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(54) **METHOD FOR MANUFACTURING AN OPHTHALMIC DEVICE HAVING AN OPTICAL FUNCTION INCLUDING AN ADDITION VALUE, AND SET OF OPHTHALMIC DEVICES HAVING DIFFERENT OPTICAL FUNCTIONS**

(57) The disclosure relates to a method for manufacturing an ophthalmic device having an optical function including at least an addition value, comprising: providing (101) a substrate having a first predetermined addition value on a first face, and determining (102) locations of positioning markings amongst the first face and a second face opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device.

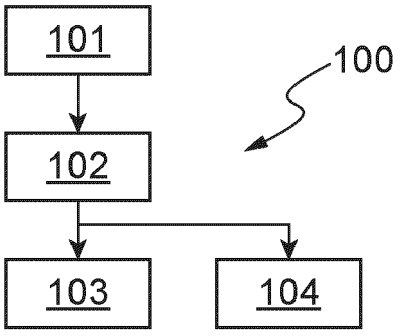

Fig.4

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Description

FIELD OF THE DISCLOSURE

[0001] The disclosure relates to a method for manufacturing an ophthalmic device having an optical function including an addition value.

[0002] The disclosure further relates to a command and control unit including system elements configured to run a computer program in order to implement at least some steps of said method.

[0003] The disclosure also relates to a manufacturing system configured for carrying out at least some steps of said method, and to a computer program including instructions configured to implement at least some steps of said method, when said computer program is run by a computer.

[0004] The disclosure further relates to a client-server communication interface for transferring to a remote computer at least some data which are determined by a computer program that implements at least some steps of said method, when said computer program is run in a command and control unit, the remote computer implementing the other steps of said method.

[0005] The invention also relates to a set of ophthalmic devices having different optical functions including at least a same addition value.

BACKGROUND ART

[0006] It is known to manufacture ophthalmic devices thanks to a machining method carried out by a machining system which machines a substrate, or blank, having a so-called semi-finished face.

[0007] The ophthalmic device may have an optical function including an addition value and a sphere value.

[0008] The substrate is generally selected amongst a set of substrates having a same predetermined material and a plurality of predetermined curvatures and also a plurality of initial addition values on a semi-finished face of the substrate.

[0009] A sub-set of substrates having the same predetermined material and the same predetermined curvature is firstly selected amongst the plurality of substrates, depending on the sphere value to be brought to the ophthalmic device, and independently of the initial addition values.

[0010] Then, a substrate is secondly selected amongst the selected sub-set of substrates having the same predetermined material and the same predetermined curvature, depending on the addition value to be brought to the ophthalmic device.

[0011] If any, depending on the initial value of the selected substrate, a supplemental addition value can be added to another face of the selected substrate, opposite to the semi-finished face of the substrate.

[0012] In addition, the substrate which is selected amongst the selected sub-set of substrates is provided with so-called manufacturing markings on predetermined locations on one of the faces of the substrate.

[0013] Such manufacturing markings are used in order to position the another face relative to the semi-finished face for machining.

[0014] More generally, the another face of the selected substrate is manufactured, for instance by machining, so that the ophthalmic device has the prescribed addition and sphere values.

[0015] Then, further markings called positioning markings, or reference markings, are added by engraving on predetermined locations on one of the faces of the substrate.

[0016] Such positioning markings are used in order to center the ophthalmic device relative to an eye of a wearer thereof.

SUMMARY OF THE DISCLOSURE

[0017] The disclosure is directed to a method for manufacturing an ophthalmic device having an optical function including at least an addition value and from a substrate of the type disclosed above, which is easy and convenient to implement.

[0018] The disclosure accordingly provides, according to a first aspect, a method for manufacturing an ophthalmic device having an optical function including at least an addition value, comprising the step of providing a substrate having a first predetermined addition value on a first face; and wherein the method comprises the step of determining locations of positioning markings amongst the first face and a second face opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and on the addition value to bring to the ophthalmic device.

[0019] According to the disclosure, the ophthalmic device to be manufactured has positioning markings, also called reference markings, which are determined and located either on the first face or on the second face, depending on the first predetermined addition value on the first face and on the addition value to bring to the ophthalmic device.

[0020] Therefore, the selection of the substrate from which is manufactured the ophthalmic device is made also according to the determined locations of the positioning markings.

[0021] Such positioning markings are used in order to center the ophthalmic device relative to an eye of a wearer thereof.

[0022] In addition, thanks to the method according to the disclosure, for a given addition value to bring to the ophthalmic device, it is possible to provide a substrate having a first predetermined addition value on the first face and determined locations either on the first face or on the second face for the positioning markings.

[0023] It is to be noted that the positioning markings can be added further to the step of providing the selected substrate or can be provided with the provided substrate.

[0024] In particular, the provided substrate can comprise further markings called manufacturing markings, which are used in order to position the second face relative to the first face, which is a semi-finished face, for machining the second face. Such manufacturing markings are located on predetermined locations on the first face.

[0025] If it is determined that the positioning markings have to be located on the second face rather than on the first face where are located the manufacturing markings, the positioning markings are engraved on the second face further to the machining of the second face.

[0026] If it is determined that the positioning markings have to be located on the first face where are located the manufacturing markings, such manufacturing markings can be used also as positioning markings, or in variant, the positioning markings are engraved further on the first face further to the machining of the second face.

[0027] In other words, a set of substrates having each for instance a same predetermined material and a same predetermined curvature in addition to a first predetermined addition value on the first face, and amongst which some substrates have the positioning markings located on the first face and some other substrates are devoid of positioning markings located on the first face, but have only manufacturing markings on the first face, can be used for a range of prescribed optical functions and thus for a large set of progressive ophthalmic devices.

[0028] It is to be noted that the method may thus comprise the step of engravings the positioning markings on the determined locations.

[0029] The positioning markings can be formed for instance by micro-circles and/or micro-crosses and/or other shapes of markings.

[0030] The positioning markings can be the markings defined in reference to the norm ISO 10322-2 in the ophthalmic field.

[0031] The optical function to bring to the ophthalmic device may include a sphere value, and the method may comprise the steps of:

- selecting, depending at least on the sphere value to bring to the ophthalmic device, a sub-set of substrates having each a predetermined material and the first face having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and
- selecting, depending on both sphere value and addition value to bring to the ophthalmic device, the provided substrate having the first predetermined addition value on the first face, amongst the sub-set of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values.

[0032] According to the disclosure, the ophthalmic device to be manufactured has an optical function including at least a sphere value and an addition value which are brought to both faces of the ophthalmic device, with the first face of the selected provided substrate which has a selected predetermined curvature chosen as a function of at least the sphere value and which has a selected first predetermined addition value chosen as a function of at least the sphere value and the addition value.

[0033] Because the selected sub-set of substrates and the selected provided substrate amongst the selected sub-set of substrates are chosen both as a function at least of the sphere value to bring to the ophthalmic device, the selections can be done simultaneously so that the selected substrate can be chosen in one step, including also if any the determined positioning markings, or only the locations of the determined positioning markings to be added.

[0034] In other words, in a sub-set of substrates having the same predetermined material and the same predetermined curvature, for a given addition value to bring to the ophthalmic device, the selected provided substrate amongst the sub-set of substrates may have the same first predetermined addition value on the first face or different first predetermined addition values on the first face, for two different sphere values to bring to respective ophthalmic devices, and if any positioning markings on the first face or locations of the determined positioning markings either on the first face or on the second face, depending on the determined locations of these markings.

[0035] Therefore, the method according to the disclosure allows to provide a large set of progressive ophthalmic devices from a limited set of substrates.

