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(54) Internal combustion engine exhaust device

(57) An exhaust device (1) for internal combustion engines (2), having a main catalyst (3), an auxiliary catalyst (4), and an exhaust manifold (5) connecting the input of the main catalyst (3) to the exhaust outlets of the internal combustion engine (2), so as to feed the exhaust gases from the exhaust outlets to the main catalyst (3); the exhaust manifold (5) assuming a first operating configuration connecting the input of the main catalyst (3) to the output of the auxiliary catalyst (4), and the input of the auxiliary catalyst (4) to the internal combustion engine (2), and a second operating configuration connecting the input of the main catalyst (3) directly to the internal combustion engine (2) and excluding the auxiliary catalyst (4).

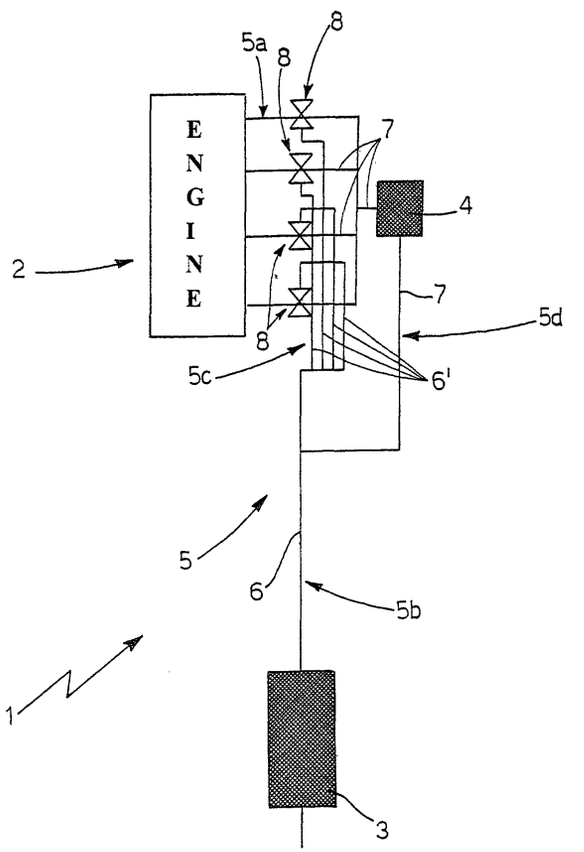

Fig.1

EP 1 188 909 A2

Description

[0001] The present invention relates to an internal combustion engine exhaust device.

[0002] More specifically, the present invention relates to an exhaust device for high-performance car explosion engines, to which the following description refers purely by way of example.

[0003] As is known, over the past few years, pollution standards governing the polluting emissions of cars have become increasingly strict.

[0004] In particular, there has been a gradual lowering of the maximum tolerance thresholds of various polluting substances emitted by car combustion engines, such as unburned hydrocarbons, carbon monoxide or nitric oxide, and measuring procedures have been revised so that greater importance is now placed, in the overall evaluation, on polluting emissions produced immediately following cold start-up of the engine.

[0005] Tests, in fact, have shown that most polluting substances are emitted by vehicles in the time interval between start-up of the engine and the catalyst, integrated in the vehicle exhaust device, reaching working temperature.

[0006] To conform with current pollution standards, the car industry, over the past few years, has developed exhaust devices featuring, upstream from the main catalyst, a small auxiliary catalyst, or so-called "precatalyst", which exploits the high temperature of the exhaust gases from the engine to reach working temperature rapidly and so make up for the poor efficiency of the main catalyst until this, too, reaches its own working temperature.

[0007] Unfortunately, the operating conditions of the auxiliary catalyst become increasingly severe the closer it gets to the engine exhaust outlets, so that location of the auxiliary catalyst downstream from the engine must be assessed carefully to strike the best compromise between minimizing the time taken by the auxiliary catalyst to reach working temperature, and ensuring an acceptable working life of the catalyst.

[0008] Tests, in fact, have shown that locating the auxiliary catalyst closer to the explosion engine reduces the time taken for it to reach working temperature, but also results in a rapid reduction in its average working life.

