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(54) **Machine with variable inclination for chamfering and drilling prescription and sunglass lenses**

(57) The invention is a new machine for processing prescription and sunglass lenses, capable of achieving a chamfered edge that is always centered and of drilling holes at an angle of inclination not necessarily parallel to the optical axis. It comprises a revolving shaft, designed to hold various tools, a bearing device for said revolving shaft, at least one lens holder, at least one tool holder, and a numerical control system. The revolving shaft bearing is designed so that it can move horizontally and swing in one or two planes.

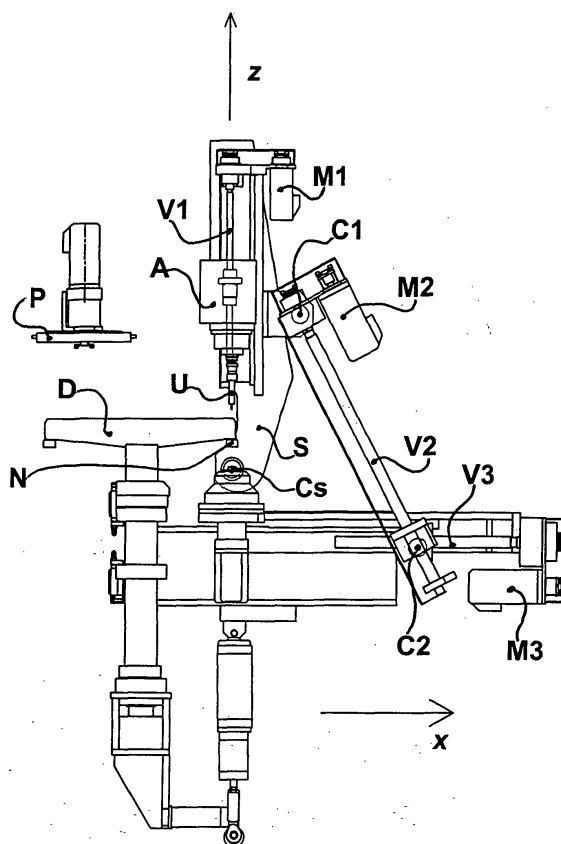


Fig. 1

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Description

[0001] This patent relates to devices for shaping prescription and sunglass lenses and in particular it concerns machines for grinding, chamfering and drilling holes in lenses. In order to fit into the frames, every lens needs to be processed in several ways, including: rough grinding, i.e. cutting the lens to suit the shape of the space it occupies in the frames; chamfering, i.e. shaping the edge of the lens to make it suitable for fitting into the frames; and/or drilling with holes for inserting bridges and temples.

[0002] At present, each of these processes is handled with specific machines.

[0003] To be more precise, currently-used grinding, chamfering and drilling machines are fitted with a lens holder, in which the round lens is placed, and a template holder containing the template with the final shape required of the lens. The flat grinding wheel for rough grinding, the shaped grinding wheel for chamfering the edge, and the drill are mounted on a revolving shaft whose axis of rotation lies in a constant direction. The template holder is brought up against a feeler, which follows the template's profile and, either directly by means of a system of levers, or indirectly by means of electro-mechanical actuators, guides the movement of the lens holder towards the flat or shaped grinding wheel, or the movement of said grinding wheel towards the lens holder.

[0004] The first problem stems from the fact that the different types of machine currently available on the market, be they mechanical (which adopt a template and a feeler to shape the lens) or electronic (using an electronic lens-shaping system), all allow for chamfering only on an axis of rotation in a constant direction, so that numerous points on the lens being processed reveal defects due to the imperfect centering of the chamfer.

[0005] To be more specific, the axis of rotation of the grinding wheel is always parallel to the optical axis, i.e. to the axis connecting the center of curvature of the lens with its focus.

[0006] Moreover, modern machines are limited in their ability to create precise shapes, especially when lenses with a marked spherical component are involved.

[0007] In fact, currently-available chamfering machines present a severe drawback when it comes to chamfering lenses in shapes other than circular or generically elliptic/oval shapes, in that the chamfering of the edge is inaccurate or may even be damaged by the shaped grinding wheel.

