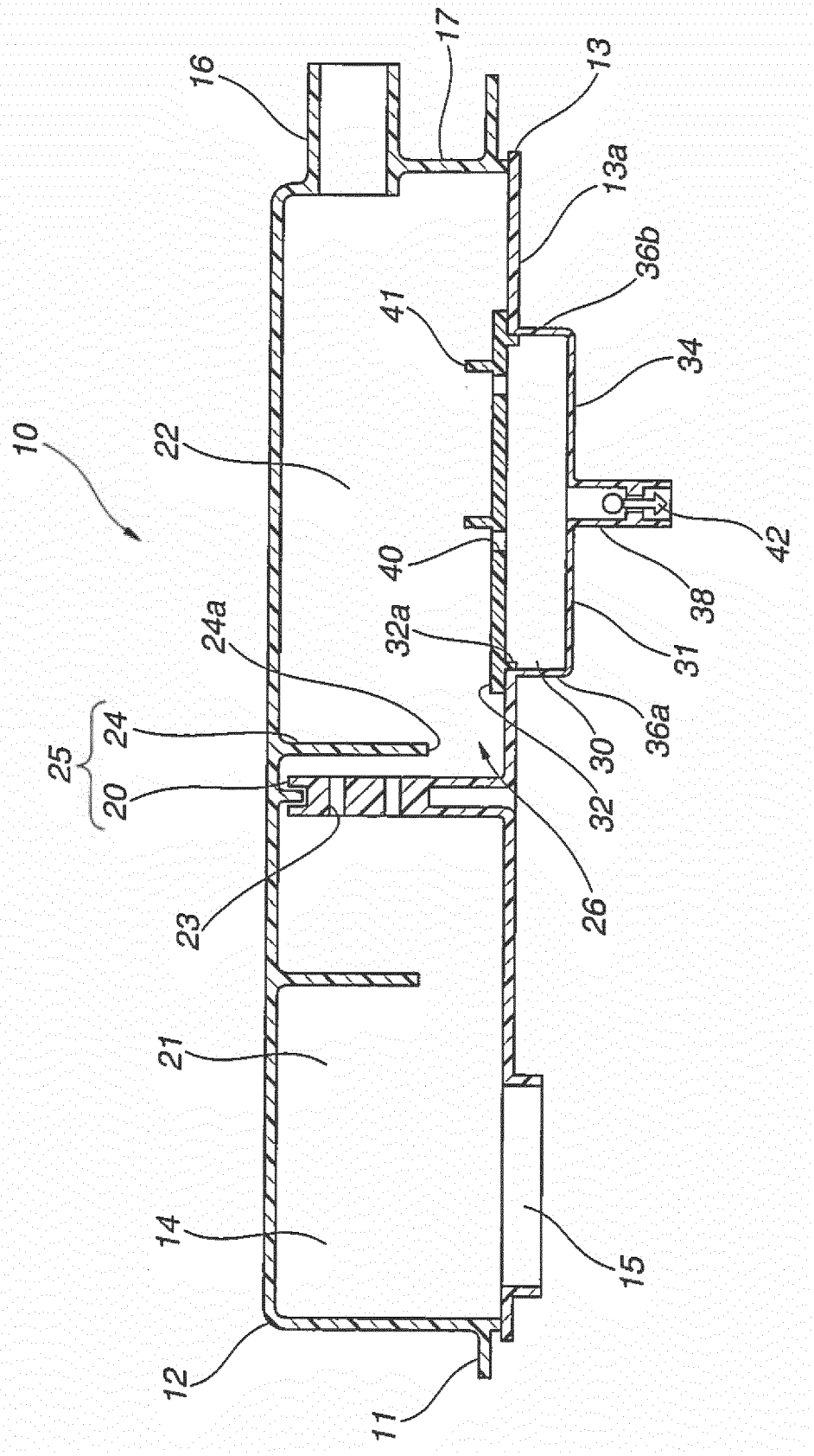

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