ABSTRACT

A compact machine is provided for grinding, finishing and beveling the edges of lenses to a pattern size and edge shape. A sizing cam permits control of size to any desired fine adjustment, with complete accuracy. The grinding of a lens blank to a selected pattern is controlled by a master cam which guides a work carriage both for grinding the lens to pattern and size, and for finishing and beveling the edge to any desired bevel center. The lens grinding operation from start to finish is completely automatic, and fully controlled, and the machine automatically comes to a halt when the lens has been shaped and ground to the selected pattern and size.

37 Claims, 14 Drawing Figures
LEN S EDGE-GRINDING, FINISHING AND BEVELING MACHINE

Eyeglass lenses today are rarely round, but have to be ground to order, to fit a variety of eccentrically shaped spectacle frames designed to suit individual tastes. It is impractical to have in stock eyeglass lenses of the range of prescriptions normally encountered to fit any particular frame. Instead, the optometrist or optician has on hand a stock of eyeglass blanks, which are then edge-shaped and cut to fit the individual frame requirements of the user. This means that the average optometrist or optician must have available suitable lens grinding and shaping equipment.

Usually, such equipment is housed in a small shop in a corner of his establishment. The space available for such equipment, and the necessity that it be simple enough to be operated by one lacking in mechanical skills, impose a need for lens grinding equipment that is both compact and simple to operate and maintain. However, the commercial manufacturers of such equipment have tended to develop machines of greater and greater complexity and size, in seeking to impose feature upon feature, for greater sales appeal, with the result that the available machines are never simple, and are rarely easy to maintain.

The recent patents in this field give a suggestion of the complexity of development of this type of machine. U. S. Pat. No. 3,332,172, to Stern, patented July 25, 1967, describes an automatic edger which is capable of performing multiple finishing operations on lenses from a single set-up of the lens in the machine. However, the machine has three motors, motor 106 for the finishing means 18, motor 60 to drive the shaft 40, and motor 156 to drive the cam shaft 152, all of which are controlled by separate control switches. There are also a host of cams, for controlling the sequence of operations, including eccentric cam 92, cam 140, cam 170, and the cam surfaces on cam shaft 152.

Whereas in simpler construction, the available lens grinding machines nonetheless have similar basic components. A lens holder is provided, which is capable of holding the lens blank to be ground for rotation during the grinding about a selected transverse axis usually through the optical center of the lens, and which is itself mounted on a carriage arranged to move along this axis. Two lens-edge trimming wheels are provided, one flat, with a coarse surface, which cuts the lens quickly to the desired size and shape, and is referred to as the grinding or flat wheel, and the second, grooved with a fine grinding surface, which accomplishes the beveling and finishing or polishing of the lens edge, and is referred to as the finishing or beveling wheel. The lens holder and associated parts are referred to as the lens head, and this is arranged to pivot about an axis parallel to the transverse axis of the lens, so as to move the lens blank into and away from contact with the grinding and beveling wheels. The size and shape of the lens are controlled by a pattern cam, which is mounted for rotation about a transverse axis which is the same as that of the lens and is at a size-determining distance from the grinding wheels. The pattern cam moves against a fixed surface, the pattern platform, which is fixed at a predetermined minimum the distance between the axis of rotation of the lens and the grinding wheels, and thus controls the lens size and pattern. The size of the lens can be changed by changing the position of the pattern platform with respect to the transverse axis through the lens, and the grinding wheels determine the actual size of the lens without regard to the size of the template, since the platform spaces the lens at a fixed minimum distance from the grinding wheels. Rotation of the pattern or template on the platform thus controls both the size and the external configuration of the lens.

The lens-holder is arranged to hold the lens blank in a stationary position, without rotation, in contact with the grinding wheel, until the desired size and shape has been ground out, at each rotational position of the lens. The pattern cam actuates the reedshank according to contact thereof with the pattern platform. Thus, the lens blank is held in each position until its edge has been ground down enough to permit such contact. Contact actuates an electrical circuit which in turn causes the lens to rotate to a new position. When the size and pattern have been cut, all around the periphery of the lens, the carriage is moved over so that the lens edge rides in the groove of the beveling wheel, and the lens is allowed to free on this wheel, to obtain the desired bevel. Usually, the lens is allowed to rotate through one or several turns, to ensure that the edge is fully cut, and conforms perfectly to the pattern.

One problem with the available lens grinding machines is the mechanism for control of the size of the lens. Usually, this is done by raising or lowering the pattern platform. However, unless the position of the platform can be exactly controlled, and correlated with a given size, the sizing cannot be done accurately. Many machines use a threaded dial combined with a threaded pattern rest shaft. The difficulty with this approach is that one revolution of the dial cannot be made to give accurately the necessary number of sizes. One revolution may give many sizes, but cannot accurately give the full range, so that several revolutions are necessary. If calibration becomes necessary, the sizes are even more difficult to determine. Moreover, with wear, play develops between the threads of the dial and of the vertical shaft, and this causes a further discrepancy in size, since a slight rotation of the dial may not cause an immediate change in the height of the pattern platform. Moreover, vibration of the machine may cause the size to vary, because there is no way of positively holding a loose size setting in a given position.

In existing machines, it is also difficult to control the position and contour of the bevel. For appearance purposes, it is not always desirable to have the lens finished with a centered bevel, i.e., with the apex of the bevel midway between the front edge and the back edge. If the lens is thick, the appearance is always better when the thickness is concealed behind the frame, which can be accomplished if the bevel is displaced towards the front of the lens. To obtain an eccentric bevel, pressure must be applied against the front of the lens during the beveling cycle, to grind more away from the rear side. This pressure must be relieved before the lens starts to lift away from the beveling wheel at the end of the cycle, because if it does not, the pressure will cause the lens to hit the side of the beveling wheel, and grind part of it away. The available machines use a solenoid to relieve the pressure (which is applied using a weight) at the correct moment. Other machines employ heavy springs, to snap the lens head up quickly, at the end of the cycle, and thus remove the lens from the beveling wheel. Solenoids may go out of order, however, and
heavy springs tend to lose some of their tension in use, and have to be replaced frequently, for accurate control.

The various movements of the lens both towards and away from the grinding and beveling wheels and sideways with respect to the wheels are normally controlled by cams. These control the dropping of the lens-carrying head down onto the grinding wheel, lifting the head away from this wheel, moving the head and the lens over to the beveling wheel, dropping the head and lens down onto the beveling wheel, applying and removing pressure at the proper time for bevel control, lifting the head and lens at the end of the beveling cycle, and moving the head and lens back over the grinding wheel in readiness for the next cycle. Needless to say, the more cams, the more opportunities there are for malfunction, and the more opportunities there are for wear. Moreover, the wear may be uneven on various cams, sometimes requiring replacement of some cams earlier than others. If some are replaced, but not all, this always means that the various cams are at different wear rates, with varying degrees of accuracy during the several stages of the grinding and beveling operations.

During the grinding operation, the lens must be kept cool, and this requires application of a coolant spray, to lubricate the lens edge and facilitate the grinding and polishing. The resulting fluid materials tend to travel all over the equipment, and unless provision is made, such material can cause unnecessary wear, because the fluid picks up ground glass sediment from the lens. Moreover, the sediment can cake upon evaporation of the fluid, which can result in malfunction, if deposits accumulate in and among moving parts.

