April 25, 1933. J. DESENBERG 1,906,050

MACHINE FOR GRINDING AND POLISHING OPTICAL LENSES, SPECTACLE GLASSES, AND THE LIKE

Filed April 15, 1929 3 Sheets-Sheet 1

Fig. 1

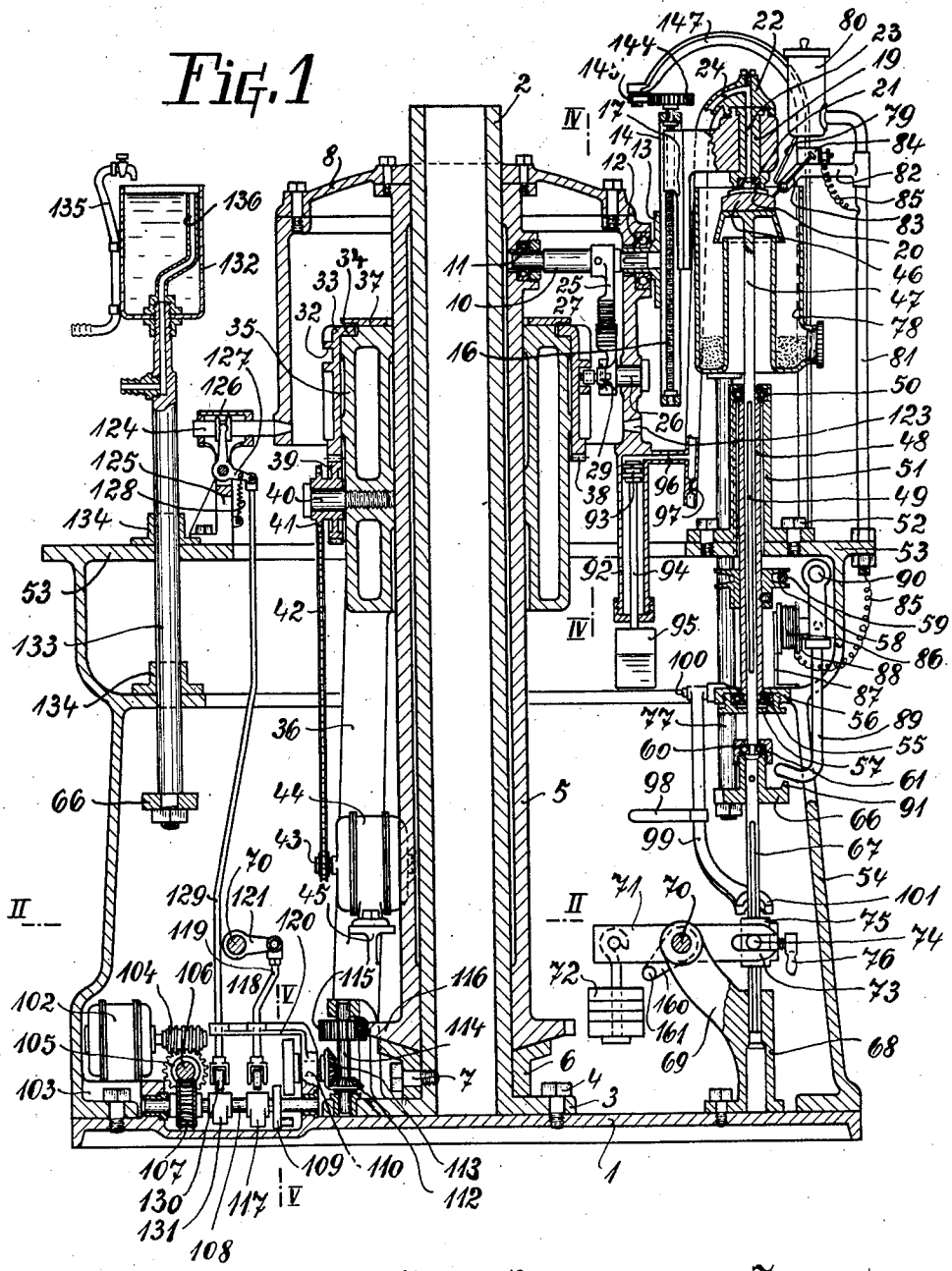
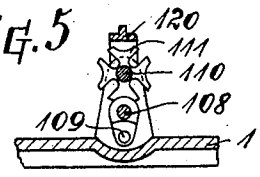


Fig. 5



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Filed April 15, 1929 3 Sheets-Sheet 2

