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(54) **Manufacturing process of wheel rims and equipment for its execution**

(57) This invention describes a procedure for the manufacturing wheel rims (11), based on shaping its perimeter profile by redistributing the thickness of the strip (12) that forms the ring, and the equipment that carries out this redistribution, making rims (11) with less total

weight, using strips (12) of less volume of material, which are given an initial configuration that makes the rim (11) stronger, obtaining at the end of the process a minimum amount of waste material and less processing time.

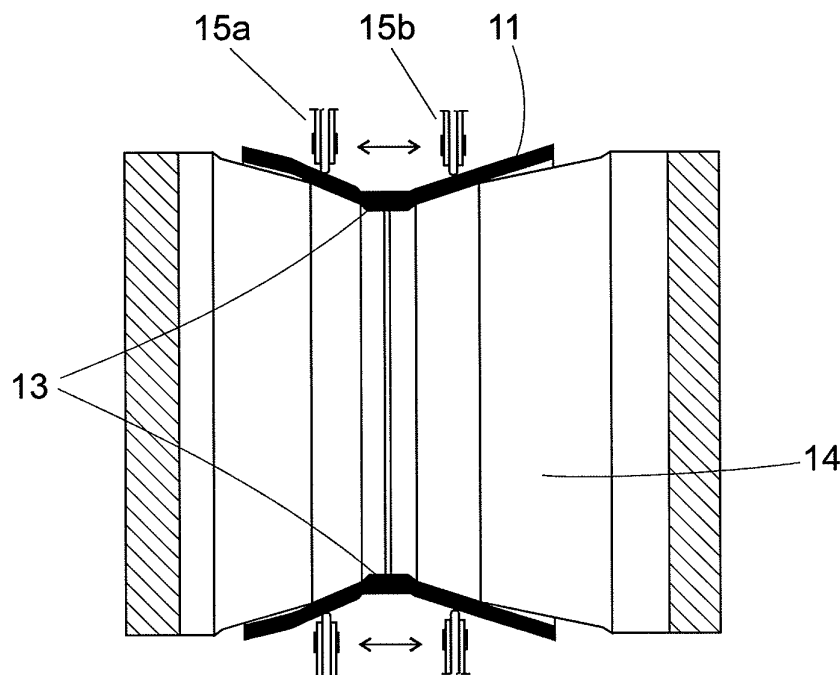


Fig. 3

Description

Object of the Invention.

[0001] More specifically the invention refers to a procedure for the manufacturing wheel rims, based on shaping its perimeter profile by redistributing the thickness of the strip that forms the ring, and the equipment that carries out this redistribution.

State of the Art.

[0002] There are other systems for processing profiles to form wheel rims on the market, and therefore can be considered as the state of the art of the invention. Among these processes is a known procedure of redistribution of the thickness of the strip that forms the ring, to create the designed profile of the wheel rim ring.

[0003] This process, commonly known as *Flow Forming*, has different modes of implementation, which achieve said redistribution of the thickness of the strip. Among said modes of implementation is the habitual process of moving the thickness of the strip that will form the profile of the rim, which is placed onto a rotating mandrel, and by means a roller during the turning of said mandrel, moulds the strip to the shape of the mandrel and this is done moving the thickness from the points where the roller begins to press until the end of the profile, in a single route made by a single set of rollers moving in the same direction.

[0004] This procedure has the drawback of having to foresee variations in the initial thickness of the strip, so as to be able to carry out the transport to parts that need it most, often needing thicker strips than necessary in order to have the capacity of moving material to where it is required. In the same manner, a large amount of movement of material is carried out by having to accumulate it from the first moment it presses on the strip, to the point that needs the greatest thickness and, therefore, at the end of the process there is a considerable concentration of transported material, requiring the cutting of the final profile, eliminating surplus material and creating waste, which increases the cost of material in each component.

[0005] The time used for this process is decisive in the manufacturing process of the rim, therefore in processes such those shown in European patent EP1389501, there are 3 or more rollers that move aligned from one end to the other of the profile, enabling the time the rollers are pressing to be reduced, as there are more pressure points.

Description of the invention.