FIG.2

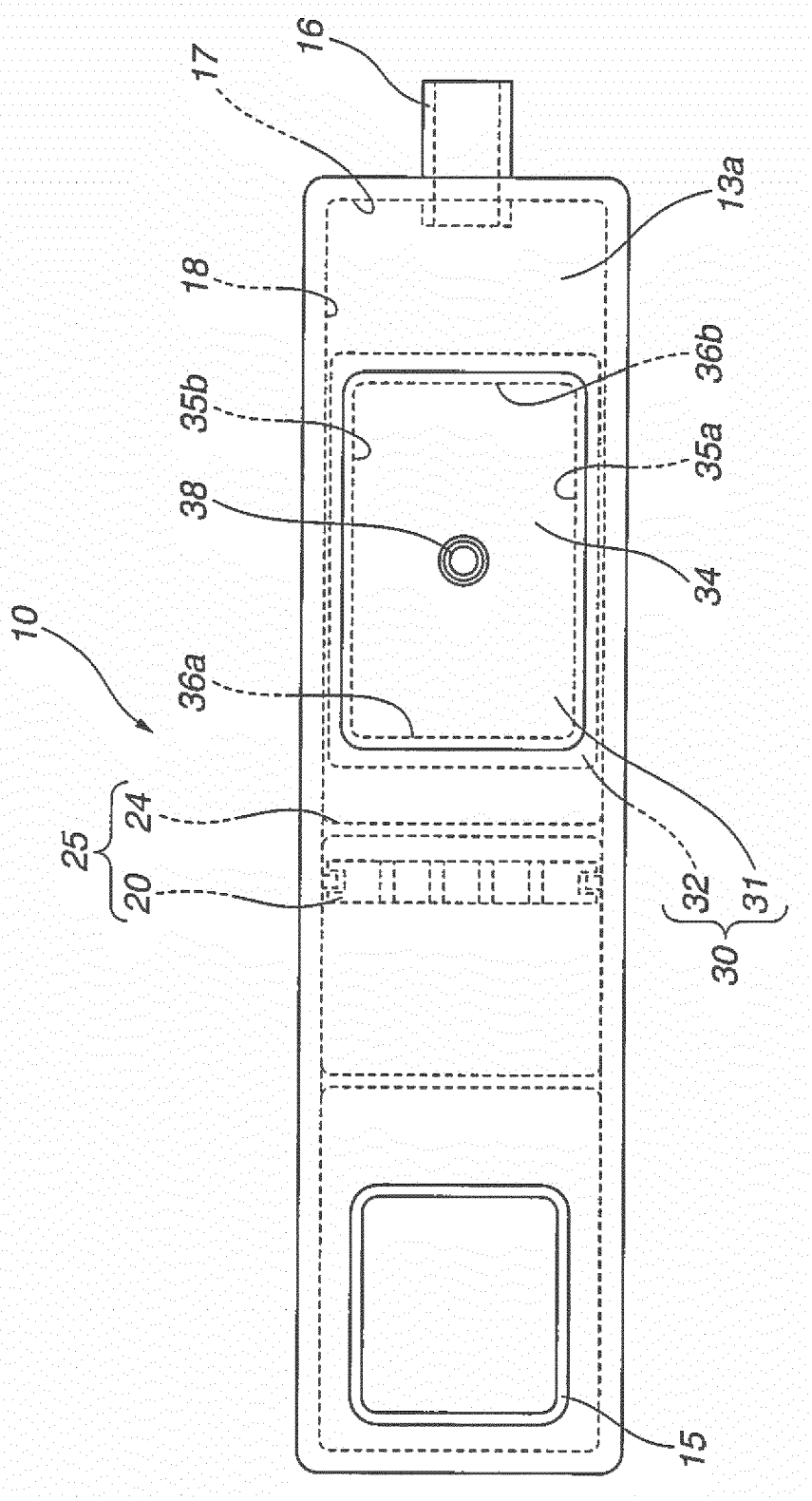

FIG.3

