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GB 2082252 A GB 2046357 A GB 1014849 A
GB 0989166 A EP 0235814 A1 US 4699323 A
US 4149496 A

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(54) Electromagnetic fuel injector air-fuel mixture supply device for i.c. engines

(57) A body 1 is formed with two ducts 4,5 each of which is controlled by a respective throttle 12,13 and leads from an air inlet 3 to two outlets 6,7. A fuel injector (10) or two injectors (Figs. 2 and 3) is/are located in the body 1 upstream of the ducts, one duct (Fig.2) or respective ducts (Fig.3), to deliver fuel into air passing through the body. Each outlet 6,7 is connected by a respective manifold to an associated group of cylinders or to associated plural inlet valves of the same group of cylinders (Figs. 4 to 7). The throttles 12,13 may be electronically controlled in accordance with engine operating conditions to provide differential opening.

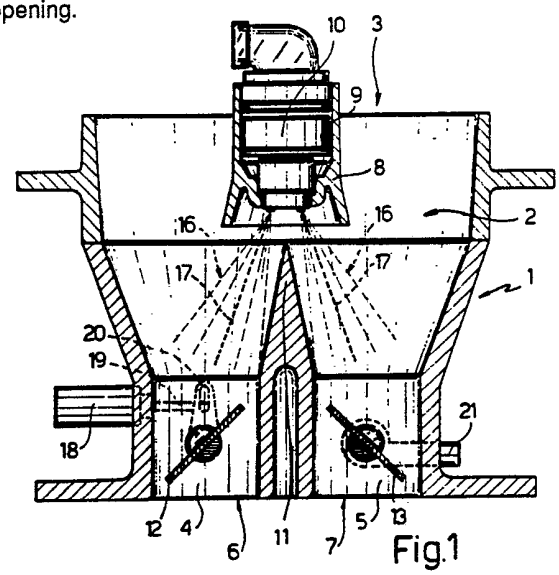

Fig.1

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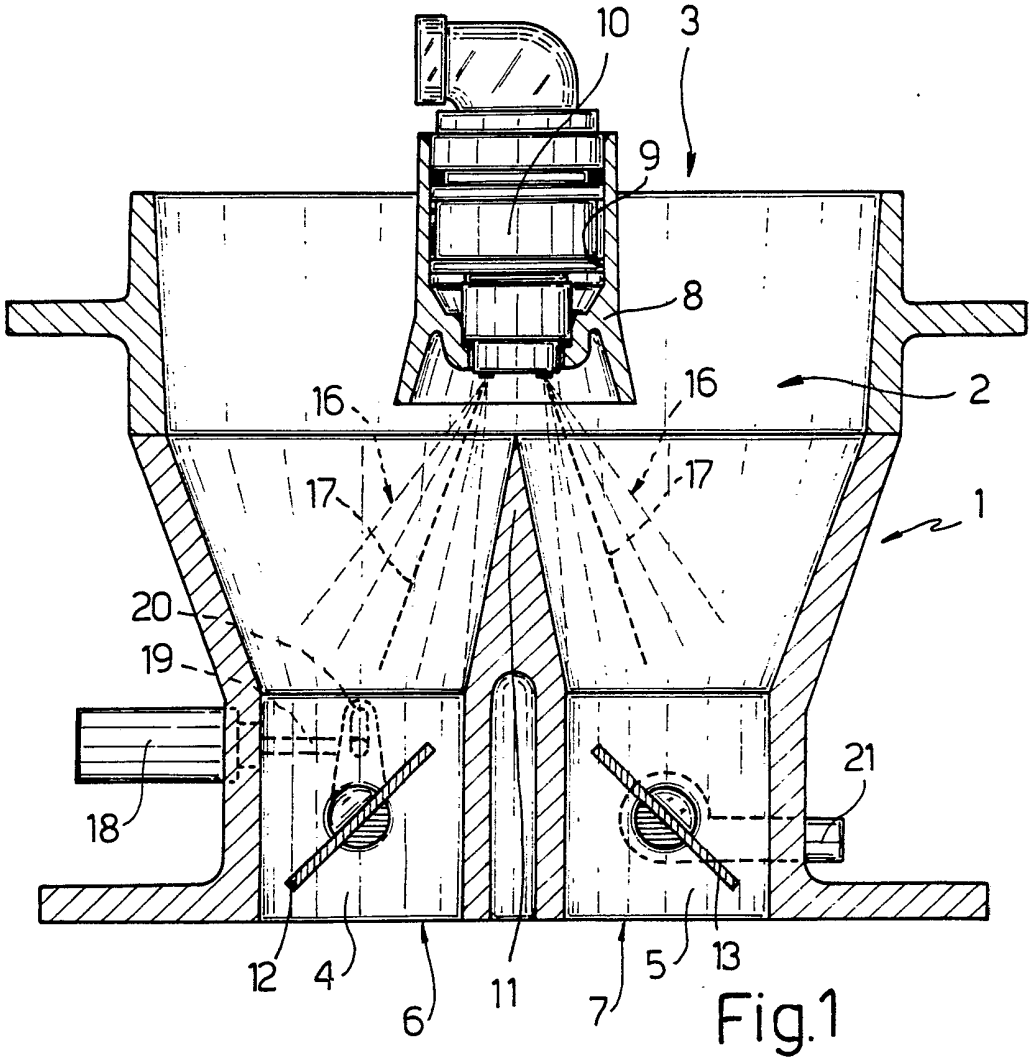

