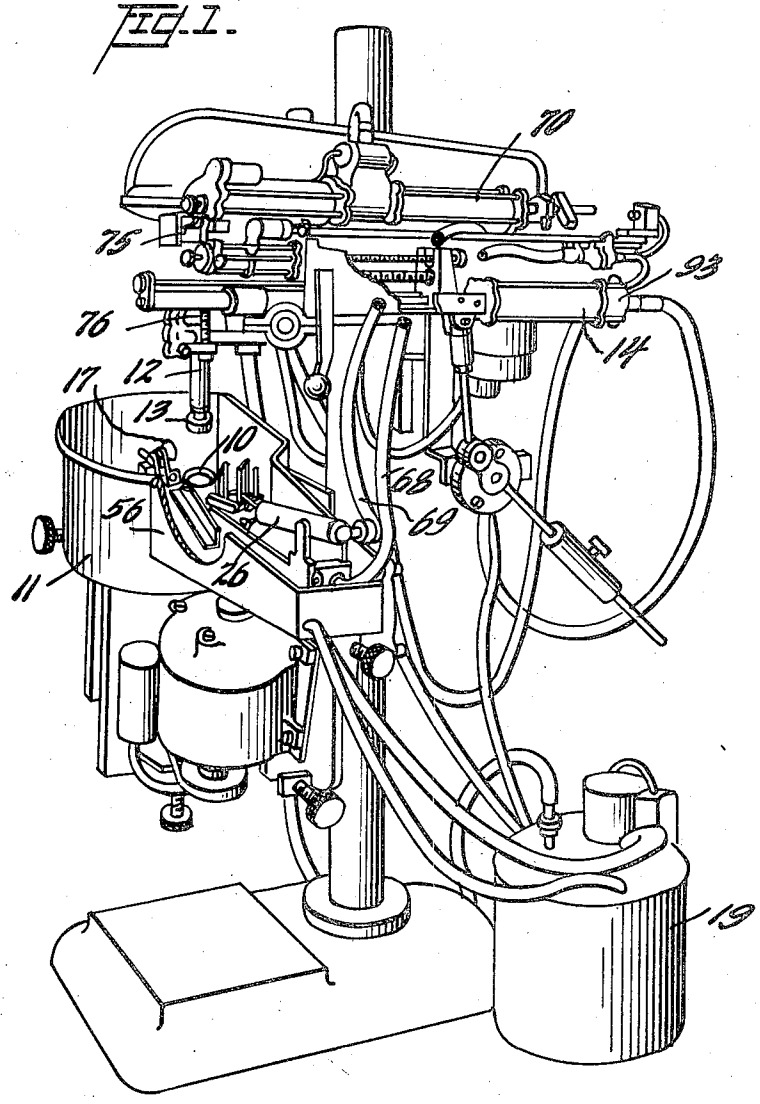
March 22, 1955 P. DE V. D'AVAUCOURT 2,704,425

AUTOMATIC GLASS GENERATING MACHINE

Filed July 7, 1954 8 Sheets-Sheet 1

FIG. 1.



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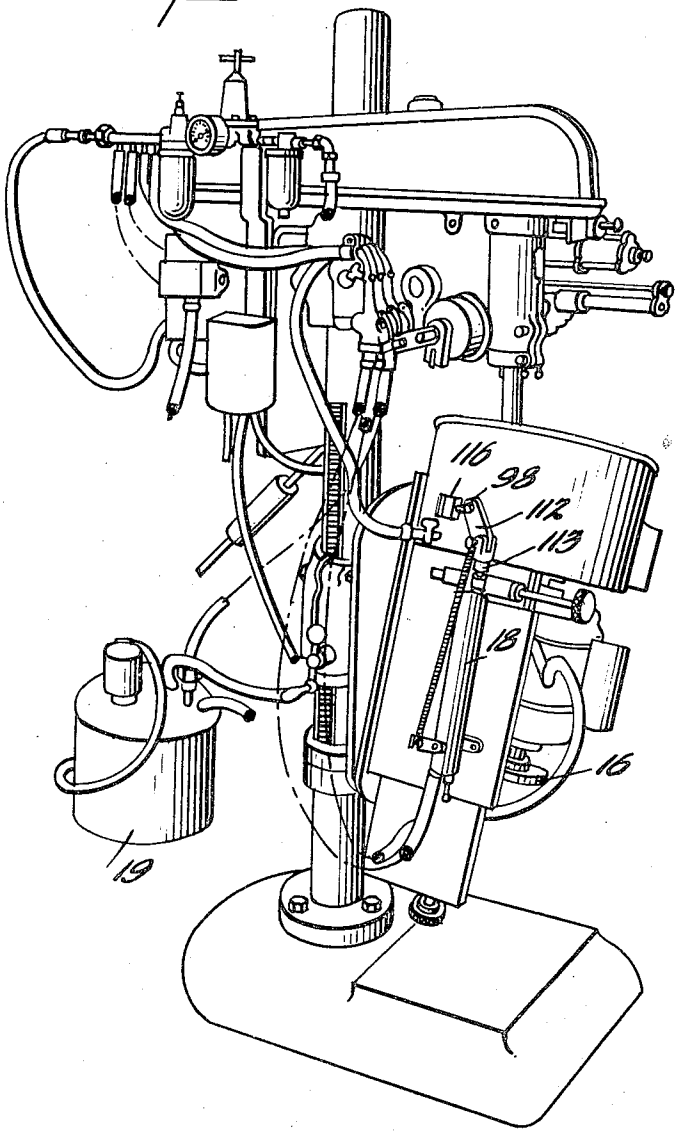
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AUTOMATIC GLASS GENERATING MACHINE

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FIG. 2.



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AUTOMATIC GLASS GENERATING MACHINE

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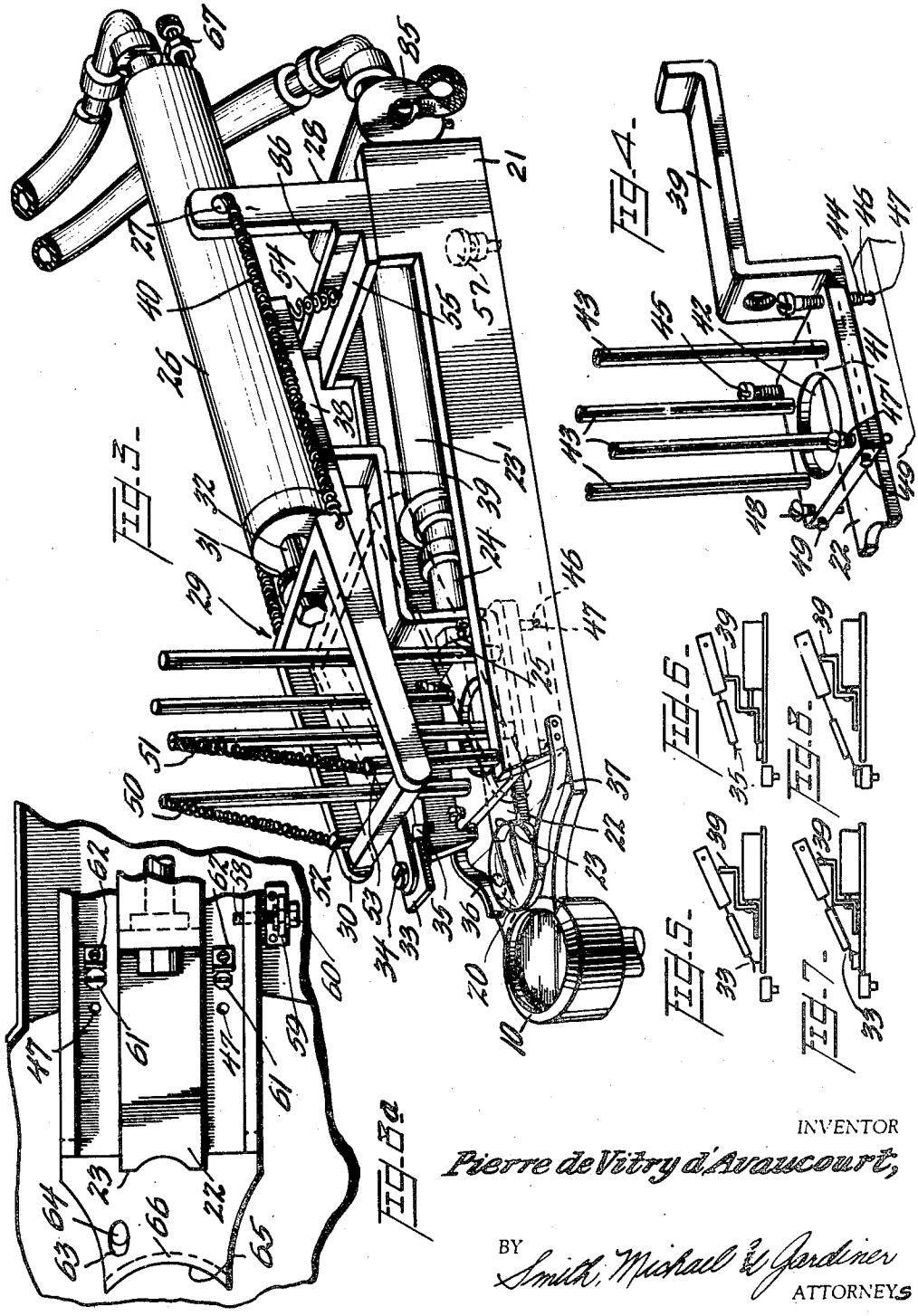


