(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 329 899 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
05.09.2012 Bulletin 2012/36

(51) Int Cl.:
B21K 1/28 *(2006.01)*

(21) Application number: **10015245.3**

(22) Date of filing: **02.12.2010**

(54) Method for producing light alloy vehicle wheel

Verfahren zur Herstellung eines Fahrzeugrads aus Leichtlegierung

Procédé de production de roue de véhicule en alliage léger

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **02.12.2009 JP 2009274388**

(43) Date of publication of application:
08.06.2011 Bulletin 2011/23

(73) Proprietor: **RAYS ENGINEERING CO., LTD.**
Osaka
547-0011 (JP)

(72) Inventor: **Inatani, Shujiro**
Osaka
547-0011 (DE)

(74) Representative: **Müller-Boré & Partner Patentanwälte**
Grafinger Straße 2
81671 München (DE)

(56) References cited:
GB-A- 235 065
US-A- 3 263 315
US-A- 3 672 021
US-A- 4 528 734

EP 2 329 899 B1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method for producing a light alloy vehicle wheel that has an excellent mechanical property even in a large diameter wheel.

Description of the Related Art

[0002] A forging method for forging and producing a casting material is well known as one of the methods for producing the light alloy vehicle wheels. In the producing method, in summary, as illustrated in FIG. 3, a round-bar billet is prepared by semi-continuous casting or the like using a mold having a circular mold outlet port (S11), and the round-bar billet is sliced in rounds to form a cylindrical casting material (S12) . Then, in a hot-forging process, the cylindrical casting material is heated (S13), the heated cylindrical casting material is pressed down from a circular surface side to forge the cylindrical casting material into a disc shape (S14), and the disc-shaped forging product is further forged to complete the forging product into a rough wheel shape having a rim portion and a disc portion (S15). Then the forging product having the rough wheel shape is subjected to spinning forming to shape the rim portion (S16), and a rim-integrated vehicle wheel is completed through a heat treatment process (S17) and a machining process (S18).

[0003] The reason the cylindrical casting material is used in the conventional producing method is that the forging process of the cylindrical casting material is simply formed into the cylindrical vehicle wheel. Conventionally, the cylindrical casting material cut from the round-bar billet is generally used in the method for producing the light alloy vehicle wheel by the forging process. Therefore, in order to deal with the current enlargement of the vehicle wheel, the round-bar billet having the large diameter is prepared during the casting, and the cylindrical casting material having the large diameter cut from the round-bar billet is used.

[0004] Generally strength of the light alloy vehicle wheel has a correlation with a crystal grain size of a metallic structure of the light alloy vehicle wheel, and the strength tends to be improved as the crystal grain size decreases. In the casting material, the crystal grain size of the metallic structure increases as a cooling rate slows down during the casting process. For the round-bar billet, because the cooling rate during the casting process depends on the diameter of the round-bar billet during the forging process, the cooling rate slows down as the diameter increases, and the crystal grain size of the metallic structure increases naturally. Therefore, when the diameter of the round-bar billet increases with increasing diameter of the vehicle wheel, the crystal grain size of the metallic structure of the casting material increases, and the crystal grain size of the metallic structure of the finishing wheel also increases, thereby degrading the strength or ductility of the light alloy vehicle wheel.

[0005] Therefore, in one of ideas for dealing with the production of the vehicle wheel having the large diameter, the relatively long, cylindrical casting material is cut from the round-bar billet having the small diameter in which the crystal grain size does not increase, the vehicle wheel having the large diameter is produced by adding an upset forging process in which the long, cylindrical casting material is upset-forged from the circular surface side to enlarge the diameter. However, even if the upset forging process is added, when the cylindrical casting material has a large material height, a cover uneven thickness is generated due to buckling and the like to hardly produce the good vehicle wheel.

SUMMARY OF THE INVENTION

[0006] In view of the foregoing, the present invention provides a method for producing a light alloy vehicle wheel having the small crystal grain size of the metallic structure and the excellent mechanical property even in the large diameter of the vehicle wheel.

[0007] According to the present invention, there is provided a method for producing a light alloy vehicle wheel in which a casting material is forged to produce a rim-integrated vehicle wheel, the method comprising:

a casting step of preparing a flat, square billet by continuous casting or semi-continuous casting using a mold whose mold outlet port is formed into a substantially rectangular shape;
a cutting step of cutting the flat, square billet at a right angle to a casting direction to flatly form a rectangular casting material in the casting direction;
a primary forging step of pressing down the rectangular casting material from a flat surface side of the rectangular casting material to forge the rectangular casting material into a disc shape; and
a secondary forging step of forging the disc-shaped forging product into a rough wheel shape having a disc portion and a rim portion.