Fig.1

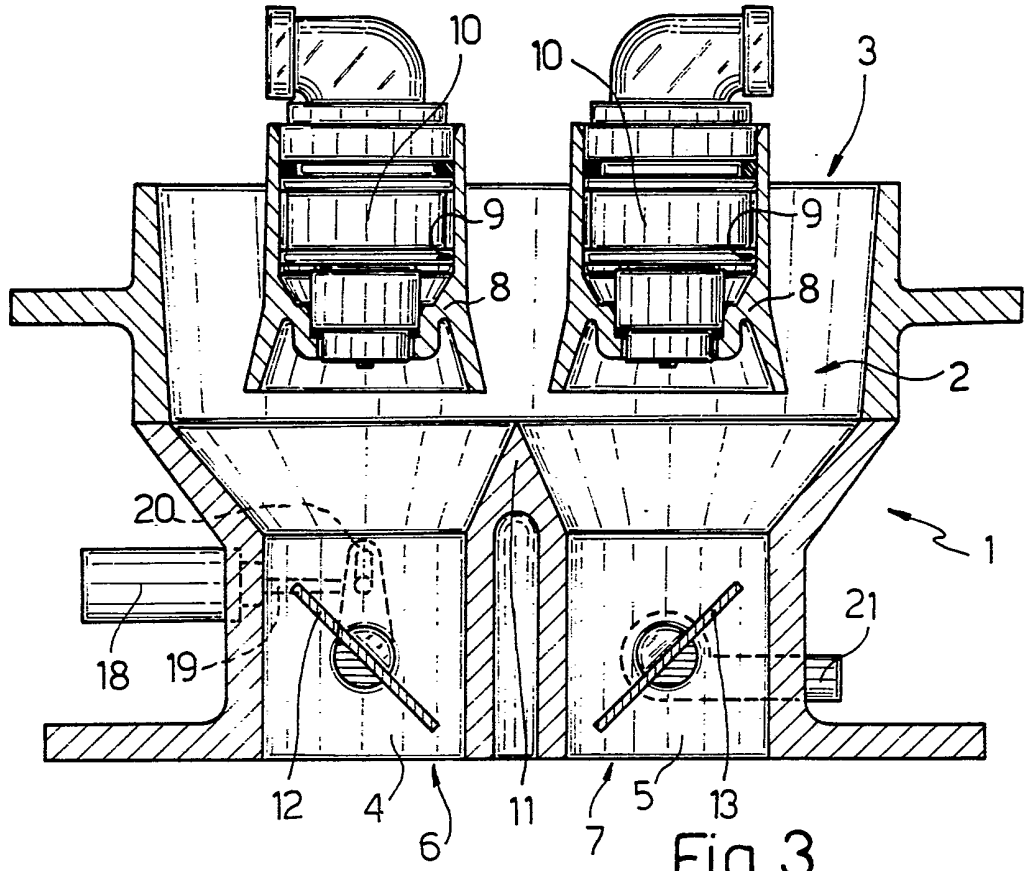
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Fig. 3

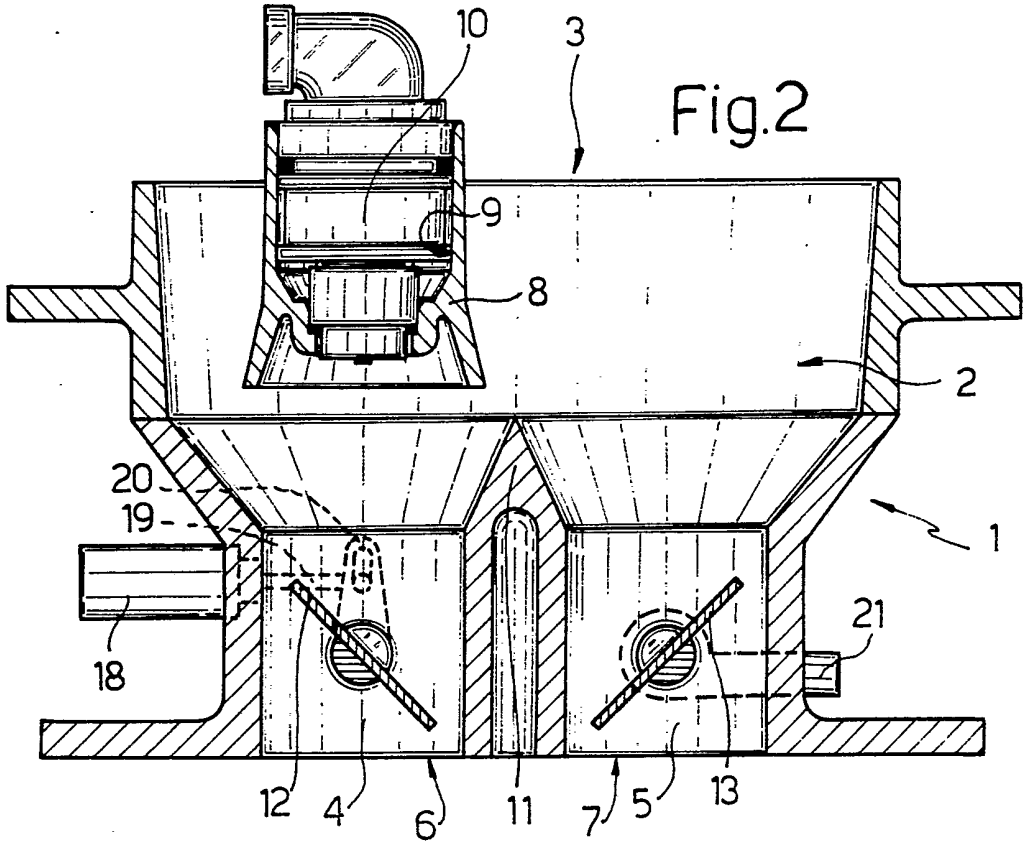
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Fig. 2

