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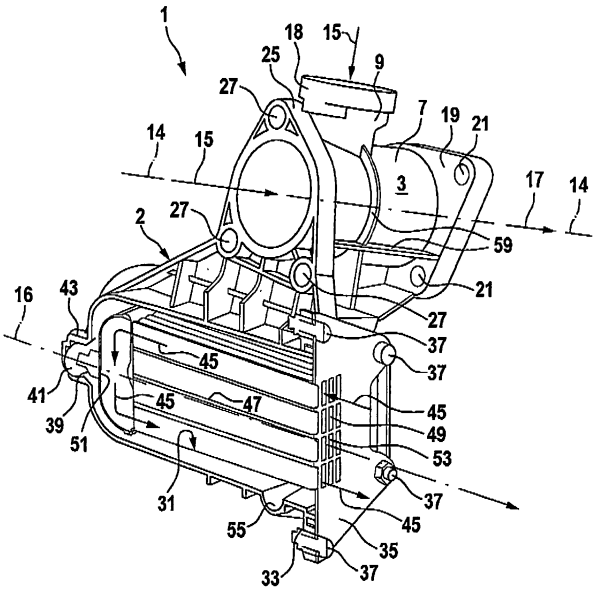
(54) **Charge fluid intake module, charge fluid intake system, charge fluid intake tract, exhaust gas recirculation system, internal combustion engine**

(57) The invention concerns a charge fluid intake module (1) for an internal combustion engine (11) having a housing (2) which forms a flow path for a gaseous charge fluid (13, 17), in particular air, a gas and/or an air/gas mixture. According to the concept of the invention, it is provided that the housing (2) is designed to receive a heat exchanger (31) for an exhaust gas (45) and substantially in one piece with two housing portions, a connection piece (7) for the charge fluid on the first housing portion (3) being designed for connection to an inlet manifold (83) of a charge fluid intake tract (10).

Fig. 1



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Description

[0001] The invention concerns a charge fluid intake module for an internal combustion engine having a housing which forms a flow path for a gaseous charge fluid. Furthermore, the invention concerns a charge fluid intake tract, an exhaust gas recirculation system and an internal combustion engine.

[0002] A charge fluid intake module of the kind mentioned hereinbefore serves to deliver the gaseous charge fluids suitable for the combustion process in the internal combustion engine, in particular in the form of charge air or charge air/gas mixture, if occasion arises also an exhaust gas or mixtures thereof. In the process, a gaseous charge fluid can appropriately be compressed and cooled.

[0003] Concepts for charge air cooling and/or exhaust gas cooling serve inter alia to reduce pollutants, in particular nitrogen oxides, in the exhaust gas.

[0004] The cooling of a charge air/exhaust gas mixture is described in GB 2 416 001, for example. In a particularly space-saving manner, in the inlet manifold can be arranged a cooling device for an exhaust gas/air mixture flowing in the inlet manifold, as described in DE 10 2004 025 187 B3. The addition of an exhaust gas to charge air here takes place through various openings in a pipe system which is divided into a gas-conducting pipe and a coolant-conducting pipe. An exhaust gas-conducting device leads into the inlet manifold in front of the cooling device in the direction of flow. An integrated charge fluid intake module of this kind which is designed to cool an exhaust gas/air mixture can be designed only to a limited extent with a view to cooling especially the exhaust gas.

[0005] Exhaust gas recirculation in which the exhaust gas is cooled by means of a separate heat exchanger for the exhaust gas in the form of an exhaust gas recirculation cooler is described in US 2005/0034713 A1. With exhaust gas recirculation of this kind, depending on the engine operating point, a portion of the exhaust gas is extracted behind the engine, cooled in a heat exchanger in the form of an exhaust gas cooler and then added to the intake air.

[0006] A heat exchanger designed as a separate component in the form of an exhaust gas cooler for cooling an exhaust gas is provided, in addition to a charge fluid intake module, as a separate unit which is connected to the charge fluid intake module in fluid-conveying relationship only via an interface, for example in the form of a pipe or flange. A disadvantage here is that a charge fluid intake module and a heat exchanger are normally arranged comparatively far away from each other. This results in an elaborate connection which is associated with corresponding costs and which can also be susceptible to breakdown.

[0007] In US 6,311,678 B1 is disclosed a charge fluid intake tract in which a heat exchanger is integrated in the charge fluid intake tract of an internal combustion engine, namely in the inlet manifold, comprising individual intake pipes for the gaseous charge fluid. The charge fluid intake tract comprises a plastic body which comprises an air inlet chamber, an air inlet and one or more individual intake pipes which communicate with the head of an internal combustion engine. The heat exchanger is formed in a further chamber which at least partially consists of plastic material and which forms a first opening to the outside and forms a second opening which communicates with the inlet chamber, and comprises a third opening which communicates with a pipe which provides cooling fluid and a fourth opening which communicates with a pipe which discharges the cooling fluid.

[0008] Admittedly, with a charge fluid intake tract of this kind the elaborateness of the connection is kept comparatively low, but an exhaust gas heat exchanger must be integrated in the charge fluid intake tract in general and can be provided only together with the charge fluid intake tract.

[0009] It would be desirable to reduce the elaborateness of the connection for a charge fluid intake module as far as possible, and yet provide exhaust gas cooling specially designed for the exhaust gas and allow a flexible connection of the charge fluid intake module to a charge fluid intake tract.

[0010] At this point begins the invention, the object of which is to provide an apparatus which allows space-saving intake of charge fluid with comparatively reduced and flexible elaborateness of the connection, and yet cooling specially designed for an exhaust gas within the framework of exhaust gas recirculation.

[0011] Concerning the apparatus, the object is achieved by the invention with a charge fluid intake module of the kind mentioned hereinbefore, in which according to the invention the housing comprises a first housing portion and a second housing portion which are integrally connected to each other, the second housing portion being designed to receive a heat exchanger for an exhaust gas, and the first housing portion comprising a connection piece for the gaseous charge fluid connected integrally to the first housing portion, and the first housing portion comprising a connection piece for the exhaust gas connected integrally to the first housing portion, the connection piece for the charge fluid being designed for connection to an inlet manifold.

[0012] The invention starts from the consideration that an arrangement of an exhaust gas heat exchanger and a charge fluid intake module comparatively close together, which is equally designed for exhaust gas cooling, is advantageously possible due to the fact that a heat exchanger for the exhaust gas can be arranged in the housing and also according to the concept of the invention the housing is constructed substantially in one piece. The invention recognised that a substantially improved, i.e. in particular reduced and more flexible, connection technique between a heat exchanger for the exhaust gas and a charge fluid intake module can be achieved by an integral housing for the two units, i.e. by a housing which is constructed in one piece, specifically formed in one

piece as a whole. The concept of the invention nevertheless leaves open the option of providing an exhaust gas recirculation pipe to the charge fluid intake module between the heat exchanger for the exhaust gas and the charge fluid intake module, separately and according to the intended purpose. But the concept of the invention ensures that, due to a one-piece housing which firstly is capable of receiving at least one heat exchanger and secondly forms only part of a charge fluid intake tract, in particular a charge fluid intake connection piece, there is provided a charge fluid intake module in which a more extensive connection technique for the relative arrangement of the heat exchanger and part of the charge fluid intake tract can in practice be eliminated. In other words, a housing is provided which, due to a one-piece construction, achieves the relative arrangement of a heat exchanger and only part of the charge fluid intake tract, in particular an intake connection piece.

[0013] According to the concept of the invention, this is achieved above all by the fact that the housing comprises a first housing portion and a second housing portion which are integrally connected to each other, the first housing portion comprising a connection piece for the gaseous charge fluid connected integrally to the first housing portion, and the first housing portion comprising a connection piece for the exhaust gas connected integrally to the first housing portion, the connection piece for the charge fluid being designed for connection to an inlet manifold. An inlet manifold preferably forms part of a charge fluid intake tract. This has the advantage that the charge fluid intake module can be separately connected to the charge fluid intake tract in an advantageous manner. Also, a further connection for example of an exhaust pipe and/or a charge air pipe due to the construction of the first housing portion with the connection piece for the gaseous charge fluid and the connection piece for the exhaust gas proves to be particularly suitable. In a particularly advantageous manner the connection piece for the gaseous charge fluid is formed as a comparatively short pipe connection piece which is designed on the one hand for receiving charge air and on the other hand for discharging the gaseous charge fluid, preferably extends along an axial extent.

