



(51) International Patent Classification:
B01D 35/30 (2006.01)

(21) International Application Number:
PCT/EP2017/053924

(22) International Filing Date:
21 February 2017 (21.02.2017)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **MAHLE INTERNATIONAL GMBH**
[DE/DE]; Pragstraße 26-46, 70376 Stuttgart (DE).

(72) Inventors: **DOMINGUES, Tadeu Geraldo**; Rua Barao de Jundiai, n° 162, ap. 60, 13201-030 Jundiai, Sao Paulo (BR). **FERRARI, Felipe**; R. Médico Edmundo de Lima Pontes, 271, 13344-450 Indaiatuba Sao Paulo SP (BR). **FRITZ, Luiz Carlos**; Rua Nicaragua, 421, Torres da liberdade, 13339-250 Indaiatuba, Sao Paulo (BR). **YOSHINO, Fernando**; Av. Professor Pedro Clarismundo Fornari, 1601, casa 327, 13214-660 Jundiai/SP, Sao Paulo (BR).

(74) Agent: **BRP RENAUD UND PARTNER MBB**
Königstraße 28, 70173 Stuttgart (DE).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,

CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: **FUEL FILTER DEVICE FOR AN INTERNAL COMBUSTION ENGINE**

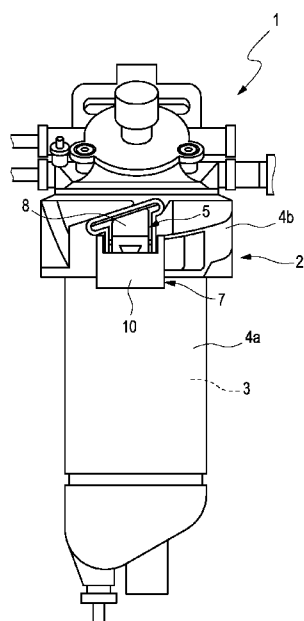


Fig. 1

(57) Abstract: The invention relates to a fuel filter device (1) for an internal combustion engine, comprising a filter housing (2) which delimits a housing interior (3) and for this comprises a first and a second housing part (4a, 4b), which are detachably fastened to one another by means of a fixing device (5), comprising an annular filter element (6) disposed exchangeably in the housing interior (3), which divides the housing interior (3) into a raw side and a clean side, wherein the fixing device (5) is adjustable between a locking position in which the two housing parts (4a, 4b) are fixed mechanically to one another and an unlocking position in which the two housing parts can be released from one another, comprising a securing device (7) for securing the fixing device (5) against an adjustment from the locking position into the unlocking position.



Fuel filter device for an internal combustion engine

The present invention relates to a fuel filter device for an internal combustion engine and an internal combustion engine with such a fuel filter device.

Modern fuel filter devices typically have an annular filter element, which is disposed exchangeably in a housing interior delimited by the filter housing. Such a filter housing is usually formed in two parts with two housing parts, which are detachably fastened to one another. In order to exchange the annular filter element, the fastening of the two housing parts is released from one another so that the annular filter element can be removed from the housing interior and a replacement part can be inserted into the housing interior. Suitable fixing systems are used for fastening the two housing parts to one another, which are also intended to prevent an undesired release of the two housing parts from one another in the case of strong vibrations acting on the filter housing, in particular during operation of the fuel filter device in a motor vehicle.

A fuel filter device with such a fixing system is known from EP 2 435 159 B1.

However, experience from practice has shown that such a simple fixing system has so far not proved adequate to absolutely reliably prevent an undesired release of the two housing parts from one another. In addition to said operation-induced vibrations, operating errors of the worker on the fixing system can also be the cause for an undesired release of the two housing parts.

It is therefore the object of the present invention to provide an improved embodiment for a fuel filter device, in which the aforesaid disadvantages no longer occur or at best in a severely restricted form.

This problem is solved according to the invention by the subject matters of the independent claims. Advantageous embodiments are the subject matter of the dependent claims.

The basic idea of the invention is accordingly to provide a double fixing of the two housing parts, i.e. to configure the fixing system as redundant. In addition to a first fixing system - hereinafter designated as "fixing device", in the fuel filter device according to the invention there is an additional fixing system - hereinafter designated as "securing device" - which ensures that in the event of failure of the first fixing system the two housing parts cannot be unintentionally released from one another.

A fuel filter device according to the invention for an internal combustion engine comprises according to a first aspect of the invention a filter housing which delimits a housing interior and for this comprises a first and a second housing part, which are detachably fastened to one another by means of a fixing device. An annular filter element is disposed exchangeably in the housing interior, which divides the housing interior into a raw side and a clean side. The fixing device is adjustable between a locking position in which the two housing parts are fixed mechanically to one another and an unlocking position in which the two housing parts can be released from one another. According to the invention, the fuel filter device comprises a securing device for securing the fixing device against an adjustment from the locking position into the unlocking position.

According to a preferred embodiment, the fixing device comprises a fixing element which can be actuated by a worker, which can be rotated about a predetermined axis of rotation between the locking position and the unlocking position. Such a rotational movement of the fixing element allows a simple

adjustment of the fixing device between the locking position and the unlocking position.

In an advantageous further development, the actuatable fixing element is pre-tensioned by means of a pre-tensioning device towards the locking position. Thus, without actuation by the worker the fixing element is located as standard in the locking position in which a release of the two housing parts from one another is not possible. Preferably the pre-tensioning device comprises a spring-elastic element, which can particularly preferably be configured as at most a leg spring. The implementation as a spring-elastic element or leg spring is particularly cost-effective.

In another advantageous further development, the securing device comprises a securing element which is pivotable between a securing position and a release position. In this further development, the securing element in the securing position blocks any adjustment of the fixing element from the locking position into the unlocking position. In the release position this blocking is cancelled again, i.e. the adjustment of the fixing element is released. Such a pivoting movement of the securing element allows a simple adjustment of the fixing device between the locking position and the unlocking position.

Expediently in a cross-section perpendicular to a pivot axis the securing element has a first element section which goes over at an angle, preferably at a right angle, to a second element section. In this variant the pivot axis is disposed on an end of the first element section facing away from the second element section. A securing element configured in such a manner allows convenient actuation by the worker.

In an advantageous further development, in the securing position the first element section of the securing element covers an upper side of the fixing element facing away from the housing parts so that it blocks an actuation of the fixing element by the worker and an associated rotary movement of the fixing element. In this further development, an unintentional actuation of the fixing element by the fixing element covering the securing element is therefore prevented.

According to another preferred embodiment, a receptacle is formed on an end of the second end section facing away from the first element section. In the securing position, this receptacle is facing the first and/or second housing part so that a projection projecting outwards from the first or second housing part away from the housing interior engages in the receptacle. This embodiment allows a mechanically stable holding of the securing element on the first or second housing part.

According to another preferred embodiment, the securing device comprises a securing element which is adjustable between a securing position and a release position along an adjustment direction in a translational manner. In this embodiment the securing element in the securing position blocks an adjustment of the fixing element from the locking position into the unlocking position. In the release position this blocking is cancelled.

Expediently the securing element in the securing position is disposed radially between the fixing element and at least one of the two housing parts and in this way prevents any undesired rotational movement of the fixing element into the unlocking position.

In an advantageous further development, the securing device comprises a securing element pre-tensioning device which preferably comprises a spring-

elastic element. In this further development, the securing element pre-tensioning device pre-tensions the securing element towards the securing position. Thus, without any actuation by the worker the securing element is located as standard in the securing position in which it is not possible to release the two housing parts from one another.

In another advantageous further development, at least one projection projects outwards from the first or second housing part away from the housing interior, which projection passes through a gap formed in the securing element and extending along the adjusting direction. In this further development, the at least one projection and the assigned gap are matched to one another in such a manner that during adjustment of the securing element between the securing position and the release position the projection moves in the respective gap along the adjusting direction. The at least one projection enables in cooperation with the assigned gap an advantageous guidance of the securing element along the adjusted direction.

In a particularly preferred variant, two projections and two gaps are provided, which are each disposed at a distance from one another transversely to the adjusting direction. By using two projections and two gaps assigned to these two projections, an undesired canting of the securing element during movement along the adjusted direction is particularly reliably avoided.

According to another preferred embodiment, the securing element is adjustable in a guide projecting from the first or second housing part along the adjusting direction. This measure also improves the reliable movement of the securing element along the adjusting direction without canting etc.

In an advantageous further development of the invention, the guide comprises two webs projecting outwardly from the first or second housing part away from the housing interior, which webs both extend along the adjusting direction and are arranged transversely to the adjusting direction at a distance from one another to form an intermediate space in which the securing element is received. The two webs, the intermediate space between the two webs and the securing element are dimensioned in this further development in such a manner that a movement of the securing element transversely to the adjusting direction is prevented. In this way, a convenient adjustment of the securing element along the adjusting direction is ensured by the worker.

