

Aug. 27, 1946.

G. W. JACKSON

2,406,606

EDGING MACHINE

Filed May 21, 1943

7 Sheets-Sheet 1

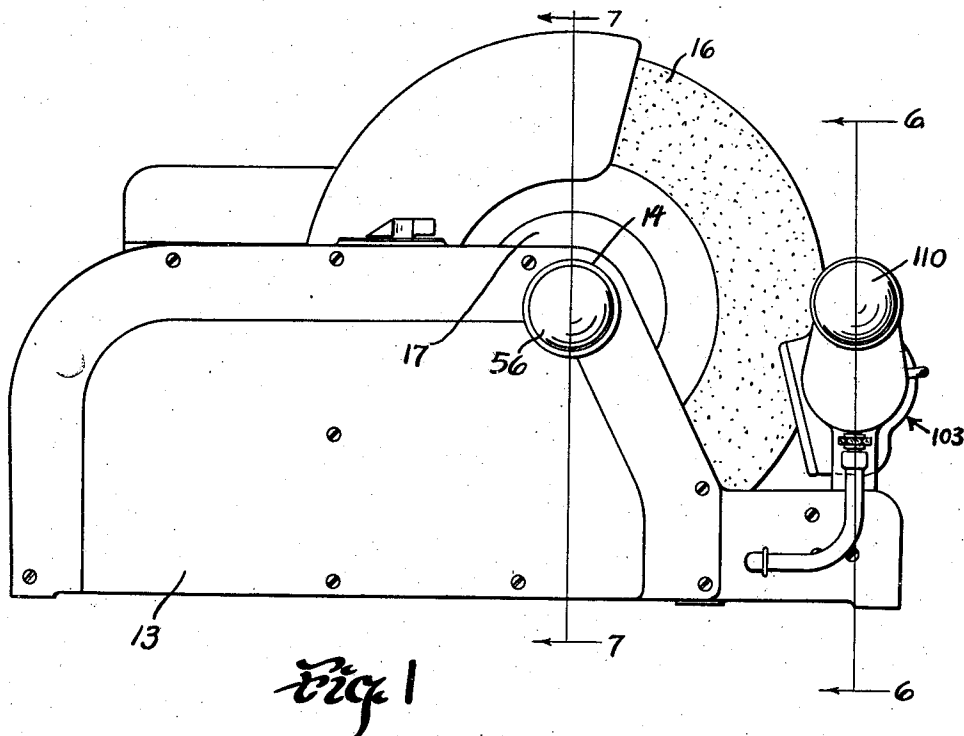


Fig 1

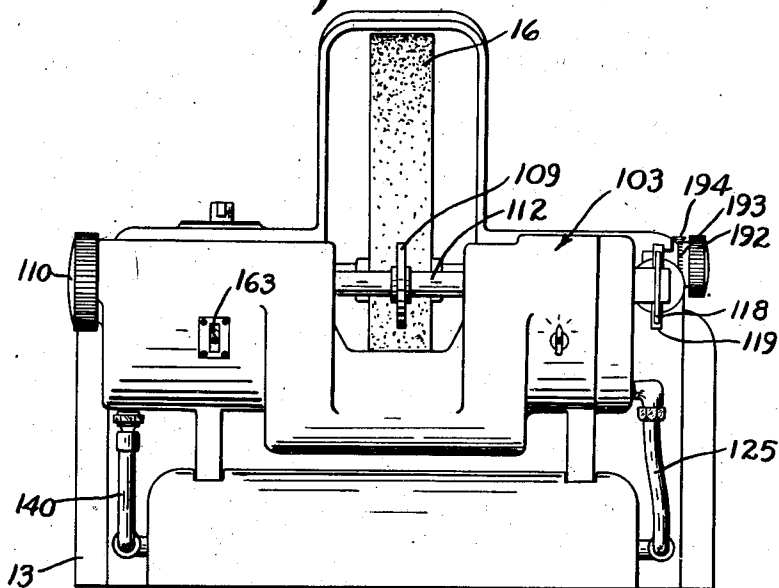


Fig 2

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7 Sheets-Sheet 2

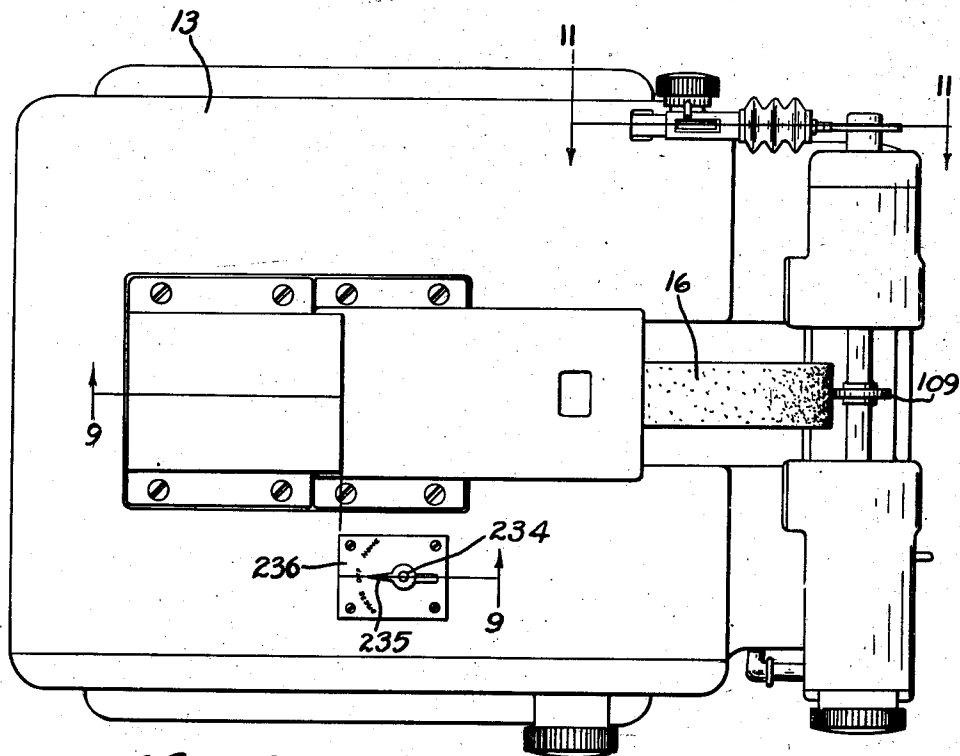


