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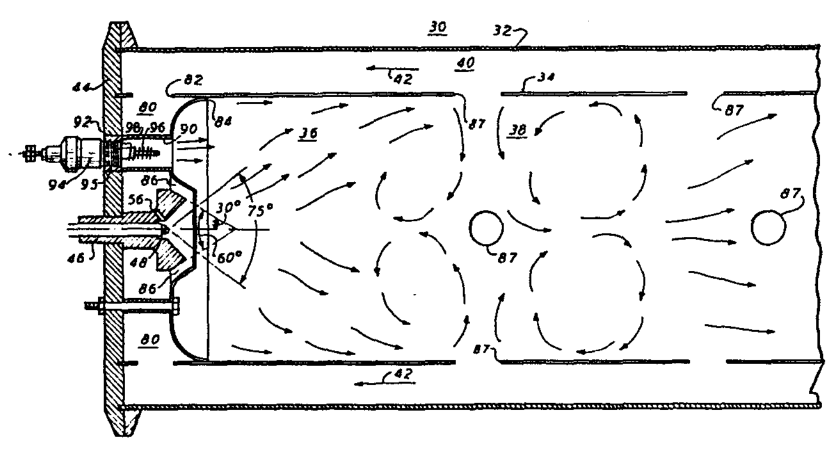
(54) **Incandescent ignitor.**

(57) An ignitor 94 comprising a low voltage incandescent resistance heater 96 is utilized to ignite a liquid oil/air mixture in an oil-fired combustor 30. The resistance heater 94 is located within a combustion chamber 36 in a zone where a combustible mixture of oil and air is present but remote from the direct spray of liquid fuel oil, thus the ignitor 94 is protected from becoming fouled by contact with the oil. When energized, the heater element 96 reaches a temperature of about 1200°F-2500°F and creates a plume of hot gas which causes ignition. In the preferred form, a commercially available glow plug is used, and is energized by a low voltage of about 12 volts and draws about 30-35 amperes.

FIG. 1



EP 0 093 016 A1

Croydon Printing Company Ltd.

INCANDESCENT IGNITOR

The present invention relates to an incandescent ignitor for use in burners or combustors of liquid fuel and to a method of igniting a combustible mixture of liquid and oxygen.

In present combustors used in oil burners, gas turbines, or vaporizers for cryogenic liquid, some positive and reliable means is needed to ignition of the oil/air mixture which is at a suitable mixture for combustion, preferably at stoichiometric conditions.

One of the facets of such reliability is that the ignitor must, of course, be sufficiently close, physically, to the combustible oil/air mixture to ignite the same yet when the ignitor is actually in the stream of oil injected into the combustor the ignitor can become fouled and its performance and reliability reduced.

In typical combustors, liquid fuel such as oil is injected by a nozzle in a spray causing atomization of the fuel and creating a combustible fuel/air mixture in certain zones of the combustion chamber.

There are in use for such liquid fuel combustors, ignition devices that produce a high voltage spark to cause ignition, however, in many instances, a source of high voltage, i.e. several thousand volts and above is not convenient and, of course, the shielding wiring, etc., for high voltage connections are more difficult to construct. In addition, sparking causes erosion of the electrodes and therefore maintenance is needed to continually monitor the spark devices and replace the devices when the erosion of its electrodes is severe enought to impair the reliability.

In the present invention, the difficulties with the existing spark or energy discharge type of ignitors are alleviated by providing an incandescent ignitor and a method of igniting a combustible fuel as claimed in the appended claims that are usable with a liquid-fuel combustor such as an oil-fired combustor.

