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(54) **DIAMOND DRESSING MANUFACTURING METHOD FOR AESTHETIC EFFECT, TO BE PERFORMED ON ITEMS SUCH AS, GOLD, SILVER AND COSTUME JEWELLERY, AS WELL AS FOR EYEGLASSES AND CLOTHING ACCESSORIES**

DIAMANTIERUNGSHERSTELLUNGSVERFAHREN ZUR ERZIELUNG EINES ÄSTHETISCHEN EFFEKTS, DER AN GEGENSTÄNDEN WIE GOLD-, SILBER- UND MODESCHMUCK SOWIE AN BRILLEN UND BEKLEIDUNGSZUBEHÖR DURCHGEFÜHRT WERDEN SOLL

PROCÉDÉ DE FABRICATION DE DIAMANTAGE POUR UN EFFET ESTHÉTIQUE, À RÉALISER SUR DES ARTICLES TELS QUE DES BIJOUX EN OR, EN ARGENT ET PERSONNALISÉS, ET POUR DES LUNETTES ET DES ACCESSOIRES D'HABILLEMENT

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EP 3 765 237 B1

Description

[0001] The present invention relates to a manufacturing method for the diamond dressing process to be performed on items, according to the preamble of claim 1, as for example known from IT VI20 130 168 A1.

[0002] As is well known, to give the surface of items used as gold, silvery and costume jewellery in general, such as beads, oval beads, drops in forms of cubes, hearts, toroids, flowers or with other irregular shapes, to be used individually as jewellery, such as rings, pins or earrings, or joined together, to form necklaces, chains, bracelets or other types of jewellery, obtained through moulding, micro-casting, electroforming or with other known systems, or other products such as eyeglasses and clothing accessories, with the aim of obtaining a surface finishing with a special aesthetic effect, said items are subjected to the process indicated with the term " diamond dressing".

[0003] This processing method consists in the controlled removal of limited amount of material so as to create micro-concavities, so-called "notches", to give the processed surface a particular shine, deriving from the different refraction of the light rays that are reflected by the multiplicity of appropriately oriented micro-surfaces obtained on said surface.

[0004] Nowadays, the manual diamond dressing process has been completely replaced by the use of automatic diamond dressing machines, equipped with a loader that picks up the items from a feeder and places them in the working area of the machine which operates automatically, regulated by an electronic control unit.

[0005] In the known diamond dressing machines, the virtual configuration of the overall shape of the item or surface to be diamond dressed, when this operation does not comprise the entire item, is communicated to an "axis control" unit, which controls a gripper to which the item is hooked, such as to make the gripping points of the item to be processed coincide on the spindle, as well as to regulate the movements of the tool which engraves the surface to be dressed.

[0006] This entire process substantially takes place through two operating modes:

- through the reading of a drawing (so-called CAD/CAM system);
- through the detection of an item's surface, chosen before the start of the manufacturing diamond dressing process, which is taken as a "sample item", virtually identical to that of the items to be diamond dressed (so-called "copy" system). Disadvantageously, with the two systems listed above, data are sent to the "axis control" unit that do not define a virtual surface which is exactly identical to that of the item to be processed since, in practice, the CAD/CAM system communicates a theoretical surface, i.e. that of the drawing, while with the "copy" system, the surface of the item taken as a sample will, of course, never be perfectly identical to the surface of the item to be processed.

[0007] In the current state of the art, in order to overcome the above-mentioned operating limits, diamond dressing machines have been marketed wherein the virtual configuration of the surface to be processed and to be communicated to the "axis control" unit is detected directly on the item to be processed itself, when it is already mounted on the operating machine.

[0008] By way of example, the Italian patent document 0001424842 is cited, wherein the "virtual" conformation of the entire total extension of the surface to be dressed is detected directly on the item to be processed and to be communicated to the "axis control" unit, said conformation being obtained through a three-dimensional detection on the item itself.

[0009] Object of the present invention is to improve the method described in the document cited above.

[0010] Specifically, object of the present invention is to implement the above-mentioned known method, so as to make possible the realization of the same diamond dressing on all the items of the same series, i.e. those which have an identical shape, said diamond dressing being perfectly equal to that realised on the sample item and being considered by the operator the best possible diamond dressing that can be realized.

[0011] A further object of the invention is to reduce the diamond dressing time of each item; in any case, considering that in every diamond dressing series hundreds of identical items are processed, the savings of a few seconds on each item processing allows, at the end of the entire operation, a considerable gain in terms of productivity.

[0012] By way of example, the patent documents JP2014117782 and JP201522923 are cited, which do not anticipate the present invention in that they operate with different processes other than diamond dressing, in which it is envisaged that the precision in the edge processing of a series of flat plate-like elements (ref. 1) or curved elements (ref. w) arranged on a rotating table, is obtained by reading the conformation of the edge of a processed element that is taken as the "sample".

[0013] On the other hand and specifically, in the manufacturing diamond dressing process, where the items to be processed consist of elements with an irregular shape, which vary from a sphere to an irregular ellipsoid in relation to the type of jewellery to obtain, and which are retained at two opposite gripping points, between the two opposite pins of a rotating spindle, the above-mentioned objects are achieved by implementing two new functions in the work program described in the above-mentioned patent 0001424842:

- a first additional function, in which the first item, after it has been "processed" through a three-dimensional spatial scan and undergone the manufacturing diamond dressing process, is encoded as a "sample"

to define the movement trajectory of the gripping system or "gripper" which individually grips the second and subsequently, always individually, the third and subsequent items such that the scanner or other vision systems, once the gripping points of this new item are recognised, transmits the spatial coordinates, detected through a developed reference system using "Euler angles" to said gripper which, consequently, places said second individual item at the spindle, exactly and always in the same "gripping zone", precisely centring the gripping holes of said new item with the gripping pins of the spindle.

- a second additional function, in which it is envisaged that the first "processed" item, already subjected to the manufacturing diamond dressing process, is encoded as a "sample" through a three-dimensional spatial scan, whereas the items (second, third..., nth), individually subjected to the manufacturing diamond dressing process and in succession undergo, through scanners or other detection systems, the three-dimensional scan of the surface to be processed and on which the diamond dressing pattern or "sample pattern" is brought, detected and memorised by the first "sample item", said "sample pattern" is adapted by modifying the processing spatial coordinates, through a reference system elaborated using the "Euler angles", to the ever present, albeit minimal, differences in extension, thickness, depth, orientation and conformation which the new three-dimensional surface to be subjected to the manufacturing process for the diamond dressing of the aforesaid items presents (second, third ..., nth).