[0014] Furthermore, the concept of the invention provides that the second housing portion is designed to receive a heat exchanger for an exhaust gas. Specifically, the second housing portion serves to receive a hot part of a heat exchanger, i.e. in particular a pipe assembly for a hot exhaust gas. The pipe assembly can be accommodated in the second housing portion, the second housing portion in turn being designed for flow of cooling fluid. Advantageously, the second housing portion can be formed from a material which is less heat-resistant compared with the hot part of the heat exchanger, for example a synthetic or plastic or aluminium material or combinations thereof. Advantageously, on the second housing portion are arranged one or more cooling fluid inlets or outlets.

[0015] By this means, in an advantageous manner a module for flexible connection to a charge fluid intake tract and flexible connection to a charge air and/or exhaust gas pipe system is provided, which integrates a receptacle for a heat exchanger and only part of a charge fluid intake tract, namely in front of a branch to individual intake pipes, and hence the corresponding connection technology, as a one-piece component. The module assists at least both exhaust gas cooling and exhaust gas recirculation, and yet ensures that a heat exchanger adjusted for exhaust gas recirculation and the special requirements thereof can be introduced into the housing.

[0016] The invention also leads to a system consisting of a charge fluid intake module according to the concept of the invention and a heat exchanger.

[0017] The invention also leads to a charge fluid intake tract with the charge fluid intake module connected according to the concept of the invention.

[0018] Within the scope of a particularly preferred development of the invention, the charge fluid intake tract and/or the charge fluid intake module additionally comprises

- an inlet manifold for the gaseous charge fluid and/or in particular
- a number of individual intake pipes which are associated with the cylinders of the internal combustion engine and through which the gaseous charge fluid can be delivered to the cylinders of the engine.

These elements can, but do not necessarily have to, be formed integrally with the one-piece housing mentioned above. In particular within the scope of this development of the invention the one-piece housing is arranged for connection in front of the inlet manifold.

[0019] The invention also leads to an exhaust gas recirculation system, in particular a high-pressure exhaust gas recirculation system, having a charge fluid intake module of the kind mentioned.

[0020] A distinction is made between high-pressure exhaust gas recirculation and low-pressure exhaust gas recirculation. With high-pressure exhaust gas recirculation, exhaust gas recirculation takes place between pipe sections which are under a comparatively high pressure, for example from an exhaust gas recirculation pipe which starts in front of an exhaust turbine on the engine output side and ends behind a compressor on the engine input side. By contrast, low-pressure exhaust gas recirculation takes place by exhaust gas recirculation between pipe sections which are under a comparatively low pressure, for example from an exhaust gas recirculation pipe which starts behind an exhaust turbine on the engine output side and ends in front of a compressor on the engine input side.

[0021] Furthermore, the invention leads to an internal combustion engine having a charge fluid intake module according to the concept of the invention. In particular,

not only did the concept of the invention prove to be advantageous with an internal combustion engine in the form of a diesel engine, but also the concept of the invention can be used with an internal combustion engine in the form of an Otto engine.

[0022] Advantageous developments of the invention can be found in the subsidiary claims and indicate in detail advantageous possibilities for realising the concept described above within the framework of the object, as well as with respect to further advantages.

[0023] In a preferred manner, further functions are accommodated in the charge fluid intake module in a space-saving manner. This eliminates further connection techniques which are expensive and susceptible to breakdown, which is to be achieved according to the general concept of the invention.

[0024] Within the scope of a particularly preferred development of the invention, a bypass device for the heat exchanger can be arranged in and/or on the housing. The bypass device or at least part of it can, depending on requirements, be formed in one piece with the housing or mounted on it. Preferably, the bypass device comprises a bypass valve and/or a bypass channel associated with the bypass valve. The bypass device is preferably arranged on the input side of the heat exchanger. Within the scope of a variant, the bypass device can also be formed as part of the heat exchanger.

[0025] Within the scope of a preferred development of the invention, an exhaust gas recirculation valve is arranged in and/or on the housing. Preferably at least a portion of the exhaust gas recirculation valve is formed, preferably integrally, with the housing or can be otherwise mounted on the housing.

[0026] Basically, the charge fluid intake module can be structurally adapted to the circumstances in the engine compartment as required with the one-piece housing which provides the flow path for the gaseous charge fluid and receives the heat exchanger. In the structural embodiment of the housing, the latter comprises according to the concept of the invention a first housing portion and a second housing portion which are integrally connected to each other, i.e. specifically, the two housing portions are formed together as a whole in one piece. The first housing portion preferably serves to provide a charge fluid intake function and the second housing portion is designed to provide the function of exhaust gas cooling, the two housing portions nevertheless being connected to each other as parts of a module formed in one piece. Preferably, the first housing portion and the second housing portion are arranged one under the other in the fitted position and are connected integrally to each other.

[0027] Following the concept of the invention, the first housing portion comprises at least one intake connection piece for the gaseous charge fluid. Following the concept of the invention, the intake connection piece is in a preferred manner connected integrally to the first housing portion, i.e. specifically formed together with a first housing portion in one piece as a whole.

[0028] Similarly, the first housing portion comprises a connection piece for the exhaust gas. Following the concept of the invention, the exhaust gas connection piece is preferably connected integrally to the first housing portion, i.e. specifically formed together with the first housing portion as a whole. According to this development, beside the function of charge air delivery and exhaust gas recirculation, the function of mixing exhaust gas and charge air is integrated in the charge fluid intake module in addition. For this purpose it proved to be particularly advantageous that a connection piece for the gaseous charge fluid and a connection piece for the exhaust gas are formed integrally in the second housing portion and connected to each other in communicating relationship, in particular realised in the form of a T-piece. It turned out that, as a result, particularly preferred mixing of exhaust gas and charge air can already be achieved in the first housing portion.

[0029] Furthermore, it proved to be advantageous that an exhaust gas recirculation pipe connects a first housing portion and a second housing portion in flow-conducting relationship and is constructed as a part, preferably as a one-piece part, on or with the housing. An exhaust gas recirculation pipe in a variant can also be mounted as a separate part on the housing.

[0030] The second housing portion is designed to receive a heat exchanger for the exhaust gas. Basically, the shape of the second housing portion can be adapted to the circumstances of the heat exchanger. It proved to be particularly advantageous that the second housing portion forms a cup-shaped receptacle for the heat exchanger. This has advantages in assembly of the heat exchanger and the housing.

[0031] In an advantageous development it is provided that the housing is designed to receive a heat exchanger in a U-flow construction. In particular, the heat exchanger can advantageously be held on one side on an end flange of the second housing portion. In addition or alternatively, it proved to be advantageous that the heat exchanger is held on the other side in a centring hole of the second housing portion. This has the advantage that the heat exchanger can easily be introduced into the second housing portion within the framework of assembly and, for example with a guide tip, can already be placed correctly in the centring hole.

[0032] Preferably, the centring hole is provided with a damping and/or insulating element which is capable of protecting the heat exchanger against vibrations, for example via a centring tip thereof.

[0033] It proved to be advantageous that the charge fluid intake module, in particular at least one outer side of the second housing portion, is provided with cooling and/or reinforcing ribs. As a result the dissipation of heat from the one-piece housing can be increased appreciably. Furthermore, the one-piece housing can very generally be provided with ribs for reinforcement thereof. A reinforcing rib can additionally be designed as a cooling

rib.

[0034] Basically, the first housing portion and the second housing portion can be oriented in any fashion relative to each other. It proved to be particularly advantageous that a longitudinal extent of the first housing portion is oriented transversely to a longitudinal extent of the second housing portion. As a result in a particularly preferred manner a flow-conducting connection can be provided between the first housing portion and the second housing portion, which furthermore can be accommodated in an engine compartment in a space-saving manner.

