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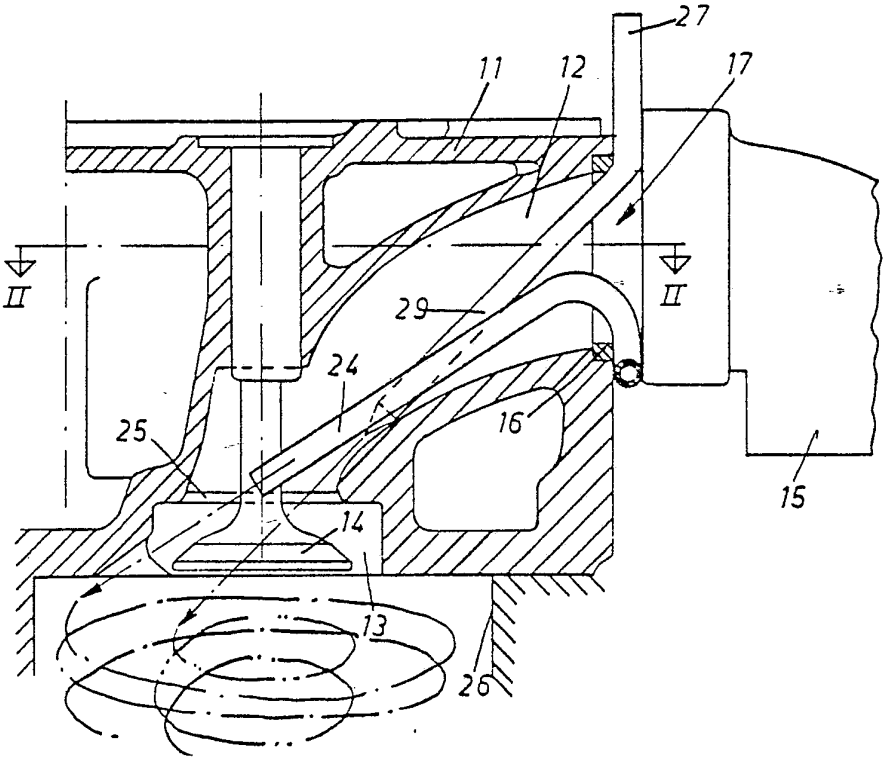
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(54) Title: A METHOD OF RUNNING AN INTERNAL COMBUSTION ENGINE WITH ALTERNATIVE FUELS AND AN INTERNAL COMBUSTION ENGINE FOR ALTERNATIVE FUELS

(57) Abstract

A method of running an internal combustion engine with alternative fuels as high or low octane gasoline, paraffin, diesel oil, ethanol, methanol or similar and/or mixtures thereof and combustible gases as LP-gas and the like at unchanged compression ratio, and which each motor cylinder can be supplied with a further medium besides the fuel for running of the engine and the fuel is heated by the heat from the exhaust system (22, 23). The invention also refers to an internal combustion engine for alternative fuels. This object has been achieved by proportioning and distributing the fuel to each motor cylinder in relation to the air sucked up and that the fuel before entering the motor cylinder is heated to a temperature between its flame temperature and above its evaporation temperature and that the evaporated fuels is fed to the respective motor cylinder preferably at a flat tangential injection angle and when using low octane fuel as an extra medium water or a mixture of water and an antifreezing agent is injected in controlled amounts at a steeper injection angle inside the path of the fuel.



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A method of running an internal combustion engine with alternative fuels and an internal combustion engine for alternative fuels.

This invention refers to a method of running an internal combustion engine with alternative fuels, as high or low octane gasoline, paraffin, diesel oil, ethanol, methanol or similar and/or mixtures thereof and combustible gases as LP-gas and the like with an unchanged compression ratio, at which each of the cylinders can be fed with an extra medium besides the fuel needed for running the engine, said fuel being heated by the heat from the exhaust system. The invention also refers to a combustion engine for running with alternative fuels.

Background of the invention

Today there is no possibility to use more or less all existing fuels in the same engine without changing the compression ratio.

In order to be able to use thicker oils in diesel engines it has previously been suggested to heat the fuel by the heat from the exhaust gases to achive lower viscosity, at which compression heat is consumed for vaporizing and combust the oil. In this way a lower compression and/or higher power output and usage of thicker oil have been made possible.

It has also been suggested to heat the fuel before it enters the intake manifold, in order to reduce unpleasant discharge of exhaust gases at low engine speed.

With direct injection internal combustion engines it is further known to use preheated air for the intake-manifold at idling and low-load-condition. Attempts are made to achive cleaner exhaust gases and lower fuel comsumption at idling and low-lead-condition in this way.

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At previously known mecanically controlled gasoline injection systems the injection is performed continuously and need no driving from the engine. The amount of fuel injected is regulated by the amount of air that is sucked into each cylinder.

All these known proposed improvements solve some minor problems, but none of them solve the problem of running an internal combustion engine for example an Otto-engine with a grat number of alternative fuels.

The purpose of the invention and its most important characteristics.

The purpose of this invention is to provide a method of running an internal combustion engine with alternative fuels. With a regulating lever at the dashboard you can switch from one fuel to an other, even if the engine has a high compression ratio and is a two-or four-stroke engine with conventional ignition system. The running of the engine shall be non-detonating, provide an improved fuel-economy, cleaner exhaust gases and not shorten the liftetime of the engine.

These objects have been achieved by proportioning and distributing the fuel to each motor cylinder in relation to the air sucked up, and by heating the fuel to a temperature between its flame temperature and above its evaporation temperature before entering the cylinder, that the evaporated fuel is fed into the resp. cylinder at a flat tangentional injection angle, and at the use of low octane fuel as an extra medium water or a mixture of water and an antifreezing agent is injected in a controlled amount at a steeper injection angle inside the path of the fuel.

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Description of the drawings

Fig. 1 shows a section through a part of a cylinder head opposite the inlet valve.

Fig. 2 is a section according to the line II-II in fig. 1.

Fig. 3 is a section along the line III-III in fig. 2.

Fig. 4 shows the heat exchange assembly in the sharpe of a middle flange in a front view.

Fig. 5 is a schematic drawing of the engine and its fuel system.

Fig.6 shows the feeding device according to the invention in a front view.

Fig.7 shows the feeding device in end view togehter with the regulating unit.