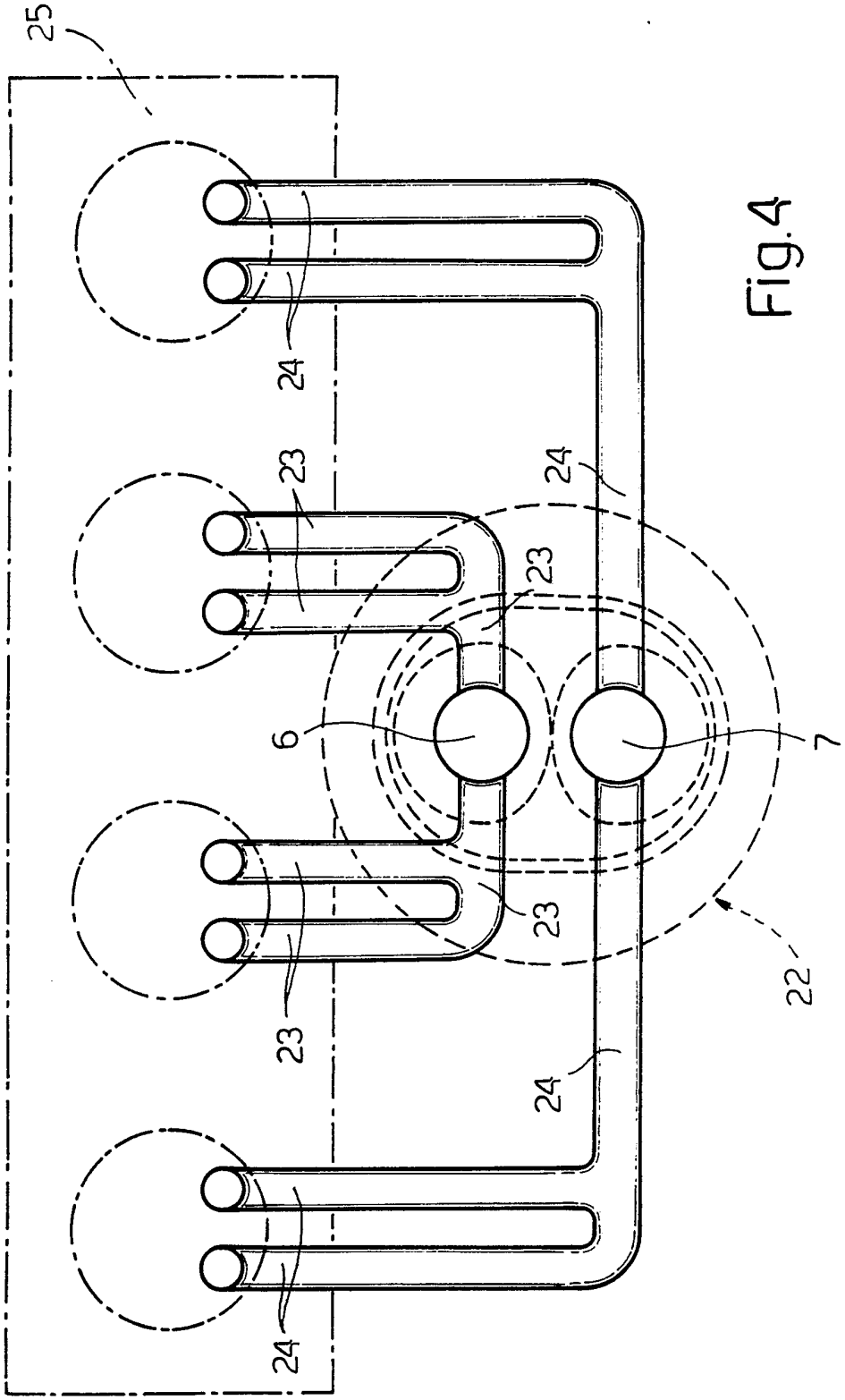

Fig.4

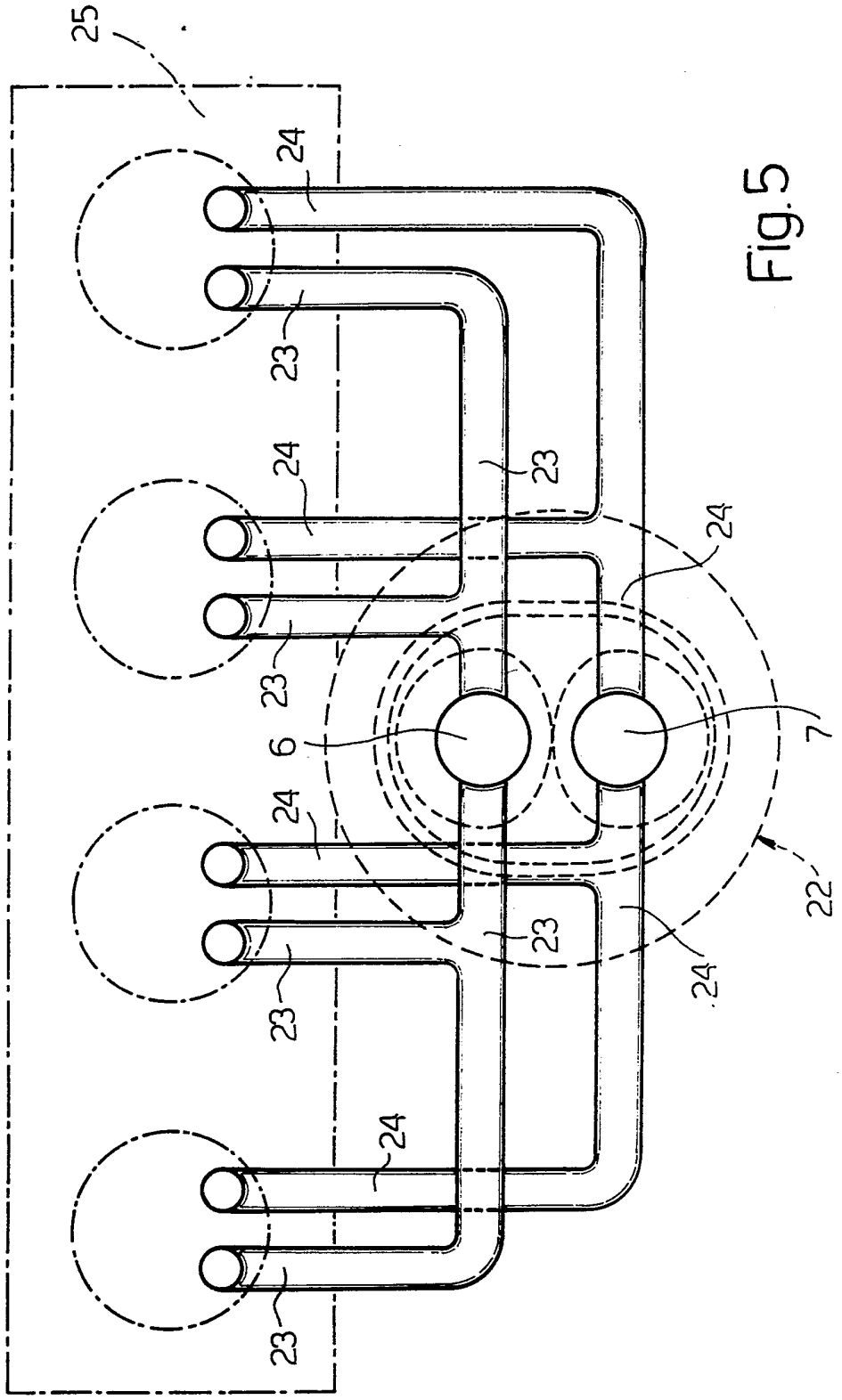

Fig.5

Fig.6

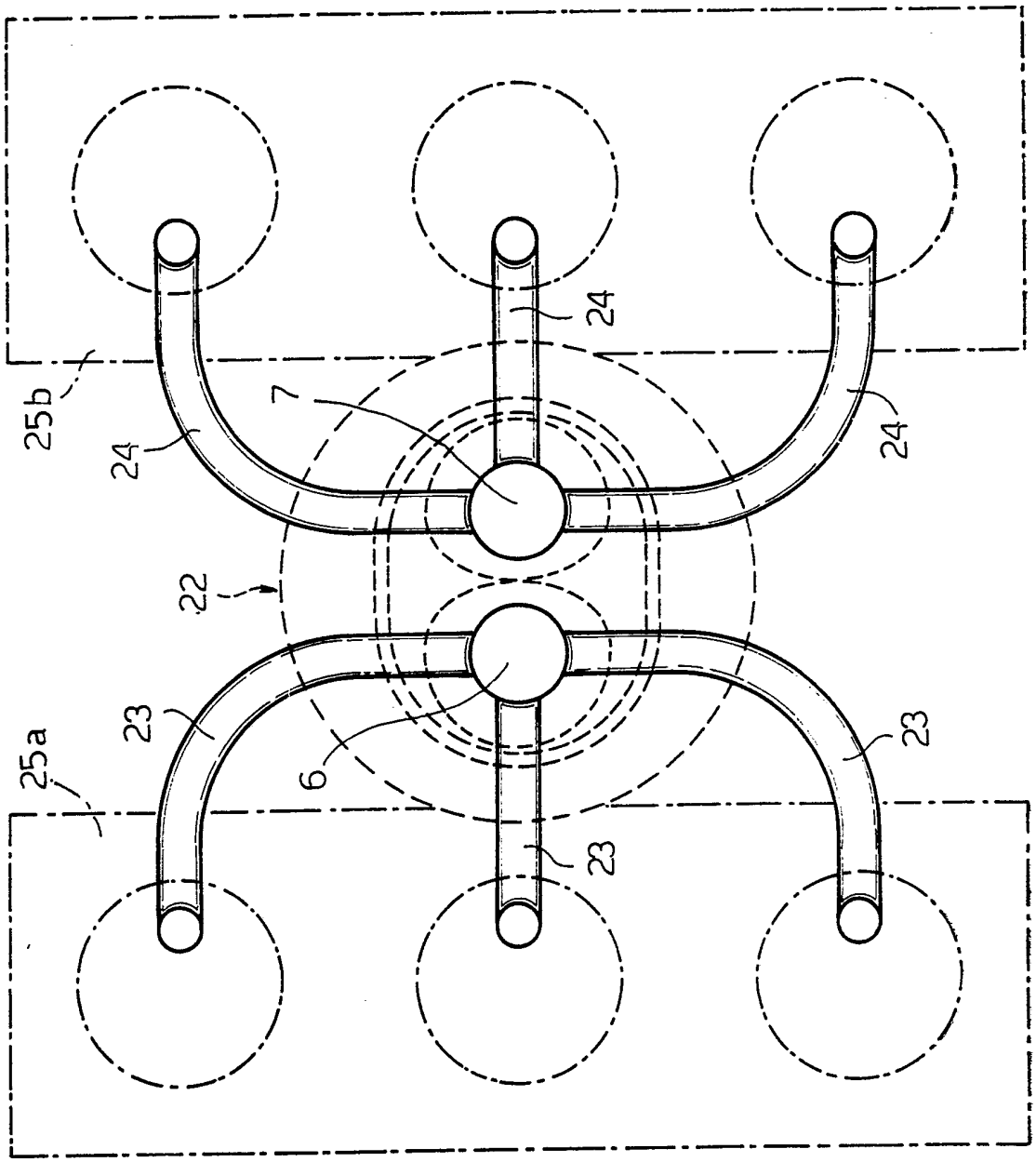

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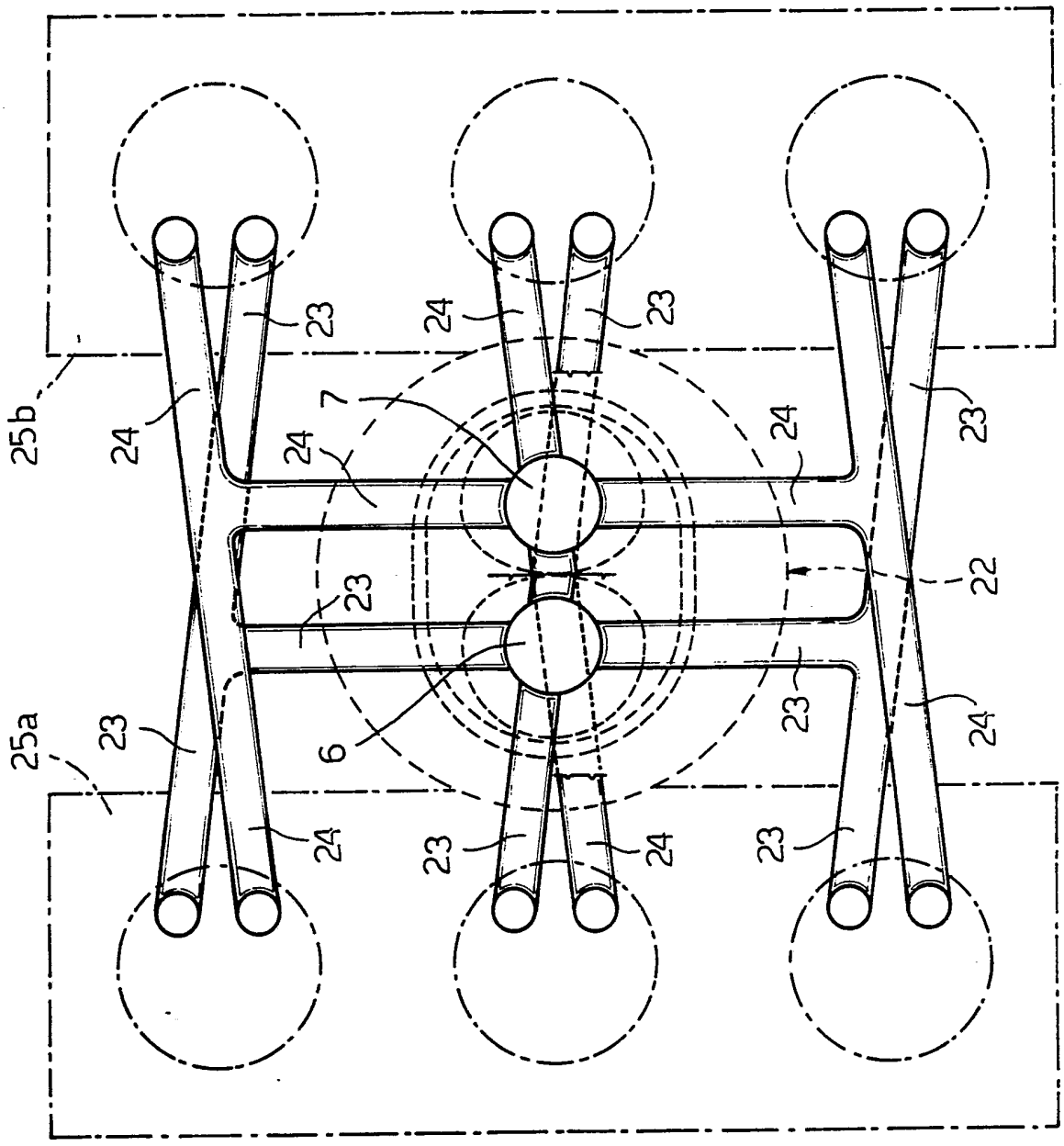
Fig.7



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AIR-FUEL MIXTURE SUPPLY DEVICE FOR AN INTERNAL COMBUSTION ENGINE

The present invention relates to an air-fuel mixture supply device for an internal combustion engine, whereby the mixture is formed by feeding a stream of air with predetermined amounts of atomized fuel via an electromagnetic fuel metering and atomizing valve. Known devices of the aforementioned type substantially comprise a body having at least an air inlet and an air-fuel mixture outlet; and an electromagnetic fuel metering and atomizing valve located on the body, along the air route between the inlet and outlet. The air from the inlet travels along a duct formed inside the body and housing the fuel metering and atomizing valve, which feeds fuel into the duct for producing a mixture of air and atomized fuel. The duct portion downstream from the fuel metering and atomizing valve houses a throttle for regulating mixture supply from the duct to a manifold communicating with the intake

