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Dec. 30, 1941.

J. J. McCABE ET AL

2,268,159

LENS SURFACING MACHINE

Filed March 27, 1941

4 Sheets-Sheet 1

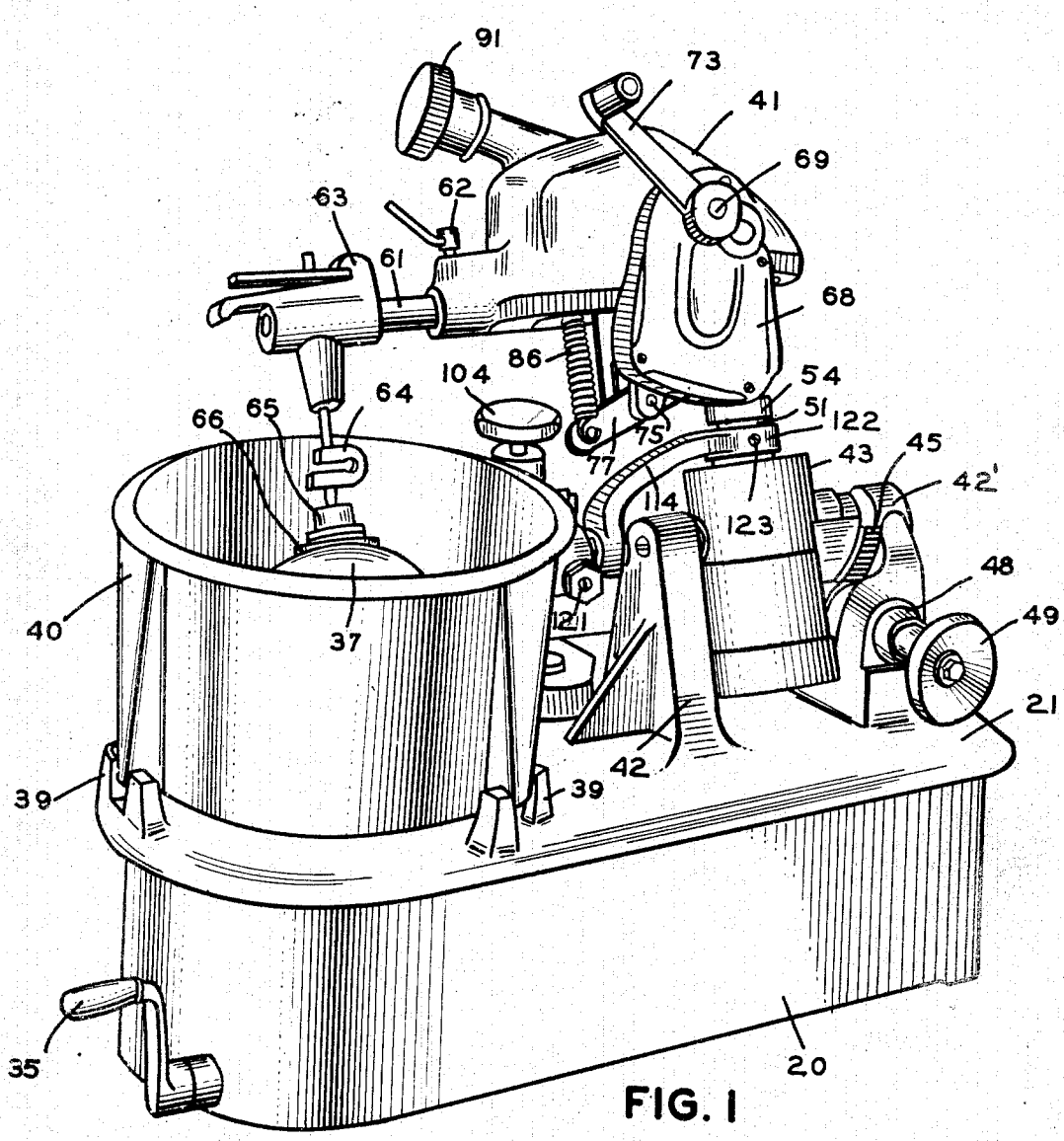


FIG. 1

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LENS SURFACING MACHINE