Fig. 8 shows a heat-exchange-assembly in a V-engine.

Fig. 9 shows a section through a part of a cylinder head where the invention is applied in new production of an internal combustion engine.

Fig. 10 shows a section through the outlet-manifold with an alternative heat exchanger.

Fig. 11 shows a section according to the line XI-XI in fig. 10.

Fig. 12 is a section corresponding to fig. 2 but of a modified embodiment.

Description of embodiments

In the drawings the numeral 11 refers to a cylinder head of an internal combustion engine, 12 the inlet to the combustion room 13 is an inlet valve 14 and 15 is the inlet manifold.

Between this and the inlet port 16 is placed a distance piece 17 which to its outer shape looks like the normal gasket used between these both parts. In the distance piece, see fig. 4, are arranged fuel lines 18 one to each cylinder. The fuel pipe comprise a fitting 19 connected to a fuel feeding device 20, a heat exchanger loop 21, which is partly

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positioned in the outlet channel in the exhaust gas channel of the resp. cylinder 22 and partly in the exhaust manifold 23. The fuel pipe further comprise an injection part 24, which is directed towards the gap of the inlet valve 14 in such a manner that a flat tangential angle is achieved relating to the cylinder wall 26.

The distance piece 17 is also provided with a feeding line 27 which is fitted to a second feeding device 28 coupled in series with the feeding device 20 and feeding the engine with an other medium, by way of example cold water. The feeding line 27 is in the inlet channel equipped with a nozzle 29, which is directed at a steeper angle than the injection part 24, towards the gap of the inlet valve. The venturi tube of the nozzle 29 has a relatively small opening, causing a thin jet of water.

The fuel feeding device 20 and the water feeding device 28, which are of the same principal construction distribute the fuel and the water respectively in relation to the amount of air sucked into the motor cylinders. A distributing valve 30 which is pivoted about its longitudinal axis distributes the fuel and the water (if needed) dependent on the pivoting movement of the valve to the respective cylinder through the fitting 19 of the fuel pipe 18 and the feeding line 27 resp. Both distributing valves 30 of the feeding devices 20 and 28, are joined together and are both regulated by a vacuum diafragm which through the line 32 communicates with a venturi 33 in the air intake 15, which as seen in the direction of the air flow is positioned in front of the throttle 34.

The distributor casing 35 of the feeding devices 20, 28 is pivotally mounted about the distributor valve 30 for adjusting the fuel amount.

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Fig. 8 shows how the evaporated fuel is conveyed from the exhaust side over the cylinder head to the inlet side. The tube connection between the exhaust and the intake side can possibly be made by a tube of a resistance material (i.e. Kanthal) and thus be heated electrically or insulated by a ceramic material.

In fig. 12 is shown an embodiment where the injection part 24 of the fuel pipe 18 has double walls and where exhaust gases are allowed to stream in the space between said double walls to the combustion room 13 and thus heat the fuel.

At new production the heat exchanger and the fuel pipe to the cylinder is built-in permanently in the cylinder head as shown in fig. 9, while the feeding line 27 is placed as previously described.

If it is not possible to arrange a distance piece 17 the heat exchanger 21 can be mounted directly in the outlet manifold as shown in fig. 10 and 11.

The function of the engine

The fuel is pumped in a conventional manner by a standard fuel pump 37 from the tank 38 through a fuel filter 39 and if needed a pressure accumulator 40 to the feeding device 20. The fuel is proportioned and distributed in the feeding device and conveyed through the fuel pipe to the heat exchanger 21 in the outlet channel 22, 23, where the fuel is heated up to a temperature between its flame temperature and above its evaporation temperature. When starting or at insufficient heat-absorbation in the exhaust channel, extra heat may be added to the fuel by an electric heater 41, for example by making injection part 24 of the fuel lines 18 by a resistance material (i.e. Kanthal), or by means of exhaust gases.

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Through the special way the injection part 24 is directed, the evaporated fuel will be injected in a relative flat path towards the cylinder wall 26 where the fuel will circulate in a spiral passing the spark plug 42 as a final phase of the injection stroke. By that a lean fuel-air-mixture is achieved, which gives a good combustion and a low fuel consumption.

In order to make it possible to use alternative fuels without changing the compression ratio it is possible to add water in a controlled amount and distribute into the combustion room.

Water is pumped by a water pump 43 from the water tank 44 by way of the filter 45 to the feeding-device 28. The water distribution line 27 from the feeding device 28, is with its nozzle portion located in the intake channel 12 arranged in such an angle that the water jet will enter at a steeper angle than the injected fuel. The fine water jet from the nozzle portion 29 will enter in a spiral inside the path of the fuel. The purpose of the water injection is to prevent predetonation by cooling and cut off the detonation peak which oppears when the motor is run on e.g. 20-octane fuel instead of e.g. the required 98-octane fuel. The energy taken from the detonation peak is consumed for evaporating the water and alcohol, thus causing a stream engine-effect and decompose the alcohol in different more combustible radicals. This contributes to a cleaner engine and cleaner exhaust gases.

Test results

Practical tests with stationary engines as well as boat- and car engines in traffic have shown good results. Using 98-octane preheated gasoline without water injection and full load, the fuel consumption at 2600 rpm was 178 gr/hph, while when using the carburator, under same condition the fuel consumption was 242 gr/hph.

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When using diesel oil as fuel in the same engine as above and with a 25 % admixture of gasoline plus water injection we have measured a feul consumption of 200-220 gr/hph at full load and 3000 rpm.

When using pure diesel oil a fuel consumption of about 110 gr/hph and a water-methanol-consumption (50/50 %) of 90 gr/hph could be noticed at full load at 3000 rpm. The compression for the engine ratio was 9:1 and the compression pressurea was 11,6.

Very good results have also been achieved with paraffine or alcohol (ethanol and methanol) as fuel.

The invention is not limited to the embodiment shown and described, but a plurality of modifications are possible within the scoop of the claims.

