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(71) Applicant: **WEBER S.r.l.**
Corso Marconi, 20
I-10125 Torino(IT)

(72) Inventor: **Lenzi, Gianluigi**
Via C. Zucchi, 21
I-40100 Bologna(IT)
Inventor: **Lionello, Aureliano**
Via Mazzoni, 39
I-40011 Anzola Emilia (Italy)(IT)

(74) Representative: **Jorio, Paolo et al**
Studio Torta, Via Viotti, 9
I-10121 Torino(IT)

(54) Modular supply device for an internal combustion engine.

(57) A device comprising a number of modular elements enabling the formation of a number of configurations for meeting the assembly and operating requirements of different types of engines. The device substantially comprises a number of couplings (1), each defining an air duct and having a tubular projection (3) defining a seat for a fuel metering and atomizing valve (6), and two fittings (7) projecting from opposite sides of the tubular projection (3). The device also comprises a supporting plate (13) to which the couplings (1) are connected, and a number of pipe sections (17) connected to the fittings (7) to form a continuous fuel pipe.

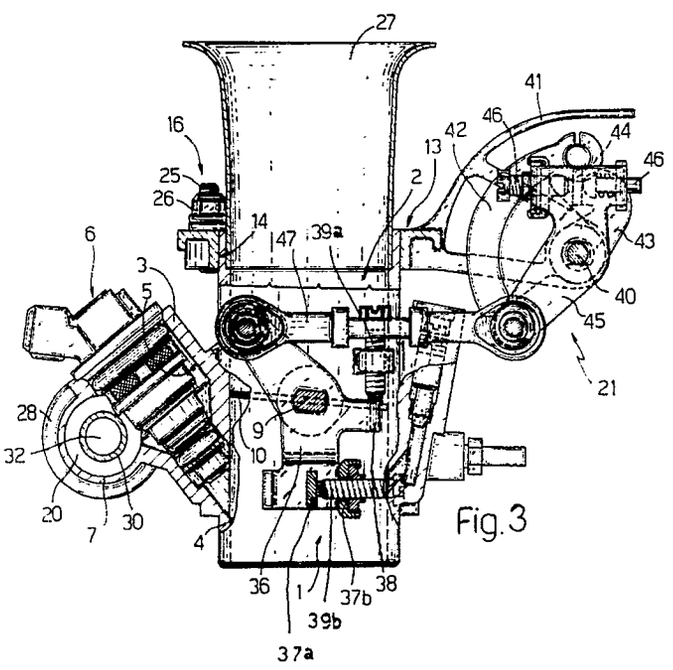

Fig.3

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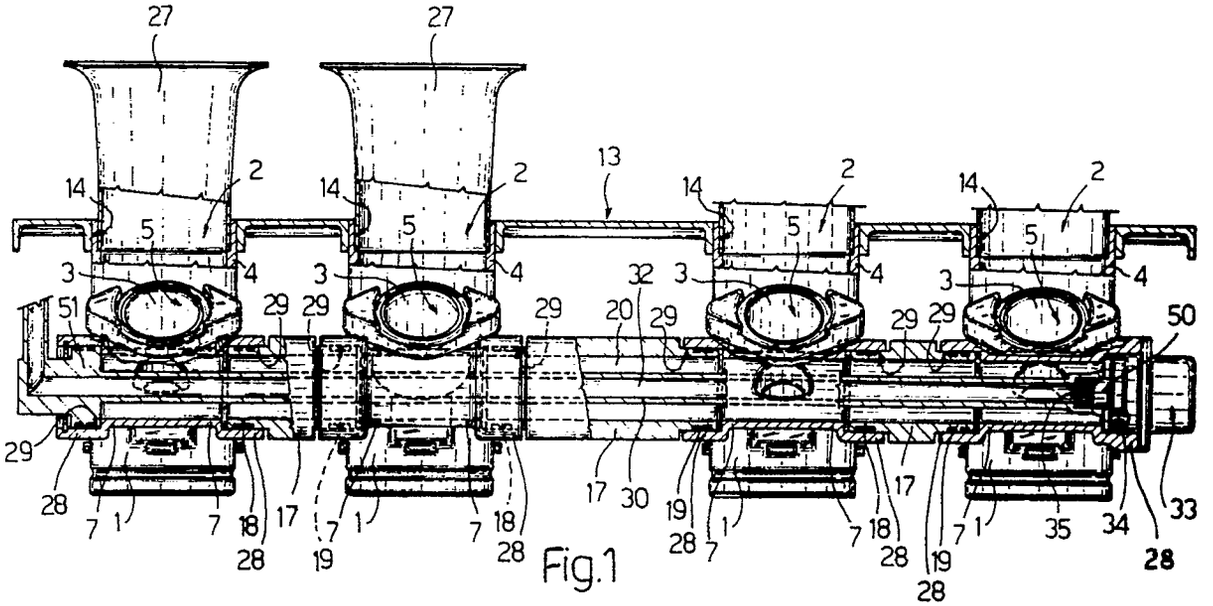

Fig.1

The present invention relates to an internal combustion engine supply device of the type comprising a number of electromagnetic fuel metering and atomizing valves, each designed to feed atomized fuel into a conduit supplied with air and the opening of which is controlled by a respective throttle valve.