[0008] With the above-described configuration, a cooling rate of the flat, square billet depends on a thickness (a short-side length in a rectangular section) of the flat, square billet during the casting . On the other hand, for the round-bar billet, the cooling rate depends on a diameter of the round-bar billet during the casting. Accordingly, for the flat, square billet, the cooling rate can considerably be enhanced during the casting compared with the round-bar billet having the diameter corresponding to a long-side length in the rectangular section. Therefore, a crystal grain size of the metallic structure of the flat, square billet formed during the casting can considerably be reduced compared with the round-bar billet having the diameter corresponding to the long-side length in the rectangular section.

[0009] The flat, square billet is cut into a quadrangular shape perpendicular to a casting direction, thereby obtaining a rectangular casting material that is flat in the casting direction. When the casting material is cut into the flat, rectangular shape, a flat, quadrangular surface orthogonal to the casting direction is formed in the obtained flat, rectangular casting material, and the quadrangular surface can constitute a broad surface suitable for reduction in the next forging process.

[0010] Accordingly, in the forging process, the rectangular casting material is pressed down from the quadrangular surface side (the broad surface side orthogonal to the casting direction) to forge the rectangular casting material into the disc shape, which allows the disc-shaped forging product in which the volume is distributed from the rectangular shape into the disc shape to be obtained without increasing the number of forging times and without generating troubles such as the uneven thickness. The disc-shaped forging product is further forged to form the forging product into the rough wheel shape having the disc portion and the rim portion. Therefore, the light alloy vehicle wheel having the small crystal grain size is obtained because the casting material has the small crystal grain size even if the diameter of the vehicle wheel increases.

[0011] Accordingly, the light alloy vehicle wheel having the small crystal grain size of the metallic structure and the excellent mechanical property can be produced even if the diameter of the vehicle wheel increases.

[0012] Preferably, a ratio of a short side and a long side of the mold outlet port is 1:1.5 or more and a short-side length is 200 mm or less in the mold, and the flat, square billet is prepared using the mold.

[0013] As the flat, square billet is thickened, possibly the cooling rate is hardly enhanced to decrease the crystal grain size during the casting. On the other hand, when the flat, square billet is prepared using the mold, in which the ratio of the short side and the long side of the mold outlet port is 1:1.5 or more and the short-side length is 200 mm or less, in the obtained flat, square billet (the ratio of the short side and the long side is 1:1.5 or more and the short-side length is 200 mm or less in the rectangular section), the cooling rate is sufficiently enhanced during the casting to successfully finely decrease the crystal grain size of the metallic structure compared with the round-bar billet having the diameter corresponding to the long-side length in the rectangular section.

[0014] Preferably, a step of scraping a chill layer by machining, the chill layer being formed in a casting surface corresponding to a wheel design surface in the flat rectangular casting material.

[0015] The cooling rate of the flat, square billet is enhanced during the casting, whereby the chill layer is easily formed in the billet surface by an influence of the cooling. The chill layer possibly degrades strength of the vehicle wheel. The flat, quadrangular surface in the flat, rectangular casting material cut from the flat, square billet is the casting surface, and one of the flat, quadrangular surfaces opposite to each other constitutes the wheel design surface. Accordingly, the chill layer formed in the casting surface corresponding to the wheel design surface in the flat, rectangular casting material is scraped by the machining, which allows a decrease in strength caused by the chill layer to be prevented in the wheel.

[0016] Preferably, the mold is formed by a semi-fire-resistant mold to suppress formation of a segregation layer in a surface of the flat, square billet, and therefore surface scraping is eliminated in the casting surface of the flat, rectangular casting material.

[0017] Therefore, a segregation layer can be suppressed in a surface of the billet to eliminate surface scraping of the casting surface. Accordingly, the high-yield, cost-reduction wheel can be provided because a material loss caused by the surface scraping is eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a producing process diagram illustrating a method for producing a light alloy vehicle wheel according to an embodiment of the present invention;

FIG. 2 is a sectional view illustrating a mold used to prepare a flat, square billet; and

FIG. 3 is a producing process diagram illustrating a conventional method for producing a light alloy vehicle wheel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] A method for producing a light alloy vehicle wheel according to an embodiment of the present invention is a method for hot-forging the casting material to produce the rim-integrated vehicle wheel. Instead of the conventional round-bar billet, the flat, square billet is used as the casting material before the forging. For example, aluminum alloys such as A6061, magnesium alloys, and titanium alloys are used as the light alloy material.

[0020] The method for producing a light alloy vehicle wheel of the embodiment will be described below.