FIG. 3.

FIG. 4.

FIG. 6.

FIG. 8.

FIG. 5.

FIG. 7.

FIG. 3a.

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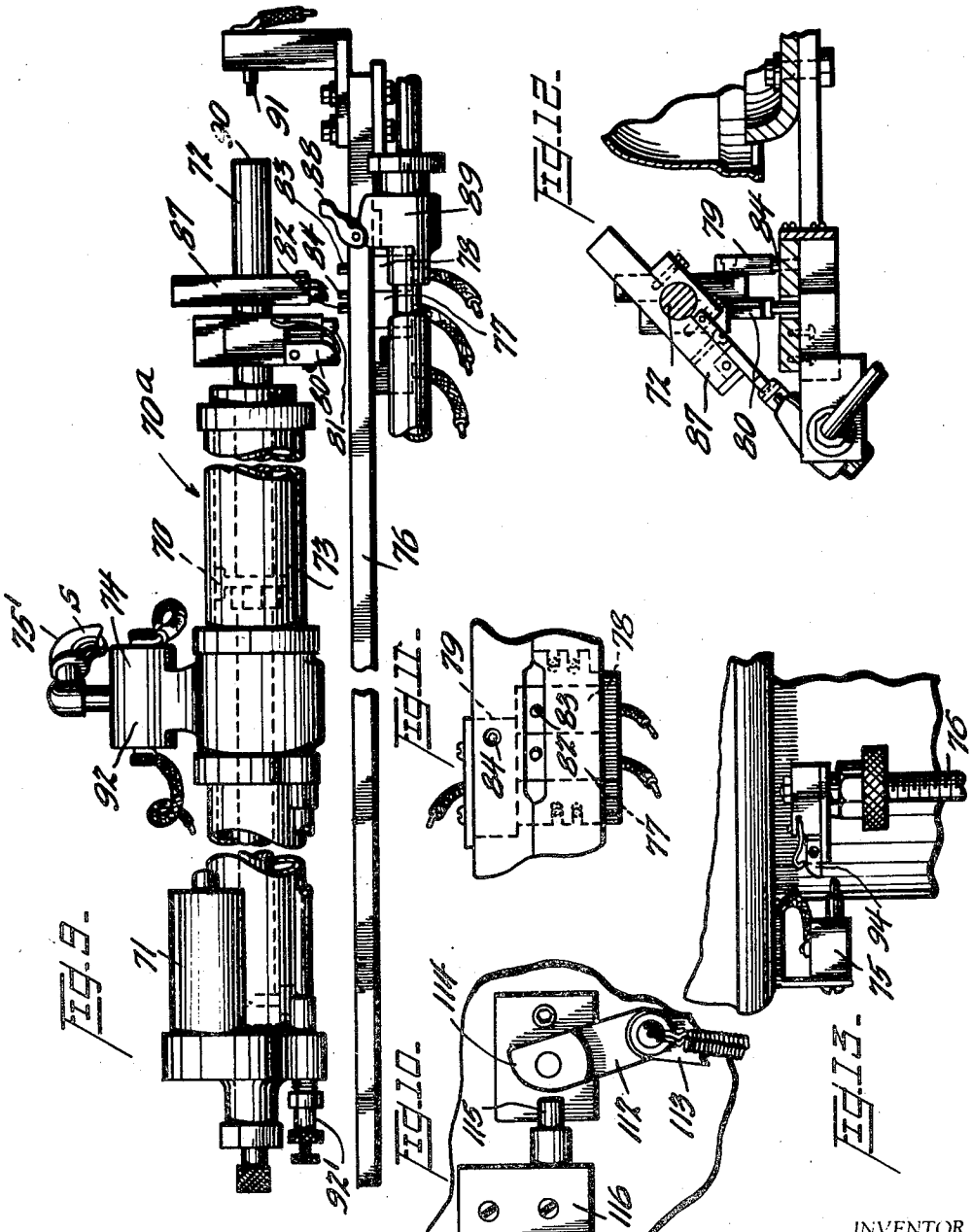
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AUTOMATIC GLASS GENERATING MACHINE

Filed July 7, 1954 8 Sheets-Sheet 4



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AUTOMATIC GLASS GENERATING MACHINE

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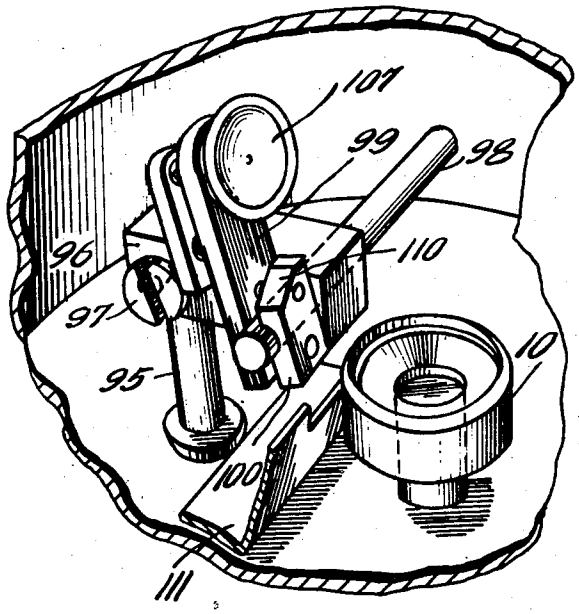


FIG. 14.

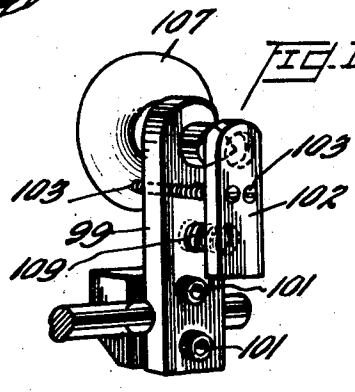


FIG. 15.

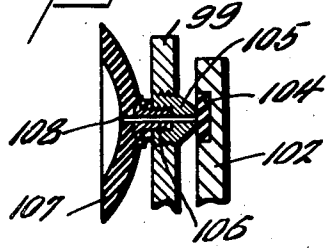


FIG. 16.

