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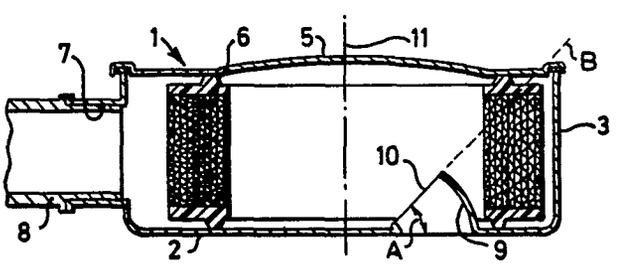
(54) Air expansion chamber.

(57) An expansion chamber (1) for an air filter assembly or an exhaust system of an internal combustion engine comprises an air inlet (7) to the chamber, and an air outlet (10) in one wall (2) of the chamber, the outlet (10) being positioned asymmetrically with respect to surrounding walls of the chamber and including a cow (9) defining an outlet orifice (10) which is inclined to the plane of the said one wall (2), thus reducing noise emitted by the chamber when used in combination with the engine.



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The present invention relates to air expansion chambers for air filter assemblies or exhaust systems of internal combustion engines.

Air filter assemblies for internal combustion engines comprise one or more expansion chambers through which air passes before entering the combustion chambers of the engine, an air filter being mounted in the, or one of the, chambers. For example, in one conventional single-chamber air filter assembly, the expansion chamber comprises a supporting surface on which a removable annular air filter may be positioned, an annular wall surrounding the supporting surface and a closure. The air filter is usually held centrally within the chamber between the supporting surface and the closure, and air is drawn through the filter from an air inlet in the annular wall to an air outlet positioned centrally in the supporting surface.

The shape and relative positions of the inlet and outlet to the exapnsion chamber must be so positioned that the air filter assembly does not interfere with the surrounding components of the engine on which it is mounted, for this reason, we have found it desirable to mount the outlet to the expansion chamber asymmetrically with respect to the surrounding walls of the chamber. Where the outlet is in the form of a simple aperture in one wall of the chamber however, the chamber generates undesirably high noise levesl within certain operating frequencies of the engine.

Similarly, asymmetrical outlet orifices in expansion chambers of exhaust systems can generate high noise levels.

In accordance with the present invention, we have found that the noise levels can be substantially reduced by froming the outlet orifice in a cowl within the chamber so that the outlet orifice is inclined to the plane of the wall in which it is mounted.

The present invention therefore specifically provides an expansion chamber for an air filter assembly or an exhaust system of an internal combustion engine comprising an air inlet to the chamber, and an air outlet in one wall of the chamber, the air outlet being positioned asymmetrically with respect to surrounding walls of the chamber and including a cowl defining an outlet orifice which is inclined to the plane of the said one wall.

In one embodiment of the invention, the expansion chamber is constructed to accommodate an air filter element which is positioned

on the said one wall around the outlet, and a wall opposite the said one wall comprises a removable closure allowing access to the extension chamber for installation and removal of the filter element. With such a chamber, the outlet orifice is preferably so inclined that its plane intersects the wall opposite the said one wall. In general the outlet orifice may be inclined to the supporting surface at any angle up to 90°. Preferably the angle of inclination is from 10 to 60°, desirably from 15°to 30°.

Usually the outlet orifice will be oriented to face across the largest dimension of the said one wall.

In order to improve air flow through the outlet, the orifice is preferably defined by an outwardly flared lip on the cowl.

The holder may be manufactured from any suitable material, for example pressed steel or a moulded plastics material.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a vertical cross-section through a first embodiment of an air filter assembly incorporating an expansion chamber in accordance with the invention;

Figure 2 is a transverse cross-section of the assembly of Figure 1 on a reduced scale with its filter and closure removed;

Figure 3 is a plan view of an expansion chamber of similar construction to that of Figures 1 and 2 but not in accordance with the invention;

Figure 4 is a vertical corss-section of part of an alternative chamber in accordance with the inventionl;

Figure 5 is a graph indicating the sound characteristics of various air filter assemblies;

Referring to Figures 1 and 2, the air filter assembly comprises an expansion chamber 1 which is composed of a supporting wall 2 and an integral annular wall 3. In the embodiment illustrated, the annular wall 3 is circular in plan, but other shapes may be used. A closure 5 is mounted on top of the wall 3 by a conventional releasable fastener (not shown) and forms an airtight seal with the wall 3.