The available machines also leave much to be desired in accessibility to various parts of the equipment, for replacement of worn parts, for cleaning operations, and for retrieval of broken pieces or waste material, including broken lenses.

Another serious problem is the lens holder. This must hold the lens blank firmly against rotation during the grinding operation, but at the same time it must not apply so much pressure that the lens can be broken or cracked during the grinding, or during the beveling operation, in which it rotates freely. A friction grip is the most practical one, but it will be appreciated that to fixedly grasp an odd-shaped surface in a friction grip requires a rather flexible holder, and this flexibility must not impair the friction grip. A large lens blank requires a large friction grip, but if the finished lens is small, there is too little room on the lens surface to apply a large friction grip.

Most lens holders are round, but the final shape of most lenses is usually larger in the horizontal direction than in the vertical direction. Thus, when the finished lens size is small, often the holder itself is ground away on the vertical side.

In accordance with the invention, a lens edge-grinding, beveling and finishing machine is provided, which is extremely simple in construction, and which is completely automatic from the start to the completion of the grinding, beveling and finishing operation. The machine employs one motor to operate the grinding, beveling and finishing wheels, and one motor for all other movements, and features a master cam of special design for complete operational control of the grinding, beveling and finishing cycle, while using a conventional template cam to control pattern shape and size. Another feature is a spiral cam size adjusting mechanism, to position the pattern platform with complete accuracy, and a locking mechanism associated with the size setting means to prevent the platform from slipping into a different size position during use, all in a manner which minimizes wear. Further features are a housing with a completely enclosed lens-grinding compartment that retains a coolant and particles of ground glass, and prevents contamination of other moving parts therewith, and is readily accessible both for changing lenses and for cleaning; pressure control means for applying pressure during the beveling and finishing operation, to displace the bevel center in any desired direction; a lens holder or chuck that can hold the lens without slippage and without grinding the holder or chuck body away; a lens blank of virtually any type and degree of curvature at its center, regardless of the size of the finished lens, throughout the grinding, beveling and finishing operations; and an electrical circuit that controls all operations during a cycle on a fail-safe basis, with an automatic shut-off at the end of the cycle.

The master cam has a plurality of cam surfaces which establish and control each of the various steps of the grinding and beveling operation, as follows:

1. Pivotal movement of the lens-carrying head and lens towards and away from the lens-carrying head and lens from opposite the grinding wheel to opposite the beveling and finishing wheel, and back.
2. Transverse or sideways movement of the lens-carrying head and lens from opposite the grinding wheel to opposite the beveling and finishing wheel.
3. Pivotal movement of the lens carrying head and lens towards and away from the beveling and finishing wheel.
4. Holding of the lens-carrying head and lens against transverse or sideways movement during the grinding, and allowing such movement during the beveling and finishing.
5. Application of and removal of pressure to the lens during the beveling and finishing, so as to control the beveling eccentricity.
6. Shut-off of the electric circuit at the end of a grinding and beveling and finishing cycle.

Functions (1) and (3) are provided by one cam surface, functions (2) and (4) are provided by a second cam surface, and functions (5) and (6) by a third and a fourth cam surface, all combined on the same cam. The cam is in the form of a cylinder, having four adjacent sections, which may be a part of one cylinder, or four cylindrical segments attached for rotation together. The cam mounted on a camshaft which is motor-driven, and the same motor can drive the camshaft and the lens holder shaft, in a synchronized operation.

Each cam surface has an associated cam follower. The first cam follower is operatively connected to the lens-carrying head, and pivots it about an axis parallel to the axis of rotation of the lens. One of the second cam follower or the second master cam surface is operatively connected to a movable carriage on which the lens-carrying holder is mounted, and actuates transverse reciprocating movement thereof, first in one direction, and then back, between limiting positions corresponding to positions of the lens opposite the grinding wheel and the beveling and finishing wheel, respectively. The third cam follower is operatively connected to the pressure-applying means, to move it into and out of a pressure-applying position with respect to the lens,
but only while the lens is in contact with the beveling and finishing wheel. The fourth cam follower is in fact a switch control means.

The first and third cam surfaces are eccentric, of the hill-and-dale type, and raise or lower the cam follower to effect the desired operation. The second cam surface is provided with a surface groove or track, along which the second cam follower rides. One portion of the groove is just wide enough to accommodate the cam follower, to hold the movable carriage on which the lens-carrying head is mounted in a fixed transverse position while the lens is in contact with the grinding wheel during one portion of the cycle, and another portion is wide enough to permit free transverse movement of the movable carriage while the lens is in contact with the beveling wheel, during another portion of the cycle.

The fourth cam surface is a small segment, holding a pressure-operated button of an electric switch in an “off” position while in contact therewith, and in all other positions allowing the button to remain in an “on” position.

The size of the lens, in the apparatus of the invention as in other conventional apparatus, is controlled by raising or lowering the pattern or template platform. When the platform is raised, the lens-carrying head is prevented from dropping any closer than a predetermined minimum distance from the grinding wheel, thus fixing a minimum size for the lens. Thus, when the platform is raised, the size is increased, and when the platform is lowered, the size is reduced.

The position of the platform with respect to the peripheral surface of the grinding wheels is controlled in accordance with the invention by a wheel having a spiral slot, and which is referred to herein as a spiral cam. The wheel is mounted on and rotates about a fixed axis with a camshaft. The spiral cam slot rises helically in a uniform curve from a central part of the cam wheel to its peripheral edge. A cam follower is guided in this spiral cam slot. The cam follower is freely mounted to the platform support, and is guided upwardly or downwardly, to raise or lower the platform support, according to its position in the spiral slot, which is determined by the rotational position of the spiral cam.

The size mechanism is provided with a sizing dial, with a scale showing the sizes of the lenses according to the position of the platform. The scale can include numbers, markings, gradations, etc., so that a given beveling position of the scale can be selected according to the lens size desired. Accurate communication of this position with respect to lens size, and locking of the platform in any selected size position, are obtained in the following manner.

Axially mounted over the camshaft and fixedly mounted on the support for the spiral cam, is a cam lock, which does not rotate with the camshaft. The cam lock can take the form of a toothed gear, or other fixedly mounted member into which locking means on the sizing dial can engage, to lock the spiral cam and sizing dial against rotation. An apertured plate can also serve as a cam lock. A locking position is provided for each lens size gradation on the size scale of the sizing dial. The camshaft is however free to rotate in the central aperture of the cam lock, through which the camshaft passes.

The sizing dial is mounted on the camshaft, for rotation therewith, and thus in any given position reflects the true position of the spiral cam, and thus the position of the platform cam follower in the slot thereof, and the platform. The sizing dial has a locking means such as an internal gear or a plurality of projections or pins meshing with and locking into the cam lock, such as the toothed periphery or apertures thereof. Thus, the rotational position of the spiral cam is reflected exactly by the position of the sizing dial, and when the sizing dial is locked to the cam lock by the locking means, the dial cannot be rotated. The cam lock has a fixed position for each position on the dial. Biaxial means is provided, to keep the sizing dial normally in locking engagement with the cam gear.

