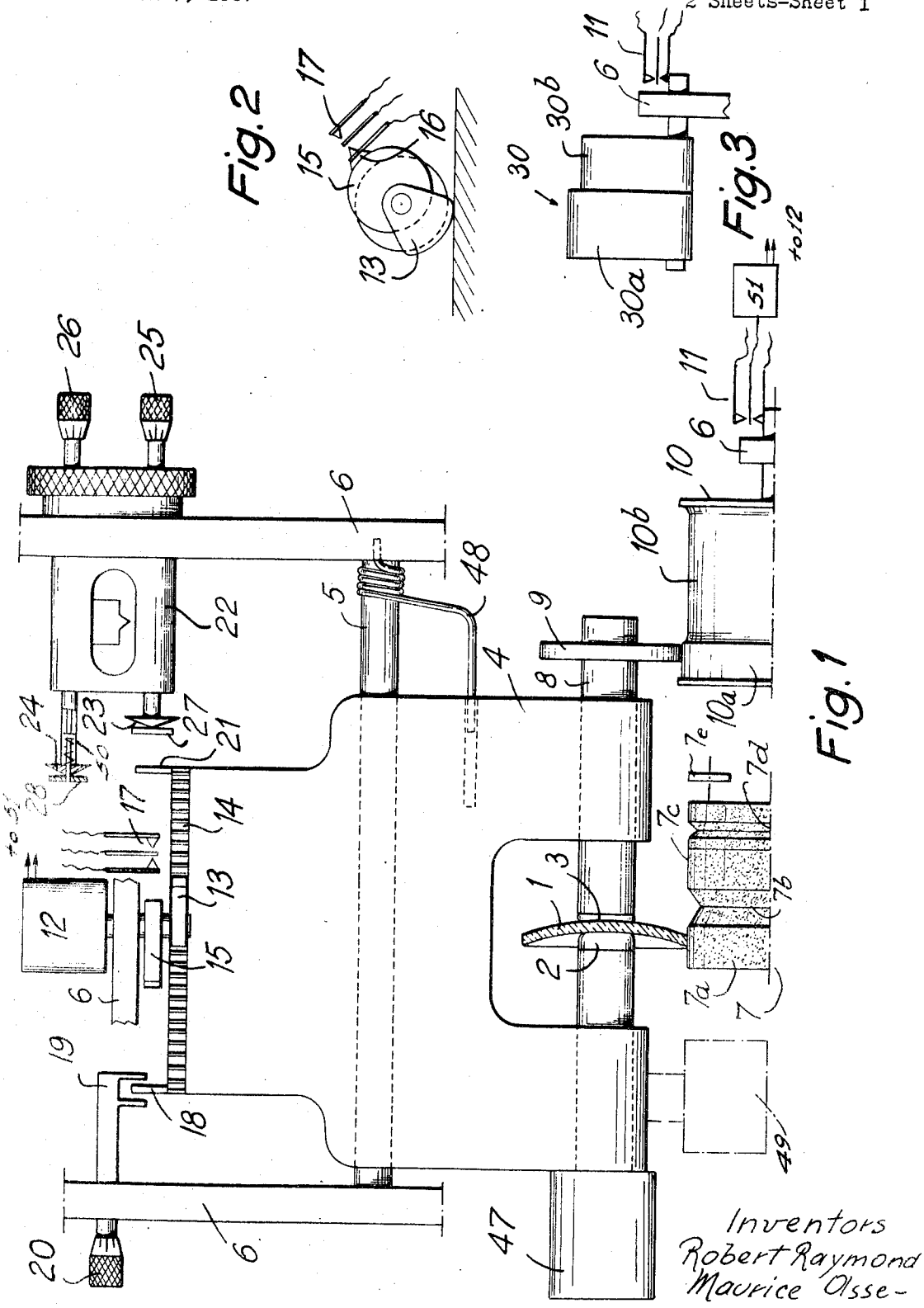
May 26, 1970 R. R. M. ASSELIN ETAL 3,513,598

SPECTACLE-LENS TRIMMING, BEVELLING AND GROOVING MACHINES

Filed March 7, 1967 2 Sheets-Sheet 1



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Filed March 7, 1967 2 Sheets-Sheet 2