The incandescent ignitor of the present invention is typically a low-voltage device (less than 250 volts) that provides a high temperature, i.e. about 1200^{o}-$2500^{o}F$ and thereby creates a plume of extremely hot gas that causes the ignition of the combustible mixture of oil and air in the combustion chamber. A high resistance coil of heated wire in the ignitor is positioned sufficiently near the combustible mixture in the combustion chamber to ignite the same mixture by the hot plume of gas but the coil is kept away from the direct stream of the atomized oil as it is injected thereinto. The location of the ignitor is typically in a zone with a fairly stable, stoichiometric mixture of the oil and air in operation of the combustor. Protection against carbon build-up may be afforded both by the position of the ignitor with respect to the spray of liquid oil and also by surrounding the heated wire of such ignitor with a cylindrical housing such that the plume of heated air is caused to pass from the heated wire of the ignitor out into the zone where the combustible mixture is present, thus causing ignition.

The invention is now described by way of example with reference to the accompanying drawings in which:

Fig 1, is a side view, partly in section, of an oil-fueled combustor having an incandescent ignitor constructed in accordance with the present invention;

Fig 2, is a side view, partly in cross section, of a nozzle holder used to retain the fuel nozzle for introducing and atomizing the liquid fuel in the combustor of Fig 1;

Fig. 3, is an end view, shown partly broken away in section, of the nozzle holder of Fig. 2;

Fig.4, is a side cross sectional view of a baffle plate used in the combustor of Fig.1 to create a stable flame pattern; and

Fig. 5, is an end view of the baffle plate of Fig. 4.

Turning first to Fig.1, there is shown a combustor 30 for use with a liquid fuel such as oil. The combustor 30 is preferably cylindrical in shape and includes an outer shell 32 generally constructed of 12 guage stainless steel. A general description of combustors can be found in Gas Turbine Engineering Handbook, Section 5, "Combustors", by Herbert R. Hazard, and provides background for this invention.

Within the outer shell 32 and which is also cylindrically shaped and coaxial thereto, is a liner 34 constructed of relative thin (.050" thick stainless steel) and within which is contained or defined a primary combustion chamber or zone volume 36 and a secondary combustion chamber or zone 38 where the hot gases from primary combustion chamber 36 are mixed with secondary air to complete the combustion process.

In the embodiment as shown, the air for the combustion taking place in primary combustion chamber 36 and for completion of combustion in secondary combustion chamber 38 is supplied by a fan, not shown, and air passes through the annular passage 40 between liner 34 and outer shell 32 and which flow of air serves to cool the liner 34 and outer shell 32. As noted in Fig.1, the air passes through the annular passage 40 in the direction of arrows 42.

An end plate 44 closes off one end of the combustor 30 and is fitted into the ends of the liner 34 and the outer shell 32 to close the same. Centrally located through end plate 44 is fitted a nozzle holder 46 which, among other functions, channels air for determining the pattern of fuel distribution for liquid fuel injected by means of the fuel nozzle 48.

The nozzle holder 46 is more fully shown in Figs.2 and 3 in cross section and end view, respectively, and generally comprises a body 50 having an opening 52, one end of which opening 52 opens into an angled opening 54 at an angle of approximately 90° about its central axis, as shown, and further comprises a plurality of radially oriented apertures 56 which open into the angled opening 54. A recess 58 is formed in body 50 in order to receive the fuel nozzle 48 (not shown in Figs. 4 and 5). The fuel nozzle 48 may be of conventional commercial design as supplied by the Delavan Corporation Nozzle Model No. 27710-1 and which is rated for a fuel consumption at 50 lbs/hr of JP4 fuel oil at a supply pressure of 100 psig.

The particular fuel nozzle 48 is of a design that sprays out the atomized fuel oil on the shape of a holloq cone at a total angle of approximately 75° ± 5° about its central axis. By passing air through the apertures 56, the liquid fuel is caused to swirl and produce a vortex flow in the primary combustion chamber 36.

As shown in Fig.1, the outer surface 57 of the nozzle holder 46 is angled with respect to its central axis at approximately 30° thereto, or converges at a total angle with respect to its central axis of about 60° in the shape of a truncated cone.

Surrounding the fuel nozzle 48 and nozzle holder 46 is a circular shaped baffle plate 60. The baffle plate 60 is shown in detail in Figs. 4 and 5, as well as shown assembled to combustor 30 in Fig. 1.