Fig. 2

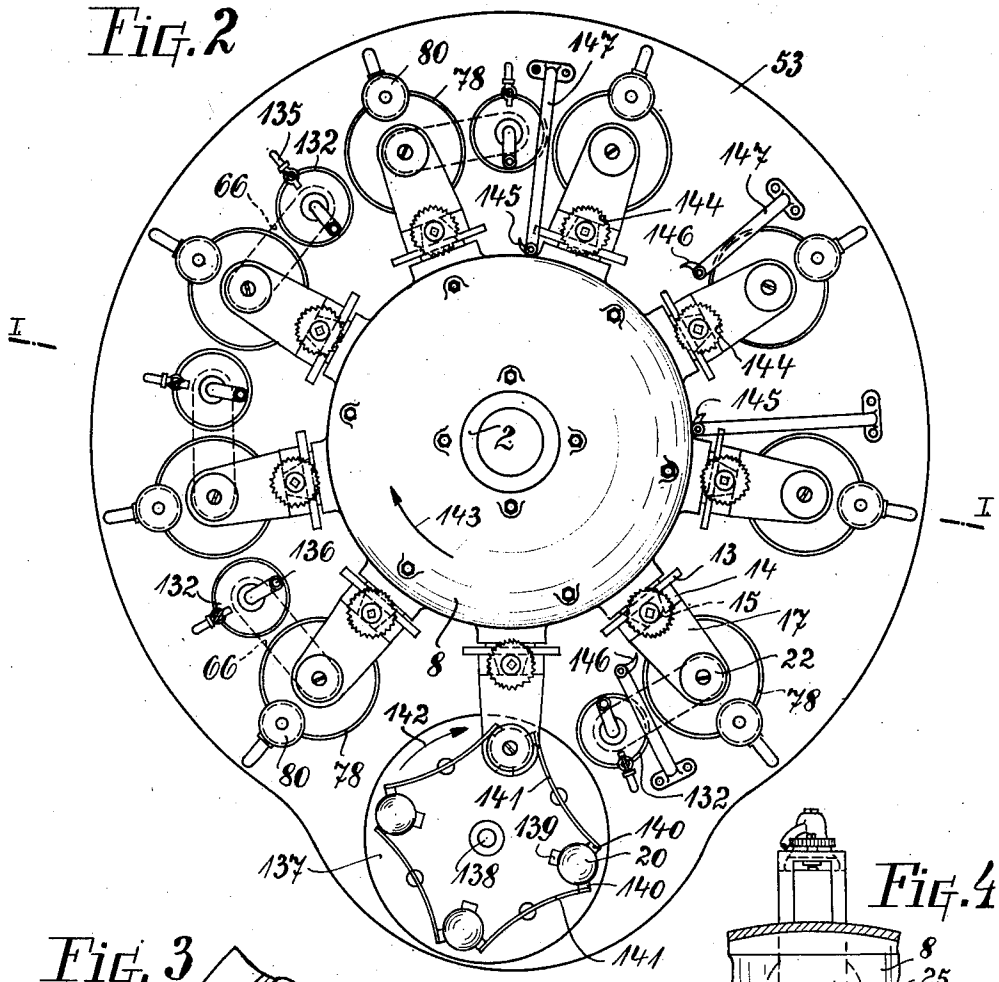


Fig. 3

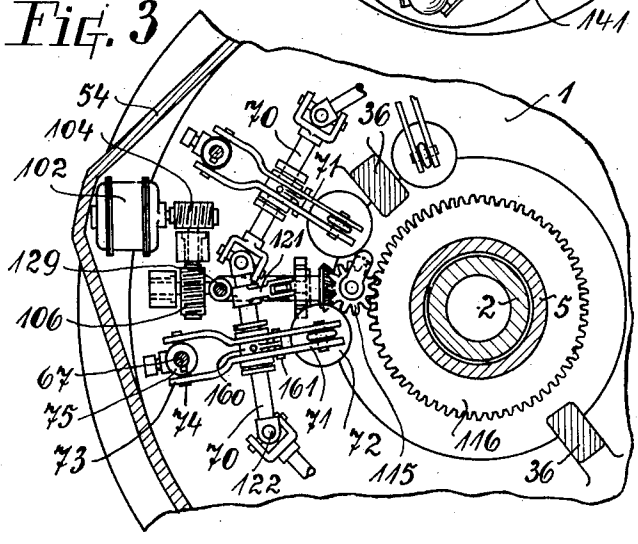
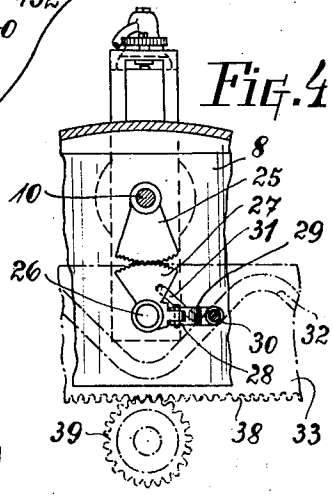


Fig. 4



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Filed April 15, 1929 3 Sheets-Sheet 3