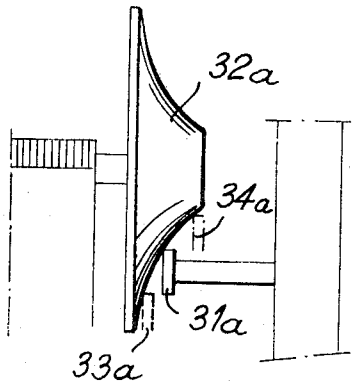


Fig. 4

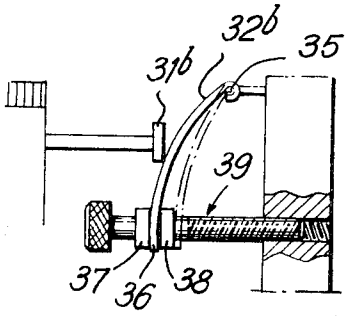


Fig. 5

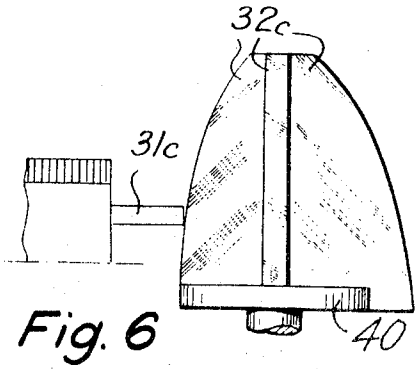


Fig. 6

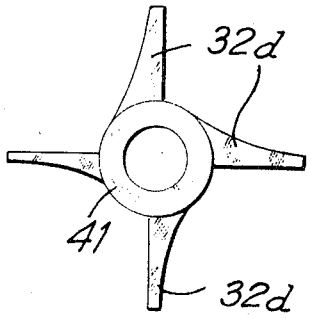


Fig. 8

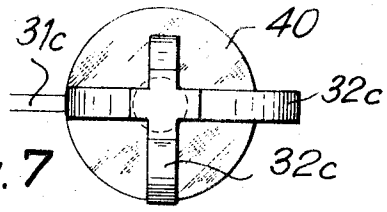


Fig. 7

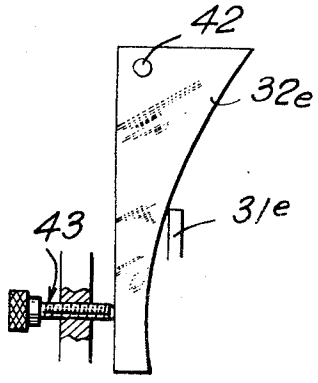


Fig. 9

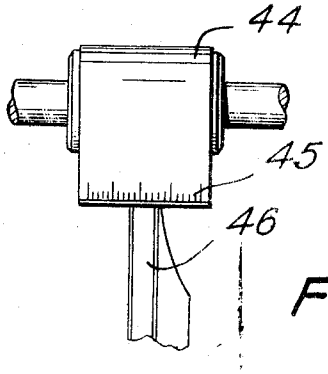


Fig. 10

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United States Patent Office 3,513,598 Patented May 26, 1970

3,513,598

SPECTACLE-LENS TRIMMING, BEVELLING AND GROOVING MACHINES

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Filed Mar. 7, 1967, Ser. No. 621,256
Claims priority, application France, Mar. 7, 1966, 52,307
Int. Cl. B24b 9/14
U.S. Cl. 51—101 14 Claims

ABSTRACT OF THE DISCLOSURE

An automatic machine for grinding spectacle lenses comprises, on one hand, a carriage pivotally and slidably mounted on a fixed shaft and supporting a positively rotated lens and template and, on the other, a feeler against which the template butts when the lens has acquired the required shape and size. The feeler is movably mounted for displacement by the template when the latter contacts it, and it cooperates with control means actuating a member which causes the carriage to rotate and translate with respect to the fixed shaft in order to move the lens out of contact with the grinding tool and fetch into an adjacent position.