In figs. 4 and 5, the baffle plate 60 is shown as generally circular in shape having an annular dished interior 62 and a central opening 64. The inner lip 66 of annular dished interior 62 is formed at an angle of about 30° to the central axis of the baffle plate 60 or a total angle of 60° in an inward conical configuration.

As shown in Fig.1, the baffle plate 60 is coaxially mounted with respect to nozzle holder 46 and fuel nozzle 48 to the end plate

44 by means such as bolts 68 secured to the end plate 44 by nuts 70 and held in its predetermined position with respect to fuel nozzle 48 by spacers 72. In the preferred embodiment, three such bolts 68, spacers 72 and nuts 70 hold the baffle plate 60 in its fixed position through bolt holes 74 in baffle plate 60 and the further hole 76 in baffle plate 60 is used in connection with the incandescent ignitor assembly 78 the function of which will be later described.

As may now be seen in Fig.1, the flow of air for use in the primary combustion chamber 36 and the secondary combustion chamber 38 proceeds as follows. The primary air, or the air actually used in the combustion of the liquid fiel passes along the annular passage 40 and enters plenum chamber 80 through a plurality of openings 82 in annular passage 40. The plenum chamber 80 is thus formed behind the baffle plate 60 and air is used from that plenum chamber 80 for a variety of purposes.

A portion of the air from plenum chamber 80 passes through radially oriented apertures 56 in the nozzle holder 46 and such air used to create the swirling motion for the fuel injected into primary combustion chamber 36 from fuel nozzle 48.

A further portion of air leaks past the outer edge 84 of the baffle plate 60 and provides some cooling to the inner surface of the liner 34 and protects liner 34 from direct action or contact by the combustion gases of primary combustion chamber 36.

Most of the air, from plenum chamber 80 passes through the annular frustrum opening 86 to serve as primary air to supply oxygen for the combustion of the liquid fuel. As noted, due to the design angles of the outer surface 57 of nozzle holder 46 and the inner lip 66 of baffle plate 60, that annular frustrum opening 86 converges in the direction toward the primary combustion chamber 36 at a total angle of about 60^{o} about the central axis of the fuel nozzle 48.

Secondary air is mixed with the hot combustion gases in secondary combustion chamber 38 to complete the combustion process and is admitted to the secondary combustion chamber 38 through a plurality of openings 87.

In operation, therefore, the fuel is injected outwardly into the primary combustion chamber 36 by the fuel nozzle 48 in the pattern of a hollow cone at a total angle of about $75^{\circ} \pm 5^{\circ}$. The fuel is atomized by the fuel nozzle 48 in such predetermined pattern into small droplets to create, in certain areas, the combustible mixture of liquid fuel and air where combustion can actually take place. The primary air for supplying oxygen for the combustible mixture impinges upon the hollow cone shaped pattern of liquid fuel through the converging annular frustrum opening 86, forming a pattern of movement generally as shown by the arrows in Fig.1.

The pattern of liquid fuel/air mixture thereby forms a zone of combustible mixture at zone 88 which is a relatively stable, quiet zone protected by baffle plate 60 and out of the direct stream of the liquid fuel. That zone 88 thus contains a mixture that can readily be ignited by means of the incandescent ignitor assembly 78.

Incandescent ignitor assembly 78 comprises a cylindrical housing 90 having one end thereof fitted within an appropriate sized opening 92 in end plate 44 and the other end thereof just passing through the opening 76 in baffle plate 60. The incandescent ignitor 94 is fitted within the cylindrical housing 90 by means such as a threaded engagement for ease of assembly and removal at 95. At the end of the incandescent ignitor 94 towards primary combustion chamber 36 is a high resistance heating wire 96, which when energized, provides a sufficiently high temperature to create ignition of the combustible liquid fuel/air mixture at zone 88 within primary combustion chamber 36, thus igniting the root flame of combustor 30.