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CLAIMS

1. A method of running an internal combustion engine with alternative fuels, as high or low octane gasoline, paraffin, diesel oil, ethanol, methanol, or the like and/or mixtures thereof and combustible gases as LP-gas and the like at unchanged compression ratio and which comprises at least one cylinder, which can be supplied with an extra medium besides the fuel needed for running the engine, said fuel being heated with heat from the exhaust system,
c h a r a c t e r i z e d b y
that the fuel is proportioned and distributed to each motor cylinder in relation to the amount of air sucked up, that the fuel before its entrance into the motor-cylinder is heated to a temperature between its flame temperature and above its evaporation temperature, that the evaporated fuel is fed into the respective motor cylinder at a flat tangetial injection angle, and that when using low octane fuel as an extra medium for example water or a mixture of water and an anti-freezing agent is injected in a controlled amount into the cylinder at a steeper injection angle inside the path of the fuel.

2. An internal combustion engine for alternative fuels as high or low octane gasoline, paraffin, diesel oil, ethanol, methanol or the like and/or mixture thereof at unchanged compression ratio, at which each cylinder is provided with a feeding line (27) for an extra medium besides the fuel needed for running the engine and with arrangements for heating the fuel with heat from the exhaust system,
c h a r a c t e r i z e d b y
that a feeding device (20) is arranged for proportioning and distributing the fuel to each motor cylinder in relation to the amount of air sucked up and that a heat-exchanger (21) is arranged for each motor cylinder in the exhaust system (22, 23) of the engine - for heating the fuel before its entrace into the motor cylinder to a temperature between its flame temperature and above its evaporation temperature, and