Already well-known are semi-automatic or automatic machines for trimming, bevelling and grooving spectacle lenses in which the lens to be ground is mounted on a carriage between two rubber pressure pads and is rotated either manually with a handle or automatically by means of a motor, depending on whichever is more convenient for the type of work to be performed.

The lens-holder carriage is pivotable about a fixed shaft, along which it is also slidable laterally, and it includes a spring or a counterweight for urging the lens against a grinding wheel of fixed axis.

The shaft carrying the pressure pads supports at one end a template of shape matching that of the lens to be obtained and which butts against a fixed feeler when the lens acquires the desired shape and size, thereby automatically arresting the removal of material by grinding.

Since the operations considered herein generally involve two passes, namely a roughing pass and a finishing pass carried out on different grinding wheels, fully automatic operation of a machine of this kind involves the following motions:

(a) Raising of the lens at the end of the roughing cut;
(b) Lateral displacement of the lens, i.e. parallel to the axis of the pressure pads, in order to position it facing the grinding wheel selected for the required finishing operation;
(c) Lowering the lens onto the finishing wheel;
(d) Effecting the finishing pass by downward feed of the lens onto the grinding wheel with concurrent removal of material until the required overall dimensions are obtained on the lens, the latter being rotated about the pressure pad axis; and
(e) Raising of the lens on termination of the finishing pass, and possible stoppage of the machine.

On all existing machines these operations are automated by means of mechanical, electro-mechanical or electronic devices, all of which include a programmer and three distinct control systems, one for raising the carriage, another for moving it parallel to the pressure-pad axis, and the third for adjusting the feeler contacted by the template, so as to ensure that sufficient material is left after the roughing pass for subsequent removal during the finishing pass.

To enable the finishing operation to be carried out, prior art machines had has many different programs as they had finishing grinding wheels of different types.

Such machines also have the following disadvantages:

the equipment used is complex and delicate;
should one of the control systems fail, the machine becomes absolutely unusable and cannot even be operated manually;
adjustments are tricky and often involve recourse to skilled specialists;
the cost of such machines is relatively high, notably when they include several finishing grinding-wheels.

As a result, known automatic grinding machines are very seldom designed for more than two kinds of finishing operations; in particular, bevelling—the most frequent and most important operation—is rarely done on the machine, most of the finishing operations being carried out by hand.

It is the object of the present invention to overcome these drawbacks by providing an automatic machine of the kind referred to, in which the template feeler is mounted movably for displacement by the template when it is contacted by the same, and in which the feeler cooperates with an electric contact switch for activating an element which rotates and translates the lens-holder carriage with respect to its fixed shaft.

In a preferred embodiment, the template feeler is a lever which upon rocking closes the contact switch through the agency of a timer, whereby the switch is closed only after the template has been continuously contacting the feeler for the time needed to complete the roughing pass.

In an alternative embodiment, the feeler is a rotating drum, with closure of the contact switch being likewise effected through the agency of time-delay device.

Preferably, the feeler is devised in two parts located at different levels with respect to the template, corresponding respectively to the final dimensions of the lens after the roughing pass and after the finishing pass.

In accordance with this invention, the element for rotating and translating the lens-holder carriage responsively to said contact switch includes a cam rotated about a fixed axis by a motor electrically connected to said switch, and during rotation of said cam a portion of the contour thereof cooperates with a bearing surface formed on the carriage whereby to shift the later by friction and thereby to firstly move the lens away from the grinding wheel by pivotal motion about the carriage axis, to secondly position the lens level with the finishing grinding wheel by a lateral translation of the carriage, and to finally replace the lens on the grinding wheel by a pivotal motion of the carriage.

Preferably, a second cam is mounted on the same shaft as the cam referred to precedingly, so that upon rotating it operates a switch which stops the motor driving these cams.

In accordance with the invention, the machine includes adjustable stops for limiting the lateral positions of the lens during the different operations. Preferably, all the stops relevant to the fininshing operations are mounted on a rotating barrel.

Preferably also, the main trimming and bevelling grinding wheel is associated to a small grooving wheel which likewise cooperates with adjustable lens-guiding stops. This avoids an additional operation on a small separate semi-automatic machine and the attendant loss of time and inaccuracy.

