



(43) International Publication Date
22 November 2012 (22.11.2012)

- (51) International Patent Classification:
F24H 1/28 (2006.01) *F24H 9/00* (2006.01)
- (21) International Application Number:
PCT/PL2011/000051
- (22) International Filing Date:
17 May 2011 (17.05.2011)
- (25) Filing Language: English
- (26) Publication Language: English
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: BOILER

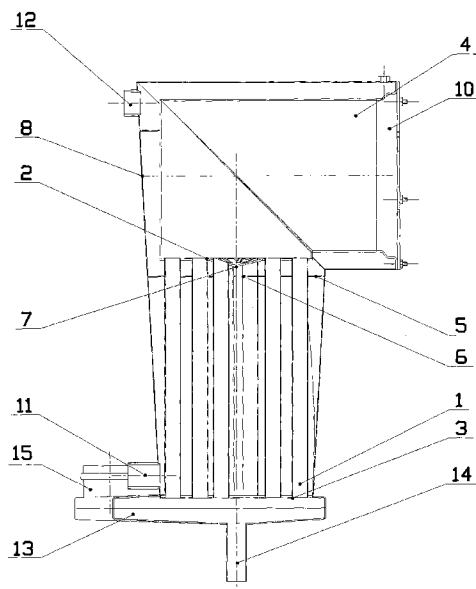


Fig. 1

(57) Abstract: The fired heat exchanger comprising an outer jacket, which encases a set of vertically running pipe elements anchored in the sieve walls on both ends, a gas combustion chamber positioned over the upper sieve wall, and a baffle mounted crosswise to the pipe elements, with openings through which the pipe elements run, plus liquid, gas, and fume inlet and outlet pipe stubs, is characterised in that the upper sieve wall (2) has a central prominence (7) pointing down towards the bottom sieve wall (3), the baffle (5) has a central opening (6) positioned under the prominence (7) of the upper sieve wall (2), and its circumference matches the circumference of the outer jacket (8).

BOILER

The invention concerns a fired heat exchanger of the pipe exchanger group, designed for exchanging heat between gas and liquid, in which the heat transferred to the liquid is generated from burning gas or heating oil. It is applied in heat engineering, particularly domestic central heating installations.

There are many known types of pipe heat exchangers. Their structure depends on the place of their application, the circulating agent used, and the specific demands and needs. All pipe heat exchangers of the liquid-gas type share a common feature, namely they all have a system of pipe elements transferring hot gas or liquid, fitted in between two sieve walls of a chamber enclosed in an outer jacket, where the heated water or gas circulates. In domestic central heating installations, where the heat is generated by burning gas or oil, heat exchangers are provided with a combustion chamber mounted above the upper sieve wall, and have water inlet and outlet pipe stubs, a gas inlet pipe stub, and a gas exhaust pipe stub. In such exchangers the pipe sets are positioned vertically. Also known, are heat exchangers used in heat engineering, called condensers or liquefiers, composed of a number of pipe sets installed in a chamber enclosed in an outer jacket. In such exchangers, the pipes are fitted in between the perforated bottom, with the water chamber underneath, from where the water is transferred into the pipes to serve as a cooling agent for the steam coming out of the turbine outlets and transferred to the chamber where the pipes are installed. Depending on the type of the pipe heat exchanger, the pipe elements used in the piping systems differ in their diameters and shapes, and may be equipped with different auxiliary elements, such as baffles or additional pipes etc., so as to enhance efficiency of the heat exchange.

Known from Polish patent specification No. 186723, is a liquid-gas pipe heat exchanger, in which hot gas is introduced into a chamber enclosed in an outer jacket cooling down while circulating around the pipes fitted in between the flat perforated bottom. The pipes are filled with the cooling agent flowing into the chamber and leaving it through the pipe stubs fitted in the perforated bottom cover. The gas condensates are drained off from the exchanger through the outlet pipe stub in the outer jacket encasing the heat exchange chamber. The chamber is also fitted with additional perforated pipes, whose end sections going through the perforated bottom are connected to the collecting pipe linked to the vapour exhaust pipe. The perforated pipes are used to suck out the air from the gas-filled space of the exchanger and discharge it outside. Moreover, the exchange chamber is divided with baffles positioned perpendicular to the pipe elements.