[0014] Concretely, with the first new additional function of the individual second item, as well as the following individual items, after having been coupled by the loader through a feeler, laser or other type of reader, the orientation of the holes or hold points in the space is detected and the data collected are sent to the CPU, which orients the manipulator gripper that retains the item, such that said item is positioned exactly in the "gripping points" of the spindle, defined with the processing of the first item; therefore, the new item to subject to the manufacturing diamond dressing process will be exactly oriented in the holes or "gripping points" which, therefore, are spatially located in the same way as the gripping points of the "sample item".

[0015] In practice, with the second new additional function, being able to directly bring to the second item, as well as the individual subsequent items, the diamond dressing pattern of the "sample item", the operator intervention phase is eliminated, said operator, with the machines of the known type, had to set the working parameters through the program unit again so that the machine could follow the software and mechanical limits for the processing of the item itself.

[0016] Operationally, the diamond dressing machine, provided with the program for carrying out the manufacturing diamond dressing process according to the invention, initially envisages the realisation of the first item or "sample item" according to the following steps:

- 1st step: when the machine is switched on, the CPU checks the "zero axis" condition;
- 2nd step: the machine is equipped with the item to subject to the manufacturing diamond dressing process, manually or using a loader provided with a gripper;
- 3rd step: a mechanical feeler, laser, scanner or other device adapted to the purpose, scans the conformation of the surface of the item being processed and transmits the data to the CPU;
- 4th step: the CPU transmits the data received to the memory, which realizes the virtual image of the item, visible at the graphic output;
- 5th step: through the program unit, the operator sets the work parameters so that the machine follows the software and mechanical limits that define the spatial limits of the zone to be dressed and the conformation characteristics of the diamond dressing profile, i.e. the depth and orientation of the micro-notches, so that the walls of said notches can reflect light, all in the same way, so as to ensure uniform reflection and shine, which qualifies the final manufactured item;
- 6th step: the CPU processes the received data and transmits the activity information to the unit programmed to activate the axes;
- 7th step: through the CPU from the zero-setting position, the tool reaches the item to be processed and is positioned on a precise zone, previously determined by means of the feeler;
- 8th step: when the axes between the tool and the item are mutually positioned at 90°, the tool starts to engrave the material, according to the predefined program, until the manufacturing diamond dressing process is complete;
- 9th step: the first dressed item is unloaded and acts as a "sample item", all as already known and as described in the above-mentioned patent document 0001424842.

[0017] The novelty feature of the invention concerns the steps of the manufacturing diamond dressing process of the second item and the items following the first, which present a conformation which is only theoretically equal to the first item but, de facto, have minimal differences following the type of processing used for its realisation (moulding, electroforming, micro-casting or other semi-finished product production methods).

[0018] The processing of the second item and subsequent items of the same series involves the following steps:

- I step: the loader takes a new (second) item from the feeder;
- II step: the loader carries the item into the "item con-

trol zone" where, through the use of a laser feeler, 3D scanner or other vision systems which can detect values (expressed in interpretable numerical values) or capture images (expressed in interpretable pixels), the loader gripper is oriented so as to position the item correctly in the "gripping points", defined during the manufacturing diamond dressing process of the first item or "sample item";

- III step: a mechanical, laser or other type of feeler probes the conformation of the surface of the item being processed at 360° or on smaller portions of said surface and transmits the data obtained to the CPU;
- IV step: the CPU processes the data received and performs a comparison operation with the corresponding data referred to the "sample" item, detecting the differences and imperfections with respect to the corresponding surface portions of the aforementioned "sample item";
- V step: the CPU processes the data received and, based on the detected differences, applies and adapts the previously memorised diamond dressing pattern of the "sample item" to the new conformation and transmits the new activity data to the unit programmed to activate the axes;
- VI step: through the CPU, from the zero-setting position, the tool reaches the new item to be processed and is positioned on the precise zone to be dressed;
- VII step: when the axes between the tool and the item are mutually positioned at 90°, the tool starts to engrave the material until the manufacturing diamond dressing process is complete;
- VIII step: the second dressed item, with the same diamond dressing as that of the "sample" item, is unloaded.

[0019] The above eight steps are repeated for all subsequent items (third, fourth ..., nth) that make up the same series.

[0020] The invention will be better defined and the working steps of the manufacturing diamond dressing process listed above will be better understood with the aid of the attached drawings, where:

- figs. 1-5 show the steps of the manufacturing diamond dressing process of the first item or "sample item";
- figs. 6-9 show the steps of the manufacturing diamond dressing process of the second, third, ... nth item;
- Fig. 10 shows the logic block-diagram of the functioning of the diamond dressing machine which performs the manufacturing diamond dressing process according to the invention.

[0021] As can be seen in figures 1-5, the entire manufacturing diamond dressing process envisages at the beginning the withdrawal from a warehouse, where the items P_1, P_2, P_3, P_n are inserted on a rod, using a gripper K, of the first item to be dressed P_1 (see fig. 1), to be positioned between the heads of the spindle M (see fig. 2), to be processed, through the tool S, which detects the spatial coordinates using, as a reference, the "Euler angles" (see fig. 4) and finally subjected to diamond dressing through the tool U (see fig. 3) to obtain the final diamond dressing PK_1 (see fig. 5). As can be seen in figures 6-9, the manufacturing diamond dressing process continues with the removal from the warehouse, using the gripper K, of the second item to be dressed P_2 (see fig. 6), which is positioned exactly in the "gripping points" T, defined during the diamond dressing of the first item P_1 or "sample item" and then, through a scanner or other detection systems Z, is subjected to the three-dimensional scanning of the surface on which the diamond dressing pattern or "sample pattern" is brought, memorised by the first item or "sample item" (see fig. 7), and finally subjected to the diamond dressing using the tool S (see fig. 8) to obtain the final diamond dressing PK_2 (see fig. 9); the whole is moved according to the spatial processing coordinates, regulated through a reference system elaborated by means of "Euler angles". Basically, the operating machine, used to carry out the manufacturing diamond dressing process described above, can be traced back to the block diagram of fig. 10, where the following are indicated:

a) the dynamic systems of the type with linear CNC axes or anthropomorphic robots which comprise an axis control 100, the control unit 200 of the software comprising in turn a CPU memory - axis activation - axis motors - a reading system, a loader 300, an item gripper 400, consisting, for example, of a pivoting gripper, a tool 500 and the item to diamond dress K_1, $K_{2...}$ K_n of the series being processed;
b) the sequence of operations, defined through progressive numbered connections.

[0022] Obviously, all the steps above described, both those for diamond dressing the "sample" item, and those for diamond dressing the subsequent items, are valid for any type of item, whatever its shape and regardless of whether or not gripping holes are present.