Fig 3

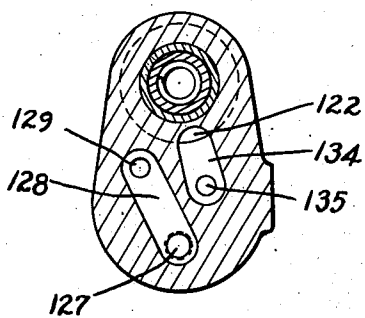


Fig 4

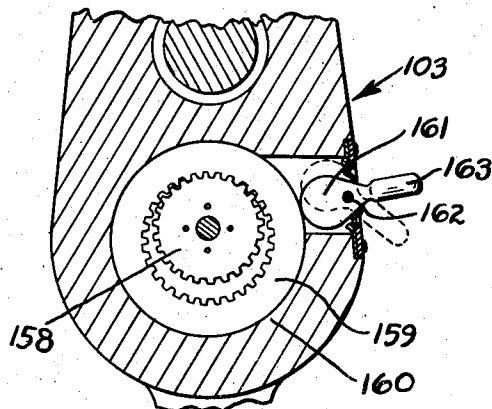


Fig 5

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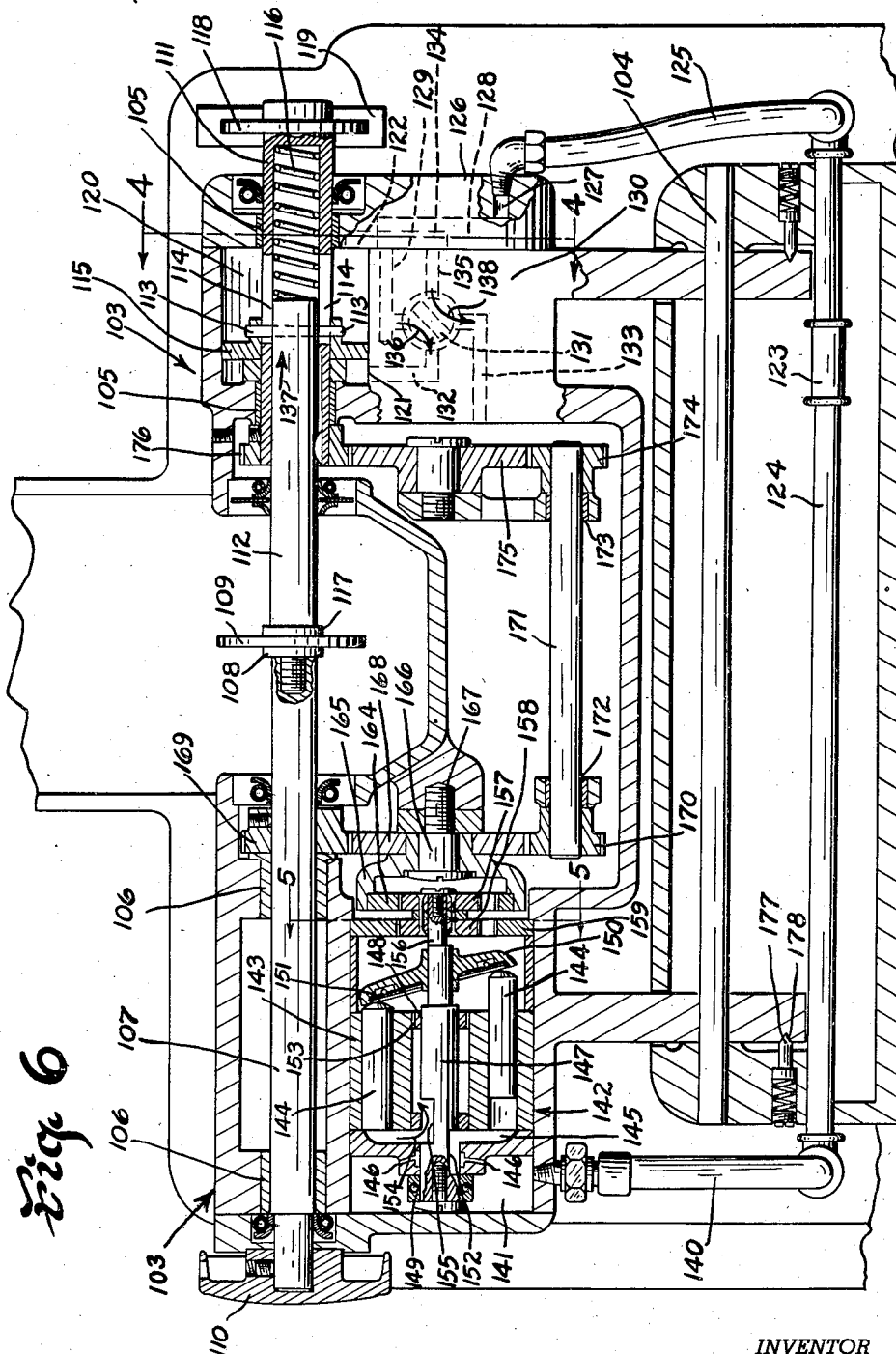
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EDGING MACHINE

