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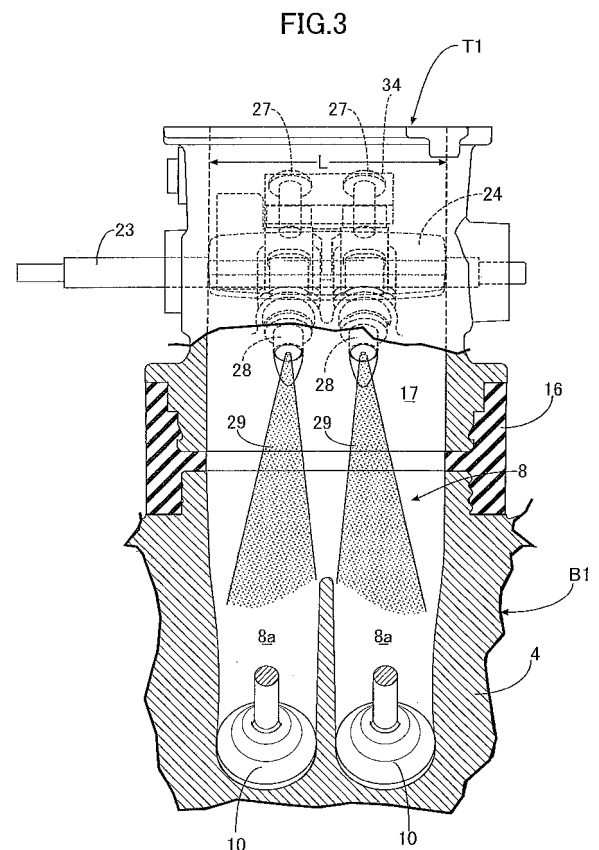
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(54) **Throttle body having fuel injection valve**

(57) In a throttle body (T1) having fuel injection valves, an intake passage (17) is formed to have a transverse cross-section thereof in an oblong circle having a long diameter (L) extending in a direction in which paired branched paths (8a, 8a), which are formed in downstream portions of an intake port (8) of an engine (E), are arranged, and a short diameter (S) extending orthogonal to the long diameter (L); and paired fuel injection valves (28, 28) are attached to a sidewall, extending along the long diameter (L), of the throttle body (T1, T2) so as to be arranged along the long diameter (L), and to be allowed to inject fuel toward the paired branched paths (8a, 8a), respectively. Accordingly it is possible to secure a wide attachment space in the sidewall of the throttle body, to easily attach the paired parallel fuel injection valves thereto, and cause the fuel injection valves to inject fuel in adequate directions to the respective paired intake passages.



Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to an improvement of a throttle body having fuel injection valves, in which a throttle body is attached to an engine having an intake port, the intake port having a downstream side formed into a pair of branched paths, the throttle body having an intake passage communicating with an upstream end of the intake port; a throttle valve is pivotally supported by the throttle body, the throttle valve opening and closing the intake passage; and a fuel injection valve is attached to the throttle body, the fuel injection valve injecting fuel toward the intake port from downstream side of the throttle valve.

DESCRIPTION OF THE RELATED ART

[0002] As such a conventional throttle body having a fuel injection valve, one having the following configuration has already been known as described in Japanese Patent No. 4053048. Specifically, in the throttle body, a single fuel injection valve attached to the throttle body is designed to form, at the time of fuel injection, fuel spray forms directed in the two respective directions to paired branched paths of the intake port. However, fuel injection holes have to be processed with a high-level technology, for forming, by use of the single fuel injection valve, the fuel spray forms directed in the two respective directions, and causing the fuel spray forms to precisely be directed to the two branched paths. This high-level processing technology tends to increase costs. Furthermore, since it is the single fuel injection valve, the amount of injecting fuel is limited to a certain amount. Therefore, the conventional throttle body is not easily applied to a large-displacement engine.

[0003] In addition, Japanese Patent No. 3724184 has disclosed another type of throttle body having fuel injection valves. This throttle body has paired fuel injection valves, which are arranged in parallel, attached thereto, and is capable of injecting a large amount of fuel to cope with a large-displacement engine. However, the throttle body, having the cross-section of its intake passage complete round, makes it difficult to secure a space, which allows the two parallel fuel injection valves to attach thereto, in a sidewall of the throttle body. Accordingly, it is difficult to direct fuel injections of the two fuel injection valves toward two predetermined directions.

SUMMARY OF THE INVENTION

[0004] The present invention has been made with the foregoing conditions taken into consideration. An object of the present invention is to provide a throttle body having fuel injection valves which secures a wide attachment

space in a sidewall of the throttle body, allows paired parallel fuel injection valves to be easily attached thereto, and is capable of causing the fuel injection valves to inject fuel in adequate directions to the respective paired intake passages.