[0035] Preferably, the first housing portion comprises a flange which serves as a connecting portion between the first housing portion and the second housing portion. Preferably the flange is designed as a flange of the intake connection piece. This has the advantage that a flange provided on the one-piece housing can additionally be used as a connecting portion between the first housing portion and the second housing portion.

[0036] Within the scope of a particularly preferred structural embodiment, the flange has a substantially triangular, planar construction. Preferably, a surface normal of the flange points in the direction of a longitudinal extent of the first housing portion and transversely to the direction of a longitudinal extent of the second housing portion. Such an arrangement proved to have particular advantages for the construction of the connecting portion. In an advantageous manner, the second housing portion integrally adjoins one side of the flange.

[0037] Basically, the housing of the charge fluid intake module can be manufactured in any appropriate manner. Construction of the housing as a casting proved to be particularly preferred, in particular as an injection moulding. Only plastic and/or aluminium are particularly suitable as the materials. A plastic injection moulding can be made particularly cheaply.

[0038] In general, the concept of the invention leads to a charge fluid intake module which is provided in modular fashion as part of a charge fluid intake tract as a modular part, at least having an intake function and a cooling function adapted to the exhaust gas. As a result, the elaborateness of assembly and connection is reduced when a heat exchanger is further mounted relative to the charge fluid intake tract, and leads to cost advantages in manufacture and assembly.

[0039] Practical examples of the invention will now be described below with the aid of the drawings. These are not necessarily intended to show the practical examples to scale, but instead the drawings, where appropriate for illustration, are in schematised and/or slightly distorted form. With respect to supplementing the instructions which can be seen immediately from the drawings, reference is made to the relevant state of the art. It must be taken into consideration here that many modifications and changes can be made in relation to the form and detail of an embodiment, without deviating from the general idea of the invention. The characteristics of the invention disclosed in the description, in the drawings and in the claims may be essential both individually and in any combination for the development of the invention. Also within the scope of the invention are all combinations of two or more of the characteristics disclosed in the description, the drawings and/or the claims. The general idea of the invention is not confined to the exact form or detail of the preferred embodiment shown and described below, or confined to a subject which would be restricted in comparison with the subject claimed in the claims. With given dimensional ranges, values which are within the limits mentioned are also intended to be disclosed as limit values and can be used and claimed as desired.

In detail, the drawings show:

[0040]

Figure 1: a perspective view partly in section, with a section along A - A in Figure 2, of a preferred embodiment of a charge fluid intake module according to the concept of the invention with inserted heat exchanger in the second portion of the housing;

Figure 2: the charge fluid intake module according to Figure 1 in a top view;

Figure 3: the charge fluid intake module of Figure 1 in a side view partly in section, with a section along A - A in Figure 2;

Figure 4: the charge fluid intake module according to Figure 1 in a side view;

Figure 5: the charge fluid intake module of Figure 1 in a side view which is the opposite to Figure 4;

Figure 6: a charge fluid intake tract having an exhaust gas recirculation system and the charge fluid intake module according to Figure 1 to Figure 5;

Figure 7: a view of the charge fluid intake module from below when arranged in a charge fluid intake tract of Figure 6;

Figure 8: an oblique view of the charge fluid intake tract with engine, which is the opposite to Figure 6.

[0041] Figure 1 to Figure 5 show a charge fluid intake module 1 according to the concept of the invention in a particularly preferred embodiment. Identical reference numbers are used for the same parts in the figures. Figure 2 shows the part-section view of Figure 1 and Figure 3 along the line A - A.

[0042] The charge fluid intake module 1 is provided for

a charge fluid intake tract 10 shown in more detail in Figure 6 to Figure 8, for an internal combustion engine 11 which in the present case is in the form of a diesel engine. The charge fluid intake module 1 comprises a housing 2 having a first housing portion 3 and a second housing portion 5 which are integrally connected to each other. The first housing portion 3 serves to deliver charge fluid to an internal combustion engine 11, described in more detail in Figure 6 to Figure 8, within the framework of a charge fluid intake tract 10, and is in the form of a tubular intake connection piece 7 which is also, in the form of a T-shaped part, additionally connected to a further connection piece 9 for an exhaust gas 15. while the charge fluid 13 is delivered through the intake connection piece 7 to the charge fluid intake tract 10 in the form of charge air delivered as fresh air, exhaust gas 15 is delivered via the connection piece 9 to the intake connection piece 7 in the T-shaped crossing zone and added to the fresh air. At the other end of the connection piece 7, the charge air/exhaust gas mixture 17 leaves the intake connection piece 7 and is delivered to the charge fluid intake tract 10 shown in more detail in Figure 6 to Figure 8.

[0043] For connection of the connection piece 9 to an exhaust gas recirculation pipe 77 described more detail with reference to Figure 6 to Figure 8 and its flange connection 79, the connection piece 9 comprises a flange 18.

[0044] For connection of the intake connection piece 7 to the charge fluid intake tract 10, the rear portion of the intake connection piece 7 comprises a flange 19 which is provided with holes 21 for connecting it to a corresponding counter-flange 23 of the charge fluid intake tract 10, shown in more detail in Figure 6 to Figure 8. The front portion of the intake connection piece 7 is provided with a further flange 25 which in the present case has a triangular, planar construction, in the corners of which are in turn provided openings 27 for connection to a counter-flange 29 of a charge fluid intake tract 10 shown in more detail in Figure 6 to Figure 8. The first housing portion 3 extends, essentially due to the intake connection piece 7, along a longitudinal extent 14 which is predetermined by the arrows at reference numbers 13 and 17 and which essentially also forms the surface normal of the triangular, planar construction of the flange 25. Transversely to the longitudinal extent of the first housing portion runs a longitudinal extent 16 of the second housing portion 5 which in the present case in the fitted position is arranged below the first housing portion 3 and, as described, transversely thereto.

[0045] According to the concept of the invention, the two housing portions 3 and 5 via the flange 25 which serves as the connecting portion form part of a one-piece housing 2 and are in general manufactured as a plastic injection moulding.

[0046] The second housing portion 5 is in the present case in the form of a cup-shaped receptacle for a heat exchanger 31 and on the one hand comprises an end flange 33 on which a block end element 35 of the heat exchanger 31 is held by screw connections 37. On the other hand the heat exchanger 31 is held with a centring pin 39 and a damping element 41 in a centring hole 43 of the second housing portion 5. This construction of the second housing portion 5 as a cup, formed in one piece with the first housing portion 3 and the flange 25 as a connecting portion, allows particularly easy assembly during manufacture of the charge fluid intake module 1 and the heat exchanger 31. The heat exchanger 31 is with the centring pin 39 first embedded in the centring hole 43 of the second housing portion 5, and is therefore already in a position according to requirements, so that fixing of the heat exchanger by the above-mentioned screws 37 can then take place via the block end element 35 and the flange 33 of the second housing portion 5.

[0047] In the present case the second housing portion 5 is designed to receive the heat exchanger 31, here formed in a U-flow construction. An exhaust gas stream is here marked by arrows - the exhaust gas 45 enters flow channels 49 located on one side of a partition 47, flows through them as far as a deflecting cover 51, and is then conducted out of the heat exchanger 31 into flow channels 53 located on the other side of the partition 47.

[0048] The quantity of heat entrained by the exhaust gas is discharged in the heat exchanger 31 to a cooling fluid 56, not shown in more detail, here in the form of a water-based coolant. The second housing portion 5 for this purpose provides a coolant inlet connection piece 55 and a coolant outlet connection piece 57 which are both shown in more detail in Figure 5.