The sizing dial is slidable mounted on a square shaft (although any other polygonal configuration can be used), so that when it is rotated, it will also rotate the spiral cam, and it can also be moved on the camshaft both away from and into engagement with the cam lock, against and with the biasing force of the biasing means. Thus, when the size to be changed, the dial has to be unlocked, before it can be turned. To do so, the dial is pulled away from the cam lock, releasing it, after which the dial is rotated to the proper size, and then allowed to return into its normal locking position on the cam lock by the biasing force, whereupon it is locked in place, preventing further rotation of the spiral cam. In this way, size control is exact, and the platform is always locked in the selected size position.

Further details of the lens edge-grinding, finishing and beveling machine of the invention will be apparent from the following description and the drawings, in which;

FIG. 1 represents a plan view, seen from above, with parts cut away, of the top of one embodiment of machine of the invention;

FIG. 2 represents a side view, with parts cut away, of the machine of FIG. 1, showing the size control dial, the pattern cam, the master cam, the beveling pressure control mechanism, and the size control support arm;

FIG. 3 represents a front view, with parts cut away, of the machine of FIGS. 1 and 2, showing the sizing dial, spiral cam, and master cam on the left of the drawing;

FIG. 4 is a top view of the machine of FIGS. 1 to 3, with the lens-head cover and movable carriage cover removed, exposing the drive mechanism for the lens holder and also showing the drive mechanism for the grinding, beveling and finishing wheels;

FIG. 5 is a rear view of the machine of FIGS. 1 to 4, with parts cut away, to show the motor and camshaft for the master cam, the motor for the grinding, beveling and finishing wheels, and electrical connections, the two shafts of the movable carriage, and the bearing supports on which the movable carriage slides transversely, and upon which are held the size control support arm, and the beveling pressure control arm;

FIG. 6 is a detailed side view on an enlarged scale of the spiral cam and lock mechanism, controlling the position of the pattern platform and pattern cam;

FIG. 7 is a detailed vertical section on an enlarged scale taken along lines 7—7 of FIG. 6 showing the spiral cam and cam lock mechanism and the microswitch controlling operation of the size rotating mechanism;

FIG. 8 is a developed view, on an enlarged scale, of the four master cam surfaces;

FIG. 9 is a detailed front view partly in section on an enlarged scale of the lens holding mechanism;
FIG. 10 is a detailed sectional side view, on an enlarged scale, of the lens holder segments; FIG. 11 is a detailed side view, on an enlarged scale, taken along lines 11—11 of FIG. 10, showing the left lens holder; FIG. 12 is a detailed cross section view, on an enlarged scale, of the lens holder segments; FIG. 13 is a detailed rear view, on an enlarged scale, of the master cam section and cam follower; and FIG. 14 is a detailed side view on the same scale as FIG. 13 of the master cam section and cam follower. The apparatus shown in FIGS. 1 to 11 has a base 1 which supports the entire machine, and is fitted with lugs 2 to carry screws 3 for leveling or attachment on a table, platform or other support 4 to position the machine at a convenient height for use.

Mounted on base 1, at the front, is a tank or container 6, with a removable door 7 which gives access to the interior of the tank 6, for cleaning purposes. The door 7 has a peripheral flange 9 engaging a matching flange 10 in the tank 6, and is held in place against the flange 10 by the latch bolt 11. The latch bolt is slidably held in the pierced lugs 12, and releases the door when it is slid out. The tank 6 can also be provided with a drain 13, at the bottom.

At rear of tank 6 are fixed two pairs 13, 14 of lugs, each of which has through apertures in which are supported linear motion ball bushings 18 such as Thomson ball bushings. These carry a movable carriage 90, which is supported as follows:

Two shafts 91, 92 extend through the bushings 18, and slide therein transversely, but do not rotate therein. The ends of shafts 91, 92 support side plate supports 13', 14' of the carriage 90, and these in turn carry the various components of the machine that form a part of the carriage. The sideways movement of the carriage on shafts 91, 92 in bushings 18 is controlled by a master cam 20, as will presently be seen.

In an alternative embodiment, the ball bushings can be fixed in the side plate supports 13', 14', and the carriage 90 can slide on the shafts 91, 92, and the shafts fixed to the lugs 13, 14.

The carriage 90 carries a lens head housing 5, pivotally mounted on a shaft 77 which extends through and is supported by the side plate supports 13', 14'.

The carriage 90 has a cover 16 on which is mounted hinged lens cover 19 by screws 17. The cover 16 protects the moving parts enclosed by the carriage housing. The cover 16 is removable, and when in place serves as a brace for the carriage structure and side plate supports 13', 14'. The hinged lens cover 19 fully encloses the lens holder and any lens held therein. The hinged cover of the cover provides ready access to the lens compartment 8 of housing 5, for insertion of a lens blank and removal of a finished lens.

Two shafts 21, 22 are supported in and extend through the side walls 23, 24 of the lens holder housing 5, which with the interior side walls 23', 24' define lens compartment 8, respectively. The end 25 of shaft 21 extends into the lens compartment from one side, while the end 26 of shaft 22 extends into this compartment from the other side. Each shaft end supports one of the two segments 27, 28 of the lens holder.

Each segment of the lens holder is smaller than the smallest size lens to be shaped, is roughly octagonal in shape, with rounded corners, and is fixed with the long side horizontal to the shaft ends 25, 26. Segment 27 presents a concave surface, and segment 28 a convex surface, to the lens held therein. The long axis of each segment corresponds to the long axis of the finished configuration of the lens, or what is known as the 180° line.

These are shaped for grasping a curved lens. They can each be flat, also, to grasp a flat lens, and each machine would normally be fitted with a set of each type, to be able to handle each kind of lens.

The lens holder of the invention although small is shaped to fit any size lens, and will grip the lens firmly without slippage because the frictional hold is maintained over a large horizontally oriented area, but with less interference vertically. There is therefore no likelihood that the grinding wheel will grind away part of the holder after the lens has been cut to size. This is achieved by the octagonal shape, and by the following structural features.

Each holder segment has a body portion 29. Segment 28 and a chuck 27a of segment 27 each have a circular socket 30 to receive the shaft end 25 or 26, and a locking slot 31 receiving the pin 32 on the shaft ends. A rim 33 extends along the central horizontal sides 34 of each of the holders, and retains a felt pad 35. Each felt is shaped to the surface configuration of the holders, and has a central cavity 36. The felt pads are bonded to the surface with cement. The pads conform in curvature to the holder surfaces, and thus lens holder 27 presents a concave felt pad surface to the lens, and lens holder 28 presents a convex felt pad surface to the lens. The central cavity 36 of each pad makes it possible for the pad to provide pad friction gripping contact with maximum gripping force with the lens periphery and minimum gripping force at the lens center to hold the lens in the proper position during grinding, finishing and beveling without undue pressure at the lens center, which is particularly important for holding lens blanks which are very thin at their center.

The lens holder segment 27 is removable. The chuck portion 27a has two pins 27b that fit in corresponding apertures 27c in the segment body 29. The lens segment is removed, a lens blank (held in a conventional lens blank clamp) is carefully fitted in the concavity so that its optical center is at the central axis of the segment, and the composite is then replaced on the pins 27b, after which the lens holder segment 28 is tightened in place against the other surface of the lens blank, to fit it in position for the grinding, beveling and finishing operations.