[0005] In order to achieve the object, according to a first feature of the present invention, there is provided a throttle body having fuel injection valves, in which a throttle body is attached to an engine having an intake port, the intake port having a downstream side formed into a pair of branched paths, the throttle body having an intake passage communicating with an upstream end of the intake port; a throttle valve is pivotally supported by the throttle body, the throttle valve opening and closing the intake passage; and a fuel injection valve is attached to the throttle body, the fuel injection valve injecting fuel toward the intake port from downstream side of the throttle valve, characterized in that the intake passage is formed to have a transverse cross-section thereof in an oblong circle having a long diameter extending in a direction in which the paired branched paths are arranged, and a short diameter extending orthogonal to the long diameter, and paired fuel injection valves are attached to a sidewall, extending along the long diameter, of the throttle body so as to be arranged along the long diameter, and to be allowed to inject fuel toward the paired branched paths, respectively.

[0006] Note that the oblong circle includes an ellipse or an oval. The oblong circle is a flat circle formed of a combination of multiple arcs, or a combination of multiple arcs and multiple straight lines.

[0007] With the first feature of the present invention, the transverse cross-section of the intake passage of each of the throttle bodies is formed of an oblong circle having the long diameter extending in the direction in which the branched paths of the intake port are arranged, and the short diameter extending orthogonal to the long diameter. This secures a large flow passage area for the intake passage.

[0008] In addition, any one of the sidewalls extending along the long diameter of the throttle bodies can have an attachment space wider than the sidewall of a throttle body which has a perfect circle cross-sectional shape and the same passage area. The paired fuel injection valves arranged along the long diameter are attached to one of the sidewalls. This enables the free arrangement of the two fuel injection valves, so that the two fuel injection valves can be arranged corresponding to the interval between the branched paths. Accordingly, it is possible to direct the conic spray forms, formed by fuel injected from the two respective fuel injection valves, to the respective branched paths appropriately. This prevents the injected fuel to attach to the inner surface of the intake port as few as possible, thereby leading to contributions to reduction in fuel consumption and exhaust emission. Furthermore, it is possible to finely control a total amount of injected fuel from small flow amount to large flow amount, by operating only one fuel injection valve or by

operating the two fuel injection valves simultaneously. Concurrently, it is possible to secure a large flow passage area for the intake passage. These factors enable the throttle body to be applied to a large displacement engine.

[0009] According to a second feature of the present invention, in addition to the first feature, the oblong circle is formed by combining paired opposed short arcs with paired opposed long arcs or paired opposed straight lines, the paired short arcs extending in a direction of the short diameter, the paired long arcs or straight lines being longer than the short arcs and extending in a direction of the long diameter; and in the throttle body, the throttle valve is attached to a valve shaft, the throttle valve having the same contour as the oblong circle has, the valve shaft penetrating the throttle body along the long diameter.

[0010] With the second feature of the present invention, the contour of each of the intake passage and the throttle valve which extends along the short diameter is formed by the short arcs. Therefore, when the throttle valve is opened from its closed position even slightly, a space is formed between end surfaces of the throttle valve extending along the direction of the short diameter and inner surfaces of the intake passage, which oppose to the end surfaces. This prevents friction between the end surfaces of the throttle valve and the inner surfaces of the intake passage, and accordingly allows smooth opening and closing of the throttle valve.

[0011] According to a third feature of the present invention, in addition to the first or second feature, a pair of the throttle bodies are respectively attached to sidewalls of first and second banks of a V-type engine, the sidewalls facing a valley between the two banks, and the throttle bodies are arranged so that the short diameters of the intake passages are directed in a direction in which the first and second banks are arranged.

[0012] With the third feature of the present invention, the first and second throttle bodies arranged over the valley between the first and second banks of the V-type engine are arranged in a flat form in the direction as the two banks are arranged. Accordingly, the first and second throttle bodies can be easily arranged over the narrow valley without interfering with each other.

[0013] The above description, other objects, characteristics and advantages of the present invention will be clear from detailed descriptions which will be provided for the preferred embodiments referring to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIG. 1 is a side view of a V-type engine for a vehicle, including a throttle body having fuel injection valves according to a first embodiment of the present invention;

FIG. 2 is an enlarged cross-sectional view of a part 2 in FIG. 1;

FIG. 3 is a cross-sectional view taken along a line 3-3 in FIG. 2;

FIG. 4 is a cross-sectional view taken along a line 4-4 in FIG. 2; and

FIG. 5 is a view corresponding to FIG. 4 and showing a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Embodiments of the present invention will be described below with reference to the attached drawings.