[0006] This invention aims to carry out a wheel rims formation process, reducing total weight, using narrower and lighter strips, with a process producing the minimum amount of waste, with a lower processing time and re-

sulting in greater structural resistance.

[0007] It is also a purpose of this invention to offer equipment to carry out said procedure, implementing the aims of the procedure that govern it. Thus, the proposed invention is materialised in a procedure of wheel rim manufacturing, more specifically the process of transforming ringshaped strips that form the profile of the rim, which will hold the tyre on its outside area and, the wheel disc on the inside.

[0008] This procedure starts with the reception of the ring that will form the rim profile, this is a metal strip that has been previously welded and treated by habitual procedures and ensuring the proper resistance of said ring. The strip that forms the ring have been adjusted to the thickness of the largest section, being possible to start off with a sheet thinner than used in the state of the art, which must carry out the transport of material for all the thicknesses of different sections. This allows the use of a lighter ring, which will result in a lighter wheel rim, with the importance of weight saving in the vehicles using these rims. When the ring is received, a biconical expansion is carried out, as the process uses equipment with a biconical mandrel, where the ring to be processed is placed. This expansion is done previously on equipment that is not part of the equipment where the transport of material or Flow Forming is carried out.

[0009] In this manner, the ring has its flat transversal section turned into a V-shaped section where its middle area projects inside, with the ends projecting out, spreading out the volume of the material needed at each side of the central area, achieving advantageously by means this new initial configuration of the ring, a release of structural tension, especially in the exterior area, which reduces the probability of breakage during the process, considerably reducing rejects and enabling greater speed and pressure, of the rollers if necessary. This new procedure reduces breakage by about 99%, carrying out a redistribution-elimination of tension in the internal structure, while in turn offering a control of reduction in thickness and reduction of time cycle due to its final configuration.

[0010] In this manner, the ring has taken on a first approximation to the rotating mandrel, which has a biconical structure and where a spreading of the volume of the material needed on each side of the central area has been carried out. Said ring is placed in the equipment which will move the material, leaving the central area of the ring adjusted to the shape of the mandrel, with the result that it is not necessary to fatigue this area with the rollers to adapt it to the shape and thickness of the design, as the strip that forms the ring has this thickness in this central area, which is the area of maximum thickness. It is not necessary to secure the ring with auxiliary elements, as its adaptation to the mandrel and the action of the rollers and its movement following the biconical mandrel, make it unnecessary, saving this step and the need for auxiliary equipment advantageously. To achieve the adaptation of the rest of the ring to the shape of the man-

drel, and with the designed thickness of the rim, the process of transport of material is carried out -*Flow Forming*- using advantageously at least two sets of rollers, formed by two or more rollers in each set, which initiate the process starting from each of the ends of the central area already adapted to the mandrel by means the expansion carried out previously. From this point, each set of rollers, habitually one pair of rollers per set, move it turning and pressing on the ring that also turns in the mandrel, following the direction of movement from the starting point of one of the ends already secured in the central area, until the end of the ring it has at its side.

[0011] This novel and advantageous process carries out transport of much less material than in current processes, as it is not necessary to drag the material needed in the middle part or on the other end of the wheel from one end of the ring to the other, rather we can start with a ring of thickness corresponding to the area of the maximum thickness, central area, and only move/reduce the thickness from the rest of the area to the ends of the ring, widening the ring which begins narrow and therefore of lighter weight, and the process of transport of material distributes it to the end of the mandrel. The total weight of the finished wheel rim is reduced thanks to the lesser weight of the sheet forming the initial ring, which as has been said, is thinner than those used in the state of the art, taking as reference the thickness of the section with the greatest thickness. Weight reduction may be greater than 0.5 kg according to the type of rim, achieving configurations up to 20% lighter.

[0012] In this transport of material, as it is designed for only half the process, from the central part to each of the ends, can adjust in a better manner the surplus material at the end of the mandrel, wasting less amount of strip, once it is cut and deburred for finishing the edge of the rim, with the resulting saving of material.

