Title: MACHINING SPECTACLE LENSES

Abstract: Apparatus for conducting operations on one or more spectacle lenses comprising: means for mounting on the apparatus one or more operating tool(s) adapted for at least shaping and/or drilling and/or buffing the or each lens, using one or more drilling and/or shaping tool(s) comprising one or more cutting diameters, means for displacing three-dimensionally the operating tool so that the tool is able to follow the path or paths of operation necessary to carry out its functions, one or more clamps each holding in use a single spectacle lens.
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MACHINING SPECTACLE LENSES

Field of the Invention

The invention relates to apparatus for conducting operations on spectacle lenses.

Review of Art known to the Applicant(s)

The first step of production of spectacle lenses involves the manufacturing of circular lenses which have specific optical properties.

The present invention is particularly concerned with the second stage of the production of spectacle lenses where the circular lenses are machined so as to correspond to specific mounting elements such as the side pieces that are designed to grip the temples and the bridge element which links both spectacle lenses.

Before actually machining the spectacle lenses, the operator places a disposable double sided adhesive with its corresponding button on a particular point of the spectacle lens. The lenses are then taken successively to the different operating stations where each operation is individually carried out. The spectacle lens and button would then be, for example, first taken to a grinding machine, then to a
drill and then finally to a buffing machine. One of the drawbacks of this set-up is that three operating tools will be required to perform these three operations. This is particularly wasteful from the point of view of the space employed by the machines in the workshop and with regards to the cost associated with having all three machines and their maintenance.

With regards to the grinding operation, the traditional method of shaping the spectacle lens involves a tool which is applied to the spectacle lens and displaced in order to obtain the desired shape. A drawback of the traditional operating stations is that they are only capable of machining one lens at a time which is very labour-intensive.

Fixing the spectacle lens to the button or lens support has not been without problems in the traditional type of machinery used in conducting operations on spectacle lenses. The weakening of the adhesive strength may cause the spectacle lens to rotate relative to the support or button to which it is attached which will cause an inaccurate shaping operation.

A consequence of this is that the lens does not meet the stringent optical requirements and that it must be discarded. The strength of the adhesive pad is variable with respect to time, therefore it is not uncommon that when the operation is interrupted for a period of time (such as during the night or during the weekend) that the adhesive bond weakens and must be replaced first thing before resuming the operation. Having to renew the adhesive pad augments the cost of overall production of the spectacle lens and shortens the life expectancy of the button. As successive pads are applied to the button’s surface, solid deposits accumulate and will eventually contribute to rendering the button unsuitable for use.

The present invention aims to overcome the drawbacks of the traditional spectacle lenses’ production. One of the objectives of the present invention is to provide an
apparatus which is capable of accomplishing multiple operations. Another objective of the present invention is to provide means for immobilising the spectacle lens during its machining. A further object of this invention is to provide means for strengthening the adhesion of the button to the spectacle lens and to even present an apparatus which would be capable of operating without an adhesive pad.

This invention also aims to propose a way of machining several spectacle lenses within the same operating unit and even to machine several spectacle lenses simultaneously.

Summary of the Invention

In a first broad independent aspect the present invention presents an apparatus for conducting operations on one or more spectacle lenses comprising:

- means for mounting on the apparatus one or more operating tool(s) adapted for at least shaping and/or drilling and/or buffing the or each lens,
- using one or more drilling and/or shaping tool(s) comprising one or more cutting diameters,
- means for displacing three-dimensionally the operating tool so that the tool is able to follow the path or paths of operation necessary to carry out its functions,
- one or more clamps each holding in use a single spectacle lens.

This configuration is particularly advantageous as it avoids the operator of having to install and uninstall the spectacle lens and its support from one operating station to another.

The actual surface occupied by the machining tool is reduced to its minimum.
This configuration is particularly advantageous as it is cost-effective to run and to maintain.

The apparatus will also permit the user to economise time. This is particularly the case when there are several lenses disposed in the apparatus so that these can be machined within the same operation.