On known so-called "multipoint" devices of the aforementioned type, each conduit provides for feeding a mixture of air and fuel to at least one cylinder on the engine. Each air conduit is formed inside a branch of the air manifold fitted to the engine, each of which branches presents a tubular projection communicating with the conduit formed inside the branch and which forms a seat for a fuel metering and atomizing valve. Upstream from the fuel metering and atomizing valve, each conduit houses a throttle for controlling air supply along the conduit.

For feeding fuel to each of the metering and atomizing valves, provision is normally made for a pipe connected by a number of fittings to each valve. Finally, the device normally presents a pressure regulator for regulating the pressure of the fuel inside the supply pipe, and having a fuel inlet hole communicating with the supply pipe, and an outlet hole connected to a drain pipe forming part of the device.

Supply devices of the aforementioned type present a number of drawbacks.

Foremost of these is that they must be sized and designed to meet the specific assembly and operating requirements of the engines to which they are fitted. As each engine model differs in terms of the number and center distance of the cylinders and the space available for housing the supply device, this means the device components must be assembled according to a strict configuration which cannot be varied for adapting the device to applications other than that for which it is designed.

Makers of supply devices of the aforementioned type must therefore design and manufacture a wide range of different types, each of which can only be assembled on one type of engine, which inevitably means producing and storing large numbers of different components and finished devices.

Moreover, mainly due to the design of the component parts, devices of the aforementioned type are fairly complex and, consequently, unreliable and expensive to produce.

It is an object of the present invention to provide an internal combustion engine supply device of the aforementioned type designed to overcome the aforementioned drawbacks, i.e. which substantially enables a variety of different configurations, each designed to meet the assembly and operating requirements of a given engine.

It is a further object of the present invention to provide a modular supply device obtainable by combining a number cf appropriately selected components.

Yet a further object of the present invention is to provide a supply device that is highly straightforward in design, highly reliable, and cheap to produce.

According to the present invention, there is provided an internal combustion engine supply device of the type comprising a number of electromagnetic fuel metering and atomizing valves, each supplying atomized fuel to a conduit supplied with air and the opening of which is controlled by a respective throttle valve, said conduit providing for supplying an air and fuel mixture to at least one cylinder on the engine; characterised by the fact that it comprises:

a number of couplings, each forming one of said conduits and having a tubular projection extending from the lateral wall of said coupling and forming a seat for one of said valves communicating with said conduit; said tubular projection having two coaxial fittings projecting from opposite sides of said tubular projection and communicating with said seat; and each said coupling having two supports for an oscillating shaft integral with one of said throttles;

a supporting plate having a number of perforations, each constituting a seat for a respective said coupling; and means for securing said plate to said engine;

means for connecting each said coupling to said plate;

a number of pipe sections, each having a first end connected to one of said fittings on one said coupling, and a second end connected to a fitting on another adjacent said coupling, so as to form, via said pipe sections and said fittings, a first continuous fuel pipe; and

drive means for transmitting rotation between said shafts of said adjacent couplings.

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

Fig.1 shows a side view of the device according to the present invention without the fuel metering and atomizing valves and designed to enable a first given configuration;

Fig.2 shows a partially sectioned plan view of the Fig.1 device;

Fig.3 shows a vertical section of the device in Fig.s 1 and 2;

Fig.4 shows an exploded side view of part of the drive on the Fig.3 device;

Fig.5 shows a further vertical section of the device in Fig.s 1 and 2;

Fig.6 shows a partial vertical section of the Fig.5

device;

Fig.7 shows a horizontal section of the Fig.5 device.

The device according to the present invention substantially comprises a number of couplings 1, each forming a conduit 2 (Fig.3) for air drawn in from the top of coupling 1. Each coupling 1 presents a tubular projection 3 extending from the lateral wall of coupling 1 and forming a seat 5 for a respective known electromagnetic fuel metering and atomizing valve 6. Each tubular projection 3, the axis of which forms a given acute angle with the axis of conduit 2, presents two fittings 7 (Fig.s 1 and 2) projecting from opposite sides of projection 3 and each communicating with seat 5, as shown clearly in Fig.s 1, 2 and 3.

Each coupling 1 presents two supports 8 (Fig.7) for an oscillating shaft 9 integral with a throttle valve 10 controlling the air passage along conduit 2.

The device also comprises a supporting plate 13 having a number of perforations 14, each forming a seat for a respective coupling 1, the top end of which is conveniently inserted inside perforation 14 as shown in Fig.s 1 and 3. Supporting plate 13 also presents means for securing it to the engine, which means may be of any suitable type comprising, for example, perforations 15 (Fig.2) and fastening members such as brackets, screws, bolts or similar.

The device also comprises fastening means indicated as a whole by 16 (Fig.s 5 and 6) for connecting each coupling 1 to supporting plate 13 and described in detail later on; and a number of pipe sections 17 (Fig.s 1 and 2), each having a first end 18 connected to one of fittings 7 on one coupling 1, and a second end 19 connected to a fitting 7 on an adjacent coupling 1, so as to form, via said pipe sections 17 and fittings 7, a first continuous pipe 20 (Fig.1) for supplying fuel to metering and atomizing valves 6.

The device also comprises drive means indicated as a whole by 21 (Fig.2) for transmitting rotation between the shafts 9 of adjacent couplings 1 as described in detail later on.

Fastening means 16 for connecting each coupling 1 to supporting plate 13 comprise at least two flanges 24 (Fig.s 6 and 7) projecting laterally from lateral wall 4 of coupling 1 and resting on the lower surface of supporting plate 13; and two threaded rods 25, each secured to one of flanges 24, inserted through a hole in plate 13 and fitted with a respective lock nut 26. Fastening means 16 may also conveniently provide for fitting coupling 1 with a nozzle 27 having two tabs in which are formed holes engaged by rods 25 as shown in Fig.6.

