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(54) Burner.

(57) The invention relates to a burner (1) provided with means (4,6) for feeding fuel and at least one primary outflow opening (2) connected to the fuel feed means (4,6) and with a number of secondary outflow openings (3) connected to the fuel feed means (4,6) and arranged at different distances from the primary outflow opening (2), whereby combustion is also stabilized at high burner loads. The secondary outflow openings (3) define a surface (9) that encloses a preferably acute angle (α) with a longitudinal axis (11) of the primary outflow opening (2).

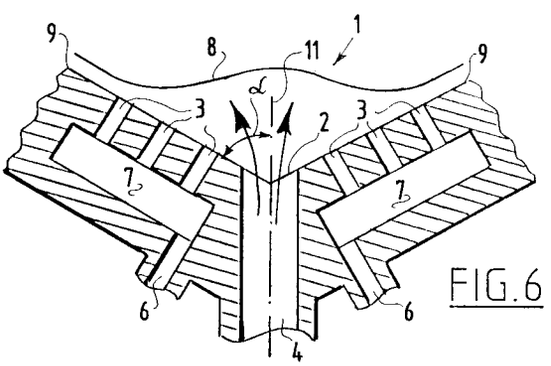

FIG.6

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The present invention relates to a burner provided with means for feeding fuel and at least one primary outflow opening connected to the fuel feed means and a number of secondary outflow openings connected to the fuel feed means and arranged close to the primary outflow opening. Such burners are known, for instance from the Auslegeschrift 1429133 and, due to the presence of the secondary outflow openings, can be controlled relatively efficiently. This is because fuel flowing out through the secondary outflow openings has a comparatively small flow speed and will thereby also burn in stable manner in the case of high burner load and associated higher flow speeds. This stably burning fuel as it were ignites the fuel flowing out of the primary outflow opening at a much higher speed, whereby it will also burn stably, even when the outflow speed from the primary opening is higher than the actual combustion rate of the fuel.

In particular conditions however, namely when they are used for heating purposes, known burners of this type cannot be controlled sufficiently well. Furthermore, relatively high combustion temperatures often occur in the known burners, whereby a relatively high content of harmful substances may be released.

The present invention therefore has for its object to provide a burner of the above described type with an improved control, an increased stability and reduced emission of harmful products when compared with the known burners. This is achieved according to the invention in that on at least one side of the primary outflow opening at least two secondary outflow openings are arranged at different distances therefrom. In this manner the combustion of the fuel flowing out of the primary outflow opening can be stabilized well over a very wide range of burner loads.

In preference the secondary outflow openings define a surface which encloses an angle with a longitudinal axis of the primary outflow opening. The area occupied by the burner can thus be reduced.

When the angle amounts to less than 90° the gas leaving the primary outflow opening flows relatively closely along the secondary outflow opening, whereby a very good stability is achieved at greatly varying gas flow rates.

An energy-efficient burner is obtained when the secondary outflow openings define a conical surface, the top of which coincides substantially with the primary outflow opening.

The primary outflow opening can also be elongate and the secondary outflow openings can define a surface that is V-shaped in cross section. The burner can then be manufactured in comparatively simple manner.

When the burner is manufactured from a ceramic material the combustion temperature is lowered further, whereby the emission of harmful substances is reduced still further. Conversely, the burner can be produced in simple manner and at low cost if it is manufactured from sheet metal.

The invention is now elucidated on the basis of a number of embodiments wherein reference is made to the annexed drawing, in which like components are designated with like reference numerals, and in which:

fig. 1 shows a section of a first embodiment of the burner according to the invention at a relatively low burner load,

fig. 2 shows a section corresponding with fig. 1 at a slightly greater burner load,

fig. 3 shows a section corresponding with fig. 1 and 2 at a very great burner load,

fig. 4 shows a section of a second embodiment of the burner according to the invention at a relatively low load,

fig. 5 shows a section corresponding with fig. 4 at a higher load,

fig. 6 shows a section corresponding with fig. 4 and 5 at a very high load,

fig. 7 is a perspective view of a burner with a number of primary outflow openings according to a third embodiment of the invention, and

fig. 8 is a perspective view of a fourth embodiment of the burner according to the invention.