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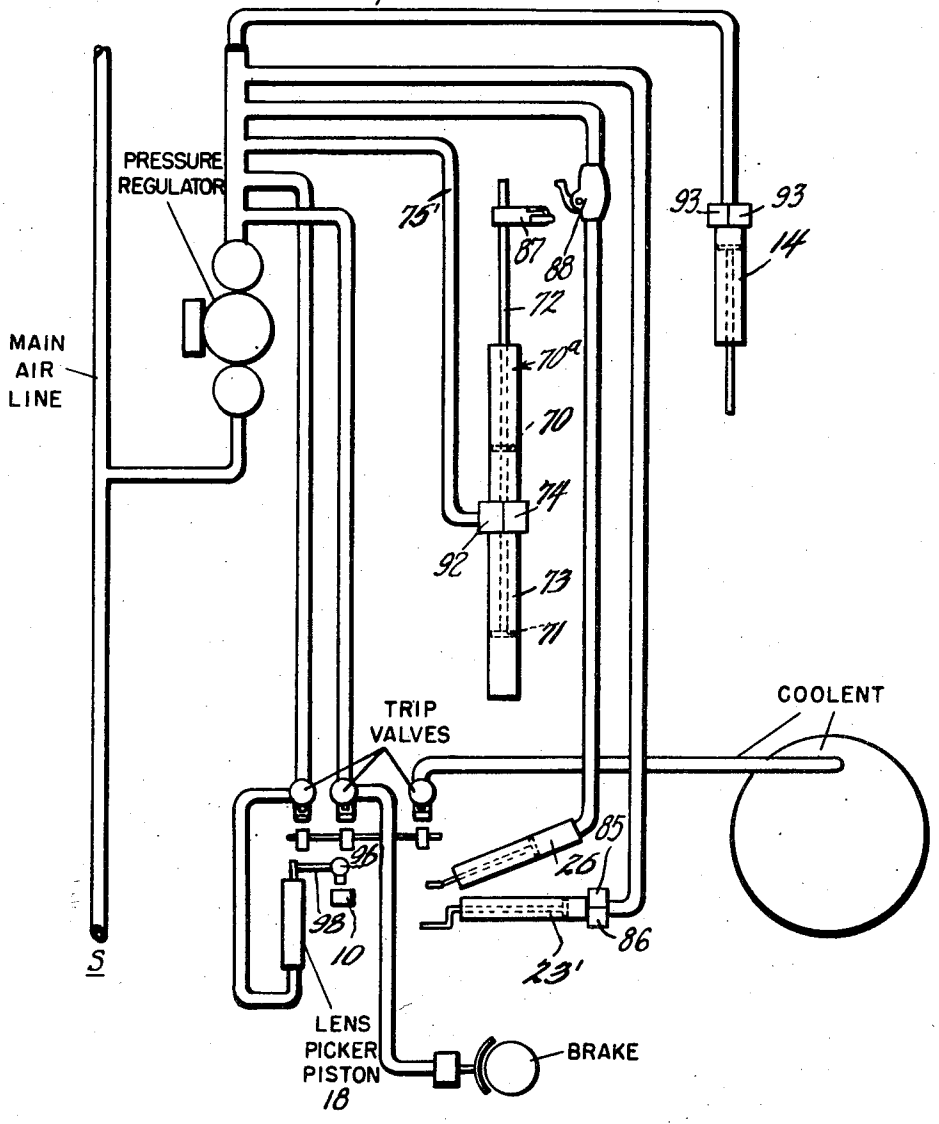
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AUTOMATIC GLASS GENERATING MACHINE

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FIG. 17.



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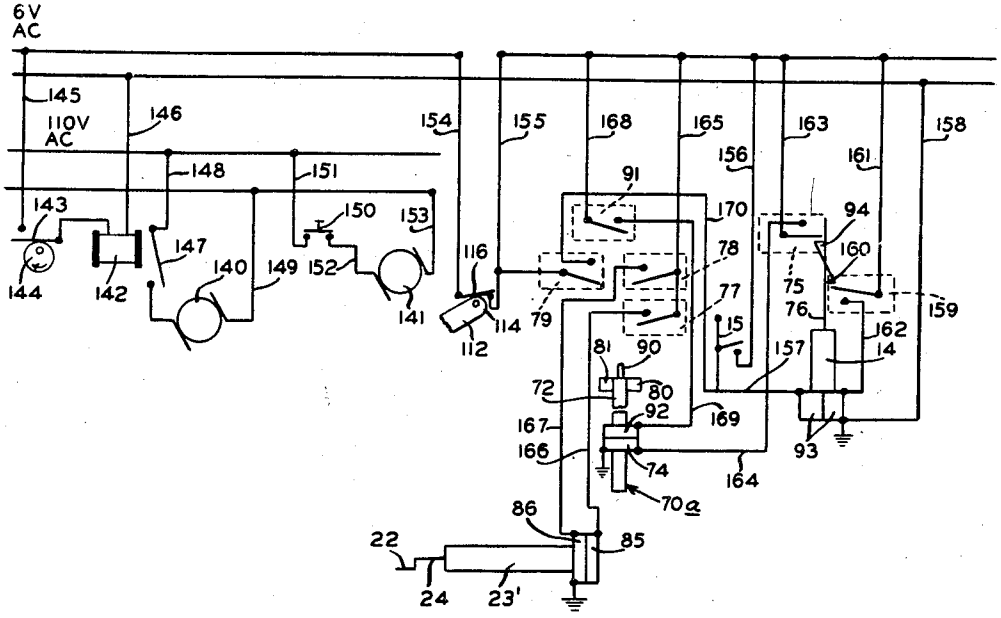
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AUTOMATIC GLASS GENERATING MACHINE

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Fig. 18



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FIG. 22.

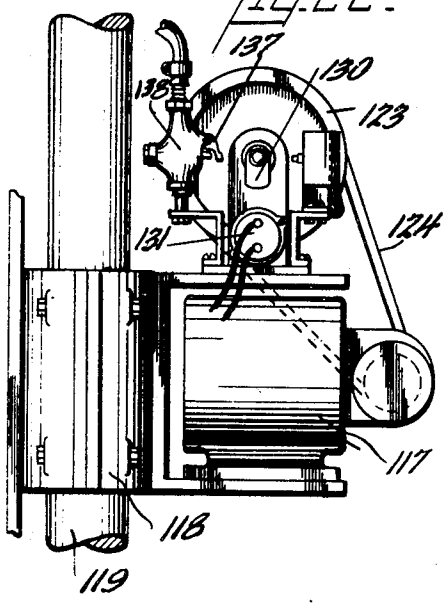
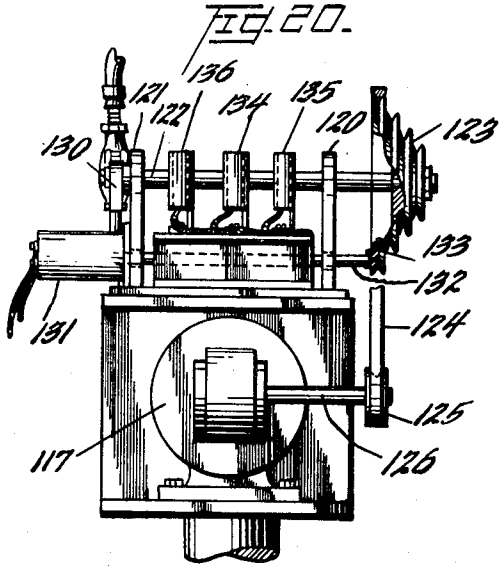


FIG. 20.