[0021] As illustrated in FIG. 1, in step S1, the flat, square billet is prepared by continuous casting or semi-continuous casting using a mold whose mold outlet port is formed into a substantially rectangular shape. For example, a DC casting process can be used as the casting process. A casting apparatus used in the DC casting includes a shallow mold 1, a vessel 2, and a water spray 3. The vessel 2 is made of an adiabatic fire-resistant material, and the mold 1 is disposed in a lower portion of the vessel 2. The water spray 3 is disposed in a mold outlet port 11 to cool an ingot (see the figure beside step S1 in FIG. 1). Referring to FIG. 2, the mold 1 includes a vertically-penetrating opening 10, the opening 10 is formed into a substantially rectangular shape, and the mold outlet port 11 in the lower portion is also formed into a substantially rectangular shape.

[0022] In the casting, light alloy molten metal is poured into the vessel 2 made of the adiabatic fire-resistant material from a holding furnace through a tub made of a fire-resistant material. When the molten metal reaches the mold 1, the molten metal is primary-cooled by thermal conduction to a mold wall to form the ingot. The ingot is shaped into the flat, square shape by a mold shape, and the ingot is discharged through the mold outlet port 11 in the lower portion of the mold by its own weight. Then the ingot discharged from the mold outlet port 11 of the mold 1 is secondary-cooled (directly water-cooled) by watering of the water spray 3. The whole ingot is solidified by the secondary cooling, thereby obtaining the flat, square billet having a predetermined length.

[0023] The flat, square billet is cast using the mold 1 whose mold outlet port 11 is formed into the substantially rectangular shape. Therefore, a cooling rate of the flat, square billet depends on a thickness (a short-side length in a rectangular section) of the flat, square billet during the casting . On the other hand, for the round-bar billet, the cooling rate depends on a diameter of the round-bar billet during the casting . Accordingly, for the flat, square billet, the cooling rate can considerably be enhanced during the casting compared with the round-bar billet having the diameter corresponding to a long-side length in the rectangular section. Therefore, a crystal grain size of the metallic structure of the flat, square billet formed during the casting can considerably be reduced compared with the round-bar billet having the diameter corresponding to the long-side length in the rectangular section.

[0024] At this point, in the mold 1, preferably a ratio of the short side and the long side of the mold outlet port 11 is 1: 1.5 or more and the short-side length is 200 mm or less. As the flat, square billet is thickened, possibly the cooling rate is hardly enhanced to decrease the crystal grain size during the casting. On the other hand, when the flat, square billet is prepared using the mold 1, in which the ratio of the short side and the long side of the mold outlet port 11 is 1:1.5 or more and the short-side length is 200 mm or less, in the obtained flat, square billet (the ratio of the short side and the long side is 1:1.5 or more and the short-side length is 200 mm or less in the rectangular section), the cooling rate is sufficiently enhanced during the casting to successfully finely decrease the crystal grain size of the metallic structure compared with the round-bar billet having the diameter corresponding to the long-side length in the rectangular section. In the mold 1, when the ratio of the short side and the long side of the mold outlet port 11 is 1:2 or more, and when the short-side length is 150 mm or less, the crystal grain size of the metallic structure of the flat, square billet can more successfully and securely finely be decreased.

[0025] Preferably a semi-fire-resistant mold made of graphite or the like is used as the mold 1. Therefore, a segregation layer can be suppressed in a surface of the billet to eliminate surface scraping of the casting surface. Accordingly, the high-yield, cost-reduction wheel can be provided because a material loss caused by the surface scraping is eliminated.

[0026] In step S2, the flat, square billet is cut into a quadrangular shape perpendicular to a casting direction, thereby obtaining a rectangular casting material that is flat in the casting direction. When the casting material is cut into the flat, rectangular shape, a flat, quadrangular surface orthogonal to the casting direction is formed in the obtained flat, rectangular casting material, and the quadrangular surface can constitute a broad surface suitable for reduction in the next forging process.

[0027] Then a chill layer in a casting surface corresponding to a wheel design surface in the flat, rectangular casting material may be scraped by machining. The cooling rate of the flat, square billet is enhanced during the casting, whereby the chill layer is easily formed in the billet surface by an influence of the cooling. The chill layer possibly degrades strength of the vehicle wheel. The flat, quadrangular surface in the flat, rectangular casting material cut from the flat, square billet is the casting surface, and one of the flat, quadrangular surfaces opposite to each other constitutes the wheel design surface. Accordingly, the chill layer formed in the casting surface corresponding to the wheel design surface in the flat, rectangular casting material is scraped by the machining, which allows a decrease in strength caused by the chill layer to be prevented in the wheel. As described above, the semi-fire-resistant mold made of graphite or the like is used as the mold 1, and the surface scraping of the casting surface can be eliminated when the formation of the segregation layer is suppressed in the surface of the flat, square billet.