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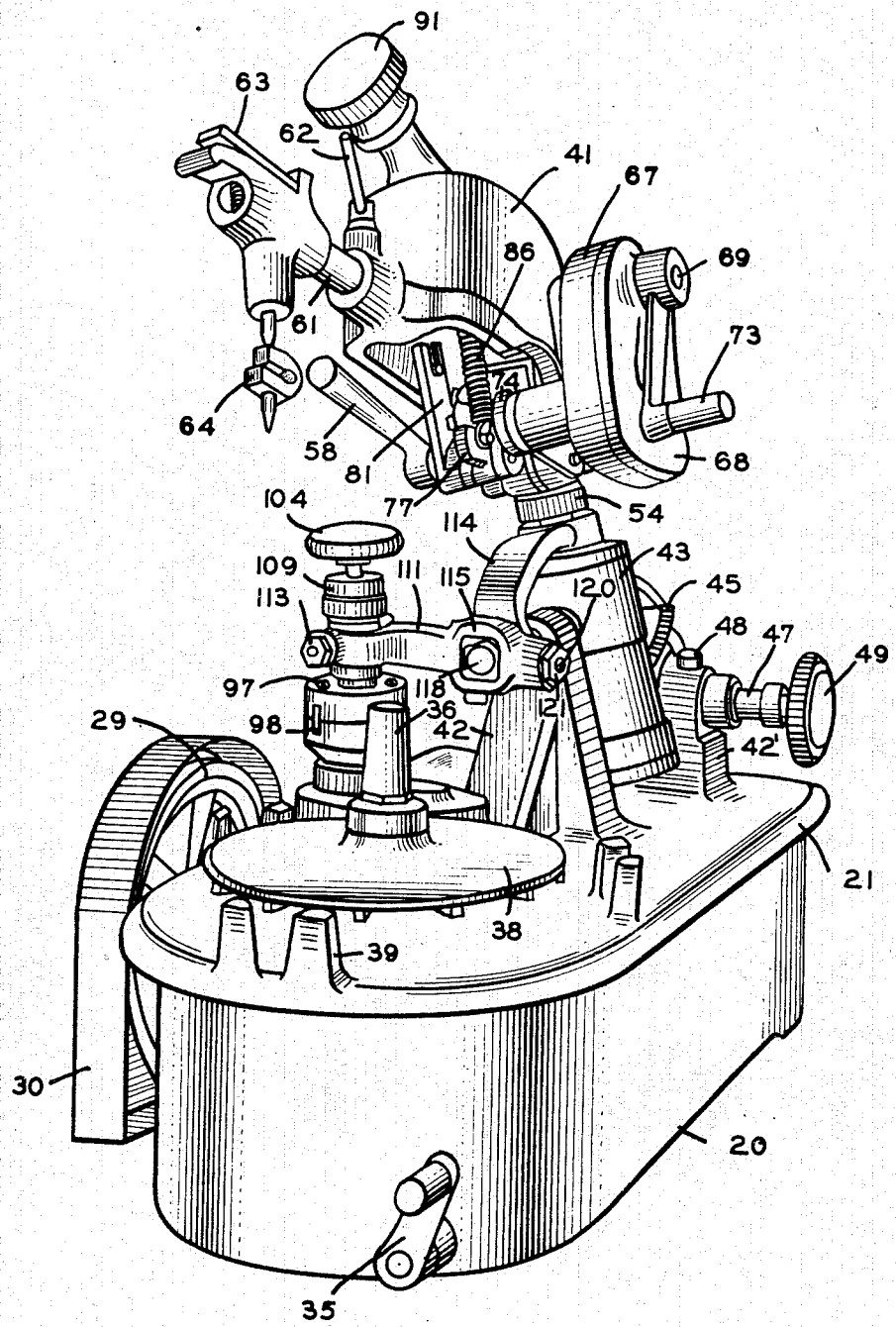


FIG. 2

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LENS SURFACING MACHINE

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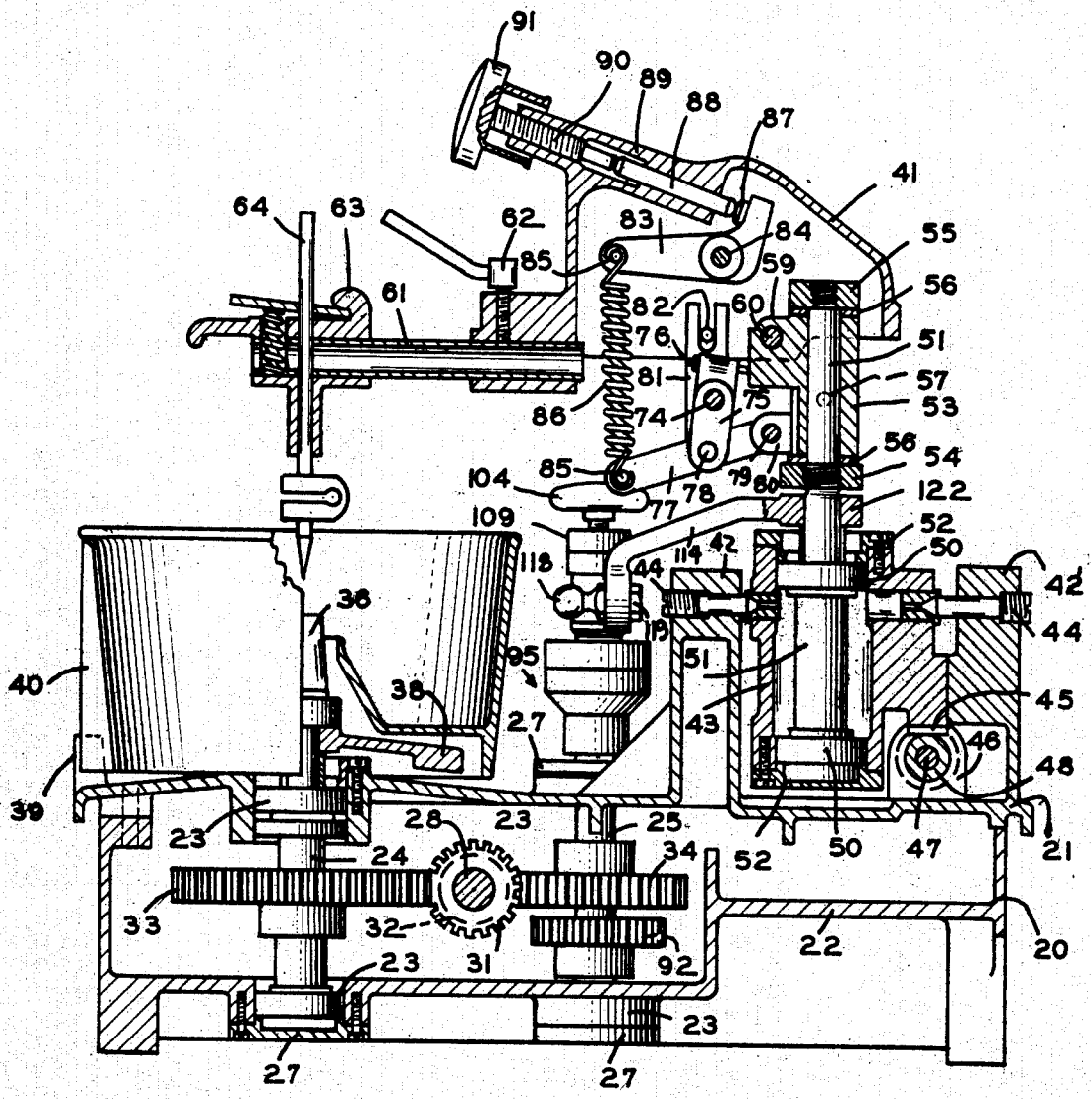