Each fitting 7 (Fig.1) presents an annular projection 28 defining a cylindrical seat 29 housing a respective end 18 and 19 of one of pipe sections 17. Provision is made for annular sealing elements between each end 18 and 19 and respective seat 29.

The device also comprises a tube 30 inserted coaxially inside pipe sections 17 and fittings 7 to form a second continuous fuel pipe 32; and a pressure regulator 33 having a substantially cylindrical casing and housed in seat 29 of fitting 7 on the coupling 1 to the extreme right of the device in Fig.1. Pressure regulator 33 presents an inlet hole 34 communicating with pipe 20, and an outlet hole 35 communicating with pipe 32 in turn connected to the drain. Via a fitting (not shown) formed on fitting 7 of coupling 1, continuous fuel supply pipe 20 is connected to a pressurized fuel source, e.g. the fuel supply pump.

Drive means 21 for transmitting rotation between shafts 9 (Fig.s 2 and 3) of adjacent couplings 1 comprise at least a lever 36 (Fig.s 3 and 5) integral with shaft 9 of coupling 1 and having at least a tab 37a or 37b. Levers 36 of adjacent couplings 1 are arranged facing each other, as shown in Fig.2, and tab 37a (Fig.3) of one lever 36 rests on tab 37b of the other, so as to transmit rotation of the second lever to the first. Tab 37b of one of levers 36 conveniently presents an adjustable pin 39b (Fig.3) cooperating with tab 37a of the other lever 36. Each lever 36 also presents a second tab 38 cooperating with an adjustable pin 39a.

The device also comprises a rotary shaft 40 (Fig.s 2 and 3) supported on two arms 41 of supporting plate 13; and a crank 42 (Fig.s 3 and 4) integral with shaft 40. Shaft 40 is fitted with a lever 43 having a tab 44, and presents an idle lever 45 having two adjustable pins 46 located on opposite sides in relation to tab 44, as shown in Fig.3. Lever 45 is connected by a rod 47 to one of levers 36 of coupling 1, as shown in Fig. 3. Rod 47 is conveniently adjustable in length, and presents one end hinged to lever 45 and the other to lever 36.

Crank 42 is connected by a drive of any appropriate type to the accelerator pedal of the vehicle.

As shown in Fig.7, shaft 9 is conveniently fitted to respective coupling 1 via the interposition of roller bearings 48, and at least one helical spring 49 is provided for normally maintaining throttle 10 in the closed position. Spring 49 presents one end secured to coupling 1 and the other to lever 36 integral with shaft 9. The device according to the present invention is assembled and operates as follows.

Firstly, a number of small assemblies are prepared, each comprising coupling 1, shaft 9 with respective throttle 10, and lever 36 secured integral with shaft 9 and connected as described above to spring 49.

The assemblies so formed are then connected together by means of pipe sections 17, as shown in Fig.1, for which purpose each end 18 and 19 of each section 17 is inserted inside respective seat 29 on annular projection 28 to form continuous pipe 20. Tube 30 is then inserted inside pipe 20 and secured to the other elements by fitting a cylindrical enlargement 51 (Fig.1) on tube 30 inside seat 29. Pressure regulator 33 is then fitted to annular projection 28 at one end of the device, by inserting it inside the seat on projection 28 and at the same time inserting cylindrical projection 50 inside the end of tube 30.

The assembly so formed is then secured to supporting plate 13 by inserting threaded rods 25 (Fig.6) inside the respective holes in plate 13 and screwing nuts 26 on to rods 25 to lock couplings 1 firmly to plate 13. If nozzles 27 are provided, these are secured using the same rods 25, as shown in Fig.6.

Levers 36 of each coupling 1 are then connected mechanically to shaft 40 using the members already described and as shown in Fig.s 3 and 4. In particular, tab 37a of one of couplings 1 is located substantially opposite tab 37b of the adjacent coupling 1, and adjustable pin 39b of tab 37b is rested on the other tab as shown in Fig.3. Finally, metering and atomizing valves 6 are fitted inside respective seats 5, as shown in Fig.3.

The device according to the present invention therefore provides for forming a number of configurations for supplying any type of engine, by simply providing for a number of supporting plates 13 enabling the number and center distance of couplings 1 to be selected as required. For adapting to the required configuration, couplings 1 may be spaced as required and connected using pipe sections 17 of different lengths.

The device according to the present invention operates in the same way as known devices of the same type. When idle, throttles 10 are maintained in the closed position by respective springs 49. In each of said configurations, tab 38 of levers 36 (Fig.s 3 and 5) rests on adjustable pin 39b screwed inside a hole formed in a projection on the respective coupling.

When the accelerator is pressed, crank 42 is rotated which in turn rotates shaft 40 and integral levers 43, each of which acts on pin 46 to rotate lever 45 which in turn rotates levers 36 via rod 47 to open respective throttle 10.

Fuel is supplied to each metering and atomizing valve 6 by continuous pipe 20. When the fuel pressure inside pipe 20 exceeds a given limit, a certain amount is drained off by return pipe 32 so as to circulate the fuel through inlet 34 and out through outlet 35 of pressure regulator 33.

In addition to providing for a wide variety of configurations, the supply device according to the present invention is also extremely straightforward in design and highly reliable due to the design of the various component parts.