A subsidiary advantage of the invention becomes apparent when each clamp immobilises its corresponding spectacle lens during the machining operation. Having the spectacle lens immobilised during the machining operation, significantly improves the precision of the operation carried out and increases the life expectancy of the adhesive pad when compared to the life expectancy of the adhesive pad in traditional set-up where twisting may occur between the support and the lens as these are rotated about the tool.

According to a further subsidiary feature of the present invention the apparatus is adapted to machine two lenses in one overall operation, and two or more operating tools perform substantially simultaneously under pre-programmed control. This will be particularly beneficial as it will economise time and since the strength of the adhesive pad is dependent on time, this apparatus will limit the occurrence of having to prematurely substitute the adhesive pad.

In a second independent broad aspect the invention presents a clamp for holding a spectacle lens during machining, the clamp comprising:

- a stand which is adapted to be immobilised,
- a head fixed to said stand which at its top end has means for engaging a lens support and preventing said support from rotating, and
- an arm which is capable of applying a downward force to the top surface of a spectacle lens when the lens is mounted on said support; wherein the stand comprises a column on to which the head is fixed and around which
a hub is placed so as to rotate around said column, and wherein the arm extends from the hub in order to rotate together with the hub while applying a downward force to the top surface of a spectacle lens in use.

One of the advantages of this is that the lens and its support are fully immobilised. The likelihood of a displacement of the support relative to the spectacle lens is limited because of the force applied to the top surface of the spectacle lens. This will improve the quality of the machining of the lens and avoid the likelihood of the lens breaking free from the support.

Another advantageous feature of this configuration is that when an operating tool comes into contact with the arm that is applying the downward force to the top surface of the spectacle lens, this arm will displace out of the path of operation. This avoids the operating tool being blocked in its operation.

A subsidiary advantage is apparent when means for returning the arm and hub to their original positions after the arm and hub are rotated around the column, are provided. This is particularly beneficial because the tool usually starts its operation at a pre-determined location, therefore providing means for returning the arm to its original position, will avoid the tool damaging the arm as it attempts to reach its own start position.

In another independent broad aspect the invention presents a clamp for holding a spectacle lens during machining, the clamp comprising:

- a stand,
- an appropriately resilient lens support located on or forming part of the top of the stand,
- means for preventing the lens support from rotating about the stand in use when the spectacle lens is placed on the top surface of the lens support to be machined, and
- means adapting the lens support and/or the stand to transmit to the interface between the spectacle lens and said lens support a suction force which is capable of immobilising said spectacle lens.

The application of a suction force further guarantees that the spectacle lens will be immobilised during the operations carried out on it. This configuration limits the twisting of the spectacle lens with regard to the elements that support it.

This invention may be put into practice either with or without the adhesive pad. When a sufficient suction force is provided, the adhesive pad can be done away with altogether.

In a subsidiary aspect of this invention, the lens support interfacing surface does not comprise a layer of adhesive and the stand comprises a column which the lens support forms part of or onto which the lens support is placed and around which a hub is placed so as to rotate around said column, and the arm extends from the hub in order to rotate together with the hub while applying a downward force to the top surface of a spectacle lens. The combination of the suction force to the surfaces of the spectacle lens advantageously improves the immobilising of the spectacle lens during machining. The operations are carried out with a better quality and is more rapid, and consequently at a lower cost.

In order to avoid that the arm remains over the usual starting point of the operating machine, means are advantageously provided for returning the arm and hub to their original position after the arm and hub are rotated around the column.

According to a subsidiary feature the present invention provides that the support is an integral part of the stand. In this aspect, there is no need to produce a support separately from the stand and to mount the support on a stand. In effect, mounting
the spectacle lens on the support becomes a one step operation rather than a two step operation where the support is mounted on the spectacle lens and then the support is placed onto the stand.

According to a fourth independent broad aspect the invention provides a clamp for holding a spectacle lens during machining, the clamp comprising:

- a stand which is adapted to be immobilised and has at its top end means for engaging a lens support;
- a wheel, lever, or similarly hand-operable means, mounted within or on the stand at a location spaced from the lens support, and rotatable between a first position — in which the lens support is insertable into or removable from the top end of the stand — and a second position — in which the lens support is held to the stand; and
- a twist-and-hold connection between the wheel etc. and the lens support engaging means.