FIG. 3

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Dec. 30, 1941. J. J. McCABE ET AL 2,268,159

LENS SURFACING MACHINE

Filed March 27, 1941 4 Sheets-Sheet 4

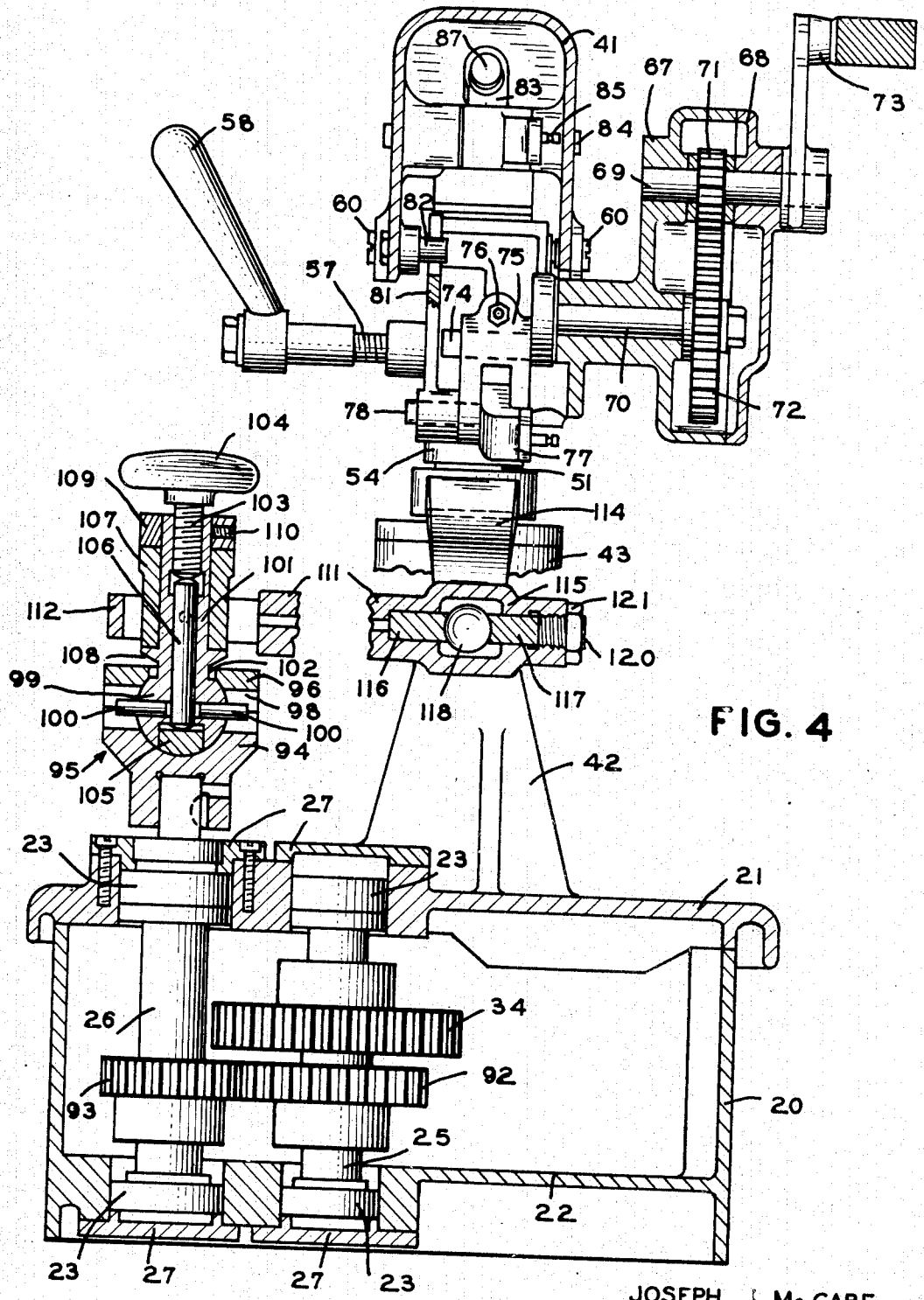


FIG. 4

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Patented Dec. 30, 1941

2,268,159

UNITED STATES PATENT OFFICE

2,268,159

LENS SURFACING MACHINE

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Application March 27, 1941, Serial No. 385,472

11 Claims. (Cl. 51—131)

The invention relates to lens surfacing machines and more especially is concerned with that type of machine wherein a reciprocating head is used to reciprocate a lens over a rotating lap.

An important object of the invention is the provision of a machine of this character which utilizes mechanical means to reciprocate a lens over a rotating lap with a movement which simulates that given a lens by an operator of a hand surfacing machine while manually reciprocating the pressure handle thereof to surface a lens.

Another object of the invention resides in providing adjustable eccentric means for controlling the reciprocating movement of the polishing head of a lens surfacing machine wherein the stroke thereof is determined by the position of an adjustable ball having a drive stud formed thereon.

The invention has as another object the provision of a novel mounting means permitting the polishing head of a lens surfacing machine to be angled in a vertical plane located transversely of the machine and to be adjustably positioned about an axis movable in that plane as well as the provision of means for varying the position of an arm carried by the polishing head for supporting work engaging means.

A further object of the invention is to provide a lens surfacing machine having gear means adapted to operate a lever system for lowering and raising the polishing head of a machine into and out of operating position together with means for maintaining work engaging means carried by the head in adjustable pressure contact with a lens block by a construction designed to leave the pressure adjustment unaffected by the actuation of the head raising and lowering means.

Yet a further object of the invention is to provide a lens surfacing machine of a simple design which may be readily embodied in a strong, durable and efficient structure.

With these and other objects in view which may be incident to our improvements, the invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements comprising our invention may be varied in construction, proportion and arrangement without departing from the spirit of the invention or exceeding the scope of the appended claims.