To those skilled in the art it will be clear that changes may be made to both the design and arrangement of the component parts of the device as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. An internal combustion engine supply device of the type comprising a number of electromagnetic fuel metering and atomizing valves (6), each supplying atomized fuel to a conduit (2) supplied with air and the opening of which is controlled by a respective throttle valve (10), said conduit (2) providing for supplying an air and fuel mixture to at least one cylinder on the engine; characterised by the fact that it comprises:

   a number of couplings (1), each forming one of said conduits (2) and having a tubular projection (3) extending from the lateral wall (4) of said coupling (1) and forming a seat (5) for one of said valves (6) communicating with said conduit (2); said tubular projection (3) having two coaxial fittings (7) projecting from opposite sides of said tubular projection (3) and communicating with said seat (5); and each said coupling (1) having two supports (8) for an oscillating shaft (9) integral with one of said throttles (10);

   a supporting plate (13) having a number of perforations (14), each constituting a seat for a respective said coupling (1); and means for securing said plate (13) to said engine;

   means (16) for connecting each said coupling (1) to said plate (13);

   a number of pipe sections (17), each having a first
   end (18) connected to one of said fittings (7) on one said coupling (1), and a second end (19) connected to a fitting (7) on another adjacent said coupling (1), so as to form, via said pipe sections (17) and said fittings (7), a first continuous fuel pipe (20); and

   drive means (21) for transmitting rotation between said shafts (9) of said adjacent couplings (1).

2. A device as claimed in Claim 1, characterised by the fact that said means (16) for connecting each said coupling (1) to said plate (13) comprise at least two flanges (24) projecting laterally from said coupling (1) and resting on

said plate (13); and two threaded rods (25), each secured to one of said flanges (24), fitted through a hole in said plate (13) and locked by a nut (26).

3. A device as claimed in Claim 1 or 2, characterised by the fact that each said fitting (7) presents an annular projection (28) defining a cylindrical seat (29) housing a respective end (18, 19) of one of said pipe sections (17); annular sealing elements being provided between said end (18, 19) and said respective seat (29).

4. A device as claimed in one of the foregoing Claims, characterised by the fact that it comprises a tube (30) inserted coaxially inside said pipe sections (17) and said fittings (7) so as to define a second continuous fuel pipe (32); said device also comprising a pressure regulator (33) for regulating the pressure of the fuel in said first continuous pipe (20); said pressure regulator (33) presenting an inlet (34) communicating with one of said fittings (7) on one said coupling (1), and an outlet (35) connected to a first end of said tube (30); the other end of said tube (30) being connected to a drain, and said first pipe (20) being connected to a pressurized fuel source.

5. A device as claimed in Claim 4, characterised by the fact that said pressure regulator (33) is housed inside one of said cylindrical seats (29) in one of said fittings (7) on one of said couplings (1).

6. A device as claimed in one of the foregoing Claims, characterised by the fact that said drive means (21) for transmitting rotation between said shafts (9) of adjacent said couplings (1) comprise at least a lever (36) integral with said shaft (9) of each said coupling (1) and having at least a first tab (37a) designed to rest on a respective first tab (37b) on the lever (36) of said adjacent coupling (1), so as to transmit rotation of said second lever to said first lever.

7. A device as claimed in Claim 6, characterised by the fact that each said lever (36) presents a second tab (38) cooperating with the end of an adjustable pin (39a) on a respective said coupling (1) so as to regulate the minimum opening angle of said throttle (10).

8. A device as claimed in Claim 6 or 7, characterised by the fact that said first tab (37b) on the lever (36) of one of said adjacent couplings (1) presents an adjustable pin (39b) cooperating with said first tab (37a) on the lever (36) of the other said coupling (1).

9. A device as claimed in one of the foregoing Claims, characterised by the fact that it comprises at least a rotary shaft (40) supported on two arms (41) of said plate (13); a crank (42) integral with said shaft (40) and having at least one tab (44); and a lever (45) pivoting in idle manner on said shaft (40) and having two pins (46) adjustable in relation to said tab (44) on said crank (42); said lever (45) being connected by a rod (47) to one of said levers (36) on the shaft (9) of one of said couplings (1); and said crank (42) being connected to the accelerator control of the vehicle fitted with said engine.