With regard to the lateral guidance of the carriage, in machines used heretofore the carriage is pushed transversely by a spring against an abutment bearing against

one of the lens faces. With such systems, the curvature of the bevel is the same as the curvature of the lens face serving as abutment, and this curvature does not invariably match the curvature of the spectacle-frame, so that the meniscus-shape of the latter must be modified-implying an additional and often delicate task. It is alternatively possible to use a guidance system consisting of a cam so contoured that the vertical displacement of the carriage produce, through the medium of the cam, transverse motions such as to permit obtainment of bevels, grooves or facets which are formed on the lens over a portion of a sphere of radius chosen according to the curvature, so that the meniscus-shape of the spectacle-tacle-frame. To accomplish this, it is customary to have as many different cams as there are radii of curvature to be obtained, and the stop which contacts the cam has a fixed position. On the other hand, it is impossible with such an arrangement for the bevel to follow all lens curvatures, so that the meniscus-shape of the spectacle-frame must be modified.

Accordingly in a preferred form of embodiment of the invention, a movable and adjustable stop is so positioned as to enable it to explore adjustable portions of the cam profile: smaller radii of curvature are obtained when the stop is moved toward the center of the cam, and larger radii of curvature when it is moved away from the center of the cam, whereby curvatures of continuously adjustable radius can be obtained with one and the same cam and the bevel can be made to follow a radius of curvature which is adjustable at will according to the radius of the lens faces and of the meniscus-configuration of the frame. The machine is thus able to grind all kinds of lenses regardless of the radius of curvature of the lenses or the frames.

It is also known to move the bevel, the groove, or the facet in the direction of the front face or the rear face of the lens by modifying the transverse location of the guide or the stop with respect to the lens or the grinding wheel. In accordance with the present invention, this operation is facilitated by providing the cam or the movable stop with a position indexing device such as a graduated scale and pointer, a micrometer screw graduated in the manner of micrometer calipers, or any other convenient device.

A machine devised as disclosed hereinabove circumvents the disadvantages referred to previously, since the conventional programmer is replaced by mechanical stops which are reliable and easily adjustable by means of verniers for example. In addition, the lens raising and transferring functions are performed by a single element, which simplifies automation. Further, this element operates by friction, so that the lens-holder carriage can never become locked, and in the event of a mishap the lens can be raised and transferred manually at any time. Lastly, the need to determine the cutting depth is obviated between the roughing pass and the finishing pass.

The description which follows with reference to the accompanying non-limitative exemplary drawings will give a clear understanding of how the invention can be carried into practice.

In the drawings:

FIG. 1 shows diagrammatically in side elevation a machine according to the present invention;

FIG. 2 shows diagrammatically in side elevation, on an enlarged scale, the lens-holder carriage transferring cam according to the invention;

FIG. 3 is a schematic side elevation view of an alternative embodiment of the template feeler shown on a smaller scale in FIG. 1;

FIG. 4 is a schematic side elevation view of an alternative embodiment of the cam follower system utilizing a fixed cam on the carriage and a movable follower on the machine stand;

FIG. 5 shows in schematic side elevation another possible embodiment utilizing a fixed follower on the carriage and an adjustable flexible cam on the machine stand;

FIGS. 6 and 7 are schematic side elevation and top views, respectively, of a third possible embodiment utilizing a plurality of cams on a vertical barrel.

FIG. 8 shows in schematic side elevation a fourth embodiment utilizing a plurality of cams on a horizontal barrel.

FIG. 9 shows yet another constructional form utilizing a screw-adjusted cam.

FIG. 10 shows in side elevation a cam position indexing device.