A fuel filter device for an internal combustion engine according to a second aspect of the invention comprises a filter housing which delimits a housing interior and for this comprises a first and a second housing part which are detachably fastened to one another by means of a fixing device. The fuel filter device comprises an annular filter element disposed exchangeably in the housing interior, which divides the housing interior into a raw side and a clean side. The fixing device is adjustable between a locking position in which the fixing device mechanically fixes the two housing parts to one another and an unlocking position in which this mechanical fixing is cancelled. Furthermore, the fuel filter device comprises a securing device for additional securing of the two housing parts against unintentional release of the fastening. The securing device comprises a securing element which is adjustable in a translational manner along an adjusting direction between a securing position in which the securing element mechanically fixes the two housing parts on one another and a release position in which this mechanical fixing is cancelled. It is only possible to release the two housing parts from one another when the securing element of the securing device is located in the release position and the fixing device is in the release position.

In an advantageous further development, the securing element is configured as a bolt which in the securing position is received in a receptacle provided on the first or second housing part, configured complementary to the bolt. The configuration of the securing element as a bolt is constructively particularly easy to achieve and therefore cost-effective.

In an advantageous further development, the securing device comprises a securing element pre-tensioning device which pre-tensions the securing element towards the securing position. Particularly preferably the securing element pre-tensioning device comprises a spring-elastic element. Thus, without any actuation by the worker the securing element is located as standard in the securing position in which it is not possible to release the two housing parts from one another.

In an advantageous further development, at least one projection projects outwards from the first or second housing part away from the housing interior. This projection passes through a gap formed in the securing element and extending along the adjusting direction. The projection and the gap are matched to one another in such a manner that during adjustment of the securing element between the securing position and the release position the projection moves along the adjusting direction in the respective gap. In this way, a convenient adjustment of the securing element along the adjusting direction is ensured by the worker.

According to another preferred embodiment, the securing element is received adjustably in a guide projecting along the adjusting direction from the first or second housing part. This measure also improves the reliable movement of the securing element along the adjusting direction without canting etc.

In an advantageous further development, the guide comprises two webs projecting outwardly from the first or second housing part away from the housing interior, which webs both extend along the adjusting direction and are arranged transversely to the adjusting direction at a distance from one another to form an intermediate space in which the securing element is received. The two webs, the intermediate space between the two webs and the securing element are dimensioned in such a manner in this further development that a movement of the securing element transversely to the adjusting direction is prevented.

According to another preferred embodiment, the securing device comprises a pin formed on a first housing part which engages in a receptacle formed on the second housing part to form a latching connection.

In an advantageous further development the receptacle comprises an undercut. In this way, the latching effect achieved by the latching connection can be improved.

Further important features and advantages of the invention are obtained from the subclaims, from the drawings and from the relevant description of the figures by reference to the drawings.

It is understood that the aforesaid features and those to be explained hereinafter can be used not only in the respectively given combination but also in other combinations or alone without departing from the framework of the present invention.

Preferred exemplary embodiments of the invention are presented in the drawings and will be explained in detail in the following description.

In the figures, in each case schematically:

Figs. 1-4 show an example of a fuel filter device according to the invention according to the first aspect of the invention,

Figs. 5-10 show a variant of the example of Figure 1,

Figs. 11-15 show an example of a fuel filter device according to the invention according to the second aspect of the invention,

Fig. 16 shows a variant of the example of Figure 1.

Figure 1 shows an example of a fuel filter device 1 according to the invention according to the first aspect in a perspective view. The fuel filter device 1 comprises a filter housing 2 which delimits a housing interior 3 and for this comprises a first and a second housing part 4a, 4b. The two housing parts 4a, 4b are detachably fastened to one another by means of a fixing device 5. An annular filter element (not shown) is disposed in the housing interior 3, which divides the housing interior 3 into a raw side and a clean side. The fixing device 5 is adjustable between a locking position in which the two housing parts 4a, 4b are fixed mechanically to one another and an unlocking position in which this mechanical fixing is cancelled so that the two housing parts 4a, 4b can be released from one another. For exchanging the annular filter element, the fixing device 5 is adjusted into the unlocking position so that the two housing parts 4a, 4b can be released from one another and the annular filter element can be removed from the housing interior 3. After arranging a replacement annular filter element (not shown) in the housing interior, the two housing parts 4a, 4b can be connected to one another again. As a result of the subsequent adjustment of the fixing device 5 into the locking position, the two housing parts 4a, 4b are fixed to

one another again. In order to prevent the fixing device 5 being unintentionally adjusted into the unlocking position so that the two housing parts 4a, 4b can be unintentionally released from one another, the fuel filter device 1 is fitted with a securing device 7. This secures the fixing device 5 against such an unintentional adjustment from the locking position into the unlocking position. The fixing device 5 comprises a fixing element 8 which can be actuated by a worker, which can be rotated about a predetermined axis of rotation D between the locking position and the unlocking position. The detailed views in Figures 2 and 3 show the fixing element 8 in the locking position, Figure 4 shows this in the release position. The fixing element 8 which can be actuated by the worker is pre-tensioned towards the locking position by means of a pre-tensioning device 9. The pre-tensioning device 9 can be implemented as a spring-elastic element, possibly in the form of a leg spring. Similarly the securing device 7 comprises a securing element 10 which is pivotable about a pivot axis S between a securing position and a release position. In the example scenario, the positions of the axis of rotation D of the fixing element 8 and the pivot axis S of the securing element 10 are identical. In the securing position the securing element 10 blocks any adjustment of the fixing element 8 from the locking position into the unlocking position. In the release position the securing element 10 releases an adjustment of the fixing element 8 from the locking position into the unlocking position.

The detailed view in Figure 3 shows the filter housing 2 in the area of the securing element 10 in a cross-section perpendicular to the pivot axis S of the securing element 10. As can be seen in Figure 3, the securing element 10 has a first element section 11a which goes over at an angle, in the example of Figures 1 to 4 even at a right angle, to a second element section 11b. The pivot axis S is disposed on an end 12 of the first element section 11a facing away from the second element section 11b.

According to Figures 2 and 3, in the securing position the first element section 11a of the securing element 10 covers an upper side 13 of the fixing element 8 facing away from the two housing parts 4a, 4b. In this way, an unintentional adjustment of the fixing element 8 into the unlocking position and an associated rotary movement of the fixing element 8 about the axis of rotation D can be blocked. In particular, an undesired or unintentional actuation of the fixing element 8 by a worker can be prevented. For stable fixing of the securing element 10 in the securing position, as shown in Figures 3 and 4, a receptacle 4 can be formed on an end 14 of the second end section 11b facing away from the first element section 11a. In the securing position of the securing element 10, the receptacle 15 is facing the first and/or second housing part so that a projection 16 projecting outwards from the first or second housing part 4a away from the housing interior 3 engages in the receptacle 15.

It can be deduced from the view of Figure 3 that the fixing element 8 in the securing position of the securing element 10 is located outside on the filter housing 2 between the securing element 10 and at least one of the two housing parts 4a, 4b. In this way, the securing element 10 prevents any rotational movement and associated with this, an adjustment of the fixing element 8.

Figures 5 to 10 show a variant of the example of Figures 1 to 4. In this variant, the securing element 10 of the securing device 7 is adjustable between a securing position and a release position along an adjustment direction V in a translational manner. Similarly to the example in Figures 1 to 4, the securing element 10 in the securing position blocks an adjustment of the fixing element 8 from the locking position into the unlocking position and releases this adjustment of the fixing element 10 in the release position. According to the detailed view in Figure 6, the securing device 7 can be fitted with a securing element pre-tensioning device 23 which comprises a spring-elastic element. The securing

element pre-tensioning device 23 or the spring-elastic element pre-tensions the securing element 10 towards the securing position. For this purpose, the securing element pre-tensioning device 23 or the spring-elastic element can be supported at one end on the securing element 10 and at the other end on the first or second housing part 4a, 4b.

As can be seen from the detailed view in Figure 7, the securing element 10 is received adjustably in a guide 20 projecting along the adjustment direction V from the first housing part 4a. This guide 20 comprises two webs 22a, 22b projecting outwardly from the first or second housing part 4a, 4b away from the housing interior 3. The two webs 22a, 22b each extend along the adjusting direction V. The two webs 22a, 22b are arranged transversely to the adjusting direction V at a distance from one another to form an intermediate space 21. The securing element 10 arranged adjustably along the adjustment direction V in the intermediate space 21. The two webs 22a, 22b prevent any movement of the securing element 10 transversely to the adjusting direction.