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that a fuel pipe (18) is positioned in each inlet channel (12) and directed towards the gap (25) of the inlet valve in a flat, tangetial angle relating to the cylinder wall (26), and that the feeding line (27) for the extra medium, which for example is water is directed at a steeper injection angle towards said gap inside the path of the fuel.

3. An internal combustion engine according to claim 2, characterized by that the fuel pipe (18) completely or partly is electrically heated by a heating device (41).

4. An internal combustion engine according to claim 2, characterized by that the fuel pipe (18) is heated by exhaust gases.

5. An internal combustion engine according to claim 4, characterized by that at least the injection part (24) of the fuel pipe (18) has double walls and that exhaust gases are allowed to stream in the space between the double walls.

6. An internal combustion engine according to claim 2, characterized in that the injection part (24) of the fuel pipe (18) is insulated by a ceramic material.

7. An internal combustion engine according to any of the preceding claim, characterized by that the heat exchanger (21) is an integrated part of the fuel pipe (18) positioned partly in a distance piece (17) arranged between the cylinder head (11) of the engine and the exhaust manifold (23).

8. An internal combustion engine according to any of the preceding, characterized by

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that the feeding line (27) partly is fixed in a distance piece (17) arranged between the cylinder head (11) of the engine and the inlet pipe (15).

9. An internal combustion engine according to claim 7 or 8, characterized by that the heat exchanger (21) and the feeding line (27) are arranged in the same distance piece (17).

10. An internal combustion engine according to any of the claims 1-6, characterized by that the heat exchanger (21) which is a part of the fuel line (18) is places in the manifold of the exhaust system or in the cylinder head.

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FIG 1

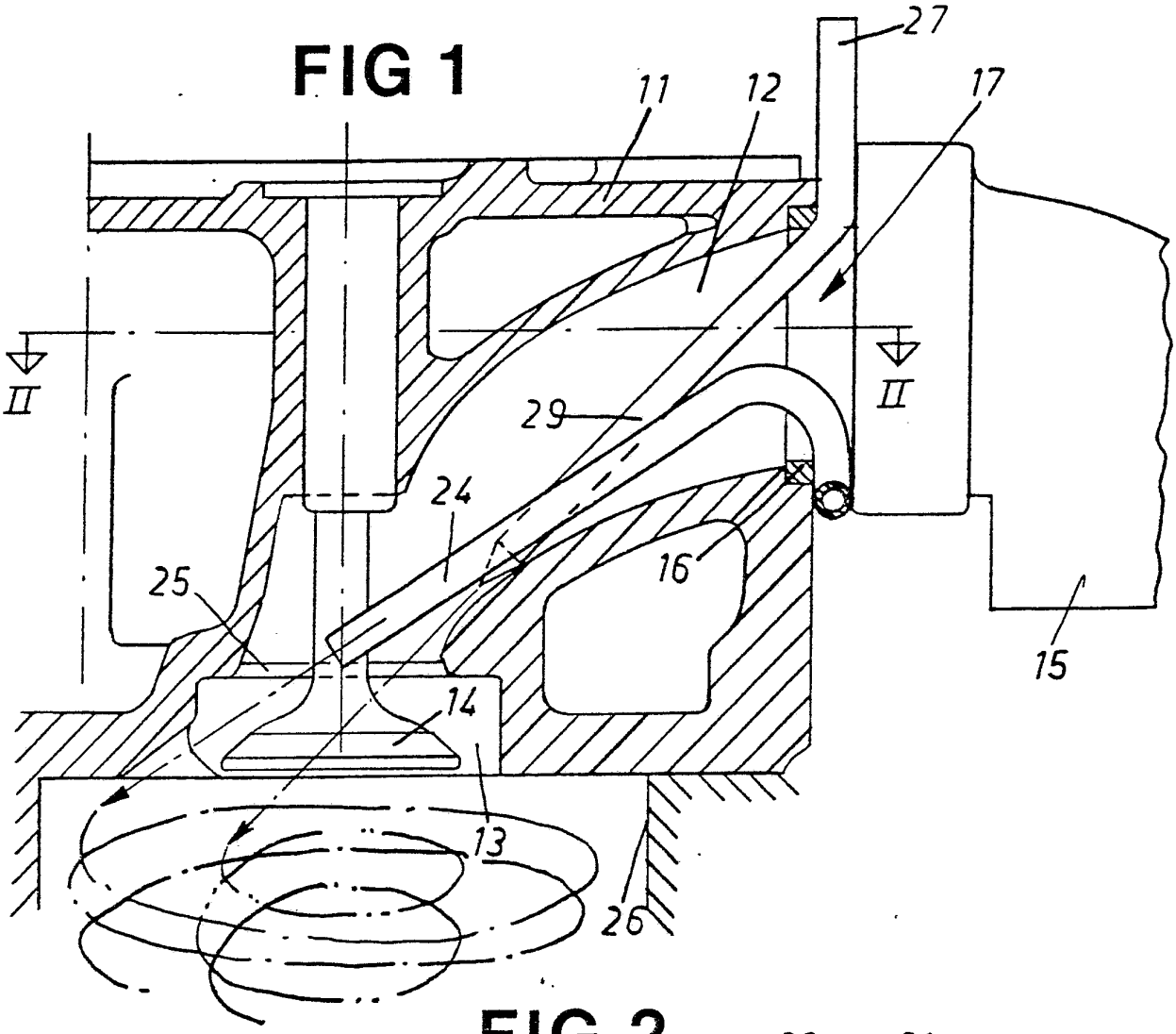
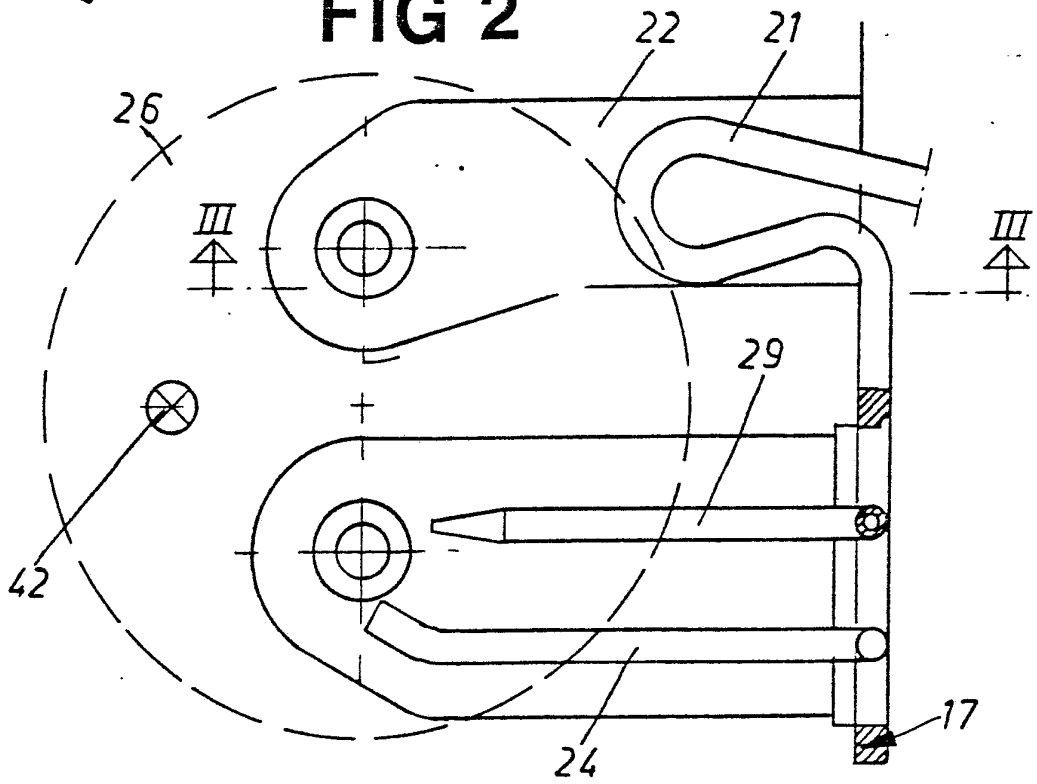