FIG. 1 shows a machine for trimming, bevelling and grooving a spectacle lens **1** gripped between two rubber pressure pads **2, 3** mounted rotatably on the lower end of a carriage **4**, the drive being provided either manually or by a motor **47**. Carriage **4** is pivotally and slidably mounted on a shaft **5** rigid with the machine stand **6**. The machine includes a grinder **7** rotating on an untranslatable shaft and consisting of a set of juxtaposed grinding wheels of different types suited to the kind of work to be done, such as for instance a roughing wheel **7*a***, a diamond-chip wheel **7*b*** formed with a V-shaped annular groove thereon for cutting a large bevel on the edge of the lens, a cylindrical diamond-chip finishing wheel **7*c*** and a diamond-chip wheel **7*d*** formed with a V-groove of smaller size than the groove on wheel **7*b*** so as to cut a small bevel. Alongside compound grinder **7** is positioned a small-diameter grinding wheel **7*e*** of suitable width for grooving the lens. Lens **1** is pressed against grinding wheel **7** or **7*e*** by a spring **48** or a counterweight **49** rigid with carriage **4**. It will be understood that each of the springs **48** and counterweight **49** may as well be used alone.

The rubber pressure pad **3** is carried on the end of a shaft **8** the other end of which carries a template **9** of shape matching that of the lens to be obtained and which contacts a feeler of adjustable level **10** when the grinding operation has imparted the required dimensions to the lens.

In accordance with the invention feeler **10** is devised in the form of a drum which is made up of two parts **10*a***, **10*b*** of different diameters and of which the shaft is supported on stand **6** and cooperates with a time-delayed microswitch **11.**

A micromotor **12**, fast with the machine stand and the feed circuit of which comprises microswitch **11**, carries on the end of its shaft a cam **13** shown schematically in side elevation in FIG. 2. As FIG. 2 clearly shows, cam **13** is a circular sector against which bears a facing friction surface **14** formed on the top of carriage **4.** The shaft of motor **12** carries, between cam **13** and the motor itself, a second cam **15** consisting of an eccentric disc formed with a catch **16** adapted to close a second microswitch **17.**

Carriage **4** additionally carries a stop **18** which, when lens **1** contacts grinding wheels **7,** is engaged between the prongs of a fork **19** which is movable parallel with the shaft **5** of carriage **4** and the position of which can be adjusted by a venier **20** fixed to stand **6.**

At the other end of carriage **4** is fixedly mounted a cam follower **21.** A rotatable barrel **22** bears on its periphery a plurality of cams of substantially frusto-conical shape the axes of which are parallel to that of shaft **5** and of which two are shown at **23** and **24** respectively in FGI. 1. These cams are respectively associated to the different finishing operations and can be shifted in parallelism with shaft **5** by means of verniers **25** and **26** respectively, fast with stand **6.** Each of cams **23** and **24** is formed with an axial bore therethrough, through which is longitudinally slidable a rod protruding from the cam and terminating in a head **27** for cam **23** and a head **28** for cam **24.** Cam follower **21** engages between one of the cams (e.g. cam **23**) and the corresponding head **27** when lens **1** contacts the grinding wheel selected for effecting

the finishing operation corresponding to the particular cam which has been previously selected by a suitable rotation of the barrel and positioned opposite follower **21**. A spring **50** urges each head toward its cam so as to retain follower **21** in pressure contact therewith.

Cam **23** is so contoured as to permit the obtainment of bevels, grooves or facets which faithfully follow the curvature of the lens surface over a portion of a sphere the radius of which is determined according to the curvature to be imparted to the meniscus of the spectacle-frame, for when changes in the lens grinding radius cause the carriage to rise and descend as the lens rotates about itself, cam **23** and its follower **21** impart lateral motion to carriage **4** of ampiltude dependent upon the amplitude of the vertical motion of the carriage.

The device hereinbefore disclosed works as follows: assuming the machine according to this invention to be in the configuration shown in FIG. 1 in which it is performing a roughing pass, stop **18** is engaged between the prongs of fork **19**, and the positively rotated lens **1** bears against roughing grinder **7***a* which removes material until the template **9** rotating with lens **1** contacts portion **10***a* of drum **10**, at which stage the lens will have the required dimensions over its entire contour. The removal of material then ceases and template **9**, which then contacts drum **10** responsively to the aforesaid counterweight or spring, begins to rotate said drum thereby closing microswitch **11**.

Through the agency of a timer **51** the delay of which corresponds to the number of revolutions of the drum **10**, required to complete the roughing pass, closure of microswitch **11** energizes micromotor **12** and causes cam **13** to be thereby rotated. The edge of the circular sector of cam **13** then contacts friction surface **14** whereby carriage **4** is pivoted about its shaft **5** against the opposing force of the spring or the counterweight at the same time as it is shifted laterally by the friction force.