[0009] In the case of high-performance car explosion engines, the stream of exhaust gases from the engine is such that, to keep polluting emissions within the prescribed limits of current pollution standards, the auxiliary catalyst would have to be located so close to the engine exhaust outlets as to result in rapid structural impairment of the catalyst. Moreover, locating the auxiliary catalyst close to the engine exhaust outlets produces counterpressures which impede outflow of the exhaust gases from the outlets and impair engine efficiency in normal operating conditions, i.e. when the main catalyst reaches working temperature.

[0010] To achieve an acceptable average working life of the auxiliary catalyst, exhaust devices have recently been experimented in which the auxiliary catalyst is provided internally with a bypass valve allowing the exhaust gases from the engine to bypass the active part of the auxiliary catalyst and so reduce the thermal stress to which the catalyst is subjected.

[0011] Unfortunately, all the solutions tested so far have proved ineffective: the thermal stress to which auxiliary catalysts with bypass valves are subjected is so severe as to require the use of highly expensive materials and technical solutions which greatly increase the overall manufacturing cost of the exhaust device.

[0012] Moreover, auxiliary catalysts with bypass valves continue to produce counterpressures at the engine exhaust outlets, as well as undesired dynamic pulsations, thus impairing the performance and overall efficiency of the explosion engine. Though negligible when dealing with conventional explosion engines, such impairment is totally unacceptable in the case of explosion engines of high-performance vehicles.

[0013] It is an object of the present invention to provide an internal combustion engine exhaust device designed to enable high-performance explosion engines to conform, cheaply and with no impairment in performance, with current pollution standards.

[0014] According to the present invention, there is provided an exhaust device for internal combustion engines, comprising a main catalyst, an auxiliary catalyst, and an exhaust manifold connecting the input of the main catalyst to the exhaust outlets of a generic internal combustion engine, so as to feed the exhaust gases from said exhaust outlets to the main catalyst; the exhaust device being characterized in that said exhaust manifold may selectively assume a first operating configuration connecting the input of the main catalyst to the output of the auxiliary catalyst, and the input of the auxiliary catalyst to said internal combustion engine, and a second operating configuration connecting the input of the main catalyst directly to the internal combustion engine and excluding the auxiliary catalyst.

[0015] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawing, in which:

Figure 1 shows, schematically, an internal combustion engine exhaust device in accordance with the teachings of the present invention;

Figure 2 shows a view in perspective of a possible practical embodiment of the Figure 1 exhaust device;

Figure 3 shows a view in perspective, with parts in section and parts removed for clarity, of a component part of the Figure 2 exhaust device;

Figures 4 and 5 show views in perspective of the Figure 3 component part in two different operating positions.

[0016] With reference to Figures 1 and 2, number 1

indicates as a whole an internal combustion engine exhaust device, particularly suitable for connection to the explosion engine 2 of any vehicle, and particularly to the explosion engine of a high-performance vehicle.

[0017] Exhaust device 1 is connected to the exhaust outlets (not shown) of explosion engine 2 of the vehicle to expel from the vehicle the exhaust gases produced by the engine, while at the same time reducing the noise level of the engine and converting the polluting substances in the engine exhaust gases into substances less damaging to the environment.

[0018] For the sake of simplicity, specific reference is made in the following description to an exhaust device 1 for connection to a four-cylinder explosion engine 2 having four exhaust outlets.

[0019] With reference to Figures 1 and 2, exhaust device 1 comprises a main catalyst 3; an auxiliary catalyst 4; and an exhaust manifold 5 for connecting the input of main catalyst 3 to the exhaust outlets of explosion engine 2, so as to feed the exhaust gases from the exhaust outlets to main catalyst 3.

[0020] Auxiliary catalyst 4 is a conventional type with no bypass valve, integrated or otherwise; and exhaust manifold 5 may selectively assume two distinct operating configurations: a first in which the exhaust gases are fed through auxiliary catalyst 4 before reaching the input of main catalyst 3; and a second in which the exhaust gases are fed directly to the input of main catalyst 3, without going through auxiliary catalyst 4.

[0021] In other words, exhaust manifold 5 is divided into an initial portion 5a connected directly to the engine exhaust outlets; an end portion 5b connected directly to main catalyst 3; and two intermediate portions 5c and 5d, each for connecting end portion 5b to initial portion 5a.