Figures 7 to 9 show the securing element 10 in the securing position, Figure 10 shows it in the release position. As Figures 7 to 10 clearly confirm, a first projection 17a and a second projection 17b project outwards from the housing part 4a away from the housing interior 3. The two projections 17a, 17b can be arranged in the intermediate space 21 delimited by the two webs 22a, 22b. Accordingly, two gaps 18a, 18b - hereinafter designated as first gap 18a and second gap 18b - extending along the adjustment direction V and arranged at a distance from one another transversely to the adjustment direction V are formed in the securing element 10. In the example scenario, the two gaps 18a, 18b are formed as oblong holes 19a, 19b extending along the adjustment direction V. The first projection 17a passes through the first gap 18a and the projection 17b passes through the second gap 18b. The two projections 17a, 17b and the two

gaps 18a, 18b are matched to one another in such a manner that during the adjustment of the securing element 10 between the securing position and the release position, the two projections 17a, 17b move into the two gaps 18a, 18b or into the two oblong holes 19a, 18b along the adjustment direction V. In a simplified variant of the example, only one projection 17a and accordingly only one gap 18a can be provided. Variants with three or more projections or gaps are also feasible.

Figures 11 to 15 show an example of a fuel filter device 1' according to the second aspect of the invention in a perspective view. The fuel filter device 1' comprises a filter housing 2' which delimits a housing interior 3 and for this comprises a first and a second housing part 4a', 4b'. The two housing parts 4a', 4b' are detachably fastened to one another by means of a fixing device 5'. An annular filter element is disposed in the housing interior 3', which divides the housing interior 3' into a raw side and a clean side. The fixing device 5' is adjustable between a locking position in which the two housing parts 4a', 4b' are fixed mechanically to one another and an unlocking position in which this mechanical fixing is cancelled so that the two housing parts 4a', 4b' can be released from one another. For exchanging the annular filter element, the fixing device 5' is adjusted into the unlocking position so that the two housing parts 4a', 4b' can be released from one another and the annular filter element can be removed from the housing interior 3'. After arranging a replacement annular filter element in the housing interior, the two housing parts 4a', 4b' can be connected to one another again. As a result of an adjustment of the fixing device 5' into the locking position, the two housing parts 4a', 4b' are fixed to one another again. In order to prevent the fixing device 5' being unintentionally adjusted into the unlocking position so that the two housing parts 4a', 4b' can be unintentionally released from one another, the fuel filter device 1' is fitted with a securing device

7' for additional securing of the two housing parts 4a, 4b against an undesired release of the fastening.

The fixing device 5' comprises a fixing element 8' which can be actuated by a worker, which can be rotated about a predetermined axis of rotation D' between the locking position and the unlocking position. The detailed views in Figures 12 to 14 show the fixing element 8' in the locking position, Figure 15 shows this in the release position. The fixing element 8' which can be actuated by the worker is pre-tensioned towards the locking position by means of a pre-tensioning device 9'. The pre-tensioning device 9' can be implemented as a spring-elastic element, possibly in the form of a leg spring. Similarly the securing device 7' comprises a securing element 10' which is adjustable along an adjustment direction V' in a translational manner between a securing position and a release position. In the securing position the securing element 10' fixes the two housing parts 4a', 4b' mechanically to one another. In the release position this mechanical fixing is cancelled.

According to the detailed view in Figure 14, the securing element 10' is configured as a bolt 25' which in the securing position is received in a receptacle provided on the first or second housing part 4a', 4b' which is configured complementary to the lock 25'.

The securing device 10' can be fitted with a securing element pre-tensioning device 23' which comprises a spring-elastic element. The securing element pre-tensioning device 23' or the spring-elastic element pre-tensions the securing element 10' or the bolt 25' towards the securing position. For this purpose, the securing element pre-tensioning device 23' or the spring-elastic element can be supported at one end on the securing element 10' and at the other end on the first or second housing part 4a', 4b'.

As can be seen from Figure 12, the securing element 10' or the bolt 25' is received adjustably in a guide 20' projecting along the adjustment direction V from the first housing part 4a'. This guide 20' comprises two webs 22a', 22b' projecting outwardly from the first or second housing part 4a', 4b' away from the housing interior 3'. The two webs 22a', 22b' each extend along the adjusting direction V'. The two webs 22a', 22b' are arranged transversely to the adjusting direction V' at a distance from one another to form an intermediate space. The securing element 10' is arranged adjustably along the adjustment direction V in the intermediate space 21'. The two webs 22a', 22b' prevent any movement of the securing element 10' transversely to the adjusting direction V'.

Figure 14 shows the securing element 10' in the securing position, Figure 15 shows it in the release position. As Figures 12 to 15 confirm, a projection 17a' projects outwards from the first housing part 4a away from the housing interior 3'. The projection 17a' can be arranged in the intermediate space 21' delimited by the two webs 22a', 22b'. Accordingly, a gap 18a' extending along the adjustment direction is formed in the securing element 10'. In the example scenario, the gap 18a' is formed as an oblong hole 19a' extending along the adjustment direction V. The projection 17a' passes through the gap 18a'. The projection 17a' and the gap 18a' are matched to one another in such a manner that during the adjustment of the securing element 10' between the securing position and the release position, the projection 17a' moves in the gap 18a' or in the oblong hole 19a' along the adjustment direction V'. In a further development two or more projections or gaps, in particular similarly to the example in Figures 7 to 10, can be provided.

Figure 16 shows a variant of the example in Figures 11 to 15. In this variant the securing device 7' comprises a pin 27' formed on the first housing part 4a' which can engage in a receptacle 28' formed in a second housing part 4b' to form a

latching connection 29' so that the two housing parts 4a', 4b' are fixed to one another in this way. The receptacle 28' can have an undercut in order to improve the latching effect achieved by the latching connection 29'.

Patent claims

1. Fuel filter device (1) for an internal combustion engine,
 - comprising a filter housing (2) which delimits a housing interior (3) and for this comprises a first and a second housing part (4a, 4b), which are detachably fastened to one another by means of a fixing device (5),
 - comprising an annular filter element (6) disposed exchangeably in the housing interior (3), which divides the housing interior (3) into a raw side and a clean side,
 - wherein the fixing device (5) is adjustable between a locking position in which the two housing parts (4a, 4b) are fixed mechanically to one another and an unlocking position in which the two housing parts can be released from one another,
 - comprising a securing device (7) for securing the fixing device (5) against an adjustment from the locking position into the unlocking position.
2. The fuel filter device according to claim 1,
characterized in that
 - the fixing device (5) comprises an actuatable fixing element (8), which can be rotated about a predetermined axis of rotation (D) between the locking position and the unlocking position.
3. The fuel filter device according to claim 1 or 2,
characterized in that

the actuatable fixing element (8) is pre-tensioned by means of a pre-tensioning device (9), preferably by means of a spring-elastic element, most preferably by means of a leg spring, towards the locking position.

4. The fuel filter device according to any one of claims 1 to 3, characterized in that
 - the securing device (7) comprises a securing element (10) which is pivotable between a securing position and a release position,
 - wherein the securing element (10) in the securing position blocks any adjustment of the fixing element (8) from the locking position into the unlocking position and releases it in the release position
5. The fuel filter device according to any one of the preceding claims, characterized in that
 - in a cross-section perpendicular to a pivot axis (A) of the securing element (10), this has a first element section (11a) which goes over at an angle, preferably at a right angle, to a second element section (11b),
 - wherein the pivot axis (S) is disposed on an end (12) of the first element section (11a) facing away from the second element section (11b).
6. The fuel filter device according to claim 5, characterized in that
 - in the securing position the first element section (11a) of the securing element (10) covers an upper side of the fixing element (8) facing away from the two housing parts (4a, 4b) so that it blocks an actuation of the fixing element (8) and an associated rotary movement of the fixing element (8).
7. The fuel filter device according to claim 5 or 6, characterized in that

on an end (14) of the second end section (11) facing away from the first element section (11a), a receptacle (15) is formed which in the securing position is facing the first and/or second housing part (4a, 4b) so that a projection (16) projecting outwards from the first or second housing part (4a, 4b) away from the housing interior (3) engages in the receptacle (15).

8. The fuel filter device according to any one of claims 1 to 3, characterized in that
 - the securing device (7) comprises a securing element (10) which is adjustable between a securing position and a release position along an adjustment direction (V) in a translational manner,
 - wherein the securing element (10) in the securing position blocks an adjustment of the fixing element (8) from the locking position into the unlocking position and releases it in the release position.
9. The fuel filter device according to any one of claims 4 to 8, characterized in that
 - the securing element (10) in the securing position is disposed between the fixing element (8) and at least one of the two housing parts (4a, 4b) and in this way prevents any rotation of the fixing element (8).
10. The fuel filter device according to any one of the preceding claims, characterized in that
 - at least one projection (17a, 17b) projects outwards from the first or second housing part (4a, 4b) away from the housing interior, which projection passes through a gap formed in the securing element (10) and extending along the adjusting direction so that during adjustment of the securing element (10) between the securing position and the release position the projection (17a, 17b) moves in the respective gap (18a, 18b) along the adjusting direction.

