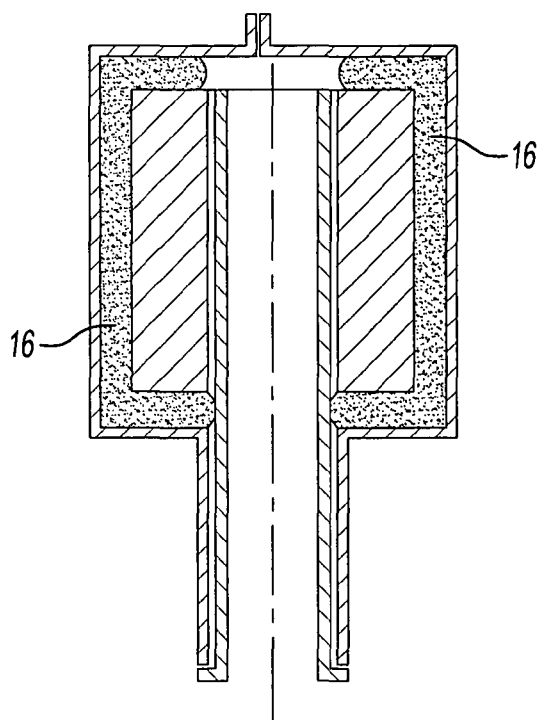




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(54) Title: IMPROVEMENTS IN OR RELATING TO VEHICLE SUBFRAME REINFORCEMENT



(57) Abstract: Vehicle subframes and their points of attachment to main frames are reinforced by structural foam (16) preferably provided on a carrier (14), the invention enhances the strength of such critical load bearing locations in the vehicle whilst at the same time reducing the weight of the vehicle.

Fig -4





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IMPROVEMENTS IN OR RELATING TO VEHICLE SUBFRAME REINFORCEMENT

The present invention is concerned with the mounting of subframes of vehicles and in particular to the reinforcement of the attachment of subframes to the mainframe of a vehicle
5 at the position of attachment sometimes known as the mounting point.

Vehicles particularly automobiles, cars, trucks and busses consist of various components assembled on a frame which consists of a main frame and a subframe. A main frame may comprise the structure defining the extremities of the vehicle. The subframe is a structure
10 within a larger body frame which carries certain components such as the axles, engine, drivetrain, transmission or suspension. Traditionally, the subframe is bolted and/or welded to the vehicle at the mounting point and the joint is reinforced with strong metal supports. The subframe can be used to spread high chassis loads over a wide area of body shell. It can also isolate vibration and harshness from the rest of the body. For example, in an
15 automobile with its powertrain contained in a subframe, forces generated by the engine and transmission can be damped enough that they will not disturb passengers. Separate front and rear subframes are sometimes used in modern vehicles to reduce the overall weight and cost.

20 There are generally two basic forms of the subframe. An "axle" type which usually carries the lower control arms and steering rack; a perimeter frame which carries the above components but in addition supports the engine, transmission and possibly full suspension typically in front wheel drive vehicles. A subframe is usually made of stamped or hydroformed steel panels that are much thicker than bodyshell panels, which are welded or
25 spot welded together. Alternatively, it may be made of aluminium and in this instance may be cast. A subframe could, for instance, provide cross struts bridging the main frame to which components such as floor panels, axels, transmissions and the like may be attached. The attachment of a subframe to the main frame at the mounting point needs to be load bearing and strong. Subframes are frequently of tubular steel structures which may be
30 welded panels or hydroformed tubes and they are fastened to the main frame of the vehicle by a combination of mechanical fastening and welding. This results in an undesirably heavy structure and requires extensive complex multistage processes in order to provide the desired structure.

35 An example of a typical subframe is shown in DE 10257222 A1.

The present invention provides a simpler, lighter weight means of securing a sufficiently strong fixation between a vehicle subframe and the main frame by providing light weight reinforcement at the position of the attachment to the subframe to the main frame (the mounting point).

5

The invention therefore provides the use of a structural foam located upon a carrier to reinforce the position of the attachment of a vehicle subframe to the main frame of the vehicle.

- 10 The invention further provides a vehicle subframe supporting a vehicle component wherein the fixation between the subframe and the component is reinforced with a structural foam which may optionally be provided on a carrier.

The reinforcement of certain areas of vehicle bodies with structural foam optionally provided
15 on a carrier is known. For example WO 9939882 shows the reinforcement of roof and tailgate supports.

