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(54) **METHOD AND SYSTEM FOR PRODUCING ALLOY WHEELS FOR MOTOR VEHICLES**

LEGIERUNGSRÄDER FÜR KRAFTFAHRZEUGE HERSTELLENDES VERFAHREN UND SYSTEM DAFÜR

PROCEDE ET SYSTEME DE FABRICATION DE ROUES EN ALLIAGE POUR DES VEHICULES A MOTEUR

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(56) References cited:
EP-A- 0 607 757
DE-A1- 2 455 279
US-A- 3 951 563
US-A- 4 279 287
US-A1- 2002 066 316

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Description

TECHNICAL FIELD

[0001] The present invention concerns a method for producing alloy-wheels. Such a method according to the preamble of claim 1 is known from EP 0 607 757 A.

BACKGROUND ART

[0002] Alloy wheels are being increasingly used in the automobile industry to equip both cars and small and medium-sized commercial vehicles and they are particularly appreciated because, besides giving the motor vehicle a particularly attractive appearance, they present mechanical characteristics, such as light weight and rigidity, that are decidedly better with respect to wheels made in the traditional way.

[0003] An alloy wheel presents an axle and comprises a hub, a rim, which are situated concentrically around the axle and an intermediate portion, which has the function of connecting the hub to the rim and is made in a very high number of models to give each wheel a distinctive character. Generally, the aforementioned models of the intermediate portion can be classified in a first family, according to which the hub and the rim are connected by a plurality of spokes, and in a second family, according to which the hub and the rim are connected by a perforated plate. Moreover, alloy wheels are made both in a single piece, that is the hub, the rim and the intermediate portion are formed of a single piece obtained by casting or by forging, and in a number of ·pieces, generally two, that is the hub, a part of the rim and the intermediate portion are made in a first piece obtained by casting or forging, while a further part of the rim is made separately, also by casting or foraging, in a second piece, which is later assembled with the first piece. The alloy wheel formed of several pieces is usually defined as being of compound type.

[0004] In both cases, the realisation of an alloy wheel contemplates a procedure of casting an alloy of aluminium or magnesium to make an untreated wheel or the pieces that make up the wheel, a heat treatment and a first and a second machining with a turning lathe. As an alternative to casting, the wheel is forged and, afterwards, subjected to heat treatment. The machining operations have the function of realising finished surfaces with high degrees of tolerance along the rim to guarantee a perfect coupling with the tyre and at the hub in the coupling area with the end part of an axle or of a semi-axle of a motor vehicle. The machining also has the function of eliminating burrs and of correcting any imprecisions derived from the previous operations. In other words, the untreated wheel presents eccentric masses which must be removed in such a way that the finished wheel, in use, is as balanced as possible in rotation around its own axis so as not to transmit vibrations to the motor vehicle. Whereas said result was once accepted as satisfactory by the automobile industry, car manufacturers are now beginning to demand decidedly higher levels of balancing in alloy wheels since car manufacturers are, on the one hand, obliged to reduce the lead weights used for balancing wheels for environmental reasons and, on the other hand, to offer ever higher levels of comfort.

[0005] According to a method for producing alloy wheels for motor vehicles disclosed in patent application EP 60,7,757, the alloy wheels are realised and finished with a cutting machine tool. In particular, the above identified method comprises the steps of measuring the unbalance of said wheels, checking whether said unbalance is lower than an unbalance, acceptability value by means of a control unit; calculating a mass to be removed and the respective phase with respect to a determined point on the wheel; said unbalance being identified by said mass and by said phase. The identified mass is removed by the cutting machine tool by offsetting the centre axis of the wheel.

[0006] Even though, the above method is a step forward in balancing the alloy wheel and allows reducing the lead applied to the outer side rim, it cannot solve completely the problem set forth above. In fact, EP 607,757 the dynamic unbalance is poorly compensate by machining the wheel by offsetting the axis of the wheel.

[0007] From DE 24,55,279 it is known a method for balancing the wheel with a mounted tyre by deforming the rim of the wheel. This technique is applicable solely to wheel made of malleable material such as deep drawn metal sheet.

DISCLOSURE OF INVENTION

[0008] The aim of the present invention is to provide a method for producing alloy wheels which is able to achieve balancing levels decidedly superior to those that can be obtained with the known methods without substantially increasing the production costs.

[0009] According to the present invention a method is supplied for producing alloy wheels according to claim 1.

[0010] The present invention concerns a system for producing alloy wheels for motor vehicles.

[0011] According to the present invention a system is realised for producing alloy wheels for motor vehicles according to claim 10.

BRIEF DESCIPTION OF THE DRAWINGS

[0012] For a better understanding of the present invention, a preferred embodiment will now be described, purely as an example without limitation, with reference to the enclosed figures, in which:

- figure 1 is a front elevation view on a reduced scale of a light alloy wheel;
- figure 2 is a view of a section of the wheel in figure 1 along the section lines II-II;

- figure 3 is a view on an enlarged scale of a detail of the wheel in figure 2;
- figure 4 is a schematic view of a geometric representation of the mass to be removed from the wheel in figure 1;
- figure 5 is a view of a block diagram which sums up the phases of the method to which the present invention refers;
- figure 6 is a schematic view of a side elevation of a cutting machine tool for machining the wheel in figure 1, realised according to the present invention;
- figure 7 is a view on an enlarged scale of a detail of the machine in figure 6 according to a variation of the present invention; and
- figure 8 is a variation of the block diagram in figure 5.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] With reference to figures 1 and 2, the reference 1 indicates overall a substantially finished wheel, that is obtained by means of known processes of casting a metal alloy or of forging, subsequently subjected to heat treatment and machining. The wheel 1 comprises an axle 2 around which extend a hub 3 with a central hole 4, a rim 5 suited to house a tyre, not illustrated in the enclosed figures, and an intermediate portion 6 which in the illustrated example is defined by seven spokes 7, which are uniformly distributed around the axle 2 and connect the hub 3 to the rim 5. In the example illustrated in the enclosed figures reference is made to a wheel 1 made all in one piece with an intermediate portion 6 defined by seven spokes 7; of course the present invention extends to any type of wheel, in one piece or compound, and to any type of intermediate portion.