The holder segments are so shaped and fixed in position on the two lens shafts that the lens can always be centered therein in any desired position with respect to its optical center. This makes it possible to shape the edge of the lens exactly with respect to the lens center, which is important for correct prescription positioning of the lens in a spectacle frame.

Rotatable drive means are provided for each lens shaft 21, 22 in the form of sprocket wheels 40, which can be fixed in any desired location along the shafts by set screws 41. The shaft 21 and the sleeve 38 through which shaft 22 passes are each rotatably supported in the central apertures of a pair of ball-bearing wheels 42. The pair of wheels 42 for shaft 21 are fitted into the lens head housing and the pair of wheels for shaft 22 and sleeve 38 are fixed within the supporting sleeve 44 fixed to the housing walls 24', 24.
A thrust bearing 43 presses against the lens head housing and prevents the wheel 42 from being pushed out, and prevents binding of the shaft 21 or the lens head housing. The shaft 21 and the sleeve 38 (and thus shaft 22) rotate on the ball bearings of the wheels 42 when the sprocket wheels 40 are driven by chain drives 75.

The shaft 21 is rotatable within its pair of ball-bearing wheels 42, but cannot be moved in a transverse direction. Shaft 22 is rotatable within sleeve 44, together with sleeve 38, and it also is mounted for transverse movement within sleeve 38, to provide the access space needed for removing and inserting a lens between the lens holder segments 27, 28. Such transverse movement is provided for by a unique mechanism which permits shaft 22 to be locked in any desired position, to fit thin or thick lenses, with the lens-holder segments 27, 28 in a firm friction grip on the lens, without danger of breaking the lens.

The sprocket wheel 40 allows transverse movement of shaft 22 without corresponding movement of sleeve 38 because set screw 41 passes through a slot 39 in shaft 22. Consequently, upon transverse movement of the shaft 22 the set screw 41 slides freely in the slot. The screw also serves to prevent rotation of shaft 22, except when the sprocket wheel 40 and sleeve 38 are rotating.

The mechanism for releasing and tightening the lens holder segments 27, 28 with respect to a lens or lens blank is as follows:

A thrust bearing 45 is mounted within the hub compartment 49a of hand wheel 49. The outer end 46a of the shaft housing 46 has an internally threaded aperture 47, which receives the threaded portion of a tubular lens holder control shaft 48 that supports hand wheel 49. The open center 48a of shaft 48 receives therein the end of shaft 22. The shaft 22 is locked into the hub compartment 49a by 22a, so that the hand wheel 49 can rotate shaft 48 in the threaded socket 47, but always holds the end of shaft 22 in the compartment 49a, and carries the shaft with it in either direction of transverse movement thereof. Thus, rotation of the hand wheel 49 to the right or left moves the shaft 22 (without rotation of the shaft, due to set screw 41) towards or away from the shaft 21, so that a lens can be inserted between the lens holder segments 27, 28.

The lens can then be fixed in position between the holders 27, 28 by rotating hand wheel 49 to move the segment 28 into holder-abutting position with segment 27, tightening the shaft 48 in the aperture 47, so as to lock it there, after the lens has been firmly gripped between the holders, while thrust bearing 45 permits rotation of the wheel without binding.

It will be seen from FIGS. 3 and 4 that the lens compartment 8 of the lens head housing 5 opens at the front into the tank 6, which extends the full length of the lens head housing 5, and serves as a lens-grinding compartment. In the tank 6 are disposed the grinding wheel 70 and beveling and finishing wheel 71 which are driven by the motor 135. Particles of glass ground from the lens may collect in the tank 6, together with any coolant fluid sprayed against the lens. The tank can be cleaned out from time to time; removal of the door 7 gives complete access to all portions thereof. When the lens cover 19 is in place, the tank is closed off fully. Consequently, any glass particles can travel anywhere about the machine; they are confined to the tank 6. However, even when the cover 19 is up, the interior wall 72 and top wall 73 of the lens compartment 8 prevent splash in the direction of the operator of the machine.

The end 50 of shaft 21 extends out over a pattern platform 51, and the end 50 is shaped to receive, for rotation therewith, a lens pattern or template 122 of conventional type, thus ensuring that the axis of rotation of the pattern or template will be the same as the axis of rotation of the lens during grinding, finishing and beveling.

The platform 51 is mounted on a vertical shaft 52a, which is slidable held through the aperture 54 to a pivotable size control support arm 53. The shaft 52a is held spaced from a second coaxial shaft 52b by a coil compression spring 69. The arm 53 is carried on pivot pin 74, held in wall 13' of the movable carriage 90. The top end of the shaft 52a is fixed to the platform 51. The bottom end of the shaft 52b carries a cylindrical ball bearing 55, which serves as a cam follower.

A vertical set screw 52c parallel to shaft 52a bears against the top of shaft 52a, and adjusts and limits the downward movement of shaft 52a.

A cam wheel 56 is mounted for rotation on a camshaft 57 directly below the shaft 52b, with its center in line with the longitudinal axis of the shaft. The cam 56 has a spiral cam slot 58, wide enough to receive the bearing 55, which is guided in the slot. The cam wheel is fixedly mounted on the camshaft 57 for rotation therewith. The camshaft 57 extends through and rotates in the aperture 59 of the support arm 53. Thus, the radial position of the slot 58 determines the position of the ball bearing 55 and with it, the elevation of the shafts 52a, 52b, attached thereto, and consequently the height of the platform 51 with respect to the axis of rotation of the grinding and beveling wheels 70, 71.

On the other side of and fixed to the support 53 is a peripherally toothed cam lock 60. This lock has a central aperture 61 through which the camshaft 57 extends. The periphery of the lock can have any desired number of teeth, in conformity with the exact number of sizes desired; in the lock shown, there are 144. The lock teeth hold the sizing dial and therefore the spiral cam in any desired fixed position.

Beyond the lock 60, the camshaft 57 has a square configuration, and supports a slidable sizing dial 62. A sizing knob 63 is slidable attached to the end of the shaft 57. The sizing dial is attached to the knob, and can be rotated manually by rotating the knob. The knob 63 and the dial 62 rotate the shaft, and always have the same radial position as the cam wheel 36, so that their position reflects exactly the position of the spiral cam slot 58, and therefore of the platform 51.

The sizing dial 62 has an internal recess 64, conforming to the external configuration of and receiving the cam lock 60, and the sizing dial 62 and knob 63 can be slid along the shaft 57, so that the dial 62 moves into and out from engagement with the cam lock. Such movement is controlled by the sizing knob.

In spaced positions along the interior wall of the recess 64 of the sizing dial are four pins 65, which are positioned to mesh with the teeth of the cam lock 60, and when so placed the camshaft 57 is locked against rotation. When the sizing dial is moved to the right, so that the cam lock 60 fits within the recess, the pins lock into the teeth. A coil spring 66 in the dial handle biases the dial towards the lock, so as to keep the pins normally meshed in the teeth thereof, to lock the cam wheel 56.
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in any selected position. Sliding of the dial to the left by the sizing knob releases the pins. This permits rotation of the spiral cam and of the sizing knob to a new selected position, and thus permits adjustment of the platform height to correspond to any desired size of a lens by raising or lowering the platform 51 via the cam follower 55 guided by the spiral cam slot 58 of the cam wheel 56, and the platform can be locked in each selected position by meshing the pins 65 in the teeth of the cam lock 60.