FIG 2



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FIG 3

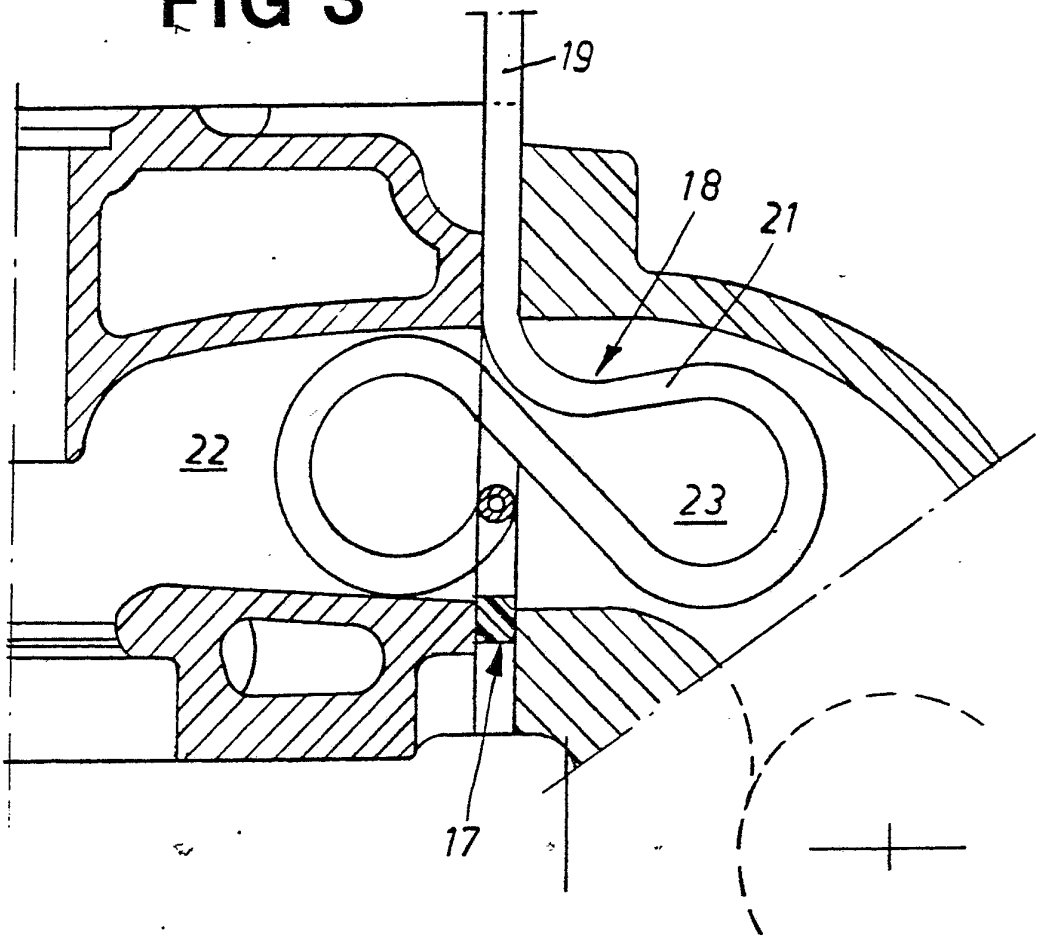
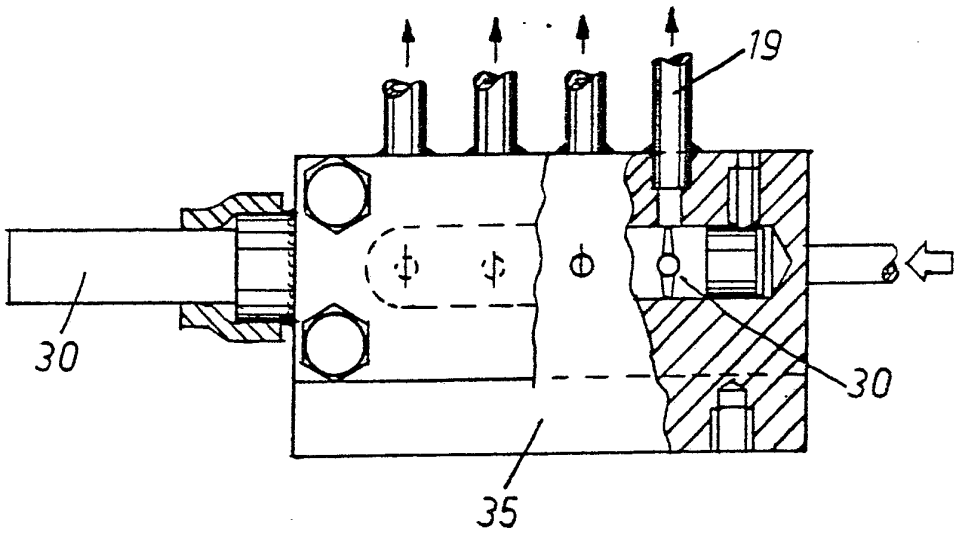
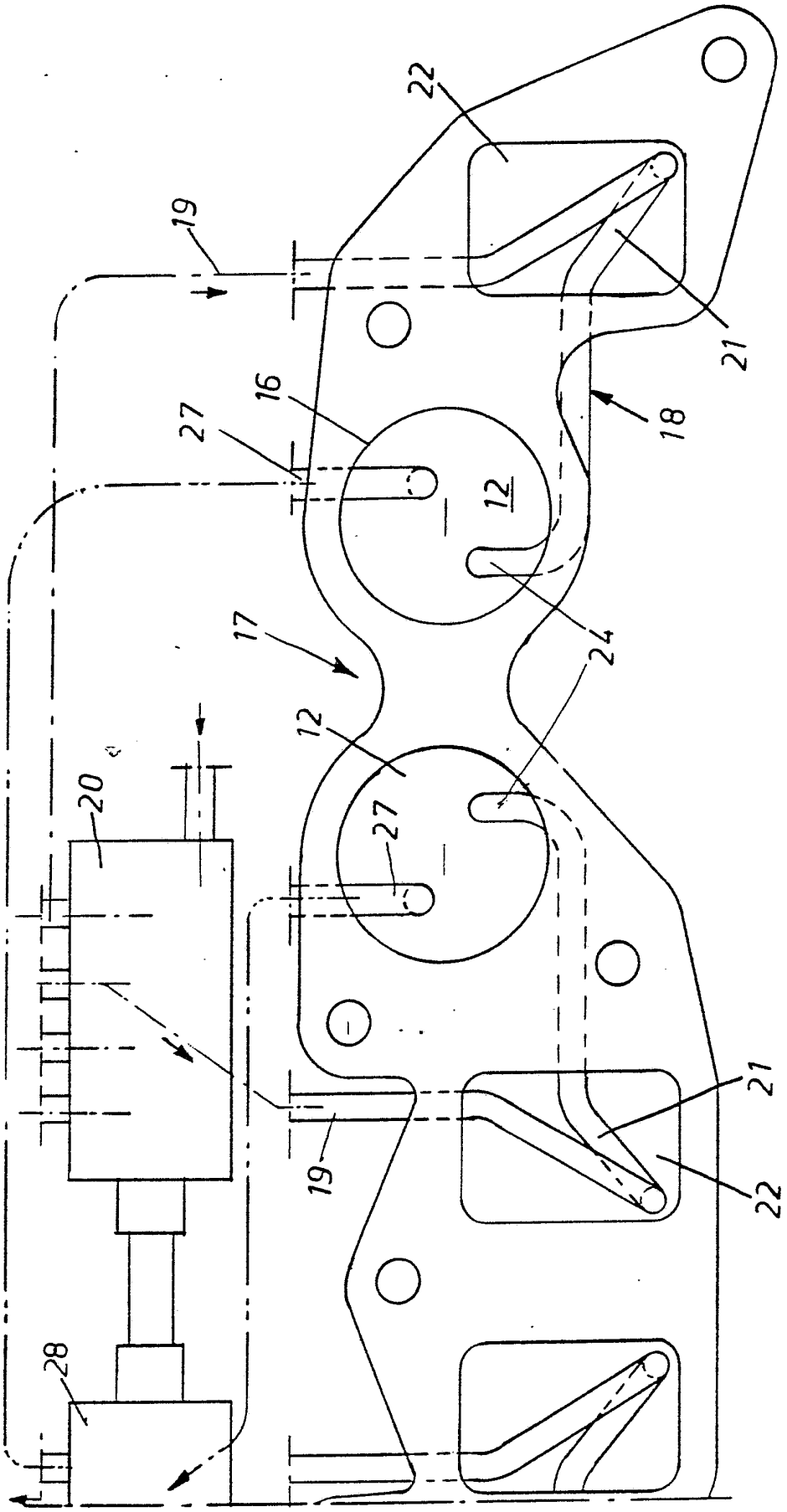