Moreover, the heat exchanger known from the international patent application published under No. WO2008/131616 consists of a cylindrical jacket with inlet and outlet pipe stubs, enclosing a set of pipe elements, where the pipes go through a spiral baffle and are connected to sieve walls shaped into flat discs fitting the cylindrical outer jacket. Inside the exchanger tie rods are installed, one of which runs along the central axis of the cylindrical outer jacket. The tie rods are anchored in the sieve wall on the one end, and in the spiral baffle on the other. They are divided into segments and equipped with distance pipes. The described exchanger may also feature additional pipes running through the spiral baffle, though not anchored in the sieve walls, to improve the rigidity, protect against deformations, and facilitate matching the openings in the spiral baffle to the exchanger pipes. The specification discloses the structure of the spiral baffle in detail.

Known from the international patent application published under No. WO2009/078577 is a boiler comprising a cylindrical casing, vertically positioned liquid-gas exchanger, burner installed in the combustion chamber of the exchanger, inlet and outlet of the heated water, fume exhaust duct, gas inlet, fittings which supply the air and appropriately mix it with the gas, as well as control devices. This embodiment of the heat exchanger contains a set of pipe elements rectangular in cross section, regularly distributed between the walls of the outer jacket forming the chamber, through which the heated water flows. The top ends of the pipes are anchored in the flat upper sieve wall under the combustion chamber. The pipes, piercing through the flat bottom sieve wall and crossing the exhaust gas recirculation chamber, are linked with the fume exhaust duct. The water chamber is fitted with flat disc-shaped baffles, through which the pipe elements run. These separating baffles disturb water circulation and thus improve heat exchange. They are positioned perpendicular to the pipe elements, and their diameter is smaller than the inner diameter of the heat exchanger jacket to leave some space between the baffles and the jacket for the water to flow. The said specification discusses the correlation between the width of this space and water circulation, as well as the pressure of the water on the baffles. In the described embodiment it is proposed to equip the baffles with circulation pipes to prevent increased pressure of water on the baffles. These pipes are anchored in the top baffle on the one end, and the bottom on the opposite end. The structural variant of the embodiment described in the application envisages leaving some space between the pipe element walls and the openings in the baffles, through which the pipes run to increase water circulation disturbance and improve heat exchange efficiency. The described boiler is equipped with an auxiliary independent water circuit consisting of spiral pipes installed in the water chamber and coiled around the combustion chamber.

The fired heat exchanger according to the invention, comprising an outer jacket, which encases a set of vertically running pipe elements anchored in the sieve walls on

both ends, a gas combustion chamber positioned over the upper sieve wall, and a baffle mounted crosswise to the pipe elements, with openings through which the pipe elements run, plus liquid, gas, and fume inlet and outlet pipe stubs, is characterised in that the upper sieve wall has a centrally-positioned prominence pointing down towards the bottom sieve wall, the baffle has a central opening positioned under the prominence of the upper sieve wall, and its circumference matches the circumference of the outer jacket.

In one of the variants of the fired heat exchanger the walls of the prominence are conical in shape.

In another variant of the fired exchanger, the walls of the prominence are spherical in shape.

Preferably, the geometry of the apex of the prominence on the upper sieve wall changes in steps.

The prominence apex is beveled flat.

The advantage of the embodiment according to the invention consists in achieving symmetric and even flow of liquid around the combustion chamber, which improves the working conditions of the whole exchanger system, and intensifies the cooling of the central section of the upper sieve wall, which is an element most exposed to damage caused by material overheating.

The exemplary embodiment of the heat exchanger according to the invention is illustrated on the drawing, where fig. 1 presents the longitudinal section of the exchanger, and Fig. 2 visualises different shape variants of the exchanger upper sieve wall.

The fired heat exchanger consists of a vertically positioned set of pipe elements 1 arranged spokewise, whose ends are welded to the upper sieve wall 2 at the top, and the bottom sieve wall 3 at the bottom. The pipe elements 1 have two parallel walls connected together with arch-shaped walls, which make them resemble a rectangle in cross-section. Above the upper sieve wall 2 is the steel-sheet combustion chamber 4 permanently welded to the said wall. Fitted perpendicular to the pipe element set, under the sieve wall 2 and in its immediate vicinity, is a horizontally positioned baffle 5 made of steel sheets. The baffle 5 has a number of openings, the diameters of which correspond with the diameters of pipe elements 1 running through them. The baffle 5 is shaped into a flat disc with a central opening 6 in the middle. In the middle of the upper sieve wall 2, also shaped into a flat disc, there is prominence 7, its apex pointing down towards the bottom sieve wall 3. The bottom sieve wall 3 is also shaped into a flat disc. The diameter of the prominence 7 on the upper sieve wall 2 corresponds with the diameter of the central opening 6 in the baffle 5. The bundle formed of the set of pipe elements 1, sieve walls 2,3, and the baffle 5 is encased in an outer jacket 8 shaped into a truncated cone gaining in diameter towards the top. The baffle 5 has outer diameter