[0023] In practice, the procedure described above proved to be particularly advantageous:

- in automatic processing cycles provided with a loader;
- for items made with sheets of different thickness, from printed jewellery to those made through microcasting, electroforming or other processes, using the most varied materials, from precious materials (such as gold and silver) to less expensive ones, such as nickel and copper or other materials adapted to diamond dressing;
- for items having any shape, even considerably irregular, for which the invention provides a gripping sys-

tem that, upon the blocking of the second, third or nth item taken from the feeder, conform to the deformities and misalignment of the same, as the perforated items are inserted on rods, tubes or other linear supports;

- furthermore, considering the specific nature of the process according to the invention and the constructional and operating characteristics of the machine which operates with said process, it is possible to guarantee that the same "diamond dressing pattern" can be realised on all the items of the same series.

[0024] The items with a diamond dressed surface realised according to the method of the invention are also claimed.

[0025] It should be noted that the design, constructional and operative details can be the most various and in particular the method and the machine can be used to perform various processes, such as with electrospindle, laser for engraving or cutting, welding, punching, brushing and other possible processes, providing that everything falls within the inventive concept defined by the following claims.

Claims

1. MANUFACTURING METHOD FOR THE DIAMOND DRESSING PROCESS TO BE PERFORMED ON ITEMS, which is obtained with the creation on the surface of said items (P1) of micro-concavities, so-called "notches", that create a special shine, deriving from the different refraction of the light rays that are reflected by the multiplicity of appropriately oriented micro-surfaces, fashioned on said surface and of the type in which the manufacturing method for diamond dressing process envisages that said process is detected directly on the surface of the item to process already mounted on the machine, and that a "virtual" conformation of the entire complete extension of the surface to be diamond processed is communicated to the electronic "axis control" unit through a three-dimensional spatial detection,
said manufacturing diamond dressing process **characterised in that** two functions are implemented in the work program described above:

   - a first function in which the first item, after it has been "processed" through a three-dimensional scan and undergone the manufacturing diamond dressing process, is encoded as a "sample", to define the movement trajectory of the gripping system (K) or "gripper", which individually grips the second, and subsequently, always individually, the third and subsequent items such that the scanner or other vision systems, once the gripping points of this new item are recognised, transmit the spatial coordinates, detected through a developed reference system using "Euler angles" to said gripper which, consequently, places said new item at the spindle (M), exactly and always in the same "gripping zone", precisely centring the gripping holes of said new item with the gripping pins of the spindle;
   - a second function in which it is envisaged that the first "processed" item, already subjected to the manufacturing diamond dressing process, is encoded as a "sample" through a three-dimensional spatial scan, whereas the subsequent items, individually subjected to the manufacturing diamond dressing process and in succession undergo, through scanners or other detection systems, the three-dimensional scan of the surface to be processed and on which the diamond dressing pattern or "sample pattern" is brought, detected and memorised by the first item or "sample item", said "sample pattern" is adapted by modifying the processing spatial coordinates, through a reference system elaborated using "Euler angles", to the ever-present, albeit *minimal, differences in extension, thickness, depth, orientation and* conformation which the new three-dimensional surface to be subjected to the manufacturing method for the diamond dressing process of the aforesaid items presents (second, third ..., nth),

said method also **providing that** the first item is realised through the following steps:

   - 1st step: when the machine is switched on, the CPU checks the "zero axis" condition;
   - 2nd step: the machine is equipped with the item to subject to the manufacturing diamond dressing process, manually or using a loader provided with a gripper;
   - 3rd step: a mechanical feeler, a laser, a scanner or other device adapted to the purpose, scans the conformation of the surface of the item being processed and transmits the data to the CPU;
   - 4th step: the CPU transmits the data received to the memory, which realises the virtual image of the item, visible at the graphic output;
   - 5th step: through the program unit, the operator sets the work parameters so that the machine follows the software and mechanical limits that define the spatial limits of the zone to be dressed and the conformation characteristics of the diamond dressing profile, i.e. the depth and orientation of the micro-notches, so that the walls of said notches can reflect light, all in the same way, so as to ensure uniform reflection and shine, which qualifies the final manufactured

item;
- 6th step: the CPU processes the received data and transmits the activity information to the unit programmed to activate the axes;
- 7th step: through the CPU from the zero-setting position, the tool (U) reaches the item to be processed and is positioned on a precise zone, previously determined by means of the feeler;
- 8th step: when the axes between the tool and the item are mutually positioned at 90°, the tool starts to engrave the material until the manufacturing diamond dressing process is complete;
- 9th step: the first dressed item is unloaded from the operating machine, said diamond dressing process **providing that** said first realised item is considered as a "sample item" and the manufacturing method for the diamond dressing process of the second item and the successive items of the same series comprises the following steps:
- I step: the loader takes a new (second) item from the feeder;
- II step: the loader carries the item into the "item control zone" where, through the use of a laser feeler, 3D scanner or other vision systems which can detect values (expressed in interpretable numerical values) or capture images (expressed in interpretable pixels), the loader gripper is oriented so as to position the item correctly in the "gripping points", defined during the manufacturing method for the diamond dressing process of the first item or "sample item";
- III step: a mechanical feeler, laser or other type of system probes the conformation of the surface of the item being processed on 360° or on smaller portions of said surface and transmits the data obtained to the CPU;
- IV step: the CPU processes the data received and performs a comparison operation with the corresponding data referring to the "sample item", detecting the differences and imperfections with respect to the corresponding surface portions of the aforementioned "sample item";
- V step: the CPU processes the data received and, based on the detected differences, applies and adapts the previously memorised diamond dressing pattern of the "sample item" to the new conformation and transmits the new activity data to the unit programmed to activate the axes;
- VI step: through the CPU, from the zero-setting position, the tool reaches the new item to be processed and is positioned on the precise zone to be dressed;
- VII step: when the axes between the tool and the item are mutually positioned at 90°, the tool starts to engrave the material until the manufacturing diamond dressing process is complete;
- VIII step: the second dressed item, with the same diamond dressing as that of the "sample item", is unloaded from the operating machine.

2. METHOD, according to claim 1, **characterised in that,** following the first new additional function, applied to the second individual item, as well as the following individual items, after having been coupled by the loader through a feeler, laser or other type of reader, the orientation of the holes or hold points in the space is detected, and the data collected are sent to the CPU, which orients the manipulator gripper that retains the item, such that said item is positioned exactly in the "gripping points" of the spindle, defined with the processing of the first item, so that the new item to subject to the manufacturing diamond dressing process will be exactly oriented in the same "gripping points" spatially located as the "gripping points" of the "sample item".

