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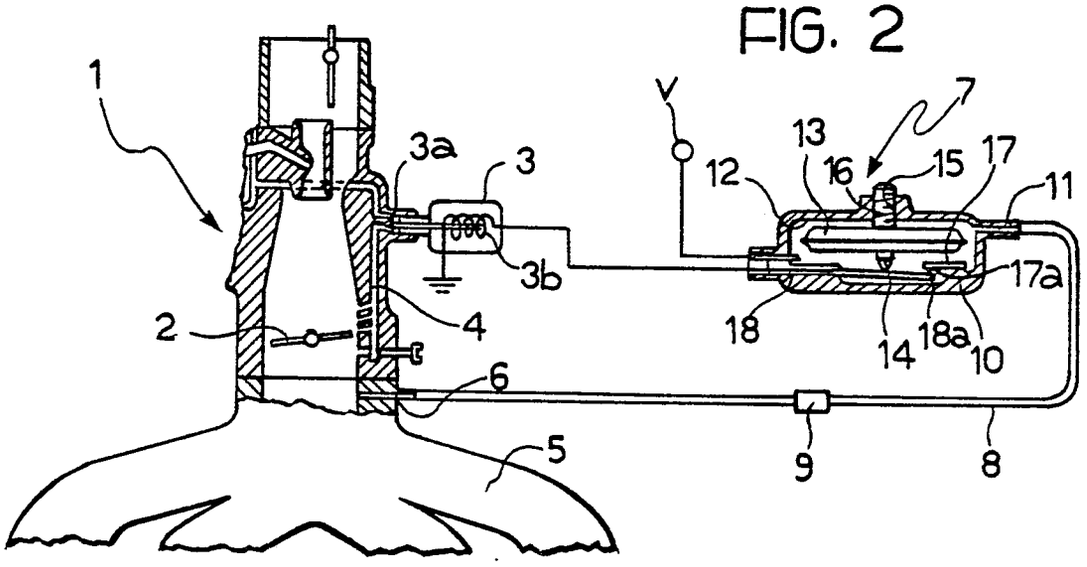
(54) **Electro-pneumatic device for controlling the flow of fuel to a carburation engine for motor vehicles.**

(57) The device comprises a solenoid value (3) arranged to cut-off the supply of fuel and controlled by a sensor (7) arranged to detect the pressure in the induction manifold of the engine. This sensor (7) is an absolute pressure sensor whereby the cut-off solenoid (3b) is energised and de-energised respectively when the absolute pressure in the induction manifold assumes a first and a second predetermined value respectively.

FIG. 2



EP 0 207 010 A1

Electro-pneumatic device for controlling the flow of fuel to a carburation engine for motor vehicles.

The present invention relates to a device for controlling the flow of fuel to a carburation engine for motor vehicles.

It is known that the use of devices for cutting-off the flow of fuel to the engine of a motor vehicle during deceleration results in tangible advantages in terms of reduction of fuel consumption.

There are various devices for effecting cut-off of the fuel, some of these devices being integrated in more complex systems for controlling the supply of fuel (electronically controlled injection systems), others being formed as specific devices having solely the cut-off function. These latter may be divided essentially into two categories: electronic devices and electro-pneumatic devices.

The first are characterised by the presence of a more or less sophisticated electronic unit arranged to detect the values of several operating parameters of the engine and to discriminate between the conditions in which the engine acts as a "brake" and those in which it acts properly in a propulsion mode. In general such electronic control units are supplied with signals indicative of the rate of rotation of the engine and a signal indicative of the open or closed condition of the throttle valve.

The operation of electro-pneumatic devices is however, based exclusively on the detection of the vacuum in the induction manifold by means of a pneumatic capsule: when the engine is "motoring over", the degree of vacuum in the induction manifold rises above a certain value. The pneumatic capsule, suitably calibrated, may act directly on an obturator device disposed in the idling duct or channel of the carburettor or may operate an electrical switch by means of which a solenoid is energised, the movable member of the latter acting as the obturator for the idling duct of the carburettor. An electro-pneumatic device of this type is described in detail in Italian Patent Application No. 67743-A/82 filed in the name of the same applicants.