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7 Sheets-Sheet 4

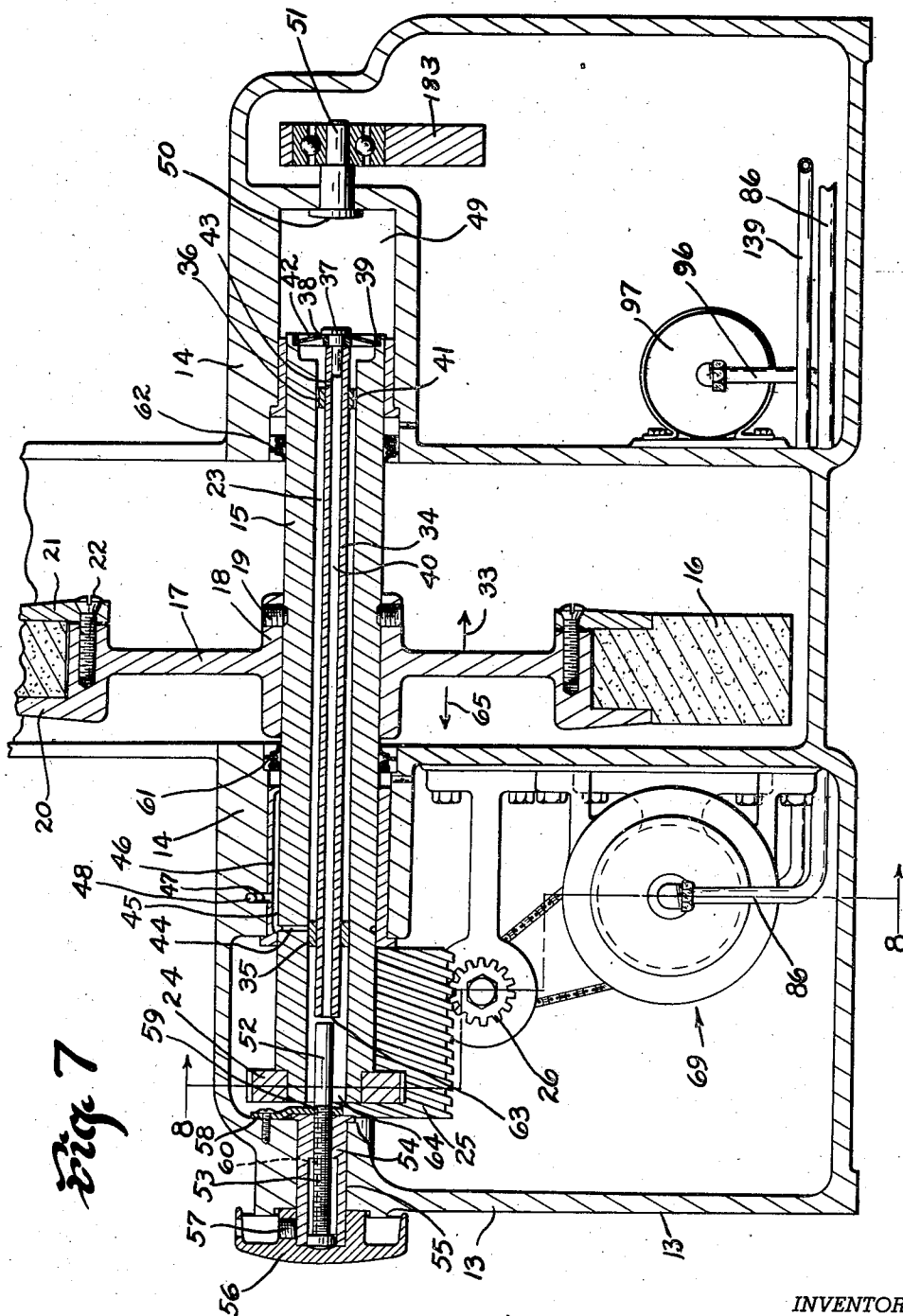


Fig. 7

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EDGING MACHINE

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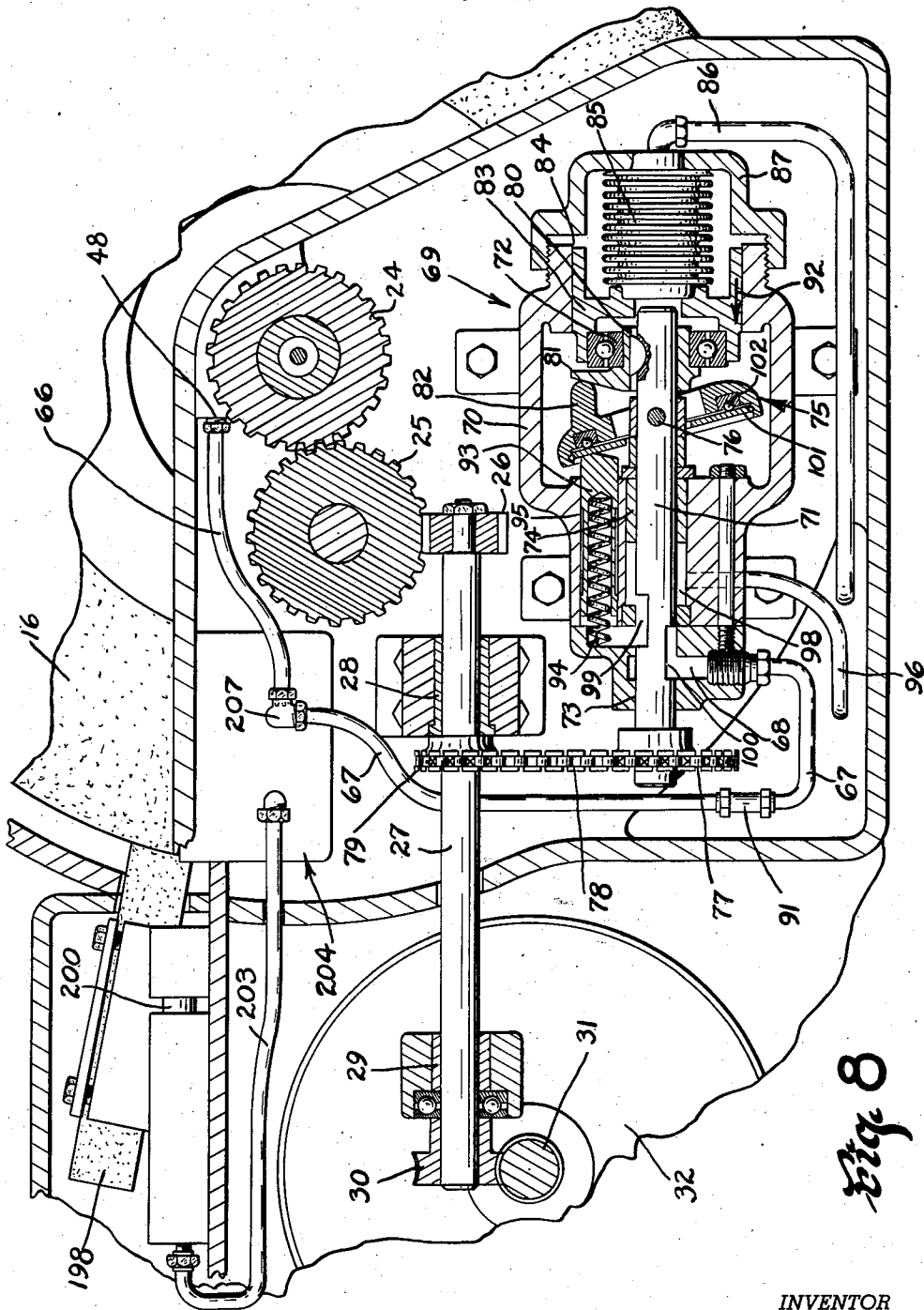