[0036] In addition to have the set of substrates, a range of prescribed optical functions including a range of sphere value, addition values and also locations of determined positioning markings can also be proposed for each selected provided substrate amongst the set, and sub-set, of substrates.

[0037] The above shows that not only the sphere value and the addition value, taken independently, plays a role in the selection of the substrate, but they rather here play a role in combination together and with the determined locations of the positioning markings in the method according to the disclosure.

[0038] Advantageous and convenient features of the manufacturing method are described below.

[0039] The optical function to bring to the ophthalmic device includes a cylinder value and the sub-set of substrates is selected also depending on the cylinder value to bring to the ophthalmic device.

[0040] The plurality of first predetermined addition values comprises between 3 and 5 values, for instance between 0,25 diopters and 5 diopters with a pitch between 0,5 diopters and 2 diopters.

[0041] The step of determining locations of positioning markings further depends at least on the first predetermined curvature of the provided substrate and on the sphere value to bring to the ophthalmic device

The positioning markings are located on a face amongst

the first face and the second face of the provided substrate, which is the most complex and/or which has the highest addition value, the complexity being defined by at least one of the parameters amongst a highest cylinder gradient and a highest sphere gradient on the respective face.

[0042] Determining locations of positioning markings takes into account a numerically simulated and/or physically tested optical quality of the ophthalmic device to be manufactured.

[0043] Numerically simulated, respectively physically tested, optical quality includes probability of, respectively actual, inacceptable properties of the ophthalmic device to be manufactured due to manufacturing errors.

[0044] The method comprises a step of determining a second curvature value and a second addition value to bring to the second face of the provided substrate, depending on the first face of the provided substrate and at least on the addition value to bring to the ophthalmic device.

[0045] The method comprises the steps of manufacturing the second face of the provided substrate to bring at least the second curvature value and second addition value thereto and engraving the positioning markings on the determined locations on either the first face or the second face obtained after manufacturing.

[0046] The method comprises the steps of positioning thanks to the positioning markings the ophthalmic device in a frame of spectacle lenses for centering the ophthalmic device relative to an eye of a wearer.

[0047] The disclosure also provides, according to a second aspect, a command and control unit configured for manufacturing an ophthalmic device having an optical function including at least an addition value and including system elements configured to run a computer program in order to implement at least the steps of: providing a substrate having a first predetermined addition value on a first face, and determining locations of positioning markings amongst the first face and a second face opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device.

[0048] The command and control unit may also implement the steps of: selecting, depending at least on a sphere value to bring to an ophthalmic device, a sub-set of substrates having each a predetermined material and comprising a first face having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and selecting, depending on both sphere value and addition value to bring to the ophthalmic device, the provided substrate having the first predetermined addition value on the first face, amongst the sub-set of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values.

[0049] The disclosure also provides, according to a third aspect, a manufacturing system comprising a tool for manufacturing an ophthalmic device having an optical function including at least an addition value, and a command and control unit, the system being configured for carrying out at least the following: providing a substrate having a first predetermined addition value on a first face, and determining locations of positioning markings amongst the first face and a second face opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device.

[0050] The manufacturing system may also be configured for carrying out at least the steps of: determining a second curvature value and a second addition value to bring to the second face of the provided substrate, depending on the first face of the provided substrate and at least on the addition value to bring to the ophthalmic device, manufacturing the second face of the provided substrate so that to obtain the ophthalmic device, and optionally engraving the positioning markings on either the first face or the second face obtained after manufacturing, and also optionally positioning thanks to the positioning markings the ophthalmic device in a frame of spectacle lenses for centering the ophthalmic device relative to an eye of a wearer.

[0051] The manufacturing system may also be configured for carrying out at least the steps of: selecting, depending at least on a sphere value to bring to an ophthalmic device, a sub-set of substrates having each a predetermined material and comprising a first face having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and selecting, depending on both sphere value and addition value to bring to the ophthalmic device, the provided substrate having the first predetermined addition value on the first face, amongst the sub-set of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values.

[0052] The disclosure also provides, according to a fourth aspect, to a computer program including instructions configured to implement at least the steps of: providing a substrate having a first predetermined addition value on a first face, and determining locations of positioning markings amongst the first face and a second face opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device, when said computer program is run by a computer.

[0053] The computer program may also be configured to implement at least the steps of: selecting, depending at least on a sphere value to bring to the ophthalmic device, a sub-set of substrates having each a predetermined material and comprising a first face having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and selecting, depending on both sphere value and addition

value to bring to the ophthalmic device, the provided substrate having the first predetermined addition value on the first face, amongst the sub-set of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values, when said computer program is run by a computer.

[0054] The disclosure also provides, according to a fifth aspect, a client-server communication interface to be used for carrying out a method for manufacturing an ophthalmic device having an optical function including at least an addition value, comprising: providing a substrate having a first predetermined addition value on a first face, and determining locations of positioning markings amongst the first face and a second face opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device; the client-server communication interface being configured for transferring to a remote computer at least some data, such as locations of positioning markings, which are determined by a computer program that implements at least some steps of the method, when said computer program is run in a command and control unit, the remote computer implementing the other steps the method.

[0055] The client-server communication interface may also be used for carrying out the steps of: selecting, depending at least on the sphere value to bring to the ophthalmic device, a sub-set of substrates having each a predetermined material and comprising a first face having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and selecting, depending on both sphere value and addition value to bring to the ophthalmic device, the provided substrate having the first predetermined addition value on the first face, amongst the sub-set of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values; the client-server communication interface being configured for transferring to a remote computer at least some data, such as sphere value and addition value, which is determined by a computer program that implements at least some steps of the method, when said computer program is run in a command and control unit, the remote computer implementing the other steps the method.

[0056] The disclosure also provides, according to a sixth aspect, a set of ophthalmic devices having different optical functions including at least a same addition value, the ophthalmic devices being made from provided substrates having different first predetermined addition values on respective first faces of the substrates, some substrates having determined locations for positioning markings on the first face and some other substrates having determined locations for positioning markings on a second face opposite to the first face.

[0057] The set of ophthalmic devices may also have different optical functions including different sphere values and a same addition value, the ophthalmic devices being made from provided substrates having different first predetermined addition values on respective first faces of the substrates, the substrate being selected amongst a sub-set of substrates having a same predetermined material and a same first predetermined curvature and a plurality of first predetermined addition values on the respective first faces.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058] The description of the disclosure now continues with a detailed description of advantageous embodiments given hereinafter by way of nonlimiting example and with reference to the appended drawings.

Figure 1 schematically depicts a manufacturing system comprising a machining device and a command and control unit, configured to carry out steps of a method for manufacturing an ophthalmic device, according to the disclosure.

Figure 2 diagrammatically shows a client-server communication interface comprising system parts configured for transferring at least some data determined by the method according to the disclosure, to a remote data processing system.

Figure 3a is a section view of a substrate provided and manufactured in order to obtain the ophthalmic device thanks to the method according to the disclosure.

Figure 3b is a top view of the provided substrate of Figure 3a.

Figure 3c is a rear view of a variant of the provided substrate of Figure 3a.

Figure 4 is a block diagram illustrating main operating steps of the method for manufacturing an ophthalmic device obtained thanks to the manufacturing system and/or to the client-server communication interface illustrated in Figures 1 and 2.

Figure 5 is a block diagram illustrating more detailed operating steps of the method for manufacturing an ophthalmic device illustrated in Figure 4.

Figure 6 represents a determined table which can be stored in a command and control unit of the manufacturing system and/or of the client-server communication interface illustrated in Figures 1 and 2, used for determining the selected and provided substrate.

Figure 7a represents a quality map of an ophthalmic device made from a selected and provided substrate for instance thanks to Figure 6, with locations of positioning markings located on a first face of the substrate.