[0028] Then the rectangular casting material is subjected to the hot-forging. In the forging process, in step S3, the flat, rectangular casting material is heated to 450°C to 550°C in a heating furnace. In step S4, the heated rectangular casting material is set in a primary forging die (die temperature of 150°C to 350°C), and primary forging is performed to form the casting material into a disc shape. Specifically, the rectangular casting material is flatly placed in the center of the primary forging die having a disc-shaped cavity, the rectangular casting material is pressed down in a thickness direction from the flat, quadrangular surface side of the rectangular casting material, each side of a periphery of the rectangular casting material is pushed out to form the casting material into the disc shape. The primary forging process is similar to the conventional process of pressing down the cylindrical casting material in the thickness direction to form the casting material into the disc shape, the primary forging process can be performed using the primary forging die similarly to that of the conventional technique. Accordingly, a disc-shaped primary forging product in which a volume is distributed from the rectangular shape into the disc shape can be obtained without increasing the number of forging times and without generating an uneven thickness.

[0029] In step S5, the disc-shaped primary forging product is set in a secondary forging die (die temperature of 150°C to 350°C), and secondary forging is performed to form the primary forging product into a wheel shape having a rim portion and a disc portion. Specifically, the forging is preferably performed in two stages, that is, coarse forging and finishing forging. In the coarse forging, the primary forging product is set in a coarse forging die to roughly distribute the volume of the primary forging product into the rim portion and the disc portion. In the finishing forging, the coarse forging product is set in a finishing forging die to mainly form the shape of the disc portion. When the disc portion is formed into an irregular shape while the volume is distributed into the rim portion and the disc portion, possibly a strain is locally generated depending on the wheel design. The reason the forging is preferably performed in the two stages of the coarse forging and the finishing forging is that the generation of strain is prevented. However, for the relatively simple wheel design in which the local strain is hardly generated, the disc-shaped primary forging product may be set in the finishing forging die to shape the rim portion and the disc portion by one-time forging. The grain size of the metallic structure can more finely be formed in the casting material through the forging process.

[0030] In step S6, the wheel of the forging product is subjected to spinning forming to obtain the shape of the rim portion. Specifically, while the wheel-shaped forging product is rotated, a pressure roller is pressed against the rim portion to shape the rim portion. The spinning forming may be performed in either a hot temperature or a cool temperature (room temperature) . In step S7, the post-spinning wheel is subjected to a heat treatment (T6 heat treatment). Specifically, the post-spinning wheel is subjected to a solution heat treatment while heated at a temperature of 500°C to 550°C for 3 to 180 minutes, and then the wheel is subjected to an aging heat treatment while retained at a temperature of 170°C to 220°C for 30 minutes to 6 hours. Therefore, the metallic structure becomes stable to enhance the strength. In step S8, the post-heat-treatment wheel is subjected to a machining process such as chamfering, thereby completing the rim-integrated vehicle wheel.

[0031] As described above, according to the method for producing the light alloy vehicle wheel of the embodiment, the flat, square billet in which the crystal grain size of the metallic structure can be formed smaller than that of the round-bar billet is prepared, and the flat, rectangular casting material is cut from the flat, square billet to obtain the shape suitable to the hot-forging. In the hot-forging process, the flat, rectangular casting material is pressed down from the flat surface side to perform the forging, which allows the casting material to be formed into the vehicle wheel shape without increasing the number of forging times and without generating troubles such as the uneven thickness. Accordingly, the light alloy vehicle wheel having the small crystal grain size of the metallic structure and the excellent mechanical property can be produced even if the diameter of the vehicle wheel increases.

(Example 1)

[0032] An aluminum forging wheel having a rim diameter of 17 inches was produced in Example 1.

[0033] An aluminum alloy (A6061) flat, square billet having a rectangular section of 80 mm by 300 mm was prepared using semi-continuous casting facilities including a mold whose mold outlet port is formed into the substantially rectangular shape. When the crystal grain of the flat, square billet was measured, it was confirmed that an average crystal grain size was 95 μm. Then the flat, square billet was cut in a longitudinal direction (casting direction) with a length of 290 mm, the cut surface was burred, and the design surface was subjected to cutting work with a cutting margin of 1 mm, thereby obtaining the flat, rectangular casting material having the length of 290 mm, the width (wide) of 300 mm, the thickness (long) of 79 mm, and a weight of about 18 kg.

[0034] Then, in the hot-forging process, the flat, rectangular casting material was put in the heating furnace and heated to about 500°C, the primary forging was performed to obtain the disc-shaped primary forging product such that the substantially square surface (the side of the surface orthogonal to the casting direction) of the flat, rectangular casting material was pressed down at a die temperature of 300°C. Then the disc-shaped primary forging product was subjected to the coarse forging and the finishing forging at the die temperature of 300°C, thereby obtaining the forging product in which the rim portion and the disc portion are shaped.