A microswitch 67 is attached to arm 53, with its pushbutton 67’ extending upwardly. A lug 68 on shaft 52 is positioned to depress the electrical circuit when the shaft is moved downwardly against the upward biasing force of coil spring 69, which occurs whenever the lens pattern 122 is in position on the end of shaft 21, and is resting on platform 51, due to the weight of the lens head housing 5 and associated parts, transmitted through the pattern to the platform and shaft. In consequence, the button 67’ is depressed and the switch is on only when the lens edge has been cut down to such a size that the pattern 122 rests on the platform. Set screw 52c adjusts and limits the depression of the button 67’ by limiting the downward movement of shaft 52a against spring 69.

The master controls the electrical circuit operating the lens drive mechanism for rotating the shafts 21, 22 during the grinding operation. This drive mechanism is a gear drive motor with a brake arrangement to prevent override. The switch is off and the lens is held against rotation during grinding down to size, because the pattern is elevated above the platform during this operation, but as soon as the right size is reached, the pattern is lowered to and rests on the platform 51, which pushes the shaft 52a down, moves the lug 68 to depress pushbutton 67’ and actuates the switch 67. This actuates the lens drive mechanism, rotating the lens until the pattern is again elevated above platform 51, whereupon shaft 52a rises, carrying lug 68 with it, the pushbutton 67’ rises, and the switch 67 shuts off the lens drive mechanism. The lens is held stationary until that part is ground down to size, and the cycle then is repeated.

The lens drive mechanism is as follows. Fitted to the like sprocket wheels 40 on each shaft 21, 22 are like loop chain drives 75, which at their other end loop over sprocket wheels 76. The wheels 76 are fixedly mounted to shaft 77, which rotates on ball bearings 78 fitted in the lens head housing 79. The shaft 73 extends between side walls 13’, 14’ of movable carriage 90. The shaft extends through the side walls 13’, 14’ on each side, and the side walls are fixed ball bearings 77a on which the shaft 77 pivots. On the projecting portion at side wall 14’ is mounted another sprocket wheel 82 and loop chain drive 83 extending to the main drive sprocket wheel 84 on the drive shaft 80 of an electric motor 81. The chain 83 thus constitutes the primary chain, and the chains 75, the secondary chains, of the lens drive mechanism. Operation of the motor 81 rotates the drive shaft 80, and with it the primary and secondary chains, for corresponding rotation of the lens-carrying shafts 21 and 22 during the grinding operation, as controlled by microswitch 67.

The master cam 20 is mounted for rotation on one end of shaft 85 which is supported at the rear side of plates 13’ and 14’ of the movable carriage, on ball bearings 85a which are fixed in the plates 13’, 14’. On the stub end 95 of camshaft 85 projecting from side wall 14’ is mounted a toothed drive gear 88, which meshes with and is driven by a corresponding main drive gear 89 attached to the motor drive shaft 80, together with the main drive sprocket wheel 84. Thus, operation of the motor rotates the gear 89 and with it the gear 88 and camshaft 85, and thus the master cam 20.

The beveling pressure control is arranged for actuation by section 111 of the master cam 20, and comprises a cam follower 97, a weight 98 and a thrust point 99, carried on arms 100, 101, 102, extending from the pivotally mounted support base 107. The support base 107 pivots on the pivot pin 103, which is attached to the movable carriage 90. The weight is slidably held on a weight support shaft 104, which is fixed at one end of the arm 102. The thrust point 99 bears against the upright arm 93, when the beveling pressure control is actuated, tending to thrust carriage 90 to the right, its shaft 91, 92 moving sideways along bushings 18, under the pivoting force of weight 98, but it can reach this position only when permitted to do so by the surface con-
configuration of the master cam section 111 on which the cam follower 97 travels.

In the normal non-actuating position, the cam surface 111 holds the cam follower 97 down, so that the weight 98 is raised, and the thrust point 99 is held away from the plate upright arm 93. The pressure control assembly is held in this position throughout all of the grinding cycle, except when the lens is in contact with the beveling wheel. When this portion of the cycle is reached, the pressure control assembly is brought to an actuating position. The surface of the cam section 111 on which the cam follower 97 travels is depressed at this moment, permitting the cam follower 97 to rise, and the pressure control support 107 to pivot, to the right, until the thrust point 99 is brought in contact with the upright arm 93, at which point it can move no further. Since the pivot pin 103 is carried on the movable carriage 90, the force exerted by the weight 98 on arm 93 now thrusts the cam follower towards the right, thus increasing the pressure contact of the lens with the left-hand taper of the beveling wheel, tending to bevel the lens more on the right side than on the left. The amount of pressure can be controlled by the leverage of the weight, determined by the weight and by the position of the weight on the arm support 102. The weight can be moved along shaft 104 as desired, and locked in the desired position by means of the set screw 106. In this way, any desired amount of pressure can be applied to the lens during beveling.

The master cam 20 has a complex four-component surface configuration, which makes it possible to control via the four cam followers all of the sequential grinding steps of the machine, in a given lens grinding and finishing and beveling cycle. A single rotation of the master cam corresponds to a single cycle.

As best seen in FIGS. 1, 2, 3, 5 and 8, the master cam 20 is composed of four cam sections (1) a lift and drop control section 110 for pivoting the lens-carrying head housing 5 and associated parts; (2) a bevel control cam section 111; (3) a moveable cam control cam section 112; and (4) a switch control cam segment 113.

The bevel control cam section 111 comprises a cylinder segment in which the cut-out portion 114 corresponds to the desired actuation period for the beveling pressure control assembly, whose cam follower 97 moves along this portion. When the cam follower reaches the cut-out portion 114, the assembly is permitted to pivot to the right, and the thrust point 99 is brought against the upright arm 93, applying a side-ways-moving force to the moveable carriage 90.

The lift and drop section 110 comprises a cylinder segment in which there is a portion 115 of intermediate diameter, a cut-out portion 116, and a projecting portion 117. The portion 115 corresponds to that part of the cycle where the lens is in contact with the flat grinding wheel. The cut-out portion 116 corresponds to the portion of the cycle where the lens is in contact with the beveling wheel, which is lower than the grinding wheel. The projecting portion 117 corresponds to the lifting of the lens-carrying head 5 at the conclusion of the beveling cycle.

The cam follower end 119 of the pivotable platform support arm 53 travels on the cam section 110. When the end 119 moves off the portion 117 to portion 115, the head 5 is lowered until the lens can contact the grinding wheel. Grinding continues with intermittent lens rotation, controlled by switch 67 to occur only when the pattern contacts the platform 51. When grinding is complete, the end 119 moves onto portion 116, and the head 5 lifts slightly, and then is lowered further, to contact the beveling wheel. When the end 119 moves onto portion 117, the platform-supporting end 120 lifts, carrying with it the pattern resting on the platform 51 and shaft 21 to which it is attached, thus lifting the lens-carrying head 5, ending the beveling operation.

The carriage control section 112 of the cam 20 controls the relative transverse position of the carriage 90 with respect to the grinding wheel.