Figure 7b is similar to Figure 7a, representing a quality map of an ophthalmic device made from a selected and provided substrate, with positioning markings located on a second face opposite to the first face of the substrate.

Figure 7c is similar to Figures 7a and 7b, representing a quality map of an ophthalmic device made from a selected and provided substrate, with positioning markings located both on the first face and second face, depending on an addition value of an optical function of the ophthalmic substrate.

Figure 7d is similar to Figure 6 except that it represents the locations of the position markings on the determined table.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

[0059] The disclosure is directed to a method for manufacturing an ophthalmic device from a selected and provided substrate in a set of determined substrates.

[0060] In particular, thanks to the method according to the disclosure, it is possible to provide a large set of progressive ophthalmic devices from a limited set of substrates.

[0061] Figure 1 illustrates a manufacturing system configured to carry out the manufacturing of the ophthalmic device from the selected and provided substrate 3.

[0062] The system may comprises a manufacturing machine 21 and system parts generally formed by at least one command and control unit 22 configured to communicate with a data processing system (or control unit) of the machine 21 and configured to run a computer program having instructions configured to implement at least the manufacturing step of the method, when said computer program is run by a computer.

[0063] The machine 21 is here a numerical-control machine, numerical control denoting the set of equipment and software, the function of which is to give movement instructions to all the elements of the machine.

[0064] The machine 21 comprises here a cutting tool 27 and a data processing system or a control unit (not shown) configured for controlling the cutting-tool 27, which is for instance mounted on a moveable arm.

[0065] The command and control unit 22 comprises a microprocessor 23 having a memory 24, in particular a non-volatile memory, allowing it to load and store the computer program, also called software, which when it is executed in the microprocessor 23, allows the implementation of method according to the disclosure.

[0066] This non-volatile memory 24 is for example of the ROM ("read only memory") type.

[0067] The command and control unit 22 further comprises a memory 25, in particular a volatile memory, allowing data to be stored during the execution of the software and the implementation of the method.

[0068] This volatile memory 25 is for example of the RAM or EEPROM type (respectively "random access memory" and "electrically erasable programmable read only memory").

[0069] The command and control unit may be only at least partially integrated into the machine. In other words, the control unit may be arranged in part, or in whole, outside the machine.

[0070] The command and control unit can form at least partially a part of the machine and may comprise one or a plurality of command and control modules located inside and/or outside the machine.

[0071] The machine 21 is here configured to machine at least a face of the selected and provided substrate 3 which is mounted according to a determined position on a blocking device 4 in order to form the ophthalmic device.

[0072] The machine 21 can also be configured to engrave the positioning markings on the determined locations on the provided substrate, after machining.

[0073] The command and control unit 22 is configured to command and control at least some steps of the manufacturing method described below in reference to Figures 4 and 5.

[0074] Figure 2 shows a client-server communication interface 26 comprising for instance a so-called supplier side 29a and another, so-called client side 29b, and these two sides communicating via an internet interface 28.

[0075] The supplier side comprises a server 29a linked to a data processing system or a command and control unit 22a of the same type as that in Figure 1, this server 29a being configured to communicate with the internet interface 28.

[0076] The client side 29b is configured to communicate with the internet interface 28, and is linked to a data processing system or a command and control unit 22b of the same type as that of the supplier side.

[0077] Further, the command and control unit 22b on the client-side is linked to a manufacturing machine 21b of the same type as that in Figure 1 for manufacturing at least a face of the ophthalmic substrate 3.

[0078] For instance, the command and control unit 22b on the client-side is configured for receiving by a user some parameters about the ophthalmic device to be manufactured and in particular an optical function including at least an addition value, a sphere value and/or a cylinder value.

[0079] The command and control unit 22b on the client-side, using the internet 28 and server 29a interface, sends the data received to the command and control unit 22a on the supplier-side for the determination of other parameters, such as locations of positioning markings on the substrate 3.

[0080] The command and control unit 22a on the supplier-side executes the computer program that it contains in order to determine the locations of the positioning markings.

[0081] The command and control unit 22a on the supplier-side executes the computer program that it contains in order to select, depending at least on a sphere value to bring to the ophthalmic device, a sub-set of substrates having each a predetermined material and comprising a first face having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and to select, depending on both sphere value and addition value to bring to the ophthalmic de-

vice, the provided substrate 3 having the first predetermined addition value on the first face, amongst the subset of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values.

[0082] Using the server 29a and the internet interface 28, the command and control unit 22a on the supplier-side sends the manufacturing file and operational parameters, namely at least the determined locations of positioning markings on the selected and provided substrate 3.

[0083] The command and control unit 22b on the client side is here configured to execute software for implementing the other steps of the method for manufacturing the ophthalmic device thanks to the manufacturing system 21b.

[0084] In variant, a step of determining locations of positioning markings can be carried out by the command and control unit 22b on the client side.

[0085] In another variant, the manufacturing system can be located on the supplier side so that the command and control unit 22a on the supplier side is further configured to machine the ophthalmic surface.

[0086] Figures 3a to 3c show the selected and provided substrate 3 which is to be manufactured in order to obtain the ophthalmic device thanks to the method according to the disclosure.

[0087] The selected and provided substrate 3 is made from a predetermined material.

[0088] The selected and provided substrate 3 has a first face 11, which is here a semi-finished face, having a first predetermined curvature value and a first predetermined addition value.

[0089] The selected and provided substrate 3 has a second face 12, opposite to the first face 11, and an edge 10 defining an outline and joining the first face 11 and the second face 12.

[0090] In Figure 3b, the selected and provided substrate 3 has also some positioning markings 14 for instance in a shape of micro-crosses and which are here located on the first face 11 on determined locations.

[0091] In particular, the manufacturing markings 14 are made on the first face 11 of the selected and provided substrate 3 and are used for positioning the second face 12 relative to the first face 11, which is a semi-finished face, on the blocking device 4, at least for machining the second face 12, so as to obtain the ophthalmic device having at least the finished or semi-finished second face 13, thus acting as manufacturing markings.

[0092] In this respect, the finished or semi-finished second face 13 may comprise a second curvature value and/or a second addition value, so that the ophthalmic device thus obtained has a prescribed optical function including at least the addition value, the sphere value and/or the cylinder value.

[0093] The finished lens will also include positioning markings. According to the disclosure, such positioning markings can be located either on the first face 11 or on the finished or semi-finished second face 13 obtained from the second face 12, and especially on the face which is the most complex and/or which has the highest addition value.

[0094] In other words, the positioning markings can be different from the manufacturing markings 14.

[0095] Figure 3c is a rear view of the ophthalmic device obtained from the selected and provided substrate 3 and machined, showing the finished or semi-finished second face 13 obtained from the second face 12 manufactured and on which are engraved positioning markings 14 here in a shape of micro-circles. The positioning markings 14 on Figure 3c are also manufacturing markings.

[0096] It is to be noted that the complexity is defined by at least one of the parameters amongst a highest cylinder gradient and a highest sphere gradient on the respective face of the selected and provided substrate 3.

[0097] Figure 4 shows steps for manufacturing 100 the ophthalmic device from the selected and provided substrate 3, the ophthalmic device having an optical function including at least the addition value, the sphere value and/or the cylinder value, thanks to the system and/or to the client-server communication interface illustrated in Figures 1 and 2.

[0098] In a first embodiment, the method comprises the step of providing 101 a substrate having a first predetermined addition value on the first face 11, and the step of determining 102 locations of the positioning markings 14 made amongst the first face 11 and the second face 12 opposite to the first face 11, the locations of the positioning markings 14 being determined depending at least on the first predetermined addition value on the first face 11 of the selected and provided substrate 3 and on the addition value to bring to the ophthalmic device.