FIG 6



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FIG 4



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FIG 5

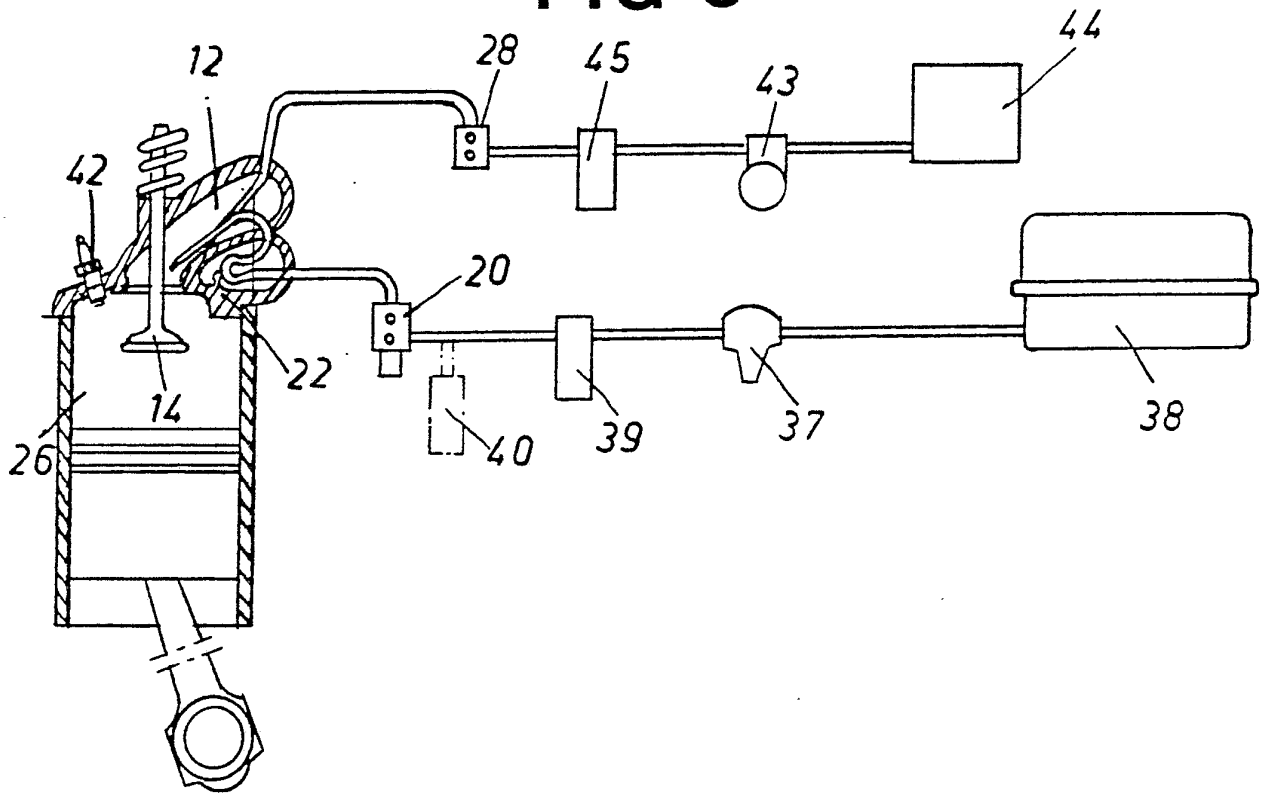
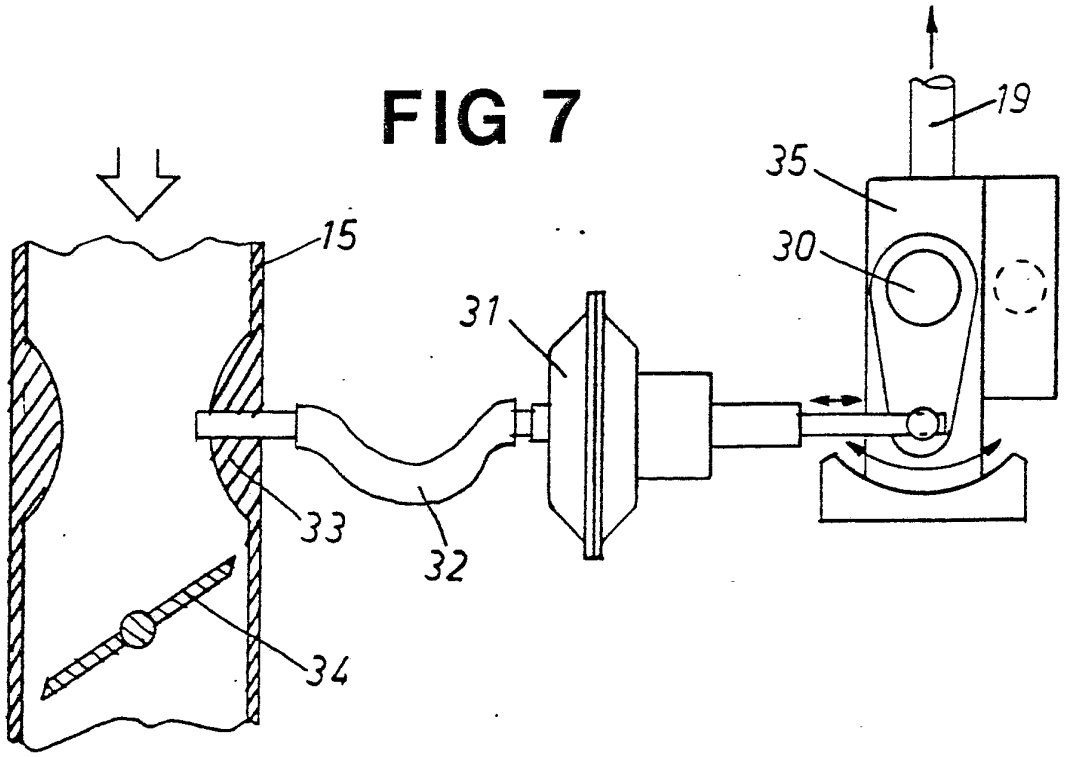