[0014] As better illustrated in figure 3, the rim 5 presents a substantially cylindrical wall a laterally delimited by two annular edges 9 and 10, which together with the wall 8 defined a channel 11 suited to contain a tyre not illustrated in the enclosed figures. The wall 8 presents a face 12 facing towards the outside and along which will be performed the interventions for balancing the wheel 1. Moreover, (fig. 1 and 2) the wall 8 is crossed by a hole 13, which is suited to house the valve of the tyre, not illustrated in the enclosed figures.

[0015] In brief, the method according to the present invention contemplates determining the unbalance of the wheel 1 by the phases of measuring the unbalance and of checking the acceptability of the unbalance. If the unbalance does not fall within parameters considered acceptable, then the method calculates the coordinates of a mass to be removed and removes the mass by machining.

[0016] With reference to figure 5, in the acquisition block 14 characteristic signals of unbalance are acquired, while in the calculation block 15 the mass M and the phase F of the unbalance are calculated. The mass M represents the mass to be removed to balance the wheel, while the phase F is the angular reference, from which the mass M must be removed, with respect to a determined point of reference of the wheel 1. In the block 16, the mass of the valve MV (which will be installed on the wheel 1) and the phase of the valve FV with respect to the determined point are extracted from a memory not illustrated. In the block 17, a simulation is made of the unbalance in working conditions of the wheel 1 as though the valve were fitted on the wheel 1 and the simulated mass MS to be removed and the relative simulated phase FS are calculated. In the block 18, a value M_{max} of the maximum acceptable unbalance is extracted from the memory and in the block 19 it is checked whether the mass MS is lower than the value M_{max}. If this condition is found, in the block 20 a signal of acceptability A of the wheel 1 is given. If, on the contrary, the condition of block 19 is not found, then it is necessary to remove the mass MS from the wheel 1. For this purpose the following data are extracted from the memory in the block 21; specific weight PR of the material of the wheel 1, the geometry GR of the wheel 1, the allowed zones of removal ZL and the type of machining LT chosen for removing the mass MS.

[0017] In the block 22, the geometry G of the mass MS to be removed is calculated, while in the block 23 the coordinates C of the geometry G are calculated with respect to a point of reference.

[0018] In order to avoid unattractive machining on the wheel 1, the geometry G of the mass MS is distributed along a relatively large angle a, as illustrated in figure 1 and in figure 4 which represents an example of the geometry G of the mass MS to be removed from the wheel 1. The coordinates C are transferred to a cutting machine tool with numerical control which removes the mass MS from the wheel 1.

[0019] The method described contemplates different possibilities of implementation. The first consists of carrying out the finishing operation on a cutting machine tool, checking the unbalance and if necessary calculating the coordinates C of the mass MS to be removed in order to correct the unbalance on a machine for measuring unbalance, and correcting the unbalance on a cutting machine tool. The second possible implementation lies in the fact that the finishing operation, checking and possible calculation of the coordinates C are carried out on the same cutting machine tool, while the correction of unbalance is carried out on another cutting machine tool. Lastly, the third possible implementation is certainly the most advantageous because the finishing, the determination of the unbalance and the correction of the unbalance are all carried out on a single cutting machine tool.

[0020] With reference to figure 6, a cutting machine tool 24 is illustrated which is suited to operate according to the method described for finishing, checking the unbalance and eventually correcting the unbalance in a single machine.

[0021] The machine tool 24 comprises a base 25, which supports a piece holding chuck 26, which is motor-driven and rotates around an axle 27, and a frame 28, which supports a slide 29 moving along a horizontal axis X1 with respect to the frame 28, a slide 30 moving along a vertical axis Z1 with respect to the slide 29, a third slide 31 moving along a horizontal axis X2 with respect to the slide 30. The slide 31 supports a motor-driven chuck 32 rotating around a horizontal axis 33 and suited to support a tool 34. Substantially, the machine tool 24 is able to carry out milling and turning operations, or both processes simultaneously. The machine tool 24 also comprises a control unit 35, sensors 36 for detecting static unbalance (accelerometers or velocimeters), sensors 37 for detecting the angular position (encoder) of the chuck 26 and a numerical control 38. The control unit 25 carries out all the operations described in the block diagram in the figure and transfers the coordinates C to the numerical control 38 which controls the shifting of the tool 34 according to the angular shifting of the wheel 1.

[0022] With reference to figure 7, the machine tool 24 is equipped with further sensors 39 (piezoelectric sensors, load cells, accelerometers) suited to detect the dynamic unbalance, that is the torque T on the chuck 26 exerted by the mass M. The block diagram in figure 8 concerns the operating method of the variation in figure 7. This method differs from the previous one by the fact that it contemplates the removal of material from the wheel 1 on two horizontal planes P1 and P2 intersecting the wheel 1 respectively near the edge 9 and the edge 10 (figure 7).