[0022] Auxiliary catalyst 4 is located along one of the two intermediate portions 5c, 5d - in the example shown, intermediate portion 5d; and exhaust device 1 comprises selective connecting means, which, on command, connect initial portion 5a of exhaust manifold 5 directly to intermediate portion 5c or 5d respectively, so as to feed the exhaust gases from explosion engine 2 through main catalyst 3 only, or successively through auxiliary catalyst 4 and main catalyst 3.

[0023] With reference to Figures 1 and 2, in the example shown, the whole comprising initial portion 5a, intermediate portion 5c, and end portion 5b of exhaust manifold 5 is defined by a single connecting pipe 6, which, before reaching the exhaust outlets of the engine, is divided into four smaller-section pipes, each connected directly to a respective exhaust outlet of explosion engine 2. The smaller-section pipes are commonly referred to as "exhaust pipes" and indicated 6' in the following description.

[0024] In the example shown, intermediate portion 5d of exhaust manifold 5 is defined by a series of auxiliary connecting pipes 7, a first of which connects the output of auxiliary catalyst 4 to connecting pipe 6, between main catalyst 3 and the point at which connecting pipe 6 divides into the four exhaust pipes 6'. The other auxiliary connecting pipes 7 each connect the input of auxiliary catalyst 4 to a respective exhaust pipe 6'.

[0025] With reference to Figures 1, 2 and 3, in the example shown, the selective connecting means for selecting which of the two intermediate portions 5c, 5d is to be connected to initial portion 5a of exhaust manifold 5 are defined by a group of three-way valves 8, preferably, but not necessarily, electrically controlled, and each located at the point at which a respective auxiliary connecting pipe 7 is connected to the corresponding exhaust pipe 6', i.e. at the point at which portions 5a, 5c and 5d of exhaust manifold 5 join.

[0026] More specifically, each three-way valve 8 is located at the connection of auxiliary connecting pipe 7 to the corresponding exhaust pipe 6', so that the inlet communicates with exhaust pipe 6' (i.e. with initial portion 5a of exhaust manifold 5), one of the outlets again communicates with exhaust pipe 6' (i.e. intermediate portion 5c), and the other outlet communicates with auxiliary connecting pipe 7 (i.e. intermediate portion 5d of exhaust manifold 5).

[0027] More specifically, with reference to Figures 3, 4 and 5, each three-way valve 8 may preferably, though not necessarily, be defined by a rotary slide valve comprising a tubular, substantially rectangular-section body 20 through which the exhaust gases flow.

[0028] Tubular body 20 is defined by a portion of exhaust pipe 6', and has, at a lateral portion 21, a rectangular opening 22 to which auxiliary connecting pipe 7 fits.

[0029] The rotary slide valve also comprises a shutter 23, which pivots inside tubular body 20 so as to rotate, about a transverse axis A, between a first operating position closing rectangular opening 22 and permitting flow through tubular body 20 (Figure 4), and a second operating position closing off the inside of tubular body 20 and forcing flow through rectangular opening 22 (Figure 5); and a hydraulic or electric actuator 24 for rotating shutter 23, on command, between the above two operating positions.

[0030] In the Figure 2 example, one hydraulic or electric actuator 24 provides for simultaneously rotating shutter 23 and all four valves 8.

[0031] Operation of exhaust device 1 is easily deducible from the foregoing description with no further explanation required.

[0032] It should be pointed out, however, that, as stated, exhaust device 1 is designed to assume, on command, two distinct configurations : one designed to effectively combat polluting emissions during the time taken for main catalyst 3 to reach working temperature; and the other to ensure optimum performance of explosion engine 2 once main catalyst 3 reaches working temperature.

[0033] More specifically, in the first configuration, the engine exhaust gases are fed sequentially through the

initial portions of exhaust pipes 6', the first group of auxiliary connecting pipes 7, auxiliary catalyst 4, the remaining auxiliary connecting pipe 7, the end portion of connecting pipe 6, and main catalyst 3. In the second configuration, auxiliary catalyst 4 is isolated, and the engine exhaust gases are fed through connecting pipe 6 (including, obviously, exhaust pipes 6') and main catalyst 3.

[0034] It should be pointed out that, in the second configuration, auxiliary catalyst 4 is unaffected by passage of the exhaust gases, and the exhaust outlets of explosion engine 2 are connected to main catalyst 3 solely by connecting pipe 6, so that the length, section and shape of connecting pipe 6 as a whole can be designed for maximum engine efficiency and performance.