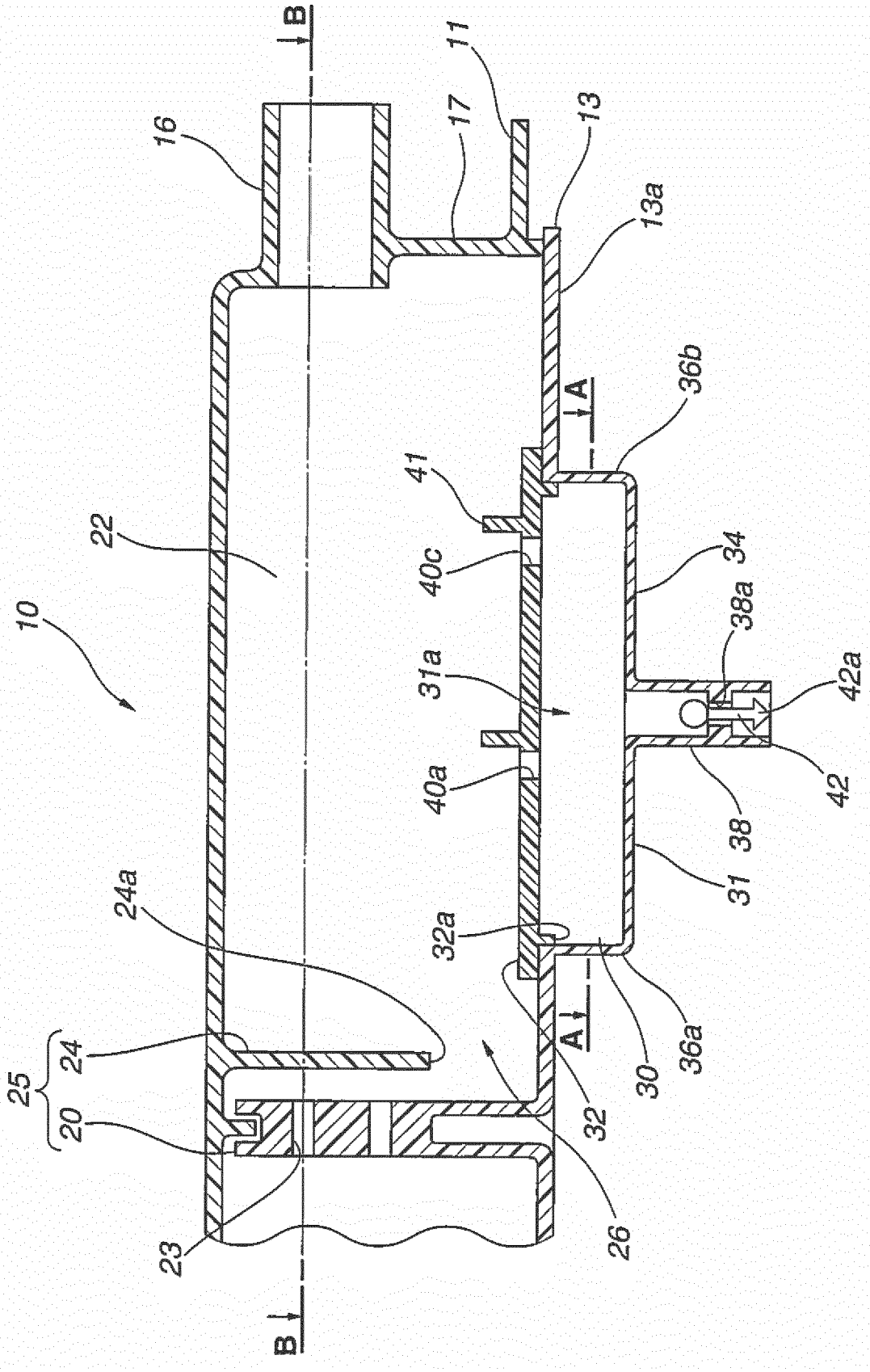
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FIG.4