[0013] As there is less transport of material, the rollers need to exert less pressure, which will reduce their wear and therefore lower maintenance costs, and reduce fatigue of the ring forming the rim. In the same manner, having to exert less pressure means less power is needed to carry out the process than is currently used, that carries out the transport of material from end to end of the profile of the ring, with the resulting energy saving in the process.

[0014] Likewise, the use of two or more rollers per set allows the use of less pressure exerted by said rollers on the material, which reduces their wear and minimises material fatigue.

[0015] The advantageous configuration of the *Flow Forming* process that starts from the central area to the end, enables a reduction in the processing time by close to half that normally used, without having to increase the processing speed and therefore having to cause more fatigue on the ring.

[0016] The process is carried out by equipment that has a biconical mandrel, with the shape you wish to give to the profile of the ring that forms the rim, without needing

to have a gripping area of the ring on one of its ends, as it is secured to the mandrel by means of the biconical expansion that adapts the central part to the mandrel. This expansion is carried out by pressing prior to fitting to the mandrel inside the equipment.

[0017] The equipment has advantageously at least two sets of rollers, which by a numerical calculation system, move from the central area already adapted, to the end of the mandrel, pressing on the ring that turns in said mandrel, and moving material to said end. Within each of the sets that are in action, one of the rollers is subject to the main wear, whereas the other, or the rest of those working in the same set, accompany with hardly any wear.

[0018] The configuration of the novel process and the features of the equipment that carries it out, provide the invention with solutions to the problems caused by currently known systems. Thus the process and the equipment shown here:

[0019] Enables a reduction of processing time and therefore increases the capacity of the process, as both sets of rollers press on both halves of the ring.

- Enables a reduction of the weight in the final rim, as less volume of material is used in the initial strip.

[0020] Enables an increase in resistance to breakage during the process as it is begun through a biconical expansion of the ring.

- Enables better use of the material, as there is not so much waste on the ends of the rim, once the transport from the central part to the ends has been carried out.
- Enables a reduction of fatigue in the wheel rim, as less pressure is used.
- Enables less wear on the rollers as there is less pressure on the ring.
- Enables better control of the final thickness, as there is no subsequent thinning due to the biconical.

[0021] Other details and characteristics shall be shown throughout the description below referring to drawings attached to this report which are shown for illustrative but not limiting purposes a practical embodiment of the invention.

Description of the drawings.

[0022]

Figure 1 is a view of the ring formed and with pressed in biconical shape.

Figure 2 is a sectional view of the shaping equipment, with the biconical ring in adjusted to its central part and with the rollers in their position at the beginning of the process.

Figure 3 is a sectional view of the shaping equipment, with the process started.

Figure 4 is a sectional view of the shaping equipment, with the process of transit of material done in the ends of the mandrel

Description of a preferred embodiment of the invention

[0023] In a preferred embodiment of this invention, the manufacturing procedure for wheels starts with the creation of the wheel rim ring (11) using a metal strip (12), by habitual procedures, but with the novelty of having a thinner strip (12) than habitually used.

[0024] Once the welding and the rest of the processes that ensure the reliable build of the wheel rim ring (11) have been carried out, said ring (11) is expanded by means of pressing that provides it with a V-shaped biconical configuration, as shown in Figure 1, giving the ring (11) an central area (13) that fits into the mandrel (14) of the equipment (10) in charge of transporting the material -*Flow Forming*-. After expanding the ring (11) to a biconical shape, as said before, it is fitted to the mandrel (14), the central area (13) being supported in said mandrel (14), to start the transit process of material, as shown in Figures 2 to 4.

[0025] The equipment (10), not shown in the drawings, has two sets (15a and 15b) of rollers (16), each of the sets (15a and 15b) being independent, incorporating in this embodiment two rollers (16) in each set (15a and 15b). The rollers (16) are normally located in the set (15a and 15b) symmetrically to each other with regard to the rotating shaft of the mandrel (14).