In order to make our invention more clearly understood, we have shown in the accompanying drawings means for carrying the same into practical effect without limiting the improvements in their useful applications to the particular constructions which, for the purpose of explanation, have been made the subject of illustration. To this end the invention is disclosed in the following manner, wherein:

Figure 1 is a perspective view of our lens surfacing machine taken from a side thereof.

Figure 2 is a perspective view of the lens surfacing machine taken from the front thereof.

Figure 3 is a longitudinal vertical section of the machine with certain parts thereof removed.

Figure 4 is a transverse vertical section of the machine with certain parts thereof removed.

There is shown in Figure 1, like reference characters being used throughout the drawings to designate like parts, a machine engaged in surfacing a lens having a spherical surface. It will be appreciated, however, that through the use of suitable attachments our machine may be adapted to the polishing of cylindrical surfaces. The machine comprises a hollow base **20** having a top **21** and bottom **22** which latter members are provided with pairs of aligned bearings **23** within which are journaled the vertical work spindle **24**, intermediate shaft **25** and stroke control shaft **26**. The function of the shafts **25** and **26** will presently appear. Suitable bearing covers **27**, secured to the top and bottom of the base, are provided for the bearings **23**.

Also journaled in the base in suitable bearings (not shown) is a horizontal drive shaft **28** one end of which extends beyond the base and is provided with a drive pulley **29** around which is a guard **30** carried from the base. A spiral gear **31** and worm **32**, the latter shown in dotted lines in Figure 3, are fixed to the drive shaft **28**. Gear **31** meshes with a spiral gear **33** fixed to the work spindle while the worm **32** cooperates with a worm **34** fixed on the intermediate shaft **25**, these means being employed to drive the work spindle and the intermediate shaft.

For operation, the machine is adapted to be placed upon a table or stand which carries an electric motor connected by any conventional drive means, for example a belt, to the drive pulley **29** for driving the drive shaft **28**. Suitable switch mechanism (not shown), for controlling the drive motor, is mounted within the base **20** of the machine and is operated by the switch handle **35** conveniently located at an end of the machine and extending within the base.

The work spindle **24** extends above the base top **21** and is provided with a tapered end **36** upon which there is removably supported a con-

ventional grinding or polishing lap 37 best shown in Figure 1. Use is made of the usual fan 38 fixed to the work spindle 24 above the top of the base in machines of this nature to prevent abrasive from entering the bearings of the apparatus. As best noted in Figures 2 and 3, lugs 39 are formed upon the top of the base for detachably engaging the ribs or flanges on the exterior of a conventional splash pan 40 which surrounds the spindle during operation of the machine. A suitable opening is formed in the bottom of the pan 40 to permit it to be placed over the work spindle and to be seated upon the base top 21 of the machine.

Cooperating with the work spindle and lap is a hollow polishing head 41 which functions to maintain a lens on the lap in pressure engagement therewith and to cause the lens to be moved back and forth over the lap with a suitable grinding motion. To this end the polishing head 41 is mounted above the base by a construction which makes use of the spaced apart standards 42 and 42' located on the top 21 transversely of the machine. A support member 43 is mounted between the standards 42 by means of pivot screws 44 to pivot about a horizontal axis which is parallel to the longitudinal axis of the base 20 and which intersects the axis of rotation of the work spindle 24. It is to be noted that the pivot axis of the support member 43 is horizontally arranged and is located above the top 21 of the machine base so that it is substantially tangent to the center of a lap 37.

The support member 43 is provided with an extension having a worm gear segment 45 formed thereon for engagement with a worm 46 fixed on a shaft 47 located at right angles to the pivots 44 and carried in shaft bearings 48 provided on the standard 42'. It will be apparent that proper rotation of the operating handle 49 fixed on the shaft 47 will cause the support member 43 to be rocked or tilted about its pivots 44 and angled as desired in a vertical plane located transversely of the base of the machine. If desired, suitable clamping means may be associated with the structure just described to assure the maintenance of the support member in adjusted positions.

As may be observed in Figure 3 the support member 43 is formed with a bore which is provided with bearings 50 for rotatably mounting the support shaft 51 which is carried by the support member and which in turn carries the polishing head, suitable bearing covers 52 being employed with this mounting. The shaft 51 extends above the support member 43 and is adapted to have a head support member 53 loosely mounted thereon between a nut 54 which engages a threaded portion on the shaft located above the shaft support 43 and a nut 55 which engages the upper end of the shaft. Thrust washers 56 are placed between each nut and the end of the head support 53 adjacent thereto. Means for locking the head support 53 in adjusted position on the support shaft 51 comprises a clamp screw 57 which extends through a threaded bore in the wall of the head support and is adapted to engage the support shaft 51, an operating handle 58 being provided on the clamp screw to facilitate this adjustment.

Head support 53 is the member of the support structure to which the polishing head 41 is directly connected and for this purpose is formed with a projection or support bracket 59. The polishing head is positioned to surround the end of the support shaft 51 so that the head may be secured to the support bracket 59 by pivot screws 60 which extend through opposite sides of the head and engage the bracket. This construction allows the polishing head 53 to be tilted about an axis located transversely of the machine and normal to shaft 51 so that the head may be moved into and out of operative positions. The use of pivot screws for the connecting means not only permits wear adjustment but also provides a centering adjustment for the head with respect to the axis of shaft 51.

As previously noted, the polishing head 41 supports work engaging means. Use is made of an arm 61, held within a bore in a projection on the head 41 by a clamp screw 62 for slidable and rotatable adjustment with respect to the work spindle, to permit adjustment of work engaging means adapted to be carried on this arm. A well known manually operated clamp 63 is fixed on arm 61 and is adapted to support a conventional type of pressure pin, for example the resilient pin 64, in adjustable relation to the work spindle. The pin 64, as illustrated in Figure 1, is adapted to contact a lens block 65 having a blocked lens 66 and hold this work against the lap.