[0099] The method may then comprise the step of selecting 103 the substrate having the positioning markings 14 on the determined locations or being devoid of positioning markings amongst a set of substrates having the first predetermined addition value on the first face 12 and positioning markings 14 on different locations or devoid of positioning markings.

[0100] In variant, the method may comprise the step of engravings 104 the markings on the determined locations on the provided substrate 3 if not yet engraved.

[0101] In a second embodiment illustrated on Figure 5, which can be combined to the first embodiment, the method further comprises the step of receiving 105 the optical function including the addition value, the sphere value and if any the cylinder value to bring to the ophthalmic device.

[0102] The method comprises the step of selecting 106, depending at least on the sphere value and if any cylinder value to bring to the ophthalmic device, a sub-set of substrates being each made from the same predetermined material and having each the first face having the first predetermined curvature, amongst a set of substrates having different materials and different curvatures.

[0103] The method comprises the step of selecting 107, depending on the sphere value, if any the cylinder value, and the addition value to bring to the ophthalmic device, the provided substrate 3 having the first predetermined addition value on the first face 11, amongst the sub-set of substrates having the predetermined material and the first predetermined curvature and a plurality of first predetermined addition values.

[0104] The plurality of first predetermined addition values may comprise between 3 and 5 values, for instance between 0,25 diopters and 5 diopters with a pitch between 0,5 diopters and 2 diopters.

[0105] The method may then comprise the step of determining 102 locations of the positioning markings 14, depending on the first predetermined addition value and on the first predetermined curvature on the first face 11 of the selected and provided substrate 3, and on the addition value and sphere value and if any on cylinder value to bring to the ophthalmic device.

[0106] The method may further comprises the step of determining 108 a second curvature value and a second addition value to bring to the second face 12 of the selected and provided substrate 3, depending on the first face 11 of the selected and provided substrate 3 and at least on the addition value to bring to the ophthalmic device.

[0107] The method may also comprise the steps of positioning 109 the selected and provided substrate 3 thanks to the manufacturing markings (whcich can be the same as the positioning markings), and manufacturing 110, for instance by machining, the second face 12 of the selected and provided substrate 3 to bring at least the second curvature value and the second addition value thereto, in order to obtain the finished or semi-finished second face 13 of the ophthalmic device.

[0108] The method then comprises, if any, the step of engravings 104 (illustrated in Figure 4) the positioning markings 14 on the determined locations on the first face 11 or on the finished or semi-finished second face 13 obtained from the second face 12.

[0109] It is to be noted that the step of determining 102 locations of the positioning markings 14 may take into account a numerically simulated optical quality of the ophthalmic device to be manufactured, the numerically simulated optical quality including probability of inacceptable properties of the ophthalmic device to be manufactured due to manufacturing errors.

[0110] In variant or in combination, the step of determining 102 locations of the positioning markings 14 may take into account a physically tested optical quality of the ophthalmic device to be manufactured, the physically tested optical quality including actual inacceptable properties of the ophthalmic device to be manufactured due to manufacturing errors.

[0111] Figure 6 represents a determined table used for determining the selected and provided substrate 3.

[0112] In particular, the table is here provided for a set of substrates made from a predetermined material and with the first face having a first predetermined curvature.

[0113] The substrates of the set of substrates have here for instance three distinct first predetermined addition values, namely FA1 diopters, FA2 diopters and FA3 diopters, on the first face of the substrate.

[0114] The table shows that the first predetermined addition values amongst FA1, FA2 and FA3 can be selected depending on both the addition value and the sphere value to bring to the ophthalmic device.

[0115] In addition, the table shows that for a given addition value to bring to the ophthalmic device, the choice of the first predetermined addition values amongst FA1, FA2 and FA3 may be done depending on the sphere value to bring to the ophthalmic device.

[0116] Said otherwise, the table also shows that a large range of prescribed optical function can be brought to the ophthalmic device for a given set of substrates.

[0117] It is to be noted that the second addition value to bring to the second face of the substrate can be determined thanks to the first predetermined addition values and the addition value. The second addition value can be positive or negative.

[0118] It is the same for the second curvature value to bring to the second face of the substrate, which is thus determined at least thanks to the first predetermined curvature and to the sphere value and, if any cylinder value.

[0119] Such table can be duplicated at least with different materials and/or first predetermined curvatures of the substrates.

[0120] In addition, as explained below, such table can be built for more than three first predetermined addition values, and more generally between 3 and 5 values, for instance between 0,25 diopters and 5 diopters with a pitch between 0,5 diopters and 2 diopters.

[0121] The tables can be stored in a command and control unit of the manufacturing system and/or of the client-server communication interface illustrated in Figures 1 and 2 and can be used for determining the selected and provided substrate 3 from which is made the ophthalmic device.

[0122] Figure 7a represents the quality map of the ophthalmic device made from the selected and provided substrate 3, for instance thanks to the above described table(s), when the positioning markings 14 are located on the first face 11 thereof.

[0123] In other words, the positioning markings 14 are located on the first face 11 whatever the location on the table illustrated in Figure 6.

[0124] To be noted that the positioning markings can be also the manufacturing markings or can be different to the manufacturing markings.

[0125] As explained above, the optical quality can be numerically simulated and/or physically tested, based respectively on probability of and/or actual inacceptable properties of the ophthalmic device to be manufactured due to manufacturing errors caused by the positioning of the selected and provided substrate on the blocking

device for the machining of the second face.

[0126] The optical quality is here obtained from simulations and classified from a first level to a fourth level, from light gray to dark gray, referenced L1, L2, L3 and L4. The first level corresponding to the lighter gray refers to negligible errors and thus high quality while the fourth level corresponding to the darker gray refers to high errors and thus low quality.

[0127] In particular, Figure 7a illustrates that the locations of the positioning markings 14 can be determined at least from simulations, by modeling an ophthalmic device with positioning markings on the first face corresponding to a front diopter, simulating a positioning error of the second face corresponding to the rear diopter with respect to the front diopter of the ophthalmic device, assuming that the front diopter is correctly positioned with respect to a wearer's eye, and evaluating a performance of such an ophthalmic device for the wearer.

[0128] Figure 7a shows a first distribution of the optical quality from the first level to the fourth level, depending on the optical function including addition value and sphere value of simulated ophthalmic devices.

[0129] Figure 7b is similar to Figure 7a, representing the quality map of the ophthalmic device made from the selected and provided substrate 3, when the positioning markings 14 are located on the second face 12 thereof.

[0130] In other words, the positioning markings 14 are located on the second face 12 whatever the location on the table illustrated in Figure 6.

[0131] Therefore, Figure 7b illustrates that the locations of the positioning markings 14 can be determined at least from simulations, by modeling an ophthalmic device with positioning markings on the rear diopter, simulating a positioning error of the front diopter with respect to the rear diopter of the ophthalmic device, assuming that the rear diopter is correctly positioned with respect to a wearer's eye, and evaluating a performance of such an ophthalmic device for the wearer.

[0132] Figure 7b shows a second distribution of the optical quality from the first level to the fourth level, depending on the optical function including addition value and sphere value of simulated ophthalmic devices.

[0133] The second distribution clearly differs from the first distribution, thus showing that it is possible to determine the best locations of the positioning markings from the above simulations, depending on the optical function and thanks to the above described table(s).

[0134] In this respect, Figure 7c is thus similar to Figures 7a and 7b, and represents the quality map of the ophthalmic device made from the selected and provided substrate 3, when the positioning markings 14 are located both on the first face 11 and second face 12 thereof, depending at least on the first predetermined addition value on the first face 11 and on the first predetermined curvature, and on the addition value and sphere value to bring to the ophthalmic device.