[0035] Then, the forging product was subjected to the spinning forming. Then, after the forging product was sequentially subjected to the solution heat treatment at a temperature of 540°C for 5 minutes, water quenching at a substantial temperature of 60°C or less, the aging heat treatment at a temperature of 180°C for 5 hours, the aluminum alloy vehicle wheel was obtained through the machining.

(Example 2)

[0036] An aluminum forging wheel having a rim diameter of 20 inches was produced in Example 2.
[0037] In Example 2, the flat, square billet (the average crystal grain size was 100 μm) of 150 mm by 300 mm was prepared, the flat, square billet was cut in the longitudinal direction (casting direction) with the length of 290 mm, the cut surface was burred, and the design surface was subjected to the cutting work with the cutting margin of 1 mm, thereby obtaining the flat, rectangular casting material having the length of 290 mm, the width (wide) of 300 mm, the thickness (long) of 149 mm, and the weight of about 35 kg. Other processes were similar to those of Example 1, and the aluminum alloy vehicle wheel was obtained.

(Comparative Example)

[0038] An aluminum forging wheel having a rim diameter of 17 inches was produced in Comparative Example.
[0039] An aluminum alloy (A6061) round-bar billet having the circular section of the diameter of 300 mm was prepared using semi-continuous casting facilities including a mold whose mold outlet port is formed into the circular shape. When the crystal grain of the round-bar billet was measured, it was confirmed that the average crystal grain size was 230 μm. Then the round-bar billet was cut in the longitudinal direction (casting direction) with the length of 94 mm, the cut surface was burred, and the design surface was subjected to the cutting work with the cutting margin of 1 mm, thereby obtaining the flat, circular casting material having the diameter of 300 mm, the thickness of 93 mm, and the weight of about 18 kg.
[0040] The aluminum alloy vehicle wheel was obtained through the processes that were similar to those of Example 1 except that in the hot-forging process, the flat, circular casting material was subjected to the primary forging such that the circular surface (the side of the surface in the casting direction) of the flat, circular casting material was pressed down.
[0041] Spoke portions of the aluminum alloy vehicle wheel obtained in Examples 1 and 2 and Comparative Example were cut to perform structure observation and measurement of a mechanical property. TABLE 1 illustrates the results.

Table 1

		Example 1 (17 inches)	Example 2 (20 inches)	Comparative Example (17 inches)
billet	type	Flat-square	Flat-square	Round-bar
	size(mm)	80×300	150×300	Φ300
	average crystal grain size	95μm	100μm	230μm
average crystal grain size		50μm	60μm	120μm
tensile strength		380Nmm	380Nmm	350Nmm
elongation		14%	14%	10%

[0042] Referring to TABLE 1, for the crystal grain of the casting material, the flat, square billets of Examples 1 and 2 had the average crystal grain sizes of 95 μm and 100 μm, respectively. On the other hand, the round-bar billet of Comparative Example has the average crystal grain size of 230 μm. Accordingly, in the flat, square billets of Examples 1 and 2, the crystal grain was able to be considerably formed smaller than that of the round-bar billet of Comparative Example having the diameter corresponding to the long-side length of the rectangular section. In the round-bar billet of Comparative Example, the cooling rate during the casting depends on the diameter of the round-bar billet. On the other hand, in the flat, square billets of Examples 1 and 2, the cooling rate during the casting depends on the thicknesses ("80 mm" in Example 1 and 150 mm" in Example 2) of the flat, square billets. Therefore, in the flat, square billets of Examples

1 and 2, the cooling rate can considerably be enhanced during the casting compared with the round-bar billet of Comparative Example having the diameter (300 mmΦ) corresponding to the long-side length ("300 mm" in Examples 1 and 2) of the rectangular section.

[0043] The recrystallization was generated by performing the hot-forging to the casting material to obtain the metallic structure having finer crystal grain. However, in Comparative Example, because the crystal grain size of the casting material was as large as 230 μm, the crystal grain size of the vehicle wheel was reduced only up to 120 μm. On the other hand, in Example 1, because the crystal grain size of the casting material was as small as 95 μm, the crystal grain size of the vehicle wheel was reduced up to 50 μm. Similarly, in Example 2, the crystal grain size was reduced from 100 μm to 60 μm. Therefore, it was found that Examples 1 and 2 in which the casting material had the small crystal grain was favorable to the metallic structure having the finer crystal grain through the hot-forging.

[0044] From the crystal grain and mechanical property of the aluminum alloy vehicle wheel, it was found that Examples 1 and 2 having the small crystal grain size were excellent in the tensile strength and elongation compared with Comparative Example having the large crystal grain size.