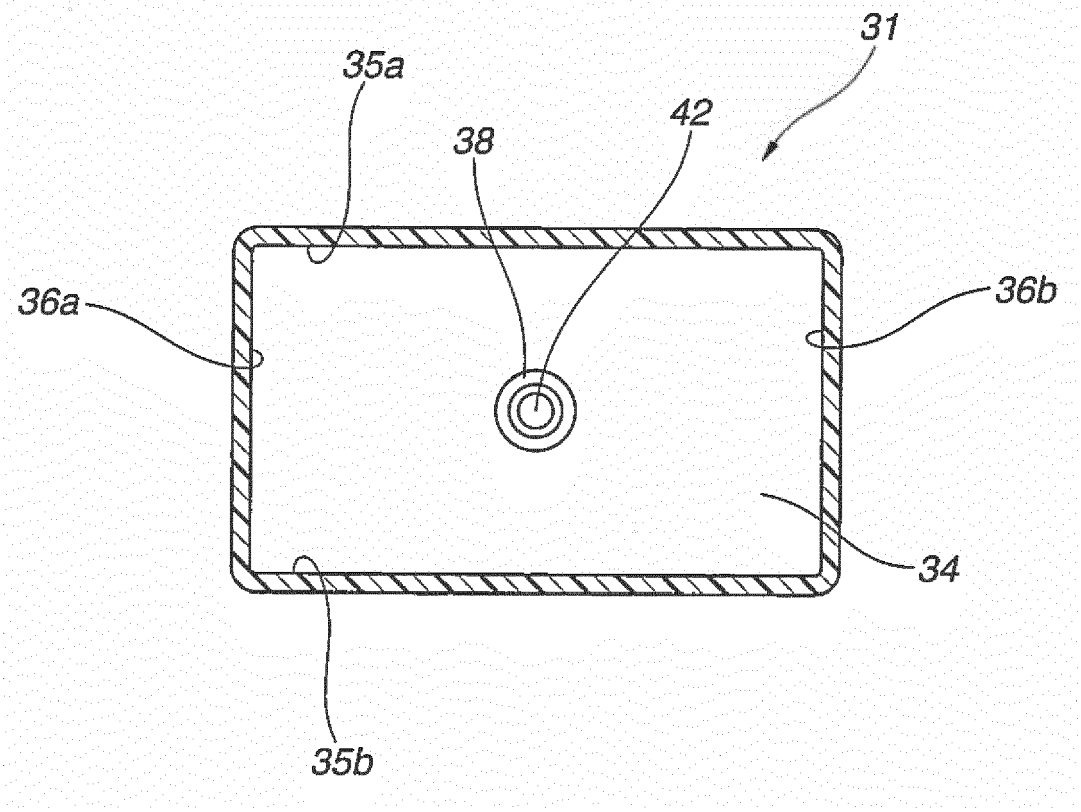

FIG.5

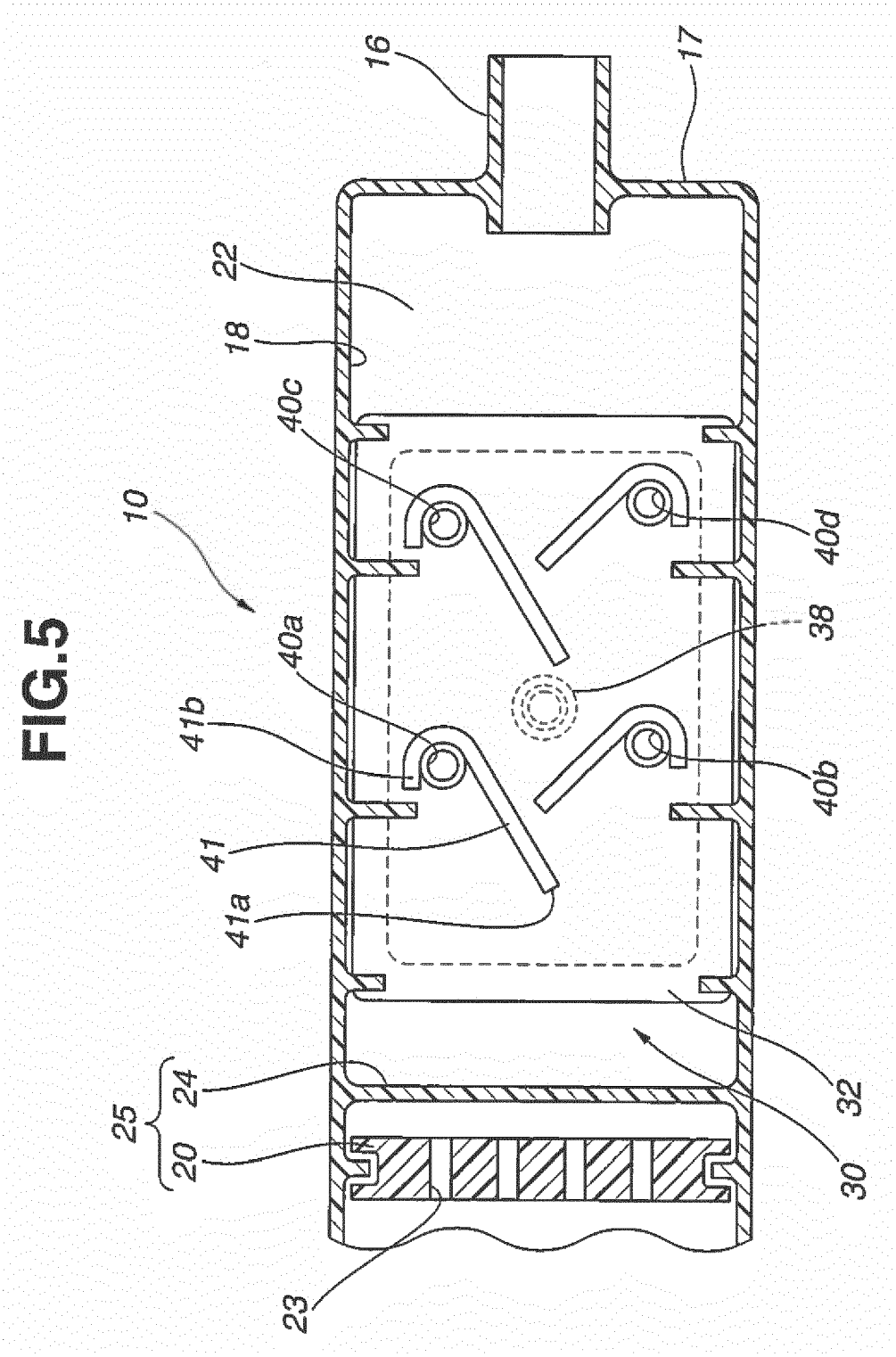

FIG.6