[0026] Each of the sets (15a and 15b) is located at one end of the central area (13) of the ring (11). In this initial position, both the rotation of the mandrel (14) and the movement of the rollers (16) pressing the ring (11) against the shape of the mandrel (14), carry out the coupling of the ring (11) to said mandrel (14), distributing the thickness of the strip (12) according to characteristics predefined by the design of the wheel profile, using preferably a numerical control system to adjust the rotation speed of the mandrel (14) and the position of the rollers (16), controlling the movement of the sets (15), in order to achieve said wheel rim profile design.

[0027] The set of rollers (15a and 15b) move out from the initial position of their corresponding end of the central area (13), towards the end of the strip (12), each of them following in a non-Cartesian axis, and acting only on their corresponding side of the ring (11), from the central position to the end (17a and 17b).

[0028] This transport of material finishes at the end (17a and 17b) where the sets stop acting on the ring (11) which has the thickness in each section as needed to form the wheel rim.

[0029] The formation process of said wheel rim continues with the habitual cutting and deburring processes of surplus material, as well as the definition of definitive shapes of said wheel profile, and the installation of its disc.

[0030] The equipment (10), not shown in the drawings,

has a biconical mandrel (14), on which the ring (11) is fitted, and having two sets (15a and 15b) with two rollers (16) each, that move in opposite directions from an initial position, without needing auxiliary securing systems.

[0031] Having sufficiently described this invention using the drawings attached, it is easy to understand that any modification may be made to the detail which may be deemed to be appropriate, whenever these changes do not alter the essence of the invention summarised in the following claims.

Claims

1. "PROCEDURE FOR MANUFACTURING RING WHEEL RIMS" carrying out transport of material in the strip that forms it, from one point to another of the same strip, by the action of moving rollers and the turning of a mandrel **characterised in that** the procedure has at least the following stages:

- the ring, once formed with the strip of material, is biconically expanded by means of pressure,
- this biconical expansion adjusts the central part of the ring to the mandrel, and spreads the volume of material needed on each side.
- the ring is secured to the mandrel and on the central area of the ring are placed at least two sets of rollers with independent movement,
- the set of rollers begin in an initial position located at each end of the central part fitted to the mandrel,
- each of the sets of rollers moves on a single non-Cartesian axis, from the central position to the end of the mandrel carrying out the transport of the material of a single part of the ring,
- each of the rollers carries out the transport in opposite directions,
- when the sets reach the end of the mandrel and having left the profile of the ring completed, the surplus material is cut, and it is deburred for correct final finish.

2. "PROCEDURE FOR MANUFACTURING RING WHEEL RIMS" according to the claim 1, **characterised in that** the central part of the ring is defined by the area that has the same thickness before the processing as that required by the final design after processing.

3. "PROCEDURE FOR MANUFACTURING RING WHEEL RIMS" according to the claim 1, **characterised in that** the stages that correspond to transport of material, and therefore, with the rotating speed of the mandrel and the movement of the rollers in each of the sets, is carried out automatically by a control system that starts with the desired configuration of the profile.

4. **"PROCEDURE FOR MANUFACTURING RING WHEEL RIMS"** according to the claim 1, **characterised in that** in the securing of the ring to the mandrel, the sets of rollers and the size of the mandrel in its central area, act securing the ring to the mandrel, without needing auxiliary securing systems. 5

5. **"PROCEDURE FOR MANUFACTURING RING WHEEL RIMS"** according to the claim 1, **characterised in that** the thickness of the central area of the ring, from the ends of which start the sets of rollers, corresponds to the thickness of the final design of this area, therefore there is no pressure exerted on it. 10