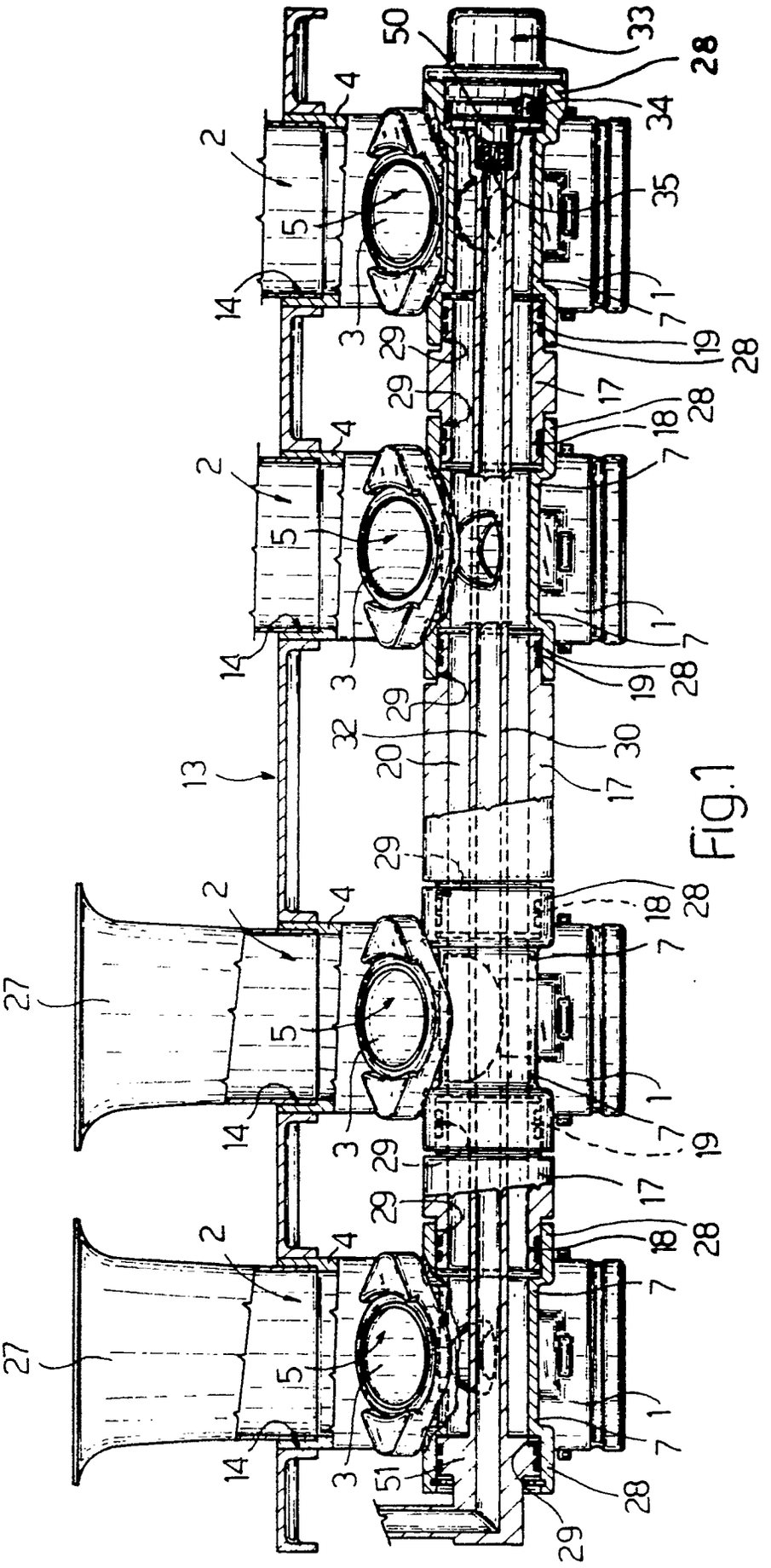

Fig.1

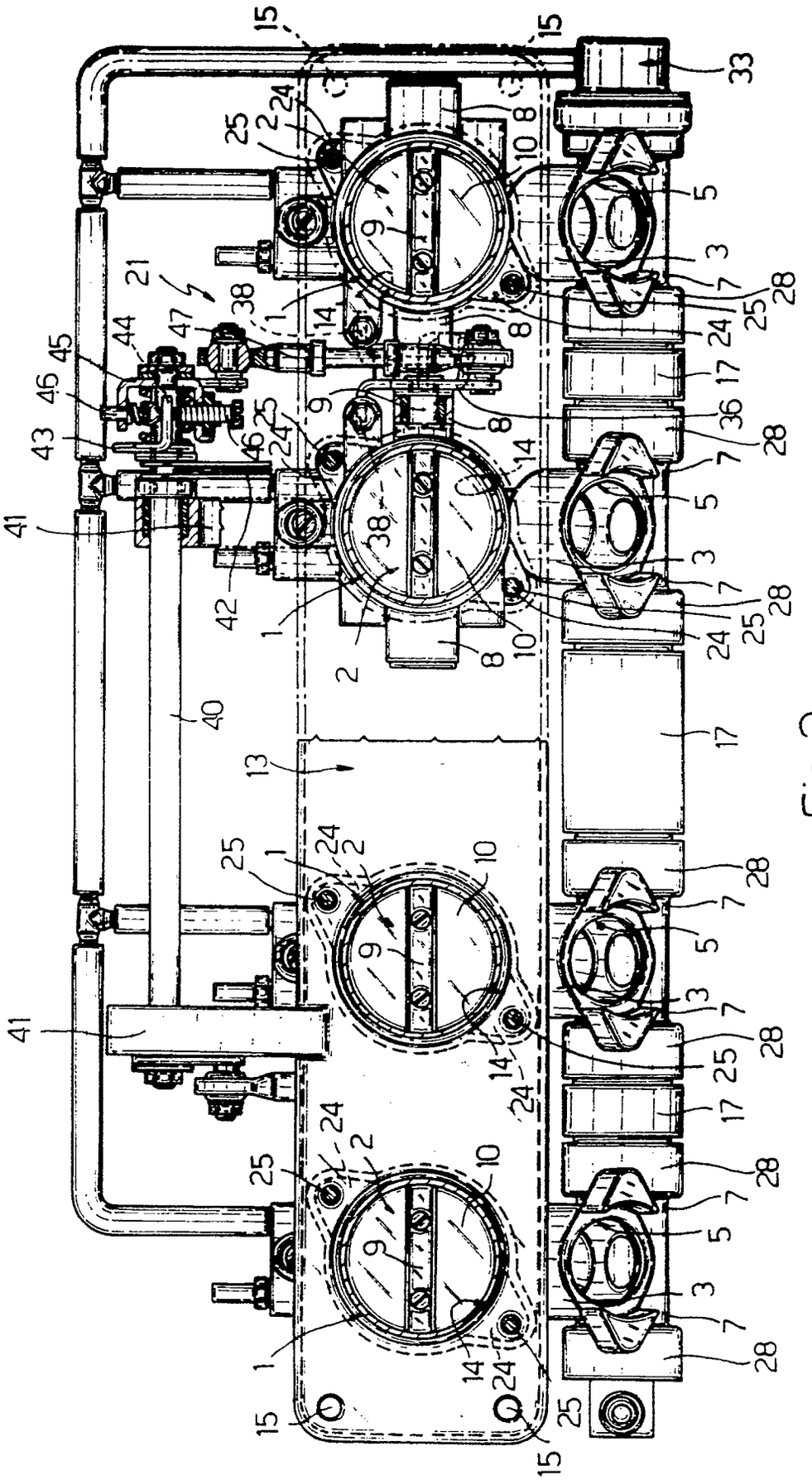

Fig.2

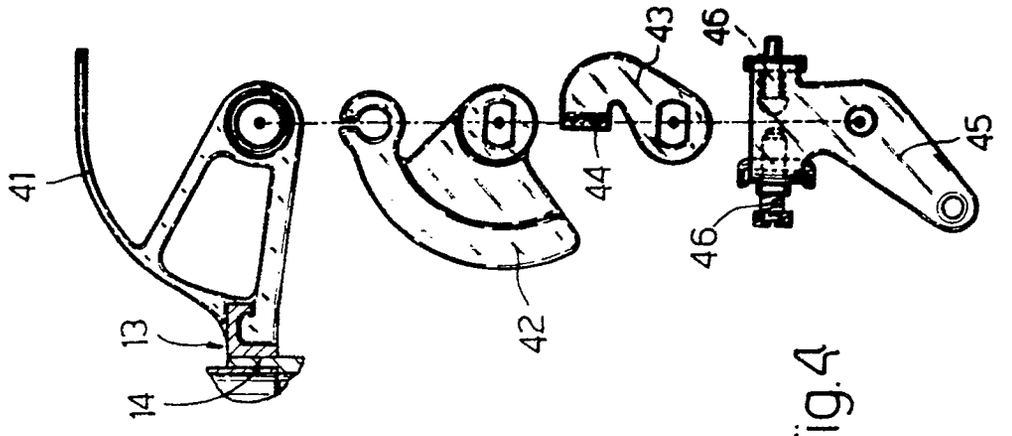