European Patent Publication 1354789 A1 and United States Patent 6495126 discloses the use of structural foam to reinforce bolted sections. However, it has not been proposed to
20 use structural foams to provide additional strength to the critical load bearing activities associated with the subframe, particularly the mounting point.

In a further embodiment the structural foam is derived from a heat foamable material that develops strength and adhesive properties as it foams. It is further preferred that the
25 material foam at temperatures experienced in the automobile assembly process such as in the paint or anti-corrosion (e-coat) coating bake operations. This enables the subframe, main frame and reinforcing materials to be assembled on an assembly line and passed into an oven where the foamable material foams, develops strength and adhesive properties to provide strong reinforcement to the subframe mounting point.

30

The reinforcement attachment may be provided exclusively by the structural foam optionally together with the carrier. In this embodiment the structural foam may be provided around the mechanical attachment so that it provides strength between the components that are held together and can also help to stabilise the location of the attachment.

35

Where the structural foam is located upon a carrier the carrier may be of metal or strong plastic material such as fibre reinforced polyamide or polypropylene. Where the carrier is of

metal it may be a stamping from steel or aluminium. Where the carrier is of plastic it may be produced by injection moulding or extrusion including extrusion in place as is described in PCT patent application PCT/EP2012/000437. The foamable material may be applied to the carrier by extrusion or injection moulding of the material onto the carrier at temperatures
5 below that at which foaming and/or curing to develop strength occur.

Structural foam is a well known term in the automobile art and it relates to a foamed material that provides a structural reinforcement to a component of the vehicle. Typical structural foams have a lap shear of 5 MPa or greater and a modulus of 500 MPa or greater with a
10 degree of expansion of up to 500%, typically from 50% to 200% to give a density between 1 and 2 Kg/dm³. The reinforcement member may include a polymeric carrier, which may be amenable to injection moulding or other such mouldable material such as polymeric, metallic or ceramic, and a load distributing foamable medium disposed on the carrier. The load distributing foamable medium disposed on the carrier is a structural foam and is preferably a
15 curable (by cross linking) epoxy-based foamable material. The preferred load distributing medium is an epoxy based structural foam such as the products L0506, L0507, L5001, L5204, L5206, L5207, L5214, L5234, L5235, L5236, L5244, L8050 and L8051 structural foam, which is commercially available from L&L Products of Romeo, Michigan and L&L Products Europe of Strasbourg, France.

20 During an automobile assembly process the reinforcement member with the foamable material in an unfoamed un-cured state is positioned against the automobile frame so that the uncured structural foamable material can be heated to cause foaming and curing to provide the structural foam. Once the foam is cured, the reinforcement member adheres to
25 the subframe and distributes any loads that impact the bond and the components it supports such as wheels, transmissions, engines etc.

The invention is illustrated by reference to the accompanying Figures in which Figure 1 illustrates where a subframe can be located within a vehicle.

30 Figure 2 shows a traditional (prior art) attachment between a subframe and a main frame.

Figure 3 shows how the metal structure can be replaced by a carrier provided with a foamable material at the mounting point and Figure 4 shows the finished structure reinforced
35 with a structural foam.

Figure 1 shows a section of a car body comprising a main frame (1) consisting front rails (2) and (3) together with pillars (4) and (5). (6) is the subframe attached to the main frame at (7) and a corresponding right side portion (not shown). The subframe illustrated will support the vehicle engine.

5

Figure 2 shows a traditional structure at one of the joints between the subframe and the main frame as illustrated in Figure 1. Figure 2 shows the welded panels (8) and (9) which are part of the front rail (2) in place and welded reinforcing metal components (10) and (11). A tubular spacer (12a) is assembled between the panels (8) and (9). The tubular spacer can
10 receive a bolt (not shown) for fixing the subframe (6) (not shown in Figure 2) to the main frame (1). A further L-shaped metal reinforcement is provided at (13).

Figure 3 shows how the welded reinforcing metal components (10), (11) and (13) may be removed and replaced by a carrier (14) provided with a foamable material (15) and Figure 4
15 shows how the structural foam (16) derived from the foamable material (15) can be expanded to reinforce the position where the main frame is attached to the subframe (the mounting point).

The carrier can be formed of a polymeric material, a preferred polymeric material being
20 nylon, but may also consist of a metallic or ceramic material. More preferably the nylon material is glass filled nylon. However, it will be appreciated that other materials having similar properties may be used. The carrier is preferably overmoulded around the tubular spacer (12b).