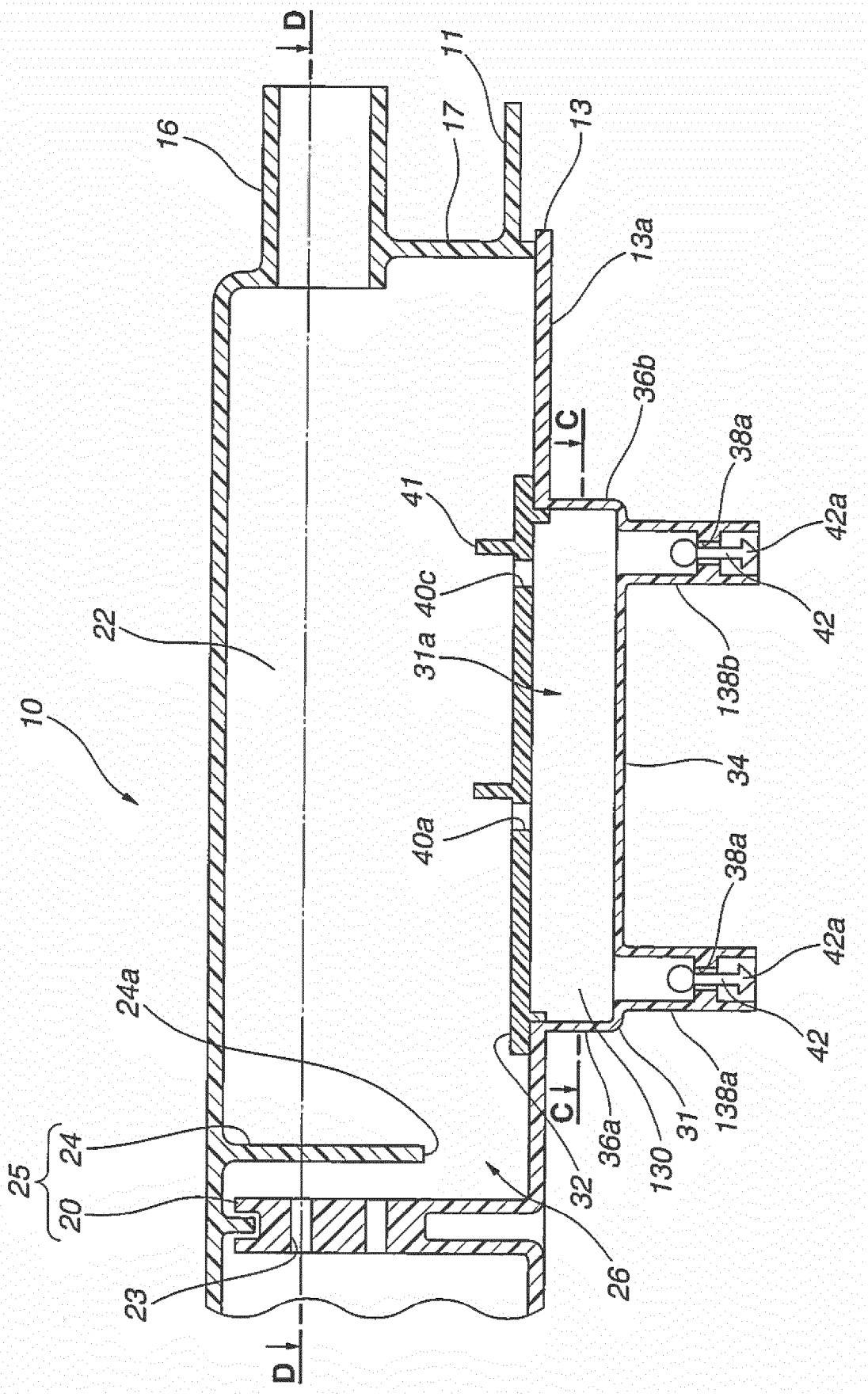
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FIG.7