[0135] In other words, the positioning markings 14 are located either on the first face 11 or on the second face 12 depending on the locations on the table illustrated in Figure 6.

[0136] It is illustrated in Figure 7d which is similar to Figure 6 and which shows on which areas of the table the positioning markings 14 are located on the first face 11 and on the second face 12.

[0137] In this example, the positioning markings 14 are located on the first face 11 on the area of the table corresponding to FA2 and FA3, referenced Front on Figure 7d, and on the second face 12 on another area of the table corresponding to FA1, referenced Rear on Figure 7d.

[0138] Figure 7c thus shows a third distribution of the optical quality only from the first level to a second level of optical quality, depending on the optical function including addition value and sphere value of simulated ophthalmic devices.

[0139] Therefore, Figure 7c illustrates that the locations of the positioning markings 14 can be determined as an optimal manner thanks to the above simulations, by choosing, in reference to Figure 7d, the locations of the positioning markings that provide the awaited performances for the wearer in term of quality and in the presence of positioning errors.

[0140] Such a third distribution can be also physically tested with wearers in order to confirm the optical quality in real-life conditions.

[0141] According to the disclosure, the ophthalmic device to be manufactured has thus positioning markings 14 which are determined and located either on the first face 11 or on the second face 12, depending on the first predetermined addition value on the first face 11 and on the addition value to bring to the ophthalmic device.

[0142] Therefore, the selection of the substrate 3 from which is manufactured the ophthalmic device is made also according to the determined locations of the positioning markings 14.

[0143] In addition, thanks to the method according to the disclosure, for a given addition value to bring to the ophthalmic device, it is possible to provide a substrate 3 having a first predetermined addition value on the first face 11 and determined locations either on the first face 11 or on the second face 12 for the positioning markings 14.

[0144] As explained above, if it is determined that the positioning markings 14 have to be located on the first face 11 where are located manufacturing markings, such manufacturing markings can be used also as positioning markings, or in variant, the positioning markings are engraved further on the first face further to the machining of the second face. In this case, it is possible to provide the substrate 3 with the positioning markings 14.

[0145] In contrast, if it is determined that the positioning markings 14 have to be located on the second face 12 rather than on the first face 11 where are located manufacturing markings, the positioning markings 14 are engraved on the second face further to the machining of the second face 12. In this case, it is possible to provide

the substrate 3 without the positioning markings, which are engraved later.

[0146] In other words, a set of substrates having each for instance a same predetermined material and a same predetermined curvature in addition to a first predetermined addition value on the first face, and amongst which some substrates have the positioning markings located on the first face and some other substrates are devoid of positioning markings located on the first face, but have only manufacturing markings on the first face, can be used for a range of prescribed optical functions and thus for a large set of progressive ophthalmic devices.

[0147] Therefore, the method according to the disclosure allows to manufacture a set of ophthalmic devices having different optical functions including at least a same addition value, the ophthalmic devices being made from provided substrates 3 having different first predetermined addition values on the respective first faces 11 of the substrates, some substrates having determined locations for positioning markings 14 on the first face 11 and some other substrates having determined locations for positioning markings 12 on a second face 12 opposite to the first face 11.

[0148] In addition, according to the disclosure, the ophthalmic device to be manufactured has an optical function including at least a sphere value and an addition value which are brought to both faces of the ophthalmic device, with the first face 11 of the selected provided substrate 3 which has a selected first predetermined curvature chosen as a function of at least the sphere value and which has a selected first predetermined addition value chosen as a function of at least the sphere value and the addition value.

[0149] Because the selected sub-set of substrates and the selected provided substrate amongst the selected sub-set of substrates are chosen both as a function at least of the sphere value to bring to the ophthalmic device, the selections can be done simultaneously so that the selected substrate can be chosen in one step, including also the determined positioning markings 14.

[0150] In other words, in a sub-set of substrates having the same predetermined material and the same predetermined curvature, for a given addition value to bring to the ophthalmic device, the selected provided substrate 3 amongst the sub-set of substrates may have the same first predetermined addition value on the first face 11 or different first predetermined addition values on the first face 11, for two different sphere values to bring to respective ophthalmic devices, and if any positioning markings 14 on the first face 11 or locations of the determined positioning markings 14 either on the first face 11 or on the second face 12, depending on the determined locations of these positioning markings.

[0151] Therefore, the method according to the disclosure allows to provide a large set of progressive ophthalmic devices from a limited set of substrates 3.

[0152] In particular, the method according to the disclosure allows to use a so-called "semi-finished mappings" based for instance on Figures 6 and 7a-d where the complexity of the ophthalmic device is either on the first face or on the second face, by taking into account good performances for the wearer in spite of potential positioning errors between the opposite faces of the ophthalmic device.

[0153] The set of ophthalmic devices may also have different optical functions including different sphere values and a same addition value, the ophthalmic devices being made from provided substrates 3 having different first predetermined addition values on respective first faces 11 of the substrates, the substrate being selected amongst a sub-set of substrates having a same predetermined material and a same first predetermined curvature and a plurality of first predetermined addition values on the respective first faces 11.

[0154] In addition to have the set of substrates, a range of prescribed optical functions including a range of sphere value, addition values and also locations of determined positioning markings 14 can also be proposed for each selected provided substrate 3 amongst the set, and sub-set, of substrates.

[0155] The above also shows that not only the sphere value and the addition value, taken independently, plays a role in the selection of the substrate 3, but they rather here play a role in combination together and with the determined locations of the positioning markings 14 in the method according to the disclosure.

[0156] Furthermore, the method according to the disclosure can be used for making aesthetic ophthalmic devices, for instance having a thinner edge and a limited center thickness despite the progressive prescribed features.

[0157] Indeed, the distribution of the addition values on the opposite faces of the ophthalmic device can be defined based on aesthetics considerations. For instance, if we want to obtain an ophthalm ic device as flat as possible, a substrate having a low addition value on a front face can be selected so that to add a higher addition value on a rear face. In another example, including hyperopes high add, the ophthalmic device may become biconvex if the substrate has a too low first curvature. A substrate having a major part or all the addition of the ophthalmic device can be selected so as to obtain a flatter ophthalmic device without biconvexity.

[0158] It should be noted more generally that the disclosure is not limited to the examples described and represented.

Claims

1. Method for manufacturing an ophthalmic device having an optical function including at least an addition value, comprising providing (101) a substrate (3) having a first predetermined addition value on a first face (11); wherein the method comprises determining (102) locations of positioning markings (14)

amongst the first face and a second face (12) opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device.

2. Method according to claim 1, wherein the optical function to bring to the ophthalmic device includes a sphere value, the method comprising:

- selecting (106), depending at least on the sphere value to bring to the ophthalmic device, a sub-set of substrates having each a predetermined material and the first face (11) having a first predetermined curvature, amongst a set of substrates having different materials and different curvatures; and
- selecting (107), depending on both sphere value and addition value to bring to the ophthalmic device, the provided substrate (3) having the first predetermined addition value on the first face (11), amongst the sub-set of substrates having a predetermined material and a first predetermined curvature and a plurality of first predetermined addition values.

3. Method according to claim 2, wherein the optical function to bring to the ophthalmic device includes a cylinder value and the sub-set of substrates is selected also depending on the cylinder value to bring to the ophthalmic device.

4. Method according to one of claims 2 and 3, wherein the plurality of first predetermined addition values comprises between 3 and 5 values, for instance between 0,25 diopters and 5 diopters with a pitch between 0,5 diopters and 2 diopters.

5. Method according to any one of claims 2 to 4, wherein determining (102) locations of positioning markings (14) further depends at least on the first predetermined curvature of the provided substrate (3) and on the sphere value to bring to the ophthalmic device.