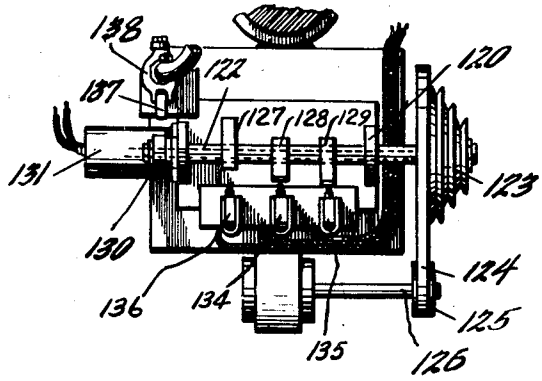


FIG. 21.

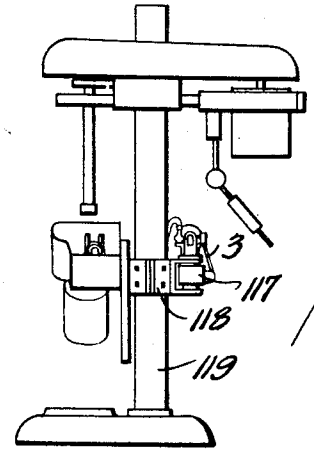


FIG. 19.

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United States Patent Office 2,704,425 Patented Mar. 22, 1955

2,704,425

AUTOMATIC GLASS GENERATING MACHINE

Pierre de Vitry d'Avaucourt, Bainbridge, Pa.

Application July 7, 1954, Serial No. 441,893

15 Claims. (Cl. 51—131)

This invention relates to an automatic generating machine and is concerned more particularly with a machine for generating surfaces on lens blanks and the like.

In my prior application Serial No. 752,115, filed June 3, 1947, now Patent 2,616,226, dated November 4, 1952, and entitled Method and Apparatus for Abrading, there is disclosed a machine for generating surfaces on lens blanks including mechanism to adjust the position of the lap spindle with respect to the work holder spindle in three different planes. The present invention includes this type of grinding machine although the invention is not limited thereto.

In my application filed July 28, 1952, entitled Apparatus for Abading, Serial No. 301,334, of which this application is a continuation-in-part, there is disclosed a semi-automatic machine for grinding lens blanks and the like which includes means for automatically moving the lap spindle with respect to the work holder spindle to bring the lap into proper operating relationship with respect to a workpiece held in the workholder chuck carried by the spindle. This application also includes an automatic arrangement for stopping the rotation of the lens holder spindle and picking the lens from the lens chuck.

The present invention is illustrated as incorporating all of the features and structure of my said prior applications and reference may be had thereto for a clearer understanding of this application, but it is to be understood that this application is not limited to such prior structures but may be used with machines of other types.

It is an object of the present invention to provide a machine which will be substantially fully automatic in operation. The machine is designed to deliver lens blanks from a magazine or stacker onto the lens chuck, automatically generate the desired surface on the lens blank and reduce the blank to the proper thickness. It also automatically picks the ground lens from the lens chuck and automatically discharges the same. The essential features of the present invention may be said to reside in first, a blank feeding or delivery mechanism; second, an automatic lens picking and discharging mechanism; and third, a control mechanism for energizing the various operations in sequence and in a fully automatic manner.

Another object of the present invention is to provide automatic means for performing a series of sequential operations upon initial actuation of the machine, with the completion of the last of said operations again initiating the sequence regardless of the time interval between operations.

A further object is to provide means for feeding lens blanks only after a previous lens has been ground and removed from the lens chuck regardless of the time required for such grinding and discharging operations.

Still another object is to provide lens feeding means which is brought into operation by movement of the grinding spindle to its retracted position away from the lens chuck.

A further object is to provide an improved lens blank feeding mechanism in which the blanks are fed one at a time to the lens chuck where the lens is positively forced downwardly onto the chuck to insure its proper mounting.

An additional object is to provide a lens feeding means in which the means for forcing the lens downwardly onto the chuck is moved out of the path of movement of the lens blank during initial feeding stages so that accurate feed is obtained.

Another object is to provide a detachable lens magazine or stacker which is so mounted that it may rock away from its base so as to permit concavo-convex lenses to be fed therefrom accurately one by one.

Further objects include a safety switch operable by the lens picker in the event of the sticking of a lens blank; means for releasing a lens from the picker and conveying means for receiving the released lens and conveying it to a point of discharge.

Other objects and advantages will be evident as the description proceeds and it is to be understood that changes in size, shape and other details may be resorted to so long as they fall within the spirit and scope of the appended claims.

In order that the invention may be more readily understood, an embodiment thereof will be described in conjunction with the attached drawings in which:

Fig. 1 is a perspective view showing a lens grinding machine embodying the features of the present invention,

Fig. 2 is a view similar to Fig. 1 taken from the opposite side of the machine and showing part of the control arrangement,

Fig. 3 is a detail perspective view illustrating the lens feeding mechanism,

Fig. 4 is a detail perspective view showing the lens blank magazine or stacker and the feeding shuttle associated therewith,

Figs. 5, 6, 7, and 8 are diagrammatic views illustrating the sequence of operations of the lens feeder,

Fig. 8*a* is a top view of a portion of the feeding mechanism showing principally the slide or shuttle arrangement and the mounting table therefor,

Fig. 9 is a side elevation, partially broken away, illustrating a portion of the control mechanism,

Fig. 10 is a detail view illustrating a safety control switch for the lens picker mechanism,

Fig. 11 is a top view illustrating the mode of mounting the control switches on the main frame of the mechanism shown in Fig. 9,

Fig. 12 is a rear elevation, partly in section, illustrating the tripping arrangement for the air control of Fig. 9,

Fig. 13 is a detail view showing a switching arrangement for controlling the operation of the automatic valve of Fig. 9 by movement of the lens grinding spindle to its retracted position away from the lens chuck,

Fig. 14 is a fragmentary view showing the lens picker in perspective,

Fig. 15 is a rear view of the lens picker,

Fig. 16 is a detail view showing the lens releasing means for the lens picker,

Fig. 17 is a diagram of the fluid circuits employed,

Fig. 18 is a similar view of the wiring system,

Fig. 19 is a perspective diagrammatic view showing the mounting of a modified form of control mechanism,

Fig. 20 is a side elevational view partly broken away, showing the modified control,

Fig. 21 is a top plan view of the arrangement shown in Fig. 20, and

Fig. 22 is an end elevation of Fig. 21.

The lens blank feeding mechanism

Referring in detail to the drawings, it will be seen particularly in Figs. 1 and 2, that the machine illustrated is in general the same as that disclosed in my above mentioned application including a rotating lens chuck **10** surrounded by a reservoir **11**, a reciprocating lap spindle **12** carrying a lap **13** and a power unit **14** for reciprocating the grinding spindle under the control of a starting lever **15**. It is also shown as being provided with a brake **16** for the lens chuck spindle, a lens picker **17** operated through piston and cylinder arrangement **18** and a coolant supply **19**, all as shown in my application filed July 28, 1952, Serial No. 301,334.

In said application the lens blanks were manually placed upon the lens chuck and when removed therefrom by the lens picker, it was necessary to remove the lens from the picker by hand, whereas the present case differs in that both operations are completely automatic and no manual operations are required except loading the lens

magazine or stacker and starting the machine in operation.

The lens feeding mechanism is shown in Figs. 3 to 8*a* inclusive. In the drawings the lens blanks have been removed from the magazine or stacker of the machine in order to facilitate illustration of the various component parts of the apparatus.