FIG 7



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FIG 8

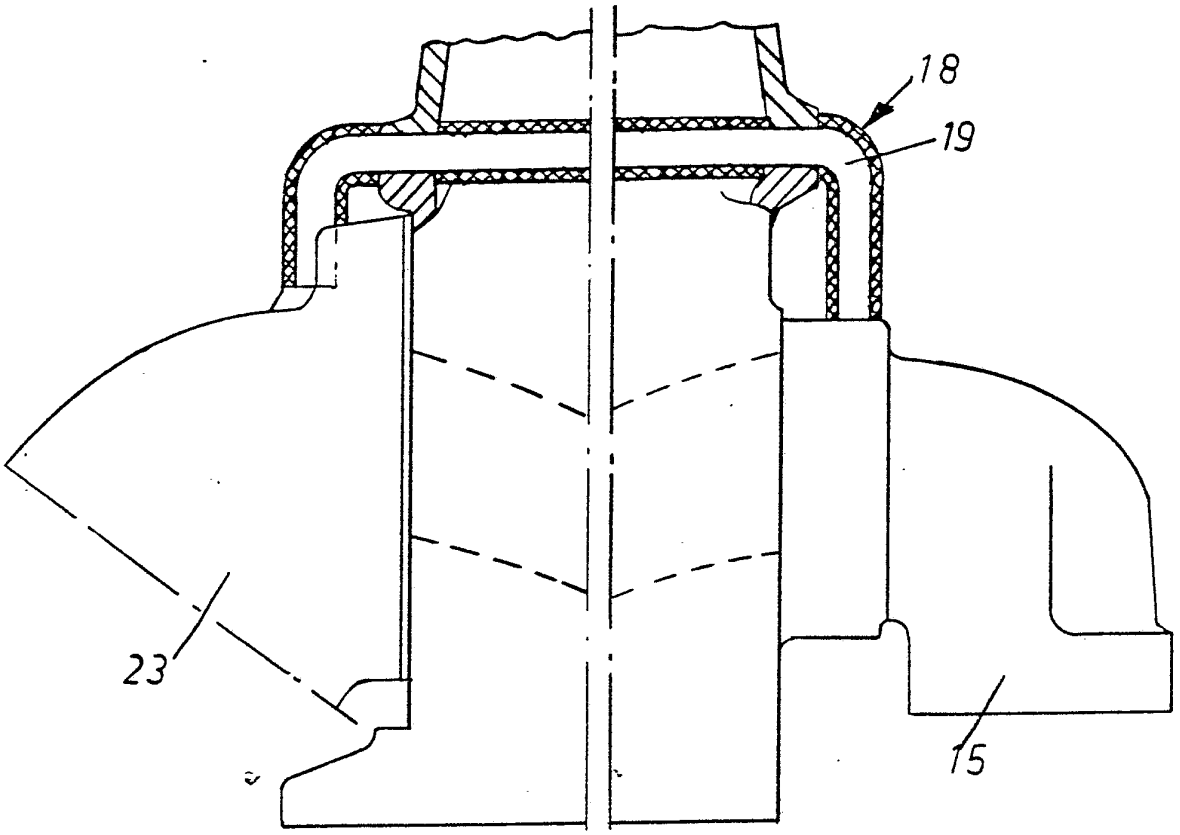
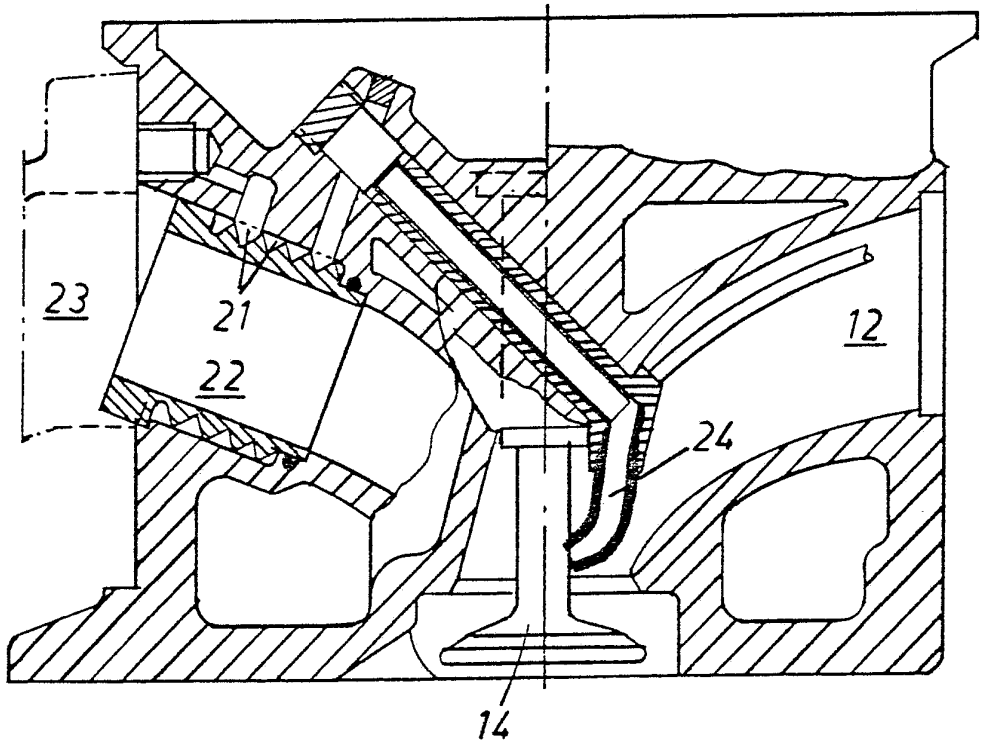