[0016] Firstly, FIG. 1 shows an engine E mounted on a body of an automobile, a motorcycle or the like. The engine E includes a first bank B1 and a second bank B2 which project upward from a crank supporting part 2 to together form a V shape. Thus, the engine E is formed in a V shape. The crank supporting part 2 supports a crank shaft 1. Each of the banks B1 and B2 includes a cylinder block 3 connected to the crank supporting part 2, and a cylinder head 4 connected to the upper end of the cylinder block 3. The cylinder block 3 includes a cylinder bore 6 in which a piston 5 reciprocates. The cylinder head 4 includes: a combustion chamber 7 communicating with the cylinder bore 6; an intake port 8 and an exhaust port 9 which are opened to this combustion chamber 7.

[0017] As shown in FIG. 3, the intake port 8 includes branched paths 8a and 8a into which the intake port 8 is branched from a longitudinal middle portion thereof and the branched paths 8a and 8a extend toward the combustion chamber 7 in a direction to which the crank shaft 1 extends. Paired intake valves 10 and 10 for opening and closing the respective branched paths 8a and 8a are installed in the cylinder head 4. The exhaust port 9 has a branched structure similar to that of the intake port 8. Paired exhaust valves 11 and 11 (only one of which is shown in FIG. 1) for opening and closing the exhaust port 9 are installed in the cylinder head 4 as well.

[0018] Returning to FIG. 1, the upstream ends of the intake ports 8 and 8 of the two banks B1 and B2 are opened to a valley 15 between the two banks B1 and B2. First and second throttle bodies T1 and T2 whose intake passages 17 and 17 communicate with the upstream ends of the intake ports 8 and 8 are attached to the first and second banks B1 and B2 with cylinder-shaped insulators 16 and 16 interposed in between, respectively. Thereby, the first and second throttle bodies T1 and T2 are arranged symmetrically over the valley 15.

[0019] Basically, the first and second throttle bodies T1 and T2 have the same structure. Therefore, taking the first throttle body T1 as a representative of these, descriptions will be provided referring to FIGS. 2 to 4. Hereinafter, the first throttle body T1 is simply referred to as a "throttle body T1."

[0020] As clearly shown in FIG. 4, the intake passage 17 of the throttle body T1 which communicates with the intake port 8 has a transverse cross-section formed of an oblong circle. The oblong circle has a long diameter

L extending in a direction in which the paired branched paths 8a and 8a of the intake port 8 are arranged, and a short diameter S extending orthogonal to the long diameter L.

[0021] Basically, the oblong circle shown in the drawings is formed of a combination of paired short arcs 20 and 20 and paired long arcs 21 and 21. The paired short arcs 20 and 20 extend along the short diameter S, and are opposed to each other. The paired long arcs 21 and 21 extend along the long diameter L, are opposed to each other, and are longer than the paired short arcs 20 and 20. Each corner portion is curved at which one of the short arcs 20 and the corresponding one of the long arcs 22 cross.

[0022] As shown in FIGS. 2 to 4, a valve shaft 23 is rotatably supported by the throttle body T1. The valve shaft 23 penetrates a longitudinal middle portion of the throttle body T1 along the long diameter L. A butterfly-type throttle valve 24 which opens and closes the intake passage 17 according to rotation of the valve shaft 23 is fixedly attached to the valve shaft 23. This throttle valve 24 has an oblong-circle contour which matches the transverse cross-section of the intake passage 17 so as to come into close contact with the inner peripheral surface of the intake passage 17 when the throttle valve 24 is at the closing position.

[0023] Paired attachment bosses 25 and 25 are integrally formed in a side surface, extending along the long diameter L, of the throttle body T1, particularly in the side surface closer to the middle of the valley 15. The paired attachment bosses 25 and 25 are arranged along the long diameter L, in other words, in a direction in which the branched paths 8a and 8a are arranged. Paired electromagnetic fuel injection valves 28 and 28 are fitted into the respective attachment bosses 25 and 25 with seal members 32 being interposed in between, respectively. A fuel joint 34 for enabling fuel to be supplied to these fuel injection valves 28 and 28 is fitted to the outer end portions of the fuel injection valves 28 and 28, respectively. The fuel joint 34 includes a supporting arm 34a. By fixedly attaching this supporting arm 34a to attachment bosses 26 by use of bolts 27, respectively, the fuel joint 34 is fixed to the throttle body T1, and concurrently holds the paired fuel injection valves 28 and 28. In this respect, the attachment bosses 26 are formed in the side surface of the throttle body T1. Each fuel injection valve 28 includes a power supply coupler 28a which projects in a lateral direction. Positioning forks 34b are formed in the fuel joint 34. Each positioning fork 34b pinches the root of the corresponding coupler 28a to prevent the corresponding fuel injection valve 28 from rotating. Thus, the paired fuel injection valves 28 and 28 are arranged in a way that conic spray forms 29 and 29 formed by fuel injected from the fuel injection valves 28 and 28 are directed to the branched paths 8a and 8a, respectively.

