

①②

EUROPEAN PATENT APPLICATION

②① Application number: **85200381.3**

⑤① Int. Cl.⁴: **F 02 D 43/00**

②② Date of filing: **14.03.85**

③① Priority: **20.03.84 IT 2014084**

⑦① Applicant: **ALFA ROMEO AUTO S.P.A., Via Medina 40,
I-80133 Napoli (IT)**

④③ Date of publication of application: **30.10.85**
Bulletin 85/44

⑦② Inventor: **Ciccarone, Angelo, Piazza Napoli 34,
I-20146 Milan (IT)**

⑧④ Designated Contracting States: **DE FR GB**

⑦④ Representative: **Henke, Erwin et al, Ing.Barzanò &
Zanardo Milano S.p.A. Via Borgonuovo, 10,
I-20121 Milano (IT)**

⑤④ **Internal combustion engine exhaust system provided with a probe for measuring the oxygen in the exhaust gas.**

⑤⑦ In an internal combustion engine exhaust system provided with a catalytic muffler, at least one probe is provided for measuring the oxygen concentration in the exhaust gas downstream of said catalytic muffler.

EP 0 159 734 A1

This invention relates to a system for discharging the exhaust gas of an internal combustion engine to atmosphere, the system being provided with a trivalent catalytic muffler and at least one sensor
5 for measuring the oxygen present in said exhaust gas.

In order to remove the pollutants present at the engine outlet from the exhaust gas, ie to simultaneously eliminate the three harmful components, namely HC, CO and NOx, so-called trivalent catalytic mufflers are disposed in the exhaust systems in order to oxidise
10 HC and CO to H_2O and CO_2 , and to reduce the NOx components to N_2 , they being formed either with a single oxidising and reducing catalytic bed or with two catalytic beds, one being oxidising and the other reducing.

The purification efficiency of the catalyst constituting the catalytic
15 bed is a maximum when the air/petrol ratio of the mixture fed to the engine cylinders is equal to the stoichiometric ratio.

Consequently, when a trivalent catalytic muffler is used, the mixture ratio must be kept as close as possible to the stoichiometric ratio.

In order to produce a signal related to the air/petrol ratio, an
20 exhaust gas composition sensor is generally used constituted by a probe able to measure the oxygen concentration in said exhaust gas and to provide a signal indicative of a rich or lean mixture.

Probes of this type are essentially constituted by a layer of solid electrolyte which conducts oxygen ions, such as zirconic oxide
25 stabilised with calcium oxide, a layer which forms a measurement electrode, generally of porous platinum and disposed on one of the faces of the solid electrolyte, and a layer which forms a reference

- 2 -

electrode, disposed on the other face of said electrolyte.

The solid electrolyte layer is in the form of a tube closed at one end so that the reference electrode layer, which is located on the inside, can be exposed to the air used as the source of reference
5 oxygen partial pressure, while the measurement electrode layer, which is located on the outside, is exposed to the engine exhaust gas.

The probe generates an electromotive force when a difference exists between the partial pressure of the oxygen in the air in contact with the reference electrode and the variable partial pressure of the air
10 present in the exhaust gas applied to the measurement electrode.

The value of the electromotive force generated by the probe, which indicates the air/petrol ratio of the mixture fed to the engine, remains constant at a high level if said air/petrol ratio is less than the stoichiometric ratio (rich mixture), whereas it remains
15 practically constant at a low level if the ratio exceeds the stoichiometric (lean mixture).

In devices for regulating the air/petrol ratio, in which feedback control is provided under certain engine operating conditions, the electromotive force generated by the probe for measuring the oxygen
20 present in the exhaust gas is fed to an electronic circuit which provides a control signal to the engine fuel feed means on the basis of the result of a comparison between a predetermined reference voltage corresponding to the stoichiometric ratio, and the value of the electromotive force.

25 In order to provide a reliable indication, the oxygen measurement probe must be located at a point in the exhaust system to which the gas discharged from all the engine cylinders flows, so that the probe

- 3 -

is able to measure the total oxygen concentration in the engine exhaust gas.

Now if it is required to maintain an exhaust duct sizing which is optimised to obtain maximum power from the engine at determined

5 operational speeds, it can be advantageous to dispose the converging point of the ducts from the individual cylinders in a position upstream of the catalytic muffler and very close to the muffler itself, or indeed to dispense with the converging point completely and make the ducts open directly into the catalytic muffler.

10 In this case there is a problem in locating the oxygen measurement probe because the only space which remains available for its mounting lies in one or other of the ducts which open into the muffler. However, this means that the probe would sense only part of the exhaust gas, namely that originating from the cylinders which discharge into the
15 duct in which the probe is disposed, and would not be struck by the entire engine exhaust gas.