[0049] The cooling fluid 56 here circulates round the heat exchanger part 31 through which flows the exhaust gas stream and which is therefore, to put it more precisely, comparatively hot, and thus cools the exhaust gas stream. As the second housing portion 5 therefore has a lower temperature than the heat exchanger part 31, the second housing portion 5 can be formed integrally with the first housing portion, also from a less heat-resistant material than the heat exchanger part 31, for example a synthetic or plastic material or here as an aluminium material. The hotter heat exchanger part 31 is here referred to as a heat exchanger 31 for simplicity's sake, but it should be understood that the heat exchanger 31 in general is formed by the hotter heat exchanger part and the second housing portion 5.

[0050] To stabilise the heat fluid intake module 1 structurally, on the first housing portion both in the axial longitudinal extent 14 and in the peripheral direction are mounted ribs 59 which in particular stabilise the flanges 25, 19 in conjunction with the intake connection piece 7. Further ribs 61 run on the inside of the flange 25 and its extension which serves the function of a connecting portion, towards the second housing portion 5. The second housing portion 5 also has ribs 63 running along its longitudinal extent 16 and perpendicularly thereto.

[0051] The manner of operation of a charge air intake tract 10 for an internal combustion engine 11 can be seen from Figure 6 to Figure 8.

[0052] In an appropriate manner, after a starting phase

via an exhaust gas recirculation valve 71, a bypass device 73 not shown in more detail in Figure 8, here in the form of a valve, is activated for the exhaust gas cooler 31. Exhaust gas 45 is delivered from the exhaust gas cooler 31 in the second housing portion 5 through the block end element 35 via an exhaust gas recirculation pipe 77 connected to a flange 75, in cooled form to the connection piece 9 for cooled exhaust gas 15. The exhaust gas recirculation pipe 77 is for this purpose connected to the connection piece 9 by a corresponding flange connection 79.

[0053] In the manner illustrated in Figure 4 by arrows for the exhaust gas 15, the cooled exhaust gas 15 in the intake connection piece 7 of the first housing portion 3 is added to the fresh air delivered through a fresh-air receiving region 81 in the form of charge air in the region of the intake connection piece 7. To improve the quality of mixing or reduce a pressure loss, in the T-piece region or downstream or in the intake connection piece 7, mixing elements not shown in more detail here and preferably integrally connected to the housing 2 such as a nozzle-like modification of the connection piece 9 in the region of the opening to the intake connection piece 7, mixing vanes or permeable elements can modify the flow path or be arranged therein. The exhaust gas/air mixture 17 is then delivered to an inlet manifold 83 for the gaseous charge fluid in the form of a mixture of charge air and exhaust gas. The inlet manifold 83 distributes the gaseous charge fluid to a number of individual intake pipes 85 which are associated with the cylinders of the internal combustion engine 11 and via which the gaseous charge fluid is delivered to the cylinders of the engine 11 and there consumed in the combustion process.

[0054] The charge fluid intake module 1 in its one-piece form as described with reference to Figure 1 to Figure 5 is therefore arranged in front of the inlet manifold 83 of the charge fluid intake tract 10. The continuing charge fluid intake tract 10, in particular the inlet manifold 83 on the one hand and the fresh-air receiving assembly 81 is connected to the charge fluid intake module 1 by the flanges 25, 19 of the charge fluid intake module 1 shown in Figure 1 to Figure 5.

[0055] To sum up, the invention concerns a charge fluid intake module 1 for an internal combustion engine 11 having a housing 2 which forms a flow path for a gaseous charge fluid 13, in particular air, a gas and/or an air/gas mixture. According to the concept of the invention, it is provided that the housing 2 is arranged for receiving a heat exchanger 31 for an exhaust gas 45 and the housing 2 is essentially constructed in one piece with two housing portions 3, 5, a connection piece 7 for the charge fluid on the first housing portion 3 being designed for connection to an inlet manifold 83 of a charge fluid intake tract 10.

Claims

1. Charge fluid intake module (1) for an internal combustion engine (11) having a housing (2) which forms a flow path for a gaseous charge fluid (13), in particular air, a gas and/or an air/gas mixture;
characterised in that
the housing (2) comprises a first housing portion (3) and a' second housing portion (5) which are integrally connected to each other, the second housing portion (5) being designed to receive a heat exchanger (31) for an exhaust gas (45), and the first housing portion (3) comprising a connection piece (7) for the gaseous charge fluid (13) connected integrally to the first housing portion (3), and the first housing portion (3) comprising a connection piece (9) for the exhaust gas (15) connected integrally to the first housing portion (3), the connection piece (7) for the charge fluid being designed for connection to an inlet manifold (83).

2. Charge fluid intake module (1) according to claim 1,
characterised in that
a bypass device (73) for the heat exchanger (31), in particular a bypass valve, is arranged in and/or on the housing (2), in particular on the input side of the heat exchanger (31).

3. Charge fluid intake module (1) according to claim 1 or 2,
characterised in that
an exhaust gas recirculation valve (71) is arranged in and/or on the housing (2).

4. Charge fluid intake module (1) according to any of claims 1 to 3,
characterised in that
the connection piece (7) for the charge fluid and/or the connection piece (9) for the exhaust gas is tubular.

5. Charge fluid intake module (1) according to any of claims 1 to 4,
characterised in that
the connection piece (7) for the charge fluid and/or the connection piece (9) for the exhaust gas is designed for connection to an inlet manifold (83) and/or a pipe, in particular comprises a flange (25, 19, 18) for connection to a pipe.

6. Charge fluid intake module (1) according to any of claims 1 to 5,
characterised in that
the connection piece (7) for the charge fluid in an axial longitudinal extent (14) is designed on the one hand for receiving charge air (13) and on the other hand for discharging the gaseous charge fluid (17).

7. Charge fluid intake module (1) according to any of claims 1 to 6,
characterised in that
the connection piece (7) for the gaseous charge fluid (13) and the connection piece (9) for the exhaust gas (15) are formed as a T-shaped part on the first housing portion (3).

8. Charge fluid intake module (1) according to any of claims 1 to 7, further comprising:
an exhaust gas recirculation pipe (77) which connects a first housing portion (3) to a second housing portion (5) in flow-conducting relationship.

9. Charge fluid intake module (1) according to any of claims 1 to 8,
characterised in that
the second housing portion (5) comprises a cup-shaped receptacle for the heat exchanger (31) for the exhaust gas (45).

10. Charge fluid intake module (1) according to any of claims 1 to 9,
characterised in that
the housing, in particular the second housing portion (3), is designed to receive a heat exchanger (31) in a U-flow construction.

11. Charge fluid intake module (1) according to any of claims 1 to 10,
characterised in that
the second housing portion (5) comprises an end flange (33) on which the heat exchanger (31) is held on one side.

12. Charge fluid intake module (1) according to any of claims 1 to 11,
characterised in that
the second housing portion (5) comprises a centring hole (43), preferably with a damping and/or insulating element (41), in which the heat exchanger (31) is held on the other side preferably with a damping and/or insulating element.

13. Charge fluid intake module (1) according to any of claims 1 to 12,
characterised in that
the housing (2), at least one outer side of the second housing portion (5), comprises cooling and/or reinforcing ribs (59, 61, 63).

14. Charge fluid intake module (1) according to any of claims 1 to 13,
characterised in that
the first housing portion (3) and the second housing portion (5) are arranged one under the other in the fitted position.

15. Charge fluid intake module (1) according to any of claims 1 to 14,
characterised in that
a longitudinal extent (14) of the first housing portion (3) is oriented transversely to a longitudinal extent (16) of the second housing portion (5).

16. Charge fluid intake module (1) according to any of claims 1 to 15,
characterised in that
the first housing portion (3) comprises a flange (25) which serves as a connecting portion between the first housing portion (3) and the second housing portion (5), in particular for an intake connection piece (7).

17. Charge fluid intake module (1) according to any of claims 1 to 16,
characterised in that
a connecting portion, in particular a flange (25), has a substantially triangular, planar construction, and in particular comprises a surface normal in the direction of a longitudinal extent (14) of the first housing portion (3) and transversely to the direction of a longitudinal extent (16) of the second housing portion (5).