3. METHOD, according to one or more of the previous claims, **characterised in that** the spatial coordinates that regulate the movements of the gripper, the items and the tool are defined through a reference system elaborated using "Euler angles".

4. METHOD, according to one or more of the previous claims, **characterised in that** it is performed on items of any shape.

5. METHOD, according to one or more of the previous claims, **characterised in that** it is performed on items lacking any gripping holes.

Patentansprüche

1. HERSTELLUNGSVERFAHREN FÜR DEN AN GEGENSTÄNDEN DURCHZUFÜHRENDEN VORGANG DES DIAMANTABRICHTENS, das durch die Erzeugung von Mikrovertiefungen, den sogenannten "Kerben", auf der Oberfläche der Gegenstände *(P1)* erhalten wird, die einen besonderen Glanz erzeugen, der sich aus der unterschiedlichen Brechung der Lichtstrahlen ergibt, die von der Vielzahl der zweckmäßig ausgerichteten Mikrooberflächen reflektiert werden, die auf der Oberfläche ausgebildet sind und von der Art sind, bei der das Herstellungsverfahren für den Vorgang des Diamantabrichtens vorsieht, dass der Vorgang direkt auf der Oberfläche des zu bearbeitenden Gegenstands, der bereits auf der Maschine montiert ist, erkannt wird, und dass eine "virtuelle" Beschaffenheit der vollständigen Gesamtausdehnung der Oberfläche, die dem Diamantabrichten zu unterziehen ist, durch eine dreidimensionale räumliche Erkennung an die elektronische "Achsensteuerungseinheit" übermittelt wird,
wobei der Herstellungsvorgang des Diamantabrich-

tens **dadurch gekennzeichnet ist, dass**
in dem oben beschriebenen Arbeitsprogramm zwei Funktionen implementiert sind:

- eine erste Funktion, bei der der erste Gegenstand, nachdem er durch einen dreidimensionalen Scan "bearbeitet" und dem Herstellungsvorgang des Diamantabrichtens unterzogen wurde, als "Vorlage" kodiert wird, um die Bewegungsbahn des Greifsystems (K) oder "Greifers" zu definieren, der den zweiten und anschließend, immer einzeln, den dritten und die folgenden Gegenstände einzeln so greift, dass der Scanner oder andere Bildverarbeitungssysteme, sobald die Greifpunkte dieses neuen Gegenstandes festgestellt sind, die Raumkoordinaten, erkannt durch ein unter Verwendung von "Euler-Winkeln" entwickeltes Referenzsystem, an den Greifer übertragen, der folglich den neuen Gegenstand an der Spindel *(M)* exakt und immer in derselben "Greifzone" platziert, wobei die Greiflöcher des neuen Gegenstandes mit den Greifstiften der Spindel präzise zentriert werden;
- eine zweite Funktion, bei der vorgesehen ist, dass der erste "bearbeitete" Gegenstand, der bereits dem Herstellungsvorgang des Diamantabrichtens unterzogen wurde, durch einen dreidimensionalen räumlichen Scan als "Vorlage" kodiert wird, während die nachfolgenden Gegenstände einzeln dem Herstellungsvorgang des Diamantabrichtens unterzogen werden und nacheinander durch Scanner oder andere Erkennungssysteme dem dreidimensionalen Scan der zu bearbeitenden Oberfläche unterzogen werden, auf der das Diamantabrichtmuster oder "Vorlagemuster" gebracht wird, erkannt und gespeichert durch den ersten Gegenstand oder "Vorlagegegenstand", wobei das "Vorlagemuster" durch Modifizierung der Raumkoordinaten der Bearbeitung durch ein Referenzsystem, das unter Verwendung von "Euler-Winkeln" erstellt wurde, an die stets vorhandenen, wenn auch minimalen Unterschiede in Bezug auf Ausdehnung, Dicke, Tiefe, Ausrichtung und Beschaffenheit angepasst wird, die die neue dreidimensionale Oberfläche, die dem Herstellungsverfahren für den Vorgang des Diamantabrichtens der vorgenannten Gegenstände unterzogen werden soll, aufweist (zweiter, dritter ..., n-ter),

wobei das Verfahren ferner **vorsieht, dass** der erste Gegenstand durch folgende Schritte erreicht wird:

- 1. Schritt: beim Einschalten der Maschine prüft die CPU den Zustand "Nullachse";
- 2. Schritt: die Maschine wird mit dem Gegenstand ausgerüstet, der dem Herstellungsvorgang des Diamantabrichtens unterzogen werden soll, manuell oder unter Verwendung eines Laders, der mit einem Greifer versehen ist;
- 3. Schritt: Ein mechanischer Taster, ein Laser, ein Scanner oder eine andere für den Zweck geeignete Vorrichtung scannt die Beschaffenheit der Oberfläche des zu bearbeitenden Gegenstandes und überträgt die Daten an die CPU;
- 4. Schritt: Die CPU überträgt die empfangenen Daten an den Speicher, der das virtuelle Bild des Gegenstandes realisiert, sichtbar am Grafikausgang;
- 5. Schritt: Der Bediener stellt über die Programmeinheit die Arbeitsparameter ein, so dass die Maschine den softwaremäßigen und mechanischen Grenzen folgt, die die räumlichen Grenzen der abzurichtenden Zone und die Eigenschaften der Beschaffenheit des Diamantabrichtprofils definieren, d.h. die Tiefe und die Ausrichtung der Mikrokerben, so dass die Wände der Kerben das Licht reflektieren können, alle auf die gleiche Art und Weise, so dass ein gleichmäßiges Reflektieren und ein gleichmäßiger Glanz gewährleistet werden, was die Qualität des fertiggestellten Gegenstandes ausmacht;
- 6. Schritt: Die CPU verarbeitet die empfangenen Daten und überträgt die Aktivitätsinformation an die Einheit, die zur Aktivierung der Achsen programmiert ist;
- 7. Schritt: Das Werkzeug (U) erreicht durch die CPU von der Nullstellung aus den zu bearbeitenden Gegenstand und wird auf eine zuvor mit dem Taster bestimmte, präzise Zone positioniert;
- 8. Schritt: wenn die Achsen zwischen dem Werkzeug und dem Gegenstand unter 90° zueinander stehen, beginnt das Werkzeug, das Material zu gravieren, bis der Herstellungsvorgang des Diamantabrichtens abgeschlossen ist;
- 9. Schritt: der erste abgerichtete Gegenstand wird von der Arbeitsmaschine entladen, wobei der Vorgang des Diamantabrichtens **vorsieht, dass** der erste realisierte Gegenstand als ein "Vorlagegegenstand" betrachtet wird und das Herstellungsverfahren für den Vorgang des Diamantabrichtens des zweiten Gegenstands und der aufeinanderfolgenden Gegenstände derselben Serie folgende Schritte umfasst:
- I Schritt: der Lader nimmt einen neuen (zweiten) Gegenstand von der Zuführeinrichtung;
- II Schritt: der Lader befördert den Gegenstand in die "Gegenstand-Steuerungszone", wo durch Verwendung eines Lasertasters, eines 3D-Scanners oder anderer Bildverarbeitungssysteme, die Werte (ausgedrückt in auswertbaren nu-