The object of the present invention is therefore to provide a location for the probe which does not penalise the design or construction of the exhaust system ducts, while at the same time enables the probe
20 to make contact with the entire engine exhaust gas:

With at least one catalytic muffler provided with at least one catalytic bed, this object is attained according to the invention by disposing at least one oxygen concentration measurement probe downstream of said at least one catalytic bed, and possibly immediately
25 downstream thereof.

In this manner, the probe location does not influence the design of the ducts upstream of the muffler, while at the same time having the

- 4 -

advantage of correct location with respect to the exhaust gas stream. Characteristics and advantages of the invention will be more apparent hereinafter with reference to the accompanying drawing, the single figure of which represents by way of non-limiting example a preferred
5 embodiment of an exhaust system according to the invention for an internal combustion engine.

In the figure, the reference numeral 10 indicates the engine air intake filter, and 11, 12, 13, 14 indicate the intake ducts, each provided with a throttle valve 15, 16, 17, 18. The electrically
10 operated injectors 19, 20, 21, 22, which feed petrol to the engine cylinders, are disposed in the intake ducts. The figure also diagrammatically indicates the cylinder block, indicated by 23, and the cylinders, indicated by 24, 25, 26, 27.

The reference numerals 28, 29, 30, 31 indicate the exhaust ducts of
15 the individual cylinders, the ducts 28 and 31 converging into the common duct indicated by 32, and the ducts 29 and 30 converging into the common duct 33. The ducts 32 and 33 open into the catalytic muffler 34, which in this case is provided with a trivalent catalytic bed 35, ie a catalyst able to simultaneously eliminate the pollutant
20 CO, HC and NOx components.

A duct 36 emerges from the catalytic muffler 34 for conveying the gas to the normal silencers (not shown) and then to atmosphere.

A probe 37 for measuring the oxygen concentration in the exhaust gas is disposed in the duct 36, immediately downstream of the catalytic
25 muffler 34.

Said probe 37 could also be disposed immediately downstream of the catalytic bed 35 as shown by dashed lines. The signal provided by

- 5 -

the probe 37 is fed by the line 38 to the regulator device represented by the central electronic unit 45, which processes it together with the signals indicative of the engine parameters, such as the r.p.m. and throttle valve angles, represented diagrammatically by the arrows 39 and 40.

The central unit 45, which could be constructed as described in ~~the U.S.~~

~~Pat. Appl. N° 6,245,09~~ of the present applicant, calculates the petrol quantity to be delivered by the electrically-actuated injector as a function of the engine parameters, and in the case of feedback operation corrects the calculated values on the basis of the signal provided by the probe 37, in order to enrich or weaken the mixture fed to the engine if its ratio deviates from the stoichiometric value, so as to restore it to said stoichiometric value.