6. **"EQUIPMENT FOR MANUFACTURING RING WHEEL RIMS"** using rollers that press on a ring that is attached to a mandrel, following the stages shown in claims 1 to 5 **characterised in that** the equipment has un biconical mandrel on which the ring to be processed is fitted, with at least two sets of rollers with independent movement, these sets being formed by at least two rollers, which have an initial position at the end of the central area of the ring that has been attached to the mandrel and a movement to the end of the mandrel, following the parameters of speed of rotation of the mandrel and of movement of the sets indicated by un control system. 15
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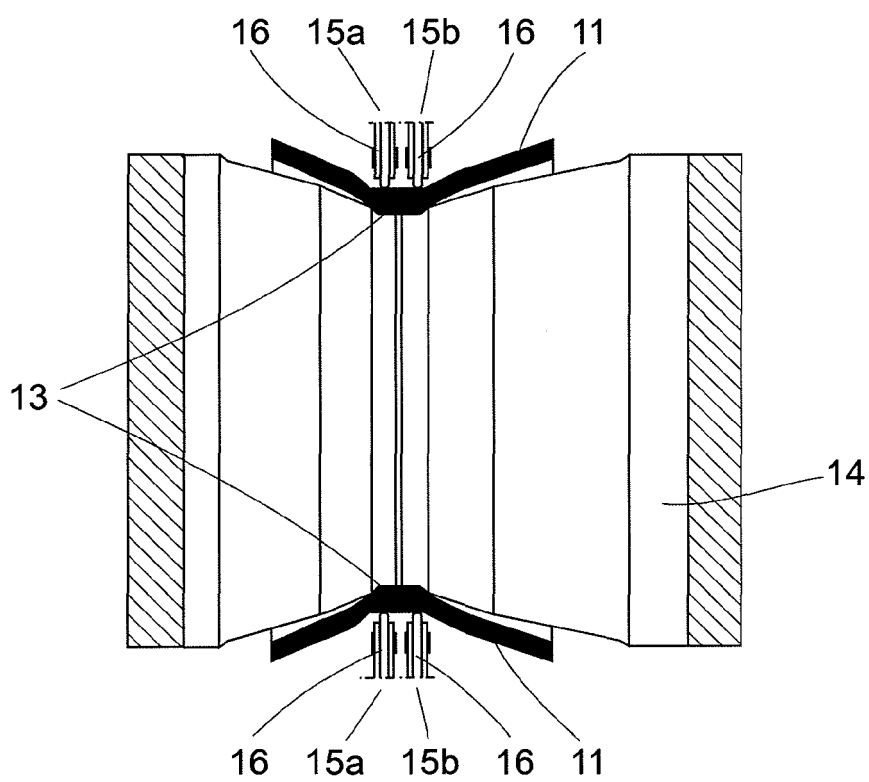
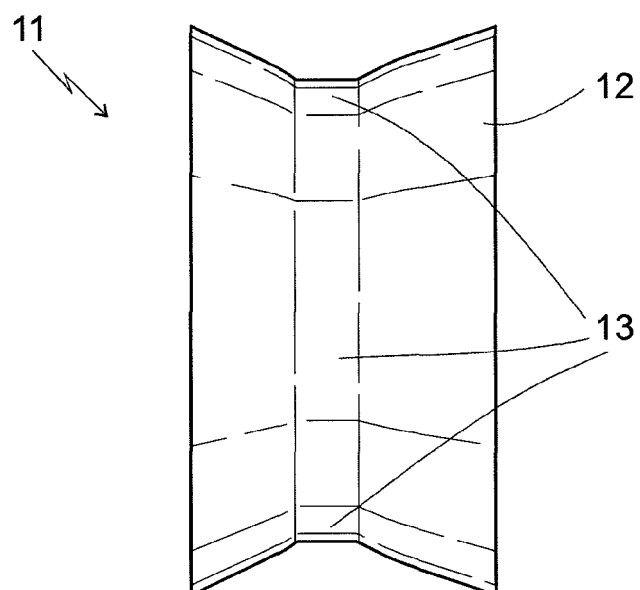
7. **"EQUIPMENT FOR MANUFACTURING RING WHEEL RIMS"** according to the claim 6, **characterised in that** the control system is formed by a numerical control system built into the equipment, regulating the position of the rollers by means of coordinates, as well as the rotation speed of the mandrel and the movement and speed of the rollers towards the ends. 30
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8. **"EQUIPMENT FOR MANUFACTURING RING WHEEL RIMS"** according to the claim 6, **characterised in that** the biconical mandrel is dimensioned in such a manner that the central part fits into the ring to be processed, needing no auxiliary means of attachment. 40

9. **"EQUIPMENT FOR MANUFACTURING RING WHEEL RIMS"** according to the claim 6, **characterised in that** the equipment comprises two sets with two rollers each. 45