merischen Werten) erkennen oder Bilder (ausgedrückt in auswertbaren Pixeln) aufnehmen können, der Greifer des Laders so ausgerichtet wird, dass der Gegenstand korrekt in den "Greifpunkten" positioniert wird, die während des Herstellungsverfahrens für den Vorgang des Diamantabrichtens des ersten Gegenstandes oder "Vorlagegegenstandes" definiert wurden;
- III Schritt: Ein mechanischer Taster, ein Laser oder eine andere Art von System tastet die Beschaffenheit der Oberfläche des zu bearbeitenden Gegenstandes auf 360° oder auf kleineren Abschnitten dieser Oberfläche ab und überträgt die erhaltenen Daten an die CPU;
- IV Schritt: die CPU verarbeitet die empfangenen Daten und führt einen Vergleich mit den entsprechenden Daten durch, die sich auf den "Vorlagegegenstand" beziehen, wobei die Unterschiede und Mängel in Bezug auf die entsprechenden Oberflächenabschnitte des vorgenannten "Vorlagegegenstandes" erkannt werden;
- V Schritt: die CPU verarbeitet die empfangenen Daten und wendet, auf der Grundlage der erkannten Unterschiede, das zuvor gespeicherte Diamantabrichtmuster des "Vorlagegegenstandes" an und passt es an die neue Beschaffenheit an und überträgt die neuen Aktivitätsdaten an die Einheit, die zur Aktivierung der Achsen programmiert ist;
- VI Schritt: das Werkzeug erreicht durch die CPU von der Nullstellung aus den neuen zu bearbeitenden Gegenstand und wird auf die präzise abzurichtende Zone positioniert;
- VII Schritt: wenn die Achsen zwischen dem Werkzeug und dem Gegenstand unter 90° zueinander stehen, beginnt das Werkzeug, das Material zu gravieren, bis der Herstellungsvorgang des Diamantabrichtens abgeschlossen ist;
- VIII Schritt: der zweite abgerichtete Gegenstand, mit der gleichen Diamantabrichtung wie die des "Vorlagegegenstandes", wird von der Arbeitsmaschine entladen.

2. VERFAHREN gemäß Anspruch 1, **dadurch gekennzeichnet, dass**, nach der ersten neuen Zusatzfunktion, die auf den zweiten einzelnen Gegenstand sowie die folgenden einzelnen Gegenstände angewandt wird, nach der Kopplung durch den Lader über einen Taster, Laser oder eine andere Art von Lesegerät die Ausrichtung der Löcher oder Haltepunkte im Raum erkannt wird und die gesammelten Daten an die CPU gesendet werden, die den Manipulatorgreifer, der den Gegenstand festhält, so ausrichtet, dass der Gegenstand exakt in den "Greifpunkten" der Spindel positioniert wird, die bei der Bearbeitung des ersten Gegenstandes definiert wurden, so dass der neue Gegenstand, der dem Herstellungsvorgang des Diamantabrichtens unterzogen werden soll, exakt in denselben "Greifpunkten" ausgerichtet wird, die räumlich wie die "Greifpunkte" des "Vorlagegegenstandes" gelegen sind.

3. VERFAHREN gemäß einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Raumkoordinaten, die die Bewegungen des Greifers, der Gegenstände und des Werkzeugs regeln, durch ein Referenzsystem definiert werden, das unter Verwendung von "Euler-Winkeln" erstellt wird.

4. VERFAHREN gemäß einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es an Gegenständen beliebiger Form durchgeführt wird.

5. VERFAHREN gemäß einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es an Gegenständen ohne Greiflöcher durchgeführt wird.

Revendications

1. PROCÉDÉ DE FABRICATION POUR LA RÉALISATION DU TRAITEMENT DE DIAMANTAGE SUR DES OBJETS, qui est obtenu avec la création sur la surface desdits objets *(P1)* de micro-concavités, dites « entailles », qui créent une brillance spéciale, découlant de la réfraction différente des rayons lumineux qui sont réfléchis par la multiplicité de microsurfaces adéquatement orientées, façonnées sur ladite surface et du type dans lequel le procédé de fabrication pour le traitement de diamantage prévoit que ledit traitement soit détecté directement sur la surface de l'objet à traiter déjà monté sur la machine, et qu'une conformation « virtuelle » de toute l'étendue de la surface à diamanter soit communiquée à l'unité de « commande des axes » électronique par le biais d'une détection spatiale tridimensionnelle, ledit traitement de diamantage de fabrication étant **caractérisé en ce que** deux fonctions sont mises en œuvre dans le processus décrit ci-dessus :

- une première fonction dans laquelle le premier objet, après avoir été « traité » par un balayage tridimensionnel et avoir subi le traitement de diamantage de fabrication, est codé comme « échantillon », afin de définir la trajectoire de déplacement du système de préhension (*K*) ou « préhenseur », qui saisit individuellement le deuxième, et ensuite, toujours individuellement, le troisième objet et les objets suivants, de telle sorte que le scanneur ou d'autres systèmes de vision, une fois que les points de préhension de

ce nouvel objet ont été reconnus, transmette(nt) les coordonnées spatiales, détectées à l'aide d'un système de référence développé employant les « angles d'Euler », audit préhenseur qui, ensuite, place ledit nouvel objet au niveau de la broche (*M*), exactement et toujours dans la même « zone de préhension », en centrant précisément les trous de préhension dudit nouvel objet sur les goupilles de préhension de la broche ;