Fig. 8

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EDGING MACHINE

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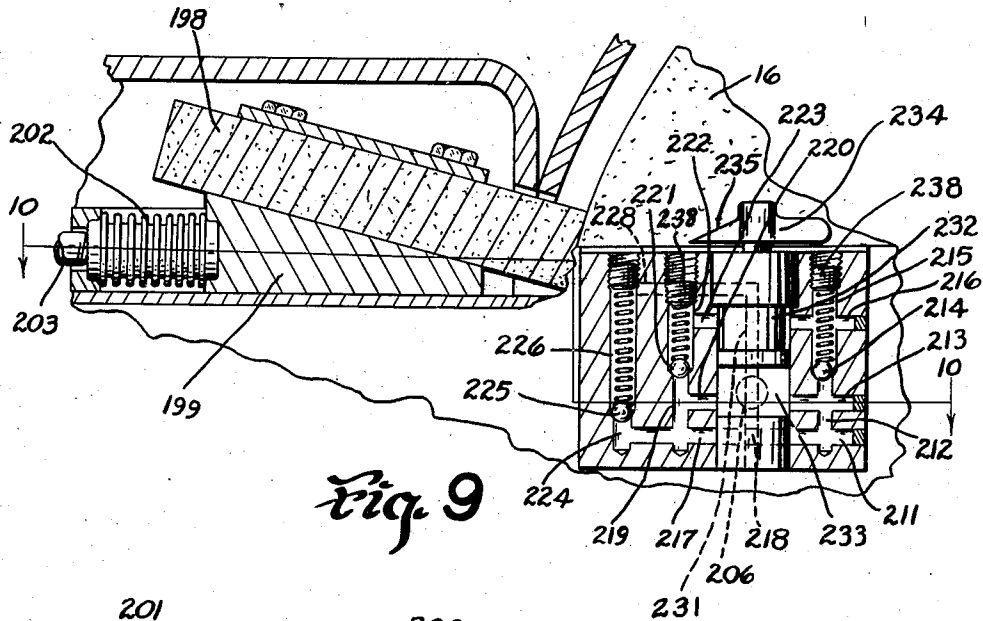