[0035] More specifically, the length, section and shape of exhaust pipes 6' defining the initial portion of connecting pipe 6 can be designed to achieve maximum outflow of the exhaust gases from the engine.

[0036] The advantages of exhaust device 1 are obvious : being unaffected by the exhaust gases once main catalyst 3 reaches working temperature, auxiliary catalyst 4 may be located extremely close to the exhaust outlets of explosion engine 2, thus minimizing the time taken for it to reach working temperature, while in no way impairing its average working life.

[0037] Excluding auxiliary catalyst 4 completely from the path of the exhaust gases also eliminates the formation of counterpressures at the exhaust outlets when the engine is "hot".

[0038] The ability of exhaust device 1 to assume two distinct configurations - one for combating polluting emissions when cold-starting the engine, and the other for operating explosion engine 2 once main catalyst 3 reaches working temperature - provides for optimizing both operating modes, without one conditioning the other.

[0039] Clearly, changes may be made to internal combustion engine exhaust device 1 as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. An exhaust device (1) for internal combustion engines (2), comprising a main catalyst (3), an auxiliary catalyst (4), and an exhaust manifold (5) connecting the input of the main catalyst (3) to the exhaust outlets of a generic internal combustion engine (2), so as to feed the exhaust gases from said exhaust outlets to the main catalyst (3); the exhaust device (1) being **characterized in that** said exhaust manifold (5) may selectively assume a first operating configuration connecting the input of the main catalyst (3) to the output of the auxiliary catalyst (4), and the input of the auxiliary catalyst (4) to said internal combustion engine (2), and a second operating configuration connecting the input of the main catalyst (3) directly to the internal combustion engine (2) and excluding the auxiliary catalyst (4).

2. An exhaust device as claimed in Claim 1, wherein the exhaust manifold (5) comprises an initial portion (5a) connected directly to the exhaust outlets of the internal combustion engine (2); an end portion (5b) connected directly to the input of the main catalyst (3); and a first (5c) and a second (5d) intermediate portion, each for connecting the end portion (5b) to the initial portion (5a); the auxiliary catalyst (4) being located along said second intermediate portion (5d); and the exhaust device (1) also comprising selective connecting means (8) for connecting, on command, the initial portion (5a) of the exhaust manifold (5) directly to said first intermediate portion (5c) or said second intermediate portion (5d) respectively.

3. An exhaust device as claimed in Claim 2, wherein said selective connecting means (8) comprise at least one three-way valve (8) located at the point at which the initial portion (5a) and the first (5c) and second (5d) intermediate portion of the exhaust manifold (5) join.

4. An exhaust device as claimed in Claim 3, wherein said at least one three-way valve (8) has the inlet communicating with the initial portion (5a) of the exhaust manifold (5), and the two outlets communicating with the first intermediate portion (5c) and the second intermediate portion (5d) of the exhaust manifold (5) respectively.

5. An exhaust device as claimed in any one of Claims 2 to 4, wherein the initial portion (5a), the first intermediate portion (5c), and the end portion (5b) of the exhaust manifold (5) are defined by a single connecting pipe (6).

6. An exhaust device as claimed in Claim 5, wherein, before reaching the exhaust outlets of said internal combustion engine (2), said single connecting pipe (6) is divided into four smaller-section pipes (6'), each connected directly to a respective exhaust outlet of the internal combustion engine (2).

7. An exhaust device as claimed in Claim 5 or 6, wherein said connecting pipe (6) is of such a length, section and shape as to maximize efficiency and performance of the internal combustion engine (2).