[0023] With reference to figure 8, a block 40 is shown for acquiring signals by means of the sensors 36, 37 and 39, a block 41 for calculating the values M, T and F, a block for calculating the mass M1 and the phase F1 for the plane P1 (figure 7) and the mass M2 and the phase F2 for the plane P2 (figure 7); then in the block 43 the values of the mass of the valve MV and of the phase of the valve FV are extracted and in block 44 the mass MS with the respective phase FS1 and the mass MS2 with the respective phase FS2 are calculated as resulting from the simulation of valve presence. In the block 45 the acceptability values Ml_{max} and $M2_{max}$ are extracted from the memory and are compared respectively with the values of MS1 and of MS2 in the blocks 46, 50 and 51. If the masses MS1 and MS2 are both lower than $M1_{max}$ and $M2_{max}$ (see blocks 46, 51) the block 50 gives an unbalance acceptance signal A. If the masses MS1 and MS2 are not respectively lower than $M1_{max}$ and $M2_{max}$. then in a similar way to that described for the blocks from 21 to 23 in figure 5, the geometry G1 and the coordinates C1 of the mass MS1 are calculated (blocks 47, 48 and 49), and the geometry G2 and the coordinates C2 of the mass MS2 (blocks 52, 53 and 54). The blocks 47 and 52 are equivalents of the block 21 in figure 5. If only one of the conditions has not occurred, then only the coordinates C1 or the coordinates C2 are calculated. The coordinates thus calculated are transmitted to the numerical control 38 (figure 6) of the machine tool 24 which carries out the machining to balance the wheel 1.

Claims

1. Method for producing alloy wheels for motor vehicles, each wheel (1) comprising a hub (3) and a rim (5); the method including realising a finishing operation with a cutting machine tool; the method comprising the steps of measuring the unbalance of said wheel (1), and checking whether said unbalance is lower than an unbalance acceptability value ($M1_{max;}$ $M2_{max}$) by means of a control unit (35); calculating a mass (M1; M2) to be removed and the respective phase (F1; F2) with respect to a determined point on the wheel (1) ; said unbalance being identified by said mass (M1; M2) and by said phase (F1; F2); the method being **characterised by** calculating a first mass- and a second mass (M1, M2) to be removed and the respective first and second phases (F1, F2), said first and second masses (M1, M2) being separated from each other along the axle (2) of the wheel (1).

2. Method according to claim 1, **characterised by** calculating a first and a second simulated masses(MS1, MS2) and the respective first and second simulated phases (FS1, FS2) in working conditions of the wheel (1), said first and second simulated masses (MS1, MS2) being separated from each other along the axle of the wheel; and by removing the first simulated mass (MS1) when the first simulated mass (MS1) is not lower than a first unbalance acceptability value ($M1_{max}$) and by removing the second simulated mass (MS2) when the second simulated mass (MS2) is not lower than a second unbalance acceptability value ($M2_{max}$)

3. Method according to claim 2, **characterised by** removing the first and the second simulated mass (MS1: MS2) from the wheel (1) to compensate the unbalance when the unbalance is not acceptable.

4. Method according to claim 3, **characterised in that** the finishing machining process, the checking of unbalance and the possible removal of the first and second simulated masses (MS1, MS2) are carried out on a single cutting machine tool (24).

5. Method according to one of the claims from 2 to 4, **characterised by** calculating the first and second simulated masses (MS1, MS2) according to the first and second masses (M1, M2) and the first and second phases (F1, F2) and the mass of a valve (MV) and the phase of the valve (FV).

6. Method according to any one of the claims from 2 to 5, **characterised by** calculating a first and second geometries (G1, G2) of the respective first and second simulated masses (MS1, MS2) according to the geometry (GR) of the wheel (1) and the specific

weight (PR) of the wheel (1).

7. Method according to claim 6, **characterised by** calculating the first and second geometries (G1, G2) of said first and second simulated masses (MS1, MS2) according to the type of machining (LT) selected.

8. Method according to claim 7, **characterised by** determining the first and second coordinates (C1; C2) of said first and second geometries (G1, G2) with respect to a point of reference on the wheel (1).

9. Method according to claim 8, **characterised by** transferring the first and second coordinates (C1, C2) to a numerical control (38) of the cutting machine tool (24).

10. System for producing alloy wheels for motor vehicles, each wheel (1) comprising a hub (3) and a rim (5); the system comprising a cutting machine tool for carrying out finishing operation; the system comprising means for detecting (14; 40) the unbalance of said wheel (1) and means for checking (19; 46; 50; 51) whether said unbalance falls within an unbalance acceptability value ($M1_{max,}$ $M2_{max}$) ; means for calculating a mass (M1; M2) to be removed and the respective phase (F1: F2) with respect to a determined point on the wheel (1); said unbalance being identified by said mass (M1; M2) and by said phase (F1; F2); the system being **characterised by** comprising means for calculating a first mass and a second mass (M1, M2) to be removed and the respective first and second phases (F1, F2) with respect to a determined point of the wheel (1) said first and second masses (M1; M2) being separated from each other along the axle (2) of the wheel (1).

11. System according to claim 10, **characterised by** comprising means for calculating (17; 44) a first and second simulated masses (MS1, MS2) to be removed from the wheel (1) to correct the unbalance of the wheel (1) in working condition and the respective first and second simulated phases (FS1, FS2).

12. System according to claim 11, **characterised by** comprising means for checking (19; 46; 50; 51) the first and second simulated masses (MS1, MS2) of the unbalance acceptability with respect to a first and second unbalance acceptability values ($M1_{max,}$ $M2_{max}$).

13. System according to claim 11 or 12, **characterised by** comprising a cutting machine tool for removing said first and second masses (MS1, MS2) from said wheel (1) to compensate the unbalance, when at least one of the first and the second masses (MS1, MS2) is not lower than the respective first and second unbalance acceptability values ($M1_{max}$, $M2_{max}$).

14. System according to claim 13, **characterised in that** said cutting machine tool (24) comprises sensors (36, 37; 36, 37, 39) for detecting unbalance, a control unit (35) for calculating the first and second simulated masses (MS1, MS2) and the respective first and second phases (FS1, FS2) and the first and second coordinates (C1, C2) of said first and second simulated masses (MS1, MS2), and a numerical control (38) suited to acquire said coordinates, said cutting machine tool (24) being suited to carry out the machining finishing operation, to check the unbalance and eventually to remove the first and second simulated masses (MS1, MS2).