Fig. 9

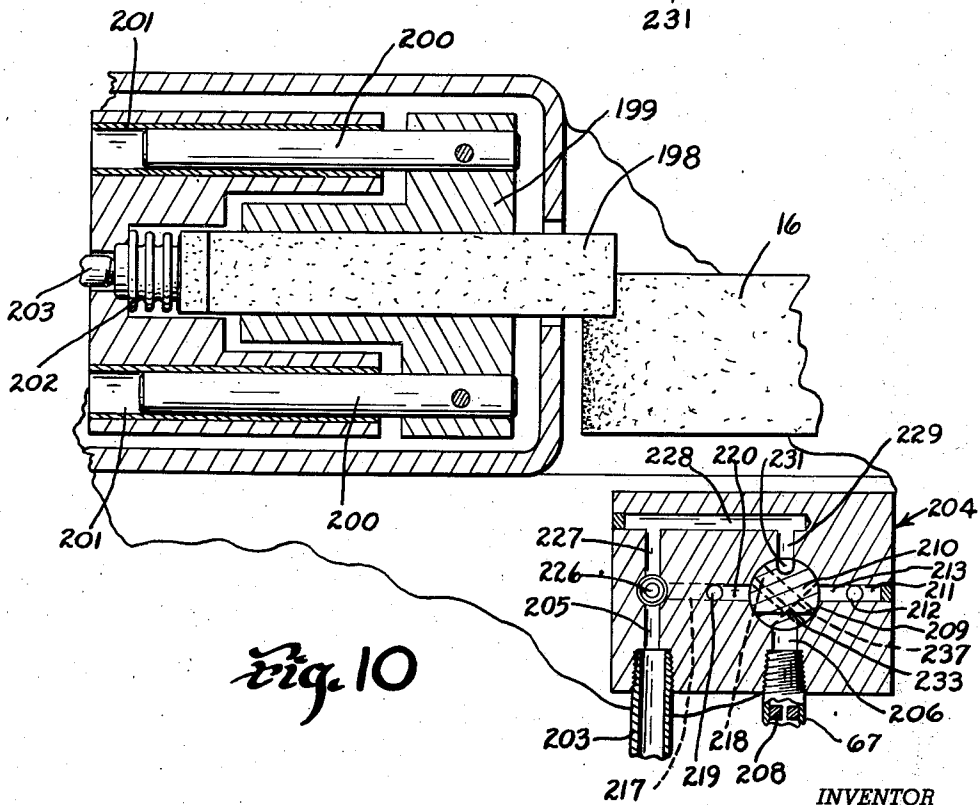


Fig. 10

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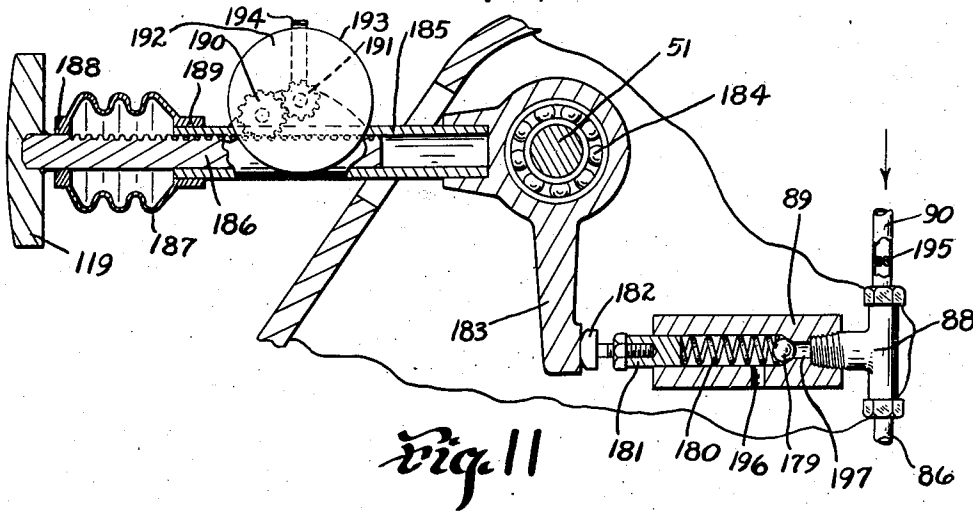
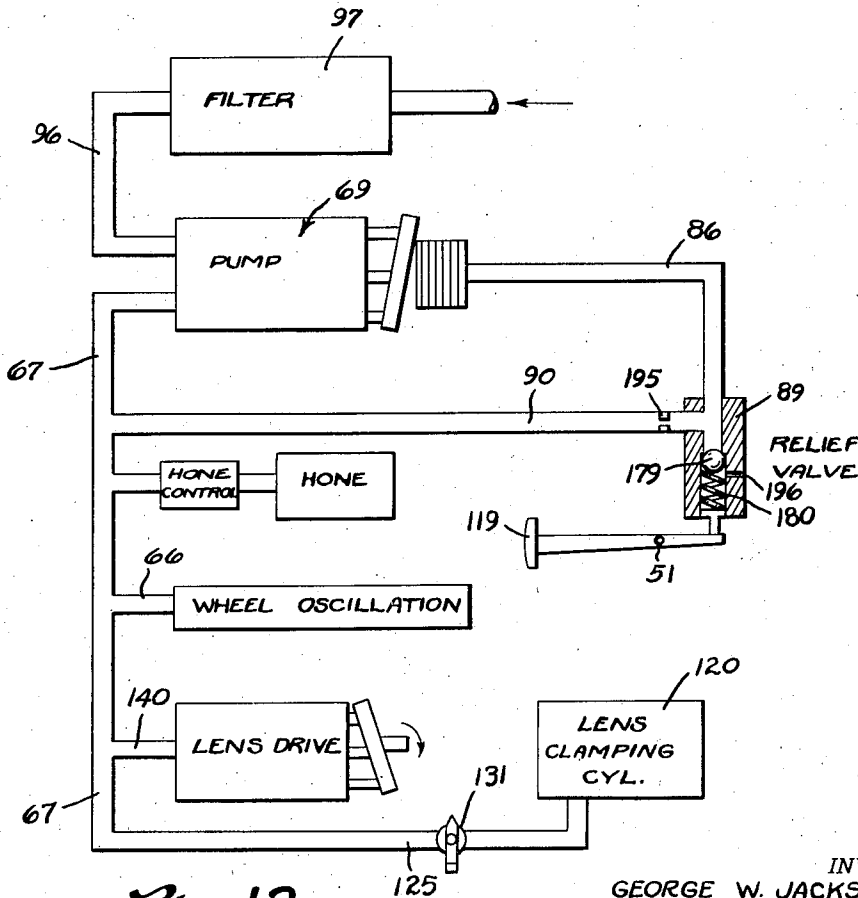
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EDGING MACHINE

Filed May 21, 1943

7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,406,606

EDGING MACHINE

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Application May 21, 1943, Serial No. 487,907

9 Claims. (Cl. 51—101)

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This invention relates to improvements in machines for edging articles to controlled contour shape and more particularly to machines of this character having automatically functioning parts and method of obtaining said functions.

One of the principal objects of the invention is to rotate an article relative to an abrading wheel for reducing the article to a given contour shape and size whereby the said article is reduced to the contour shape and size desired throughout substantially one complete cycle of movement of said article relative to the abrading wheel with said cycle of movement being hydraulically controlled.

Another object of the invention is to provide a device for edging articles to given contour shapes and sizes whereby the article may be hydraulically clamped into working position or released with the clamping device being rotatable with the article under hydraulic control as to its extent and speed of rotation relative to the abrading wheel for removing the required amount of material from the article and with the abrading wheel hydraulically oscillated in a direction transversely of the article with the extent of the transverse movement or oscillation of the abrading wheel being variable.

Another object is to provide hydraulically controlled holding means for a device of the character described.

Another object is to provide hydraulically operated means of the above character interconnected with an oil feed system having the oil pressure of said system controlled by a variable displacement pump.

Another object is to provide a hydraulically operated power unit for rotating the article at least throughout one complete cycle of movement and having associated therewith speed reduction means for transferring the power from said hydraulic power unit to the article.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings and it will be apparent that many changes may be made in the details of construction, arrangement of parts and methods shown and described without departing from the spirit of the invention as expressed in the accompanying claims. I, therefore, do not wish to be limited to the exact details of construction, arrangement of parts and methods shown and described as the preferred forms only have been given by way of illustration.