Fig. 6

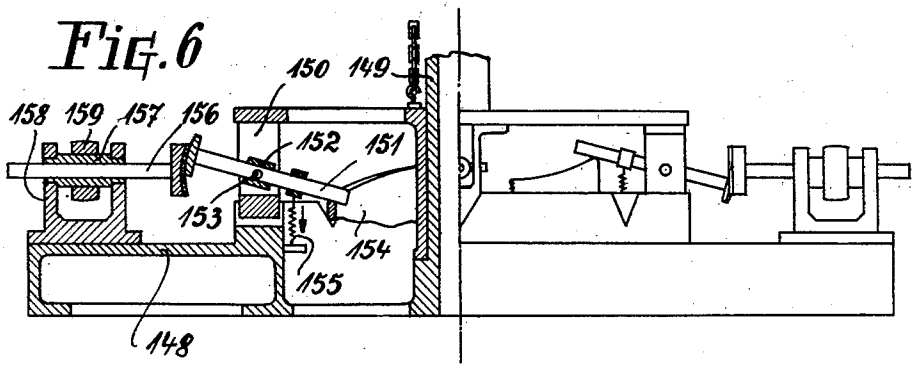
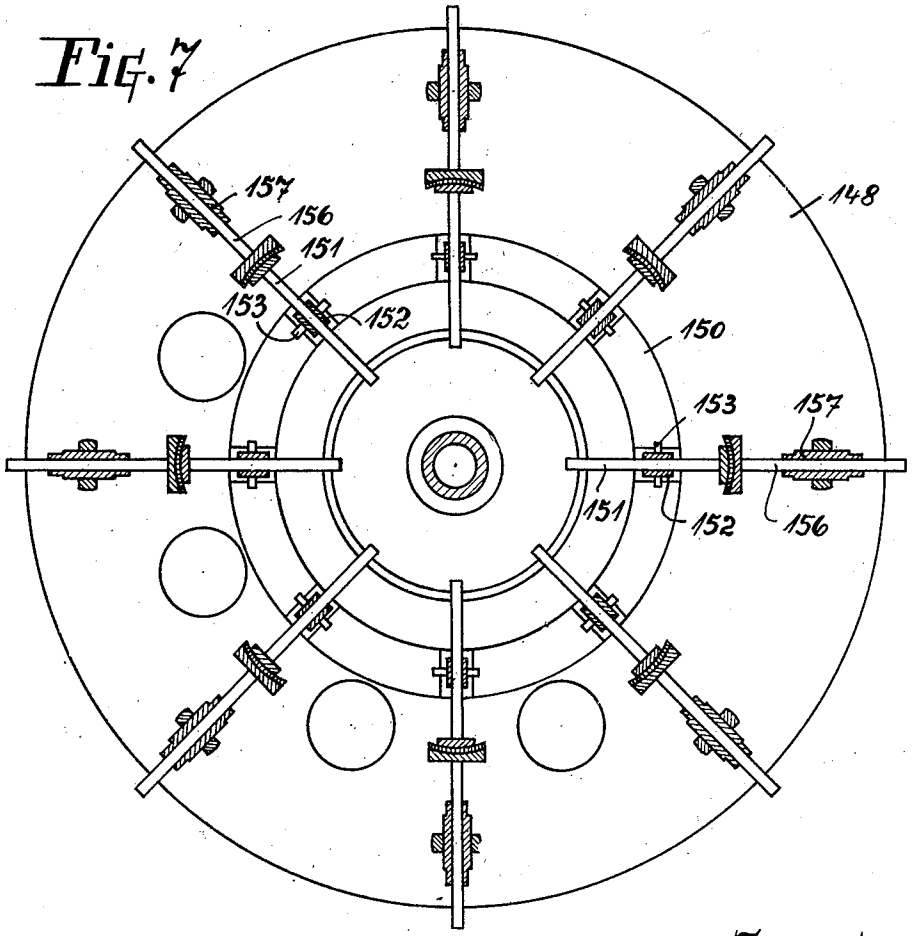


Fig. 7



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UNITED STATES PATENT OFFICE

JOSEF DESENBERG, OF COLOGNE, GERMANY

MACHINE FOR GRINDING AND POLISHING OPTICAL LENSES, SPECTACLE GLASSES, AND THE LIKE

Application filed April 15, 1929, Serial No. 355,280, and in Germany April 17, 1928.

The invention relates to a machine for grinding and polishing optical lenses, spectacle glasses, and the like which is so constructed as to be capable of producing automatically a product which is absolutely uniform in an optical sense. The principle underlying the operation of the machine is that the glass elements forming the work pass intermittently in succession through a series of operating stations which are arranged concentrically to a rotary head adjustable in uniform angular steps, each station comprising a grinding tool having the desired spherical surface and rotating about the axis thereof and a work carrier co-operating alternately in pairs with these grinding tools.