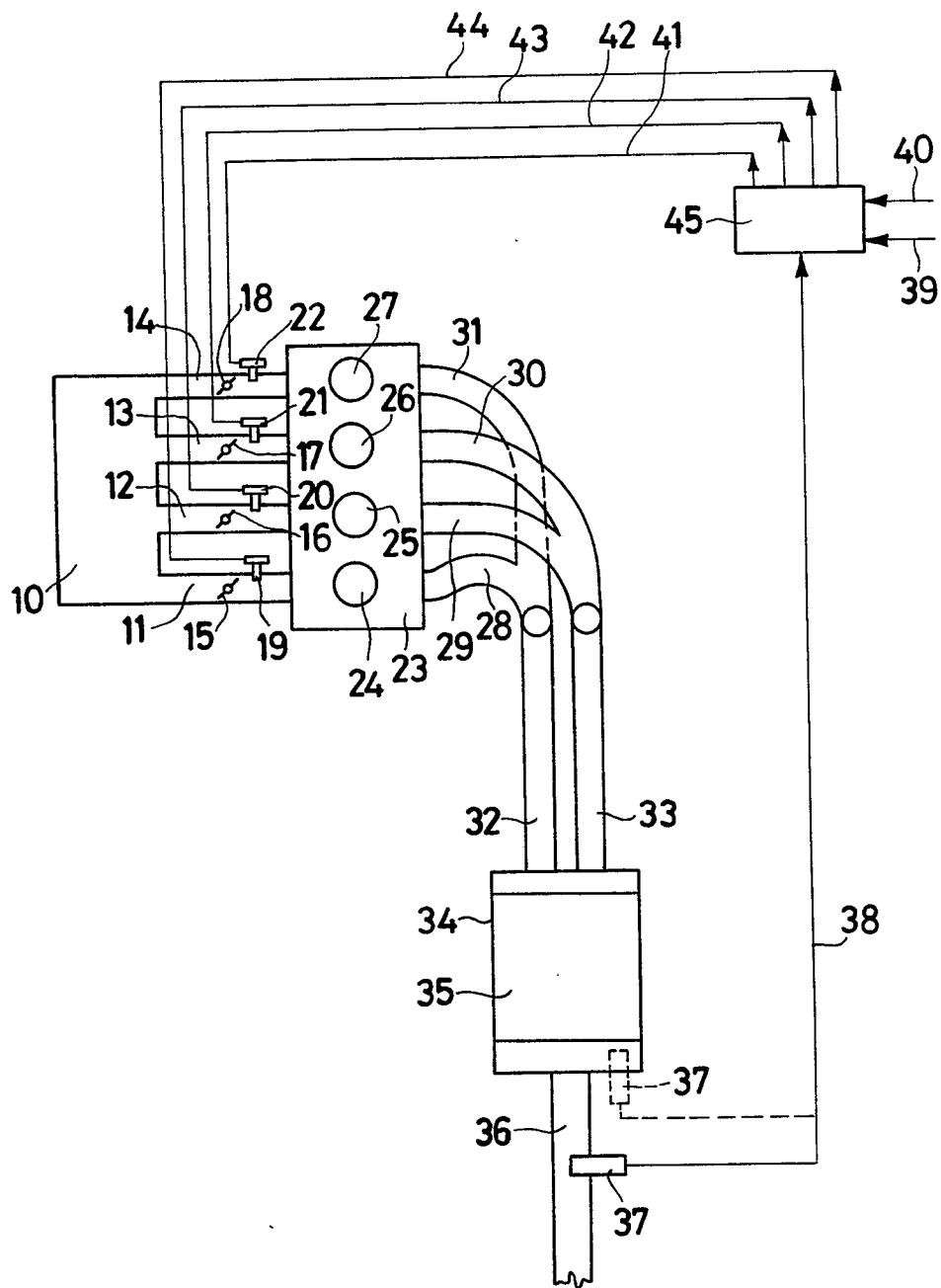
The other signals indicative of other engine parameters are not shown for simplicity of representation, these including for example the engine cooling water temperature, and which could be fed to the central unit 45 for processing, to give the electrically-actuated injector control signals, represented by the petrol quantity to be injected, these signals being fed to said electrically-actuated injector through the lines 41,42,43,44.

Arranging the probe 37 downstream of the catalytic bed gives a double advantage. On the one hand, maximum freedom is obtained in choosing the sizing of the ducts 28, 29, 30, 31 and 32, 33, and on the other hand the probe comes into contact with the entire engine exhaust gas and can operate effectively in providing a signal indicative of the air/petrol ratio (rich, lean, stoichiometric) of the mixture fed to the engine.

BAD ORIGINAL

CLAIMS:

1. An internal combustion engine exhaust system provided with an air and petrol feed arrangement and with a device for regulating the petrol as a function of prechosen engine parameters, said exhaust
5 system being formed from individual exhaust ducts deriving from the engine cylinders, from common exhaust ducts into which the exhaust gas of at least two individual exhaust ducts flows, and from at least one catalytic muffler provided with at least one catalytic bed, and to which said exhaust ducts are connected, the system being provided
10 with at least one probe for measuring the oxygen concentration in the exhaust gas and operationally connected to said regulator device, characterised in that said probe is disposed downstream of said catalytic bed.
2. An exhaust system as claimed in claim 1, characterised in
15 that said at least one probe is disposed in a common exhaust duct which emerges from said catalytic muffler.
3. An exhaust system as claimed in claim 1, characterised in that said at least one probe is disposed immediately downstream of said catalytic bed.



0159734



European Patent
Office

EUROPEAN SEARCH REPORT

Application number

EP 85 20 0381

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-4 136 645 (ITO) * Column 3, lines 20-49; figure 2 *	1,2	F 02 D 43/00
X	FR-A-2 242 564 (UNIVERSAL OIL) * Page 1, line 19 - page 2, line 5; page 8, line 33 - page 9, line 9; figure 3 *	1,2	
A	DE-A-2 328 459 (BOSCH) * Page 3, last paragraph; figure 1 *	1,3	
A	DE-A-2 704 777 (ALFA ROMEO) * Page 10, last paragraph - page 12, paragraph 2; figure 1 *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 02 D F 01 N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 27-06-1985	Examiner HAKHVERDI M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			