Referring to the drawings:

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Fig. 1 is a side elevation of the device embodying the invention;

Fig. 2 is a front elevational view of said device;

Fig. 3 is a plan view of said device;

Fig. 4 is a sectional view taken as on line 4—4 of Fig. 6 and looking in the direction indicated by the arrows;

Fig. 5 is a fragmentary sectional view taken as on line 5—5 of Fig. 6 and looking in the direction indicated by the arrows;

Fig. 6 is a sectional view taken as on line 6—6 of Fig. 1 through the operating head of the device;

Fig. 7 is a fragmentary sectional view taken as on line 7—7 of Fig. 1 through the stone oscillating mechanism of the device;

Fig. 8 is an enlarged fragmentary sectional view taken as on line 8—8 of Fig. 7 and looking in the direction indicated by the arrows;

Fig. 9 is an enlarged fragmentary sectional view taken as on line 9—9 of Fig. 3 and looking in the direction indicated by the arrows;

Fig. 10 is a sectional view taken as on line 10—10 of Fig. 9 and looking in the direction indicated by the arrows;

Fig. 11 is an enlarged fragmentary sectional view taken as on line 11—11 of Fig. 3 and looking in the direction indicated by the arrows; and

Fig. 12 is a schematic view illustrating the hydraulically operating system of the device.

Devices for reducing articles to given contour shapes and sizes are not new in the art, particularly, devices for reducing ophthalmic lenses to desired contour shape and size.

Many attempts have been made to provide devices for reducing a lens to a given contour shape and size through one complete cycle of movement of the lens relative to the abrading wheel but in most instances in the past such devices embodied mechanical or electrical means for accomplishing the desired results. Most prior art devices of this nature were of such character as to have relatively positively operating parts with no intermediate variable as to the function of said parts. In most instances, the control was mainly directed to means for completing the cycle of movement of the article relative to the abrading wheel with the article held in a fixed position until a given amount of material was removed therefrom whereby a contact was made, in the instance of electrically operated means, with a switch or a similar device which closed the circuit to a motor or electrically operated clutch which imparted a given rotary movement to the article. There is no intermediate variable

as to this operation and in most instances did not produce an article having the desired edge finish. The remaining parts of the device operated in a similar manner to other known devices. It, therefore, is one of the primary objects of this invention to overcome the above difficulties with such prior art devices through the provision of hydraulically operated means with intermediate controls for clamping the article in operating position, for rotating the article relative to the abrading wheel throughout one complete cycle of movement with intermediate controls for insuring the reduction of said article to proper contour shape and size and to proper edge finish, for controlling the surface shape of the stone during said edging operation and for imparting an oscillatory movement to the stone during said edging.

Referring more particularly to the drawings wherein like characters of reference designate like parts throughout the several views, the device embodying the invention comprises a base 13 having spaced bearings 14 in which the stone supporting shaft 15 is rotatably supported. The stone 16 is carried by a web 17 having a hub 18 secured to the shaft 15 by a set screw or the like 19. The web 17 is provided with an integral flange 20 on one side thereof which overlies one side surface of the stone 16 and with a clamp ring 21 secured to the web by screws or the like 22 for supporting the stone in operating position on said web.

The shaft 15 has a hollow bore 23 longitudinally thereof. The said shaft 15 is provided adjacent one end thereof with a spiral gear 24 meshing with a spiral gear 25, said spiral gear 25 is in turn connected with a spiral gear 26 carried by a stud shaft 27. The stud shaft 27 is supported within suitable spaced bearings 28 and 29. The stud shaft in turn is provided with a worm gear 30 in mesh with a worm 31 carried by the driven shaft of a suitable motor or the like 32.

The above provides the power for rotating the abrading wheel or stone 16 with the ratio of the said gearing being such as to give you the proper speed of rotation of the stone.

The spiral gear 25, which is set forth above as being driven by a spiral gear 26, meshing with the gear 24 for imparting a rotary movement to the shaft 15 is so designed that when the said gear 25 rotates, a rotary movement will be imparted to the gear 24 and simultaneous to said rotary movement a thrust action will take place causing said gear 24 to move in a direction longitudinally of the spiral gear 25 causing the shaft 15 and stone carried thereby to be moved in the direction indicated by the arrow 33. Internally of the hollow bore 23 of the shaft 15 there is a valve stem 34 supported by spaced bushing like members 35 and 36. The bushing 36 is secured in fixed position internally of the bore 23 and the bushing 35 is fixedly secured to the valve stem 34. The end 37 of the valve stem 34 opposed to the gear 24 is provided with a spring washer 38 secured throughout the periphery thereof as illustrated at 39 to the adjacent end of the shaft 15. The washer 38 is cupped and is adapted to have its cupping characteristics reversed by snapping to one side or the other of a plane extending through the peripheral edges thereof.

The valve stem 34 is provided with a hollow bore 40 with the connecting means 37 for securing the spring washer 38 to the stem func-

tioning as stopper means for closing one end of said bore.

The bushing 36 is preferably provided with a scalloped contour forming oil ports 41 between the inner wall of the bore 23 and said bushing. The spring 38 is preferably provided with a plurality of openings 42. The valve stem 34 is provided with an opening 43 communicating with the internal bore 40 of said stem and with the space between the stem and the bore 23 of the shaft 15. The shaft 15 is provided with an opening 44 communicating with the bore 23 and with a hollow chamber 45 internally of the bearing member 46. The bearing member 46 is connected through a port 47 with an oil line 48.

The bearing 14 has an oil chamber 49 internally thereof and is provided with stop means 50 internally thereof having a portion 51 extending outwardly of the bearing to which a part is pivotally attached as will be described later herein. The base 13 adjacent the end of the shaft 15 having the gear 24 thereon is provided with adjustable stop means 52 extending internally of the bore 23. The stop means 52 is provided with a threaded portion 53 threadedly supported within a sleeve 54. The sleeve 54 is rotatably supported in a bearing 55 formed in the base 13 and has a hand wheel 56 attached by a set screw or the like 57. A suitable key plate 58 secured internally of the base 13 and having a tongue 59 fitting within a longitudinal slot 60 in the stop member 52 is adapted to retain said stop member against rotation when the sleeve 54, which is threadedly connected with the stop member 52, is rotated through manipulation of the hand wheel 56. This provides means for varying the position of the stop means 52 in a direction longitudinally of the bore 23.