In the known lens grinding machines, the grinding tools consisting as usual of soft metal shaped on their working surfaces according to the spherical surface to be produced by the grinding operation are movably and freely connected with their driving axis of rotation so that during the grinding operation they bear on the shaped surface of the work itself. This arrangement which is also usual in most of the hand actuated lens grinding apparatus has the disadvantage that the surface of the grinding tool which determines the grinding shape continually alters owing to the more or less non-uniform wear caused by the rough grinding material. The ground surface of the work is also obviously modified correspondingly, and therefore a definite desired surface can only be obtained by constantly supervising the progress of the wear so that the grinding operation can be interrupted when the desired shape is attained. The continual alteration in shape of the grinding tool can only be compensated by frequently exchanging and reconditioning the tool, thereby excluding theoretically and practically automatic operation of the machine in the sense of producing a uniform product of manufacture having predetermined optical properties without supervising individual grinding operations.

In the machine which forms the subject of the invention the aforesaid hindrance to the automatic operation of the machine is removed, for instead of regulating the sliding and rotary movements on the surface of the work being operated on by the surfaces themselves I impart positive transverse oscillations to one of the two temporarily co-acting elements about a transverse axis which passes through the centre of curvature of the surface to be produced and the axis of rotation of the other element or for the purpose of obtaining special corrective results through a point located at an accurately calculable small distance from said centre of curvature, and also as before through the axis of rotation of the other element.

The necessary grinding pressure is produced by causing the element which is not adapted to carry out a transverse oscillatory movement to be yieldingly pressed upwards in an axial direction against the oscillating element. This pressure may be produced by a weighted lever and can obviously be accurately regulated.

According to the invention the transversely oscillating elements constructed as work carriers are mounted on a part of the machine which is rotatable intermittently after the manner of a rotary head. The oscillating elements are further arranged at uniform angular distances on the rotary head with their oscillatory axes radially disposed in relation to the axis thereof. The non-oscillating elements of the individual stations mechanically rotated about the optical axes of the surfaces to be worked are preferably arranged parallel to the axis of rotation of the rotary head.

A machine according to the invention is illustrated in the accompanying drawings in which:—

Figure 1 is a sectional elevation,

Figure 2 is a plan view corresponding to Figure 1,

Figure 3 is a sectional plan on the line III—III of Figure 1 of part of the machine.

Figure 4 is a vertical section on the line IV—IV of Figure 1 of a part of the machine.

Figure 5 is a vertical section on the lines V—V of Figure 1.

Figure 6 shows diagrammatically partly in elevation and partly in section the main features of a modification of the invention in which the rotary grinding spindles are arranged horizontally.

Figure 7 is a plan view corresponding to Figure 6.

The base plate 1 of the machine carries centrally a vertical cylindrical column 2 provided with a flange 3 by which the column is secured by screws 4 to the base plate. A hollow shaft 5 embraces the column and is rotatably supported at its lower end on a foot bearing ring 6, which is non-rotatably connected by a screw 7 with the column 2. The upper end of this hollow shaft carries a bell-shaped rotary head 8 non-rotatably connected therewith and provided with a number of horizontal oscillatory axes 10 radially disposed relatively to the axis of rotation of the rotary head and angularly equi-distant from one another. The inner ends of the oscillatory axes are carried in ball bearings 11 lodged in the wall of the hollow shaft 5. On the outer end of each of the oscillatory axes is secured a boss 13 and oscillatory arm 14. The boss 13 is supported by a ball bearing 12 mounted in the cylindrical wall of the rotary head. The arm 14 carries a guide 15 having its path of movement extending vertically to the oscillatory axis. A slide 17 is mounted in the guide and is adjustable therein on both sides of the oscillatory axis by means of a screw spindle 16. The slide 17 carries in a cylindrical hole parallel to the guide 15 an exchangeable and passively rotatable work holder 19 on the lower end of which the work 20 formed for example by a convex-concave lens is arranged. The work 20 is held against the end face of the work holder by the co-operation of a suction box 21 which in known manner is placed under vacuum. The suction box is connected by a canal 23 extending through the work holder 19 and an upper retaining cap 22 therefor with an adjacent pipe 24 which communicates with a suitable air suction pump.

A toothed sector 25 is secured on each of the oscillatory axes 10 in the interior of the rotary head and engages with a similar sector 27 supported on a pin 26 on the inside of the head. This sector 27 carries a cam roller 30 on a lateral arm 29 capable of oscillation in an axial plane radial to the pin 26 about a pivot 28. The roller 30 is normally caused to engage in a groove 32 of a cam drum 33 by means of a plate spring 31 acting on the lateral arm 29. The drum 33 is supported on a framehead 35 by means of an annular flange 34 arranged on the upper end of the drum and by its inner cylindrical surface bearing against appropriate surfaces on the framehead 35 which is secured by means of two columns 36 to the base plate so as to be co-axially mounted with the column 2 and rotary head 8. The cam drum is prevented from longitudinal movement in the upward direction by an annular plate 37, and is provided at its lower edge with a toothed crown 38 engaging with a driving wheel 39 rotating around a pivot pin 40 secured to the side of the head 35. The boss of the driving wheel 39 carries a chain wheel 41 connected by a chain 42 to a chain wheel 43 of an electric motor 44 by which it is driven. The motor 44 is mounted on a lateral bracket 45 of one of the columns 36.