This lateral motion ceases when follower **21** contacts the selected cam on barrel **22** (e.g. cam **23**), whereupon the carriage ceases its lateral motion whereas cam **13** continues to rotate since the coefficient of friction between it and surface **14** is insufficient to stop the rotation of micromotor **12**. When the sector on cam **13** leaves surface **14**, carriage **4** pivots about shaft **5**, follower **21** engages between cam **23** and its head **27**, and lens **1** descends onto the grinding wheel corresponding to cam **23**, again responsively to said spring **48** or counterweight.

After cam **13** has rotated through half a revolution, microswitch **11** stops micromotor **12** via the timer, and once the finishing operation has been terminated template **9** contacts the potrion **10***b* of drum **10** and proceeds to rotate the same, thereby rotating cam **13** once more through the medium of microswitch **11**, as explained precedingly, and raising lens **1**. After cam **13** has completed a full revolution, catch **16** closes contact switch **17** and stops micromotor **12**, carriage **4** then being in the raised position.

In the alternative embodiment shown in FIG. 3, drum **10** is replaced by a compound lever **30** devised in two stages **30***a* and **30***b* and which upon rotating on its pivot closes microswitch **11** through the agency of a timer.

In the various constructional forms of the adjustment device shown in FIGS. 4 through 9, this device includes a cam follower designated by numeral **31** and suffixed *a* through *e*, and a cam designated by numeral **32** followed by like suffixes. Cam **32** can either be fast with the lens-holder carriage (cams **32***a* and **32***c* in FIGS. 4, 6 and 7) and the follower **31** fast with the grinder mount (followers **31***a* and **31***c* in FIGS. 4, 6 and 7), or else cam **32** can be fast with the mount (cam **32** in FIG. 5) and the follower fast with the carriage (follower **31***b* in FIG. 5).

In the embodiment of FIG. 4, cam **32***a* has a concave surface of revolution. The vertical distance between cam **32***a* and follower **31***a* is caused to vary continuously or discontinuously, and this distance is indicated by a graduated scale or a pointer. The concave profile of the cam is such that, when the follower is in a position **33***a* remote from the cam axis, a subsequent vertical displacement of the carriage produces a smaller transverse shift thereof than when the follower is in a position **31***a* or **34***a* closer to said axis, whereby a greater radius of curvature of the bevel is obtained. Depending on the vertical position of follower **31** in relation to cam **32**, it is possible to generate bevels on different bases calibrated once and for all.

In the embodiment shown in FIG. 5, the variable-profile cam **32***b* is a thin flexible steel blade hingedly connected to one end of a pin **35** and formed at its other end **36** with an opening therein which is retained between two shoulders **37** and **38** of a screw **39** which enables the cam profile to be continuously varied.

In FIGS. 6 and 7, the barrel of FIG. 1 is replaced by a circular plate **40** bearing four flat cams of convex profile **32***c* lying in four planes perpendicular to plate **40** and equi-angularly spaced at 90°. These four cams are differently contoured and can be fetched separately into position opposite follower **31***c* by rotating plate **40**.

In FIG. 8, the barrel of FIG. 1 is replaced by a plate **41** which bears four flat cams of concave profile **32***d* lying in the plane of plate **41** and spaced radially at 90° from one another.

The cam **32***e* shown in FIG. 9 is flat with a concave profile and has one end pivotally mounted about a spindle **42** and a screw **43** contacting its other end. Rotation of screw **43** rotates the cam about spindle **42** and its angle of inclination varies the profile cooperating with follower **31***e*.

Cam **32** or follower **31** may comprise lateral adjustment means for shifting the groove or bevel forwardly or rearwardly of the lens, the position being indicated by a vernier **44** having its scale set perpendicularly to the cam base **46** (see FIG. 10).

Manifestly, many detail changes may be made to the specific forms of embodiment of the present invention described hereinabove.