6. Method according to any one of claims 1 to 5, wherein the positioning markings (14) are located on a face amongst the first face (11) and the second face (12) of the provided substrate (3), which is the most complex and/or which has the highest addition value, the complexity being defined by at least one of the parameters amongst a highest cylinder gradient and a highest sphere gradient on the respective face.

7. Method according to any one of claims 1 to 6, wherein determining (102) locations of positioning markings (14) takes into account a numerically simulated and/or physically tested optical quality of the ophthalmic device to be manufactured.

8. Method according to any one of claims 1 to 7, comprising determining (108) a second curvature value and a second addition value to bring to the second face (12) of the provided substrate (3), depending on the first face (11) of the provided substrate and at least on the addition value to bring to the ophthalmic device.

9. Method according to claim 8, comprising manufacturing the second face (12) of the provided substrate (3) to bring at least the second curvature value and second addition value thereto and optionaly engraving the positioning markings (14) on the determined locations on either the first face (11) or the second face (12) obtained after manufacturing.

10. Command and control unit configured for manufacturing an ophthalmic device having an optical function including at least an addition value and including system elements configured to run a computer program in order to implement at least the following: providing (101) a substrate (3) having a first predetermined addition value on a first face (11), and determining (102) locations of positioning markings (14) amongst the first face and a second face (12) opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device.

11. Manufacturing system comprising a tool for manufacturing an ophthalmic device having an optical function including at least an addition value, and a command and control unit, the system being configured for carrying out at least the following: providing (101) a substrate (3) having a first predetermined addition value on a first face (11), and determining (102) locations of positioning markings (14) amongst the first face and a second face (12) opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device.

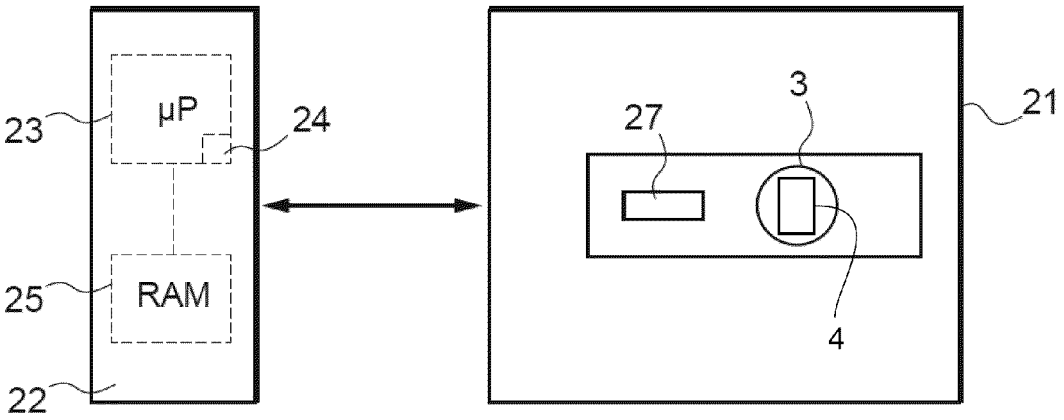
12. Manufacturing system according to claim 11, configured for carrying out the following: determining (108) a second curvature value and a second addition value to bring to the second face (12) of the provided substrate (3), depending on the first face (11) of the provided substrate and at least on the addition value to bring to the ophthalmic device, manufacturing (110) the second face of the provided substrate to bring at least the second curvature value and second addition value thereto so that to obtain the ophthalmic device, and optionally engraving the positioning markings (14) on either the first face or the second

face obtained after manufacturing, and also optionally positioning thanks to the positioning markings the ophthalmic device in a frame of spectacle lenses for centering the ophthalmic device relative to an eye of a wearer.

13. Computer program including instructions configured to implement at least the following: providing (101) a substrate (3) having a first predetermined addition value on a first face (11), and determining (102) locations of positioning markings (14) amongst the first face and a second face (12) opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device, when said computer program is run by a computer.

14. Client-server communication interface to be used for carrying out a method for manufacturing an ophthalmic device having an optical function including at least an addition value, comprising: providing (101) a substrate (3) having a first predetermined addition value on a first face (11), and determining (102) locations of positioning markings (14) amongst the first face and a second face (12) opposite to the first face, depending at least on the first predetermined addition value on the first face of the provided substrate and the addition value to bring to the ophthalmic device; the client-server communication interface being configured for transferring to a remote computer at least some data, such as locations of positioning markings, which are determined by a computer program that implements at least some steps of the method, when said computer program is run in a command and control unit, the remote computer implementing the other steps the method.

15. Set of ophthalmic devices having different optical functions including at least a same addition value, the ophthalmic devices being made from provided substrates (3) having different first predetermined addition values on respective first faces (11) of the substrates, some substrates having determined locations for positioning markings (14) on the first face and some other substrates having determined locations for positioning markings (14) on a second face (12) opposite to the first face.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µP
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RAM
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Fig.1

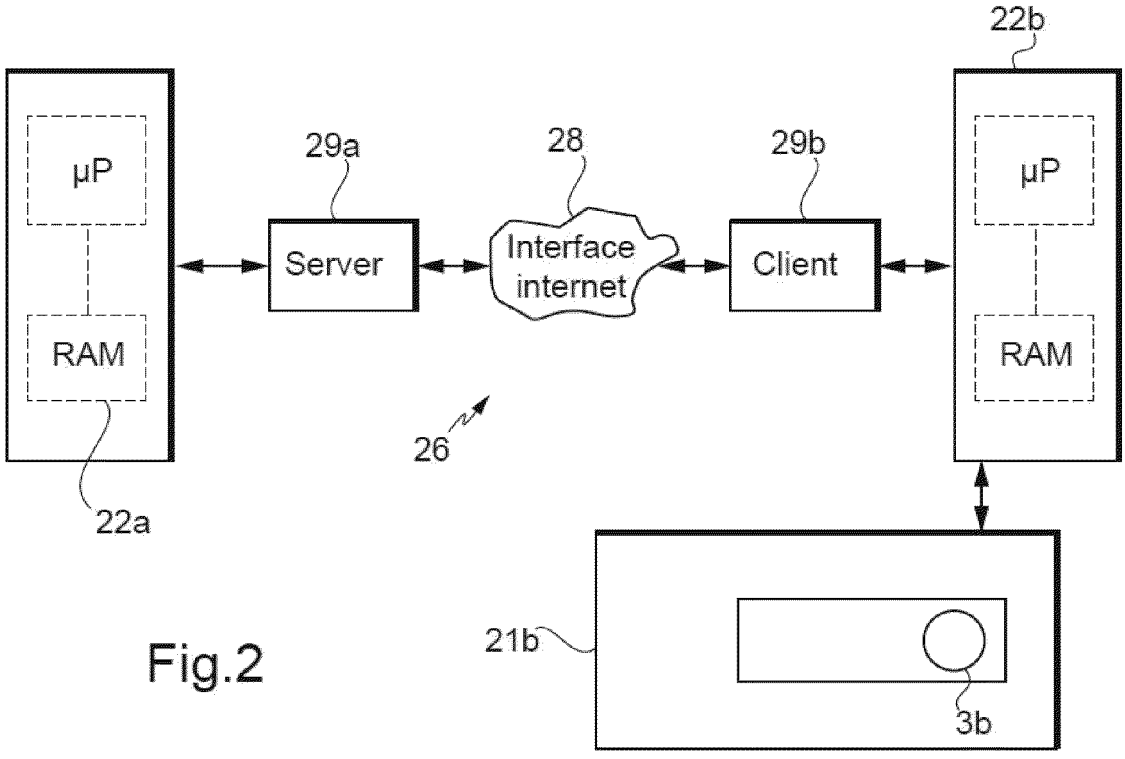
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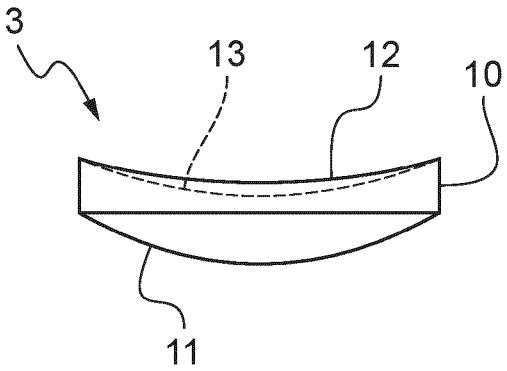
Fig.2