In the region of the lower end of each of the work holders 19 a grinding tool 46 made of suitable metal or the like is exchangeably secured to the upper end of a spindle 47 which extends longitudinally through a hollow spindle 48 parallel to the axis of rotation of the rotary head. The spindle 47 is non-rotatably connected with the spindle 48 as indicated by the spring bar 49 but is capable however of longitudinal adjustment in the spindle 48. The hollow spindle is supported at its upper end by means of a ball bearing 50 in a bearing block 51 secured by means of screw bolts 52 to an annular platform 53 carried by the casing 54 of the machine. The lower end of the hollow spindle is supported in a ball bearing 55 which is mounted in an inwardly directed annular projection 56 of the casing 54 by means of a screw plug 57. A cord pulley 58 is secured to each hollow spindle and can be driven in common with other pulleys by a cord 59 driven by a motor (not illustrated) in order to impart the necessary drive to the tool spindle 47 and the grinding tool 46. The lower end of each of the spindles 47 is connected with a cross beam 66 so as to be immovable in the longitudinal direction relatively thereto by means of a channel bearing held in position by a screw cap 60. The cross beam 66 is mounted on the upper end of a pressure rod 67 adjustable longitudinally and guided at its lower end in a block 68. A pin 70 is rotatably mounted in a horizontal axis in the forked end of a lateral arm of the block 68. A compensating lever 71 is oscillatably carried by the pin 70 and consists of two bars connected in parallel so as to leave an intermediate space. This compensating lever is loaded at its inner end by a counterweight 72 and at its outer end engages an adjusting collar 75 by means of a fork 73 and two lateral pins 74. The collar 75 is longitudinally movable on the rod 67 and can be set in an adjusted position by means of a pressure screw 76. The transverse member 66 carries a collecting vessel 78 by means of two columns 77 longitudinally movable

through suitable apertures in the casing of the machine. The upper end of the collecting vessel or receiver 78 surrounds the grinding zone during the grinding operation and serves to receive the particles flung off during the grinding operation. The receiver is made annular for the purpose of allowing the passage of the spindle 47.

Whilst the grinding tool 46 is rapidly rotated by means of its spindle 47 through the medium of the pulley 58 and spindle 48 it is pressed by the counter balance lever 71 with the desired grinding pressure against the contacting surface of the work 20 which is being operated on. As through the medium of the drum 33 constantly being rotated by the motor 44 and the intermediate action of the two toothed sectors 25 and 27, the work holder 19 is moved to and fro parallel to a vertical plane passing through the axis of rotation of the tool spindle, completely uniform wear on the operative surface of the grinding tool is obtained whilst permanently maintaining the maximum value and the co-axial position of its centre of curvature with the grinding rotation.

The grinding material is fed to the operative position through a small tube 79 from a storage container 80 which is mounted at the upper end of a standard 81 secured to the platform 33. A feeler or lever 83 is movably arranged on a lateral arm 82 of the standard so that its point, preferably consisting of a diamond is disposed in the vicinity of the upper surface of the grinding tool 46. A contact-making member 84 is arranged adjacent the opposite arm of the lever 83, and its terminal is connected by a wire conductor 85 passing downwards through the interior of the standard 81 to the winding of a magnet coil 86, which by means of an angle bracket 87 is fixedly mounted on the lower annular projection 56 of the casing 54. The movable magnet core 88 of this coil is provided on a swinging lever 89 rotatable about a pin 90 carried by the casing. The lower inwardly directed end of said lever lies adjacent an inclined abutment surface 91 provided on top of the transverse member 66. The proportions and co-operation of the parts are such that when the effective grinding surface of the work reaches a predetermined limiting position corresponding to the desired thickness of the work the contact 84 is closed under the action of the feeler 83 and thereby the coil 86 is energized. The core 88 and with it the supporting lever 89 is thereby moved inwardly so that the latter contacts with the abutment surface 91 and takes over the supporting of the load of the counter-weighted lever 71. By so doing further undesired continuation of the grinding action on the work concerned is interrupted.