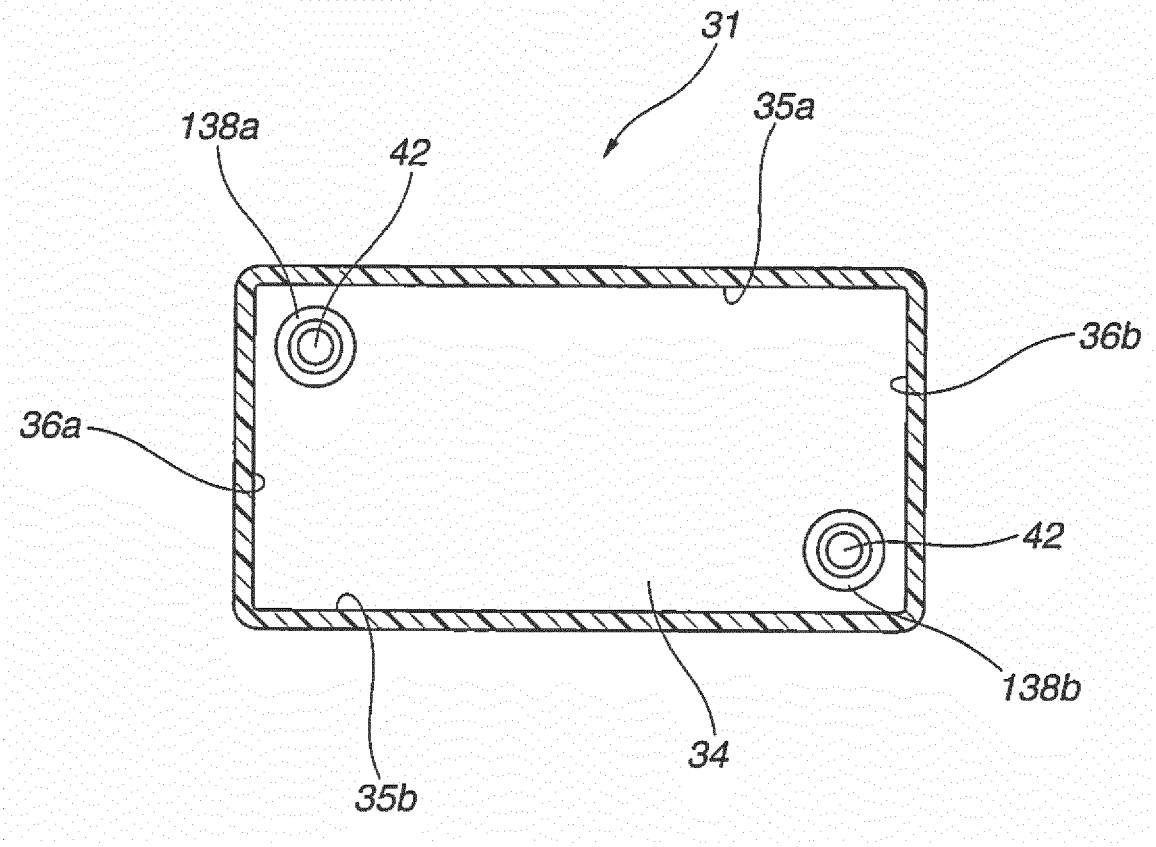