[0024] Returning to FIG. 1, the first and second throttle bodies T1 and T2 mounted on the first and second banks B1 and B2 over the valley 15 between the first and second

banks B1 and B2 are arranged in a way that the short diameters S of the intake passages 17 are directed in a direction in which the first and second banks B1 and B2 are arranged, respectively. In addition, a fuel distributing block 36 to which the fuel is supplied from a fuel pump (not illustrated) through a fuel supplying pipe 37 is connected to the fuel joints 34 and 34 of the first and second throttle bodies T1 and T2, respectively.

[0025] Next, an operation of this embodiment will be described.

[0026] The transverse cross-section of the intake passage 17 of each of the first and second throttle bodies T1 and T2 is formed of an oblong circle having a long diameter L extending in the direction in which the branched paths 8a and 8a of the intake port 8 are arranged, and a short diameter S extending orthogonal to the long diameter L. This secures a large flow passage area for the intake passage 17.

[0027] In addition, any one of the sidewalls extending along the long diameter L of each of the throttle bodies T1 and T2 can have an attachment space wider than the sidewall of a throttle body which has a perfect circle cross-sectional shape and the same flow passage area. The paired fuel injection valves 28 and 28 arranged along the long diameter L are attached to one of the sidewalls. This enables the free arrangement of the two fuel injection valves 28 and 28, so that the two fuel injection valves 28 and 28 can be arranged corresponding to the interval between the branched paths 8a and 8a. Accordingly, it is possible to direct the conic spray forms 29 and 29, formed by fuel injected from the two respective fuel injection valves 28 and 28, to the respective branched paths 8a and 8a appropriately. This prevents the injected fuel to attach to the inner surface of the intake port 8 as few as possible, thereby leading to contributions to reduction in fuel consumption and exhaust emission.

[0028] Furthermore, it is possible to finely control a total amount of injected fuel from small flow amount to large flow amount, by operating only one fuel injection valve 28 or by operating the two fuel injection valves 28 and 28 simultaneously. Concurrently, it is possible to secure a large flow passage area for the intake passage 17. These factors enable the throttle body to be applied to a large displacement engine.

[0029] The contour of each of the intake passage 17 and the throttle valve 24 which extends along the short diameter S is formed by the short arcs 20. Therefore, when the throttle valve 24 is opened from its closed position even slightly, a space is formed between the end surfaces of the throttle valve 24 extending along a direction of the short diameter S and inner surfaces of the intake passage 17, which oppose to the end surfaces. This prevents friction between the end surfaces of the throttle valve 24 and the inner surfaces of the intake passage 17, and accordingly allows smooth opening and closing of the throttle valve 24.

[0030] In addition, the first and second throttle bodies T1 and T2 are arranged over the valley 15 between the

first and second banks B1 and B2 of the V-type engine E in a way that the short diameters S of their respective intake passages 17 are directed in the direction in which the first and second banks B1 and B2 are arranged. Accordingly, the first and second throttle bodies T1 and T2 are arranged in a flat form in the direction as the two banks B1 and B2 are arranged. Accordingly, the first and second throttle bodies T1 and T2 can be easily arranged over the narrow valley 15 without interfering with each other.

[0031] Next, a second embodiment of the present invention shown in FIG. 5 will be described.

[0032] The throttle body according to the second embodiment is the same as the throttle body according to the above-described embodiment except for the following point. In the second embodiment, the transverse cross-section having an oblong circle of an intake passage 17 of each of first and second throttle bodies T1 and T2 is formed of a combination of paired opposed short arcs 20, extending along a direction of a short diameter S, and paired opposed straight lines 21' and 21' which are longer than the short arcs 20 and 20, and which extend along a direction of a long diameter L. In FIG. 5, parts corresponding to those of the previous embodiment will be denoted by the same reference numerals. Thereby, overlapped descriptions will be omitted. The second embodiment is capable of bringing about the same operation effect as the previous embodiment has.

[0033] The present invention is not limited to the above-mentioned embodiments and may be modified in a variety of ways as long as the modifications do not depart from the gist of the present invention. For instance, the paired fuel injection valves 28 and 28 in each of the throttle bodies T1 and T2 can be arranged in parallel as shown in the illustrated examples, or in such a way as to tilt to each other, depending on the arrangement and/or shapes of the paired branched paths 8a and 8a at discretion.