valves on the engine.

In many respects, devices of the aforementioned type are undoubtedly ideal for modern internal combustion engines, by virtue of providing for a homogeneous mixture, and enabling highly accurate electronic control of mixture strength and supply, for adapting to various engine operating conditions. A device of this type along, however, is usually insufficient for supplying extremely high-power engines, due to the limited maximum amount of mixture supplied. Moreover, variation in supply as a function of the throttle opening substantially depends on the geometry of the device, and cannot be adjusted as required for ensuring optimum supply under specific engine operating conditions. Though undoubtedly ideal for medium-power engines, devices of the aforementioned type fail to provide a solution to the supply problems of high-power engines featuring numerous cylinders, two or more intake valves per cylinder, and/or two cylinder blocks.

The aim of the present invention is to provide an air-fuel mixture supply device for an internal combustion engine, designed to overcome the drawbacks typically associated with known devices of the aforementioned type, i.e. a device enabling the supply of large quantities of mixture and, therefore, suitable for use on high-power engines, and whereby mixture supply may be regulated as required according to the operating conditions of the engine.

With this aim in view, according to the present invention, there is provided an air-fuel mixture supply device

for an internal combustion engine; said device comprising a body having at least an air inlet and an air-fuel mixture outlet; an electromagnetic fuel metering and atomizing valve located on said body and along the air route between said inlet and said outlet; and at least a manifold for said air-fuel mixture, connected to said inlet and designed to supply said mixture to said engine; characterised by the fact that said body comprises two ducts, the ends of which define said mixture outlet, and the openings of which are controlled by respective throttles; and by the fact that at least one of said fuel metering and atomizing valves is located upstream from said ducts and designed to supply said mixture to at least one of the same.

The invention will be described by way of example with reference to the accompanying drawings, in which :

Fig.1 shows a section of a first embodiment of a supply device in accordance with the teachings of the present invention;

Fig.s 2 and 3 show sections of respective second and third embodiments of the device according to the present invention;

Fig.4 shows a schematic view of the ducts formed inside the intake manifold on the device, for supplying mixture to a four-cylinder engine featuring two intake valves per cylinder;

Fig.5 shows a schematic view of a further embodiment of the intake manifold on the device, for supplying a four-cylinder engine featuring two intake valves per cylinder;

Fig.6 shows a schematic view of a further embodiment of the intake manifold on the device, for supplying a six-cylinder engine featuring two blocks of three cylinders;

Fig.7 shows a schematic view of a further embodiment of the intake manifold on the device, for supplying a six-cylinder engine featuring two blocks of three cylinders and two intake valves per cylinder.