corresponding with the inner diameter of the outer jacket 8 and is, in the exemplary embodiment, connected to the combustion chamber with distance elements. The prominence 7 on the upper sieve wall 2 is shaped into a cone with a horizontal flat bevel 9 at the apex. Above the upper sieve wall 2 is the combustion chamber 4, which may be encased in the outer jacket 8 together with the pipe bundle, or in another element welded to the conical outer jacket 8. The exchanger has a cover 10 fitted with a gas or heating oil inlet pipe stub, a set of openings for installation of the burner and the system supplying the exchanger with fuel-air mixture burned in the combustion chamber, and other mounting elements, which ensure safe use of the exchanger and allow its integration with a boiler. The bottom sieve wall 3 is permanently welded to the outer jacket 8 at the contact points. Water inlet 11 and water outlet 12 stub pipes are installed respectively in the top and bottom section of the outer jacket 8, and the bottom tank 13 formed under the bottom sieve wall 3 is fitted with condensate drain pipe stub 14 and gas fume exhaust pipe stub 15.

The fired heat exchanger may be performed in many variants different in terms of the shape of the upper sieve wall 2 and its centrally-positioned prominence 7, the shape of the baffle 5, the shape of the bottom sieve wall 3, and the shape of combustion chamber 4. In particular, the upper sieve wall 2 may be either flat, conical, or spherical, and the prominence 7 pointing down may be shaped into a cone, or a fragment of a sphere. Moreover, preferably, the geometry of the prominence 7 apex changes in steps, particularly if the apex is horizontally beveled flat 9. In specific embodiments also the bottom sieve wall 3 and the baffle 5 may have different shapes, such as discs, cones, fragments of spheres, or other. In particular, the bottom sieve wall 3 may be shaped so as to match the shape of the upper sieve wall 2 and have a prominence in the centre. Different embodiments of the invention may differ in the cross-sections of the exchanger pipe elements 1 and the geometry of their mutual positioning.

The heat exchanger is designed for burning natural gas, propane, and heating oil and thus obtain heat used to heat the water circulating in the central heating installation. The fuel is burnt in the combustion chamber 10 in the top section of the exchanger, then the fumes flow down through the vertical pipe elements 1 passing heat on their way to the water circulating inside the outer jacket 8, between the water inlet 11 and the water outlet 12. When flowing down, the fumes cool down below the dewpoint temperature and accumulate in the bottom container 13, from where they are drained off together with the accumulated condensate through the condensate drain pipe stub 14 and the gas fume exhaust 15. The heated water circulates outside and around the pipe elements 1, in the direction opposite to the flow of the fumes, i.e. the water is introduced through the water inlet pipe stub 11 at the bottom of the exchanger and flows upwards around the pipe elements 1 and the combustion chamber 4, whereupon it is removed from the heat exchanger through the water outlet pipe stub 12 in the upper section of the

exchanger. The desired water flow against the upper sieve wall 2, which forms the bottom of the combustion chamber 4, is forced by the appropriate shape of this sieve wall and the baffle 5 immediately underneath. Through the central opening 6 in the baffle 5 the flow of the liquid is first directed to the central point, i.e. prominence 7 in the centre of the upper sieve wall 2. Thus, the stream flowing out of the central opening 6 in the baffle 5 is symmetrically and evenly split in all directions. This ensures a uniform distribution of temperature at the upper sieve wall and protects it from local overheating. The irregular geometry of the prominence 7 at its apex, especially its flat beveling 9, makes the wall-adjacent stream detach from the upper sieve wall 2 and adds turbulence to the flow. This, in turn, translates to improved heat exchange ratio between the liquid and the sieve wall and reduced risk of scale sediment deposits.