A further arrangement for avoiding any undesired grinding action is provided and adapted to come into operation when the work carried by the holder 19 concerned breaks or slips out or even when the holder has not been fed with work. For this purpose a suction cylinder 92 is secured to the lower edge of the rotary head at each operating station. The piston rod 94 of a piston 93 movable within the cylinder is loaded at its lower free end with a weight 95. The upper closed end of the cylinder communicates by a connection 96 with the suction pipe 24 connected to the suction box of the associated work holder 19 and communicating through the medium of a throttle 97 provided below the connection 96 with the pump producing the necessary vacuum. In the line of movement of the weight 95 and below the suction cylinder is disposed a lateral arm 98 of a supporting lever 99 which oscillates about a pin 100 secured to the casing. The end of the lever 99 which is forked as indicated at 101 can be set in the path of the adjusting bush 75 secured to the rod 67. When owing to breakage or absence of the work the suction box of the associated work holder is not closed to atmosphere, the piston 93 which under effective vacuum is normally held in its upper position moves downwards under the load of the weight 95 and contacts with the lateral arm 98 causing the supporting lever 99 to oscillate so that its forked end 101 moves in the path of the adjusting collar 75 and thereby preventing the undesired upward movement of the pressure rod of the grinding spindle and grinding tool. By these means in such cases the destruction of the grinding surfaces is avoided.

A motor 102 mounted on a bracket surface 103 of the casing 54 serves for the intermittent rotation of the rotary head by which the work elements are brought in succession to the different operating stations. A worm 104 is provided on the motor shaft and drives a worm wheel 105 of a counter shaft which in turn through the medium of a worm 106 drives a second worm wheel 107 causing a control shaft 108 to rotate at a slow speed in accordance with the desired duration of the individual operative periods. The shaft 108 carries near its inner bearing a crank pin 109 which so co-operates with a Maltese cross 111 mounted on a parallel countershaft 110 that the latter remains stationary for the greater part of the rotation of the control shaft, but during the remainder of the rotation of the control shaft is rotated through a definite angle. This intermittent angular rotation is transmitted by two bevel wheels 112 and 113, vertical shaft 114, and a gear wheel 115 mounted thereon to a

toothed crown 116 secured to or formed on the lower end of the hollow shaft 5.

In order to clear the path of movement for the tool holder and the work carried thereby during this intermittent movement of the rotary head, a return device is provided which is actuated by a cam 117 mounted on the control shaft 108. This cam acts for a certain period of its rotation through the medium of a roller 118 on a rod 119 which is guided in an arm 120 on the casing 54 and which is connected at its upper end to a lever 121 mounted on the axle 70 supporting the counter-balance lever 71. These axles 70 are connected by universal joints 122 or similar means in such a manner that they rotate together. The boss of a lift arm 160 non-rotatably connected with the axle 70 is arranged between the two bars of each compensating lever 71, and at its end located below the loaded arm of the latter is provided lateral projections 161 so that without interfering with the ordinary free oscillating movement of the lever 71 they are capable upon sufficient upward movement of contacting therewith. By the action of the lever 121 and the cam 117 all the counterweighted levers are therefore so moved in unison that by means of the pressure rods 67, the associated grinding spindles and tools and also through the medium of the cross members 66 and the columns 77, the collecting containers 78 are moved down to such an extent that they pass out of the region of rotation of the lower ends of the work holders 19.

In order to determine accurately the angular position of the rotary head in the individual operating stations, the head is provided near its lower edge with appropriately spaced apertures 123 in which a pin 124 engages. This pin is movably arranged in a radial direction in a guide bush 126 carried by a part 125 of the casing 54 and is adapted to be brought out of engagement against the action of a spring 128 by means of a bell crank lever 127 pivotally mounted in the part 125.

For this purpose the horizontal arm of the bell crank lever 127 is connected with a pressure rod 129 carrying at its lower end beneath the arm 120 a roller 130 coacting with a cam 131 mounted on the control shaft 108. The cam on this shaft is so constructed that before the commencement of an angular movement of the Maltese cross 111, the cam 131 lifts the roller 130 and thereby retracts the pin 124 from its engagement position in the hole 123 concerned.

In order to provide for cleaning the work and the work holders between two successive grinding operations for the purpose of removing adherent coarse grinding material the rotary head is not moved from station to station in a single step but in two steps so that in the intermediate position the work can be subjected to the action of a washing or rinsing device. For this purpose washing tanks 132 are arranged between the operating stations. Each of the tanks is carried by a column 133 supported by the transverse member 66 of the adjacent grinding spindle in the direction of movement, each column 133 participating in the movement of the transverse member and being guided vertically in the casing 54 as indicated at 134. The washing tank is open at the top and is supported at such a height that during the upward movement which it makes with the transverse beam the lower end of the work holder is immersed in the water contained in the tank. The tanks are each fed by an inlet pipe 135 and are provided with an outlet pipe 136, the upper end of which ensures uniformity in the height of the rinsing fluid. Owing to the oscillatory movement which the work holders undergo continually during the operation as hereinbefore described, and therefore also during the rinsing periods the cleaning action of the washing fluid is very much enhanced so that the grinding residues are removed with certainty from the work and tool holders.