15. System according to claim 13, **characterised in that** said cutting machine tool (24) comprises sensors for detecting the dynamic unbalance (36, 37; 36, 37, 39) and means for calculating the first and second mass in correspondence of a first and a second planes (P1, P2) along the axle (2) of said wheel (1).

Patentansprüche

1. Verfahren zur Produktion von Leichtmetatträdern für Motorfahrzeuge, wobei jedes Rad (1) eine Nabe (3) und eine Felge (5) umfasst; wobei das Verfahren die Durchführung einer Schlichtarbeit mit einem Schneidmaschinenwerkzeug umfasst; wobei das Verfahren ferner die Schritte des Messens der Unwucht des Rades (1) und der Prüfung, ob diese Unwucht kleiner sei als ein Unwucht-Akzeptanzwert ($M1_{max}$; $M2_{max}$), mittels einer Kontrolleinheint (35); der Berechnung einer zu entfernenden Masse (M1; M2) und der entsprechenden Phase (F1; F2) mit Bezug auf einen bestimmten Punkt auf dem Rad (1) umfasst; wobei die Unwucht durch die Masse (M1; M2) und die Phase (F1; F2) identifiziert wird; wobei das Verfahren **gekennzeichnet ist durch** die Berechnung einer zu entfernenden ersten Masse und zweiten Masse (M1, M2) und der entsprechenden ersten und zweiten Phase (F1, F2), wobei die erste und die zweite Masse (M1, M2) voneinander entlang der Achse (2) des Rades (1) getrennt sind.

2. Verfahren gemäß Anspruch 1, **gekennzeichnet durch** die Berechnung einer ersten und einer zweiten stimulierten Masse (MS1, MS2) und der entsprechenden ersten und zweiten simulierten Phase (FS1, FS2) unter Arbeitsbedingungen des Rades (13, wobei die erste und zweite simulierte Masse (MS21, MS2) voneinander entlang der Radachse getrennt sind; und ferner **gekennzeichnet durch** das Entfernen der ersten simulierten Masse (MS1), wenn die erste simutierte Masse (MS1) nicht kleiner ist als ein erster Unwucht-Akzeptanzwert (M^1_{max}), und **durch** das Entfernen der zweiten simulierten Masse (MS2), wenn die zweite simulierte Masse

(MS2) nicht kleiner ist als ein zweiter Unwucht-Akzeptanzwert ($M2_{max}$).

3. Verfahren gemäß Anspruch 2, **gekennzeichnet durch** das Entfernen der ersten und der zweiten simulierten Masse (MS1; MS2) vom Rad (1), um die Unwucht auszugleichen, wenn die Unwucht nicht akzeptabel ist.

4. Verfahren gemäß Anspruch 3, **dadurch gekennzeichnet, dass** der Schlicht-Bearbeitungsvorgang, das Prüfen der Unwucht und das mögliche Entfernen der ersten und zweiten simulierten Masse (MS1, MS2) an einem einzelnen Schneidmaschinenwerkzeug (24) ausgeführt werden.

5. Verfahren gemäß einem der Ansprüche 2 bis 4, **gekennzeichnet durch** Berechnung der ersten und zweiten simulierten Masse (MS1, MS2) nach Maßgabe der ersten und der zweiten Masse (M1, M2) und der ersten und zweiten Phase (F1, F2) und der Masse eine Ventils (MV) und der Phase des Ventils (FV).

6. Verfahren gemäß einem der Ansprüche 2 bis 5, **gekennzeichnet durch** die Berechnung einer ersten und einer zweiten Geometrie (C1, G2) der entsprechenden ersten bzw. zweiten simulierten Masse (MS21, MS2) nach Maßgabe der Geometrie (CR) des Rades (1) und des spezifischen Gewichts (PR) des Rades (1),

7. Verfahren gemäß Anspruch 6, **gekennzeichnet durch** die Berechnung der ersten und zweiten Geometrie (G1, G2) der ersten und zweiten simulierten Masse (MS1, MS2) nach Maßgabe des gewählten Bearbeitungstyps (LT).

8. Verfahren gemäß Anspruch 7, **gekennzeichnet durch** die Bestimmung der ersten und zweiten Koordinaten (C1, C2) der ersten und zweiten Geometrie (G1, G2) mit Bezug auf einen Referenzpunkt auf dem Rad (1).

9. Verfahren gemäß Anspruch 8, **gekennzeichnet durch** die übertragung der ersten und zweiten Koordinate (C1, C2) auf eine numerische Steuerung (38) des Schneidmaschinenwerkzeugs (24).

10. System zur Production von Leichtmetallrädern für Motorfahrzeuge, wobei jedes Rad (1) eine Nabe (3) und eine Felge (5) umfasst; wobei das System ein Schneidmaschinenwerkzeug zur Durchführung einer Schlichtarbeit umfasst; wobei das System Mittel zum Feststellen (14; 40) der Unwucht des Rades (1) und Mittel zum Prüfen (19; 46; 50; 51) der Tatsache umfasst, ob diese Unwucht einem Unwucht-Akzeptanzwert. ($M1_{max,}$ $M2_{max}$) gerecht wird; ferner Mittel zum Berechnen einer zu entfernenden Masse (M1; M2) und der entsprechenden Phase (F1; F2) mit Bezug auf einen bestimmten Punkt auf dem Rad (1); wobei die Unwucht durch die Masse (M1; M2) und die Phase (F1; F2) identifiziert wird; wobei das System **dadurch gekennzeichnet ist, dass** es Mittel zur Berechnung einer zu entfernenden ersten Masse und zweiten Masse (M1; M2) und der entsprechenden ersten und zweiten Phase (F1; F2) mit Bezug zu einem bestimmten Punkt des Rades (1) umfasst, wobei die erste und die zweite Masse (M1, M2) voneinander entlang der Achse (2) des Rades (1) getrennt sind.