The electro-pneumatic devices, although being simpler and more economical than electronic devices, are not, however, able to ensure the same degree of precision and stability as the latter upon variation of the enviromental conditions and in particular upon variation of atmospheric pressure. In fact the said pneumatic capsules are sensitive to the relative pressure in the induction manifold, that is, to the pressure relative to atmospheric pressure. Figure 1 of the appended drawings shows a graph illustrating typical changes in the vacuum (relative) Δp, in mmHg, detected in the induction manifold of an Otto-cycle engine under engine "motoring over" conditions with the throttle valve closed, as a function of the rotational speed n of the engine in r.p.m. The graph of Figure 1 shows two curves a and a' indicative of the changes in Δp for two different values of the barometric pressure of about 750 mm Hg and 700 mm Hg respectively.

Essentially, upon variation of the barometric pressure, the curve of Δp is displaced parallel to itself along the ordinate axis by an amount practically equal to the variation in the barometric pressure. If the pressure sensor which controls the cut-off device is calibrated for a threshold pressure value ΔpO of 550 mm Hg, in the case of the curve a the cut-off device for the fuel flow would operate when the engine rotational speed was equal to n_o = 1600 r.p.m. As a result of a 50 mm Hg reduction in the atmospheric pressure, the operating threshold of the cut-off device would be displaced to a value of n'_o = 2400 r.p.m.

In an entirely similar manner, for barometric pressures greater than that corresponding to the curve a the activation of the cut-off device would be moved towards ever lower engine rotational speeds causing the engine to operate poorly. On the contrary, in the case of very low atmospheric pressure, the activation would be moved towards higher rotational speeds, partly or completely annulling the benefits which would be expected from the fuel-flow cut-off device.

The object of the present invention is to provide an electro-pneumatic device for controlling the fuel flow to a carburation engine for motor vehicles which does not have the disadvantages indicated above. This object is achieved according to the invention by means of an electro-pneumatic device for controlling the fuel flow, comprising a cut-off device arranged to cut-off the supply of fuel and a pressure sensor for causing the energisation and de-energisation respectively of the cut-off device when first and second predetermined pressure conditions respectively occur in the induction manifold of the engine; the device being characterised in that the pressure sensor is an absolute pressure sensor whereby the cut-off device is energised and de-energised respectively when the absolute pressure in the induction manifold assumes a first and a second predetermined value respectively.

The device according to the invention ensures a good degree of stability and precision in operation even upon variation of the enviromental conditions, in particular upon variation of the atmospheric pressure, while retaining the advantages of simplicity and economy typical of electro-pneumatic devices.

Further characteristics and advantages of the device according to the invention will become apparent from the detailed description which follows, given with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1, already described, shows the changes in the vacuum (relative) in the induction manifold of an engine as a function of the r.p.m.,

Figure 2 is a partially sectioned view of a carburettor for a motor vehicle engine, provided with an electro-pneumatic control device according to the invention, also shown in section, and

Figure 3 is a graph showing typical changes in the absolute pressure detected in the induction manifold of a carburation engine, under "motoring over" engine conditions with the throttle valve closed.

In Figure 2 a carburettor of known type is indicated 1, including a throttle valve 2 and provided with a cut-off device 3, for example an solenoid comprising a movable element 3a acting as an obturator for the carburettor idling duct 4 and an energising winding 3b.

A pressure take-off 6 is formed in the induction manifold 5 of the engine and is connected to a pressure sensor 7 through a tube 8 in which is located a bush 9 defining a calibrated passage or restrictor.

The pressure sensor 7 comprises a rigid casing 10, for example of plastics material, having an aperture 11 connected to the tube 8. A chamber 12 is defined within the casing 10 and communicates with the induction manifold through the aperture 11, the tube 8 and the pressure take-off 6 formed in the manifold. A barometric capsule 13 of aneroid type is located in the chamber 12. A further, threaded, hole 15 is formed in the wall of the casing 10 and engaged by an adjusting screw 16 of which the end within the casing bears against one of the walls of the capsule 13. A control ferrule indicated 14 is applied to the outer face of the other wall of the capsule 13.

Two blades 17 and 18 of electrically conductive material extend into the chamber 12 through the wall of the casing 10. The blade 18 is connected to one end of the energising winding 3b of the cut-off device, the other end of this winding being connected to earth. The blade 17 is intended to be connected to a D.C. power source V. The ends of the blades 17 and 18 face each other within the chamber 12 and carry respective contacts 17a and 18a. The ferrule 14 carried by the aneroid capsule 13 touches the blade 18.