11. The fuel filter device according to claim 10,
characterized in that
two projections (17a, 17b) and two gaps (18a, 18b) are provided, which are
each disposed at a distance from one another transversely to the adjusting
direction.
12. Fuel filter device (1') for an internal combustion engine,
- comprising a filter housing (2') which delimits a housing interior (3') and for
this comprises a first and a second housing part (4a', 4b') which are
detachably fastened to one another by means of a fixing device (5'),
- comprising an annular filter element disposed exchangeably in the housing
interior (3'), which divides the housing interior (3') into a raw side and a clean
side.
- wherein the fixing device (5') is adjustable between a locking position in
which the fixing device (5') mechanically fixes the two housing parts (4a', 4b')
to one another and an unlocking position in which the two housing parts (4a',
4b') can be released from one another,
- comprising a securing device (7') for additional securing of the two housing
parts (4a', 4b') on one another against unintentional release of the fixing of
the two housing parts (4a', 4b'),
- wherein the securing device (7') comprises a securing element (10') which is
adjustable in a translational manner along an adjusting direction (V') between
a securing position in which the securing element (10') mechanically fixes the
two housing parts (4a', 4b') on one another and a release position in which
this mechanical fixing is cancelled.
13. The fuel filter device according to claim 12,
characterized in that

the securing element (10') is configured as a bolt (25') which in the securing position is received in a receptacle (26') provided on the first or second housing part (4a', 4b'), configured complementary to the bolt (25').

14. The fuel filter device according to claim 12 or 13, characterized in that
at least one projection (17a, 17b) projects outwards from the first or second housing part (4a', 4b') away from the housing interior, which passes through a gap (18a', 18b') formed in the securing element (10) and extending along the adjusting direction so that during adjustment of the securing element (10') between the securing position and the release position the projection (17a', 17b') moves along the adjusting direction in the respective gap (18', 18b') .
15. The fuel filter device according to any one of the preceding claims, characterized in that
the securing device (7; 7') comprises a securing element pre-tensioning device (23; 23) which preferably comprises a spring-elastic element which pre-tensions the securing element (10; 10') towards the securing position.
16. The fuel filter device according to any one of claims 4 to 15, characterized in that
the securing element (10; 10') is received adjustably in a guide (20; 20') projecting along the adjusting direction from the first or second housing part (4a, 4b; 4a', 4b').
17. The fuel filter device (1; 1') according to claim 16, characterized in that
the guide (20; 20') comprises two webs (22a, 22b; 22a', 22b') projecting outwardly from the first or second housing part (4a, 4b; 4a', 4b') away from

the housing interior (3; 3'), which webs both extend along the adjusting direction (V; V') and are arranged transversely to the adjusting direction (V; V') at a distance from one another to form an intermediate space (21; 21') in which the securing element (10; 10') is received so that a movement of the securing element (10; 10') transversely to the adjusting direction (V; V') is prevented.

18. The fuel filter device (1') according to any one of the preceding claims, characterized in that
the securing device (7') comprises a pin (27') formed on a first housing part (4a) which engages in a receptacle (28') formed on the second housing part (4b') to form a latching connection (29').
19. The fuel filter device (1') according to claim 18, characterized in that
the receptacle (28') comprises an undercut.