A groove 120 extends all around the surface of this section of the cam. Cam follower 96 attached to upright 93 rides in the groove, which thus is a cam track. The upright 93 has a slot 125 across the top end, in which is slidable a plate 123 to which the cam follower 96 is affixed. The plate 123 and cam follower 96 can be held in any position in the slot by set screws 124, which allow a small adjustment of the plate towards the center or side of the slot. The upright 93 can be rotated, and is held against rotation by set screw 93a. Such rotation together with the position of the plate in the slot provides a considerable adjustment of the position of the cam follower 96 so that it will track properly along the side of the cam track 120.

The upright 93 is rotatably attached to the base 1, while the master cam is attached via camshaft 85 to the movable carriage 90, so that the course of the groove 120 along the surface of master cam 20 determines the transverse position of the carriage 90. Thus, the groove 120 of cam section 112 guides the floating carriage 90 and the lens-holding lens head 5 transversely, to position it precisely with respect to the grinding and beveling wheels at each stage of the grinding and beveling cycle. It is also possible to fix the master cam 20 to the base, and the cam follower 96 to the movable carriage, but this requires that the other cam followers mounted on the carriage be slidable with respect thereto, and fixed against transverse movement to the base with the master cam, which is a more cumbersome arrangement.

The cam track 120 at the start of the cycle is just the size of follower 96, so that it fixes the carriage in a transverse position, and positions the carriage 90 so that the lens holders of head 5 hold the lens directly opposite the grinding wheel 70. Then, at the conclusion of this operation, the cam track 120 describes a left-hand S curve, and guides the floating carriage 90 transversely so as to put the lens opposite the finishing and beveling wheel 71. At this stage, beyond the S curve, the groove 120 in the cam widens, so that the follower 96 is no longer fixedly held in a transverse position with respect to the beveling wheel 71. Therefore, the carriage 90, the head 5 and the lens can float freely, as controlled by the contour of the lens edge in the groove of the beveling wheel. During this portion of the cycle, the beveling pressure control is operative, as stated above, to prepare an off center bevel.

At the end of the beveling cycle, the groove 120 narrows again to the width of the cam follower 96, so as to once more fix the carriage 90 in a transverse position, and then describes a righthand S curve, moving the carriage 90 to the right, to position the lens over the grinding wheel 70, ready for the next cycle.

The cam segment 113 holds the microswitch 87 in the "off" position at the end of a grinding, finishing and
beveling cycle. At all other positions of the cam 20, switch 87 is "on".

In operation, the main control switch 86 is turned on, and the machine is then ready to start. However, the motor 81 is not yet on, because the push-button switch 87 is in the "off" position, held there by cam segment 113 of the master cam 20. The lens holder control hand wheel 49 is rotated to loosen it, and the shaft 22 thereby pulled to the right, separating the lens holder segments 27, 28. The lens is then put in place between the two lens holder segments 27, 28. The lens holder segment 27 is removed, the lens blank fitted converse in, against the concavity, with its optical center at the central axis thereof. The lens holder segment is carefully fitted back in the chuck 27a on pins 27b, using a lens clamp of conventional type, and the control hand wheel 49 then rotated in the opposite direction, so as to lock the lens between the two holder portions, by moving shaft 22 and segment 28 to the left, and tightening it down, and firmly gripping the lens therebetween for the grinding operation.

A pattern or template 122 is placed on the end 50 of the shaft 21, and the sizing dial 62 turned by knob 63 to and locked in the proper size setting for the lens to be ground from the blank. This raises the platform 51 to the correct height. The machine is then ready to operate.

Now, the pushbutton 121 is depressed, shorting out switch 87, starting the motor 81, as well as pump 130, and starting rotation of the master cam 20, as well as the grinding and beveling wheels 70, 71. Rotation of the master cam moves cam section 110 into the portion 115, to lower the head 5, and brings the lens into contact with the grinding wheel 70. The lens is oversize, and holds template 122 above the platform 51. Hence, the platform is not depressed, so that lug 68 does not actuate switch 67, and the shafts 21, 22 are stationary, and held so by the stationary drive mechanism, supported by wheels 46, chain 75. The lens is ground down rather quickly, and eventually the template 122 comes into contact with the platform 51, depresses it sufficiently to actuate the switch 67, and then shafts 21, 22 and the lens are rotated to a new lens position, since the lens is oversize there. This results in again lifting the template, and halting the rotation. Grindings continues in this way, with intermittent rotation, until one complete rotation of the lens has been effected, and the lens conforms in size and shape to the desired pattern. Thus, the lens blank is held firmly against the grinding wheel and does not rotate until it has been ground down to the desired size, reflected in the position of the pattern on the platform. After the lens has reached the desired size, the cam follower 96 reaches the first S curve in the groove 120, as well as an elevator in periphery of a cam. This lifts the lens away from the wheels, and completes the initial grinding operation.

The cam follower 96 traveling in the groove 120 on the master cam now travels the S curve, by which it is deflected to the left, carrying with it the carriage 90 and the lens-carrying head 5, to a position over the beveling and finishing wheel 71. Since the cam follower end of support arm 53 has traveled the course of portion 115, and has reached the next portion 116 of the cam, the arm 53 is lifted a little (to allow sideways movement of the carriage) and lowered to a lower position, carrying with it the platform 51, pattern 122 and the lens-carrying head 5, so that the lens is moved down to the beveling wheel 71. The pattern 122 rests on the platform, since the lens has been cut to size, so switch 67 is on and shafts 21, 22 rotate, while the rough-edged lens blank is in engagement with the beveling wheel 71. The cam follower 96 controlling the transverse movement of the carriage 90 now enters the wide portion of the groove 120, where sideways movement of the cam follower 96 is no longer restricted, thus setting the lens blank free to move sideways, in contact with the beveling wheel.

However, the freedom of the lens to do so is not wholly uncontrolled, if an off-center bevel is desired, for the bevel control cam section 111 now puts the bevel pressure control in operation, and the weight 98 exerts a rightward-directed sidewise force on the carriage 90 and thus tends to drive the lens toward the right, during the beveling operation. Of course, use of the beveling control is optional; on thin lenses, an off-center bevel may not be desired, for example. In this event, the weight 98 is removed, so that the bevel control is ineffective. It is not necessary to inactivate the cam.

As the master cam 20 continues to turn, the beveling is completed, and the cam follower 97 of the beveling pressure control pivot shaft 99 reaches the end of portion 114, and enters the normal diameter portion of this section, and is moved downwardly, so that thrust point 99 is moved away from upright 93, and the pressure is released. At the same time, the cam follower 96 traveling in the groove 120 on the master cam reaches the narrow portion of the groove, and travels the returning S curve, so that it moves the carriage 90 to the right, at the same time as the support arm 53 has reached the cam portion 117 and is moved downwardly, thus lifting the platform 51 and the lens-carrying head 5, so that the lens is brought away from contact with the beveling wheel, and the carriage is returned to its original position, when the lens is directly over the grinding wheel 70. The master cam 20 has now completed one full revolulution, and the cycle is complete. The raised cam segment 113 on the master cam comes in contact with the pushbutton 87' of the microswitch 87, turning off the current, and shutting off the motor 81, so that the machine stops. The lens is always at the same angle of rotation at the end, so that a new lens may be inserted easily. The control dial 49 can now be loosened, and the finished lens removed. After insertion of a new blank, another cycle can be begun by depressing the pushbutton 121, which starts a new cycle.