Fig.3a



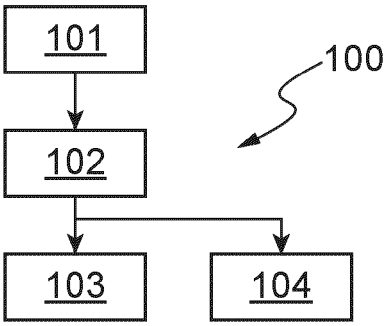
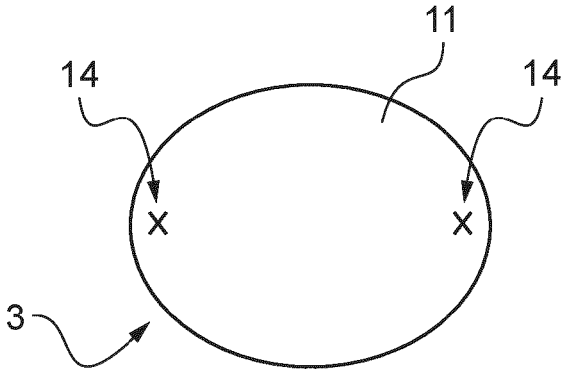


Fig.4

Fig.3b



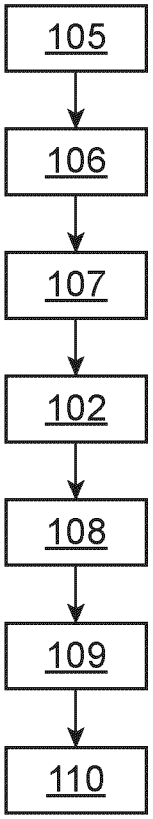
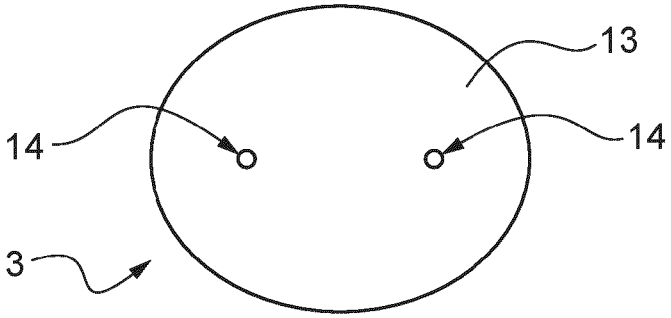
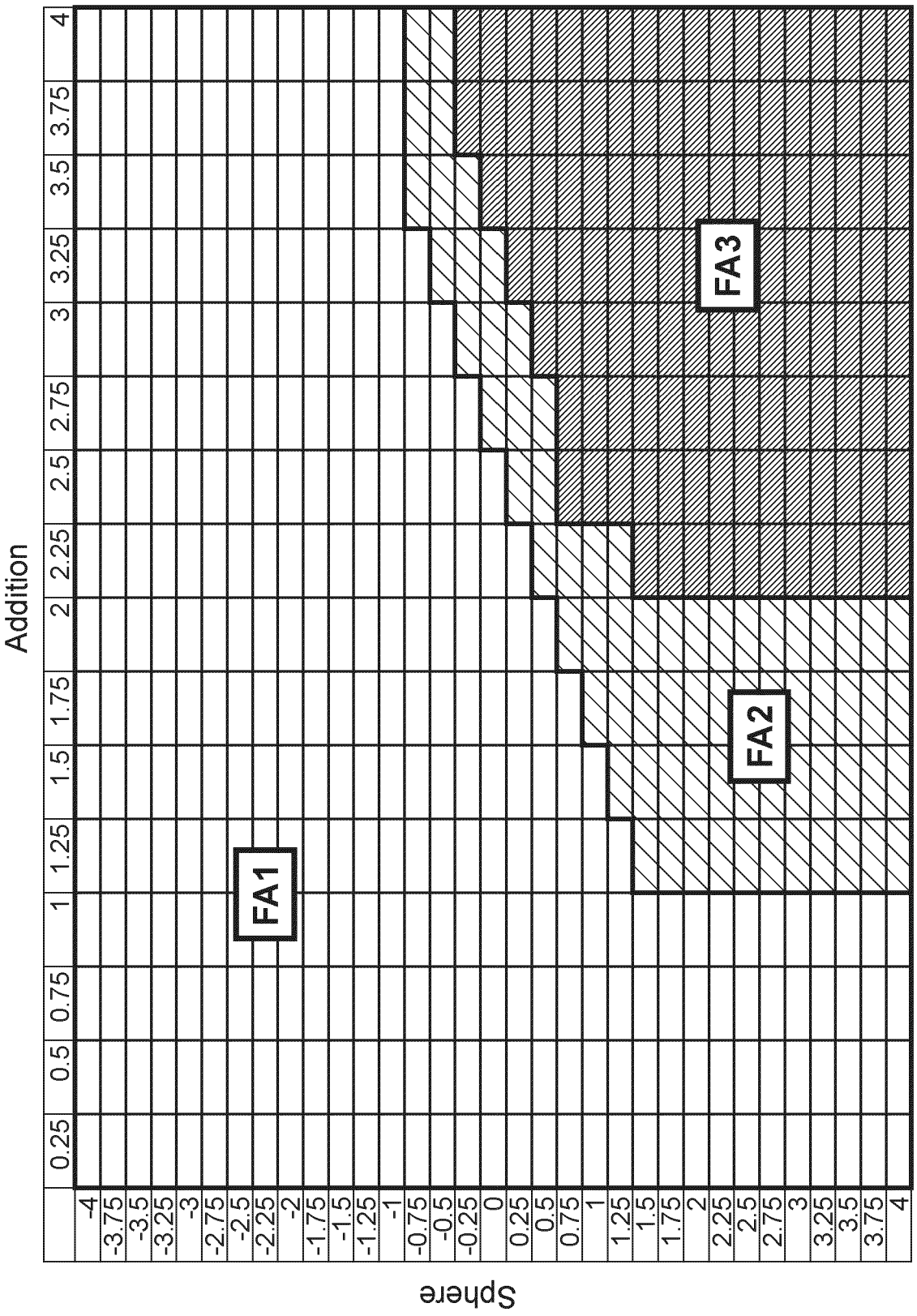