In operation, if the internal combustion engine is not running, the aneroid capsule 13 is compressed as a result of the barometric pressure. When the internal combustion engine is running, the aneroid capsule 13 is subject to the vacuum in the induction manifold 5 downstream of the throttle valve 2. Under these conditions, the capsule 13 can expand. If the absolute pressure in the manifold 5 falls below the calibrated value of the sensor 7, the capsule 13 causes the contacts 17a and 18a to separate, causing the de-energisation of the cut-off device 3: the movable element 3a moves to the cut-off position (under the action of a return spring not shown) cutting-off the fuel supply to the idling duct 4 of the carburettor, and achieving the fuel cut-off function.

Subsequently, as the deceleration of the engine increases, the absolute pressure in the manifold 5 increases until it causes the reclosure of the contacts 17a and 18a, the re-energisation of the solenoid 3 and the resumption of the fuel flow to the engine.

The fuel flow may be resumed suddenly if, from the condition of release of the accelerator pedal, there is a sharp re-opening of the throttle valve. In fact, under these conditions there is a rapid rise in the pressure in the manifold and consequently a rapid re-closure of the contacts of the pressure sensor 7 and a simultaneous resumption of the fuel flow.

From tests carried out by the applicants it has emerged that the system described above does not require temperature sensors or other additional devices for avoiding malfunction during engine warm-up. This is advantageous compared with electronic systems which must either provide for de-energisation of the system until the engine has reached its running temperature or must provide an increase in the enabling threshold of the fuel cut-off when the engine is cold.

Figure 3 illustrates a typical change in the absolute pressure p in the induction manifold of an internal combustion engine under "motoring over" engine conditions with the throttle valve closed, as a function of n r.p.m: upon variation of the barometric pressure the curve of p is practically unchanged. In effect, a variation in the barometric pressure affects the value of the absolute pressure only to a very small extent: this effect is due simply to the fact that upon variation of the barometric pressure the exhaust back-pressure of the engine also varies and hence the volumetric yield thereof varies.

By virtue of the use of an absolute pressure sensor in the device of the invention, the dependence of the operating threshold of the cut-off device upon the barometric pressure is rendered practically negligible as is also the dependence on altitude or height relative to sea level.

For the device illustrated above to operate well it is advisable to provide the calibrated passage 9, acting as a damper for the pressure oscillations detected.

Moreover, the pressure sensor 7 must have adequate hysteresis to avoid spurious switchings at pressure values around the operating threshold.

Claims

1. Electro-pneumatic device for controlling the flow of fuel to a carburation engine for motor vehicles, comprising a cut-off device (3) arranged to cut-off the supply of fuel and a pressure sensor (7) for causing the energisation and de-energisation respectively of the cut-off device (3) when first and second predetermined pressure conditions respectively occur in the induction manifold (5) of the engine, characterised in that the pressure sensor - (7) is an absolute pressure sensor, whereby the cut-off device (3) is energised and de-energised respectively when the absolute pressure in the induction manifold (5) assumes a first and a second predetermined value respectively.

2. Device according to Claim 1, characterised in that the pressure sensor (7) comprises:

-a rigid casing (10) having an aperture (11) intended to be put in communication with the induction manifold (5) of the engine,

-an electric switch (17, 18) preferably with hysteresis, mounted in the casing (10) and having a

movable control member (14), and

-a barometric capsule (13) of aneroid type mounted in the casing (10) and cooperating with the control member (14) of the switch (17, 18); the capsule - (13) expanding or contracting when pressure in the casing (10) decreases or increases.

3. Device according to Claim 2, characterised in that it further includes damper means (9) for reducing the amplitude of pressure osillations measured by the pressure sensor (7).

4. Device according to Claim 3, characterised in that the damper means comprise a bush (9) defining a calibrated-diameter passage mounted in the duct (8) for connecting the aperture (11) of the casing (10) of the sensor (7) to the induction manifold (5) of the engine.

5. Device according to any one of the preceding Claims, characterised in that the casing (10) has a further, threaded, aperture (15) facing the said barometric capsule (13); an adjusting screw - (16) being mounted in the said second aperture - (15) with its end inside the casing (10) in contact with a wall of the capsule (13).