Suitable sealing members or the like 61 and 62 are provided in the respective bearings 14 which are adapted to prevent oil leakage from the bearings and to simultaneously prevent abrasive particles from entering the bearing.

The device set forth above is for imparting an oscillatory movement to the abrading wheel or stone 16. The function of said device is as follows:

It is first pointed out that the chamber 49 contains oil built up to a given pressure as will be hereinafter described more in detail. When the spiral gear 25 is rotated the gear 24 rotates. It is herein pointed out that the helix angle of the spiral gear 25 is such as to simultaneously urge the gear 24 in the direction of the arrow 33. This causes the shaft 15 and the stone carried thereby to be urged in said direction simultaneously to being rotated. As the shaft 15 moves in the direction of the arrow 33 the valve stem 34 is simultaneously moved in said direction. As the shaft 15 and stem 34 move in said direction, oil in the chamber 49 is forced through the perforations 42 through the port 43 into the hollow bore 40 of the stem. The said oil travels longitudinally of said stem and is exhausted from the end 63 thereof where upon the said oil will flow through the open end 64 of the bore 23 back down into the sump internally of the base 13. This permits the stone to be moved in the direction of the arrow 33. Movement is continued in said direction until the member 37 engages the stop means 50 whereupon pressure will be exerted on the end 37 of an amount sufficient to cause the spring 38 to be moved from its cupped position, as illustrated in Fig. 7, to a reversely cupped position. This causes a valve stem

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34 to be simultaneously moved in a longitudinal direction, relative to the shaft 15, by an amount equal to the reverse cupping of the spring 38. This movement of the valve stem 34 causes the port 43 to be moved to a position underlying the bushing 36 thereby closing said port. Simultaneously to this movement the bushing 35 carried by the valve stem 34 will be moved in the direction indicated by the arrow 65 by an amount sufficient to cause the port 44 to communicate with the bore 23 of the shaft 15. Oil forced under pressure through the inlet 48 and flowing through the port 47 into the chamber 45 will thereby travel through the port 44 into the hollow bore 23. The oil will then travel through the ports 41 formed in the periphery of the bushing 36 and will thereby travel through the openings 42 in the spring washer 38 and build up a pressure in the oil chamber 49 of an amount sufficient to overcome the thrust imparted to the gear 24 by the spiral gear 25 and thereby cause the shaft 15 to move in the direction of the arrows 65. Repeated operations of this nature impart oscillatory movement to the stone 16.

The oil inlet 48 is connected through a pipe line 66 to a pipe line 67 which, in turn, is connected with the exhaust chamber 68 of a variable displacement pump 69. The variable displacement pump comprises a housing 70 having a pump shaft 71 supported therein by suitable bearings 72, 73 and 74. The pump shaft 71 has a wobble plate 75 pivotally attached thereto at 76. The pump shaft 71 is provided with a sprocket 77 connected through a sprocket chain 78 to a sprocket 79 carried by the stud shaft 27. As the shaft 27 is rotated by the motor 32 the pump shaft 71 is simultaneously rotated. This causes the wobble plate 75 to be simultaneously rotated. Rotatably supported in the bearing 72 and keyed to the pump shaft 71 there is provided a sleeve 80 having a bearing projection 81 thereon adapted to contact an engagement member 82 carried by the wobble plate 75. The key connection of the sleeve 80 with the shaft 71 is such as to permit the bushing to be moved longitudinally of the shaft. It is to be understood that the bearing 72 also moves with said bushing; the bearing 72 being carried by a plunger 83 which is slidably supported in a bearing 84. The plunger 83, in turn, engages a bellows 85 which, in turn, is connected with an oil line 86. The bellows 85 is supported by a threaded cap 87 which is threadedly attached to the housing 70. The oil line 86 is connected with a T 88 see Fig. 11 which, in turn, is connected with a pressure relief valve 89 and a pipe line 90. The pipe line 90 is, in turn, connected through the T 91 to the main oil supply line see Fig. 8. It is to be understood that oil is forced under pressure through the supply line into the pipe line 90 and, in turn, through the oil line 86. This causes a pressure to be built up in the bellows 85. As the pressure is built up internally of the bellows 85 the said bellows will expand and simultaneously move the plunger 83, bearing 72 and bushing 80 in the direction indicated by the arrow 92. This causes the wobble plate 75 to be tilted about its pivot 76. The amount of said pivot being controlled by the amount of pressure which is permitted to be built up internally of the bellows 85.

Internally of the housing 70 there is slidably supported a plurality of pistons 93 having contact with the wobble plate by spring means 94. The plurality of pistons 93 may be three or more in number and are disposed at given meridional

positions in spaced relation with each other about the axis of the pump shaft 71. As the wobble plate 75 is rotated the said wobble plate will cause said pistons 93 to be reciprocated in their cylinders 95. Oil is fed internally of the housing 70 by means of an intake pipe line 96 which is connected with a suitable filter 97, as shown in Fig. 7. The oil is merely fed from the sump through the filter 97, into the pipe line 96 and, in turn, inwardly of the housing 70 of the variable displacement pump 69. The oil from the pipe line 96 flows inwardly of a chamber 98, as the respective pistons 93 are reciprocated by the wobble plate 75, whereby oil will be drawn inwardly of the pipe line 96 into the chamber 98. This takes place when the respective valve ports 99 are in communicating relation with the oil chamber 98 and the respective cylinders 95. Continued rotation of the shaft 71 will cause the valve port 100 formed in said shaft adjacent the valve port 99 to communicate with the exhaust chamber 68 whereupon compression of the respective piston 93 whose port is in communication with the exhaust chamber 68 will cause the oil to be forced outwardly of the cylinder through the supply line 67. This causes a pressure to be built up through said supply line into the parts connected with said supply line, the only part so far described is the stone reciprocating mechanism.