A single lens blank **20** is shown in a position about to be delivered to the lens chuck **10** of the machine. The device comprises a base or table member **21**. Mounted for sliding movement over the table **21** is a shuttle **22** which is provided at its forward end **23** with a projecting portion formed to the contour of the lens blank to be fed. The shuttle **22** is actuated by an air cylinder and piston arrangement **23'** which is rigidly mounted in the framework of the feeder. Piston rod **24** of the air cylinder and piston arrangement **23'** is attached to the shuttle **22** by a fastening **25**. The piston rod **24** of air cylinder and piston arrangement **23'** is movable in two directions and is controlled in its operation by a pair of magnetic valves, the operation of which will be more fully described hereinafter. A second air cylinder and piston arrangement **26** is pivotally mounted on the table **21** over the unit **23'**, the same being pivoted as indicated at **27** in Fig. 3. There are a pair of supporting arms **28** which extend upwardly from the table **21** and receive the pivots for the unit **26**. The air cylinder and piston arrangement **26** carries a reciprocating pusher mechanism generally indicated by the numeral **29** which includes also an arrangement for applying axial pressure to the lens blank **20** as the same is delivered to the lens chuck **10**. This is provided in order that the blank **20** may be brought into firm engagement with the chuck and assist in obtaining a good "capillary" bond between the blank and the chuck as disclosed in my prior application filed July 28, 1952, Serial No. 301,334 referred to above.

The pusher mechanism **29** is shown in elevated position in solid lines in Fig. 3 and in lowered position in dotted lines in that view. The pusher mechanism **29** includes a generally rectangularly shaped frame **30** which is secured by fastening **31** to the piston rod **32** of the piston and cylinder arrangement **26**. At the forward end of the frame **30** there is provided a feeding finger holder **33** which is fastened by means of a screw **34** to an extension which projects forwardly of the frame **30**. Mounted on the holder **33** are a pair of diverging spring steel fingers **35** which are adapted to engage the peripheral edge of the blank **20** at spaced points on the circumference thereof to deliver the blank from the position shown in Fig. 3 into the lens chuck **10**. By providing the fingers **35** of spring steel they will tend to override a lens blank should the same become lodged in the machine through accident. In order to properly position the blank **20** and prevent it from becoming misaligned due to vibration of the machine or other causes, a fixed guide **36** and a leaf spring guide **37** are positioned to engage the peripheral edge of the blank as the same is delivered to the position shown in Fig. 3 by the shuttle **22** and from such position into the lens chuck **10** by the pusher mechanism **29**.

The feed arrangement which delivers the blank from the position shown in Fig. 3 into the chuck is arranged so that the same may be disposed out of the path of the oncoming lens blank during the initial feeding cycle by the shuttle **22**. This is accomplished by providing means for elevating the piston and cylinder arrangement **26** and the associated pusher mechanism frame **30** which carries the feeding finger holder **33** and the fingers **35**, such elevation being effected upon forward movement of the piston rod **34** of the cylinder and piston arrangement **23'**. A wear plate **38** is secured to the lower surface of the air cylinder and piston arrangement **26** and this is engaged by a projecting lifter **39** provided on the shuttle **22** (Figs. 3 and 4) and projecting upwardly into engagement with the wear plate **38**. As seen in Fig. 3 the air cylinder and piston arrangement **26** and pusher mechanism **29** are normally inclined downwardly to the plane of the base **21** so that rectilinear movement of the lifter **39** will cause the pusher mechanism **29** and air cylinder and piston arrangement **26** to swing about the pivot **27** ad remove the spring fingers **35** out of the path of the oncoming lens blank. This arrangement is diagrammatically shown in Figs. 5 to 8.

It will be observed from Figs. 3 to 6 that in initial position with the piston rod **24** retracted, the lens feeding finger holder **33** and the fingers **35** will be in lowered position (Fig. 5). As the second step of the operation is effected and the piston rod **24** moves to its outermost position as shown in Fig. 6, the lens blank **20** will be moved into position as shown in Fig. 3 by the shuttle **22** for subsequent engagement between feeding fingers **35**. Simultaneously, the air cylinder and piston arrangement **26** will be swung about the pivot points **27** by engagement of the lifter **39** with the wear plate **38** and the fingers **35** will be elevated out of the path of movement of the blank. Upon return of the piston rod **24** to the fully retracted position as shown in Fig. 7, the cylinder and piston arrangement **26** will pivot to a lower position with the fingers **35** lying in engagement with the periphery of the blank **20** or closely adjacent thereto, ready to deliver the blank onto the chuck **10**. Thereupon air is supplied to the cylinder and piston arrangement **26** and as shown in Fig. 8, upon movement of the piston to an extended position, the lens blank **20** is moved from the supporting table **21** onto the chuck **10** and due to the inclination of the pusher mechanism **29**, a downward component of force is applied to the blank, effective for bringing the lens blank into firm engagement with the chuck which is wetted with water and provided therein with a layer of resilient material such as rubber or other similar abrasion resistant and resilient material as shown in my previous application. In place of water, the conventional oil coolant which is supplied in the grinding of lenses will wet the chuck surfaces adequately to obtain the desired bond between the lens blank and the chuck.

The cylinder and piston arrangement **26** is controlled so as to supply air to the cylinder and move the piston to extended position. Return motion of the piston is effected through a pair of springs **40** which are secured to the framework of pusher mechanism **29** and to the extending arms **28**, one of which may be seen in Fig. 3.

The lens magazine or stacker

The arrangement for holding a plurality of lens blanks in properly aligned position is shown in Fig. 4. It includes a plate member **41** provided with a central opening **42** through which a lens blank of the proper size may pass. Four guiding posts **43** project upwardly from the plate **41** and position the lens blanks in proper orientation relative to the opening **42** for delivery, one at a time, through the opening **42** and into the path of movement of the shuttle **22**. The shuttle is shown in its extended position in Fig. 4, assumed to have fed a lens blank from the magazine. The plate member **41** is positioned on the table **21** by means of two machine screws **44** and **45** which are provided with reduced pin points **46** which are adapted to be received within enlarged openings **47** provided in the base or table **21**. Adequate clearance is provided between the points **46** and the walls of the openings **47** in the base member **21** to permit slight rocking movement of the support **41** about the points **46** as the fulcrum point. The forward end of the plate member **41** is mounted in an adjustable position with respect to the table **21** by a pair of adjusting screws **47'** and **48** which may be locked in position by means of set screws **49**. The screws **47'** and **48** rest on the upper surface of the base **21** and may be adjusted to position the plate **41** so that a single lens blank may pass freely between the base **21** and the plate member **41**.

In order to provide for a slight upward rocking motion of the supporting member **41** allowed by the pin points **46**, a pair of springs **50** and **51** (Fig. 3) are secured to posts **52** and **53** which are fixed to the sides of the table **21**. The springs **50** and **51** are received within slotted openings provided in the upper ends of the forward pair of posts **43** as best shown in Fig. 3 and with this arrangement a slight tilting motion of the forward end of the supporting member **41** is permitted, the member **41** normally being urged to its at rest position with the screws **47'** and **48** in engagement with the table **21** and being yieldingly held in this position by the springs **50** and **51**. The posts **52** and **53** lie within the frame **30** and serve the added function of guiding the frame **30** in its reciprocating movement imparted thereto by the piston rod **32**.

Although the weight of the piston and cylinder arrangement **26** and its associated pusher mechanism **29** may be sufficient to normally hold them in their lowered position, better control of pressure is obtained by using

a spring and to this end it is preferable to provide a spring 54 which is connected between angle bracket 55 extending between the arms 28 and the plate 38 secured to the piston and cylinder arrangement 26. This spring will serve to apply a predetermined downward force to the lens blank as the same is positioned in the chuck by the fingers 35.

An arrangement which is provided for adjusting the position of the lens feeding mechanism with respect to the work-holding chuck is shown in Fig. 3. The table 21 is mounted as shown in Fig. 1 in a trough 56 extending from the lens chuck spindle reservoir 11. A stud 57 is shown in Fig. 3 and this passes through the bottom wall of the base 21 and of the trough and secures the table 21 to the trough. This permits the whole lens feeding mechanism to be swung horizontally about the stud 57 as a pivot to align the feeding mechanism with the axis of the lens chuck 10.

In order that this adjustment may be accurately effected by more minute adjustment, machine screws 58 (one is shown in Fig. 8*a*) passes through a bracket 59 mounted on the trough 56 and which are threaded into the side of the mounting table 21. The machine screws 58 are provided with an operating head 60 by means of which the screw may be adjusted to control the swinging movement of the table 21.