An annular filter cartridge 6 is positioned between the closure 5 and the supporting wall 2 and is held in sealing engagement therewith.

The wall 3 defines an air inlet orifice 7 in which an air feed tube 8 is mounted. The supporting wall 2 carried a cowl 9 which defines a circular outlet orifice 10. The cowl 9 is offset from the centre 11 of the supporting wall and so shaped that the orifice 10 lies in a plane which is inclindd at an angle A to the plane of the supporting wall 3. In the embodiment illustrated the angle A is 45°, and the plane of the orifice 10 passes through the closure 5, as indicated by the broken line B in Figure 1. As best seen from Figure 2, the orifice 10 faces across the largest dimension of the chamber 1, generally towards the inlet orifice 7. The precise angle of inclination A of the orifice 10 and its orientation with respect to the inlet orifice 7 will vary according to the exact construction of the holder and is determined by simple experiment.

In use, the chamber 1 is mounted on an internal combustion engine so that the cowl 9 communicates with the carburettor of the engine. The fact that the cowl 9 is off-set from the centre of the supporting wall 3 facilitates accommodation of the assembly adjacent bulky engine components, and the inclination of the orifice 10 reduces the level of noise which would otherwise be generated in the chamber 1.

Although we do not wish to be limited by any theoretical explanation of the operation of the expansion chamber we believe that the inclination of the orifice 10 reduces the possibility of reverberation in the chamber 1. Figure 3 illustrates a chamber of similar shape and size to that of Figures 1 and 2 but in which the outlet orifice lies in the plane of the supporting wall 2. We believe that, in the chamber of Figure 3, sound waves emitted from the orifice, indicated by broken lines 14, meet opposite sides of the annular wall 3 at different times, and interfere with the sound waves reflected from the walls 3 indicated by the broken lines 15. At certain frequencies, this interference will be additive, thus causing the chamber to generate a loud note.

By contrast, in the chamber of the present invention, the sound waves generated at the orifice 10 (see Figure 2) all meet the wall 3 substantially simultaneously. Reflected waves from the walls do not therefore interfere additively with the original waves. In this respect, the wave forms within the chamber are similar to those of conventional expansion chambers in which the outlet is located centrally in the supporting wall. The levels of noise generated by such chambers

are usually completely acceptable.

The audible characteristics of a number of chambers are illustrated in Figure 5. Curve 1 was obtained using a conventional air filter assembly having a chamber of similar shape to that of Figure 1, except that the outlet orifice was located centrally in the supporting wall. The chamber was connected to a loudspeaker system c apable of emitting signals in the frequency range 30–1000 Hz, and the sound emitted from the chamber was detected and its frequency analysed using conventional sound analysis equipment. Figure 5 illustrates the variation in intensity of the sound emitted by the chamber over the frequency range 400 to 900 Hz, which is the range in which greatest variation in intensities is observed with the chambers tested. The intensity is recorded on the ordinate in decibels, and the frequency is recorded on the abscissa in Hertz. As can be seen from Figure 5, the frequency curve exhibits there maxima in the region of 450, 650 and 850 Hz. The noise emitted by the chamber when fitted to a vehicle was acceptable.

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Curve 2 was obtained using a chamber similar to that illustrated in Figure 3. The noise level emitted by the chamber was generally much higher than that of the first chamber. The curve also exhibits

three maxima at approximately the same frequencies as curve 1. However the level of sound emitted at frequencies above 650 Hz is much higher, indicating the general increase in noise which produced unacceptable noise levels when fitted to a vehicle.

Curve 3 was obtained using a chamber similar to that of Figure 1, except that the cowl 9 is curved through 90° (i.e. the angle A is equal to 90°). The noise emitted by the chamber was less than that emitted by the second chamber and would have been acceptable for commercial use. The level was however greater than that emitted by the first chamber. The curve also exhibits the three maxima at about 430, 650 and 850 Hz. In contrast to curve 2 however, the sound levels at frequencies between 650 and 850 Hz are greatly reduced.

Curve 4 was obtained using a chamber similar to that of Figure 1 in hhich the angle A of the cowl was 20°. The noise emitted by this chamber was less than that of either the second or third chamber. Thus, the audible frequency distribution curve exhibits the same three maxima as curves 1 to 3, but the maximum at about 850 Hz is no greater than that for curve 1, and the levels for frequencies in the range 750 to 800 Hz are substantially less than those of curves 2 and 3.