18. Charge fluid intake module (1) according to any of claims 1 to 17,
characterised in that
a second housing portion (5) integrally adjoins one side of a connecting portion, in particular a flange (25).

19. Charge fluid intake module (1) according to any of claims 1 to 18,
characterised in that
the housing (2) is formed as a casting, in particular as an injection moulding, preferably from plastic and/or aluminium.

20. System consisting of a charge fluid intake module according to any of claims 1 to 19 and a heat exchanger, in particular a heat exchanger in a U-flow construction.

21. Charge fluid intake tract (10) for an internal combustion engine (11) having a charge fluid intake module according to any of claims 1 to 19, in particular further comprising:

- an inlet manifold (83) for the gaseous charge fluid; and/or in particular
- a number of individual intake pipes (85) which are associated with the cylinders of the internal combustion engine (11) and through which the gaseous charge fluid (13) can be delivered to the cylinders of the engine (11);
- the one-piece housing (2) being arranged in

front of the inlet manifold (83).

22. Exhaust gas recirculation system, in particular high-pressure exhaust gas recirculation system, having a charge fluid intake module (1) according to any of claims 1 to 19.

23. Internal combustion engine (11) having a charge fluid intake module (1) according to any of claims 1 to 19.

Fig. 1

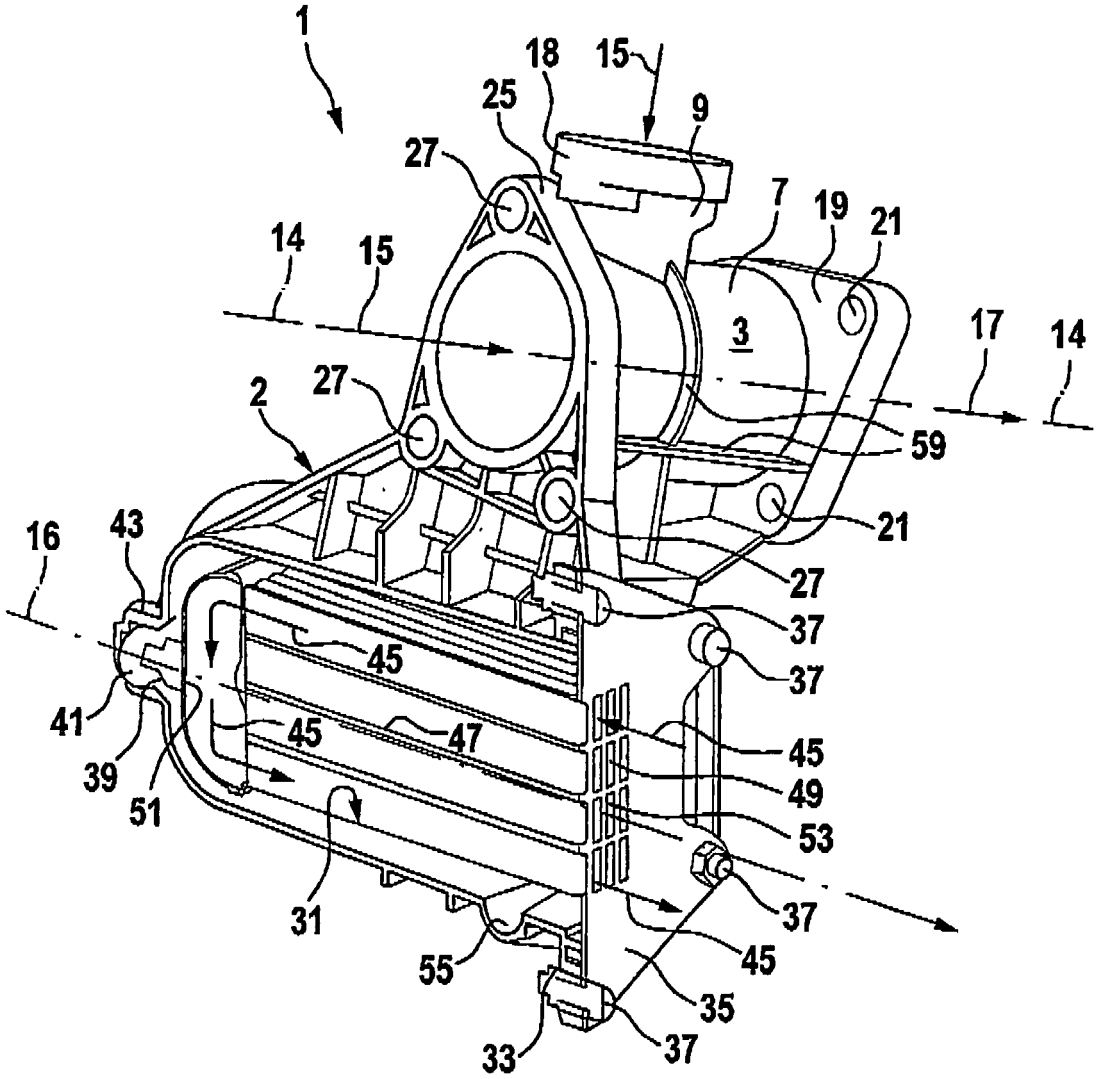
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Fig. 2