Patent Claims

1. A heat exchanger comprising an outer jacket, which encases a set of vertically running pipe elements anchored in sieve walls on both ends, a gas combustion chamber positioned over the upper sieve wall, and a baffle mounted crosswise to the pipe elements, with openings through which the pipe elements run, plus liquid, gas, and fume inlet and outlet pipe stubs, characterised in that the upper sieve wall (2) has a centrally-positioned prominence (7) pointing down towards the bottom sieve wall (3), and the baffle (5) has a central opening (6) under the prominence (7) on the upper sieve wall (2) and its circumference matches the circumference of the outer jacket (8).
2. The heated exchanger according to Claim 1, characterised in that the walls of the prominence (7) are conical in shape.
3. The heated exchanger according to Claim 1, characterised in that the walls of the prominence (7) are spherical in shape.
4. The heated exchanger according to Claims 1-3, characterised in that the geometry of the apex of the prominence (7) on the upper sieve wall (2) changes in steps.
5. The fired exchanger according to Claim 4, characterised in that the apex of the prominence (7) is beveled flat (9).

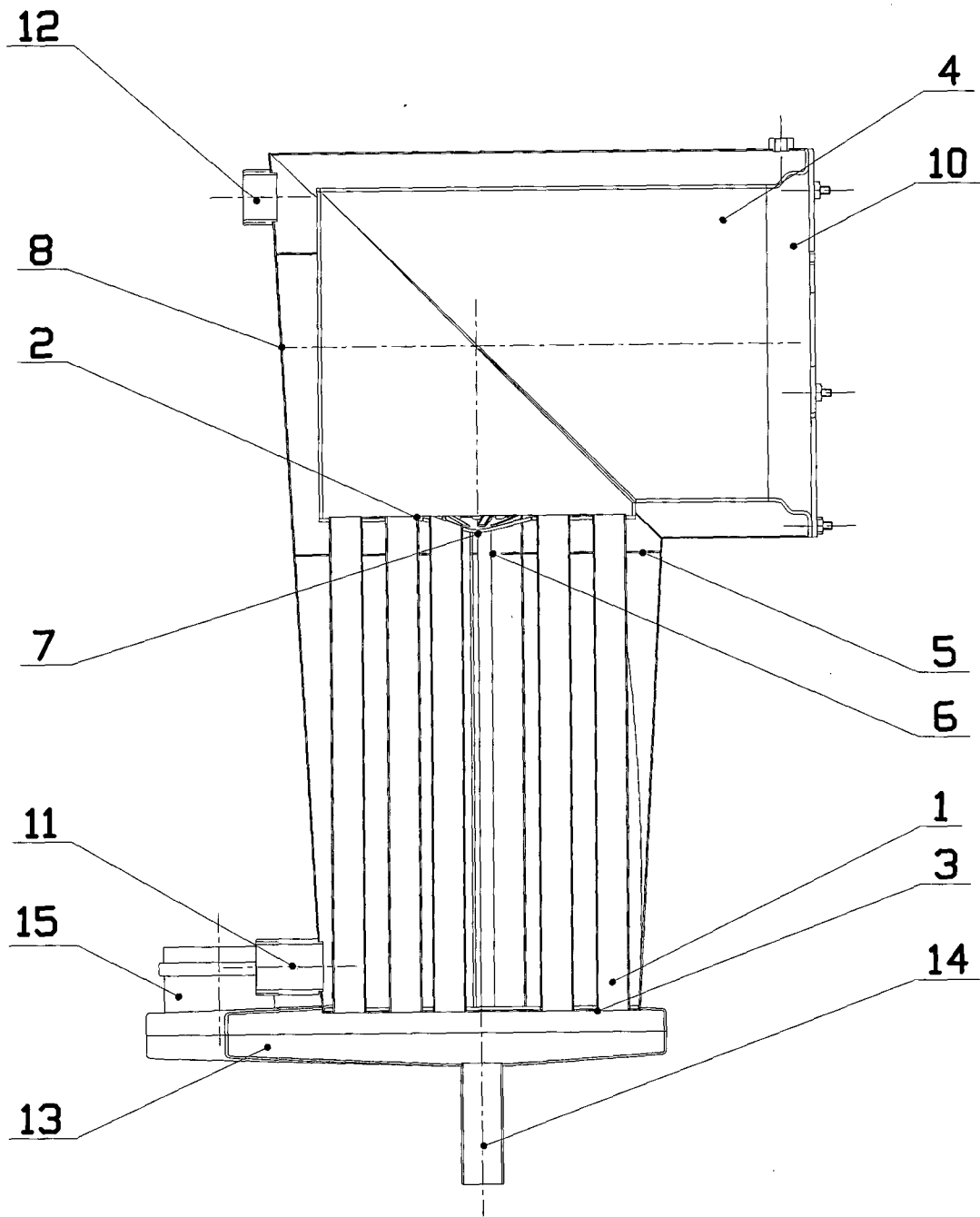


Fig. 1

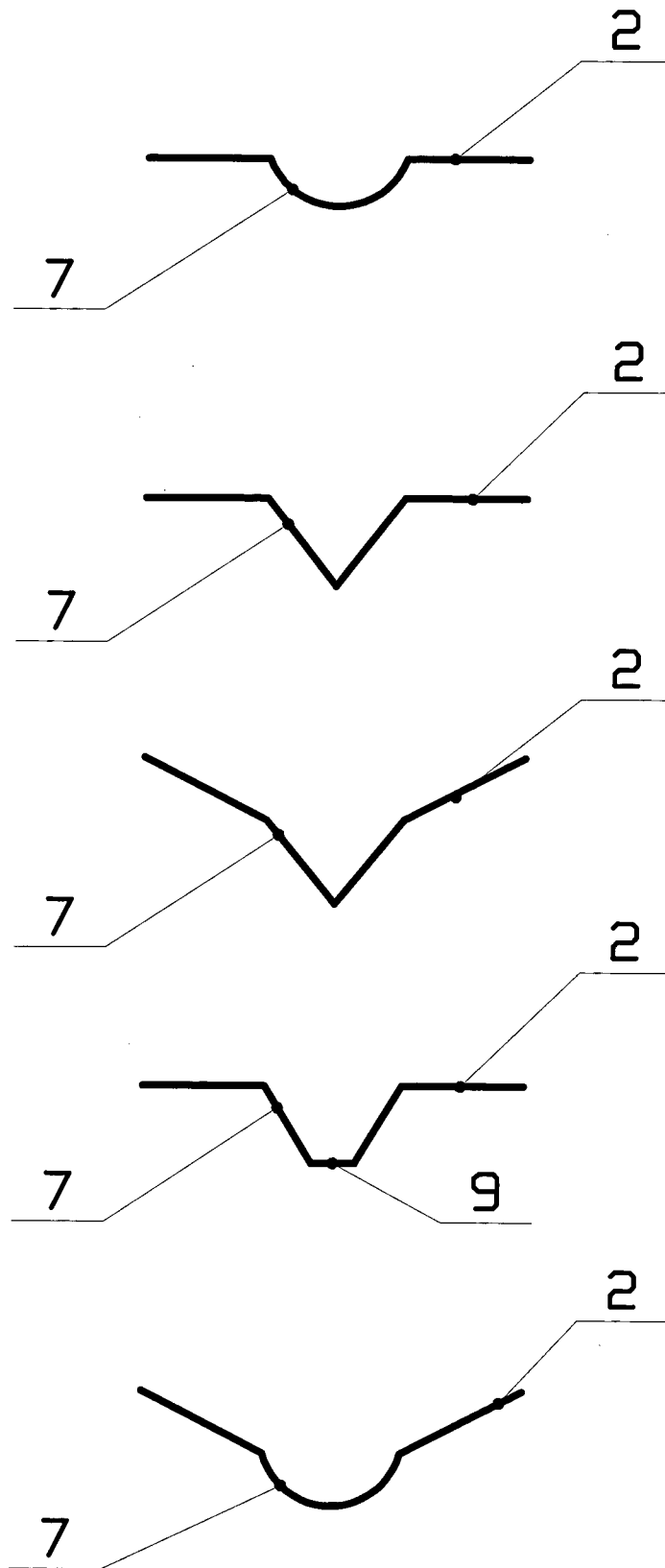


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No

PCT/PL2011/000051

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F24H1/28 F24H9/00
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 271 434 A2 (VAILLANT JOH GMBH & CO [DE]) 15 June 1988 (1988-06-15) column 8, lines 34-53; figures 1,12,13 -----	1-5
A	WO 2009/146990 A2 (JAHIER GIOVANNI [IT]) 10 December 2009 (2009-12-10) abstract; figures -----	1
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A	DE 93 09 771 U1 (VIESSMANN WERKE KG [DE]) 26 August 1993 (1993-08-26) abstract; figures -----	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search

6 February 2012

Date of mailing of the international search report

16/02/2012

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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