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Fig.4

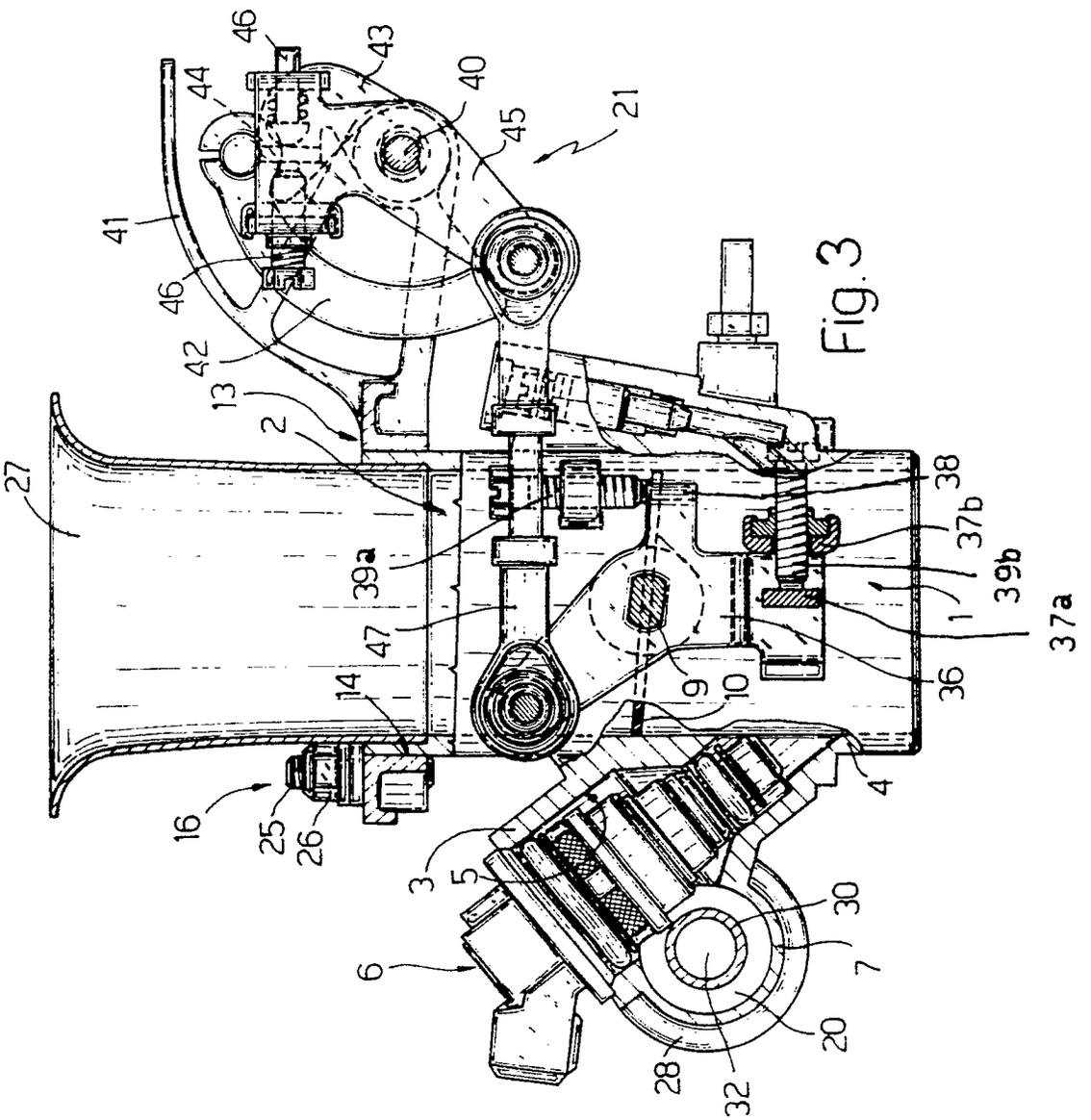
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Fig.3