In order to remove the finished work from the ends of the tool holders and to exchange it for new work to be operated on, a feed table 137 is provided in place of a grinding spindle at a position on the machine where the exchange is effected. The table 137 can be operated about a vertical shaft 138. Centering abutments 139 and 140 are provided near the circumference of the surface of this feed table and at appropriate radial distances from its axis in the receiving position of the work holders. For example four of such abutments are provided displaced 90° with respect to one another, and are yieldingly arranged in pairs on plate springs 141. The feed table 137 is moved downward before the commencement of each intermittent rotary movement by being connected, for example, with one of the cross beams 66 or by other suitable auxiliary means, and is then rotated through a right angle. In the succeeding upward movement one of the four receiving positions approaches the end of the work holder temporarily directed towards the receiving device into this co-axial movement.

During the first approaching movement to the work holders the action of the suction air holding the work against the work holder is temporarily relieved, for example, by automatically opening an air valve (not illustrated) so as to allow the work to be released from the workholder and deposited on the feed table. In the meanwhile the succeeding receiving station of the feed table rotating in the direction

of the arrow 142 has been supplied with fresh work which is lifted by the succeeding intermittent rotation of the feed table against the empty tool holder. Hereupon the suction action on this tool holder is restored so that the work is securely held in its correct position on the under surface of the holder, and in the succeeding downward movement of the receiving table is taken therefrom. The work to be operated on in the machine may be placed on the receiving position of the feed table and removed therefrom in a finished condition either by the hand of the operator or by any suitable automatic device replacing this hand manipulation.

The work supplied to the work holders of the machine in this manner is conveyed during the intermittent rotation of the rotary head of the machine in the direction of the arrow 142, Figure 2, through the whole series of operating stations. Suitably selected grinding material is supplied at the different positions and the work is subjected first of all to a coarse grinding action, then to fine grinding and finally, for example, at the last four stations to polishing. Between each station as previously described the work is immersed in a rinsing tank in which the grinding material remaining from the operation carried out at the previous station is removed.

In order to be able to carry out the polishing operation effectively it is necessary or at least preferable not to allow the tool to act uniformly over the entire surface of the work, but to increase or reduce the effective pressure alternately at the inner and outer zone of this surface. This is attained in the machine by slightly altering the effective distance of the work holder from the oscillatory axis thereof at the different stations where polishing occurs by shifting it alternately to both sides of the centre of curvature of the surface to be polished.

For this purpose and as indicated in the drawings a toothed wheel 144 is arranged on the upper end of each of the screw spindles 16 above the guides 15. Pawls 145 or 146 are so arranged at certain distances in front of the operating station on arms 147 secured to the platform 53, that these wheels 144 enter into rotary engagement during the intermittent rotary movement alternately with one of the inner pawls 145 and one of the outer pawls 146. The adjustment is so determined that the angular movement of the wheels thereby produced in the reverse direction is the same, so that before the finished work is deposited the correct mean oscillating position of the work holder 19 is attained.

A rinsing tank constructed as hereinbefore described is preferably arranged between the last polishing station and the delivery table for the purpose of removing the polishing residue before the finished work is deposited on the table.

In the modification of the machine diagrammatically illustrated in Figures 6 and 7 the grinding axes of the different operating stations are radially arranged relatively to the shaft 149 of the rotary head 150 mounted centrally of the base plate 148. The work carriers are mounted on the ends of oscillatory arms 151 which are longitudinally adjustable in bearings 152 supported on pivot pins 153 tangentially arranged to the direction of rotation of the rotary head. A cam ring 154 acts on the inner ends of the pivoted arms and is continually rotated by any desired motor power so that by co-operation of springs 155 the pivoted arms are caused to carry out an uninterrupted up and down movement. The grinding spindles 156 are so arranged radially to the rotary head that at each operating station the middle plane of oscillation of the pivoted arm or the work carrier coincides with the vertical plane through the axis of rotation of these grinding spindles. Each grinding spindle is also longitudinally adjustable in a hollow axle 157 which is supported in a bearing 158 mounted on the outer part of the base plate 148 and which carries a driving pulley 159 effecting the rotation of the grinding spindle. The necessary grinding pressure is produced by means of weight-loaded bell crank levers or the like which tend to move the grinding spindles inwardly in a radial direction and which are controlled by suitable means so that before each intermittent motion of the rotary head, said spindles may be withdrawn from the operative position and thereafter returned.

I claim:

1. A machine for grinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series, the combination of grinding tools rotatably mounted at the respective stations and having the desired surface of curvature, a rotary head, work holders, supports for said work holders, pivotally mounted on said rotary head to permit the oscillation of said work holders about points on the axis of said respective tools at approximately the centers of curvature of the surface to be ground, and means for intermittently rotating said head for moving said work holders from station to station.