1/9

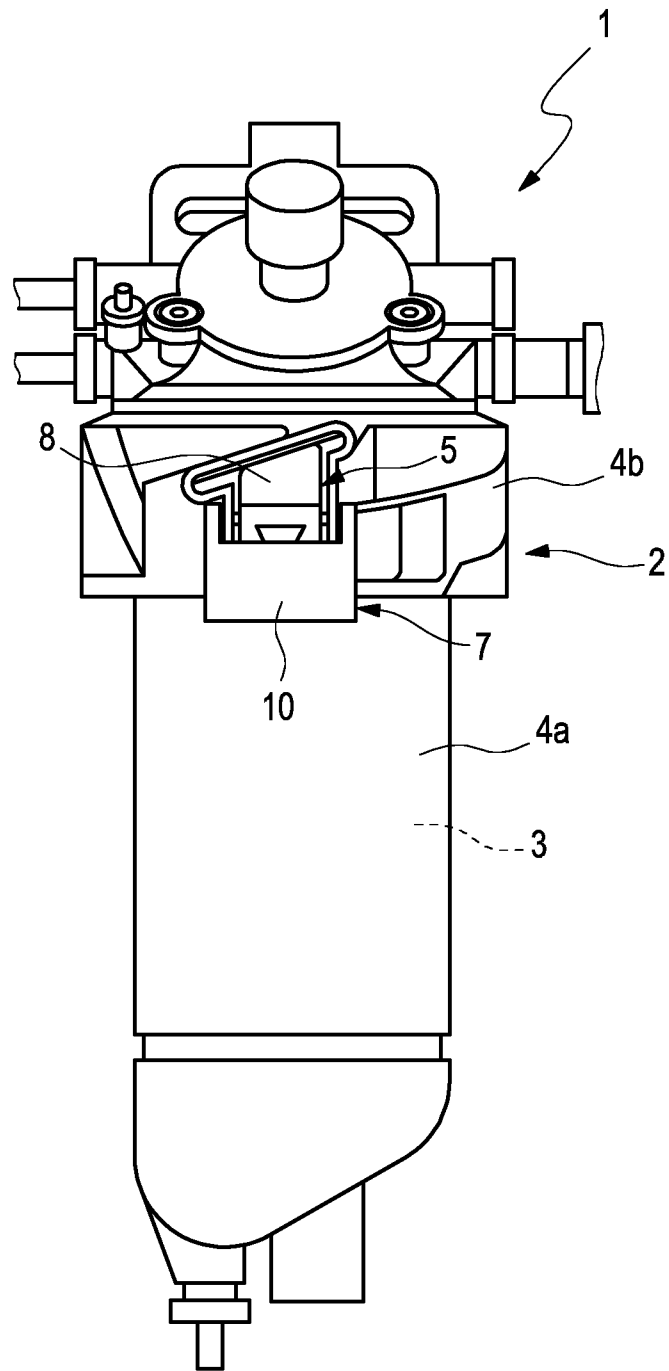


Fig. 1

2/9

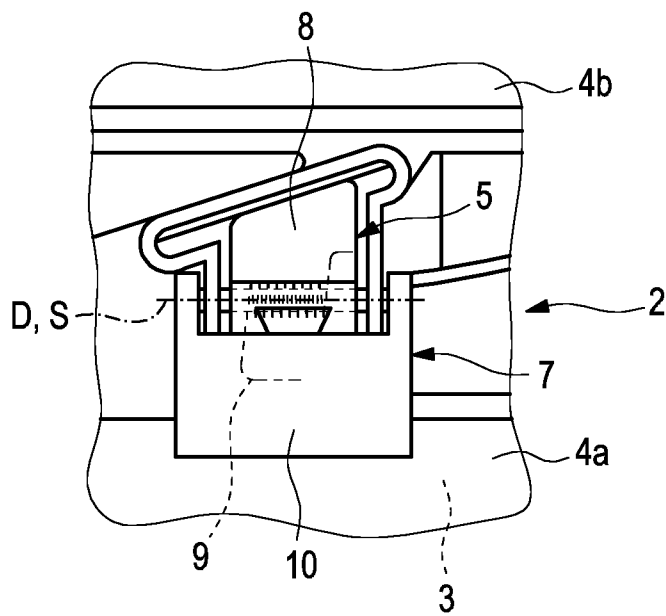


Fig. 2

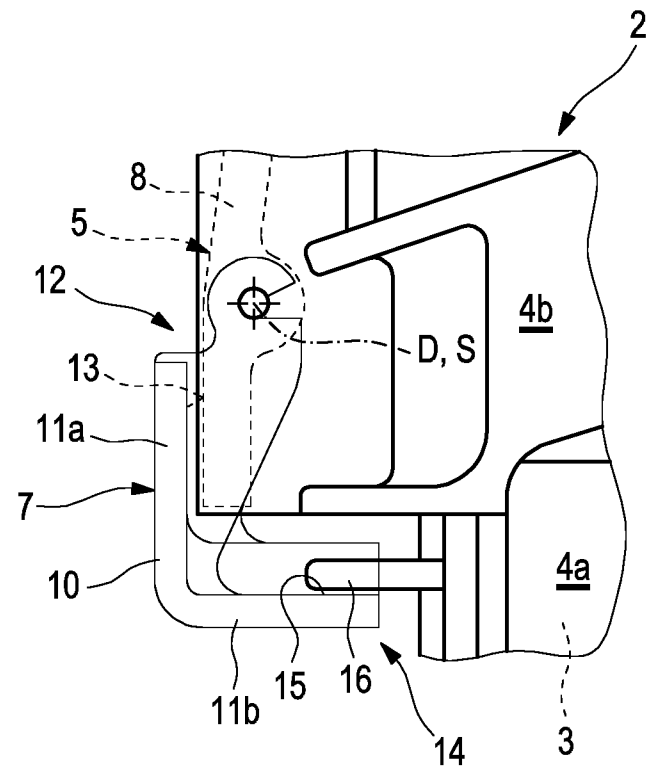


Fig. 3

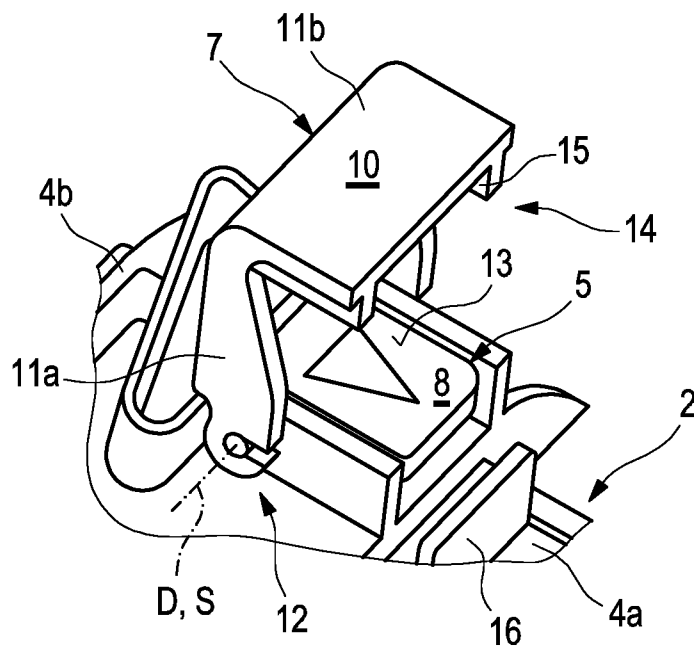


Fig. 4

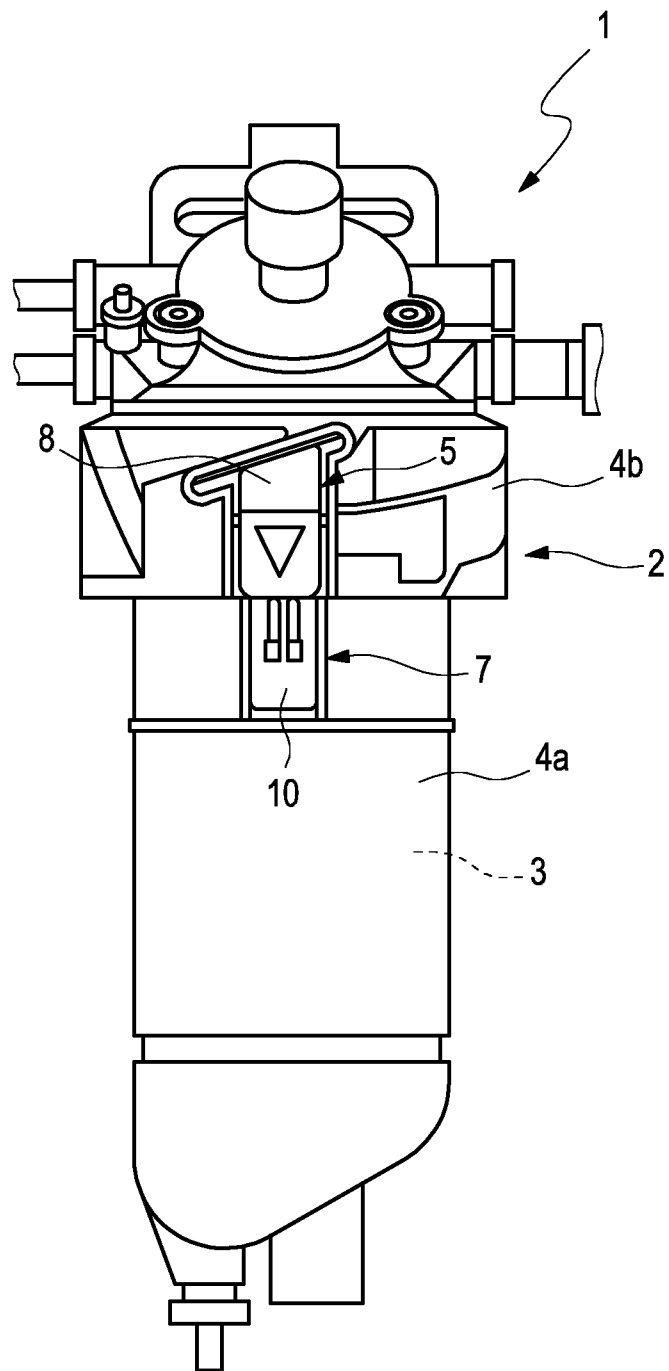