Figure 4 illustrates an alternative construction for the cowl of a chamber in accordance with the invention. The orifice of the cowl 9 is in the form of an outwardly flared lip 19 which smooths the passage of air through the cowl and thereby reduces the restriction on the air flow which is produced by sharp-edged orifices.

Both embodiments of the invention may be manufactured cheaply and easily as plastics mouldings or, alternatively, as metal pressings.

Although the embodiments of the invention described above are expansion chambers for air filter assemblies of internal combustion engines; the invention is equally applicable to expansion chambers of engine exhaust systems.

CLAIMS

1. An expansion chamber for an air filter assembly or an exhaust system of an internal combustion engine comprising an air inlet to the chamber, and an air outlet in one wall of the chamber, the air outlet being positoned asymmetrically with respect to surrounding walls of the chamber and including a cowl defining an outlet orifice which is inclined to the plane of the said one wall.

2. A chamber according to claim 1 wherein a removable filter element may be positioned on the said one wall around the outlet, and a wall opposite the said one wall includes a removable closure allowing access to the expansion chamber for installation and replacement of filter elements.

3. A chamber according to claim 2 wherein the outlet orifice is so inclined that its plane intersects the wall opposite the said one wall.

4. A chamber according to any one of claims 1 to 3 wherein the outlet orifice is oriented to face across the largest dimension of the said one wall.

5. A chamber according to any one of claims 1 to 4 wherein the outlet orifice is inclined at an angle of from 15° to 60° to the plane of the said one wall.

6. A chamber according to any one of claims 1 to 5 wherein the outlet orifice is defined by an outwardly flared lip of the cowl.

7. A chamber for an air filter assembly of an internal combustion engine susbtantially as described with reference to Figures 1 and 2 of the drawings, or with reference to Figures 1 and 2 of the drawings as modified by Figure 4.

8. An air filter assembly for an internal combustion engine comprising an expansion chamber according to any one of claims 1 to 7 and an air filter.

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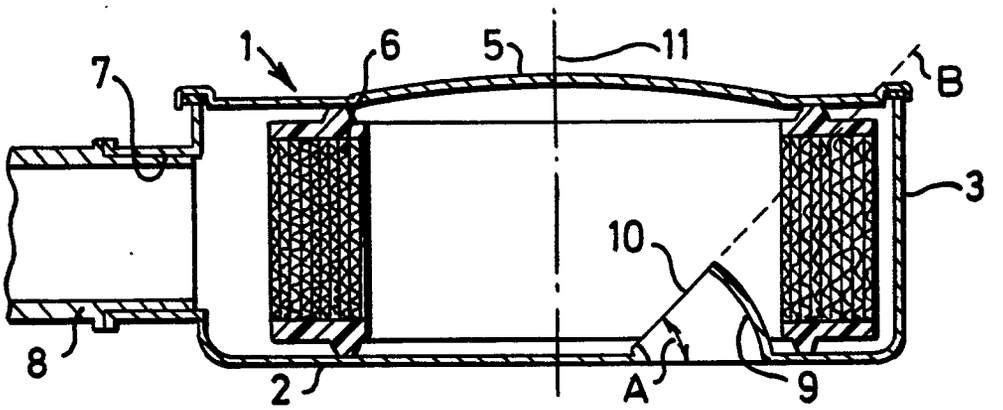