What we claim is:

1. An automatic machine for grinding at least one spectacle lens, comprising, in combination, a stand, a shaft fixedly mounted thereon, a carriage pivotally and slidably mounted on said shaft, a lens grinding template, at least one lens grinder on said stand, means for securing said lens perpendicularly to an axis parallel to said shaft, means for securing said template perpendicularly to said axis, means for urging said lens against said grinder, means for rotating said lens and said template together about said axis, said securing means and said lens and template rotating means being on said carriage, means for translating and rotating said carriage along and about said shaft whereby to simultaneously rotate said carriage about said shaft through an angle sufficient to separate said lens from contact with said grinder and translate it along said shaft through a distance sufficient to disengage said lens laterally from said grinder, a contact member on said stand and able to undergo a motion relatively thereto responsively to said template, said contact member having a first bearing surface facing said template at a distance therefrom perpendicular to said shaft equal to the thickness of lens material to be removed by said grinder, control means of said carriage translating and rotating means activated by said motion of the contact member, and means for rendering inoperative said translating and rotating means after said simultaneous translation and rotation.

2. An automatic machine as claimed in claim **1**, further comprising an arresting stop rigid with said carriage and at least one carriage translation limit stop rigid with said stand and positioned facing said arresting stop at a distance therefrom equal to the carriage translating distance.

3. An automatic machine as claimed in claim 1, wherein said carriage translating and rotating means include a friction surface formed on said carriage along a plane parallel to said shaft, and a circular sector-shaped eccentric cam having a friction surface thereon and a rotation axis which is fixed relatively to said stand and perpendicular to said shaft, said cam being rotated by said control means.

4. An automatic machine as claimed in claim 3, wherein said control means include a first electric switch closable by said motion of said contact member, an electric motor energized through said switch and having an output shaft perpendicular to said fixedly mounted shaft and parallel to said carriage friction surface, said output shaft supporting said cam.

5. An automatic machine as claimed in claim 4, wherein the means for rendering said carriage translating and rotating means inoperative include a second cam mounted on said motor output shaft and a second electric switch connected into the feed circuit of said motor and openable by said second cam.

6. An automatic machine as claimed in claim 2, comprising a plurality of grinding members juxtaposed in parallelism with said shaft, limit stops equal in number to the number of said grinding members and each associated to one thereof, means for successively fetching said limit stops opposite said arresting stop, said means being fast with said stand and each of said limit stops cooperating with said arresting stop whereby to position said lens opposite the associated one of said grinding members, and adjustment means of the position of each limit stop in a direction parallel to said shaft.

7. An automatic machine as claimed in claim 2, wherein one of the two elements of the set consisting of said limit stop and said arresting stop is formed, facing the other of said elements, with a profile matching the curvature to be imparted to the meniscus of said lens.

8. An automatic machine as claimed in claim 6, wherein said plurality of grinding members include at least one roughing grinding-wheel and one finishing grinding-wheel and said contact member is formed with a second contact surface adjacent said first contact surface in a direction parallel with said shaft and in a position more distant from said template than said first contact surface by an amount equal to the thickness of the lens material to be removed during the finishing operation.

9. An automatic machine as claimed in claim 4, wherein said contact member includes a drum having its axis parallel to said shaft, and wherein said first switch is electrically connected to said motor through a time-delay device.

10. An automatic machine as claimed in claim 4, wherein said first contact surface of said contact member is carried on a lever pivotally mounted on a spindle parallel with said shaft and is positioned facing said template, whereby pivotal motion of said lever closes said first switch, said switch being electrically connected to said motor through a time-delay device.

11. An automatic machine as claimed in claim 7, wherein said second element is positionally adjustable along the profile of said first element.

12. An automatic machine as claimed in claim 7, wherein said profile includes an elastically-deformable part and said first element includes adjustment means of the elastic deformation of said part.

13. An automatic machine as claimed in claim 7, wherein said first element is formed with a plurality of profiled portions of different profile and includes means for fetching any one of said profiled portions in position for coacting with said second element.

14. An automatic machine as claimed in claim 7, wherein said first element includes a profiled member pivotally mounted about an axis perpendicular to said shaft and adjustment means of the position of said member about said axis.

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