[0034] In a throttle body (T1) having fuel injection valves, an intake passage (17) is formed to have a transverse cross-section thereof in an oblong circle having a long diameter (L) extending in a direction in which paired branched paths (8a, 8a), which are formed in downstream portions of an intake port (8) of an engine (E), are arranged, and a short diameter (S) extending orthogonal to the long diameter (L); and paired fuel injection valves (28, 28) are attached to a sidewall, extending along the long diameter (L), of the throttle body (T1, T2) so as to be arranged along the long diameter (L), and to be allowed to inject fuel toward the paired branched paths (8a, 8a), respectively. Accordingly it is possible to secure a wide attachment space in the sidewall of the throttle body, to easily attach the paired parallel fuel injection valves thereto, and cause the fuel injection valves to inject fuel in adequate directions to the respective paired intake passages.

Claims

1. A throttle body having fuel injection valves, in which

a throttle body (T1, T2) is attached to an engine (E) having an intake port (8), the intake port (8) having a downstream side formed into a pair of branched paths (8a, 8a), the throttle body (T1, T2) having an intake passage (17) communicating with an upstream end of the intake port (8); a throttle valve (24) is pivotally supported by the throttle body (T1, T2), the throttle valve (24) opening and closing the intake passage (17); and a fuel injection valve (28) is attached to the throttle body (T1, T2), the fuel injection valve (28) injecting fuel toward the intake port (8) from downstream side of the throttle valve (24),

characterized in that

the intake passage (17) is formed to have a transverse cross-section thereof in an oblong circle having a long diameter (L) extending in a direction in which the paired branched paths (8a, 8a) are arranged, and a short diameter (S) extending orthogonal to the long diameter (L), and paired fuel injection valves (28, 28) are attached to a sidewall, extending along the long diameter (L), of the throttle body (T1, T2) so as to be arranged along the long diameter (L), and to be allowed to inject fuel toward the paired branched paths (8a, 8a), respectively.

2. The throttle body having fuel injection valves according to claim 1, wherein

the oblong circle is formed by combining paired opposed short arcs (20, 20) with paired opposed long arcs (21, 21) or paired opposed straight lines (21', 21'), the paired short arcs (20, 20) extending in a direction of the short diameter (S), the paired long arcs (21, 21) or straight lines (21', 21') being longer than the short arcs (20, 20) and extending in a direction of the long diameter (L); and in the throttle body (T1, T2), the throttle valve (24) is attached to a valve shaft (23), the throttle valve (24) having the same contour as the oblong circle has, the valve shaft (23) penetrating the throttle body (T1, T2) along the long diameter (L).

3. The throttle body having fuel injection valves according to claim 1 or 2, wherein

a pair of the throttle bodies (T1, T2) are respectively attached to sidewalls of first and second

banks (B1, B2) of a V-type engine (E), the side-walls facing a valley (15) between the two banks (B1, B2), and the throttle bodies (T1, T2) are arranged so that the short diameters (S) of the intake passages (17) are directed in a direction in which the first and second banks (B1, B2) are arranged.