In the preferred embodiment, the incandescent ignitor can be a commercially available glow plug, normally used for heating air in diesel engines, and typically may be Type CH3 sold by The Champion Spark Plug Company, Toledo, Ohio and rated at 12 volts; 31-33 amps. That particular glow plug attains a temperature of about 1200°-2500°F after about 30 seconds of energization. As can be seen, the actual high resistance heating wire 96 is positioned within a relatively protected environment, out of direct stream of liquid fuel from fuel nozzle 48 and also isolated by the cylindrical housing 90. The cylindrical housing 90 serves to prevent direct impingement of liquid fuel and consequent carbon buildup on the incandescent ignitor 94, yet the air temperature at the end of the high resistance heating wire 96 reaches a sufficiently high temperature, i.e. about 1200°-2500°F in between 10 - 60 seconds, generally around 30 seconds, that the contact of that heated air with the liquid fuel/air mixture that is relatively stable and protected from the high turbulent zones is readily sufficient to ignite the mixture.

CLAIMS

1 An ignitor for causing combustion of a combustible mixture of fuel oil and oxygen characterised in that it comprises an incandescent, high resistance heating wire, means for mounting said heating wire in close contact with the combustible mixture and means to energize said heating wire to heat said heating wire to a high temperature, said heating wire thereby creating a plume of hot gas sufficient to ignite the combustible mixture.

2. An ignitor as claimed in claim 1, characterised in that high resistance heating wire is a glow plug and said high temperature is between 1200°F and 2500°F.

3. An ignitor as claimed in Claim 2, characterised in that said means to energize said heating wire comprises an electrical source less than 250 volts and is energized for approximately 10-60 seconds to cause said glow plug to reach said temperature of between about 1200°F and 2500°F.

4. A combustor having a primary combustion chamber (or zone), a fuel nozzle for spraying liquid fuel into said primary combustion chamber, means to introduce primary air into said primary combustion chamber, means for mixing said primary air and said spray of liquid fuel to produce a combustible mixture of liquid fuel and oxygen characterised in that the combustor additionally includes an ignitor for initiating

burning of the combustible mixture, said ignitor comprising a high resistance wire, means locating said high resistance wire in a zone within said primary combustion chamber in close proximity to said combustible mixture but remote from said spray of liquid fuel and electrical energizing means to heat said high resistance wire to a temperature sufficient to ignite said combustible mixture.

5. A combustor as claimed in Claim 4, characterised in that said means locating said wire comprises a cylindrical housing extending into said primary combustion chamber and wherein said wire is fully contained within said housing.

6. A combustor as claimed in Claim 4 or Claim 5, characterised in that said means to heat said wire is adapted to heat said wire to a temperature above about 1200^{o}F.

7. A combustor as claimed in any one of claims 4 to 6, characterised in that said means to heat said wire comprises an electrical source having a voltage less than about 250 volts.

8. A method of igniting a combustible mixture of liquid fuel and oxygen within a primary combustion chamber (or zone) characterised in that the method comprises the steps of:

spraying liquid fuel into the primary combustion chamber (or zone) in a predetermined pattern;
injecting primary air into the primary combustion chamber to mix with the liquid fuel spray to produce a combustible mixture of liquid fuel and oxygen;
locating a high resistance wire in close proximity to the combustible mixture but remote from the predetermined pattern of the liquid fuel spray;
heating the high resistance wire to a temperature of at least about 1200^{o}F to cause ignition of the combustible mixture.