FIG.1

FIG.2

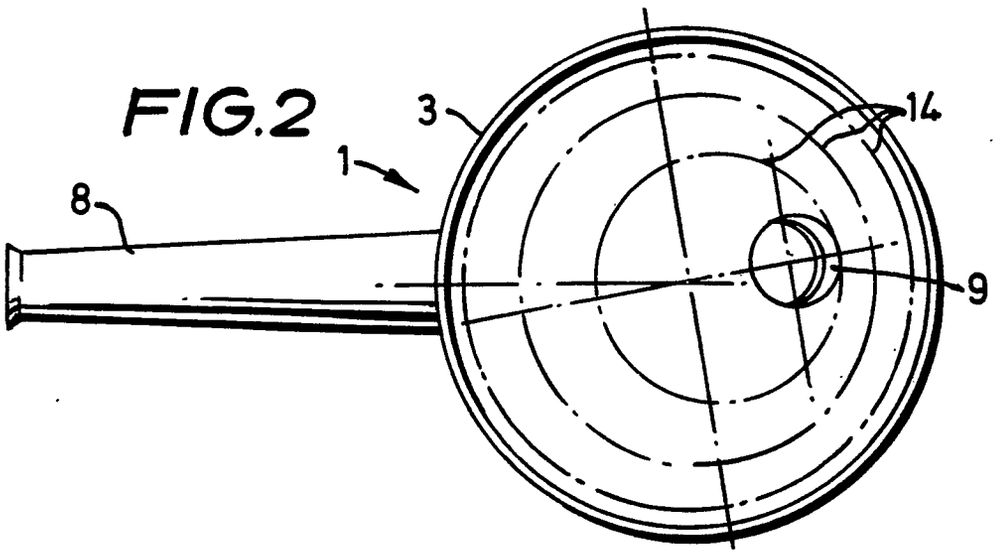

FIG.3

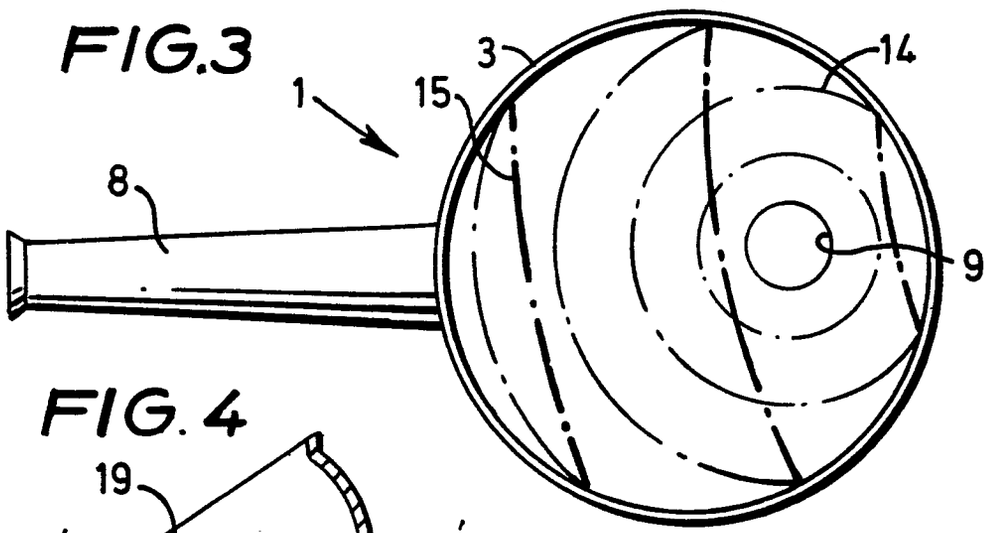

FIG.4

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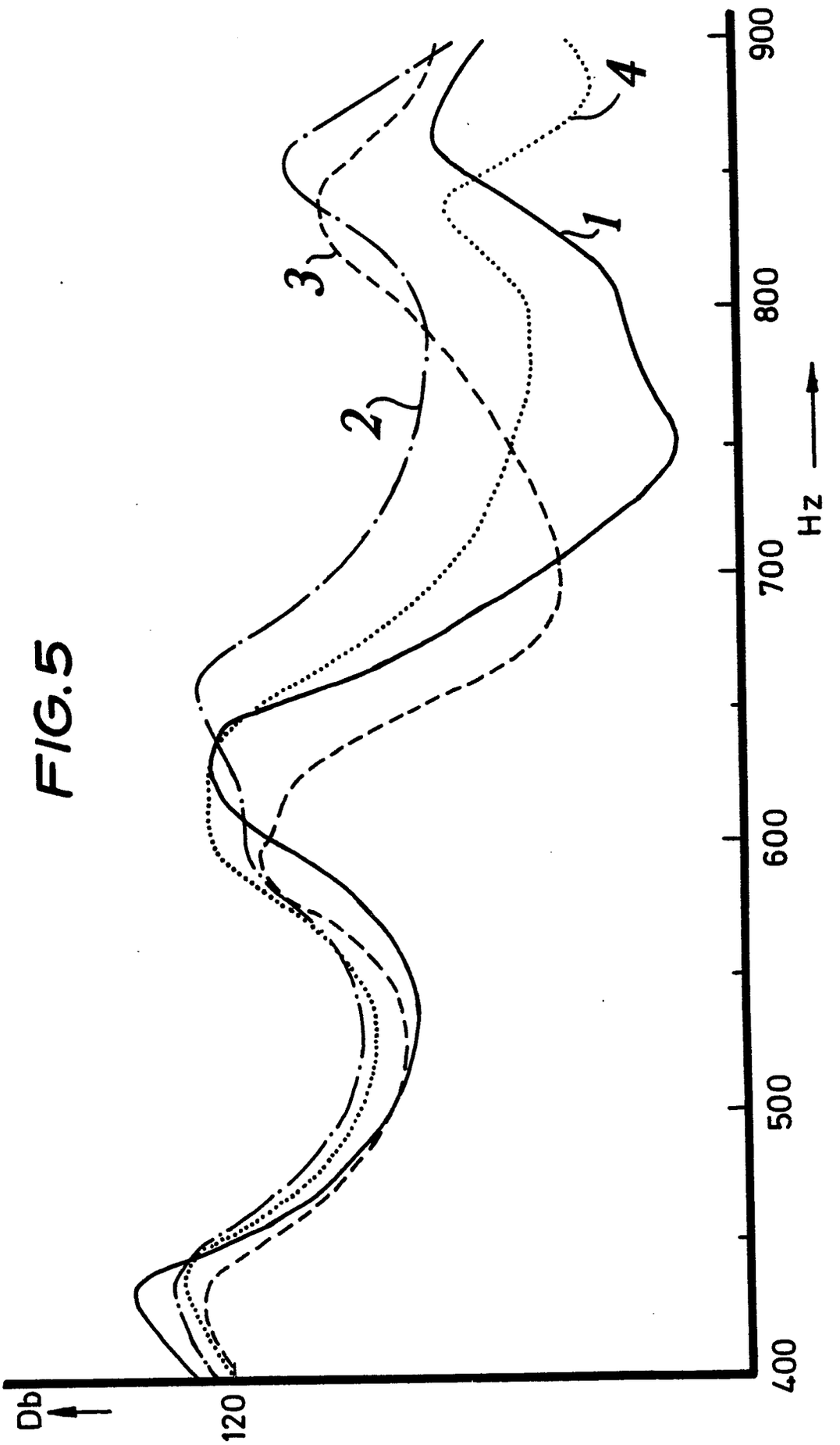
FIG.5



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EUROPEAN SEARCH REPORT

0012143
Application number
EP 78 30 0862

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 1 930 201 (HUGLEN) * Page 1, lines 1-12; 43-68; figures 5,7 *	1
	FR - A - 1 406 243 (KNECHT) * Page 1, left-hand column, 1st paragraph; right-hand column, 1st and 5th paragraph page 2, left-hand column, 3rd paragraph; figures *	1,2
	GB - A - 849 337 (G.M.) * Page 1, lines 8-9, 14-26, 36-57; figures 1,2 *	1,2
	US - A - 2 848 065 (SEBOK) * Column 1, lines 15-21; column 2, lines 12-16, 42-71; column 3, lines 19-43; column 4, lines 4-11, 21-28, 33-43, 53-63; figures 1,4 *	1,2
	FR - A - 1 140 679 (KNECHT) * Page 1, left-hand column, 1st paragraph; right-hand column, 3rd paragraph; page 2, left-hand column, 1st and 2nd paragraph, figures *	1
	GB - A - 1 060 852 (COOPERS MECHANICAL JOINTS LTD) ./.	1

CLASSIFICATION OF THE APPLICATION (Int. Cl.²)

F 02 M 35/14

TECHNICAL FIELDS SEARCHED (Int.Cl.²)

F 02 M 35/00
F 01 N 1/00
B 01 D 46/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25-05-1979	JORIS

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.²)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	* Page 1, lines 13-18, 37-54; figures 2,6 *		
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A	FR - A - 1 109 653 (GOLDSTEIN)	1	
	* Page 1, left-hand column, 1st and 2nd and 5th paragraph; right-hand column, 1st and 2nd paragraph; figures 2,4,6,7 *		
	--		TECHNICAL FIELDS SEARCHED (Int. Cl.²)
A	DE - A - 2 702 160 (V.W.)	1	
	* Page 3, 1st paragraph; page 4, 2nd paragraph; page 6, 1st and 2nd paragraph of the description; page 7, 1st paragraph; figure 1 *		
	--		
A	US - A - 4 000 786 (FORD)	1	
	* Abstract; column 1, lines 50-61; column 2, lines 48-58; figure 1 *		