A burner 1 (fig. 1) comprises a primary outflow opening 2 and a number of secondary outflow openings 3 arranged in the vicinity of the primary outflow opening at different distances therefrom. The primary outflow opening 2 and the secondary outflow openings 3 are all connected to fuel feed means in the form of a main pipe 4 and a number of drain pipes 5. Also present between drain pipes 5 and secondary outflow openings 3 are expansion spaces 7. A fuel, usually a flammable gas-air mixture, is supplied through the main pipe 4. A portion of this fuel flows out of the primary outflow opening 2 and another portion flows through the drain pipes 5 and the secondary outflow openings 3. The fuel flowing through the secondary outflow openings 3 has a considerably lower speed than the fuel flowing out through the primary outflow opening 2 as a result of the pressure fall occurring in the expansion space 7. When leaving the outflow openings the fuel will burn in a pattern with a flame front 8 as shown in fig. 1.

As the burner load increases the outflow rate of the fuel will likewise increase. Hereby the outflow rate from the primary outflow opening 2 may locally exceed the combustion rate of the outflowing fuel, whereby this could be "blown out". This is however prevented due to the presence of the secondary outflow openings 3 with a much lower

outflow rate on either side of the primary outflow opening 2. The burn front or flame front 8 is moreover enlarged due to the presence of the secondary outflow openings 3, whereby the combustion heat is distributed over a greater surface area and the combustion temperature thus remains relatively low. This is particularly important in limiting the emission of nitrous oxide NO_X.

As the burner load increases still further, the outflow rate from the primary outflow opening 2 also increases further, whereby the danger of blow-out becomes (still) greater. Owing to the likewise increased outflow rate from the secondary outflow openings 3, which however still lies well below the combustion rate of the fuel, the flame 8 present at the primary outflow opening 2 is still stabilized with a further enlarging of the combustion surface area.

In order to reduce the space occupied by the burner 1 the surface 9 defined by the secondary outflow openings 3 can enclose an acute angle α with the longitudinal axis 11 of the primary outflow opening 2 (fig. 4). This moreover achieves that, also at high burner loads, the gas leaving the primary outflow opening 2 flows closely over the surface 9 with the secondary outflow openings 3, thereby enabling a very good stability (fig. 5 and 6). In this embodiment the secondary outflow openings 3 are otherwise connected to separate feed pipes 6.

When a relatively large burner power is required, a number of primary outflow openings 2 may be present, wherein the secondary outflow openings 3 then define in each case a conical surface 9 (fig. 7). The primary outflow openings may also be of elongate shape in order to increase the burner power (fig. 8). In the surfaces defined by the secondary outflow openings 3 slot-like outflow openings 10 can also be arranged for feeding additional (oxygen-containing) air to the flame 8.

The distance between the secondary outflow openings 3 and the primary outflow openings 2 and the mutual distance between successive secondary outflow openings 3 can be determined in simple manner by the skilled person by means of tests or calculations on the basis of requirements set down for a specific burner. The distribution of the outflow openings does not necessarily have to be as regular as shown here. The angle which the plane through the secondary outflow openings 3 optionally has to enclose with the longitudinal axis of primary outflow opening 2 can also be easily determined by tests or calculations. Should this be deemed necessary for a good stability the drain pipes 5 or the secondary fuel feed pipes 6 can also be provided with valves, whereby, as the burner load increases, an increasing number of secondary outflow openings 3 is activated at increasing distance from the primary outflow opening 2.

Although in the embodiments shown secondary outflow openings 3 are present in each case on either side of primary outflow opening 2, situations are also conceivable wherein it is possible to suffice with arranging the secondary outflow openings 3 only on one side of the primary outflow opening 2.

The burner 1 can in principle be manufactured from any suitable, heat-resistant material. The burner 1 can be manufactured very simply from thin sheet metal. When the manufacturing costs are of lesser importance the burner 1 can also be manufactured from ceramic material which, due to its inherent insulating properties, results in a lower combustion temperature and therefore less emission.

Due to its efficient control and its comparatively low combustion temperature with associated low emission of harmful products, the burner 1 according to the invention is suitable for use in many different appliances. Possible examples are open burners, closed burners and also so-called fan burners. The burner is suitable for industrial application as well as for domestic heating uses.