Fig.5

Fig.3c

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FA1
FA2
FA3

Fig.6

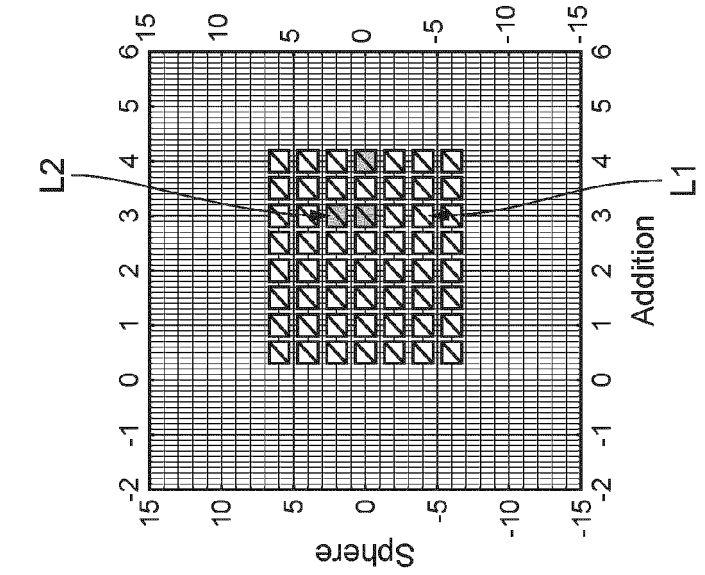


Fig.7c

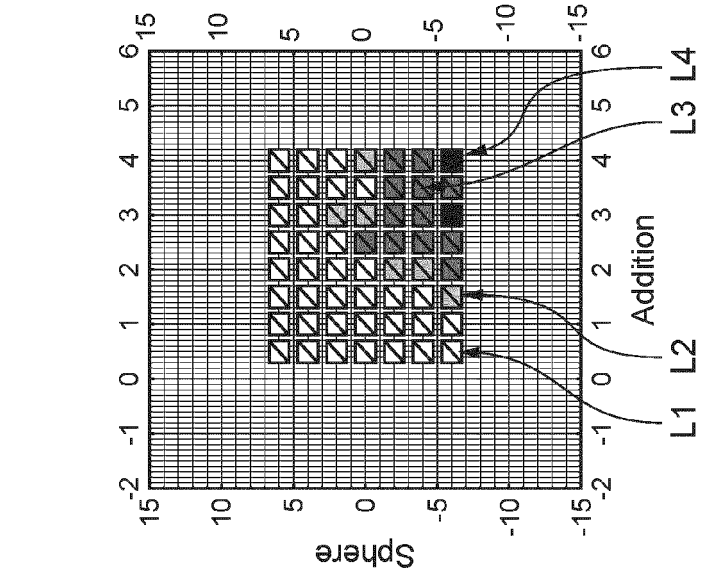


Fig.7b

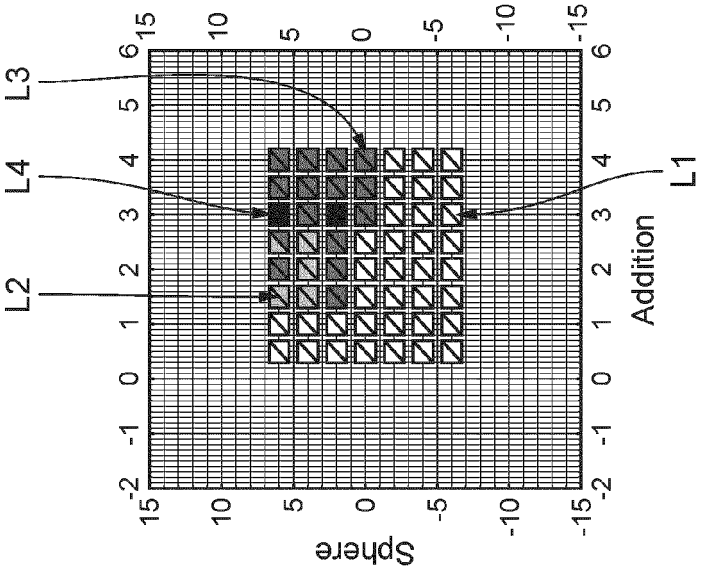
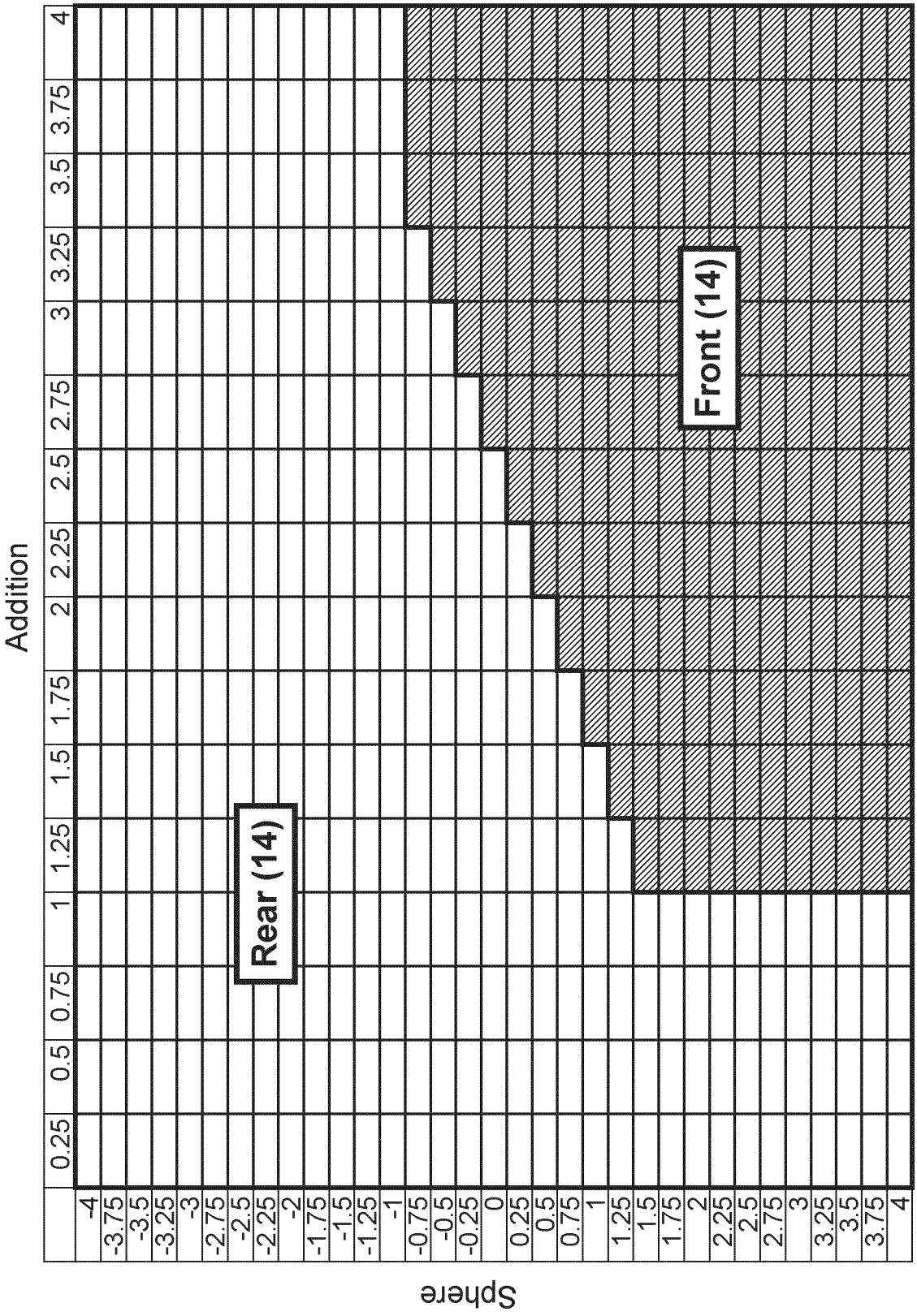


Fig.7a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3.75
4
Rear (14)
Front (14)

Fig. 7d

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EUROPEAN SEARCH REPORT

Application Number
EP 23 30 6809

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B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 April 2024	Koller, Stefan

CATEGORY OF CITED DOCUMENTS

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