FIG 9



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FIG 10

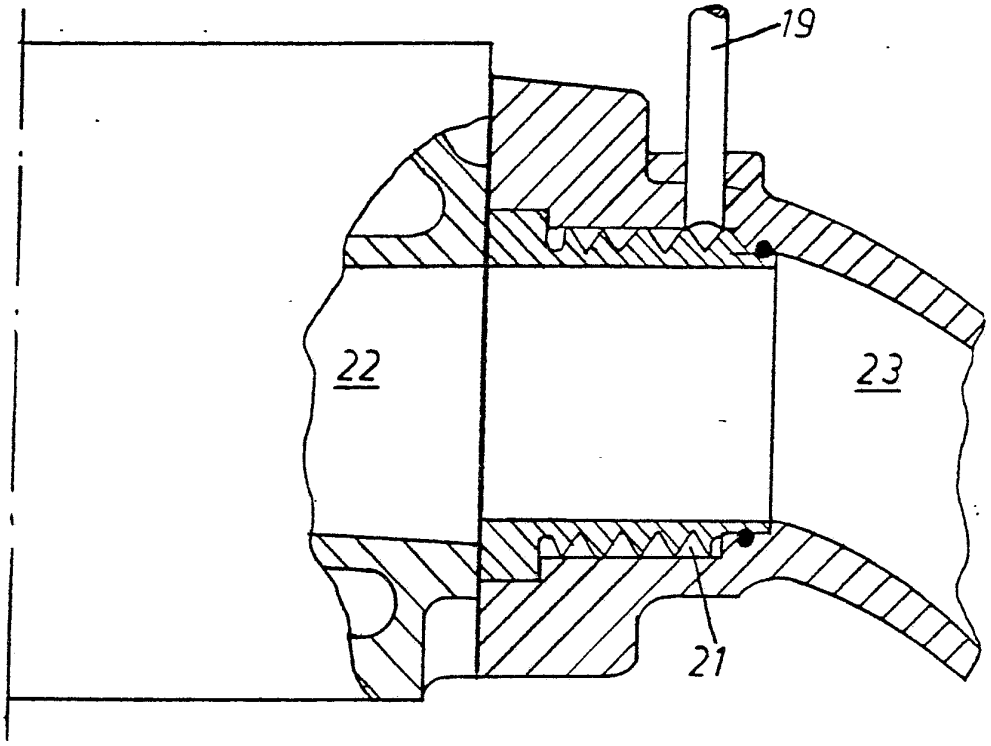
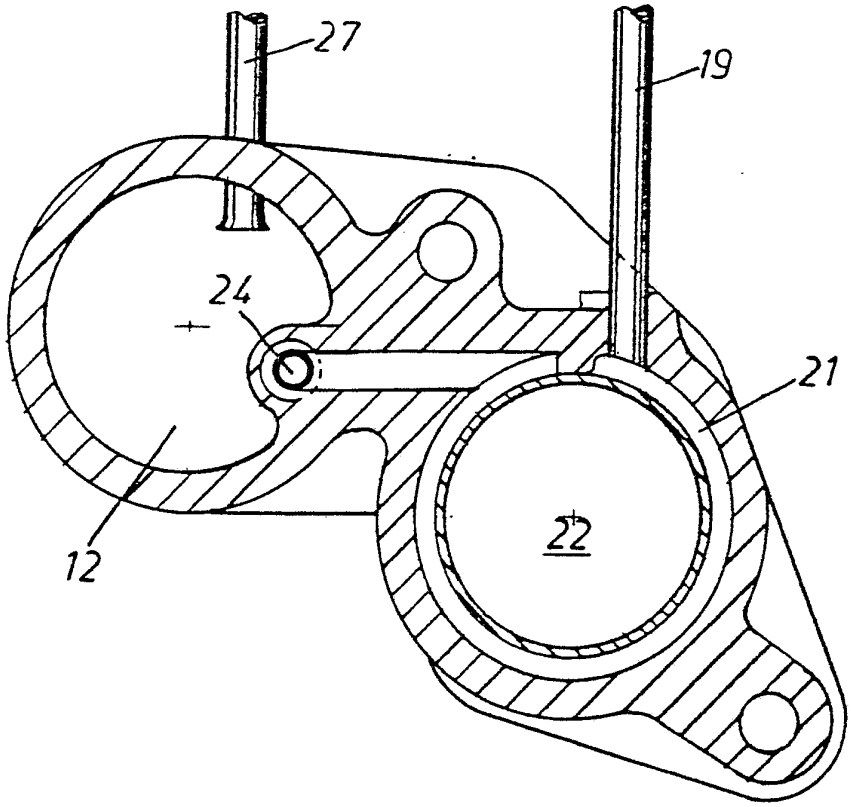
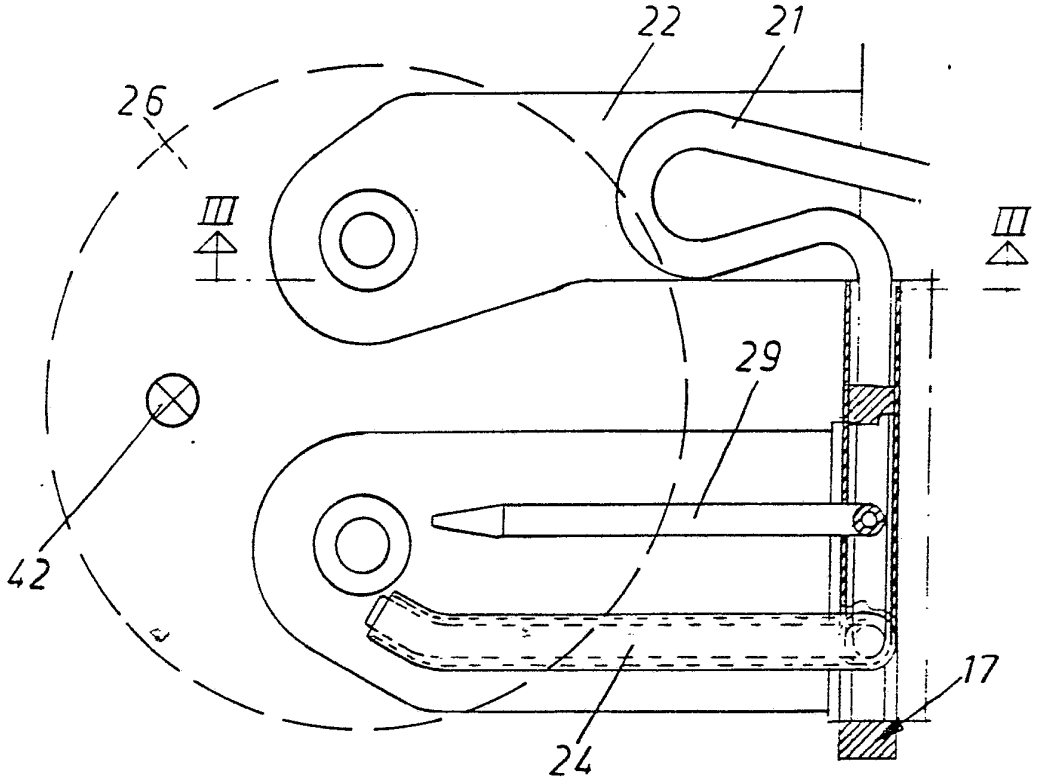


FIG 11



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FIG 12



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INTERNATIONAL SEARCH REPORT

International Application No PCT/SE82/00333

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

F 02 D 19/08,19/12, F 02 M 25/02,31/16,43/00

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC 3	F 02 D 19/00-/02, 19/06-/12, F 02 M 25/02, F 02 M 31/16, 43/00-/04, F 02 M 25/00
US Cl	123-125

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
1983-01-17	1983 -01- 21
International Searching Authority [1]	**Signature of Authorized Officer** [20]
Swedish Patent Office	Kurt Rödin

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