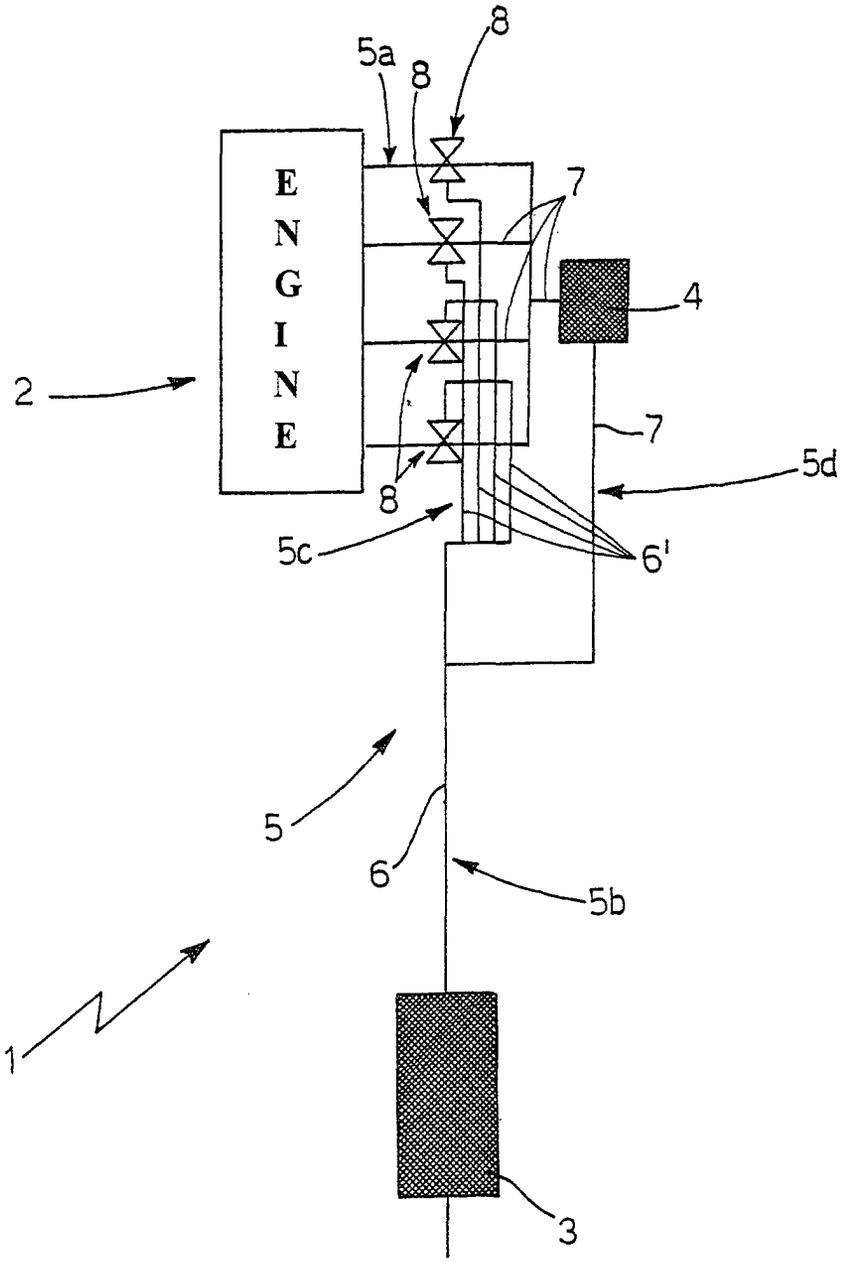

Fig.1

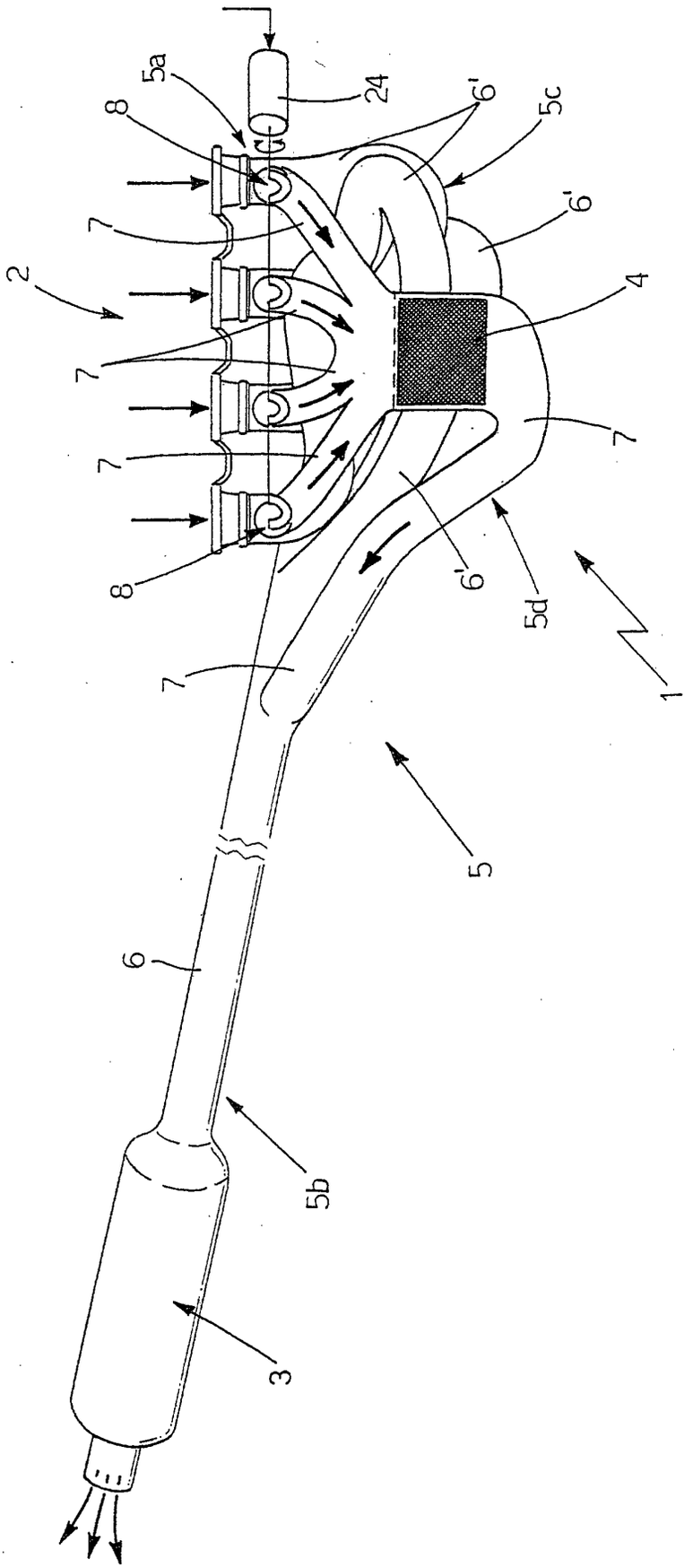