Claims

1. Burner (1) provided with means (4, 5) for feeding fuel and at least one primary outflow opening (2) connected to the fuel feed means (4, 5) and a number of secondary outflow openings (3) connected to the fuel feed means (4, 5) and arranged close to the primary outflow opening (2), **characterized in that** on at least one side of the primary outflow opening (2) at least two secondary outflow openings (3) are arranged at different distances therefrom.

2. Burner (1) as claimed in claim 1, **characterized in that** the secondary outflow openings (3) define a surface (9) which encloses an angle (α) with a longitudinal axis (11) of the primary outflow opening (2).

3. Burner (1) as claimed in claim 2, **characterized in that** the enclosed angle (α) amounts to less than 90°.

4. Burner (1) as claimed in claim 2 or 3, **characterized in that** the secondary outflow openings (3) define a conical surface (9), the top of which coincides substantially with the primary outflow opening (2).

5. Burner (1) as claimed in claim 2 or 3, **characterized in that** the primary outflow opening (2) is elongate and the secondary outflow openings (3) define a surface (9) that is V-

shaped in cross section.

6. Burner (1) as claimed in one or more of the foregoing claims, **characterized in that** it is manufactured from a ceramic material.

7. Burner (1) as claimed in one or more of the claims 1-5, **characterized in that** it is manufactured from sheet metal.