11. System gemäß Anspruch 10, **dadurch gekennzeichnet, dass** es Mittel zur βerechnung (17; 44) einer ersten und einer zweiten von dem Rad (1) zu entfernenden simulierten Masse (MS1, MS2) zur Korrektur der Unwucht des Rades (1) unter Arbeitsbedingungen und der entsprechenden ersten und zweiten simulierten Phase (FS1, FS2) umfasst.

12. System gemäß Anspruch 11, **dadurch gekennzeichnet, dass** es Mittel zum Prüfen (19; 46; 50; 51) der ersten und zweiten simulierten Masse (MS1, MS2) der Unwucht-Akzeptanz mit Bezug auf einen ersten und zweiten Unwucht-Alzeptanzwert ($M1_{max,}$ $M2_{max}$) umfasst.

13. System gemäß Anspruch 11 oder 12, **dadurch gekennzeichnet, dass** es ein Schneidmaschinenwerkzeug zum Entfernen der ersten und zweiten simulierten Masse (MS1, MS2) von dem Rad (1) zum Ausgleich der Unwucht umfasst, wenn mindestens eine aus der ersten und der zweiten Masse (MS1, MS2) nicht kleiner ist als der entsprechende erste und zweite Unwucht-Akzeptanzwert ($M1_{max}$, $M2_{max}$).

14. System gemäß Anspruch 13, **dadurch gekennzeichnet, dass** das Schneidmaschinenwerkzeug (24) Sensoren (36, 37; 36, 37, 39) zum Feststellen einer Unwucht, eine Prüfeinheit (35) zum Berechnen der ersten und zweiten simulierten Masse (MS1, MS2) und der entsprechenden ersten und zweiten Phase (FS1, FS2) und der ersten und zweiten Koordinaten (C1, C2) der ersten und zweiten simulierten Masse (MS1, MS2) sowie eine numerische Steuerung (38) umfasst, die geeignet ist, diese Koordinaten aufzunehmen; wobei das Schneidmaschinenwerkzeug (24) geeignet ist, den Schlicht-Bearbeitungsvorgang durchzuführen, die Unwucht zu prüfen und schließlich die erste und zweite simulierte Masse (MS1, MS2) zu entfernen,

15. System gemäß Anspruch 13, **dadurch gekennzeichnet, dass** das Schneidmaschinenwerkzeug (24) Sensoren zur Feststellung der dynamischen

Unwucht (36, 37; 36, 37, 39) und Mittelt zum Berechnen der ersten und zweiten Masse in Entsprechung zu einer ersten und einer zweiten Ebene (P1, P2) entlang der Achse (2) des Rades (1) umfasst.

Revendications

1. Procédé de fabrication de roues en alliage pour des véhicules à moteur, chaque roue (1) comprenant un moyeu (3) et une jante (5); le procédé comportant le fait de réaliser une opération de finition à l'aide d'une machine-outil de découpe; le procédé comprenant les étapes qui consistent à mesurer le balourd de ladite roue (1), et vérifier si ledit balourd est inférieur à une valeur ($M1_{max;}$ $M2_{max}$) d'acceptabilité de balourd au moyen d'une unité de commande (35); calculer une masse (M1; M2) à retirer et la phase (F1; F2) respective par rapport à un point déterminé sur la roue (1); ledit balourd étant identifié par ladite masse (M1; M2) et par ladite phase (F1; F2); le procédé étant **caractérisé par** le fait de calculer une première masse et une deuxième masse (M1, M2) à retirer et les première et deuxième phases (F1, F2) respectives, lesdites première et deuxième masses (M1, M2) étant écartées l'une de l'autre le long de l'axe (2) de la roue (1).

2. Procédé selon la revendication 1, **caractérisé par** le fait de calculer des première et deuxième masses simulées (MS1, MS2) et les première et deuxième phases simulées (FS1, FS2) respectives dans des conditions de fonctionnement de la roue (1); lesdites première et deuxième masses simulées (MS1, MS2) étant écartées l'une de l'autre le long de l'axe de la roue; et de retirer la première masse simulée (MS1) lorsque la première masse simulée (MS1) n'est pas inférieure à une première valeur ($M1_{max}$) d'acceptabilité de balourd et de retirer la deuxième masse simulée (MS2) lorsque la deuxième masse simulée (MS2) n'est pas inférieure à une deuxième valeur ($M2_{max}$) d'acceptabilité de balourd.

3. Procédé selon la revendication 2, **caractérisé par** le fait de retirer les première et deuxième masses simulées (MS1; MS2) de la roue (1) afin de compenser le balourd lorsque ce dernier n'est pas acceptable.

4. Procédé selon la revendication 3, **caractérisé en ce que** le processus de l'usinage de finition, la vérification du balourd et le retrait éventuel des première et deuxième masses simulées (MS1, MS2) sont effectués sur une seule machine-outil (24) de découpe.

5. Procédé selon l'une des revendications 2 à 4, **caractérisé par** le fait de calculer les première et deuxième masses simulées (MS1, MS2) en fonction des première et deuxième masses (M1, M2) et des première et deuxième phases (F1, F2) et de la masse d'une valve (MV) et la phase de la valve (FV).

6. Procédé selon l'une quelconque des revendications 2 à 5, **caractérisé par** le fait de calculer des première et deuxième géométries (G1, G2) des première et deuxième masses simulées (MS1, MS2) respectives en fonction de la géométrie (GR) de la roue (1) et du poids spécifique (PR) de la roue (1).

7. Procédé selon la revendication 6, **caractérisé par** le fait de calculer les première et deuxième géométries (G1, G2) desdites première et deuxième masses simulées (MS1, MS2) en fonction du type d'usinage (LT) sélectionné.

8. Procédé selon la revendication 7, **caractérisé par** le fait de déterminer les première et deuxième coordonnées (C1; C2) desdites première et deuxième géométries (G1, G2) par rapport à un point de référence sur la roue (1).