Fig.2

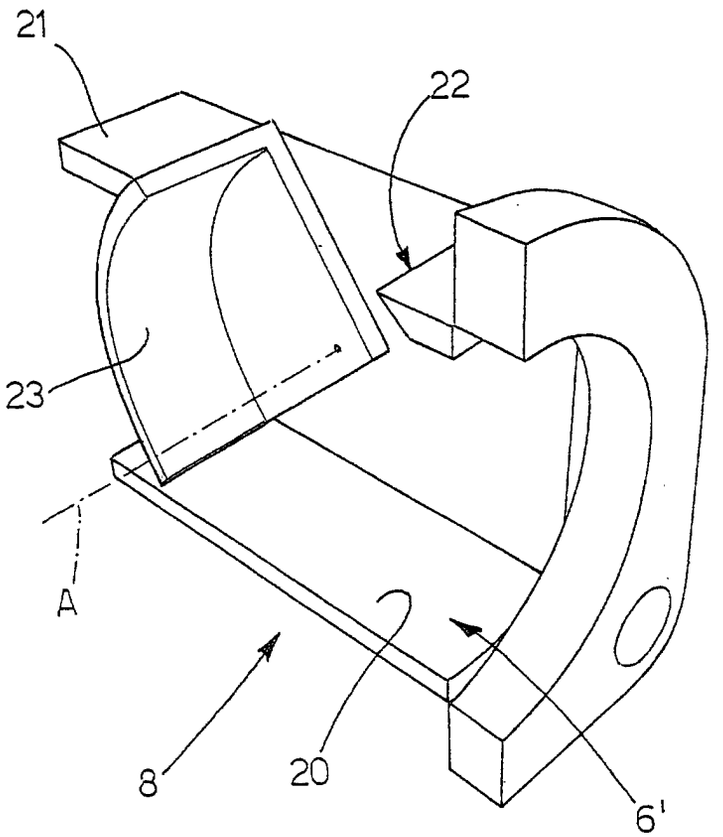

Fig.3