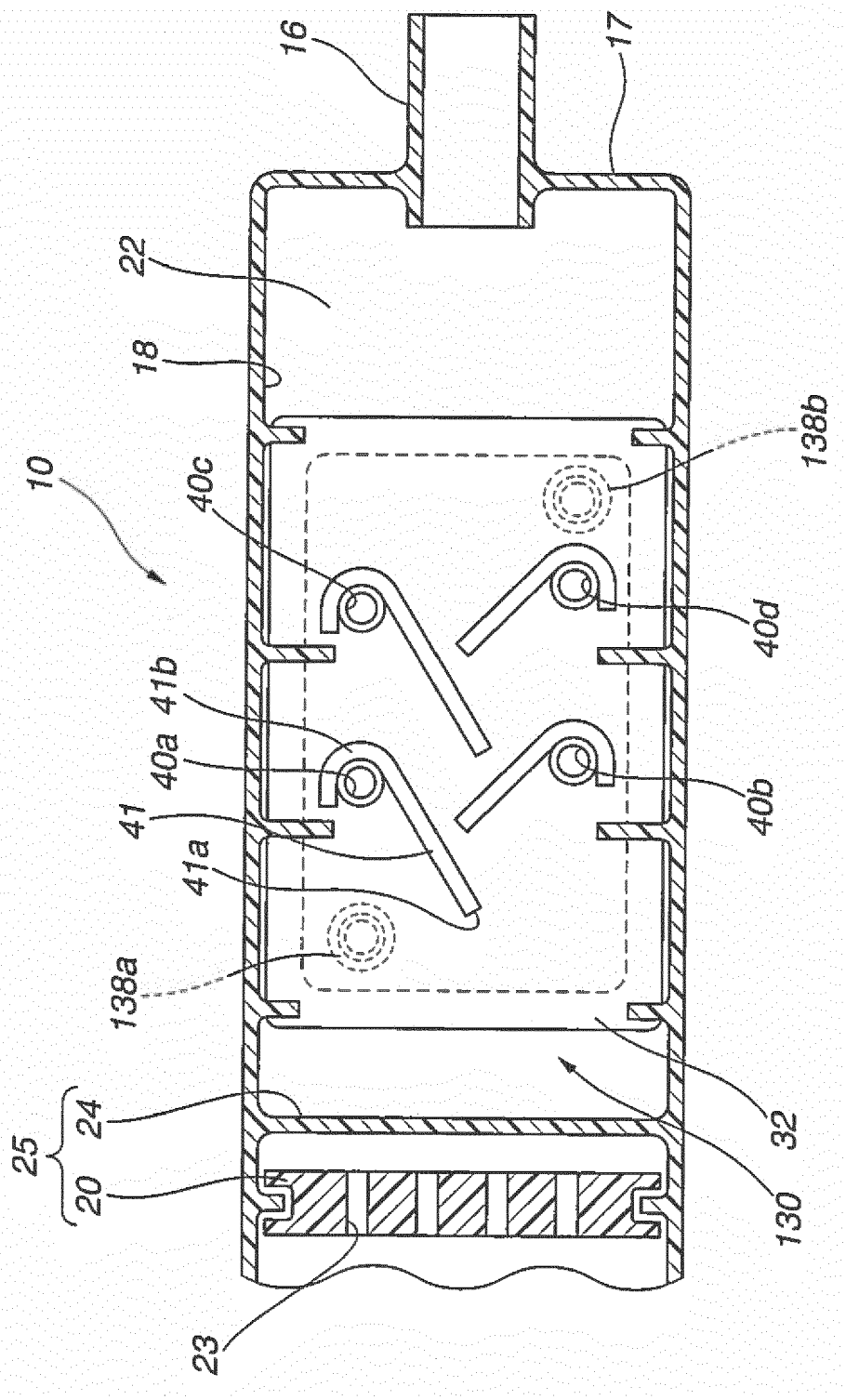