FIG. 1

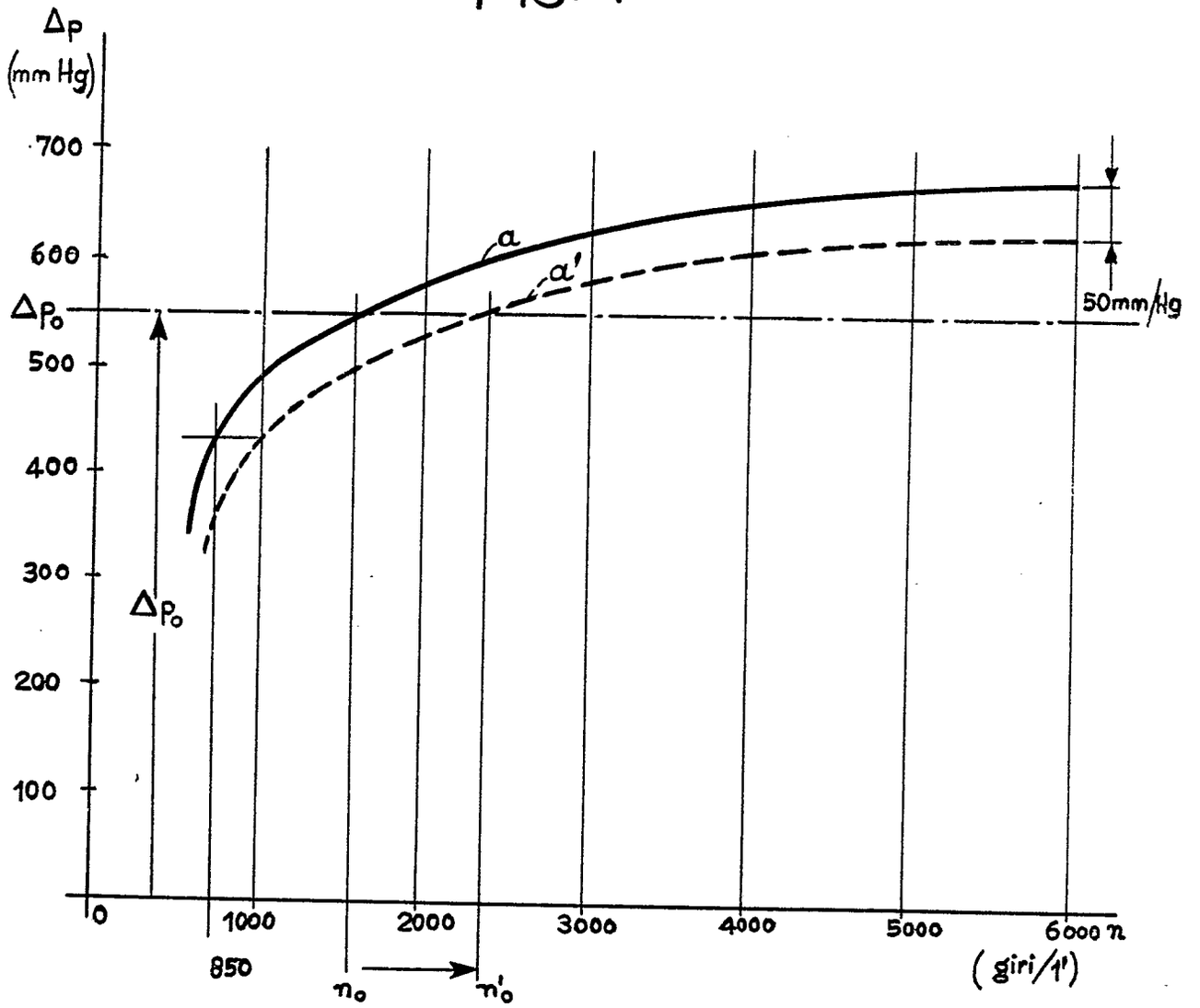