This combination of characteristics is particularly advantageous as it permits the spectacle lens to be held as an operating tool is rotated about the lens. Furthermore, the actual mounting and retaining of the support is very simple to operate.

A subsidiary aspect of this invention provides two or more stands whose respective hand operable means are linked such that operation of one automatically and preferably simultaneously causes operation of the other.

The main advantage of this configuration is that mounting and dismounting the support of the spectacle lenses can occur simultaneously which will result in a more rapid overall production of spectacle lenses.
Detailed Description

Figure 1 presents a sectional side view of an apparatus for conducting operations on spectacle lenses.

Figures 2 present a side cross sectional views of a clamp with an arm.

Figure 3 shows a side cross sectional view of a clamp with an arm.

Figures 4 show different cross sectional views of the clamp with an arm at different stages of its operation.

Figures 5 show side cross sectional views of clamps with a vacuum system.

Figures 6 show a side cross sectional view and a plan cross sectional view of clamps with a twist-and-hold connection.

Figures 7 show a cross sectional side view of clamps with a twist-and-hold connection and cross sectional plan views of its support.

Figure 1 presents a housing 1 in which is arranged an operating tool 2 destined to carry out a shaping operation on clamps 3. An axle 4 is mounted on the sides of the housing 1 to enable the displacement of a trolley 9 in the horizontal direction. A vertical axle is attached to the trolley 9 and allows the vertical displacement of an elevator 8. Further means which are not shown in Figure 1 are provided in order to displace the operating tool in the orthogonal direction. The operating tool 2 is attached to the elevator 8. In this illustration, the operating tool is mounted with a shaping tool 7. The operating tool and its shaping head are permitted to displace three-dimensionally within the housing 1. The housing may be partly or entirely made out of a transparent material so that the operator may easily be able to supervise the operation of the spectacle lenses. If the operation is fully
contained within the housing the operator will also be protected against particles which may be projected during the milling or drilling operation.

The operation of the tool can be controlled by a computer which is capable of determining the exact position with regard to time of the tool head. The person skilled in the art will easily be able to identify a computer software capable of realising a pre-determined path of operation.

Figures 2 essentially show two identical clamps 21(Figure 2A) and 22 (Figure 2B) in two different operating positions. Only clamp 21 will be described here in detail. The clamp 21 comprises a base element 28 and a central column 29. The base element of the clamp is here chosen to be of a circular shape, however any suitable geometry may be employed for the base element. Means are provided to immobilise the stand with regards to the working surface on which it sits, however these have not been shown in the drawing for simplicity.

A mobile hub 25 is placed around the central column 29. The central column 29 and the hub are so spaced that two ball bearings 31 and 32 and a helicoidal spring may be placed between the hub and the column. The ball bearings 31 sit at the lower extremity of the column 29, the external ring of ball bearing 31 comes against a ledge 35 on the wall of the hub 25 and by so doing limits the friction between the stand’s base 28 and the hub 25. Another space between the hub and the column is provided in order to enable the engagement of the ball bearing 32 where the outer ring of the ball bearing 32 will come into contact with a ledge 36 provided in the internal surface of the wall of the hub 25. In this embodiment, the ball bearing 32 is prevented from displacing in the downward direction.

In the top extremity of the hub 25, a recess 38 is provided into which the upper extremity of the helicoidal spring 33 is locked. The opposite extremity of the helicoidal spring engages in a vertical groove provided in the column 29 when the hub displaces around the column, a torsion is exerted on the helicoidal spring
which in effect puts the spring into compression and when the rotation terminates the helicoidal spring will return to its original position with the hub.

A head 26 is mounted on the hub and the central column. In order to prevent the rotation of the head with the hub, both the central column and the lower extremity, the head comprise recesses which enable the insertion of a pin 37. In the other extremity of the wall of the head 26 comprises a series of projections and recesses which engage with corresponding projections and recesses in a lens support 27.