FIG.8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Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 20 0302

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 796 678 A1 (MAHLE FILTER SYSTEMS JP CORP [JP]) 29 October 2014 (2014-10-29) * abstract * * column 5, paragraph 25 - column 7, paragraph 31; figures 1,2 *	1,4	INV. F01M13/04
Y	EP 2 594 757 A1 (MAHLE FILTER SYSTEMS JP CORP [JP]) 22 May 2013 (2013-05-22) * abstract * * column 6, paragraph 21 - column 8, paragraph 28; figure 2 *	1,4	
Y	JP 2007 009746 A (TOYOTA MOTOR CORP) 18 January 2007 (2007-01-18) * abstract; figures 1,2 *	1,4	
A	EP 2 532 850 A1 (MAHLE FILTER SYSTEMS JP CORP [JP]) 12 December 2012 (2012-12-12) * abstract * * column 4, paragraph 14 - column 5, paragraph 15; figure 2 *	1,3,4	
A	EP 2 460 984 A1 (ELRINGKLINGER AG [DE]) 6 June 2012 (2012-06-06) * the whole document *	1,3,4	TECHNICAL FIELDS SEARCHED (IPC) F01M
A	EP 2 390 477 A1 (ELASIS S C P A [IT]) 30 November 2011 (2011-11-30) * the whole document *	1,2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 May 2016	Van Zoest, Peter

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 20 0302

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-05-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2796678 A1	29-10-2014	CN 104024588 A	03-09-2014
		EP 2796678 A1	29-10-2014
		JP WO2013094452 A1	27-04-2015
		US 2014345580 A1	27-11-2014
		WO 2013094452 A1	27-06-2013
EP 2594757 A1	22-05-2013	CN 103133083 A	05-06-2013
		EP 2594757 A1	22-05-2013
		JP 5890153 B2	22-03-2016
		JP 2013108424 A	06-06-2013
		US 2013125865 A1	23-05-2013
JP 2007009746 A	18-01-2007	NONE	
EP 2532850 A1	12-12-2012	CN 102817671 A	12-12-2012
		EP 2532850 A1	12-12-2012
		JP 5847445 B2	20-01-2016
		JP 2012255372 A	27-12-2012
		US 2012312272 A1	13-12-2012
EP 2460984 A1	06-06-2012	CN 102536383 A	04-07-2012
		DE 102010062321 A1	06-06-2012
		EP 2460984 A1	06-06-2012
		US 2012138171 A1	07-06-2012
EP 2390477 A1	30-11-2011	EP 2390477 A1	30-11-2011
		US 2011290225 A1	01-12-2011

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 8158853 A **[0002]**
- JP 2009 A **[0002]**
- JP 121281 A **[0002]**
- JP 2014255667 A **[0039]**