25 The carrier may have any suitable geometric configurations. For example, the carrier may be rectangular, circular, or a variety of complex geometrical configurations. The particular configuration chosen for the carrier will vary depending on the configuration of the area that is to be reinforced.

30 When a carrier is used reinforcement is provided by the structural strength and stiffness of the carrier together with the structural foam and it may be provided by applying the load distributing structural foam to selected surfaces of the carrier member. Typically, the structural foam is applied to the carrier in the areas corresponding to frame areas where reinforcement is desired such as a continuous load transfer medium or bonding surface application.

35

The structural foam is preferably heat-activated and expands upon heating, typically by a foaming reaction such as the release of gas by a blowing agent. The structural foam is gen-

erally applied to the carrier in an unfoamed solid or semi-solid state. The structural foam may be applied to the outer perimeter of the carrier in a fluid state using commonly known injection techniques, wherein the structural foam is heated to a temperature that permits the structural foam to flow slightly. Upon cooling the unfoamed structural foam hardens and
5 adheres to the outer surface of the carrier, or via adhesive characteristics in the structural foam formulation itself. Alternatively, the structural foam may be applied to the carrier as precast pellets, which are heated slightly to permit the pellets to bond to the outer surface of the carrier. At this stage, the structural foam is heated just enough to cause the structural foam to flow slightly, but not enough to cause the structural foam to expand or cure. Note
10 that other expandable materials can be used, such as, without limitation, an encapsulated mixture of materials that, when activated by temperature, pressure, chemically, or other by other ambient conditions, will expand.

The structural foam is preferably an epoxy-based material, but may include other polymers
15 such as ethylene copolymers or terpolymers. A copolymer or terpolymer, is composed of two or three different monomers.

In applications where a heat activated, thermally expanding material is employed, an important consideration involved with the selection and formulation of the material comprising
20 the structural foam is the temperature at which a material reaction or expansion, and possibly curing, will take place. For instance, in most applications, it is undesirable for the material to be reactive at room temperature or otherwise at the ambient temperature in a production line environment. More typically, the structural foam becomes active at higher processing temperatures, such as those encountered in an automobile assembly plant, when
25 the foam is processed along with the automobile components at elevated temperatures or at higher applied energy levels. While temperatures encountered in an automobile assembly operation may be in the range of 130°C to 210°C, body and paint shop applications are commonly about 90°C or slightly higher. Generally, prior art expandable foams have a range of expansion ranging from approximately 0 to over 1000 percent. The level of expansion
30 of the structural foam may be increased to as high as 1500 percent or more. Higher expansion, now ever, typically results in mechanical property reduction.

The invention therefore provides strength and reinforcement to vehicle subframes at the position where they are attached to the main frame. In this way the subframes are able to support
35 components such as axels, engines, transmissions, gear boxes etc, electronic components of electric powered and hybrid vehicles which has hitherto required heavy metallic

means support at the point of attachment. The invention therefore results in comparable strength with reduced weight with the attendant fuel economy benefits.

CLAIMS

1. The use of a structural foam located upon a carrier to reinforce the position of the attachment of a vehicle subframe to the main frame of the vehicle.

5

2. A vehicle subframe supporting a vehicle component wherein the fixation between the subframe and the component is reinforced with a structural foam which may optionally be provided on a carrier.

- 10 3. A technique according to Claim 1 or Claim 2 wherein the material foam at temperatures experienced in the automobile assembly process such as in the paint or anti-corrosion (e-coat) coating bake operations.

- 15 4. A technique according to any of the preceding claims wherein the carrier is of metal or strong plastic material such as fibre reinforced polyamide or polypropylene.

- 20 5. A technique according to any of the preceding claims wherein the structural foams have a lap shear of 5 MPa or greater and a modulus of 500 MPa or greater with a degree of expansion of up to 500%, typically from 50% to 200% and a density between 1 and 2.5 Kg/dm³.