Fig. 5

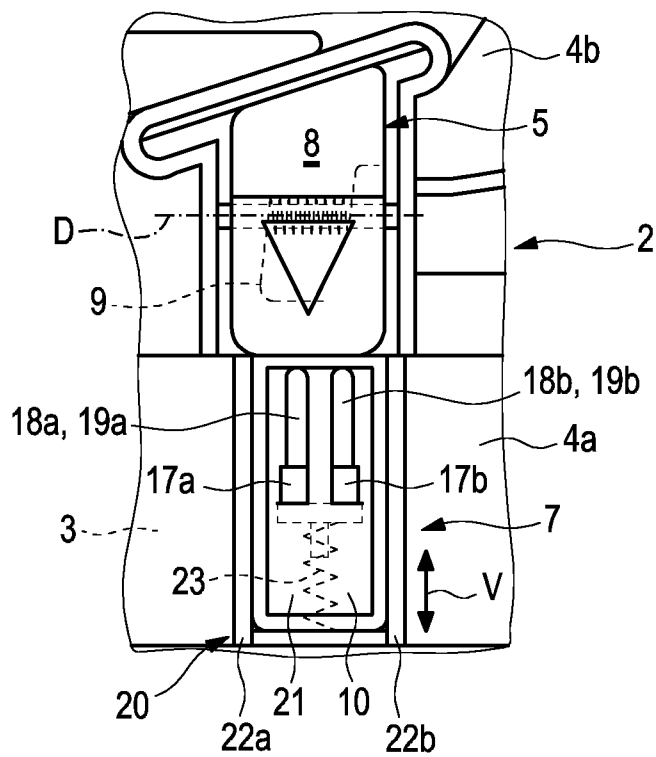


Fig. 6

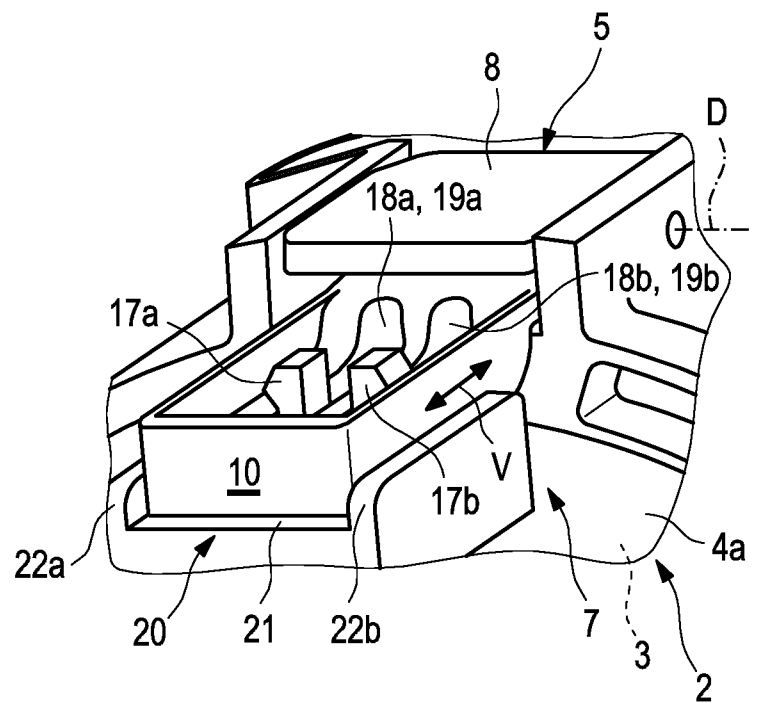


Fig. 7

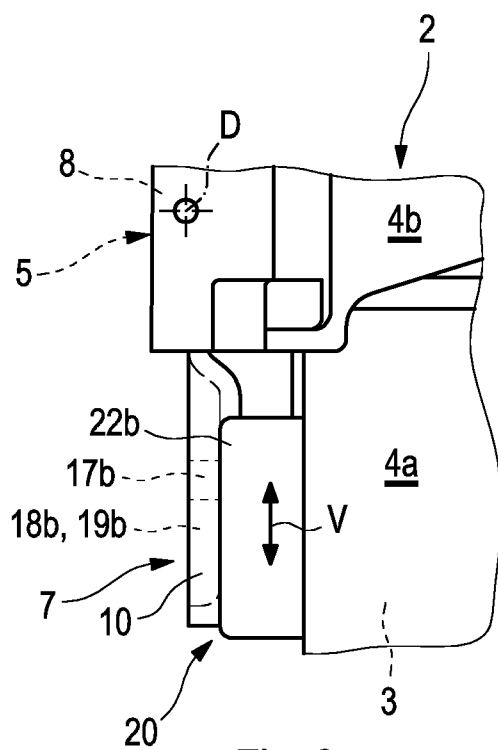
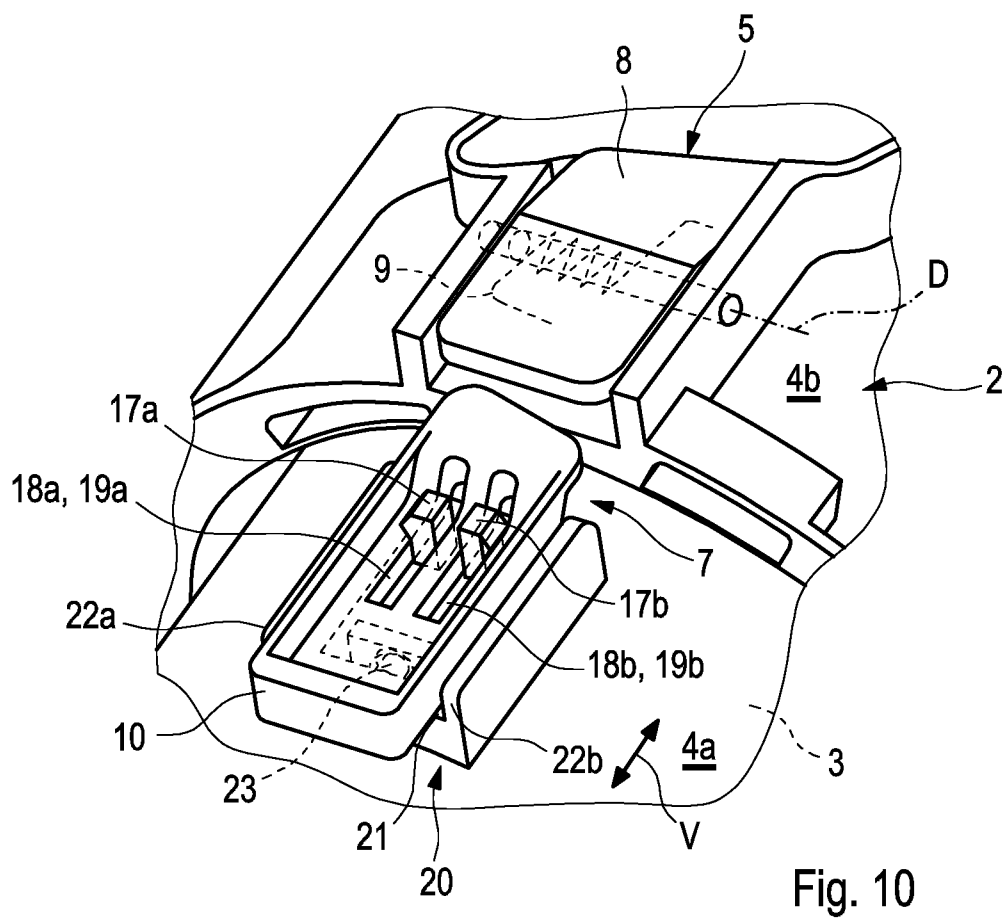
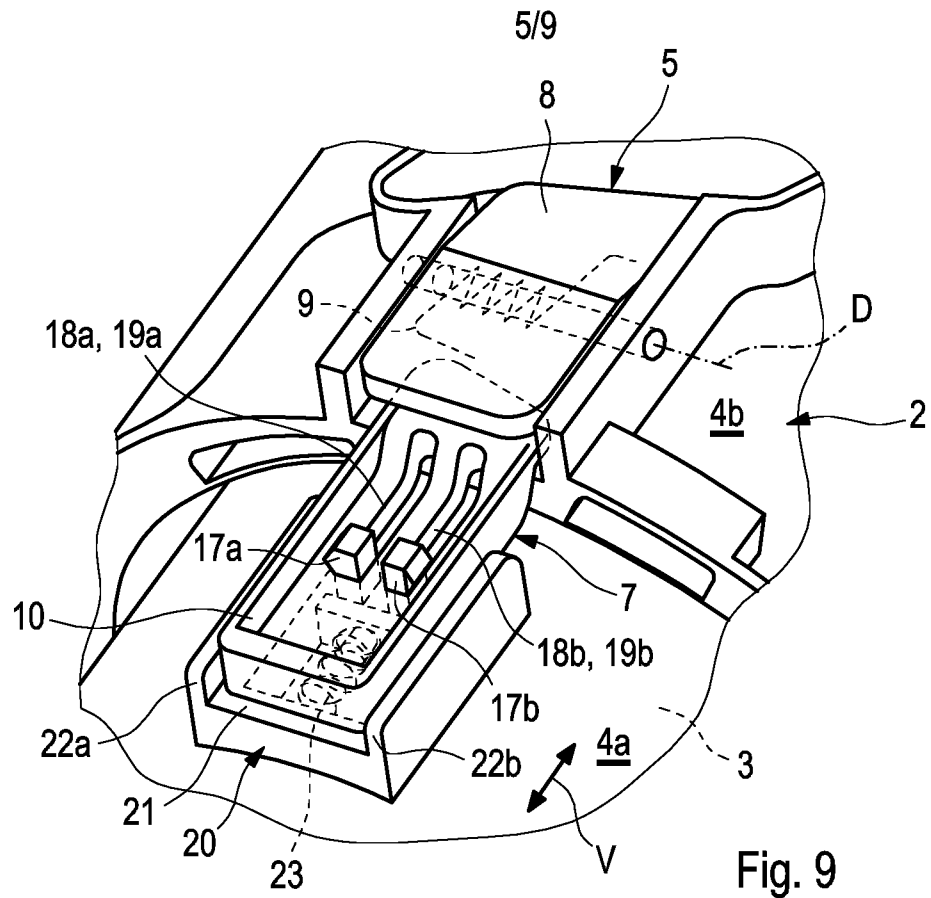