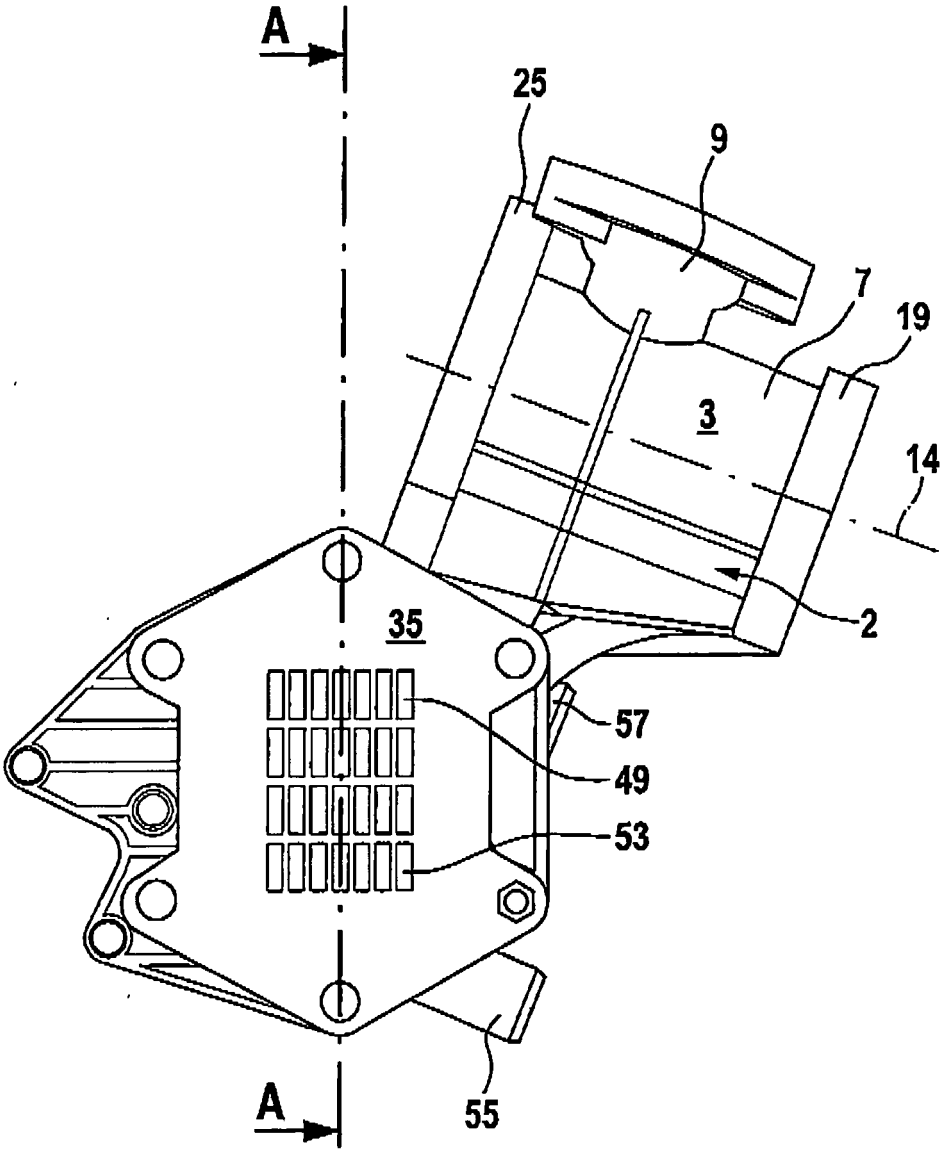


Fig. 3

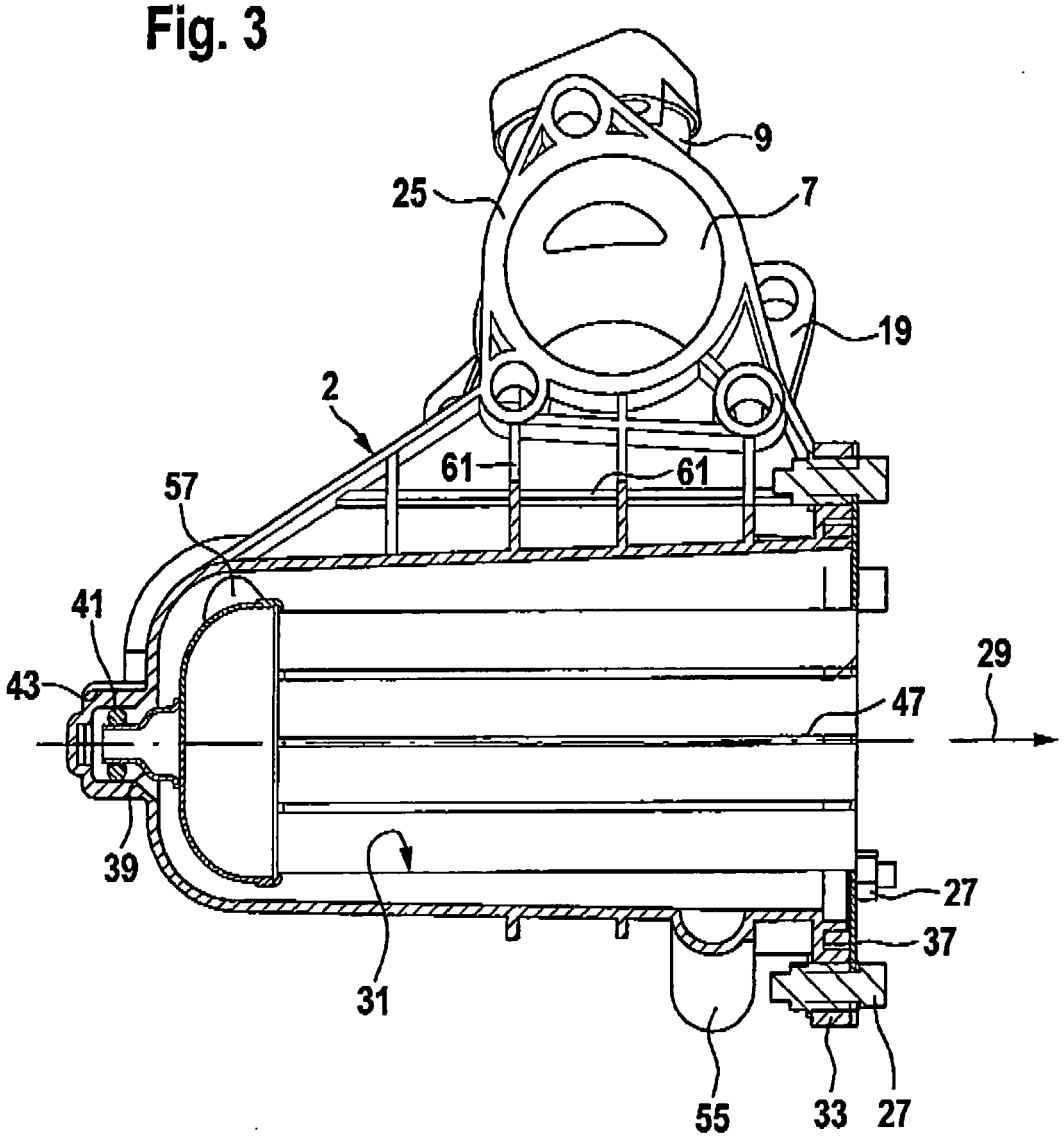


Fig. 4