The lens support 27 is sometimes referred to in the trade as a button. The buttons are usually made out of an polymeric material which allows the use of a particular type of button with a wide range of spectacle lenses which may have different curvatures for example. These buttons are also designed in order to avoid any scratching of the lens. The buttons are affixed to the lens by using a double-sided adhesive pad. In order to position the support lens or button in the head in a predictable manner, the button usually comprises a recess which corresponds to a single pin at a specific location on the top surface of the head 26.

An essentially C-shaped arm 40 extends from the hub 25 and is used in this embodiment to apply a downward force to the top surface of the spectacle lens. The lower projecting member 41 of the C-shaped arm comprises a threaded hole to engage the lower hollow cylinder 42. An upper section 43 comprises a hollow cylindrical section which permits the penetration of the lower hollow cylindrical section 42. A piston 44 is threadedly engaged to a wall of the member 43 and is placed within the lower hollow cylinder 42 so as to be free to displace in the vertical direction. A helicoidal spring 45 is placed on the piston’s arm and is mounted in compression so as to exert a force on the head of the piston 44 which will translate in a downward force which in use is applied to the top surface of a spectacle lens.
The other section 46 of the C-shaped arm is attached to the member 43 in this embodiment by a simple screw. The fist 47 of the arm is rotatably mounted to the upper section 46 of the C-shaped arm. Ball bearings 48 are provided between the fist and the upper section 46 to minimise the friction between the fist and the upper section in rotation. This configuration eliminates the possibility of the arm exerting a torsional force to the spectacle lens which could jeopardise the quality of the machining operation.

Clamp 22 comprises the same structural elements as does clamp 21. However, it shows the clamp exerting a force on the top surface of the spectacle lens and displays the head of a machining tool approaching the upper section 46 of the arm during milling operation. If the operating tool were to continue rotating from the position shown for clamp 22, it would displace the arm until the operation is completed. Then when the operating tool is returned to its original position, the arm will also return to its original position.

In Figure 3 there is a clamp 23 displayed. The only difference between the clamp 23 and the two previous clamps 21 and 22 is that the screwing means of adjoining members 43 and section 46 is done away with. In this embodiment, member 43 and section 46 are one single element comprising a ring-shaped element 49 capable of engaging the operator's finger.

Figures 4 show the operating clamp in use. Figure 4A displays the button and spectacle lens separated from the clamp. Figure 4B shows the insertion of the lens and button support into the clamp. Figure 4D shows the arm applying a force to the top surface of the spectacle lens. Figure 4E shows the machining tool approaching the edge of the spectacle lens which is to be machined. Figure 4F shows the operating tool just about to displace the arm around the central column.
Figures 5 show a series of clamps 51 which retain the lens support and its spectacle lens by creating a vacuum at the interface between the spectacle lens and the lens support. The stand 50 comprises two clamps 51 which may be used to machine both the left hand lens and the right hand lens in one operation.

The button or lens support 54 comprises as in a previous embodiment recesses and projections to prevent the rotation of the lens support in use. The main difference between the buttons in this embodiment and the buttons in the previous embodiment is that they comprise a central channel 55 through which the air is sucked out. The column of the stand 50 is hollow in order to permit the location of a duct 52 through which the air is removed. The duct 52 comprises a head 53 which is retained against surfaces of the column of the stand 50 in order to prevent the displacement of the head and the duct in the downward direction. The means for removing the air in order to create the suction which is capable of immobilising the spectacle lens are not specifically shown in this drawing, however the skilled person in the art would easily be able to identify those means. A double-sided adhesive pad is shown in the drawings, however this double-sided adhesive pad may not be necessary as long as the suction force is sufficient to fully immobilise the spectacle lens during the machining operation.