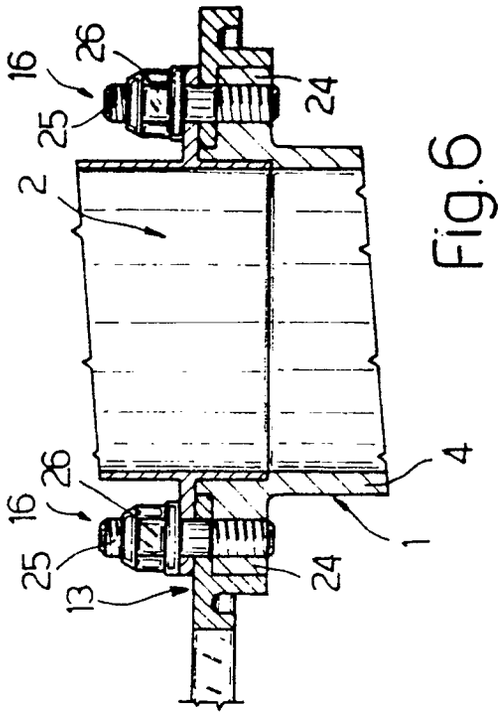
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Fig.6

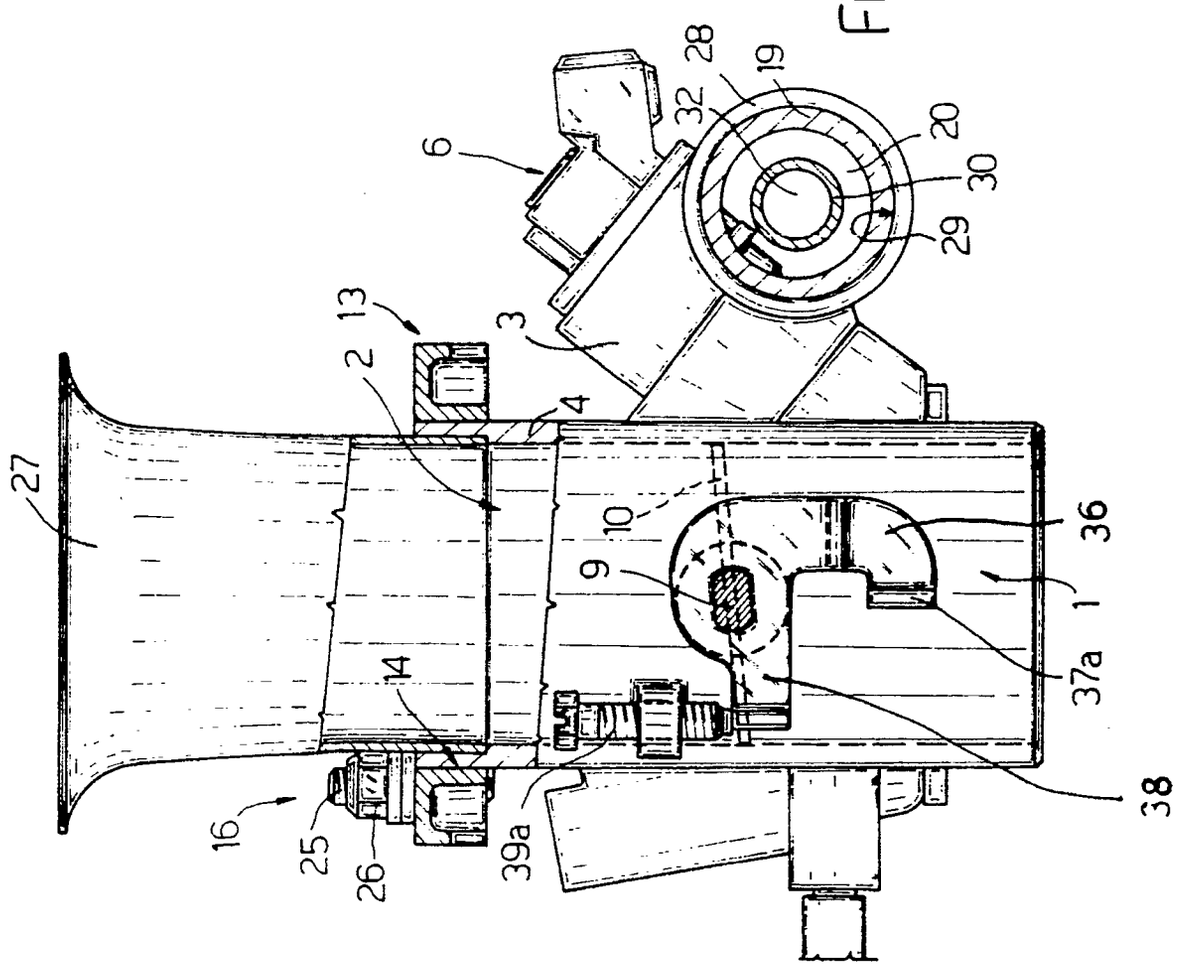
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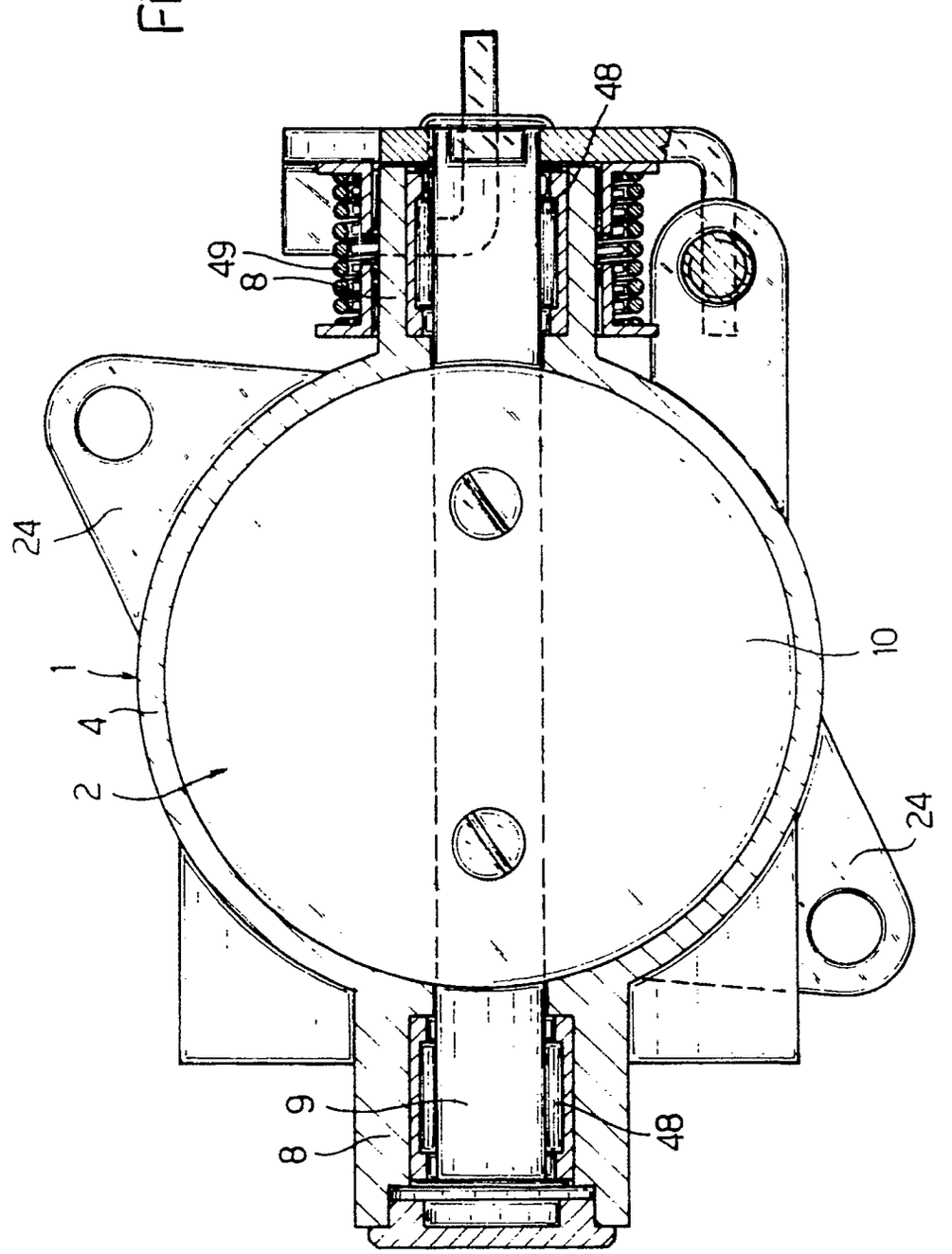
Fig.5

Fig.7



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EUROPEAN SEARCH REPORT

Application Number

EP 91 10 7042

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	MOTORTECHNISCHE ZEITSCHRIFT, vol. 51, no. 4, April 1990, pages 142-146, Stuttgart, DE; M. MICIK et al.: "Der Hochleistungsmotor für BMW M 5" * Figures 1,5 *	1,2	F 02 M 35/10 F 02 B 27/02 F 02 M 55/02
A	US-A-4 913 119 (USUI) * Column 3, lines 44-51; figures 1-3 *	1	
A	MOTO REVUE, no. 2571, 9th September 1982, Paris, FR * Nouveautés 83, page 12, Kawasaki DFI injection system *	1	
A	FR-A-2 574 475 (AUTOMOBILES PEUGEOT)		
A	US-A-2 791 205 (PLATNER)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F 02 M
F 02 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	01 August 91	KLINGER T.G.

CATEGORY OF CITED DOCUMENTS

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