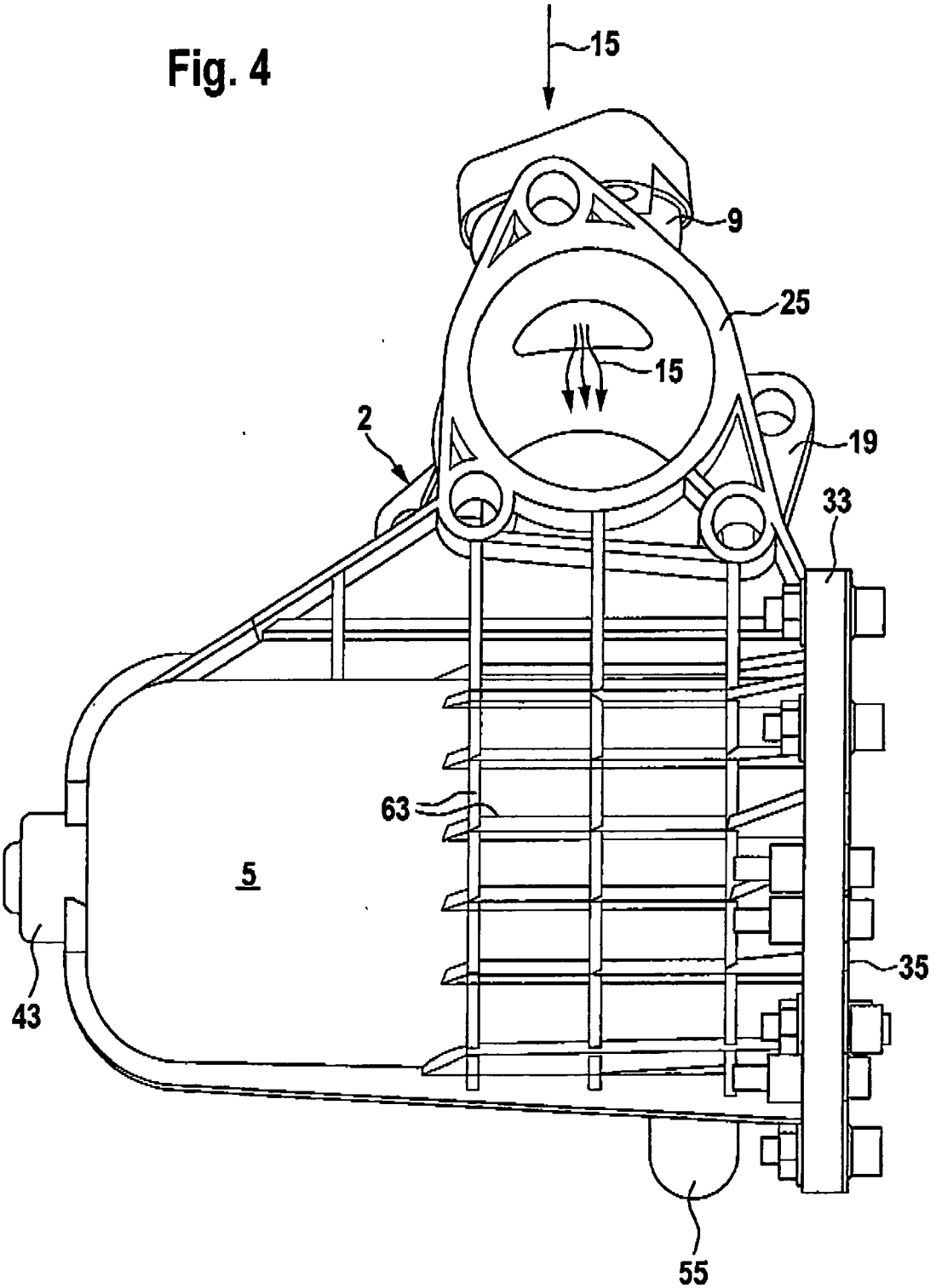


Fig. 5

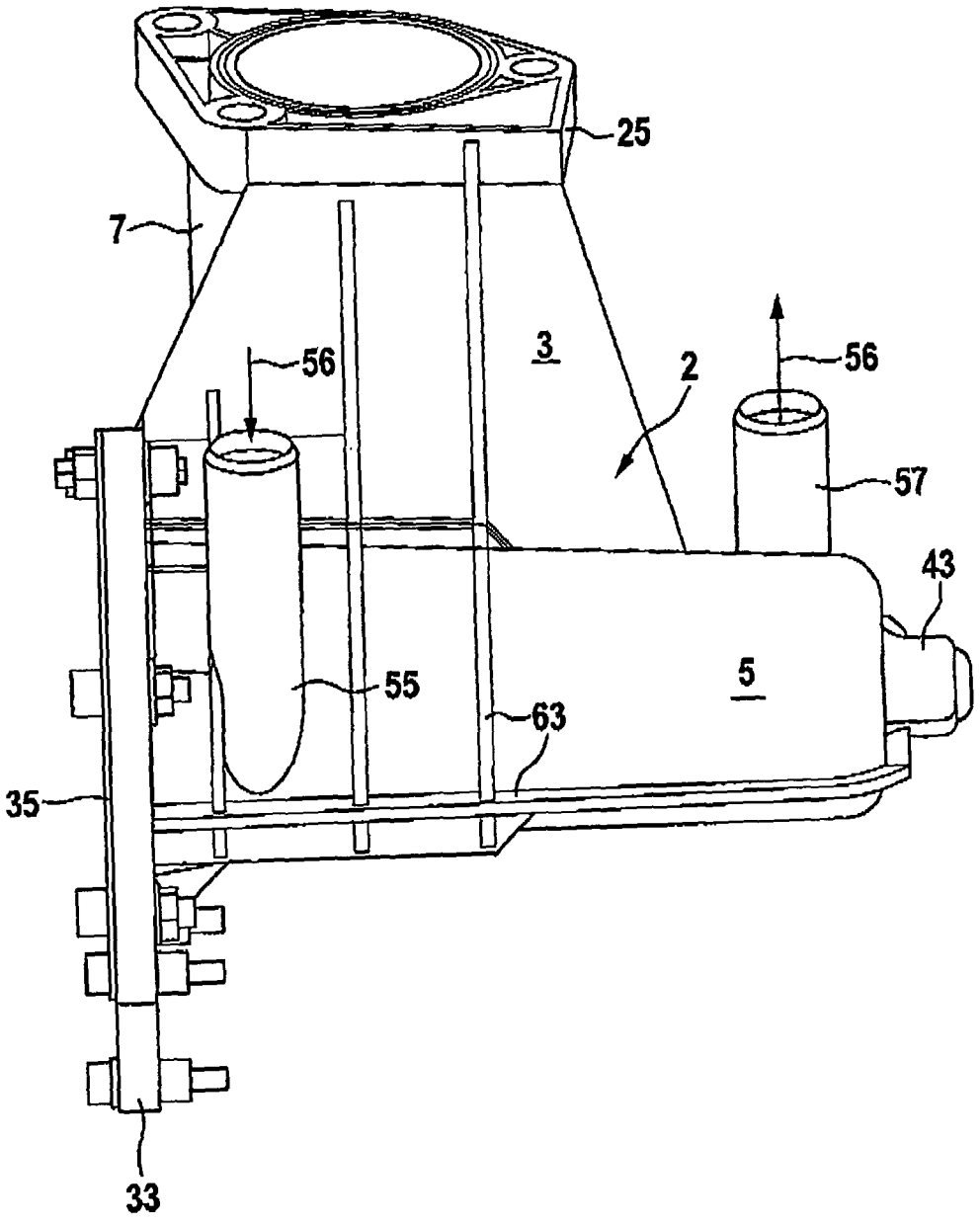
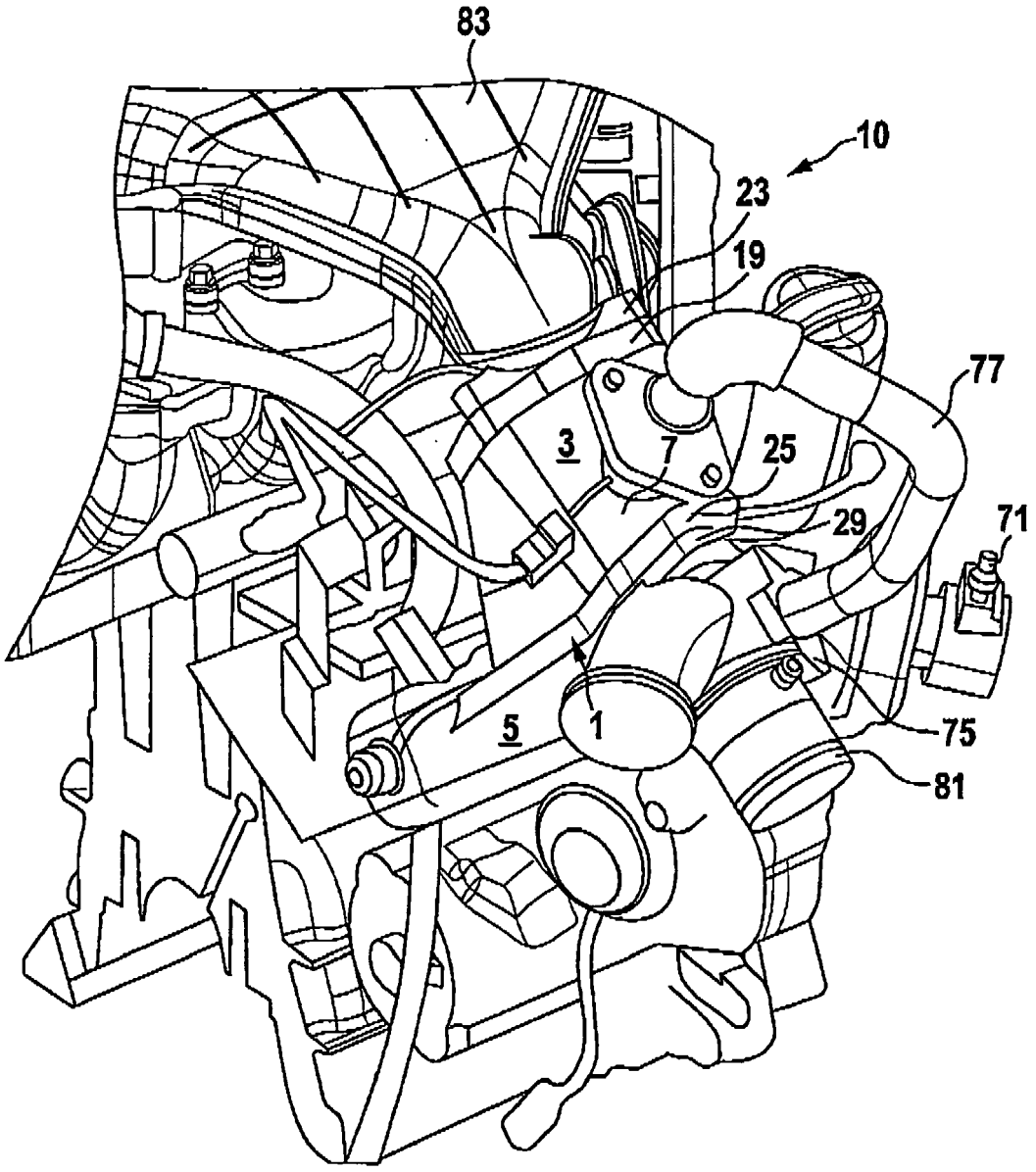