In lens surfacing machines it is necessary to keep the work in pressure contact with the lap and it is desirable to provide positive means for moving the polishing head into operating and inoperative positions and for locking the head in these positions. The mechanism for raising and lowering the head 41 out of and into a work position is shown in detail in Figures 3 and 4 and comprises a gear train which drives an eccentric connected to a lever system with which is associated spring means for applying pressure to the polishing head. To this end the head support 53, which is usually cast, is provided with a gear box 67 having a suitable cover 68 secured thereto. Gear shafts 69 and 70 are journaled in the gear box and are respectively provided with the drive pinion 71 and driving gear 72 which are in mesh with each other and which are fixed to their respective shafts. The shaft 69 extends through the cover 68 and has a suitable crank 73 secured to its end while the shaft 70 extends through the opposite side of the gear box and has its end under the polishing head 41 provided with an eccentric 74.

Pivotally secured upon the eccentric 74 is a bifurcated raising link 75 which is provided with an adjustable stop 76. A lever 77 is positioned between the forked ends of the raising link 75 and is pivoted thereto by a pivot pin 78 which extends through the raising link and to one side thereof, this lever in turn having one end mounted on a pivot pin 79 held between spaced lugs 80 formed on the head support member 53 adjacent the nut 54. The portion of pivot pin 78 which extends beyond the raising link is adapted to have an end of a lifting arm 81 pivoted thereto, the opposite end of arm 81 being slotted and engaged with a lifting pin 82 fixed on the interior of the polishing head.

It has been mentioned that spring means, whereby a variable grinding pressure may be obtained, are associated with the lever system just disclosed for raising and lowering the polishing head. These means make use of a spring pressure arm 83 mounted on a pivot 84 located within the head 41. One end of the pressure arm 83 is provided with a threaded post 85 to which is secured one end of a spring 86, a similar

post being provided upon the free end of the lever 77 for connection with the other end of the spring. A contact member 87 is formed at the end of the pressure arm away from the spring for contact with the end of a slidable pressure pin 88 carried in a guideway 89 formed in the top of the polishing head. This guideway 89 is threaded at its outer end to receive a pressure screw 90 operated by a hand wheel 91 to engage the end of the pressure pin 88 within the guideway and to adjust the tension of the spring 86.

In Figures 1 and 3 the pressure head 41 is shown in a lowered or operating position. Where such is the case the eccentric 74 is off center with the result that it is out of alignment with pivot pin 78 and lifting pin 82 as illustrated in Figure 3. Or to put it another way, the axis of the eccentric 74 is offset from a plane which passes through the axis of pin 82 and the pivot 78 for the link 75, lever 77 and arm 81. Also when the pressure head is lowered and the pressure pin 64 is engaged with a lens block, the stop 76 is in contact with the bracket 59 and the spring 86 is under tension.

The tendency of the tension developed in the spring 86 is to move the lever 77 and pressure arm 83 towards each other. But since the only effect of this is to press the stop 76 and contact 87 against their respective fixedly positioned bracket 59 and pressure pin 88, the force of the spring is limited to moving the pressure head downwardly or in a counterclockwise direction about its pivot 60. This provides the necessary pressure contact between the work and the lap and may obviously be decreased or increased at any time by suitable operation of the hand wheel 91.

When the raising link 75 and stop 76 are located as shown in Figure 3 and the resilient pin 64 is holding a blocked lens on the lap, it may be observed that the eccentric 74, which is off centered with respect to the longitudinal center line of arm 81, serves to lock the pressure head and gears 71 and 72 against movement. This expedient assures maintenance of grinding contact during surfacing operations. Obviously adjustment of the stop 76 permits any desired variation for the operating off centered position of the eccentric 74. At the same time it may be noted that actuation of the hand wheel 91 allows variation of the grinding pressure either during operation of the device or while it is at rest.

The ratio between the gears 71 and 72 is so selected that the stroke of the handle for raising the polishing head will move the eccentric 74 through an angle greater than 180° and position the eccentric somewhat above its location shown in Figure 3 but also in off centered relation to the pivot 78 and lifting pin 82. This just described movement of the eccentric 74 causes the raising link 75 to be moved in a clockwise manner as viewed in Figure 3 about the gear shaft 70 as a center. First link 75 moves downwardly and to the left and then upwardly, at first to the left and then to the right, until the stop 76 contacts the bracket 59.

The just described movement of the link 75 will, of course, lift both the lever 77 and arm 81 to which the link is pinned. This results in the spring 86 being allowed to contract and in the arm 81 fully engaging the pin 82 and raising the polishing head 41 about its pivot to the inoperative position illustrated in Figure 2. It will be apparent that when the polishing head is in its raised and inoperative position that the off centered location of the eccentric 74 will effectively prevent its downward movement under its own weight and that it will be safely locked in this position. A small amount of play has been shown in Figure 3 between the lifting arm 81 and its pin 82 when the polishing head is in operating position. This play has been provided to permit slight movement of the polishing head about its pivot 59 during operation of the machine in order to care for the curvature of the lens being surfaced.

Obviously movement of the crank 73 in a reverse direction from that described will lower the polishing head from its inoperative position to the surfacing position of Figures 1 and 3 and will cause the eccentric 74 and link 75 to move in a counterclockwise direction into the operating position heretofore described. In this downward movement of the polishing head the spring 86 will remain contracted until the resilient pin 64 contacts its lens block. Upon continued operation of crank 73 for its lowering stroke, the polishing head and arm 83 will remain substantially stationary relative to the eccentric 74 and lever 77 so that the movement of the latter will expand the spring 86 and place it under the tension necessary to create a grinding pressure between the lens and the lap.

In surfacing operations it frequently becomes necessary to remove a lens from the lap for inspection. When such is the case it is highly desirable to resume surfacing under the same grinding pressure. It will be apparent that the structure disclosed permits the head to be raised and lowered without affecting the pressure adjustment so that an operator of the machine is assured that the polishing head will develop a substantially constant operating pressure for each setting of the hand wheel 91.