2. The machine claimed in claim 1 wherein means is provided for independently adjusting the work holder supports so as to permit the radius of oscillation to be varied.

3. A machine for grinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series. the com-

bination of a rotary head, a series of hollow spindles arranged around said head, means for rotating said spindles, shafts adjustably and yieldably supported in said spindles, and adapted to be rotated thereby, grinding tools carried by said shafts, work holders pivotally mounted on said head and so supported and arranged as to permit their oscillation about points located on the axes of the spindles at approximately the centers of curvature of the surfaces to be ground and means for intermittently rotating said head to move said work and holders from station to station.

4. In a lens grinding machine, a longitudinally movable rotary shaft, a grinding tool mounted at one end of the shaft, means for feeding the tool to the work during grinding, said means consisting of a movable thrust bearing for said shaft, a weighted lever connected to said bearing and means for automatically stopping the feeding at a predetermined point, said last named means consisting of a feeler adapted to be engaged by the grinding surface of said tool, an obstacle moved into the path of feed and electrical operating means for said obstacle controlled by said feeler.

5. The machine claimed in claim 3 wherein means is provided for temporarily retracting the grinding tools as the work holders are moved from station to station.

6. The machine claimed in claim 3 wherein washing tanks are located between adjacent stations and means is provided for automatically dipping said holders and work carried thereby into said tanks as said holders and work are moved from station to station.

7. A machine for grinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series, two groups of cooperating elements, consisting respectively of grinding tools and work holders, the elements of one group being rotatably mounted at the respective stations, a rotary head, supports for the elements of the other group pivotally mounted on said rotary head to permit oscillation of the elements of said other group about points on the axis of rotation of the elements of said one group at approximately the centers of curvature of the surfaces to be ground, and means for intermittently rotating said head for moving the elements of said other group from station to station.

8. The machine claimed in claim 7 wherein means is provided for adjusting the supports so as to permit the radii of oscillation to be varied.

9. In a machine for grtinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series, the combination of grinding tools rotatably mounted at the respective stations and having the desired surface of curvature, a rotary head, oscillating work holders carried by said head, means for oscillating said work holders and means for intermittently rotating said head for moving said work holders from station to station.

10. The machine claimed in claim 9 wherein means is provided for automatically adjusting the work holders so as to permit the radii of oscillation to be varied from any station to any other station.

11. In a machine for grinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series, the combination of grinding tools rotatably mounted at the respective stations, a rotary head, lens holders carried by said head, a rotary cam, connections between said head and cam for oscillating said lens holders during grinding and means for intermittently rotating said head to move said lens holders from station to station.

12. In a machine for grinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series, the combination of grinding tools rotatably mounted at the respective stations, a rotary head mounted inside said circular series, lens holders carried by said head, a rotary cam concentric with said head, connections between said head and cam for oscillating said lens holders during grinding and means for intermittently rotating said head to move said lens holders from station to station.

13. In a machine for grinding lenses, cooperating elements comprising a circular series of work holders and a circular series of grinding tools, a rotary head for supporting the elements of one of said series, a rotary cam arranged concentric with said head, connections between said cam and the elements of one of said series for oscillating said last named elements, means for rotating the elements of the other said series and means for intermittently rotating said head so as to bring each of the elements of the series carried thereby into successive positions to cooperate successively with the elements of said other series.

14. An automatic lens grinding machine comprising a rotary grinding tool, a suction lens holder, a source of suction therefor, means forming a suction passage between said source and holders and means located in said passage and operative at predetermined increase in the pressure therein and means controlled by the operation of said last named means for preventing continued grinding.

15. In a machine for grinding lenses in which the work is subject to coarse grinding,

fine grinding and polishing at successive stations arranged in a circular series, a combination of grinding tools mounted at the respective stations, a rotary head, lens holders carried by said head, a common means for turning said lens holders, during grinding, about the axis of curvature of the surface to be ground and means for intermittently rotating said head to move said lens holders from station to station.

16. In a machine for grinding lenses in which the work is subject to coarse grinding, fine grinding and polishing at successive stations arranged in a circular series, a combination of grinding tools rotatably mounted at the respective stations and having the desired surface of curvature, a rotary head, work holders carried by said head, means for turning said work holders, during grinding, about the axis of said surface of curvature and means for intermittently rotating said head for moving said work holders from station to station.

17. In a machine for grinding lenses, cooperating elements comprising circular series of work holders and a circular series of grinding tools, a rotary head for supporting the elements of one of said series, common means for oscillating each element of one of said series, means for rotating the elements of the other of said series and means for intermittently rotating said head so as to bring each of the elements of the series carried thereby into successive positions successively with the elements of the other series.

In testimony whereof 30 March 1929 affix signature.

JOSEF DESENBERG.