The pushbutton switch 121 permits current to flow only while it is depressed, and therefore it must be held depressed for a long enough time for the main cam 20 to move so that the raised portion 113 comes away from contact with the button 87' of microswitch 87, thus permitting the button to rise and the switch to close, and current to continue for the remainder of the cycle. This is a fail-safe feature. If at any time the machine has to be stopped, in the course of a cycle, this can be done by turning off the main control switch 86, which is readily and quickly reached by the operator on bridge 94.

The machine of the invention also includes as an optional but preferred feature means for applying fluid such as a coolant liquid to the lens surface during the grinding, beveling and finishing, to facilitate these operations. A pump motor 130 is provided, on the platform or table on which the base 1 is supported. A tank
reservoir 131 is connected in series with a line 132 leading directly to a point just above a lens in position between the lens holders 27, 28, and the pump feeds a stream of coolant fluid from the reservoir 131 via this line to the lens, in a recirculating fashion. A drain 133 at the bottom of tank 6 is provided, for permitting the coolant fluid to release to pump reservoir.

Operation of the pump 130 is controlled by the microswitch 86 on the master cam 20, so that fluid is continuously supplied to the lens while the lens is being ground, bevelled and finished, and when the cycle of the machine reaches its conclusion, and power is shut off, the pump 130 is also shut off.

Any type of coolant liquid can be used, such as aqueous solutions of a polyol, such as ethylene glycol, propylene glycol, or glycerol.

Having regard to the foregoing disclosures, the following is claimed as the inventive and patentable embodiments thereof:

1. In a lens edge-grinding and finishing machine having lens-edge grinding, beveling and finishing wheels, and a rotatable, pivotable and reciprocable lens blank holder holding the lens blank in operative relation to the said wheels for grinding, beveling and finishing thereof, to a size and pattern, and the rotating, pivoting and reciprocating movement of the lens blank holder, the improvement which comprises a single master cam having a plurality of cam surfaces and associated cam followers in operative engagement therewith, which establish and control each of the various steps of the grinding and beveling and finishing operation, one cam surface effecting pivotal movement of a lens-blank holder and lens towards and away from the grinding wheel, and pivotal movement of the lens carrying head and lens towards and away from the beveling and finishing wheel; a second cam surface effecting transverse or sideways movement of a lens blank holder from opposite the grinding wheel to opposite the beveling and finishing wheel, and back, while holding the lens blank holder against transverse or sideways movement during the grinding, and allowing such movement during the beveling and finishing; and a third cam surface adapted to move into operative relation to an electric switch effecting a shut-off of the electric circuit at the end of a grinding and beveling and finishing cycle.

2. A machine according to claim 1 including a pattern cam rotatable with the lens blank holder controlling lens shape and size, a pattern cam platform on which the pattern cam rotates, and a rotatable spiral cam controlling the position of the platform to locate the pattern cam for a selected lens size.

3. A machine according to claim 2, including a locking means fixing the spiral cam against rotation and preventing the platform from moving into a different size position during use.

4. A machine according to claim 1, in which the lens blank holder is pivotally mounted on and movable with a reciprocable carrier, one portion of the master cam controlling reciprocation of the carrier, and another portion controlling pivoting of the lens blank holder.

5. A machine according to claim 1, including beveling pressure control means in operative connection with the lens blank holder for applying pressure to the lens blank to move it sideways while it is in operative engagement with the beveling and finishing wheel, to displace the bevel center in any desired direction.

6. A machine according to claim 1, including a lens holder in two segments, one presenting a concave and one presenting a convex surface to a lens blank held therebetween, and a resilient friction pad attached to each of said surfaces that can hold a curved lens blank at its optical center throughout the grinding, beveling and finishing operations, without lens breakage or slippage.

7. A machine according to claim 1, comprising an electric motor driving said wheels; an electric motor driving the rotating, pivoting and reciprocating movement of the lens blank holder and pattern cam; each motor being operatively connected thereto by an electrical circuit that controls operation of the motors during a grinding, beveling and finishing cycle on a failsafe basis, with an automatic shut-off of each motor at the end of the cycle.

8. A machine according to claim 1, including a base; at least two apertured supports fixed on the base; at least two shafts extending through the support apertures; and a movable carriage supported on the shafts and slidable transversely with respect to the supports, such transverse movement thereof being controlled by the master cam, the carriage carrying a lens head housing within which the lens blank holder is disposed.

9. A machine according to claim 8, in which the shafts are fixed to the carriage and the support apertures carry ball bushings which allow free movement of the shafts sideways with respect to the supports but prevent rotation of the carriage about the supports.

10. A machine according to claim 8, having a lens head housing pivotally mounted on a shaft which is supported on the movable carriage.

11. A machine according to claim 10, in which the lens head housing has a hinged lens cover enclosing the lens holder and any lens held therein, the hinged cover providing access to the lens holder for insertion and removal of a lens therein.

12. A machine according to claim 1, having a tank receiving sediment ground off a lens blank, the tank having a door which gives access to the interior of the tank for cleaning purposes, the apertured supports being fixed to the tank, and the lens blank holder being disposed over the tank.

13. A machine according to claim 1, including a fourth cam surface controlling application of and removal of pressure to the lens during the beveling and finishing, so as to control the beveling eccentricity.

14. A machine according to claim 13, in which the fourth cam follower is operatively connected to a pivotable pressure-applying beveling control means, to pivot it into and out of a pressure-applying position with respect to a lens blank in the lens blank holder, but only while the lens blank is in contact with the beveling and finishing wheel.

15. A machine according to claim 1, in which the master cam is in the form of a cylinder having adjacent cam sections bearing the first, second and third cam surfaces.

16. A machine according to claim 1, in which the master cam is mounted on a motor-driven camshaft, and the motor rotates the camshaft and the lens blank holder in a synchronized operation.

17. A machine according to claim 1, in which the first cam follower is operatively connected to the lens blank holder and pivots it about an axis parallel to the axis of rotation of the lens, and the first cam surface is of the
19. A machine according to claim 1, in which one of the second cam follower or the master cam is operatively connected to a movable carriage on which the lens blank holder is mounted, and actuates transverse reciprocating movement thereof, first in one direction, and then back, between limiting positions corresponding to positions of the lens opposite the grinding wheel and the beveling and finishing wheel, respectively.

19. A machine according to claim 17, in which the second cam surface is provided with a groove in which the second cam follower travels, one portion of the groove having a width to accommodate the cam follower, and to hold the movable carriage on which the lens carrying head is mounted in a fixed transverse position while the lens is in contact with the grinding wheel during the grinding portion of the cycle, and another portion having a width to permit free transverse movement of the movable carriage while the lens is in contact with the beveling and finishing wheel, during the beveling and finishing portion of the cycle.

20. A machine according to claim 1, in which the third cam surface is a small segment holding a pressure-operated button of the electric switch in an "off" position while in contact therewith, and in all other positions allowing the button to remain in an "on" position.