9. Procédé selon la revendication 8, **caractérisé par** le fait de transférer les première et deuxième coordonnées (C1; C2) à une commande numérique (38) de la machine-outil (24) de découpe.

10. Système de fabrication de roues en alliage pour des véhicules à moteur, chaque roue (1) comprenant un moyeu (3) et une jante (5); le système comprenant une machine-outil de découpe pour effectuer une opération de finition; le système comprenant des moyens (14; 40) pour détecter le balourd de ladite roue (1) et des moyens (19; 46; 50; 51) pour vérifier si ledit balourd coïncide avec une valeur ($M1_{max}$, $M2_{max}$) d'acceptabilité de balourd; des moyens pour calculer une masse (M1; M2) à retirer et la phase respective (F1; F2) par rapport à un point déterminé sur la roue (1); ledit balourd étant identifié par ladite masse (M1; M2) et par ladite phase (F1; F2); le système étant **caractérisé par** le fait de comprendre des moyens pour calculer une première masse et une deuxième masse (M1, M2) à retirer et les première et deuxième phases (F1, F2) respectives par rapport à un point déterminé de la roue (1), lesdites première et deuxième masses (M1, M2) étant écartées l'une de l'autre le long de l'axe (2) de la roue (1).

11. Système selon la revendication 10, **caractérisé par** le fait de comprendre des moyens (17; 44) pour calculer des première et deuxième masses simulées (MS1, MS2) à retirer de la roue (1) afin de corriger le balourd de la roue (1) dans des conditions de fonctionnement et des première et deuxième phases simulées (FS1, FS2) respectives.

12. Système selon la revendication 11, **caractérisé par** le fait de comprendre des moyens (19; 46; 50; 51) pour vérifier les première et deuxième masses simulées (MS1, MS2) de l'acceptabilité de balourd par rapport à des première et deuxième valeurs ($M1_{max,}$ $M2_{maz}$) d'acceptabilité de balourd.

13. Système selon les revendications 11 ou 12, **caractérisé par** le fait de comprendre une machine-outil de découpe destinée à retirer lesdites première et deuxième masses simulées (MS1; MS2) de ladite roue (1) pour compenser le balourd, lorsqu'au moins l'une des première et deuxième masses (MS1, MS2) n'est pas inférieure aux première et deuxième valeurs ($M1_{max}$, $M2_{max}$) d'acceptabilité de balourd.

14. Système selon la revendication 13, **caractérisé en ce que** ladite machine-outil (24) de découpe comprend des capteurs (36, 37; 36, 37, 39) pour détecter le balourd, une unité de commande (35) pour calculer les première et deuxième masses simulées (MS1, MS2) et les première et deuxième phases (FS1, FS2) respectives ainsi que les première et deuxième coordonnées (C1, C2) desdites première et deuxième masses simulées (MS1, MS2), et une commande numérique (38) adaptée pour l'obtention desdites coordonnées; ladite machine-outil (24) de découpe étant adaptée pour effectuer l'opération de l'usinage de finition, vérifier le balourd et éventuellement retirer les première et deuxième masses simulées (MS1, MS2).

15. Système selon la revendication 13, **caractérisé en ce que** ladite machine-outil (24) de découpe comprend des capteurs pour détecter le balourd dynamique (36, 37; 36, 37, 39) et des moyens pour calculer les première et deuxième masses en rapport avec des premier et deuxième plans (P1, P2) le long de l'axe (2) de ladite roue (1).