Fig. 6



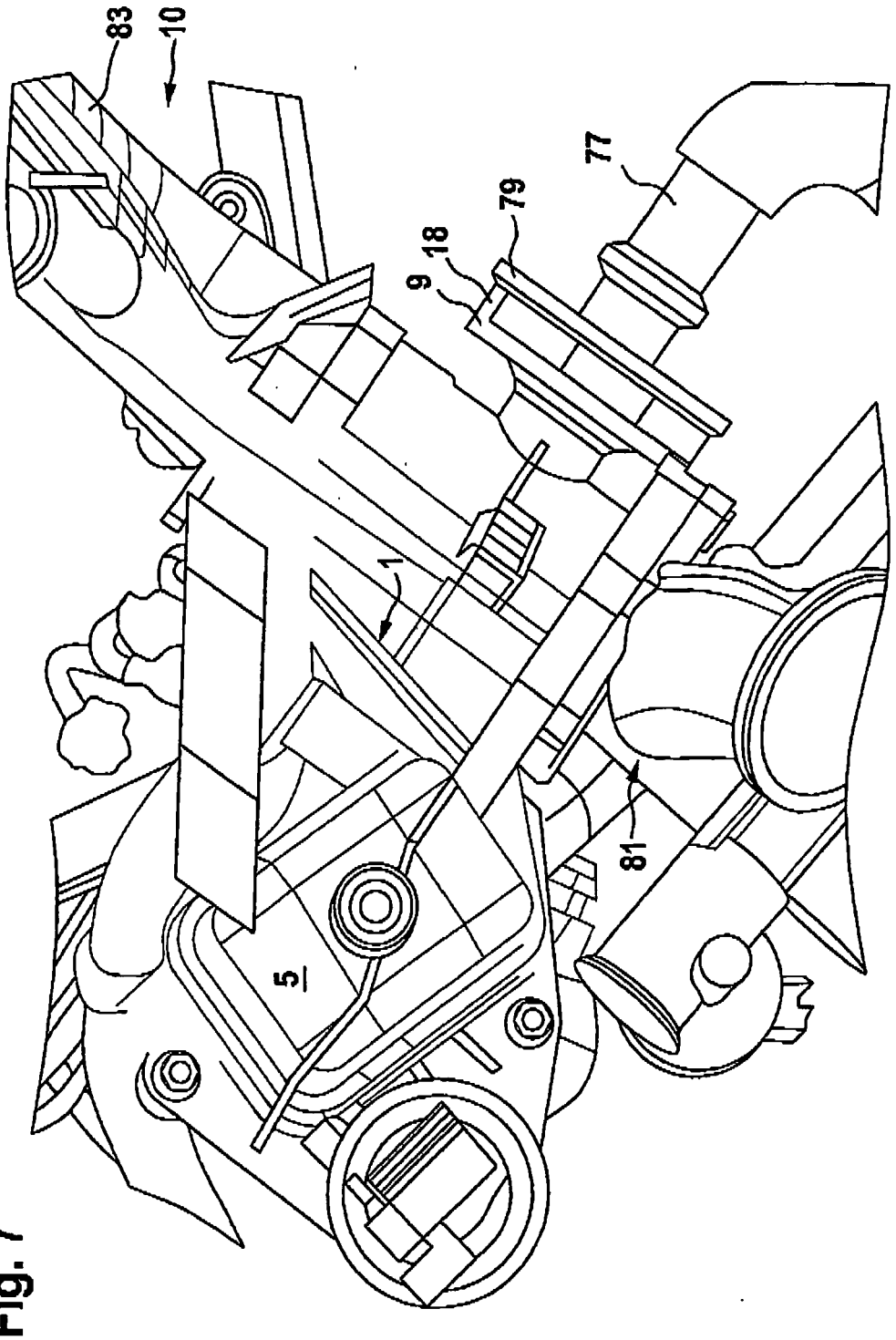
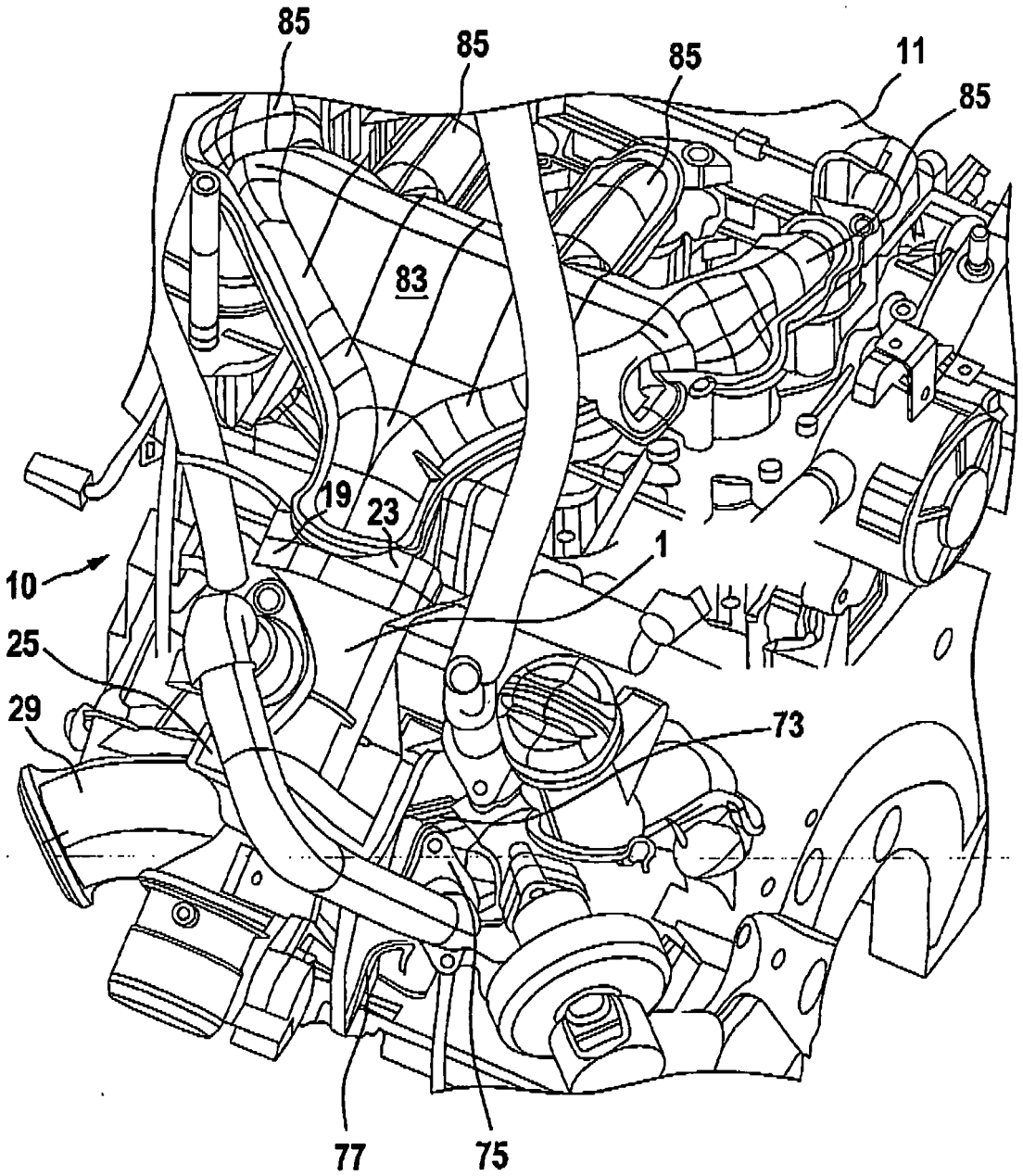


Fig. 7

Fig. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 07 02 1265

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 March 2008	Dorfstätter, Markus

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