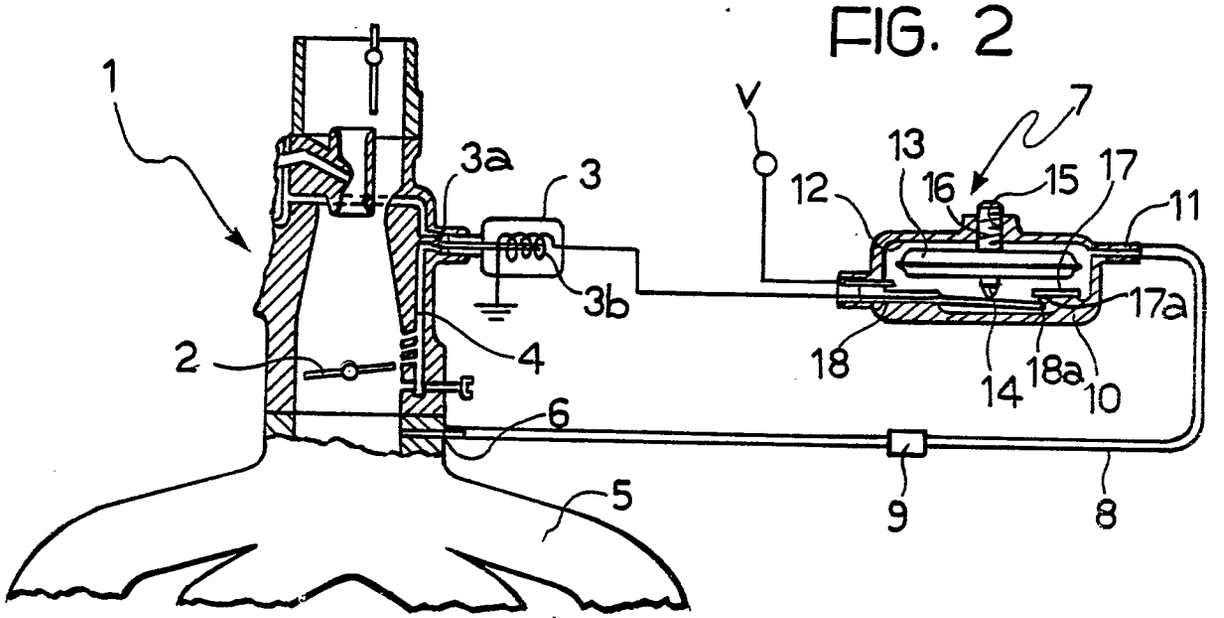