Fig. 8



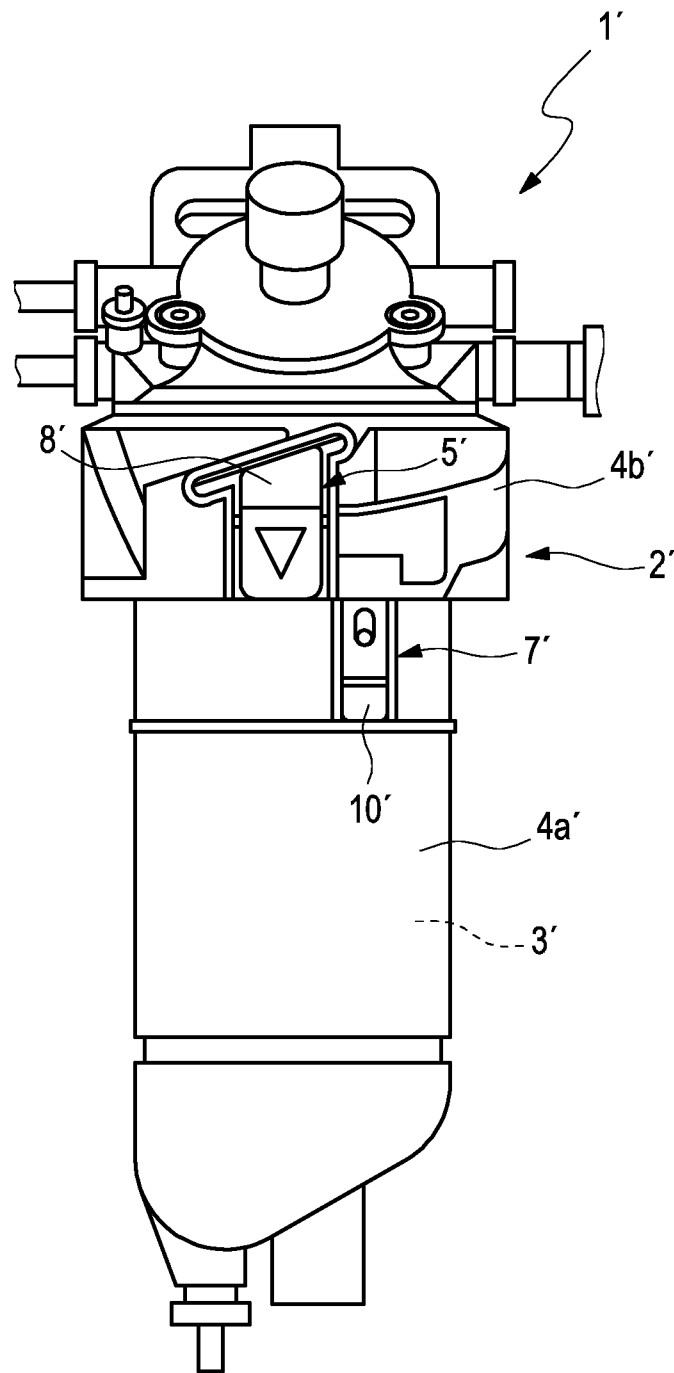


Fig. 11

7/9

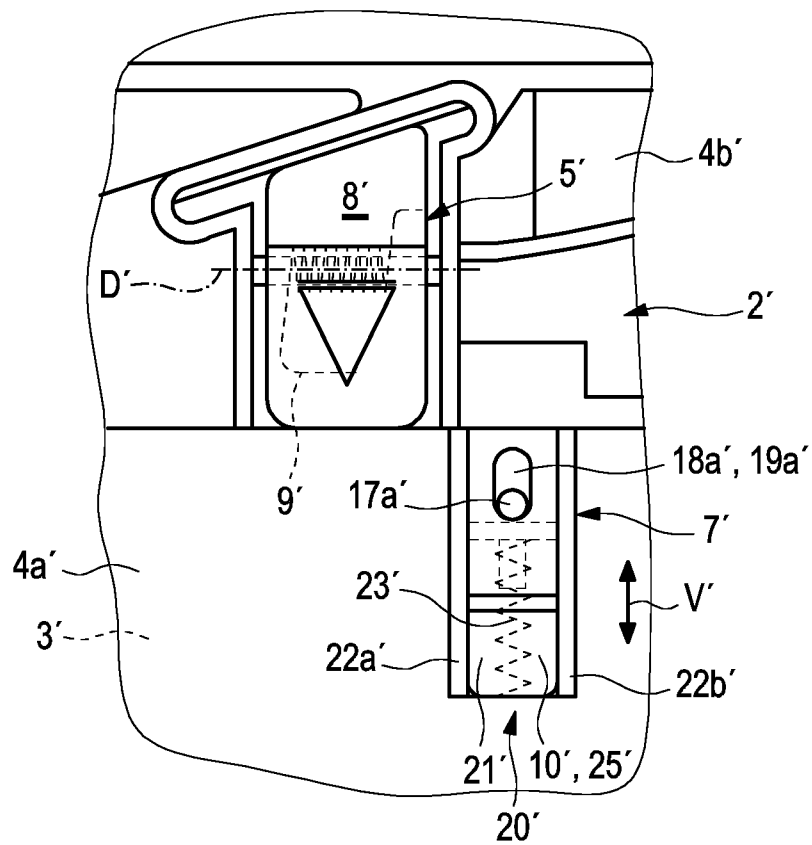


Fig. 12

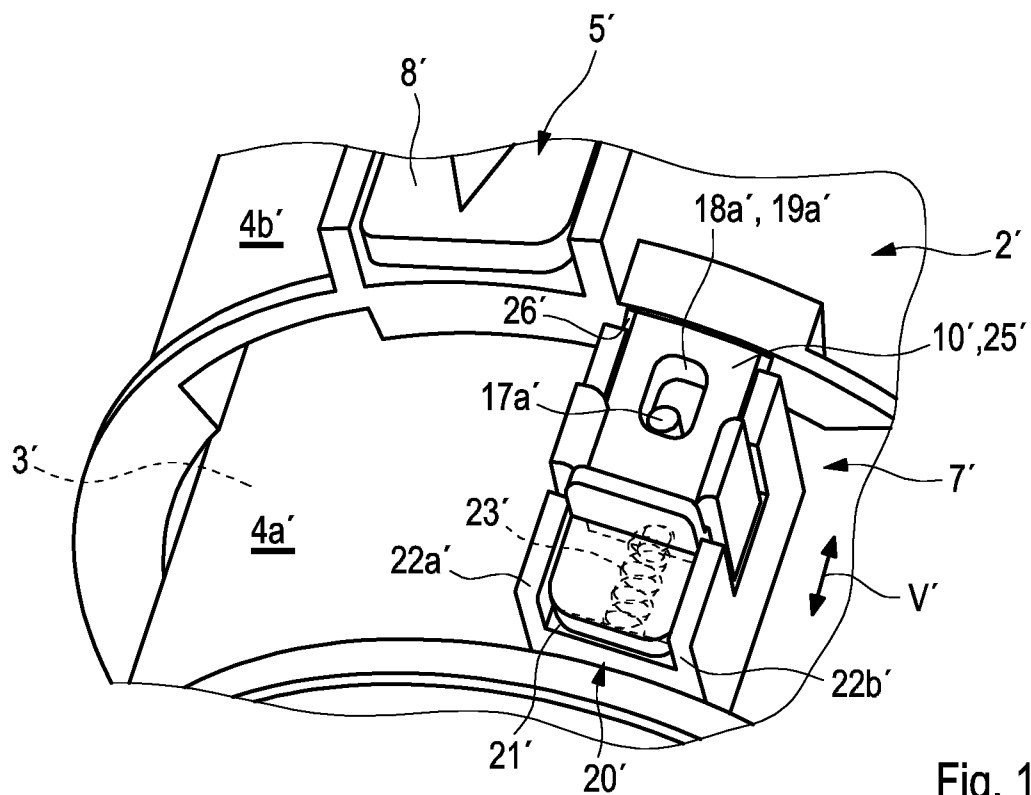


Fig. 13

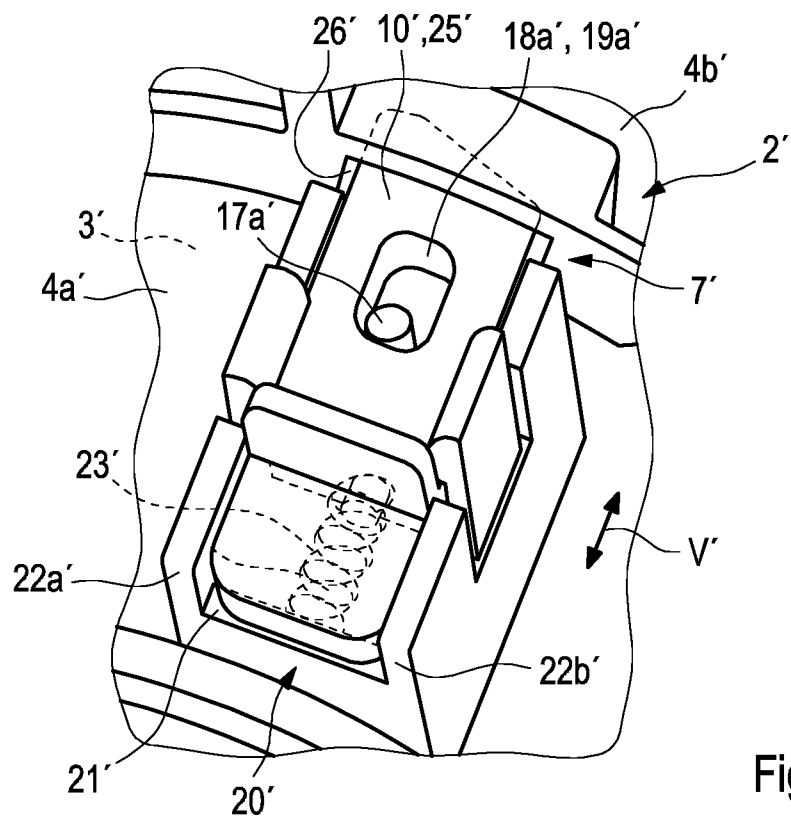


Fig. 14

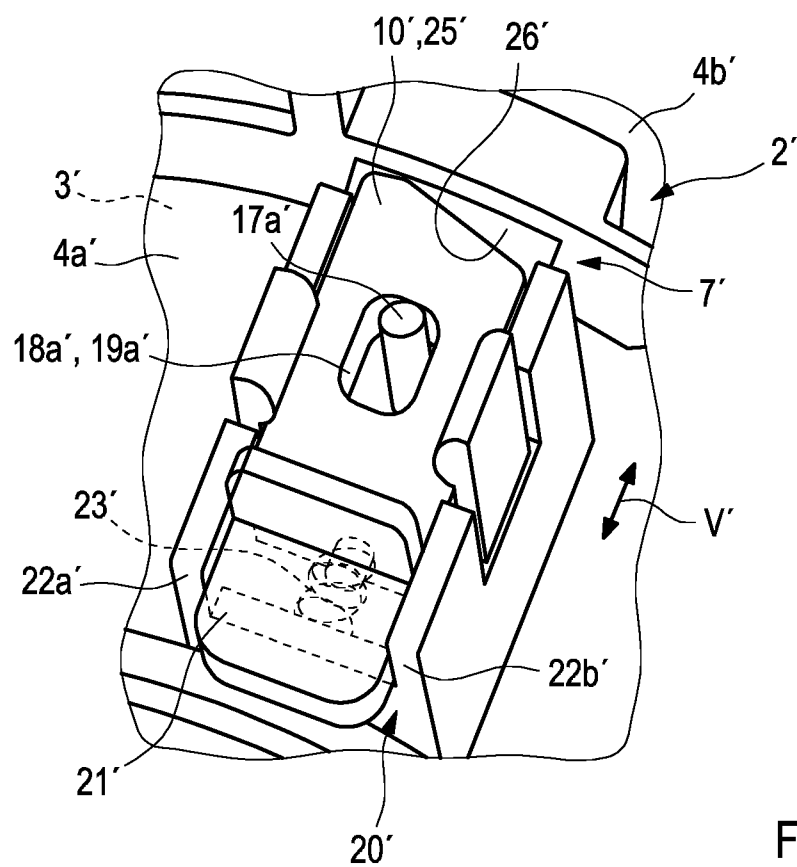


Fig. 15

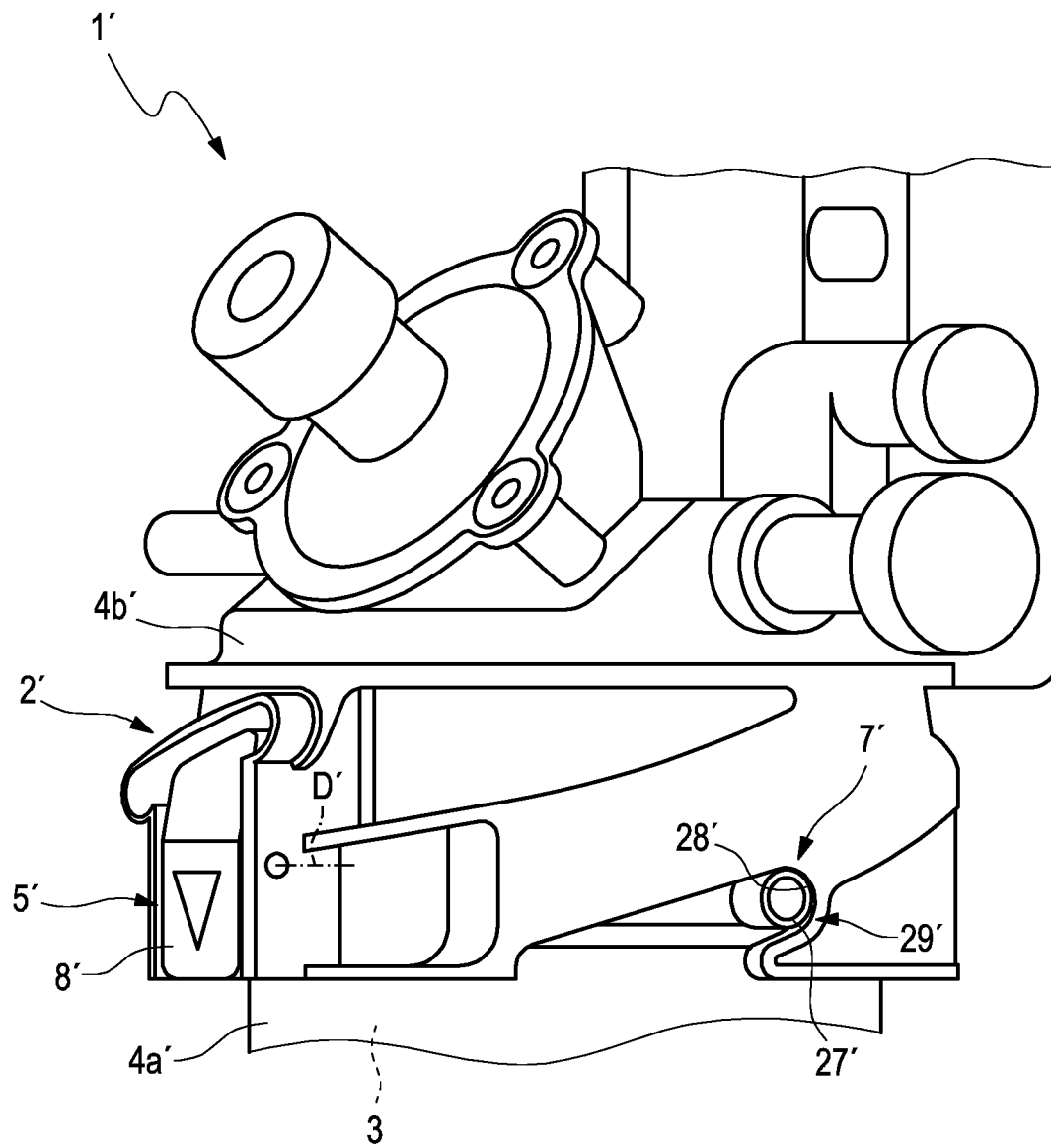


Fig. 16

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/053924

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B01D35/30
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 278 771 A1 (PROCESS SCIENT INNOVATIONS [GB]) 17 August 1988 (1988-08-17) column 1, line 12 - line 20 column 2, line 38 - column 3, line 17 column 4, line 9 - line 12 column 4, line 26 - line 40 figures -----	1-7,15
X	GB 2 052 297 B (WILKERSON CORP) 23 February 1983 (1983-02-23) the whole document -----	1-3, 8-11,15
A	EP 2 355 914 A2 (3M INNOVATIVE PROPERTIES CO [US]) 17 August 2011 (2011-08-17) the whole document ----- -/--	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

10 November 2017

Date of mailing of the international search report

17/01/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Hilt, Daniel

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/053924

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004 019901 A (NIPPON MYKROLIS KK) 22 January 2004 (2004-01-22) the whole document -----	1-7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2017/053924