- une seconde fonction dans laquelle il est prévu que le premier objet « traité », déjà soumis au traitement de diamantage de fabrication, soit codé comme « échantillon » par un balayage spatial tridimensionnel, tandis que les objets suivants, soumis individuellement au traitement de diamantage de fabrication, subissent successivement, au moyen de scanneurs ou d'autres systèmes de détection, le balayage tridimensionnel de la surface à traiter et sur laquelle le motif de diamantage ou « motif d'échantillon » est appliqué, détecté et mémorisé par le premier objet ou « objet d'échantillon », ledit « motif d'échantillon » est adapté, en modifiant les coordonnées spatiales de traitement à l'aide d'un système de référence élaboré en employant les « angles d'Euler », aux différences toujours présentes, bien que minimes, d'étendue, d'épaisseur, de profondeur, d'orientation et de conformation que présente la nouvelle surface tridimensionnelle destinée à être soumise au procédé de fabrication pour le traitement de diamantage des objets susmentionnés (deuxième, troisième..., nième),

ledit procédé **prévoyant** également que le premier objet soit réalisé par le biais des étapes suivantes :

- 1ère étape : lorsque la machine est mise en marche, l'unité centrale vérifie l'état « axe à zéro » ;
- 2e étape : l'objet à soumettre au traitement de diamantage de fabrication est installé sur la machine, manuellement ou au moyen d'un chargeur pourvu d'un préhenseur ;
- 3e étape : un palpeur mécanique, un laser, un scanneur ou un autre dispositif adapté à cet usage, balaye la conformation de la surface de l'objet en cours de traitement et transmet les données à l'unité centrale ;
- 4e étape : l'unité centrale transmet les données reçues à la mémoire, qui produit l'image virtuelle de l'objet, visible en sortie graphique ;
- 5e étape : par le biais de l'unité de programme, l'opérateur définit les paramètres de travail de sorte que la machine suive les limites logicielles et mécaniques qui définissent les limites spatiales de la zone à diamanter et les caractéristiques de conformation du profil de diamantage, c'est-à-dire la profondeur et l'orientation des micro-entailles, de sorte que les parois desdites entailles puissent réfléchir la lumière, toutes de manière égale, afin de garantir une réflexion et une brillance uniformes, qui caractérisent l'objet fabriqué final ;
- 6e étape : l'unité centrale traite les données reçues et transmet les informations d'activité à l'unité programmée pour activer les axes ;
- 7e étape : par le biais de l'unité centrale, à partir de la position zéro, l'outil (U) atteint l'objet à traiter et est positionné sur une zone précise, déterminée auparavant au moyen du palpeur ;
- 8e étape : lorsque les axes entre l'outil et l'objet sont mutuellement positionnés à 90°, l'outil commence à graver le matériau jusqu'à ce que le traitement de diamantage de fabrication soit terminé ;
- 9e étape : le premier objet diamanté est retiré de la machine de manœuvre, ledit traitement de diamantage **prévoyant que** ledit premier objet réalisé soit considéré comme un « objet d'échantillon » et le procédé de fabrication pour le traitement de diamantage du deuxième objet et des objets suivants de la même série comprend les étapes suivantes :
- étape I : le chargeur prend un nouvel objet (le deuxième) du dispositif d'alimentation ;
- étape II : le chargeur amène l'objet à la « zone de contrôle d'objet » où, à l'aide d'un palpeur laser, d'un scanneur 3D ou d'autres systèmes de vision qui peuvent détecter des valeurs (exprimées en valeurs numériques interprétables) ou prendre des images (exprimées en pixels interprétables), le chargeur-préhenseur est orienté de façon à positionner l'objet correctement dans les « points de préhension », définis au cours du procédé de fabrication pour le traitement de diamantage du premier objet ou « objet d'échantillon » ;
- étape III : un palpeur mécanique, un laser ou un autre type de système explore la conformation de la surface de l'objet en cours de traitement sur 360° ou sur de plus petites portions de ladite surface et transmet les données obtenues à l'unité centrale ;
- étape IV : l'unité centrale traite les données reçues et effectue une opération de comparaison avec les données correspondantes concernant l'« objet d'échantillon », de sorte qu'elle détecte les différences et les imperfections par rapport aux portions de surface correspondantes de l'« objet d'échantillon » susmentionné ;
- étape V : l'unité centrale traite les données reçues et, en fonction des différences détectées, applique et adapte le motif de diamantage de l'« objet d'échantillon » mémorisé précédem-

ment à la nouvelle conformation et transmet les nouvelles données d'activité à l'unité programmée pour activer les axes ;
- étape VI : par le biais de l'unité centrale, à partir de la position zéro, l'outil atteint le nouvel objet à traiter et est positionné sur la zone précise à diamanter ;
- étape VII : lorsque les axes entre l'outil et l'objet sont mutuellement positionnés à 90°, l'outil commence à graver le matériau jusqu'à ce que le traitement de diamantage de fabrication soit terminé ;
- étape VIII : le deuxième objet diamanté, présentant le même diamantage que l'« objet d'échantillon », est retiré de la machine de manœuvre.

2. PROCÉDÉ, selon la revendication 1, **caractérisé en ce que**, à la suite de la première nouvelle fonction additionnelle, appliquée au deuxième objet individuel, ainsi qu'aux objets individuels suivants, après le couplage par le chargeur à l'aide d'un palpeur, d'un laser ou d'un autre type de dispositif de lecture, l'orientation des trous ou points de maintien dans l'espace est détectée, et les données recueillies sont envoyées à l'unité centrale, qui oriente le manipulateur-préhenseur qui retient l'objet, de telle sorte que ledit objet soit positionné exactement dans les « points de préhension » de la broche, définis avec le traitement du premier objet, de sorte que le nouvel objet à soumettre au traitement de diamantage de fabrication soit orienté exactement dans les mêmes « points de préhension » situés spatialement que les « points de préhension » de l'« objet d'échantillon ».

3. PROCÉDÉ, selon une ou plusieurs des revendications précédentes, **caractérisé en ce que** les coordonnées spatiales qui régulent les déplacements du préhenseur, des objets et de l'outil sont définis à l'aide d'un système de référence élaboré en employant les « angles d'Euler ».

4. PROCÉDÉ, selon une ou plusieurs des revendications précédentes, **caractérisé en ce qu'il** est exécuté sur des objets de toutes formes.

5. PROCÉDÉ, selon une ou plusieurs des revendications précédentes, **caractérisé en ce qu'il** est exécuté sur des objets dépourvus de trous de préhension.