Δp
(mm Hg)
700
600
500
400
300
200
100
Δp₀
Δp₀
a
a'
50mm/Hg
0
1000
2000
3000
4000
5000
6000 n
(giri/1')
850
n₀
n'₀

FIG. 2


1
2
3
3a
3b
4
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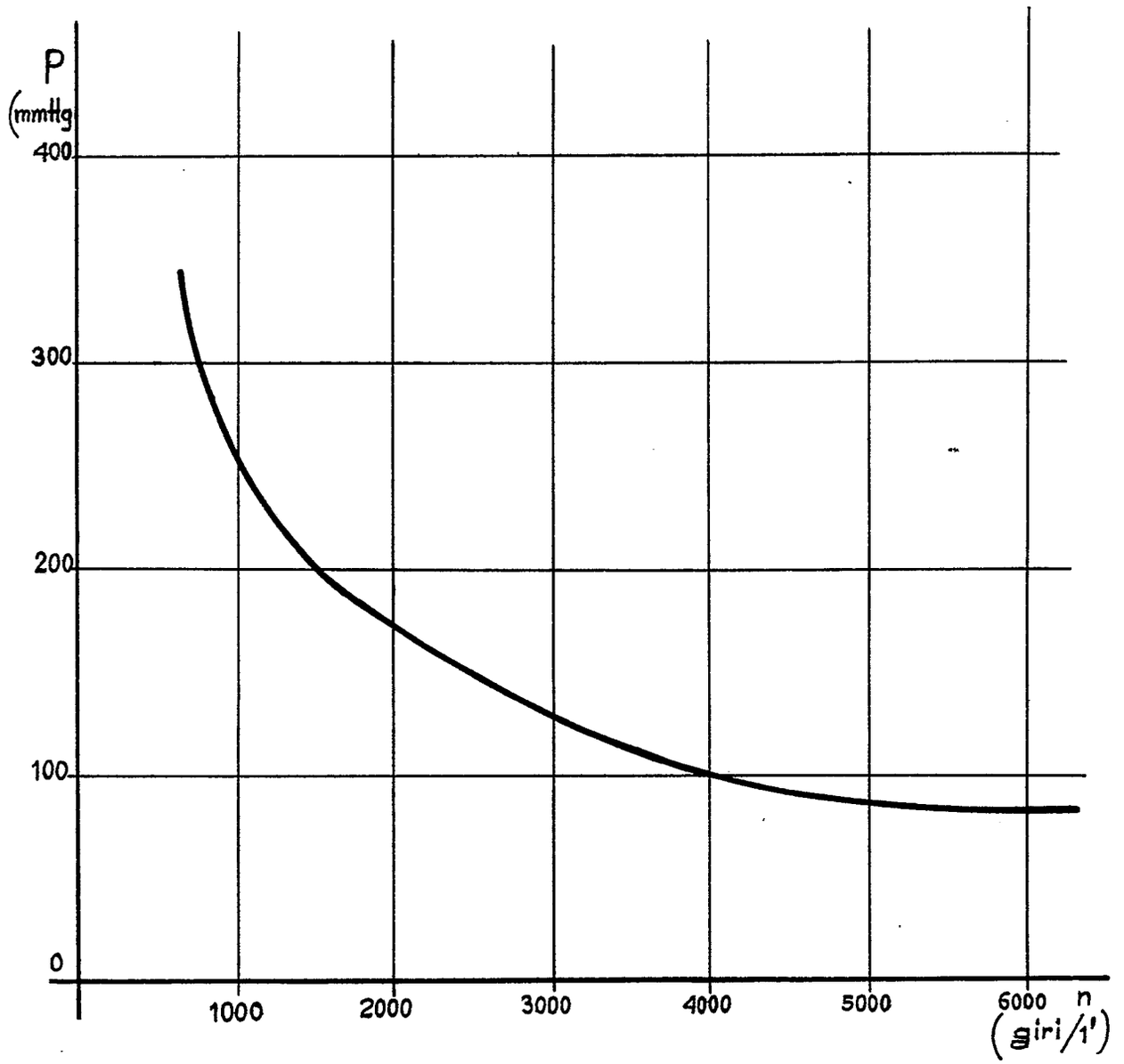
17a
18
18a
V

FIG. 3



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EUROPEAN SEARCH REPORT

Application number

EP 86 83 0127

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.4)
X	US-A-2 856 167 (HOLLEY CARBURETOR CY.) * Column 1, lines 15-18,49-53; column 2, lines 35-59; column 4, lines 13-75 *	1	F 02 M 3/045
A		2	

Y	DE-A-1 526 729 (PYRITZ) * Pages 1,2; page 4, paragraphs 2,3; page 5, lines 1-8; page 9, last paragraph; page 10, paragraph 1 *	1	

Y	EP-A-0 079 763 (BARNES) * Abstract; page 15, lines 15-26; page 16, lines 1-5; figure 4 *	1	
	---		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Y	US-A-3 455 260 (S.I.B.E.) * Abstract; column 3, lines 20-31; column 4, lines 54-56,73-75; column 5, lines 1-4; figures 4,5 *	1,3,4	F 02 M H 01 H

Y	US-A-3 046 369 (HICKS) * Column 3, lines 48-75; column 4, lines 1-16,33-37; figure 1 *	1,3,4	
A		2	
	--- -/-		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-09-1986	JORIS J.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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EUROPEAN SEARCH REPORT

Application number

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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 4)
A	US-A-2 315 715 (LEIBING) * Page 1, left-hand column, lines 1-34, right-hand column, lines 1-6; page 2, left-hand column, lines 50-57; page 3, left-hand column, lines 31-42; page 4, right-hand column, lines 65-75; page 5, left-hand column, lines 1-3 *	1	
A	US-A-2 868 182 (HOLLEY CARBURETOR CY.) * Column 2, lines 16-22,27-30; column 3, lines 43-49; column 5, lines 59-75; column 6, lines 1-5,11-15; column 9, lines 14-30,43-51 *	1	
A	US-A-4 083 267 (RAAZ) * Column 2, lines 52-65; column 3, lines 9-17 *	1-4	TECHNICAL FIELDS SEARCHED (Int. Cl 4)
A	DE-A-2 218 073 (IMHOF) * Page 2, last 2 lines; pages 3,4 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-09-1986	JORIS J.C.

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D : document cited in the application
L : document cited for other reasons

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