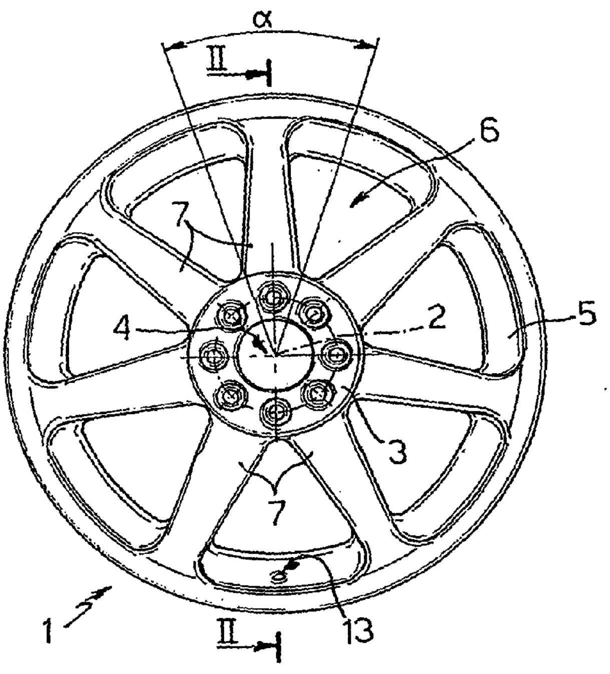

Fig.1

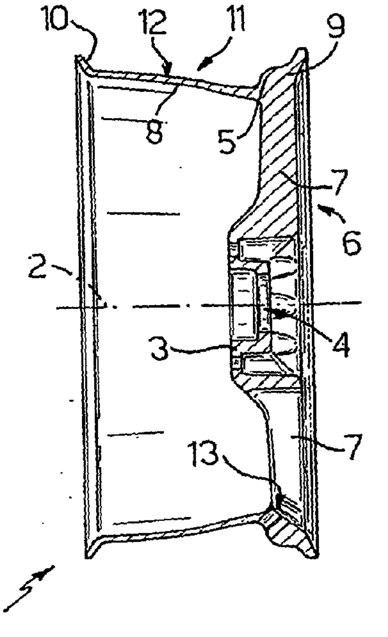

Fig.2

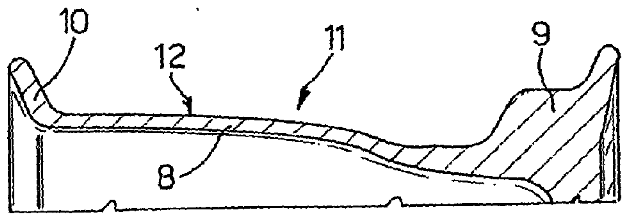

Fig.3

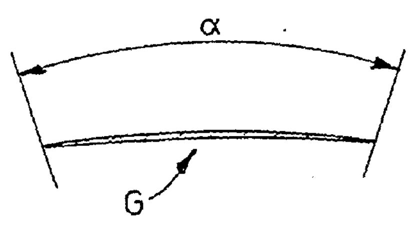

Fig.4

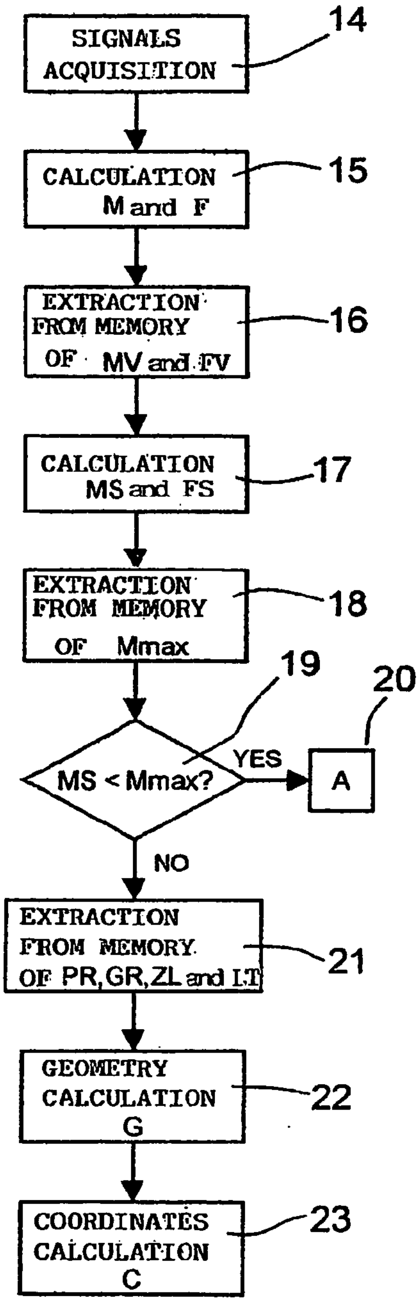
SIGNALS ACQUISITION
14
CALCULATION M and F
15
EXTRACTION FROM MEMORY OF MV and FV
16
CALCULATION MS and FS
17
EXTRACTION FROM MEMORY OF Mmax
18
19
20
MS < Mmax?
YES
A
NO
EXTRACTION FROM MEMORY OF PR, GR, ZL and LT
21
GEOMETRY CALCULATION G
22
COORDINATES CALCULATION C
23

Fig.5

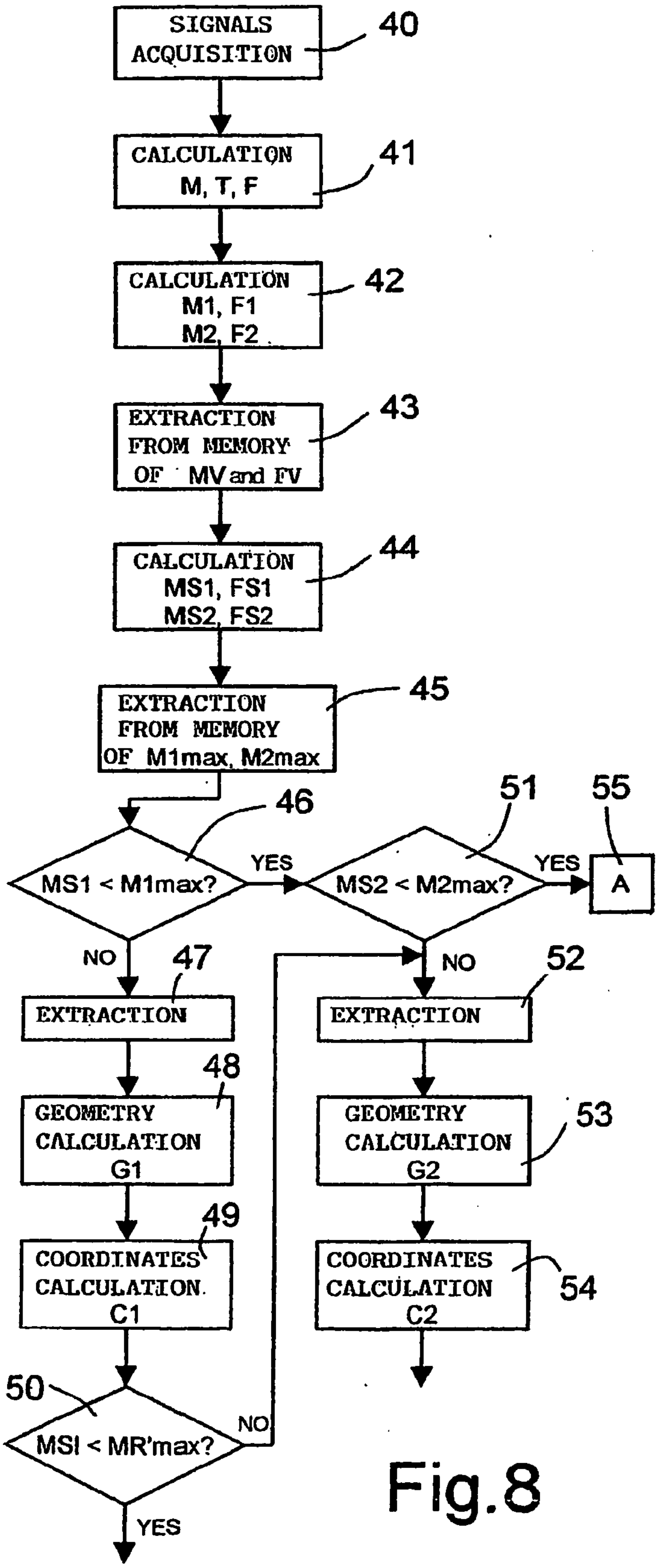
SIGNALS ACQUISITION
40
CALCULATION M, T, F
41
CALCULATION M1, F1 M2, F2
42
EXTRACTION FROM MEMORY OF MV and FV
43
CALCULATION MS1, FS1 MS2, FS2
44
EXTRACTION FROM MEMORY OF M1max, M2max
45
46
51
55
MS1 < M1max?
YES
MS2 < M2max?
YES
A
NO
47
NO
52
EXTRACTION
EXTRACTION
48
GEOMETRY CALCULATION G1
GEOMETRY CALCULATION G2
53
49
COORDINATES CALCULATION C1
COORDINATES CALCULATION C2
54
50
MSI < MR'max?
NO
YES