[0045] In Example 2, it was found that the crystal grain became larger in the billet and the vehicle wheel because Example 2 was larger than Example 1 in the thickness of the flat, square billet ("80 mm" in Example 1 and "150 mm" in Example 2).

[0046] According to Examples 1 and 2, it was found that the vehicle wheel having the high strength, high ductility, and excellent mechanical property was obtained because the crystal grain size of the metallic structure can be formed smaller than that of Comparative Example. Even in producing the aluminum alloy vehicle wheel having the same large diameter (17 inches) size, according to Example 1, the vehicle wheel having the excellent mechanical property was obtained compared with Comparative Example.

Claims

1. A method for producing a light alloy vehicle wheel in which a casting material is forged to produce a rim-integrated vehicle wheel, the method comprising:

   a casting step (S1) of preparing a flat, square billet by continuous casting or semi-continuous casting using a mold (1) whose mold outlet port is formed into a substantially rectangular shape;
   a cutting step (S2) of cutting the flat, square billet at a right angle to a casting direction to flatly form a rectangular casting material in the casting direction;
   a primary forging step (S4) of pressing down the rectangular casting material from a flat surface side of the rectangular casting material to forge the rectangular casting material into a disc shape; and
   a secondary forging step (S5) of forging the disc-shaped forging product into a rough wheel shape having a disc portion and a rim portion.

2. The method for producing the light alloy vehicle wheel according to claim 1, wherein
   a ratio of a short side and a long side of the mold (1) outlet port is 1:1.5 or more and a short-side length is 200 mm or less in the mold (1) and the flat, square billet is prepared using the mold.

3. The method for producing the light alloy vehicle wheel according to claim 1 or 2, comprising
   a step of scraping a chill layer by machining, the chill layer being formed in a casting surface corresponding to a wheel design surface in the flat rectangular casting material.

4. The method for producing the light alloy vehicle wheel according to any one of the preceding claims, wherein
   the mold (1) is formed by a semi-fire-resistant (2) mold to suppress formation of a segregation layer in a surface of the flat, square billet, and therefore surface scraping is eliminated in the casting surface of the flat, rectangular casting material.

Patentansprüche

1. Verfahren zur Herstellung eines Fahrzeugrads aus Leichtlegierung, wobei ein Gussmaterial geschmiedet wird, um ein Fahrzeugrad mit integrierter Felge herzustellen, wobei das Verfahren umfasst:

   einen Gießschritt (S1) zur Herstellung eines flachen, quadratischen Barrens durch kontinuierliches Gießen oder halbkontinuierliches Gießen unter Verwendung einer Form (1), deren Formauslasslöffnung zu einer im We-

sentlichen rechteckigen Form ausgebildet ist;
einen Schneidschritt (S2) zum Schneiden des flachen quadratischen Barrens in einem rechten Winkel zu einer Gussrichtung, um ein rechteckiges Gussmaterial in der Gussrichtung flach auszubilden;
einen primären Schmiedeschritt (S4) des Herunterpressens des rechteckgien Gussmaterials von einer flachen Oberflächenseite des rechteckigen Gussmaterials, um das rechteckige Gussmaterial zu einer Scheibenform zu schmieden; und
einen sekundären Schmiedeschritt (S5) des Schmiedens des scheibenförmigen Schmiedeprodukts in eine Rohradform mit einem Scheibenabschnitt und einem Felgenabschnitt.

2. Verfahren zur Herstellung eines Fahrzeugrads aus Leichtlegierung nach Anspruch 1, wobei
ein Verhältnis einer kurzen Seite und einer langen Seite der Auslassöffnung der Form (1) 1:1,5 oder mehr ist und eine Länge der kurzen Seite in der der Form (1) 200 mm oder weniger ist und der flache quadratische Barren unter Verwendung der Form hergestellt wird.

3. Verfahren zur Herstellung eines Fahrzeugrads aus Leichtlegierung nach Anspruch 1 oder 2, das umfasst:

einen Schritt des Abschabens einer Schreckschicht durch maschinelle Bearbeitung, wobei die Schreckschicht in einer Gussoberfläche ausgebildet wird, die einer Radgestaltungsoberfläche in dem flachen rechteckigen Gussmaterial entspricht.

4. Verfahren zur Herstellung eines Fahrzeugrads aus Leichtlegierung nach einem der vorhergehenden Ansprüche, wobei
die Form (1) aus einer halbfeuerfesten Form (2) ausgebildet ist, um die Bildung einer Entmischungs- bzw. Trennungsschicht in einer Oberfläche des flachen quadratischen Barrens zu unterdrücken, und daher das Oberflächenabschaben in der Gussoberfläche des flachen rechteckigen Gussmaterials beseitigt wird.