[0008] Moreover, chamfering on an axis that is always parallel to the optical axis prevents a perfect fit of the lens in the frames.

[0009] In some cases, there are also problems of final appearance. For instance, in the case of lenses that are too thick along the edges to fit completely into the space in the frames, the part extending from the frame is also "cut" parallel to the optical axis and thus produces an

unattractive aesthetic effect, especially in particularly thick lenses.

[0010] The same problems are encountered when it comes to drilling holes in the lenses. In fact, the drill also works in a fixed position on its own axis and only allows for the cutting of holes lying parallel to the optical axis.

[0011] To overcome these drawbacks, a new machine for shaping, chamfering and drilling prescription and sunglass lenses with a tilting working axis has been studied and implemented.

[0012] The object of the new machine is to enable chamfering at a variable angle of inclination.

[0013] Another object is to obtain a chamfer that is perfectly centered and has a constant height around the entire circumference of the lens.

[0014] Another object is to drill holes at an angle of inclination that is not parallel to the optical axis.

[0015] Another object is to perform the grinding and polishing of the edge, the chamfering, drilling and any special processing using one and the same machine.

[0016] Another object is to chamfer the edge of the lens correctly regardless of its shape.

[0017] Another object is to enable the chamfering of lenses with different curvatures.

[0018] Another object is to keep the axis of the grinding wheel or milling machine, and of the cutter or drill, parallel to the radius of curvature of the lens at every point around its edge.

[0019] A further object is to enable the processing of single lenses, or medium-to-small batches of lenses, using models of complex shape and frequently changing the product being processed.

[0020] Yet another object of the new machine is to be of limited size, so that it can easily be used in an optical laboratory.

[0021] These and others, direct and complementary objects are achieved by the new machine for grinding, chamfering and drilling prescription and sunglass lenses, featuring a tilting bearing for supporting a revolving shaft for grinding, chamfering and drilling at any chosen angle of inclination.

[0022] The new machine is fundamentally composed of a revolving shaft on a tilting bearing, fitted at one end with a spindle for holding tools, the inclination of which is governed by a numerical control system, a lens holder for keeping the lens in position and for turning said lens, a circular tool holder capable of turning in steps around its own vertical axis.

[0023] In the various processing stages, the revolving shaft enables the rotation and variable inclination of its tool, which may be a flat grinding wheel, a chamfering grinder, or a drill. Each of these tools is presented in turn by the tool holder and then hooked up to said shaft. Said tool change is handled automatically.

[0024] Thus, simply by placing the lens in position, and using the same machine, the grinding, chamfering, drilling and polishing of the lens can be done with the necessary precision and at the required inclination.

[0025] All the operator has to do is input the data relating to the lenses and the shape of the frames in the computer. In particular, this involves specifying parameters such as the lens thickness, the type of chamfer or channel for containing nylon yarn, and the positions of the holes to drill.

[0026] There is an automatic device for loading/unloading the lens. Said lens is preferably contained in a tray, which is transferred automatically along a rail, picked up automatically by a lens magazine, or placed manually in position for loading into the machine.

[0027] The lens is picked up automatically and placed in the lens holder, which keeps it in position and induces its rotation.

[0028] Then the tool spindle begins to move in. The first step involves bringing said tool spindle up to the magazine containing the tools to enable the required tool to be fitted.

[0029] After fitting the tool, the tool spindle is moved into a suitable position and the grinding, milling, chamfering, drilling or polishing of the lens takes place, as necessary.

[0030] The tool spindle is tilted according to the curvature of the lens: this enables the chamfering to be centered and any holes to be drilled parallel not to the optical axis but to the radius of curvature of the lens.

[0031] When the lens has acquired its final appearance, it is collected and returned to the rail.

[0032] Machines can be produced in which the tool spindle can also tilt in a single plane, in addition to moving along the axis x and along the axis z; machines also exist in which said tilting angle can be obtained in two directions. The latter solution is particularly useful for processing prescription lenses.

[0033] The characteristics of the new machine for grinding, chamfering and drilling lenses will be better clarified by the following description, with reference to the drawings attached, which are provided to give a non-restrictive example of the invention.

[0034] The attached drawings show a non-restrictive example of a practical embodiment of the invention. To be more precise, they show an example of a machine wherein the tool spindle is capable of tilting in a single plane.