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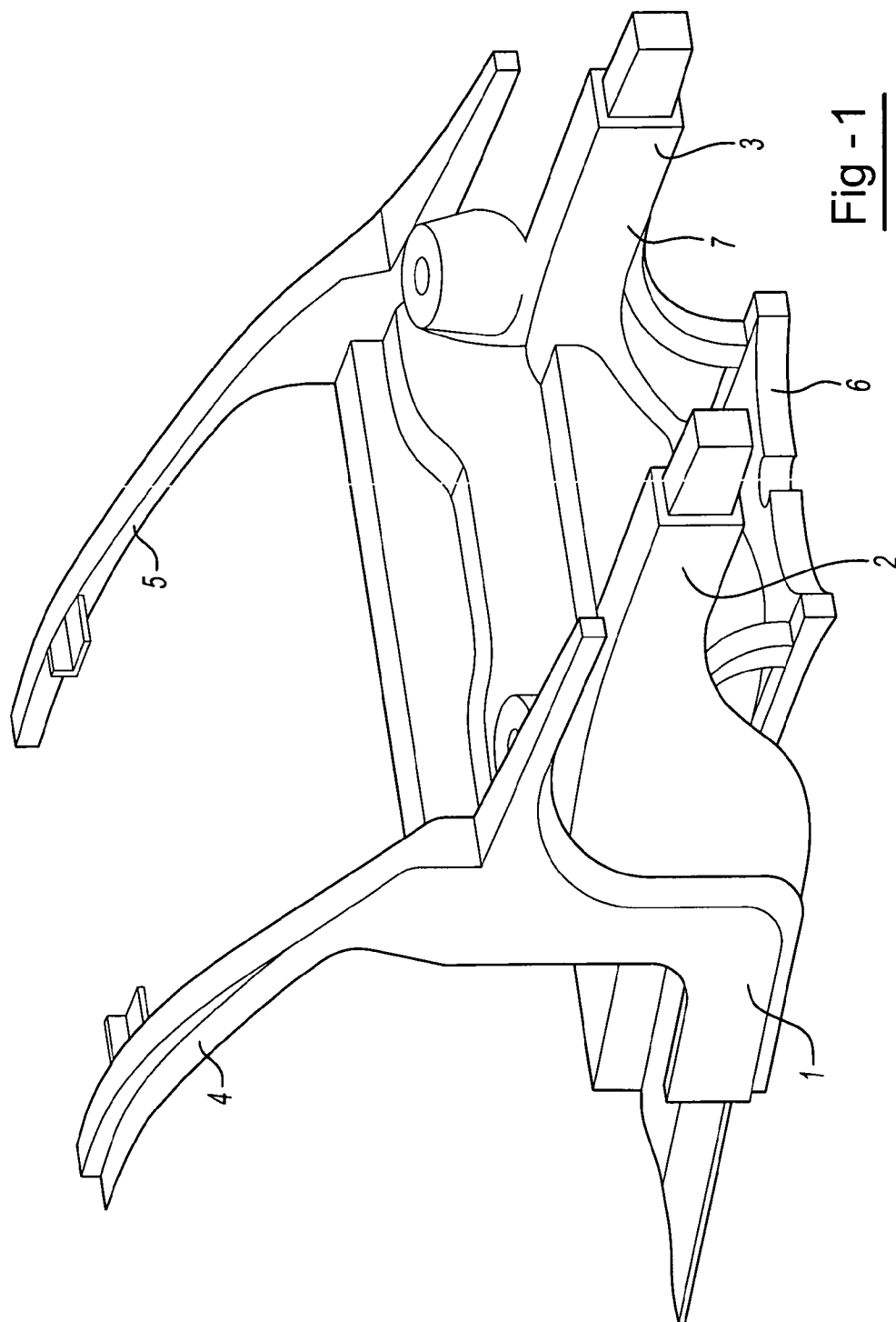