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-11(completely); 15(partially)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11(completely); 15(partially)

Fuel filter device for an internal combustion engine

2. claims: 12-14, 16-19(completely); 15(partially)

Fuel filter device for an internal combustion engine,
wherein the securing device comprises a securing element
which is adjustable in a translational manner.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/053924

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0278771	A1	17-08-1988	AU 595432 B2 29-03-1990
		CA 1306271 C 11-08-1992	
		CN 88100784 A 24-08-1988	
		DE 3867645 D1 27-02-1992	
		EP 0278771 A1 17-08-1988	
		ES 2030851 T3 16-11-1992	
		GB 2224666 A 16-05-1990	
		IN 169956 B 18-01-1992	
		JP 2625188 B2 02-07-1997	
		JP H02502207 A 19-07-1990	
		US 4989636 A 05-02-1991	
		WO 8806059 A1 25-08-1988	
GB 2052297	B	23-02-1983	DE 3018158 A1 27-11-1980
		GB 2052297 A 28-01-1981	
		JP S562819 A 13-01-1981	
		JP S5834171 B2 25-07-1983	
		US 4215790 A 05-08-1980	
EP 2355914	A2	17-08-2011	BR PI0913488 A2 30-05-2017
		CN 102176955 A 07-09-2011	
		EP 2355914 A2 17-08-2011	
		JP 5536774 B2 02-07-2014	
		JP 2012501832 A 26-01-2012	
		KR 20110053380 A 20-05-2011	
		US 2011247974 A1 13-10-2011	
		WO 2010027989 A2 11-03-2010	
JP 2004019901	A	22-01-2004	JP 4125051 B2 23-07-2008
		JP 2004019901 A 22-01-2004	