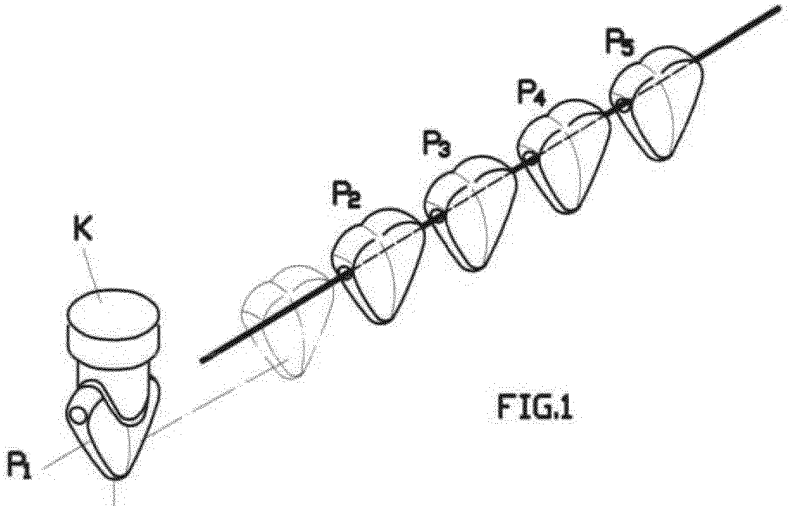

FIG.1

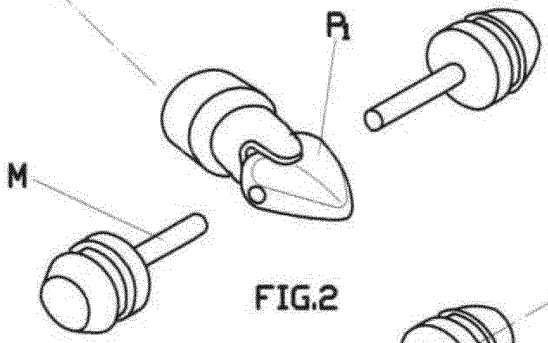

FIG.2

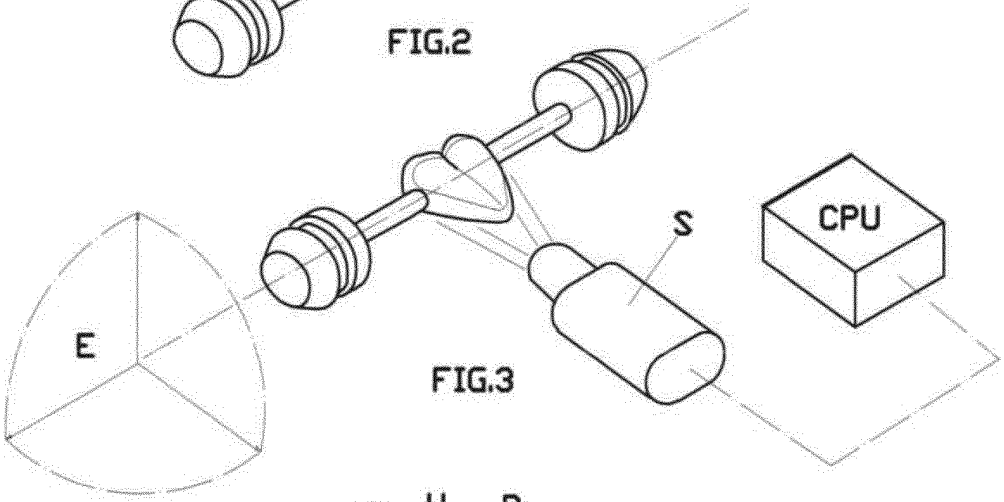

FIG.3

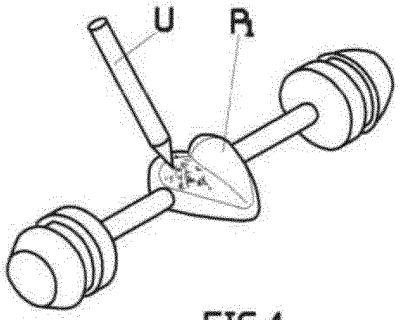

FIG.4

FIG.5

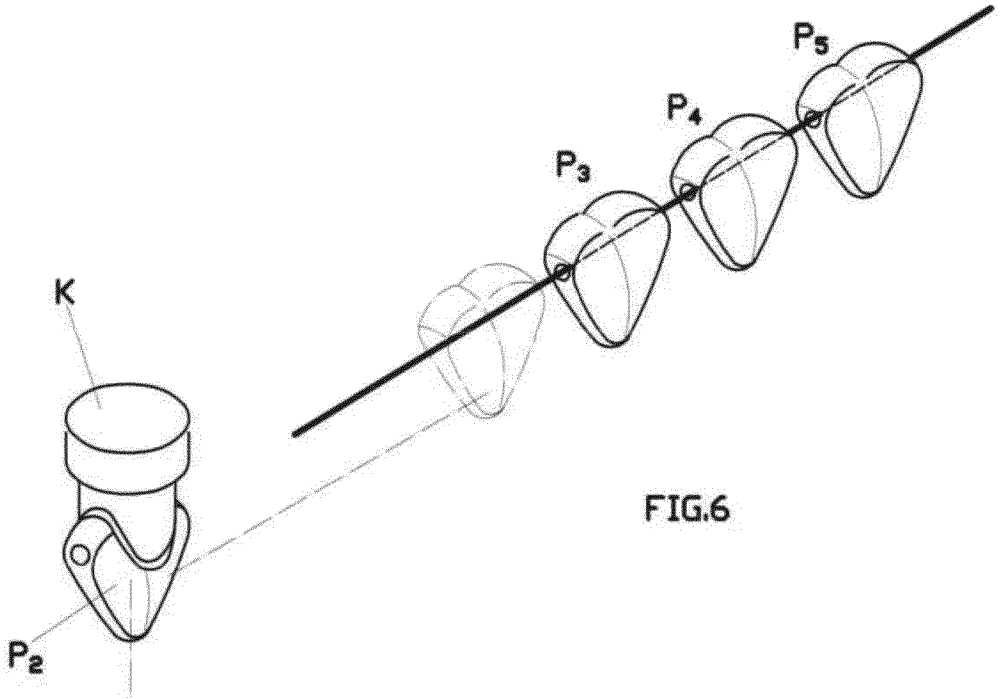

FIG.6

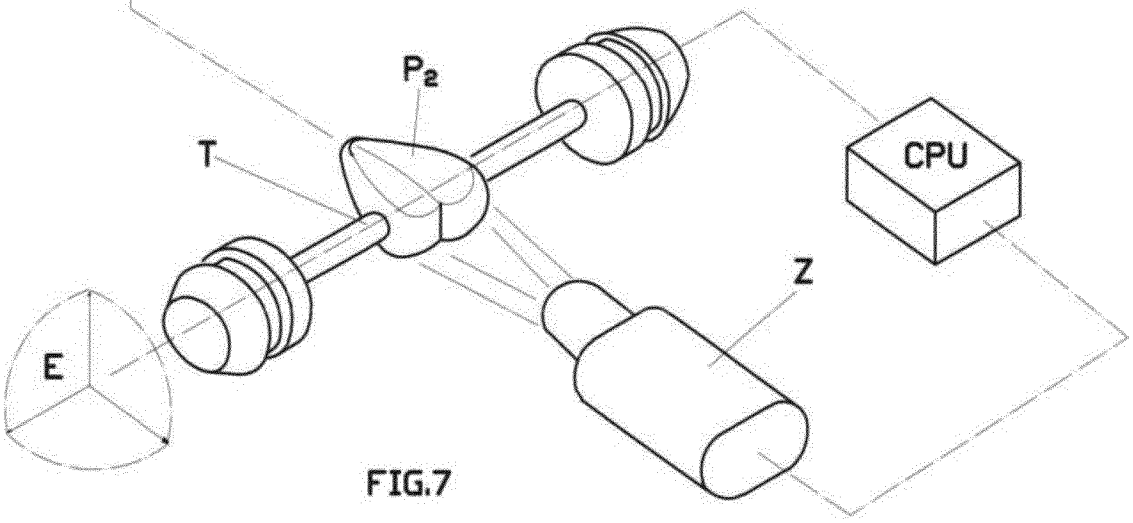

FIG.7

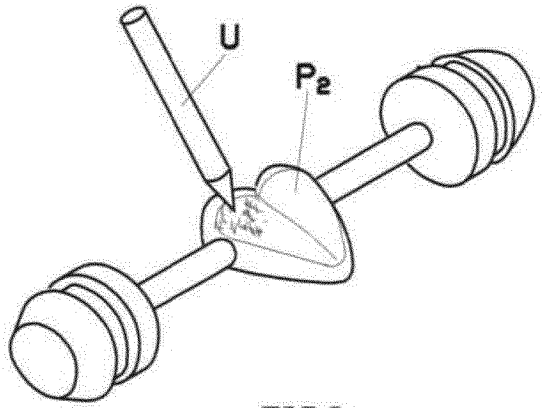

FIG.8

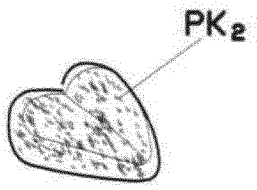