As shown in Fig.1, the supply device according to the present invention substantially comprises a body 1 in which is formed a chamber 2 having an air inlet 3 at the top, and communicating with a pair of ducts 4 and 5 defining respective mixture outlets 6 and 7 at the bottom.

Chamber 2 houses a support 8 connected in any manner to body 1, and defining a seat 9 for an electromagnetic fuel metering and atomizing valve 10.

Chamber 2 may be of any section and, in the example shown, tapers gradually towards ducts 4 and 5, and houses a diaphragm 11 at the bottom for separating the air from inlet 3 into two streams, each flowing into one of ducts 4 or 5, inside which are housed respective throttles 12 and 13.

Air inlet 3 is connected to a filter for filtering the air fed through chamber 2, whereas mixture outlets 6 and 7 come out inside a manifold (not shown in Fig.1) for feeding the mixture, as described later on, to the internal combustion engine cylinders.

On the Fig.1 supply device, fuel metering and atomizing valve 10 is of the type designed to produce two jets

16 of atomized fuel, the axes 17 of which form a given angle conveniently ranging between 18° and 36°. As shown clearly in Fig.1, each of said jets is directed towards one of ducts 4 or 5, and is separated from the other by diaphragm 11. The atomized fuel from each of jets 16 thus mixes with the air from inlet 3 flowing through chamber 2, so as to form two streams of homogeneous mixture, each flowing along one of ducts 4 or 5, and the supply of which is controlled by respective throttle 12 or 13.

In the Fig.2 embodiment, body 1 presents substantially the same design and component parts as in Fig.1, which are therefore indicated using the same numbering system. In the Fig.2 embodiment, however, support 8 of fuel metering and atomizing valve 10 is substantially coaxial with duct 4, and valve 10 is of the type designed to produce a single jet also substantially coaxial with duct 4.

The air from inlet 3 is thus divided into substantially two streams directed respectively towards ducts 4 and 5, as in the Fig.1 embodiment. But, whereas the air stream towards duct 4 is fed with atomized fuel by valve 10, duct 5 is fed solely with air. Consequently, whereas outlet 6 of duct 4 to the manifold supplies a mixture of air and fuel, outlet 7 of duct 5 supplies only air.

Body 1 in the Fig.3 embodiment is substantially the same as in Fig.s 1 and 2, except that two supports 8 are provided for respective fuel metering and atomizing valves 10, each coaxial with a respective duct

4 or 5. The air from inlet 3 is thus divided into two streams, each directed towards one of ducts 4 or 5, and each injected with atomized fuel by a respective metering and atomizing valve 10.

Throttle 12 controlling mixture supply along duct 4 is controlled normally by the accelerator pedal via an appropriate drive. Throttle 12 may also be controlled by an actuator 18 of any suitable type, and conveniently a linear step-by-step actuator for axially displacing a rod 19 connected to a crank 20 integral with throttle 12. Said actuator 18 is designed to automatically control throttle 12 for cold start-up of the engine, during which the throttle setting depends solely on the temperature of the engine, and whenever idling speed control is required. A detector 21 may also be provided for generating a throttle 13 setting signal. Said detector, which may be located on either or both ducts, provides for indicating minimum opening of the throttle, or for triansient fuel control.

Throttle 13 may be controlled mechanically or pneumatically, and in time with or independently of throttle 12. If independent control is adopted, it may prove useful to control both throttles in such a manner that throttle 13 starts opening upon throttle 12 reaching a given open setting, so that total mixture supply from outlets 6 and 7 increases gradually alongside increasing pressure on the accelerator pedal.

More generally speaking, throttles 12 and 13 may be controlled in any convenient manner using actuators of any type, designed to set throttles 12 and 13 as

a function of specific engine operating conditions, e.g. by means of signals generated by a suitably designed electronic control system.

The device according to the present invention operates as follows.

When synchronized, as in the Fig.1 embodiment, throttles 12 and 13 are opened only slightly at low engine speed, and fully, when high-power performance is required, thus maximising total mixture supply along ducts 4 and 5.

When operated independently, however, as in the Fig.2 and 3 embodiments, throttles 12 and 13 are controlled in such a manner that, at low engine speed, only throttle 12 is opened, throttle 13 remaining closed. Only when high-power performance is required, is throttle 13 opened gradually until both throttles 12 and 13 are eventually wide open. Throttle 13 may start opening before throttle 12 is wide open, so as to gradually increase total mixture supply along ducts 4 and 5. In the Fig.2 embodiment, the additional air supplied via duct 5 is added to that in the mixture from duct 4, so as to produce a high-oxygen-content mixture as required for exceptionally high-power performance. In the Fig.3 embodiment, the metering and atomizing valve producing the mixture supplied by duct 5 is not activated until throttle 13 opens.