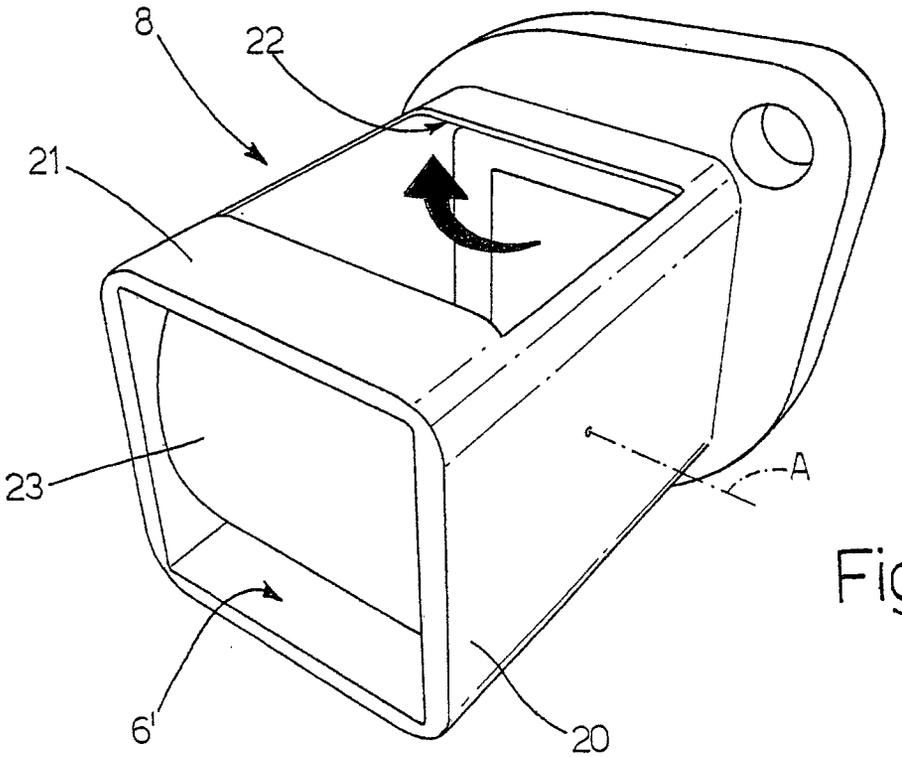

Fig.5

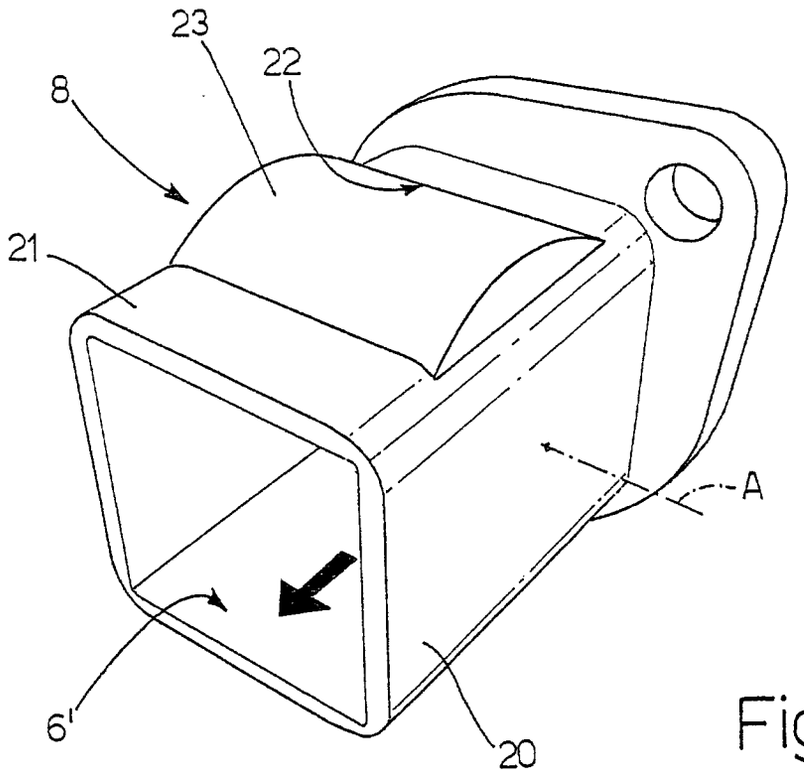

Fig.4