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FIG. 1

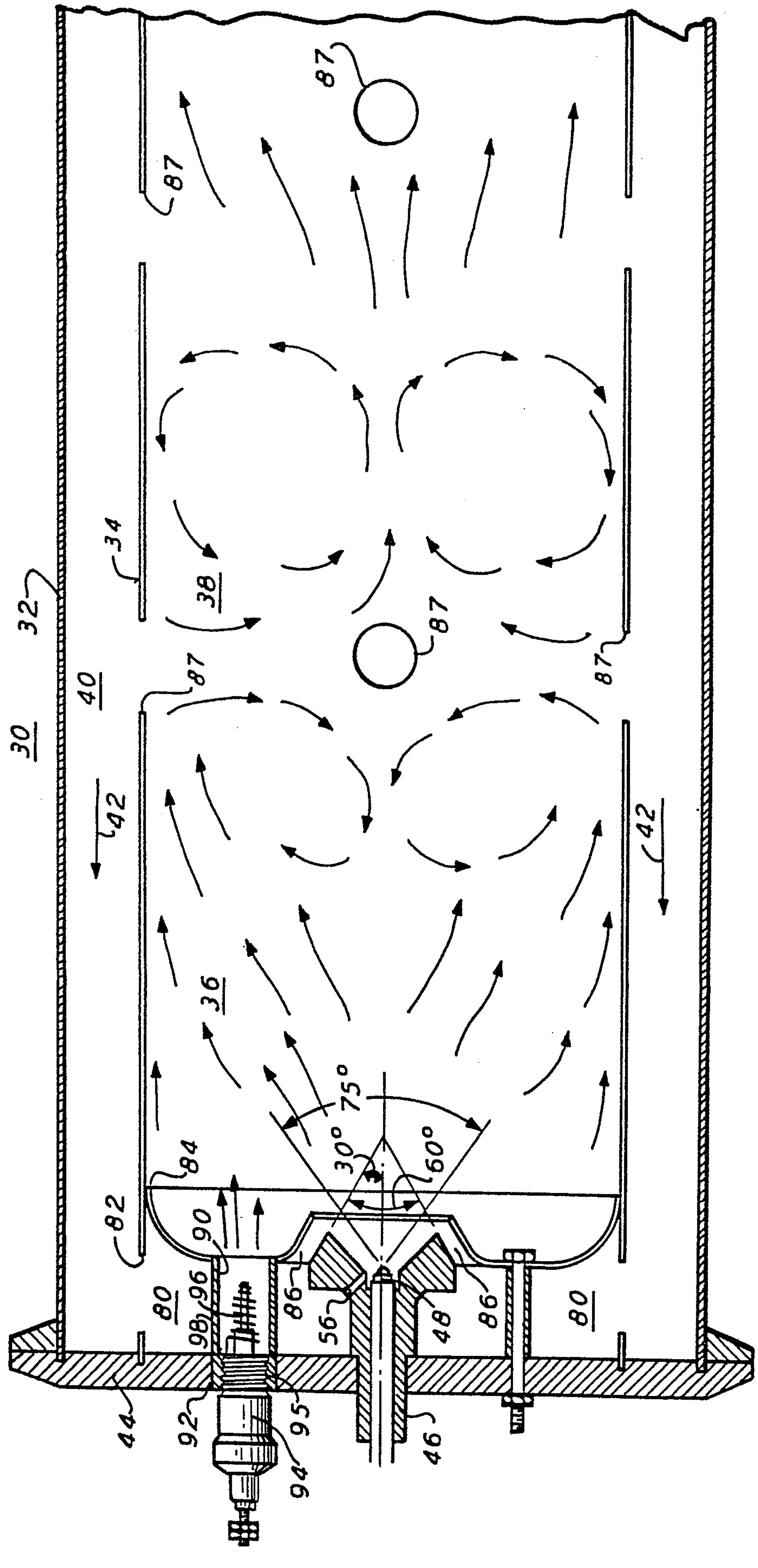


FIG. 4

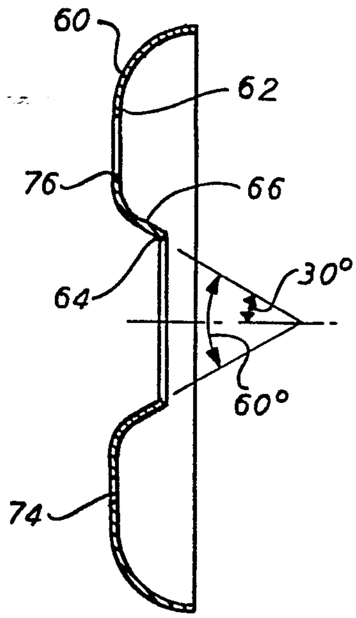


FIG. 5

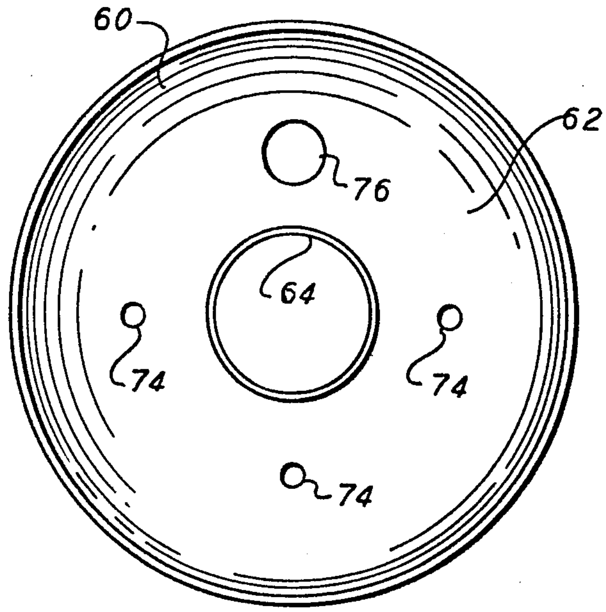


FIG. 2

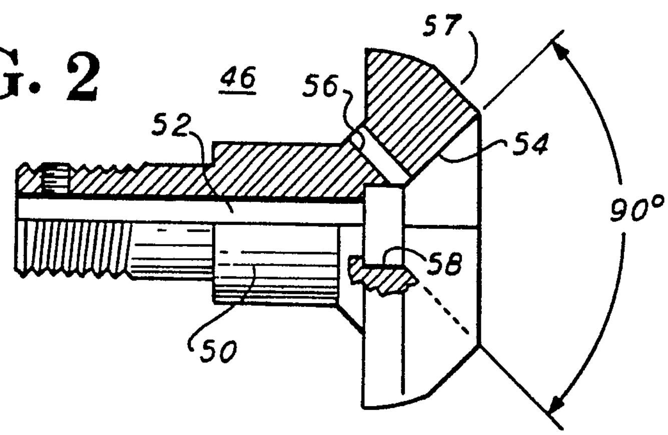
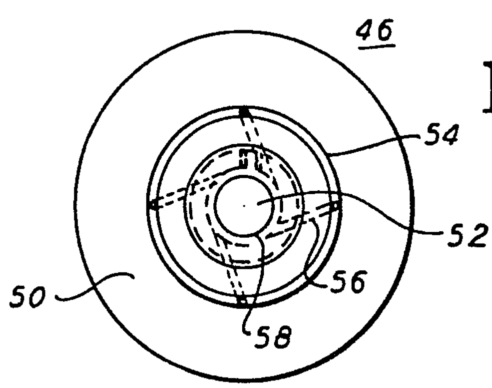


FIG. 3



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EUROPEAN SEARCH REPORT

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Application number: EP 83302373.2

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. 3)
X,Y	AT - B - 232 169 (WEBASTO-WERK) * Totality *	1-3	F 23 Q 7/06
Y	GB - A - 331 874 (AULD)	2	
A	* Page 2, lines 1-9 *	6	
Y	DE - B - 1 209 689 (WEBASTO-WERK)	3	
A	* column 2, claim 1 *	4,7	
A	DE - B - 1 000 952 (ZÜLLIG-SCHMID) * Fig. 1 *	1,4	
A	DE - C - 919 554 (DRESING) * Totality *	1,4	

TECHNICAL FIELDS SEARCHED (Int. Cl. 3)

F 23 Q 7/00
F 23 D 11/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	05-08-1983	TSCHÖLLITSCH

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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