The polishing head and the work engaging means have been described as adapted for reciprocation over the lap of the machine. In accomplishing this it is necessary to reciprocate the support shaft 51 with the head locked thereto. To this end, power is taken off the intermediate shaft 25 to drive the stroke control shaft 26 which is coupled to the support shaft 51. As best shown in Figure 4, a drive spur gear 92 is fixed to the intermediate shaft 25 to mesh with a driven spur gear 93 fixed on the stroke control shaft 26. Under these conditions it will be apparent that the stroke control shaft 26 will be rotated upon actuation of the drive shaft 28.

The stroke control shaft 26 extends above the top 21 of the base of the machine and has the lower part 94 of a divided ball housing 95 fixed to its free end to rotate therewith, the upper part 96 of the ball housing being secured to the lower part by means of suitable fastenings 97. As may be observed in Figure 4, the interior of the ball housing 95 is provided with an opening which extends therethrough and whose axis is normal to the shaft 26. This opening has outer portions which are in the form of slots 98 while its central portion is recessed to form a socket for a ball 99 having drive pins 100 extending therefrom and engaged within the slots 98. Also projecting from ball 99 is a drive stud 101 which extends through an opening 102 provided in the upper member 96 of the ball housing and for some distance above the same.

The height of the slots 98 is considerably greater than the diameter of the drive pins 100

while the width of the slots is substantially equal to that of the drive pins. Through this expedient the ball 99 and its stud 101 are caused to rotate with the housing 95 and the shaft 26. At the same time this construction permits adjustment of the ball 99 within its recess whereby the drive stud 101 may be moved into a position out of alignment with the longitudinal axis of the shaft 26. Obviously the angular movement of the drive stud with respect to the shaft 26 is limited only by the size of the opening 102 and the height of the slots 98.

The drive stud 101 serves as a crank, the throw or eccentricity of which is adjustable at will. For the purpose of holding the drive stud in adjusted positions, a passageway is formed to extend through the drive stud 101 and the ball 99. One end of this passageway is threaded to receive a clamp screw 103 provided with a suitable operating knob 104. The opposite or ball end of this passageway is enlarged as shown in Figure 4 to receive a slidable pressure plug 105 adapted to be pressed against the bottom of the recess in the ball housing 95 to hold the ball and the drive stud in adjusted position. As may be noted, the head of the plug 105 is a spherical surface of the same radius as the ball 99 so as to permit suitable contact with the socket in the lower housing 94.

Slidable within the passageway in the drive stud and ball is a pressure pin 106 which is located between the end of the clamp screw 103 and the pressure plug 105. As the ball is retained within its socket by reason of the connection of the upper housing 96 to the lower housing 94, it will be apparent that sufficient movement of the clamp screw 103 towards the ball 99 will force the pressure pin 106 against the pressure plug 105 to cause the latter to firmly hold the drive stud in an adjusted position.

The construction for coupling the drive stud to the support shaft makes use of a sleeve or eccentric strap 107 loosely supported on a shoulder 108 formed on the drive stud and held thereon by the collar 109 fixed to the stud by the set screw or other fastening 110. A connection link 111 having a yoke 112 pivoted to the eccentric strap 107 by pivot screws 113 is coupled to a reciprocating drive arm 114 which in turn is secured to the support shaft 51. Another yoke 115 is formed on the other end of the connection link 111 at a right angle to the yoke 112.

The face of yoke 115 adjacent the drive stud is provided with a recess which supports a resilient connection plug 116 adapted to extend within the yoke. A second resilient connection plug 117, aligned with the plug 116, is slidably carried in a passageway in the connection link 111 which opens into the yoke and extends through the link to its outer end. Plugs 116 and 117 pivotally connect the link 111 to a ball 118 formed on a connection member suitably secured to the end of the reciprocating arm 114 by suitable fastening means 119. By means of the pressure screw 120 engaged in the threaded end of the support guideway for the resilient connection plug 117, the plugs 116 and 117 and ball 118 are pivotally connected to each other. A lock nut 121 is used with the screw 120 to lock the same in engaged position. It is to be noted that the center of the ball 118 lies in the axis of the pivot screws 44 about which the support member 43 and support shaft 51 are adapted to pivot.

As may be noted, the reciprocating drive arm 114 bends upwardly from the ball connection 118 and has its end opposite thereto provided with a connection collar 122 which loosely engages the support shaft 51 and is secured thereto by the set screw 123 (Figure 1) or other suitable fastening means. This connection completes the drive means for reciprocating the pressure head 41 and its work engaging means.

Hand surfacing machines wherein a lens is reciprocated by hand over a rotating lap possess certain advantages which it is desirable to simulate. For example, in hand surfacing, the lens is readily located on any portion of the lap and is easily changed to other positions. Also the amount of movement imparted to a lens over a lap is determined by the length of the hand stroke of the operator, which stroke is of course variable at the will of the operator. In addition, hand surfacing in a machine of the type just described is accompanied by reciprocation of the lens along substantially continuously changing paths which are very rarely repeated. At the same time hand surfacing requires a separate operator for each machine so that it is impossible for one person to operate a number of machines.

That our machine is capable of closely retaining the advantages of a hand surfacer while overcoming its limitation will be apparent from a consideration of its operation. With the polishing head 41 in raised condition and the proper lap 37 secured to the work spindle, a blocked lens is located in a suitable position upon the lap in the manner well known to skilled operators of machines of this nature and the work engaging means are adjusted so that the resilient pin 64 will engage the lens block 65 when the head is lowered.

Location of the pin 64 on either side of the longitudinal axis of the machine is readily effected by tilting the polishing head 41 about its pivots 44 through the mechanism driven by the hand wheel 49 and also by the arcuate adjustment of the polishing head about the support shaft 51 as a center, the polishing head being held in adjusted position on the shaft 51 by locking the head support member 53 to the shaft through the clamp 57. By adjusting the arm 61, the resilient pin 64 may be angled with respect to its lap and also may be positioned forwardly or rearwardly of a transverse axis of the machine which passes through the work spindle 24 while obviously the vertical position of the pin will be controlled by its locking location with respect to the clamp 63. It will be apparent that the foregoing adjustments permit a lens to be located wherever desired upon its lap, which position may be shifted whenever necessary by suitable readjustment of pin 64.