21. In a lens-edge grinding and finishing machine having lens-edge grinding, beveling and finishing wheels, a rotatable, pivotable and reciprocable lens blank holder holding the lens blank in operative relation to the said wheels for grinding, beveling and finishing thereof, to a size and pattern, a pattern or template platform controlling lens size according to its position with respect to the peripheral surface of the grinding, beveling and finishing wheels, and a pattern cam rotatable with the lens blank holder controlling lens shape and size, the improvement which comprises, in combination, a spiral cam for adjusting the position of the platform with respect to the peripheral surface of the grinding, beveling and finishing wheels, comprising a cam wheel mounted on and rotatable about a fixed axis with a camshaft, and having a spiral cam slot rising helically in a uniform curve from a central part of the wheel to its surface, and a cam follower fixedly attached to the platform, and travelling in the spiral cam slot, moving the platform reciprocably according to its position in the slot, and the position of the cam wheel; and a lens size control mechanism in operative connection with the spiral cam, and rotatable therewith, including a cam lock which is axially mounted over and does not rotate with the camshaft, and locking means operatively connected to and rotatable with the camshaft and reciprocably movable into and away from fixedly interlocking engagement with the cam lock at any of a plurality of fixed positions corresponding to lens size gradations so that the position of the spiral cam is fixed when said locking means is interlocked with the cam lock, and the spiral cam cannot be rotated; and biasing means to keep said means normally in interlocking engagement with the cam lock.

22. A machine according to claim 21, comprising a vertical shaft on which the platform is mounted; and a pivoting support arm having an aperture in which the shaft is slidably held, the top end of the shaft being fixed to the platform, and the bottom end of the shaft carrying a cylindrical ball-bearing which serves as the cam follower.

23. A machine according to claim 22, in which the camshaft extends through and rotates in an aperture of the support arm, a peripherally toothed cam lock is fixed to the support arm, and having a central aperture through which the camshaft extends, the camshaft beyond the lock having a polygonal configuration, and supporting a sizing dial and a sizing knob slidably attached to the end of the shaft, and rotatable manually to rotate the shaft, and always having the same radial position as the spiral cam, so that their position reflects exactly the position of the spiral cam, and therefore of the platform.

24. A machine according to claim 23, in which the sizing dial has an internal recess conforming to the external configuration of and receiving the cam lock, and the sizing dial and knob can be slid along the shaft so that the dial moves into and out from engagement with the cam lock, such movement being controlled by the sizing knob, with pins disposed in spaced positions along the interior wall of the recess of the sizing dial to mesh with the teeth of the cam lock, and lock the camshaft against rotation.

25. A machine according to claim 22, having an electric motor to rotate the lens holders; a switch operatively connected to the motor and attached to the support arm, with a switch control means extending outwardly therefrom; a lug on the shaft positioned to depress the control means and actuate an electric circuit; the shaft being movable with respect to the support arm, to move the lug and depress the control means whenever a lens pattern is resting on the platform, so that the switch is on and the lens holders rotated only when a lens blank has been cut down to a size such that the pattern rests on the platform.

26. In a lens edge-grinding and finishing machine having lens-edge grinding, beveling and finishing wheels, and a lens blank holder in two segments holding the lens blank in operative relation to the said wheels for grinding, beveling and finishing thereof to a size and pattern, the improvement which comprises two lens holder shafts in axially end-facing relationship, each facing end having a lens holder segment attached thereto; drive means for rotating each shaft, and at least one of the shafts being movable axially transversely with respect to the other, and being slidably supported in a rotatable sleeve, the movable shaft being supported within a housing and having a control means attached to its other end, the control means having a socket in which the shaft end is inserted; a thrust bearing in the socket and disposed over the shaft end; an externally threaded tubular shaft enclosing the said end of the movable shaft and attached at one end to the control means, for rotation therewith over the movable shaft; a threaded socket in the housing into which the tubular shaft threads; and retaining means affixed to the movable shaft end within the socket of the control means and retaining it within the socket for movement with the control means upon relative movement of the tubular shaft within the socket.

27. A machine according to claim 26, in which the two shafts are rotatably supported in the central apertures of two pairs of ball-bearing wheels.

28. A machine according to claim 26, in which the drive means for the shafts and/or sleeve are sprocket wheels attached thereto and driven by chain drives.
29. In a lens edge-grinding and finishing machine having lens-edge grinding, beveling and finishing wheels, a rotatable, pivotable and reciprocable lens blank holder holding the lens blank in operative relation to the said wheels for grinding, beveling and finishing thereof, to a size pattern, and a pattern or template platform controlling lens size according to its position with respect to the peripheral surface of the grinding, beveling and finishing wheels, the improvement which comprises a lens size control mechanism in operative connection with the platform, to raise or lower the platform, including a rotatable sizing dial mounted on a shaft, rotation of which raises or lowers the platform, a lock axially and fixedly held over the shaft so as not to rotate therewith, and locking means fixedly interlocking with the lock at any of a plurality of fixed positions corresponding to lens size gradation and holding the dial and shaft against rotation when so interlocked.

30. A machine according to claim 29, including means to bias the dial and locking means into locking engagement with the lock.

31. A machine according to claim 29, in which the lock comprises a toothed gear, and the locking means is adapted to mesh with teeth on the gear.

32. In a lens edge-grinding and finishing machine having lens-edge grinding, beveling and finishing wheels, and a rotatable, pivotable and reciprocable lens blank holder holding the lens blank in operative relation to the said wheels for grinding, beveling and finishing thereof, to a size and pattern, the improvement which comprises a beveling pressure control for imposing an off-center bevel to a lens edge, comprising a weight and a thrust point carried on arms spaced on opposed sides of and extending from a support pivotally mounted in operative connection with the lens blank holder, the thrust point being adapted to bear against a fixed base and thrust the lens blank holder sideways under the pivoting force of the weight, to impart a sideways-applied beveling pressure to a lens blank against one side of the beveling and finishing wheel.

33. A machine according to claim 32, in which the weight is slidably held on a shaft to adjust the bearing pressure of the thrust point against the base.

34. A machine according to claim 32, arranged to be cam-actuated, comprising a cam surface; and a cam follower attached to an arm extending from the support; the cam surface normally holding the cam follower so that the thrust point is held away from the fixed base, but when a lens is in contact with the beveling wheel permitting the cam follower to pivot the pressure control support until the thrust point is brought in contact with the fixed base.

35. In a lens edge-grinding and finishing machine having lens-edge grinding, beveling and finishing wheels, and a rotatable, pivotable and reciprocable lens blank holder holding the lens blank in operative relation to the said wheels for grinding, beveling and finishing thereof, to a size and pattern, the improvement which comprises a base; at least two apertured supports fixed on the base; at least one shaft extending through the apertures between the supports; and a movable carriage attached to the shaft, which is arranged for reciprocable transverse movement with respect to the supports in the apertures, and carrying the lens blank holder for pivotal movement thereof towards and away from the grinding wheel, and towards and away from the beveling and finishing wheel, the carriage carrying a cam movable by a cam follower fixed to the base, for effecting and controlling reciprocable movement of the carriage and the shaft with respect to the grinding and beveling and finishing wheels, and the cam having a circumferential groove in which the cam follower travels.

36. A machine according to claim 35, having two parallel shafts extending between and sliding transversely through the apertures of the supports.

37. A machine according to claim 36, in which the shafts are supported on ball bushings disposed in the support apertures allowing reciprocable movement but not pivoting movement thereof.

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