It is also desirable to provide for elevation and lowering of the supporting table 21 to bring the same into proper vertical alignment with respect to the upper edge of the lens chuck 10. This may be accomplished by a pair of threaded studs 61 threaded into the lower portion of the base 21 and held against free rotation by spring fingers 62 as shown in Fig. 8*a*. By rotating the stud 61, it is possible to raise or lower the forward edge of the table since these studs 61 are against the bottom of the trough 56 and limited vertical motion is possible by reason of the fact that the stud 57 is provided with a resilient washer disposed between the head of the stud 57 and the lower portion of the table 21 as diagrammatically shown in Fig. 3.

Fig. 8*a* also shows the locating holes for the stacker which have been numbered 47 and which are the openings into which the adjusting screws 44 and 45 are received, the pin points 46 passing freely into the holes 47 and the shoulder of each screw above the pointed end engaging the base member surrounding the openings 47.

As may be clearly seen from Fig. 8*a*, an opening 63 is provided in the base table 21 at its forward end through which may pass a conduit 64 for the delivery of coolant to the lens blank and to the lap during the grinding operation. It will be noted that the forward edge 65 of the table 21 is contoured so as to overlie the edge of the chuck 10 and fully support the lens blank until the moment of delivery to the chuck. The table is, as indicated in dotted lines in Fig. 8*a*, provided with a bevelled surface 66 which corresponds generally to the bevel on the top edge of the lens chuck 10.

The speed of return motion of the piston rod 32 and feeding device associated with it, is controlled by an adjustable check valve 67 provided on the cylinder and piston arrangement 26 as shown in Fig. 3.

Control arrangement for lens blank feeder

As disclosed in my application Serial No. 301,334, an air manifold is employed from which conduits extend to the lens chuck brake cylinder and to the lens picker cylinder. In the present application, this same manifold is utilized but it is provided with two additional conduits 68 and 69 (Fig. 1), the first of which conducts fluid under pressure to the lens feed air cylinder and piston arrangement 26 and the other to the shuttle operating air cylinder and piston arrangement 23 as will be further described.

The control arrangement for the lens feeder is shown in Figs. 9 and 11 to 13 inclusive. It comprises essentially an air motor 70^a with a "hydro-check-in-line." This air motor is of conventional construction which can be readily obtained in the open market and the details of which, with the exception of the cams, form no part of the present invention. The air motor 70^a includes a pair of pistons 70 and 71 carried by a piston rod 72. The pistons 70 and 71 are mounted in cylinders 73 and the supply of air for operation of the pistons 70 and 71 is controlled by a multiple magnetic valve 74.

As previously mentioned, starting actuation of power unit 14 is controlled by a micro-switch actuated by a manually controlled lever 15 (Fig. 1) which is the same as that disclosed in my application filed July 28, 1952, Serial No. 301,334. A second automatically controlled micro-switch 75 is provided on the machine as shown in Figs. 1 and 13 and is arranged to be actuated by a trip arrangement 94 secured to a threaded rod 75' attached to the lap spindle and movable in a vertical direction with said spindle, said threaded member being clearly shown in Fig. 6 in the above mentioned prior application filed July 28, 1952, Serial No. 301,334.

Mounted on a supporting plate 76 attached to the machine below the cylinder 73 are three micro-switches 77, 78 and 79 as shown in Fig. 11. These switches are mounted on the member 76 so as to be adjustable longitudinally with respect thereto to predetermine the precise position of actuation of the various switches. Adjustably mounted on the piston rod 72 are a pair of spring biased one-way tripping fingers 80 and 81. The tripper 80 is adapted to engage the contact controlling arms 82 and 83 of the two switches 77 and 78 as shown in Figs. 9 and 11. The tripper 81 is adapted to actuate the control member 84 of the micro-switch 79. The switches 77 and 78 are electrically connected to magnetic valves 85 and 86 of the piston and cylinder arrangement 23' for the shuttle 22. Thus, when the tripper 80 engages the control 82 of switch 77, the magnetic valve 85 will be opened and the shuttle 22 will be moved to deliver a lens blank from the magazine to the position shown in Fig. 3. As movement of piston rod 22 continues, the tripper 80 will come into contact with control 83 of the switch 78 and this will in turn energize the magnetic valve 86 for piston and cylinder arrangement and the piston 24 thereof will be moved to a retracted position, carrying the shuttle 20 to the position as shown in Fig. 7. As further movement of the piston 72 of air motor 20^a to the right in Fig. 9 is effected, spring biased one-way valve tripper 87 will engage the control arm 88 of the air valve 89. The valve 89 controls a supply of air from the source S through appropriate piping to the piston and cylinder arrangement 26 which controls the lens blank feeder or pusher mechanism. When air is supplied to the piston of the piston and cylinder arrangement 26, the feeding fingers 35 engage the lens blanks 20 and move the same from the position shown in Fig. 7 to that shown in Fig. 8. As further movement of the piston rod 72 is effected (Fig. 9), the terminal end 90 engages a micro-switch 91 carried by the support 76, which switch controls the second magnetic valve 92 of the air motor 70^a and the piston 72 is retracted to the position shown in Fig. 9. The hydraulic check includes an adjustable release valve 92' which controls the speed of movement of the pistons 70 and 71.

Prior to the completion of the return motion of the piston rod 72, the tripper 81 will come into engagement with the control arm 84 of the micro-switch 79 which controls one side of a pair of magnetic valves 93 (Fig. 1), which in turn, control the operation of the air motor power unit 14 which, through a rack and pinion arrangement raises and lowers the lap spindle in the manner previously described. Upon movement of the lap spindle 12 into the grinding position and then upon its retraction to an upper position, it brings the spring biased one-way trip finger 94 (Fig. 13) carried by the threaded member 76' into engagement with the control arm of the switch 75 and this actuates magnetic control valve 92 and the cycle is repeated. The sequence of operation will be clear from consideration of a description of the electrical circuits in conjunction with Fig. 18 which appears later.

Lens picker control arrangement

With a fully automatic machine where the lens blanks are delivered one at a time to the lens chuck and this feeding operation follows the removal of a previously finished lens, it is desirable to provide an automatic arrangement for picking and also discharging the lenses upon the completion of the grinding operation.

Such an arrangement is shown in Figs. 14 to 16 inclusive. This arrangement includes a mounting post 95 secured to the base of the reservoir 11. A mounting block 96 is adjustably secured to the mounting post 95 by a screw 97. The operating shaft 98 of the lens picker passes through the mounting block 96 and is journalled for rotation therein. Mounted on the operating shaft

98 is the lens picker holder 99 and a clamping plate 100. The holder 99 and the clamping plate 100 partially encircle the operating shaft 98 and are held in firm engagement therewith by screws 101. A control plate 102 is loosely mounted on the mounting plate 99 by a pair of screws 103 which are threaded into the mounting plate 99 and pass freely through openings in the control plate 102. As shown in Fig. 16 the control plate 102 carries a resilient sealing member 104 which is adapted to lie in engagement with a bushing 105 which is threaded into the plate 99 and into which is screwed a fastener 106 embedded in the suction cup 107 so that the suction cup is mounted on the plate 99.

When the parts are in position shown in Fig. 16, the opening 108 which extends through the center of the suction cup 107, the bushing 105 and the member 106 is closed by the resilient sealing pad 104. This is the position the parts assume during the lens picking operation. Thus, when the suction cup 107 is brought down into engagement with the lens blank which is in the chuck 10, suction is created which is effective for holding the lens blank against the suction cup 107. As the operating shaft 98 is rotated the control plate 102 is brought into engagement with the eccentrically mounted screw 97 and this causes the plate 102 to be rocked about the screws 103 and a spring 109 which is interposed between the control plate 102 and the mounting plate 99 is compressed. This separates the plate 102 which carries the sealing member 104 from plate 99 and causes the suction cup 107 to be opened to the atmosphere through opening 108 and the engagement between the suction cup 107 and the lens is broken. Upon return of the operating shaft 98 towards lens picking position, the control plate 102 is moved away from the adjusting screw 97 and the spring 109 returns the parts to the position shown in Fig. 16, closing the opening 108 by sealing member 104 and thus placing the parts in proper position for the next lens picking operation.