[0035] Figure 1 shows the main parts of the new machine.

[0036] It shows the lens positioning device (D) and the lens holder (N).

[0037] The positioning device (D) receives the lens from a device for collecting the lens, that is not illustrated in the figure. Once the lens is in position, the lens holder (N) makes it rotate. Then a numerical control system guides the movement of the tool spindle (A). The movement of said tool spindle (A) is driven by a system of hinges and worm screws. To be more precise, the tool spindle (A) can move along its own axis z, following the rotation of the worm screw (V1) driven by the motor (M1). The tool spindle (A) is attached to a bearing (S).

Said bearing (S) is hinged in (Cs) to a horizontal guide (L). Said bearing (S), supporting the tool spindle (A), is set turning in the plane x-z, on the other hand, by the rotation of the worm screw (V2) driven by the motor (M2). Said worm screw (V2) is hinged at two points, i.e. (C1), which is integral to said bearing (S) supporting the shaft (A), and (C2), which is integral to the guide (L).

[0038] Said guide (L) is moved along the axis x by the rotation of the worm screw (V3) driven by the motor (M3).

[0039] Said tool spindle (A) has an end suitable for connecting the tools (U).

[0040] Figure 1 also shows the tool holder (P), complete with seats for containing the tools (U). Said tool holder (P) is capable of turning in steps around its own vertical axis, so as to bring the tool to use into the right position.

[0041] In the initial stage of the process, by means of the above-described mechanisms, said tool spindle (A) moves over the tool holder (P) to fit the required tool. Then, guided by the numerical control system, said tool spindle (A) occupies the different positions required, as the case may be, and is operated in order to perform the processing of the lens.

[0042] After said process has been completed, the lens is collected by the device (D) and, by means of other automated devices not illustrated in the figure, it is unloaded and placed in its final packaging.

[0043] Figure 2 shows a front view of the tool spindle (A) in detail, with the tool (U) fitted therein.

[0044] The figure shows the worm screw (V1) that moves said tool spindle (A) along the axis z, and the bearing (S) for supporting said tool spindle (A). Said bearing (S) is hinged in (Cs) to the guide (L).

[0045] Thus, with reference to the previous description and to the attached drawings, the following claims are expressed.

Claims

1. Machine for processing lenses, comprising:

- a tool spindle designed to hold various tools,
- a bearing device for supporting said tool spindle, suitable for moving along the horizontal axis x and along the vertical axis z,
- at least one lens holder,
- at least one tool magazine, for at least one flat grinding wheel and one chamfering wheel,
- a numerical control system,

characterized in that the axis z of said tool spindle or said bearing is capable of swinging in the plane x-z.

2. Machine for processing lenses according to claim 1, **characterized in that** the axis z of said tool spin-

dle or said bearing is capable of swinging in two non-parallel planes.

3. Machine for processing lenses according to claims 1, 2, **characterized in that** it comprises one or more drill bits, suitable for being held by said tool spindle. 5
4. Chamfering machine according to claims 1, 2, 3, **characterized in that** it can drill holes in a direction that is not parallel to the optical axis. 10
5. . Machine for processing lenses according to claims 1, 2, 3, 4, **characterized in that** said devices are controlled by a numerical control system. 15