Fig.8

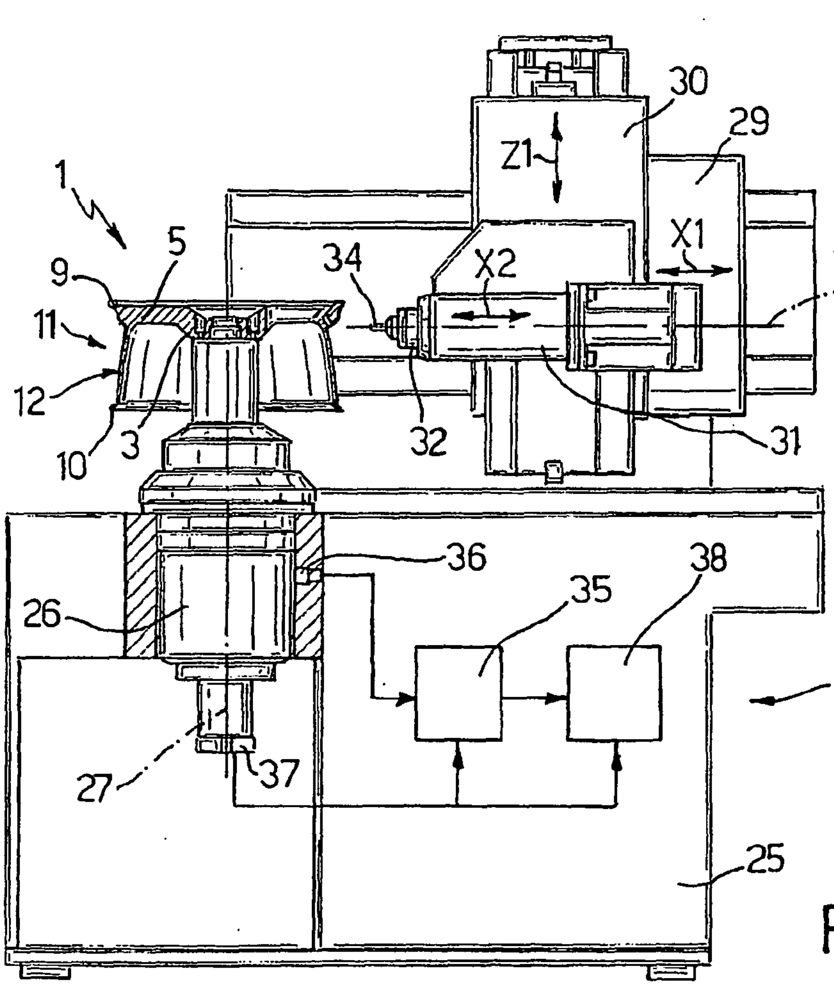
30
29
Z1
28
1
5
X1
34
X2
33
9
11
12
3
32
31
10
36
38
35
26
24
27
37
25

Fig.6

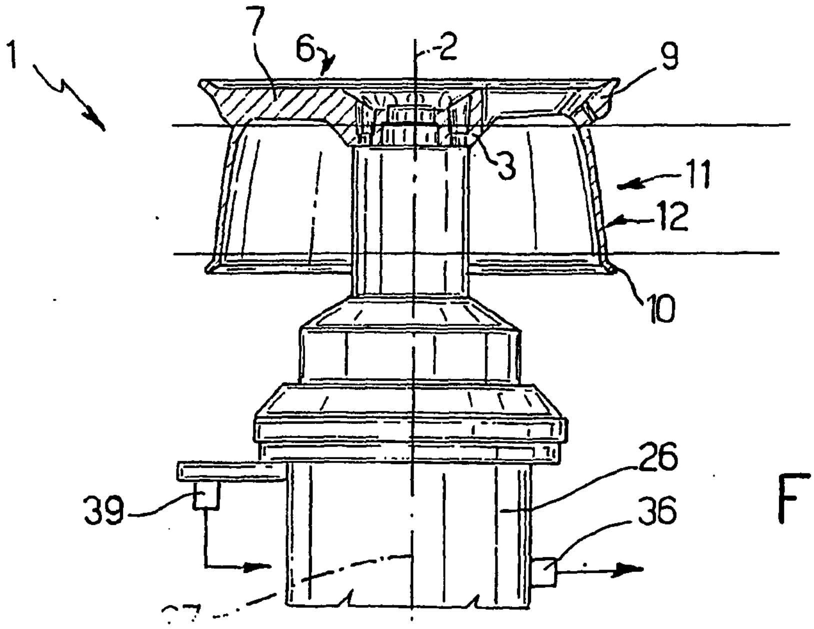
7
6
2
1
9
P1
3
11
12
P2
10
26
39
36

Fig.7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0607757 A **[0001]**
- EP 607757 A **[0005] [0006]**
- DE 2455279 **[0007]**