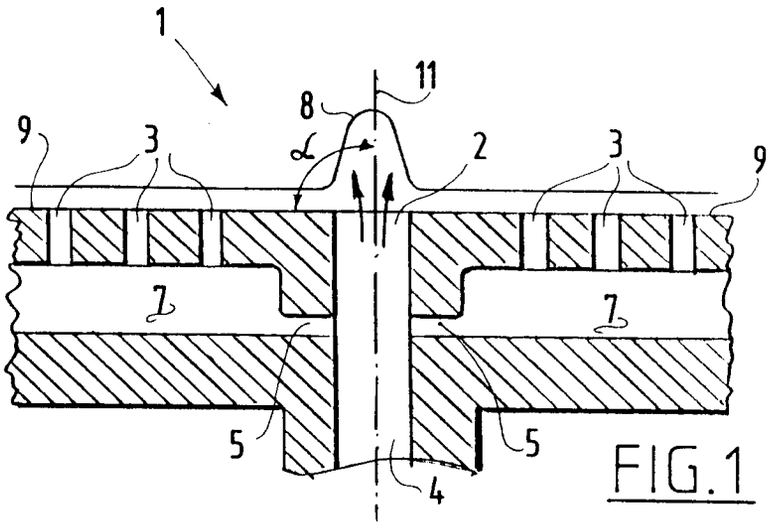

FIG.1

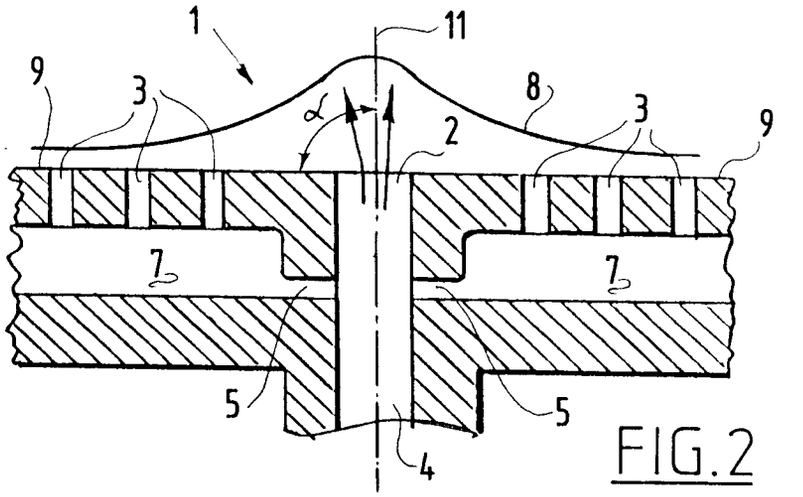

FIG.2

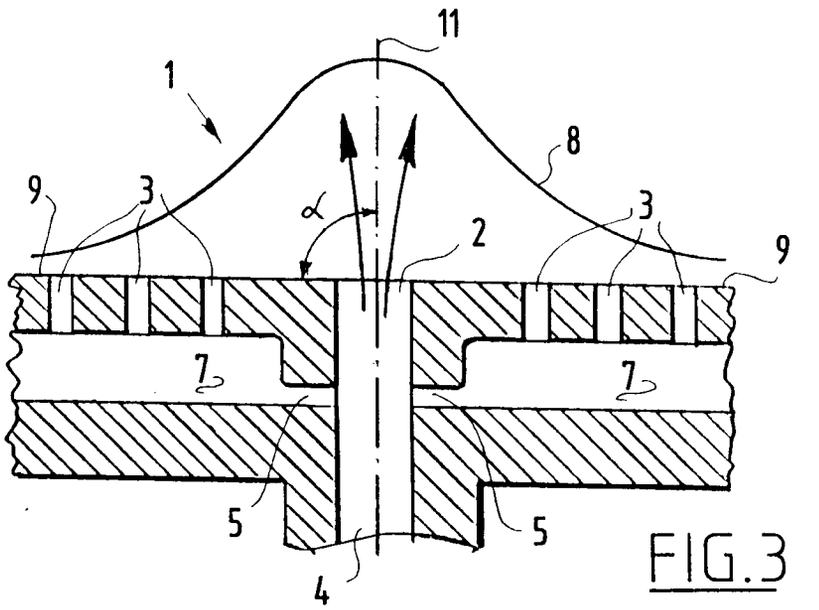

FIG.3

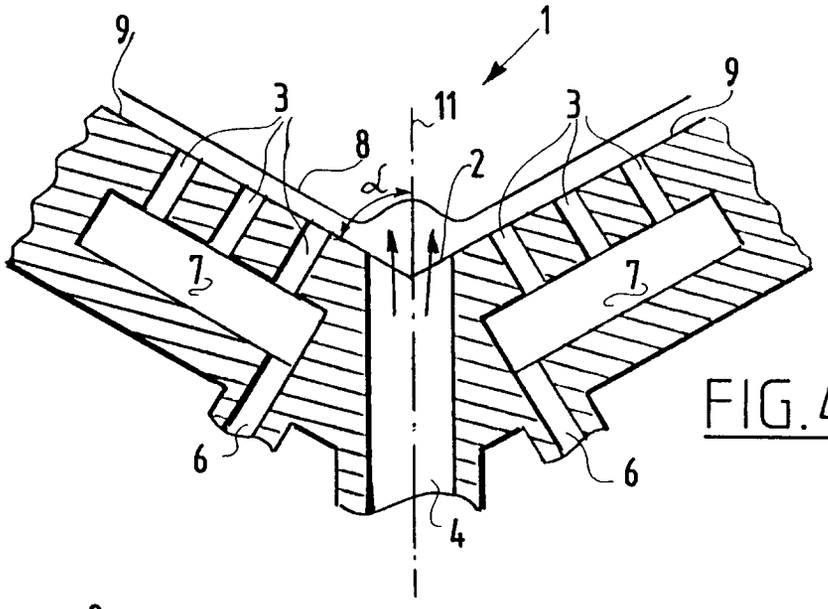

FIG.4

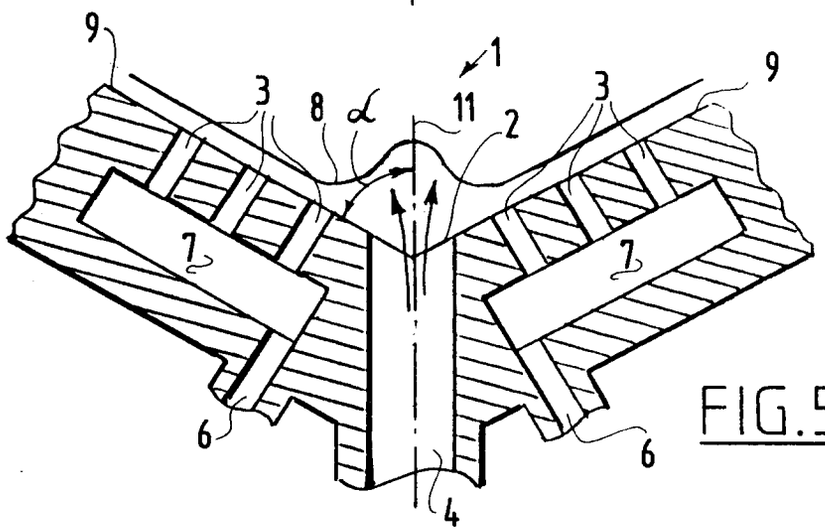

FIG.5

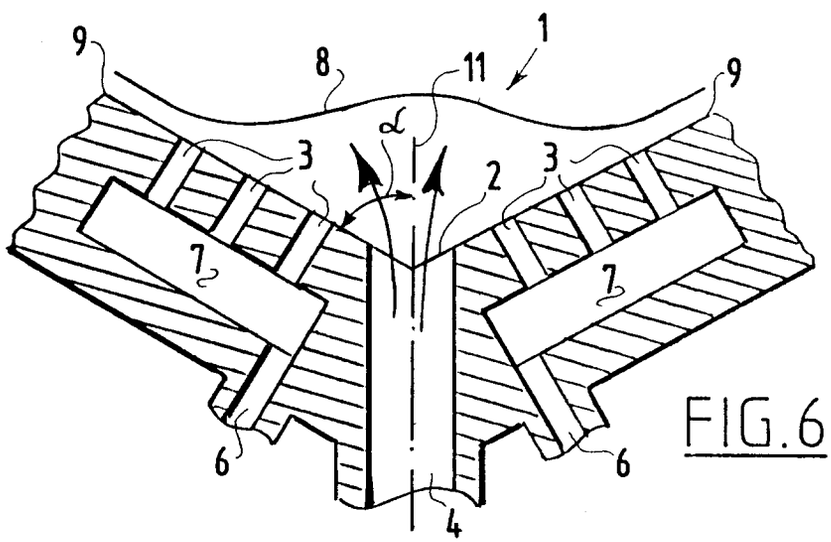

FIG.6

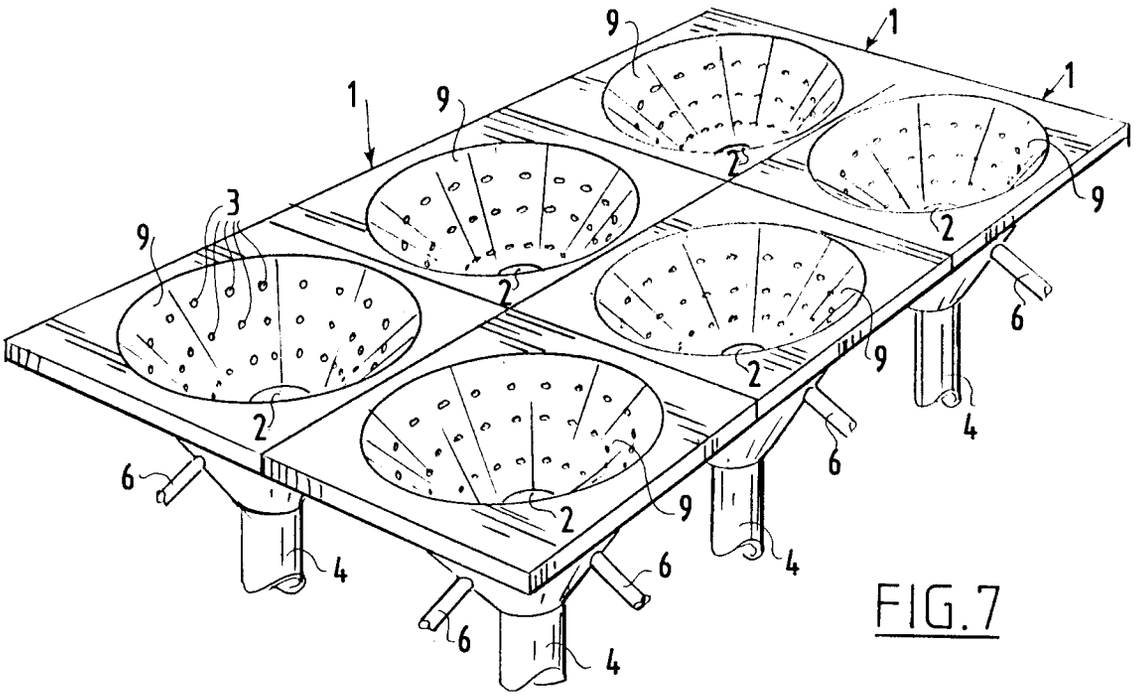

FIG.7

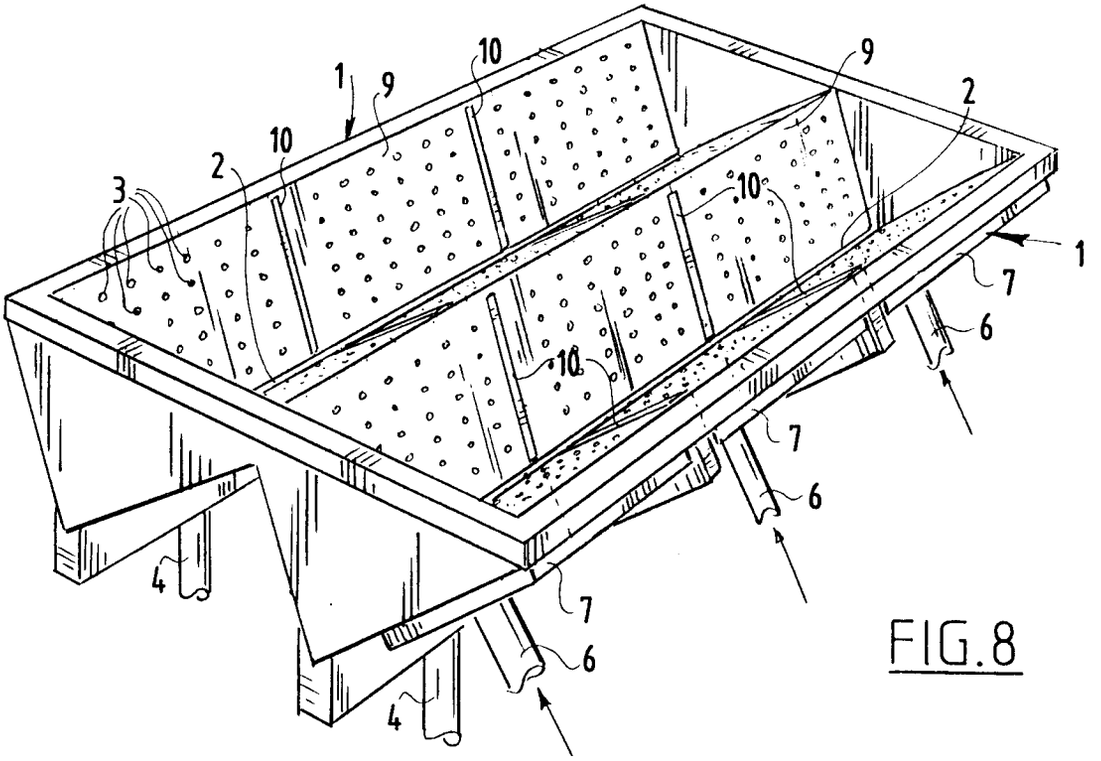

FIG.8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 20 1990

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)
X	US-A-2 121 948 (BORLAND) * page 1, left column, line 44 - right column, line 38; figures 1,2 *	1-4	F23D14/26 F23D14/58
X	PATENT ABSTRACTS OF JAPAN vol. 12, no. 45 (M-667)(2892) 10 February 1988 & JP-A-62 196 517 (OSAKA GAS) 29 August 1987 * abstract *	1-3,5,7	
X	EP-A-0 303 052 (VAILLANT) * column 4, line 2 - line 36; figures 1-3 *	1-3	
X	PATENT ABSTRACTS OF JAPAN vol. 12, no. 1 (M-656)6 January 1988 & JP-62 166 213 (PALOMA IND.) 22 July 1987 * abstract *	1,6	
A	DE-B-1 184 713 (JUNKERS) * column 1, line 33 - line 52; figure *	1,6	TECHNICAL FIELDS SEARCHED (Int. Cl.5) F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 OCTOBER 1993	COLI E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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