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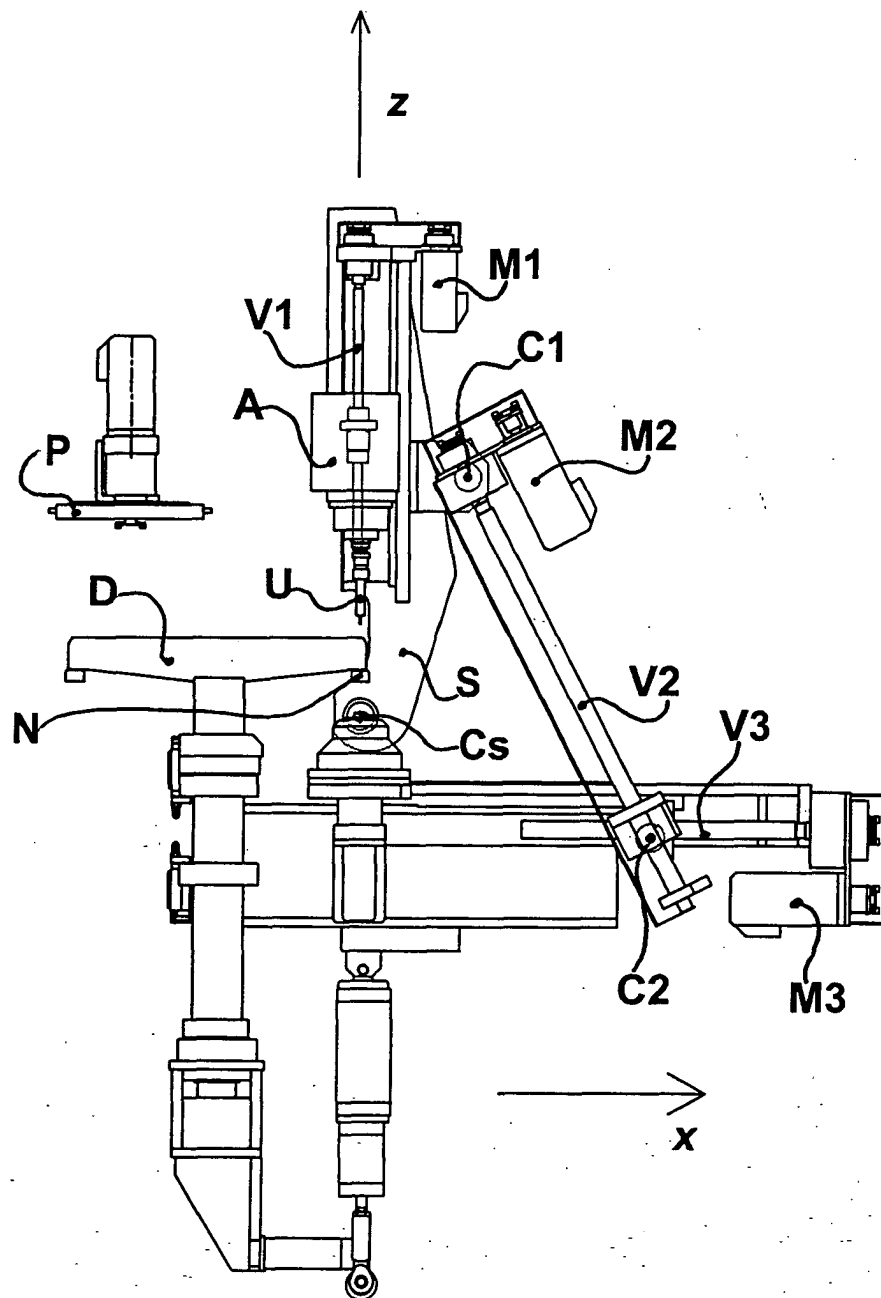


Fig. 1

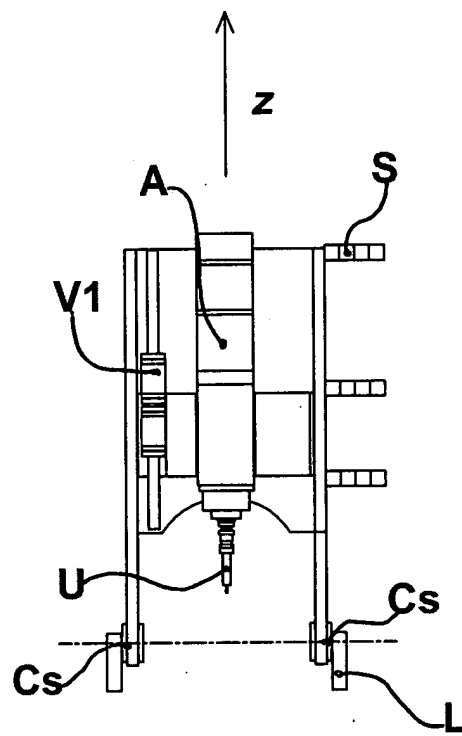


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 05 01 0120

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 September 2005	Examiner Koller, S
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 05 01 0120

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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