The mixture manifold, for feeding the mixture from outlets 6 and 7 to the engine, may be designed according to any one of the embodiments shown in Fig.s 4 to 7. In the Fig.4 embodiment, manifold 22 substantially

comprises two branches 23 and 24; branch 23 connecting outlet 6 to the middle two cylinders on engine 25, and branch 24 connecting outlet 7 to the other two cylinders. As shown in Fig.4, each cylinder is assumed to present two intake valves.

In the Fig.5 embodiment, branches 23 and 24 of manifold 22 connect outlets 6 and 7 respectively to one of the two intake valves on each cylinder of engine 25.

In the Fig.6 embodiment, wherein the engine comprises two cylinder blocks 25a and 25b, manifold 22 again comprises two branches 23 and 24, each connecting one of outlets 6 or 7 to the intake valves on one of blocks 25a or 25b.

Finally, in the Fig.7 embodiment, wherein the cylinders of each block 25a and 25b present two intake valves, manifold 22 is designed to connect each of outlets 6 and 7 to a respective intake valve on all the cylinders of both blocks.

The supply device according to the present invention thus provides for supplying the engine with large quantities of air-fuel mixture as required, thanks to the presence of a pair of ducts 4 and 5 (for the mixture, or for mixture and air, as in the Fig.2 embodiment). Moreover, supply may be regulated as required, according to the accelerator pedal setting, by virtue of throttle valves 12 and 13, which may be controlled fully independently via various types of mechanical, pneumatic, electric actuators or drives. In particular, the device according to the present invention provides for regulating mixture supply as a function of specific engine operat-

ing conditions, e.g. by means of a suitably designed electronic control system supplying signals for opening the throttle and fuel metering and atomizing valves. To those skilled in the art it will be clear that changes may be made to the embodiments described and illustrated herein without, however, departing from the scope of the present invention.

CLAIMS

1) - An air-fuel mixture supply device for an internal combustion engine; said device comprising a body having at least an air inlet and an air-fuel mixture outlet ; an electromagnetic fuel metering and atomizing valve located on said body and along the air route between said inlet and said outlet; and at least a manifold for said air-fuel mixture, connected to said inlet and designed to supply said mixture to said engine; characterised by the fact that said body comprises two ducts, the ends of which define said mixture outlet, and the openings of which are controlled by respective throttles ; and by the fact that at least one of said fuel metering and atomizing valves is located upstream from said ducts and designed to supply said mixture to at least one of the same.

2) - A device as claimed in Claim 1, characterised by the fact that it comprises one of said fuel metering and atomizing valves for supplying said air-fuel mixture to both said ducts .

3) - A device as claimed in Claim 2, characterised by the fact that said valve produces two atomized fuel jets. , each directed towards a respective said duct , and the axes of which form a predetermined angle.

4) - A device as claimed in Claim 1, characterised by the fact that it comprises one of said fuel metering and atomizing valves for supplying said air-fuel mixture

to one of said ducts; the other said duct being supplied solely with air.

5) - A device as claimed in Claim 1, characterised by the fact that it comprises two said fuel metering and atomizing valves, each designed to supply air-fuel mixture to one of said two ducts.

6) - A device as claimed in one of the foregoing Claims, characterised by the fact that the throttle of one of said ducts, to which said air-fuel mixture is supplied by said metering and atomizing valve, is controlled by an actuator during cold start-up or idling of said engine.

7) - A device as claimed in one of the foregoing Claims, characterised by the fact that it comprises a sensor designed to detect, and to supply a signal proportional to, the setting of one of said throttles.

8) - A device as claimed in one of the foregoing Claims, characterised by the fact that said manifold comprises two pipes , one connecting one said duct to the intake valves of a first set of cylinders on said engine, and the other connecting the other said duct to the intake valves of a second set of said cylinders.

9) - A device as claimed in one of the foregoing Claims from 1 to 8, wherein said engine comprises two intake valves per cylinder; characterised by the fact that said manifold comprises two pipes , one connecting one of said ducts to one of said two intake valves on each cylinder, and the other connecting the other of said ducts to the other intake valve

on each cylinder.

10) - A device as claimed in one of the foregoing Claims from 1 to 8, wherein said engine comprises two cylinder blocks; characterised by the fact that said manifold comprises two pipes , one connecting one said duct to the intake valves of the cylinders on one said block, and the other connecting the other said duct to the intake valves of the cylinders on the other said block.

11) - A device as claimed in one of the foregoing Claims from 1 to 8, wherein said engine comprises two cylinder blocks, each cylinder comprising two intake valves; characterised by the fact that said manifold comprises two pipes , one connecting one said duct to one intake valve of each cylinder on both said blocks, and the other connecting the other said duct to the other intake valve of each cylinder on both said blocks.

12) - An air-fuel mixture supply device for an internal combustion engine, substantially as described and illustrated herein with reference to the accompanying drawings.

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