Figures 6 and 7 display the twist-and-hold system used to immobilise the button or lens support on a stand. The stand 60 is designed to hold two spectacle lenses. The stands 50 comprises projections 68 which are hollow so as to permit the engagement of an axle 64 which is screwed into a wheel 61 at its lower extremity and which comprises bayonet type projections 65 at its other extremity. The lens support is shown mounted and held by the twist-and-hold connection in these drawings. Each lens support comprises a recess 59 into which the projections 65 of the axle 64 are insertable. As the axle 64 is rotated by rotating the wheel 61 the projections 65 run against the ramps 63 until they meet the stops 64. The inclination of the ramps 63 increases from the free extremity of the ramps 63 to the stops 64. A lever 62 extends from the wheel of the first clamp of the stand 60
to the wheel of the second clamp in order to permit the simultaneous rotation of the wheels. The drawing also shows the double-sided adhesive placed on the top surface of the button or lens support.
CLAIMS

1. Apparatus for conducting operations on one or more spectacle lenses comprising:

   - means for mounting on the apparatus one or more operating tool(s) adapted for at least shaping and/or drilling and/or buffing the or each lens, using one or more drilling and/or shaping tool(s) comprising one or more cutting diameters,

   - means for displacing three-dimensionally the operating tool so that the tool is able to follow the path or paths of operation necessary to carry out its functions,

   - one or more clamps each holding in use a single spectacle lens.

2. Apparatus according to claim 1, wherein the or each clamp immobilises its corresponding spectacle lens during the machining operation.

3. Apparatus according to claim 1 or claim 2, and adapted to machine two lenses in one overall operation, and in which two or more operating tools perform substantially simultaneously under preprogrammed control.

4. Apparatus for conducting operations on one or more spectacle lenses substantially as hereinbefore described with reference to any appropriate combination of the accompanying drawings.

5. A clamp for holding a spectacle lens during machining, the clamp comprising:
- a stand which is adapted to be immobilised,
- a head fixed to said stand which at its top end has means for engaging a lens support and preventing said support from rotating, and
- an arm which is capable of applying a downward force to the top surface of a spectacle lens when the lens is mounted on said support; wherein the stand comprises a column on to which the head is fixed and around which a hub is placed so as to rotate around said column, and wherein the arm extends from the hub in order to rotate together with the hub while applying a downward force to the top surface of a spectacle lens in use.

6. A clamp according to claim 5, characterised by means for returning the arm and hub to their original position after the arm and hub are rotated around the column.

7. A clamp for holding a spectacle lens during machining substantially as hereinbefore described with reference to any appropriate combination of the accompanying drawings.

8. A clamp for holding a spectacle lens during machining, the clamp comprising:

- a stand,
- an appropriately resilient lens support located on or forming part of the top of the stand,
- means for preventing the lens support from rotating about the stand in use when the spectacle lens is placed on the top surface of the lens support to be machined, and
- means adapting the lens support and/or the stand to transmit to the interface between the spectacle lens and said lens support a suction force which is capable of immobilising said spectacle lens.
9. A clamp according to claim 8, wherein the lens support’s interfacing surface does not comprise a layer of adhesive and the stand comprises a column which the lens support forms parts of or on to which the lens support is placed and around which a hub is placed so as to rotate around said column, and wherein the arm extends from the hub in order to rotate together with the hub while applying a downward force to the top surface of a spectacle lens.

10. A clamp according to claim 9, characterised by means for returning the arm and hub to their original position after the arm and hub are rotated around the column.

11. A clamp according to claims 8-10, wherein the support is an integral part of the stand.

12. A clamp for holding a spectacle lens during machining substantially as hereinbefore described with reference to any appropriate combination of the accompanying drawings.

13. A clamp for holding a spectacle lens during machining, the clamp comprising:

- a stand which is adapted to be immobilised and has at its top end means for engaging a lens support;
- a wheel, lever, or similarly hand-operable means, mounted within or on the stand at a location spaced from the lens support, and rotatable between a first position – in which the lens support is insertable into or removable from the top end of the stand – and a second position – in which the lens support is held to the stand; and
- a twist-and-hold connection between the wheel etc. and the lens support engaging means.
14. A clamp according to claim 13, and in which there are two or more stands whose respective hand-operable means are linked such that operation of one automatically – and preferably simultaneously causes operation of the other.

15. A clamp for holding a spectacle lens during machining substantially as hereinbefore described with reference to any appropriate combination of the accompanying drawings.
FIGURE 3