FIG.9

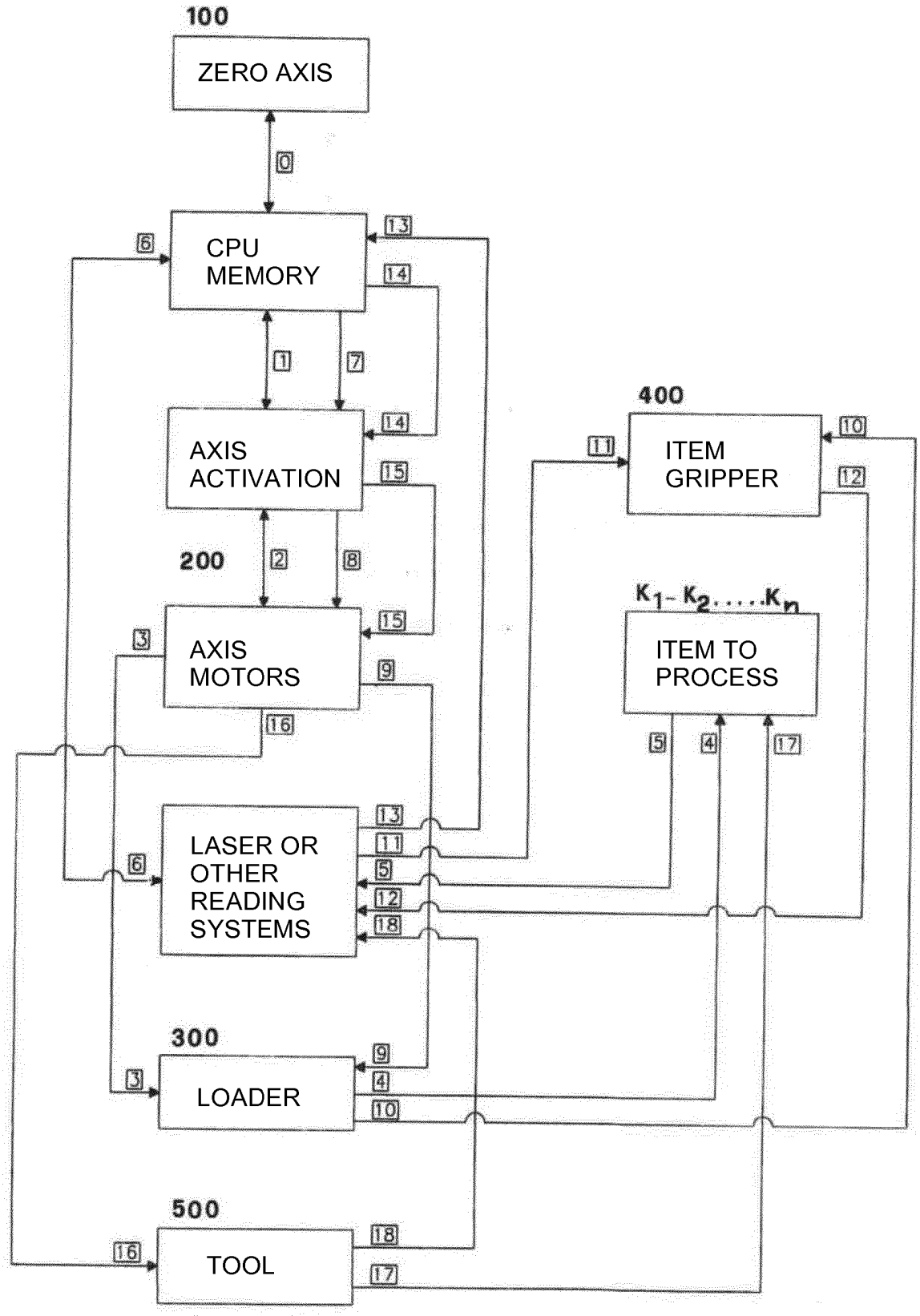
100
ZERO AXIS
0
CPU MEMORY
6
13
14
1
7
AXIS ACTIVATION
14
15
200
2
8
AXIS MOTORS
3
15
9
16
400
ITEM GRIPPER
11
10
12
$K_1 - K_2 \ldots . K_n$
ITEM TO PROCESS
5
4
17
LASER OR OTHER READING SYSTEMS
6
13
11
5
12
18
300
LOADER
3
9
4
10
500
TOOL
16
18
17

FIG.10

REFERENCES CITED IN THE DESCRIPTION

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