Revendications

1. Procédé de fabrication de roue de véhicule en alliage léger, dans lequel un matériau de coulée est forgé pour produire une roue de véhicule intégrée à la jante, le procédé comprenant :

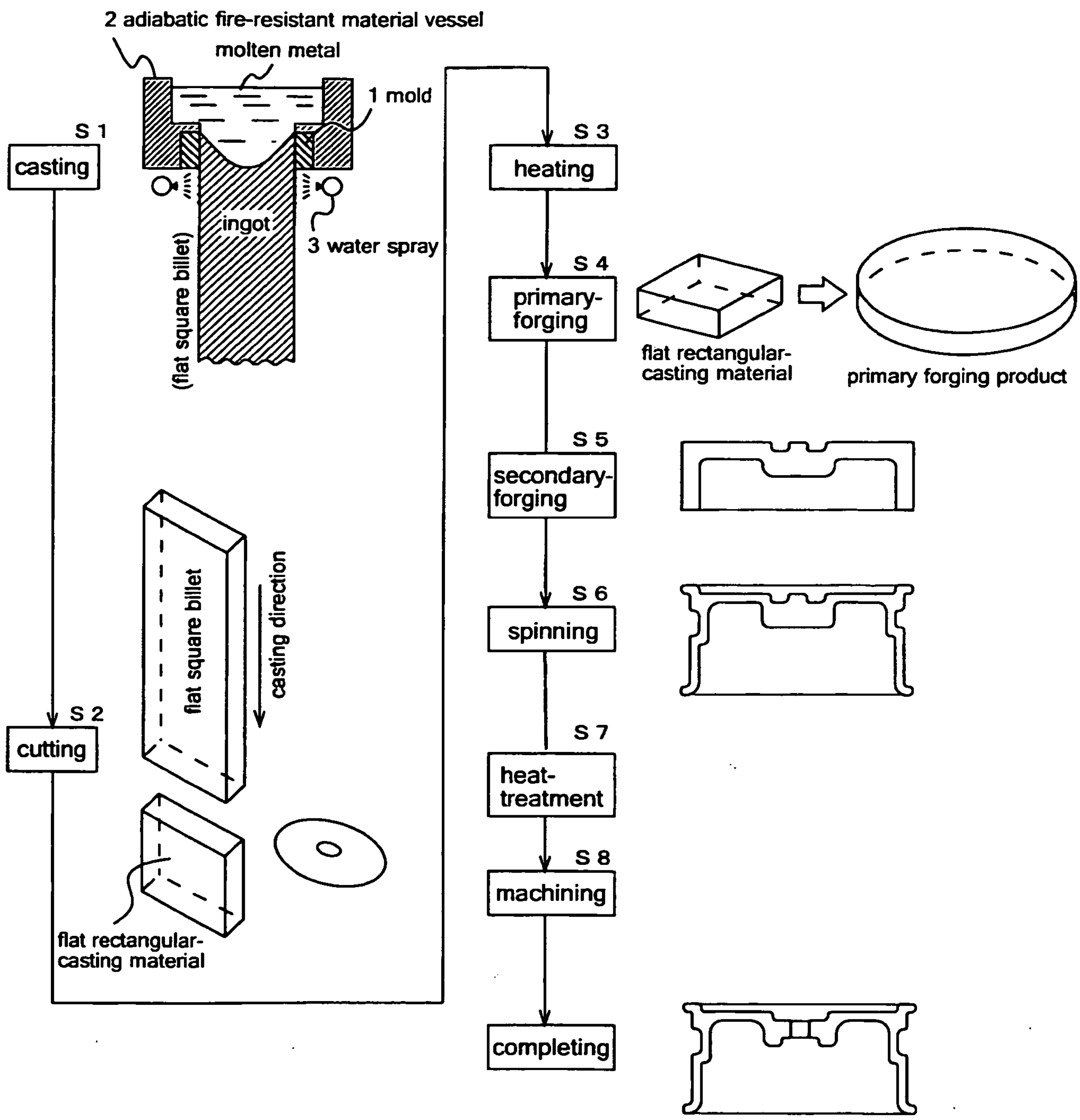
une étape de coulée (S1) consistant à préparer une billette carrée plate par coulée continue ou coulée semi-continue à l'aide d'un moule (1) dont l'orifice de sortie de moule est formé de façon essentiellement rectangulaire ;
une étape de découpage (S2) consistant à découper la billette carrée plate à angle droit par rapport à une direction de coulée pour former à plat un matériau de coulée rectangulaire dans la direction de coulée ;
une étape de forgeage primaire (S4) consistant à presser vers le bas le matériau de coulée rectangulaire à partir d'un côté à surface plate du matériau de coulée rectangulaire pour forger le matériau de coulée rectangulaire en forme de disque ; et
une étape de forgeage secondaire (S5) consistant à forger le produit de forgeage en forme de disque en lui donnant une forme de roue grossière ayant une portion de disque et une portion de jante.