The polishing head is now lowered until the resilient pin engages the lens block after which the full stroke of the crank 73 is completed to lock the head in operating position and to engage the resilient pin in pressure contact with the lens block. This pressure is easily decreased or increased by operation of the hand wheel 91. Operation of the hand wheel 104 to set the throw of the drive stud 101 may now be made. The amount of the stroke or the movement of the polishing head needed for surfacing will be dependent upon the particular lens being surfaced and is readily understood by the art. Quite obviously the stroke of the polishing head may be changed from its initial setting to some other adjustment at any time that the machine is at rest.

A suitable abrasive is placed upon the lap and the switch handle **35** is turned to cause actuation of the drive shaft **28** and rotation of the work spindle and lap and reciprocation of the polishing head and its work engaging means. It is apparent that when the axis of the drive stud **101** is moved out of alignment with the axis of the shaft **26** that the drive stud functions as an eccentric or crank which will reciprocate the link **111** and arm **114** so as to cause reciprocation of the polishing head of the machine.

The reciprocating stroke or movement of the polishing head will vary from zero when the drive stud **101** and shaft **26** are aligned to a minimum for the maximum angular setting of the drive stud with respect to the shaft **26**. It will be apparent that by reason of the adjustable ball connection of the drive stud **101** to the shaft **26** that the throw of the drive stud is susceptible to minute or large variations over a relatively wide range. These means permit a stroke variation for the work engaging means which is comparable with that obtained in a hand surfacing machine. Moreover a stroke variation is effected by a simple adjustment which is readily and quickly made without disturbing the work or any of the other adjustable parts of the machine.

The friction existing between the lens and the rotated lap will cause the former to be rotated. At the same time the lens and lens block are reciprocated over the lap at a frequency which differs from the rotational frequency of the lap. As will be well understood the combination of these movements will cause the lens to be reciprocated over the lap so that it will follow the same path of movement only at infrequent intervals.

An important feature of our machine resides in the construction which locates the pivot axis **44** in line with the center of the lap **37**. For this reason tilting of the polishing head on this axis not only permits the resilient pin **64** to be located on either side of the lap but will also allow the lens to be reciprocated over the lap in a manner to compensate for the curvature of the latter. The tilting of the polishing head is especially designed to maintain movement of the lens along paths which are approximately tangential to the lap surface. Obviously the angle of tilt required for the polishing head will increase with the radius of curvature of the lens being surfaced.

Where it is found necessary, any of the adjustments noted may be easily remade in the manner described upon stopping the actuation of the machine. Frequently, as previously mentioned, it is desirable to remove a lens from the lap for inspection. This is carried out by stopping the device and swinging the crank **73** for the full extent of its raising stroke to raise the polishing head to the position shown in Figure 2 where it is automatically locked against accidental lowering movement. After the lens block has been replaced on the lap, the crank **73** may be turned in the proper direction to again lower the polishing head into operating position and the surfacing operation may be resumed, it being noted that the pressure adjustment during the raising and relowering of the polishing head has remained at a constant setting. When the surfacing of a lens has been finished the machine is arrested, the polishing head is raised and the lens block and lens removed from the lap.

From the foregoing it will be appreciated that we have provided a lens surfacing machine of simple design and rugged construction which is susceptible of facile operation. At the same time in attaining our inventive aims, we have devised a novel machine which simulates hand surfacing procedure but greatly accelerates surfacing operations while maintaining a fine control over them.

We claim:

1. A lens surfacing machine having a base, a drive shaft journaled therein, a work spindle and an intermediate shaft also journaled therein and driven from said drive shaft, a stroke control shaft journaled in the base and driven from said intermediate shaft, a rotatable support shaft carried on said base, a polishing head secured to said support shaft, work engaging means carried by said head and means for reciprocating said head on actuation of said drive shaft comprising a housing fixed to said control shaft, a ball having a drive stud thereon, said ball adjustably mounted within said housing to permit positioning of the stud eccentric of said stroke control shaft and link members drivingly connecting said stud and said polishing head support shaft.

2. In a lens surfacing machine the combination of a base, a rotatable work spindle in said base, a polishing head secured to a rotatable shaft carried on said base, drive means for said spindle and means for reciprocating said head, said reciprocating means comprising a stroke control shaft rotatably mounted in said base and actuated from said drive means, a housing secured to said control shaft, said housing provided with a socket, a ball adjustable in said socket, a drive stud on said ball, pins on said ball engaged by said housing, pressure means for holding said ball in adjusted positions and link members operatively connecting said stud to said polishing head.

3. In a lens surfacing machine the combination of a base, a rotatable work spindle therein, a polishing head secured to a rotatable support shaft carried by said base, drive means for said spindle and means for reciprocating said head comprising a rotatable stroke control shaft mounted in said base and actuated from said drive means, a housing secured to an end of said stroke control shaft, said housing provided with a socket, a ball retainable and movable in said socket, a drive stud projecting from said ball and beyond said housing, pins on said ball engaged by said housing, said stud and ball provided with an opening extending entirely therethrough, a clamping plug engageable with said housing mounted in the end of said bore adjacent the surface of said ball, a pressure pin slidable in said bore and contacting said plug, a threaded portion at the other end of said bore, a clamp screw engaging said threaded portion and contacting said pressure pin, and link members operatively connecting said stud to said polishing head support shaft.

4. A lens surfacing machine comprising a base, a work spindle journaled therein, a support shaft rotatably mounted upon said base, a polishing head secured to said support shaft, work engaging means carried by said head, drive means for said spindle and means for reciprocating said head, said reciprocating means having a stroke control shaft journaled in said base and rotated from said drive means, a housing fixed to said stroke control shaft, a ball having a drive stud projecting therefrom, said ball adjustably mount-

ed within said housing to permit positioning of said stud eccentric of said stroke control shaft, pins on said ball engaged by said housing, a link member in the form of an arm having a yoke at each end thereof, a second link member having one end fixedly engaged to said support shaft and its other end engaged in one of said yokes, said stud extending through the other yoke and pivotally connected thereto.