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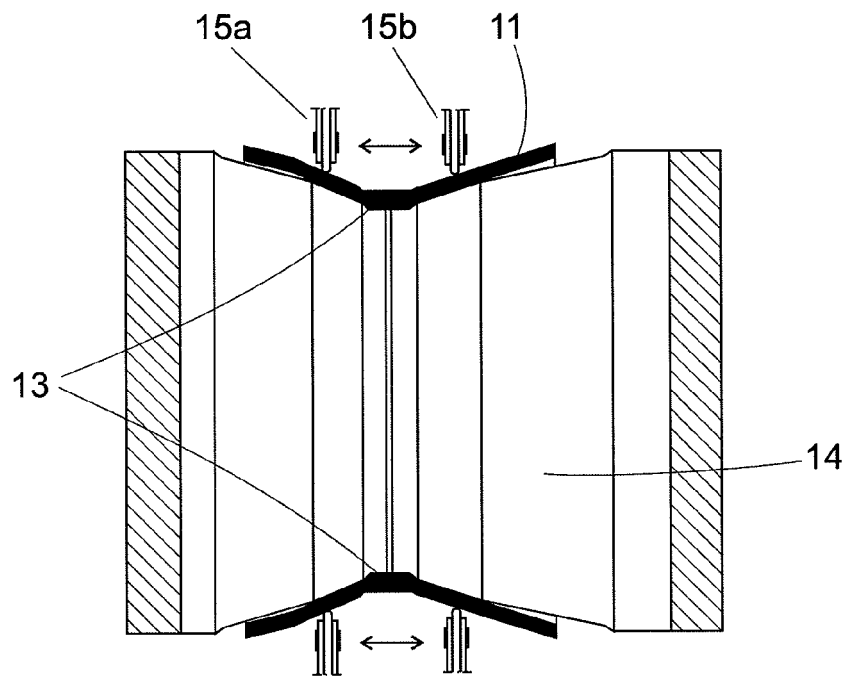


Fig. 3

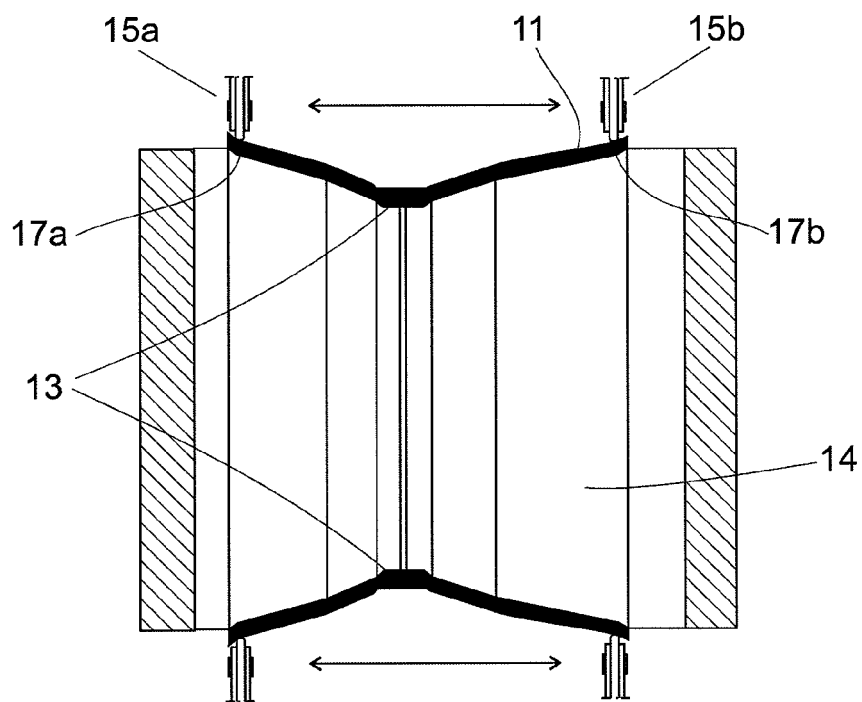


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 13 38 2273

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 October 2013	Examiner Cano Palmero, A
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 13 38 2273

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