As shown in Fig. 14, the clamping plate 100 has an inclined upper edge 110 immediately below the suction cup 107. Below the clamping plate is an inclined lens receiving gutter 111 interposed between the chuck 10 and the mounting post 95. This gutter 111 is inclined downwardly into the trough 56 as shown in Fig. 1, so that lenses released from the picker cup fall against the inclined surface and edge and roll therefrom into the inclined gutter 111 from which they are discharged into the trough 56 or to any other convenient location.

The lens picker operating shaft 98 is connected to a lever 112 which is pivoted to the piston rod 113 (Fig. 2) and when a lens is in proper position on the lens chuck 10 and the cup 107 is in engagement with the lens, the lever 112 is in the position shown in Fig. 10. However, if a lens becomes stuck or is otherwise not properly fed onto the chuck, the picker arm will swing through a greater arc so that the cam-shaped end 114 of the lever 112 will engage the control finger 115 of a micro-switch 116 carried by the reservoir 11 and energize the same to cut off current to the machine so that proper feeding may be restored.

Referring to the modification shown in Figs. 19 to 22 inclusive, there is shown a rotary control arrangement for the lens feeding and for the starting of a new cycle of operations which may be substituted for the reciprocating unit shown in Figs. 9, 11 and 12, the machine being in all other respects the same as that heretofore described.

In the modified form, an electric motor 117 is mounted on a bracket 118 clamped to the machine standard 119.

Supported on the bracket 118 are spaced bearings 120 and 121 receiving therein a cross shaft 122 carrying at one end thereof a pulley 123 driven by a belt 124 trained therearound and around the pulley 125 carried by the motor shaft 126.

Mounted on the cross shaft 122 are three angularly displaced micro-switch operating cams 127, 128 and 129. A fourth operating cam 130 is mounted on the cross shaft outboard of the bearing 121 and it controls an air valve in a manner which will be more fully described hereinafter.

The motor 117 is arranged for continuous operation so long as the generating machine is in use. Rotation of the cross shaft 122 is controlled by means of a solenoid 131 which is electrically connected in the operating circuit for the machine as will later appear.

The solenoid 131 is operative to impart reciprocating movement to a control rod 132 which, when the solenoid is deenergized, has its free end projecting into the path of movement of a stop lug 133 projecting from the inner face of the pulley 123, thereby preventing rotation of the pulley and consequently of the cross shaft 122. In this position, when the rod 132 engages the lug, the belt 124 slips on the pulley 123 and no motion is imparted thereto.

Any suitable mounting for the motor may be provided, but it should be such that the weight of the motor keeps the belt 124 taut at all times.

Mounted in the path of movement of the cams 127, 128 and 129 are three micro-switches 134, 135 and 136 and mounted in the path of movement of the cam 130 is a control arm 137 for the air valve 138. The cam 127 corresponds in function to tripper 80 of Figs. 9, 11, and 12 and controls micro-switch 136 which corresponds in function to the micro-switch 77 of Figs. 9, 11 and 12. Cam 128 also corresponds in function to tripper 80 in its actuation of micro-switch 78, the cam 128 actuating micro-switch 134, this switch corresponding in function to micro-switch 78 of Figures 9, 11 and 12. Cam 129 corresponds in function to tripper 81 and actuates micro-switch 135 which corresponds in function to switch 79 of Figs. 9, 11 and 12. The cam 130 actuates the control lever 137 of the valve 138 and these elements correspond in function to the tripper 87 which actuates the control 88 of the air valve 89 of the previously described machine.

The solenoid 131 may be electrically controlled by the micro-switch 75 shown in Fig. 13 and its tripper 94 so that upon upward movement of the lap spindle and the threaded rod 76', the solenoid 131 will be momentarily energized and the rod 132 will be retracted away from the stop lug 133, thus permitting the pulley 123 to make a complete revolution. During this revolution, the cams 127 to 129 effect their operation in exactly the same manner as the corresponding trippers and micro-switches as previously described. Such operation controls the actuation of the lens blank feeding mechanism as well as the initiation of a new cycle of operation of the machine.

The electrical circuits

Referring to the wiring diagram of Fig. 18, it will be noted that the electrical system includes a 6 volt source and a 110 volt source. Included in the 110 volt circuit is an electric motor 140 for driving the lower or lens chuck spindle and a motor 141 for driving the upper or grinding spindle 12. The motor 140 is controlled by a relay 142, the energization of which is in turn controlled by a switch 143 actuated by a cam 144. Switch 143 controls the supply of current to relay 142 from the 6 volt source through lead 145, the other side of the relay being directly connected to the source by a lead 146. Contact arm 147 of relay 142 completes the circuit for the motor 140 from the 110 volt source through lead 148, the other side of the motor being connected to the source by a lead 149. Motor 140 is intermittently operated in accordance with the motion of control cam 144 which can be seen in Figure 2. This portion of the system forms part of the disclosure of my application, Serial No. 301,334 previously referred to.

Motor 141 for rotating the grinding spindle is arranged for continuous operation and is controlled by a starting switch 150 which connects one side of motor 141 to the 110 volt source through leads 151 and 152, the other side of the motor being connected to the source by a lead 153.

The electrical controls for the magnetic valves 74 and 92 of the air motor 70a, the magnetic valves 85 and 86 of the air cylinder and piston arrangement 23', and the magnetic valves 93 of the power unit 14 are also shown in diagram form in Fig. 18. The system includes switch 116 which is shown in detail in Fig. 10. This switch is normally closed, but is opened by a cam-shaped end 114 of lever 112 if a lens becomes stuck or is otherwise not properly fed onto the lens chuck. Thus, switch 116 which is in the 6 volt circuit, being connected through leads 154 and 155, controls the supply of actuating voltage to all of the magnetic valves, preventing their actuation upon any failure of the lens feeding or picking mechanism.

When the machine is started up, the operator moves starting lever 15 to close the switch associated therewith. This completes the circuit for magnetic valve 93 of power unit 14 through leads 156 and 157. The other side of

the valve 93 is grounded, completing the circuit from the 6 volt source through ground lead 158. When power unit 14 is thus energized, grinding spindle 12 is lowered and grinding of a lens blank carried by the rotating lens chuck 10 is effected. This lowering motion of the grinding spindle 12 continues until switch 159 is actuated by an actuator 160 carried by the threaded rod 76' shown in Fig. 13 and diagrammatically illustrated in Fig. 18 as directly actuated by power unit 14. Closing of switch 159 completes the circuit for the other side of magnetic valve 93 and the motion of power unit 14 is reversed to elevate the grinding spindle 12 and also the threaded rod 76'. This circuit completion is through lead 161, the contacts of switch 159 and lead 162. As upward motion of the lap spindle is effected, trip finger 94 (Fig. 13) closes switch 75 and the circuit for magnetic valve 74 is completed through lead 163, contacts of switch 75, and lead 164. This causes piston rod 72 (Fig. 9) to move to the right, first bringing tripper 80 into contact with control arm 82 of switch 77 and completing the circuit for magnetic valve 85 through lead 165 (Fig. 18), contacts of switch 77, and lead 166. This controls actuation of shuttle 22 to deliver a lens blank from the magazine to the position shown in Fig. 3 for subsequent delivery to the lens chuck 10 by the feeding fingers 35. As further movement of the piston rod 72 continues (Figs. 9 and 18), tripper 80 will engage control 83 of switch 78 and magnetic valve 86 will be energized through lead 165, contacts of switch 78 and lead 167. This controls actuation of shuttle 22 to retract it from the Fig. 3 position to its at rest position, ready to deliver the next blank from the magazine.