2. Procédé de fabrication de la roue de véhicule en alliage léger selon la revendication 1, dans lequel
un rapport d'un côté court et d'un côté long de l'orifice de sortie de moule (1) est égal ou supérieur à 1 : 1,5, et une longueur de côté court est égale ou inférieure à 200 mm dans le moule (1), et la billette carrée plate est préparée à l'aide du moule.

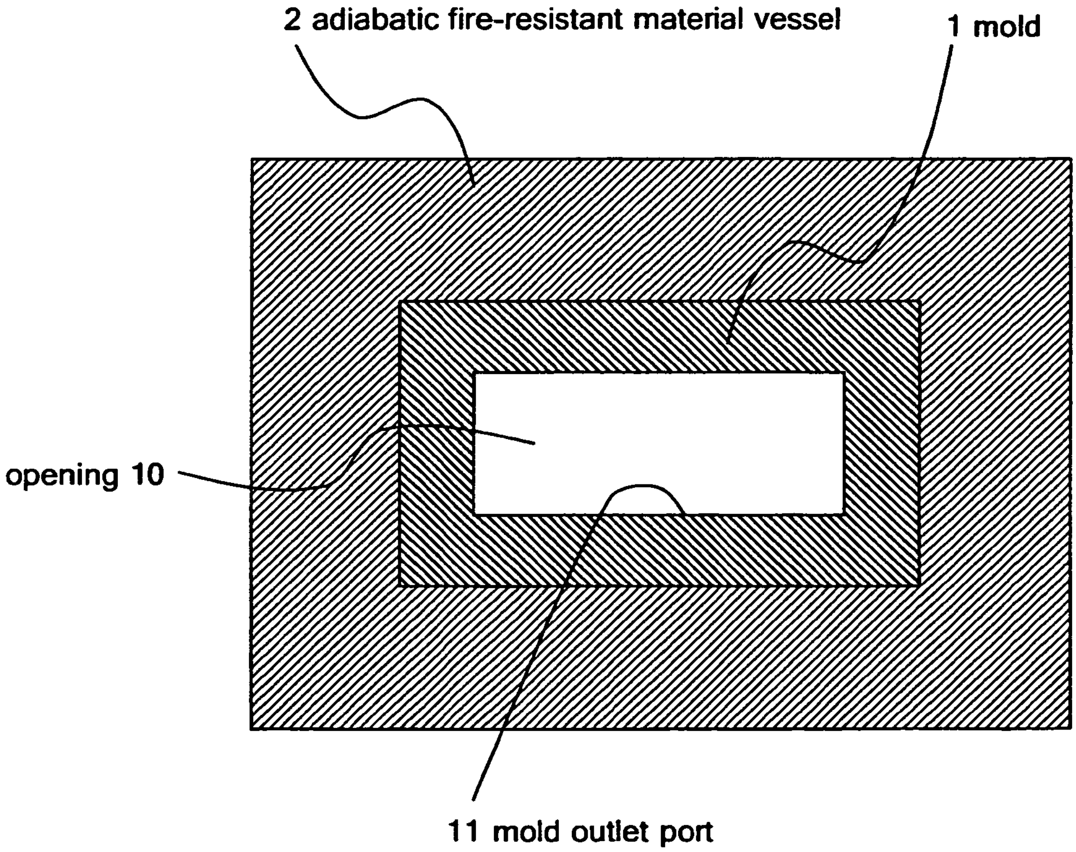
3. Procédé de fabrication de roue de véhicule en alliage léger selon la revendication 1 ou 2, comprenant
une étape consistant à racler une couche de coquille par usinage, la couche de coquille étant formée dans une surface de coulée correspondant à une surface en forme de roue dans le matériau de coulée rectangulaire plat.

4. Procédé de fabrication de la roue de véhicule en alliage léger selon l'une quelconque des revendications précédentes, dans lequel
le moule (1) est formé par un moule (2) semi-résistant au feu pour empêcher la formation d'une couche de ségrégation dans une surface de la billette carrée plate, et par conséquent le raclage de la surface est éliminé dans la surface de coulée du matériau de coulée rectangulaire plat.

FIG. 1


2 adiabatic fire-resistant material vessel
molten metal
1 mold
S 1
casting
ingot
3 water spray
(flat square billet)
S 3
heating
S 4
primary-forging
flat rectangular-casting material
primary forging product
S 5
secondary-forging
flat square billet
casting direction
S 6
spinning
S 2
cutting
S 7
heat-treatment
S 8
machining
flat rectangular-casting material
completing

F I G. 2


2 adiabatic fire-resistant material vessel
1 mold
opening 10
11 mold outlet port

F I G. 3 (PRIOR ART)