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FIG.1

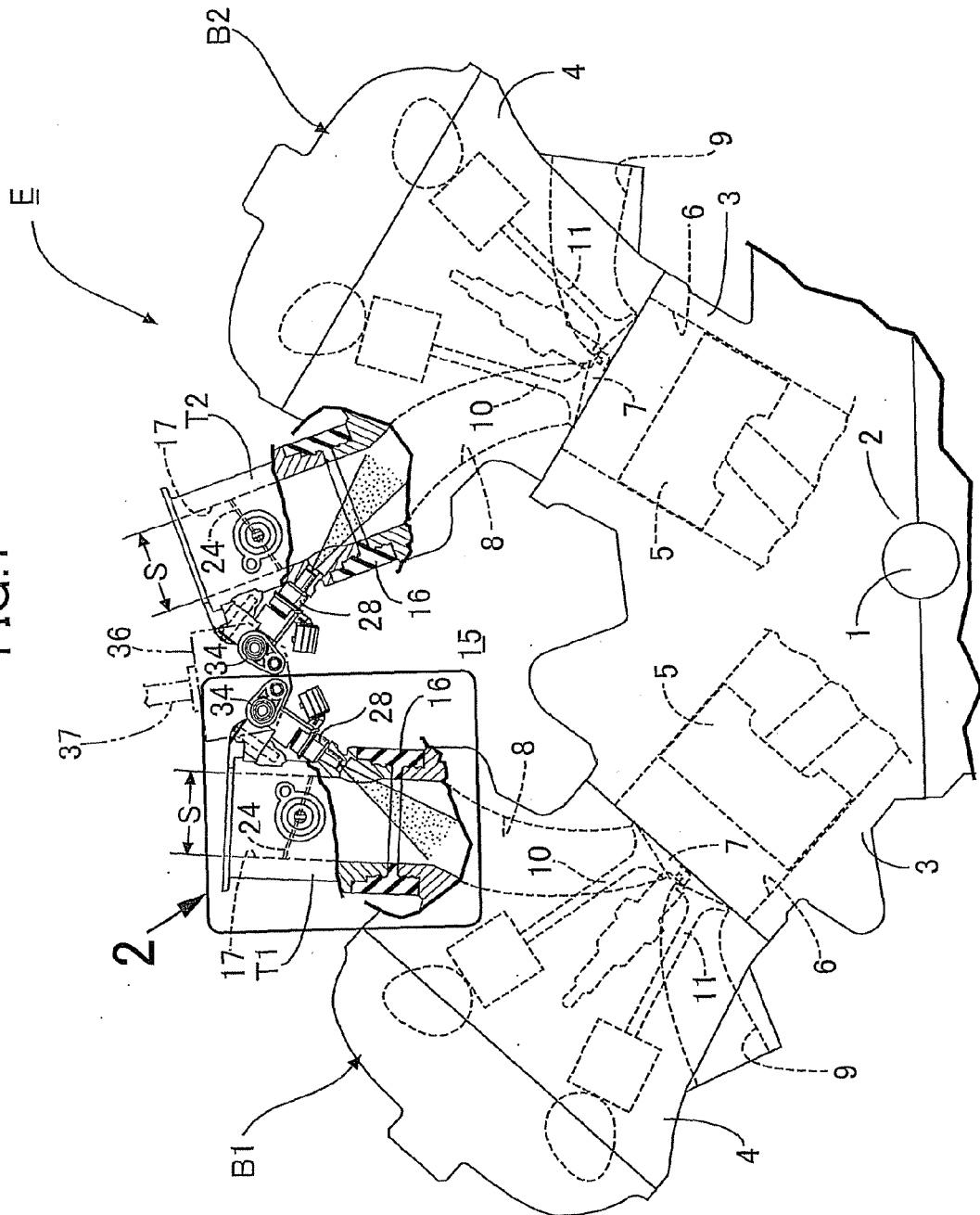


FIG.2

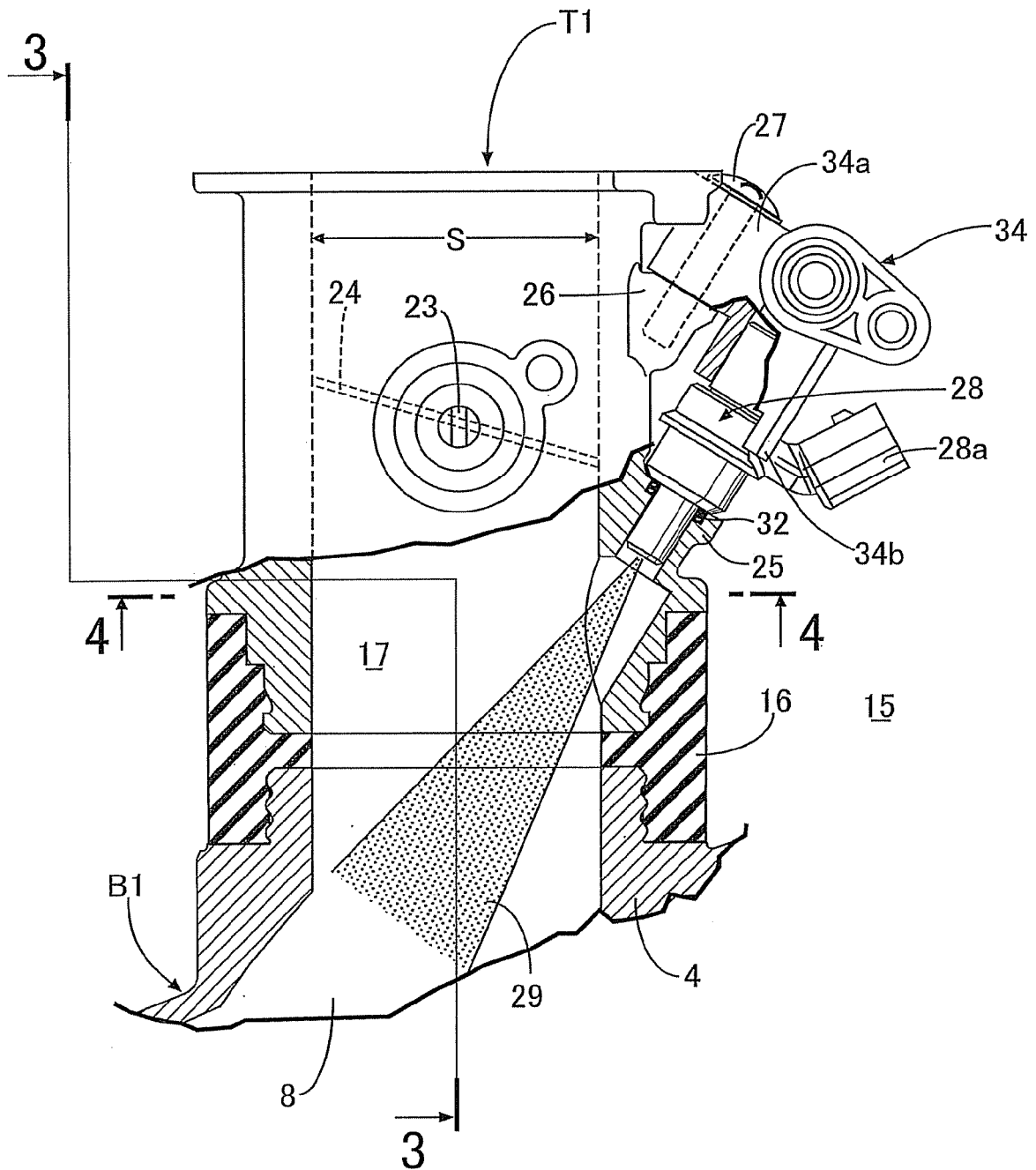


FIG.4

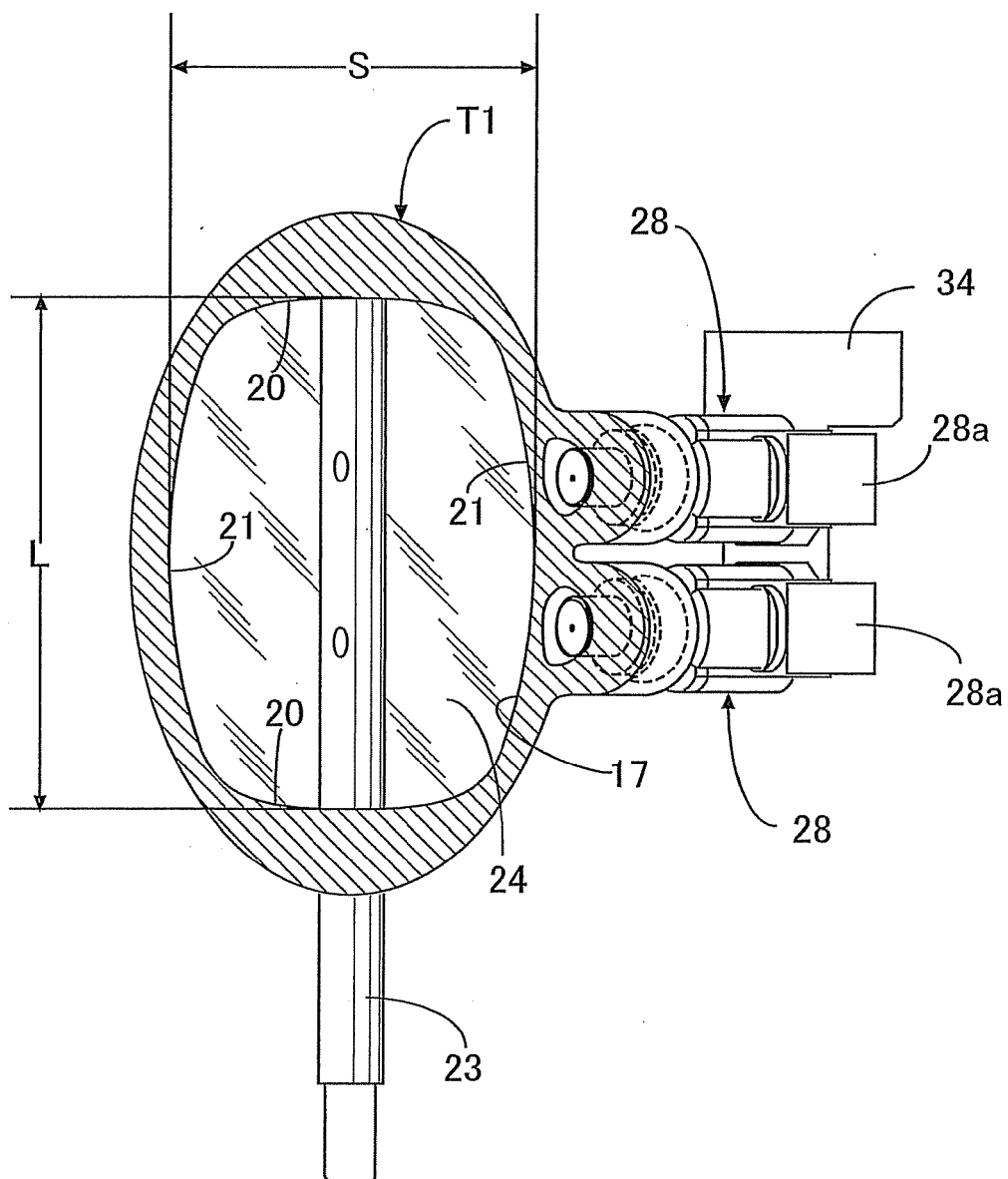