This motion of piston rod 72 (to the right in Fig. 9) continues until tripper 90 is brought into engagement with the control for switch 91, completing the circuit for magnetic valve 92 through lead 168, contacts of switch 91, and a lead 169, which reverses the motion of piston rod 72. This return motion (to the left in Fig. 9) of piston 72 of air motor 70a, brings tripper 81 into engagement with control 84 of switch 79 which completes the circuit for magnetic valve 93 through lead 155, contacts of switch 79 and leads 170 and 157, and since switch 79 is connected in parallel with the starting switch controlled by starting lever 15, closing of switch 79 operates automatically to initiate the starting of a new cycle of operation of the machine in exactly the same manner as manual starting with lever 15.

As the grinding spindle 12 moves upwardly, disengaging the lap from the lens blank being ground, the chuck spindle brake is operated to stop rotation thereof, after which the lens picker functions to remove the lens and drop it into the discharge gutter.

From the foregoing, it will be seen that all that is required of the operator is to stack the lenses in the lens magazine, properly position this magazine with reference to the lens chuck, and then initiate the operation of the machine by operation of the control lever 15 of Fig. 1. Thereafter the operation is completely automatic.

The operation of grinding lenses is greatly facilitated and the speed with which such operations may be accomplished is greatly increased over prior devices and accurate and reliable operation is provided.

This application is a continuation in part of my application Serial No. 303,653 for Automatic Glass Generating Machine filed August 11, 1952, now abandoned.

What I claim is:

1. The combination with a lens grinding machine having a lap spindle reciprocable axially toward and from a work carrying chuck, of a lens blank feeder positioned adjacent said lens chuck and having means thereon engaging said lens blank and pushing the same onto said chuck, means carried by said spindle and movable therewith for controlling the feeding of lens blanks to said chuck, said means being controlled by said lap spindle as it moves away from said chuck.

2. In a lens grinding machine having a rotating spindle carrying a lens chuck, an axially reciprocating grinding lap spindle having a lap thereon movable into and out of engagement with work on said chuck, a brake for arresting rotation of said chuck spindle, a lens picker for removing a lens from said chuck, and automatic means for reciprocating said lap spindle, operating the chuck spindle brake and picking a lens from said chuck by said picker in sequence, the combination of a lens blank feeder adjacent said chuck, including means for engaging said lens blank and pushing said lens blank onto said chuck, and means carried by the grinding spindle and movable therewith for initiating operation of the lens feeder only after a lens has been removed from the lens chuck.

3. In an automatic lens grinding machine, a rotating lens chuck, a lens blank feeder for feeding blanks onto said chuck, said feeder comprising a magazine for receiving a stack of blanks therein, a reciprocating shuttle beneath said magazine for engaging the lowermost blank in the stack and feeding it to a point adjacent said chuck, and reciprocating finger means for engaging the blank adjacent the chuck and moving it onto the chuck, said finger means pressing downwardly on said blank to force the same into firm engagement with the chuck.

4. In an automatic lens grinding machine, a rotating lens chuck, a lens blank feeder for feeding lens blanks onto said chuck, said feeder comprising a magazine for receiving a stack of blanks therein, a reciprocating shuttle beneath said magazine for engaging the lowermost blank in said stack and feeding it to a point adjacent said chuck, a reciprocating pusher above said shuttle and having spring fingers thereon normally lying in the plane of the shuttle, said fingers engaging the blank when in position adjacent said chuck and moving the same onto the chuck, means for moving said pusher along a path inclined forwardly and downwardly with respect to said shuttle to exert downward pressure on the blank and thereby force the blank axially of the chuck, and means carried by the shuttle for elevating the pusher out of the path of movement of the shuttle to permit feeding of a blank into position forwardly of said spring fingers.

5. A lens blank feeder for automatic lens grinding machines comprising a supporting table, a lens blank magazine for receiving a stack of lens blanks comprising a base having an opening therein through which blanks may fall, guide posts extending upwardly from said base for aligning the blanks with said opening, and adjustable supporting feet carried by said base and spacing the same from the table a distance sufficient to permit a blank to pass therebetween, and spring means connecting the table and base for yieldingly holding the base on the table whereby the base may rock relative to said table to permit feeding of a blank from the magazine.

6. A lens blank feeder for automatic lens grinding machines comprising a supporting table, a lens blank magazine for receiving a stack of lens blanks comprising a rectangular base having a central opening therethrough, pairs of guide posts at the forward and rear edges of said base for aligning the blanks with said opening, pairs of adjustable supporting feet extending below the forward and rear edges of said base and spacing the base from the table, and a pair of springs connected to said table and to the forward pair of guide posts, whereby the forward edge of the base may tilt upwardly about the fulcrum provided by the rear pair of feet to permit blanks to be fed from the magazine.

7. A lens picker for picking ground lenses from a lens chuck comprising a swinging arm having a vacuum cup thereon engageable with a lens on the chuck, a lens feeder, electrically controlled means for said feeder, means for swinging said arm toward and away from said chuck, and a switch in circuit with said electrically controlled means engageable by said means for swinging said arm when a lens is not on said chuck for breaking the circuit and arresting operation of the lens feeder.

8. In an automatic lens grinding machine having a grinding spindle and a lens chuck, a lens feeder for feeding lens blanks to said chuck, including a fluid operated shuttle, a fluid operated pusher, means for operating said shuttle and pusher and control means for said operating means, said control means comprising a motor, a member driven by said motor and having spaced cams thereon, switches carried by said machine and lying in the path of movement of certain of said cams, a valve for controlling fluid flow to said pusher and having a trip finger lying in the path of movement of another of said cams, magnetic valves connected to said switches and controlling the fluid flow to said shuttle, upon engagement of the cams with said switches and the valve trip finger controlling the flow of fluid to said pusher when engaged by its cam.

9. A machine as claimed in claim 8 in which the motor for the control means is provided with a reciprocating piston rod and on which the cams are angularly displaced

therearound, with the switches and valve trip finger offset to be engaged by the proper cam.

10. A machine as claimed in claim 8 in which the control means motor is a rotary motor, a cross shaft driven by said motor and having angularly displaced cams spaced therealong, with the switches and valve trip being disposed in the path of movement of their proper cam.

11. A machine as claimed in claim 8 in which the motor driven member comprises a cross shaft provided with a pulley thereon, a stop lug on said pulley and projecting from one face thereof, a reciprocating control rod having its free end in the path of movement of said stop lug to arrest rotation of the pulley and a solenoid operable to retract said control rod to permit the pulley to drive the cross shaft.

12. A machine as claimed in claim 11 in which the solenoid is actuated by movement of the grinding spindle away from the lens chuck.

13. An automatic lens grinding machine comprising a grinding lap and a lens chuck, automatic means for feeding lens blanks one at a time from a lens blank magazine onto said chuck, automatic means for removing the ground lens from the chuck, including gripping means engageable with a lens to be removed and automatic mear-

controlled for movement of said removing means to a predetermined position remote from said chuck for releasing said lens from said lens gripping means.

14. A machine as claimed in claim 13 in which the lens removing means comprises a vacuum cup swingable into engagement with the lens on the chuck and swingable away from the chuck to remove the lens therefrom, and means for breaking the vacuum in said cup to release the lens therefrom when the cup has swung out of the plane of the chuck.

15. A lens picker for lens grinding machines having a lens chuck comprising a swinging arm carrying a suction cup at one end thereof, means for swinging said cup into engagement with a lens on said chuck and away from said chuck to remove the lens therefrom, said cup having an opening therethrough, a control plate carried by said arm and carrying a pad normally closing the opening through the cup, and a stop engageable by said control plate when the arm is swung away from the chuck to move the control plate away from said opening and break the vacuum in the cup to release the lens.

No references cited.