Fig - 1

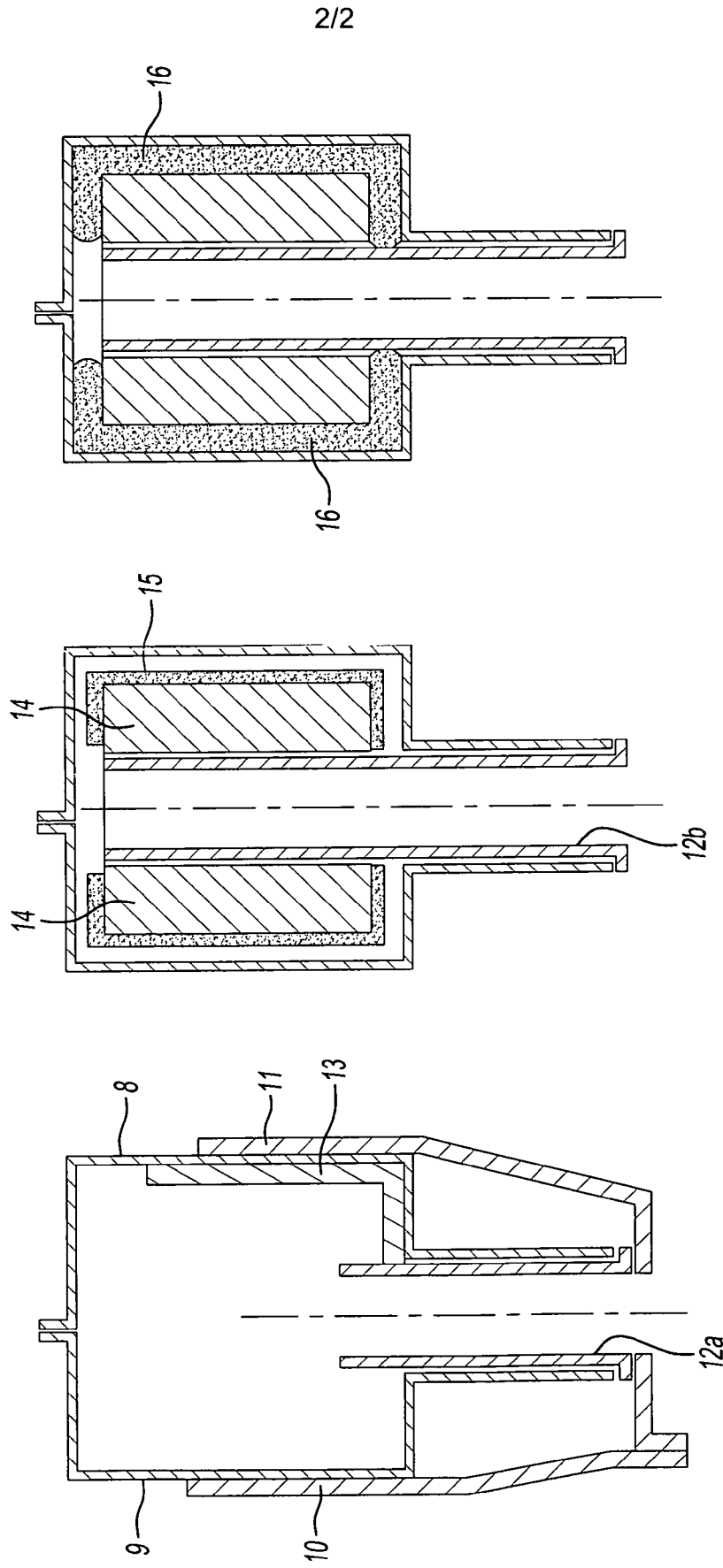


Fig - 2

Fig - 3

Fig - 4

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)
B62D

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 891 918 A1 (HENKEL CORP [US]) 20 January 1999 (1999-01-20) page 3, paragraph 50-54; claims 4,11,19,20,21 -----	1-5
E	WO 2012/052103 A1 (AUDI NSU AUTO UNION AG [DE]; LEIBL PETER [DE]) 26 April 2012 (2012-04-26) claims 3,5; figures 1-3 -----	1-4
A	EP 1 354 789 A2 (L & L PRODUCTS INC [US] ZEPHYROS INC [US]) 22 October 2003 (2003-10-22) the whole document -----	3,5



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0891918	A1	20-01-1999	AR	016354 A1	04-07-2001
			AT	3114 U1	25-10-1999
			AT	199354 T	15-03-2001
			BR	9802436 A	03-08-1999
			CA	2242860 A1	18-01-1999
			DE	29812737 U1	26-11-1998
			DE	69800544 D1	05-04-2001
			DE	69800544 T2	13-09-2001
			EP	0891918 A1	20-01-1999
			ES	2157113 T3	01-08-2001
			FR	2766254 A1	22-01-1999
			GB	2327386 A	27-01-1999
			IT	T0980623 A1	17-01-2000
			JP	11170417 A	29-06-1999
			NL	1009642 A1	19-01-1999
			NL	1009642 C2	05-03-1999
			PL	327391 A1	01-02-1999
			TR	9801382 A2	21-10-1999
			US	6237304 B1	29-05-2001

WO 2012052103	A1	26-04-2012	DE 102010049344	A1	26-04-2012
			WO 2012052103	A1	26-04-2012

EP 1354789	A2	22-10-2003	AT	391070 T	15-04-2008
			DE	60320059 T2	04-06-2009
			EP	1354789 A2	22-10-2003
			ES	2302896 T3	01-08-2008
			US	2004018341 A1	29-01-2004