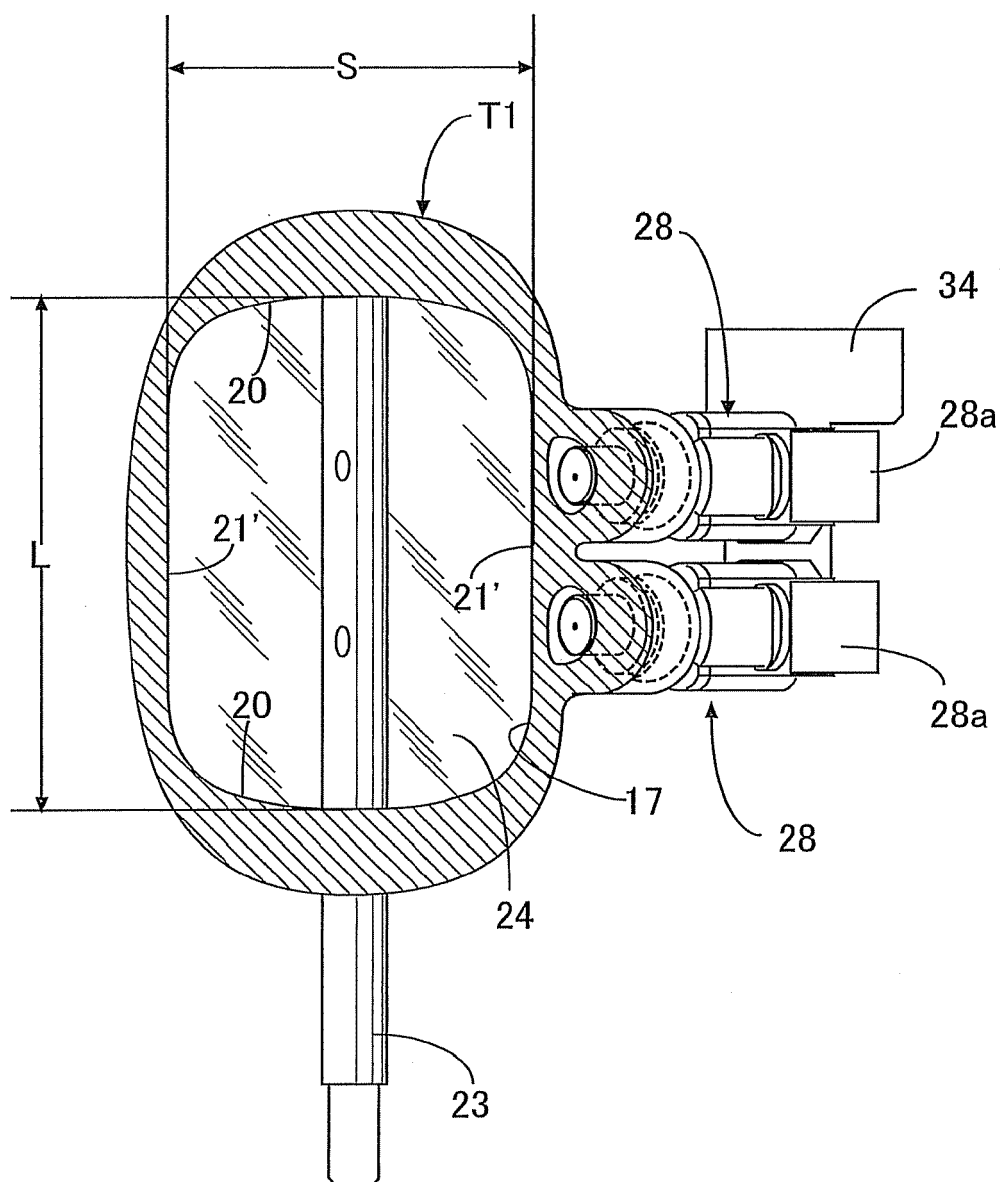


FIG.5





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EP 09 17 1587

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Place of search Munich		Date of completion of the search 25 January 2010	Examiner Mallo López, Manuel
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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