5. A lens surfacing machine having a base, a drive shaft journaled therein, a work spindle and an intermediate shaft also journaled therein and driven from said drive shaft, a stroke control shaft journaled in said base and driven from said intermediate shaft, a support shaft rotatably mounted above said base and angularly adjustable in a vertical plane located transversely of said base, a polishing head secured to the support shaft, work engaging means carried by said head, gear means for angularly positioning said support shaft, and means for reciprocating said head on actuation of said drive shaft comprising a housing fixed to said control shaft, a ball having a drive stud thereon, said ball adjustably mounted within said housing to permit the longitudinal axis of said stud to be positioned out of alignment with the longitudinal axis of said stroke control shaft and link members operatively connecting said stud to said head support shaft.

6. A lens surfacing machine having a base, a drive shaft journaled therein, a work spindle and an intermediate shaft also journaled therein and driven from said drive shaft, a stroke control shaft journaled in said base and driven from said intermediate shaft, a support shaft rotatably mounted above said base and angularly adjustable in a vertical plane located transversely of said base, a polishing head loosely mounted on said support shaft, locking means for securing said head to its support shaft to rotate therewith, an extensible arm carried by said head, work engaging means carried by said arm, gear means for angularly positioning said support shaft, and means for reciprocating said head on actuation of said drive shaft comprising a housing fixed to said control shaft, a ball having a drive stud thereon, said ball adjustably mounted within said housing to permit the longitudinal axis of said stud to be positioned out of alignment with the longitudinal axis of said stroke control shaft and link members operatively connecting said stud to said head support shaft.

7. In a lens surfacing machine the combination of a base, a work spindle rotatably mounted in the base, a pair of standards extending above the base, a shaft support member pivotally mounted between said standards for tilting movement about a horizontal axis located longitudinally of said base, gear means on said support member cooperating with gear means on said base for tilting said support member, a support shaft rotatably mounted within said support member, a polishing head secured to said support shaft, work engaging means carried by said head, drive means for said spindle and means for reciprocating said head, said reciprocating means comprising a stroke control shaft rotatably mounted in said base and actuated from said drive means, a housing secured to said control shaft, said housing provided with a socket, a ball adjustable in said socket, a drive stud on said ball, pressure means for holding said ball in adjusted positions, pins on said ball engaged by said housing, and link members operatively connecting said stud to said polishing head.

8. In a lens surfacing machine of the type having a polishing head adapted to be reciprocated over a lap, said polishing head being pivoted for movement into operative and inoperative positions, means for moving said head into said positions comprising a shaft rotatably carried by said head, an eccentric on said shaft, gear means for rotating said shaft, a link pivoted to said eccentric, an arm pivoted to said link, said arm provided with a slot, a pin fixed to said head and engaged with said slot, said eccentric located out of alignment with the pivot center of said arm and the center of said pin when the polishing head is in operative and in inoperative positions.

9. In a lens surfacing machine of the type having a polishing head pivotally mounted and adapted to be raised and lowered into operative and inoperative positions with respect to a lap mounted on said machine and to be reciprocated ever the lap to cause work engaging means carried thereby to reciprocate a lens block and lens over said lap during the actuation of the machine, means for moving said head into said positions comprising a shaft rotatably carried by the head, gear means for rotating said shaft, an eccentric on said shaft, a link having one end thereof pivoted to said eccentric, an arm having one of its ends pivoted to the other end of said link, the end of the arm opposite said pivot provided with a slot, a pin on said head engaged with said slot, the axis of said eccentric located in offset relation to a plane passing through the axis of said pin and the axis of the pivot for said link and arm when said head is in raised and lowered positions and stop means carried by said link for limiting the movement of said head about its pivot.

10. In a lens surfacing machine having a head support member and a polishing head pivoted thereto and adapted to be moved into operative and inoperative positions with respect to a lap on said machine and to be reciprocated over the lap during actuation of the machine to cause work engaging means carried thereby to reciprocate a lens block and lens over said lap, the combination of means for moving said head into said positions and means for exerting a grinding pressure on a lens on the lap comprising a shaft rotatably carried by said head, gear means for rotating the shaft, an eccentric on said shaft, a link pivoted on said eccentric, an arm pivoted to said link, said arm having a slot, a pin fixed to said head and engaged with said slot, a lever pivoted to said head support and also to said link about the pivot axis of said arm, a pressure pin in said head, a second arm pivoted to said head and held against said pressure pin by tension developed by a spring connected thereto and to said lever, and stop means on said link contactable with said head support to limit the movement of said head, the axis of said eccentric offset with respect to a plane through the axes of said slot engaged pin and the pivot for said link and first mentioned arm when said head is in said positions.

11. In a lens surfacing machine the combination of a base, a rotatable spindle in said base, a lap on the spindle, a rotatable shaft on said base, a polishing head support secured to said shaft, a polishing head, work engaging means carried by said head for contact with a lens block and lens on said lap, said head pivoted to said head support, rotatable crank means for reciprocating said head, drive means for said spindle and said crank means, adjustable means for varying the

eccentricity of said crank means, driving members connecting said crank means to said shaft, means for pivoting said head into operative and inoperative positions and for exerting a grinding pressure on a lens on said lap comprising an eccentric rotatably supported from said head, gear means for rotating the eccentric, a link pivoted to the eccentric, an arm and a lever pivoted to said link, a pin fixed on said head and engaged by said arm, said lever also pivoted to said head support, adjustable spring tension means connecting said lever to said head, and stop means on said link contactable with said head support, the axis of said eccentric located in offset relation to a plane through the axes of said pin and the pivot for said link and arm when said head is in operative and inoperative position.

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