The wobble plate 75 is provided with a bearing plate 101 supported by the balls 102 whereby the wobble plate 75 is rotated relative to the plate 101 which, in turn, has a bearing contact with the respective pistons 93. The reciprocating pistons 93 function as pump means for building up a pressure in the line 67.

As shown in Figs. 1, 2 and 6, there is pivotally attached to the base 13 a work supporting head 103. The work supporting head is pivotally supported by the pivot bar 104 as best illustrated in Fig. 6. The head 103 is provided with spaced bearings 105 and 106. The bearings 106 rotatably support a shaft 107 having a bearing pad 108 adjacent one end thereof for engaging the work 109 and a hand wheel 110 adjacent the opposed end thereof by which the said shaft may be manually rotated. The bearings 105 support a tubular shaft 111 in which is slidably supported a clamp spindle 112. The clamp spindle 112 is provided with a key pin 113 which extends through diametrically opposed longitudinal slots 114 formed in the hollow shaft 111. The key pin 113 is also adapted to secure a piston 115 to said hollow shaft. Internally of the hollow shaft there is provided a coil spring 116 which is adapted to normally urge the spindle 112 in a direction outwardly of said hollow shaft. The said clamp spindle 112 is provided with a bearing pad 117 adapted to engage the side of the work 109 opposite the bearing pad 108. The hollow shaft 111 on its end opposed to the clamp spindle 112 is provided with a suitable former 118. The former 118 is adapted to contact a former shoe 119 in a manner similar to other prior art devices and is the means for controlling the contour shape to which the article is edged. The work supporting head 103, between the spaced bearings 105, is provided with an oil chamber 120 in which the piston 115 is adapted to reciprocate. The oil chamber 120 has openings 121 and 122 on the opposed sides of the piston 115. Oil coming from the main variable displacement supply pump 69 through the feed line 67 is directed to the T 91. The T 91 is connected by a pipe line 139, as illus-

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trated in Fig. 7 to the T 123, see Fig. 6. The T 123 is connected to the pipe line 124 which, in turn, is connected to a flexible hose line 125 which is, in turn, attached to a casing 126. The casing 126 has a port 127 leading into an open chamber 128. This chamber communicates with a passageway 129 formed in the side portion 130 of the head 103. The passageway 129 communicates with a valve member 131 rotatably supported in said portion 130. There is also communicating with said valve member a passageway 132 connected with the opening 121 leading into the oil chamber 120. The valve member also communicates with a passageway 133. The member 126 also has an additional oil chamber 134 therein spaced from the chamber 128. This chamber communicates with the opening 122 adjacent the upper end thereof as illustrated best in Fig. 4 and communicates with a passageway 135 leading into the valve 131. Oil forced under pressure through the hose line 125, into the chamber 128, when the parts are in the position as illustrated in Fig. 6, will be directed through the passageway 129 into the valve 131 and, as indicated by the arrow 136, will be directed through said valve member into the passageway 132 and thereby flow into the oil chamber 120 through the opening 121. This will cause a pressure to be built up in said chamber between the adjacent wall and the piston 115 forcing said piston in the direction indicated by the arrow 137. Due to the fact that the piston is attached to the clamp spindle 122 it will force said clamp spindle against the compression of the spring 116 in the direction of said arrow 137 thereby releasing pressure of the pad 117 on the work 109. Simultaneous to this function, oil on the opposite side of the plunger 115 will flow through the opening 122, through the small chamber 134, outwardly through the valve 131, as illustrated by the arrow 138 through the exhaust line 133. This, therefore, relieves the pressure on the side of the piston 115 opposed to that being built up through the opening 121. When the valve is rotated throughout substantially a 90° cycle of movement the oil will flow through the passageway 129, through the valve 135, into the smaller of the oil chambers 134 and from said oil chamber through the opening 122 into the oil chamber 120 and cause the pressure to be built up on that side of the piston 115. When this function takes place the line 132 functions as the exhaust line whereby the oil pressure will be relieved by the flow of the oil through the opening 121, through the line 132, valve 131 and outwardly through the exhaust 133. This provides hydraulic means for clamping or releasing the work between the pads 109 and 117. It is to be understood that the tension of the spring 116 is such that it can be easily compressed through the building up of the pressure in the oil chamber 120 through the opening 121 and is adapted to normally retain the work in clamped relation between the bearing pads when no oil pressure is built up in said chamber 120. On the opposed side of the head, the pipe line 124 is connected through a hose line 140 to an oil chamber 141 formed in said head. The oil chamber 141 contains an oil operated motor 142. This motor comprises a block 143 in which is supported a plurality of longitudinally movable plungers 144. The plungers communicate with an oil chamber 145 which, in turn, communicates with the chamber 141 through the ports 146. Centrally of the block 143 there is a rotatable shaft 147 supported by spaced bearings 148 and

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149. The shaft 147 has rigidly attached thereto a plate 150 disposed at a given angle and adapted to be engaged by the respective plungers 144. This plate 150 has a face plate 151 carried thereby adapted to be immediately engaged by the plungers 144 so as to permit rotation of the plate 150 independently of rotation of the plate 151. The shaft 147 has a valve port 152 formed therein which, upon rotation of the shaft 147, is adapted to cause oil in the chamber 141 to be directed through the respective ports 146 and oil passageways 145 progressively and successively as the said shaft 147 is rotated. Simultaneously to this function an additional valve port 155, formed on the side of the shaft 147 opposed to the valve port 152 and in slightly staggered relation therewith, is provided for successively and progressively causing the plungers 144 to be compressed in communicating relation with suitable exhaust openings 153 formed in the periphery of the bearing 148 whereby oil will flow from the plunger cylinders through said exhaust openings 153 as indicated by the arrow 154.

As shown in Fig. 6, oil entering the line 140 will pass through the lower port 146, through the chamber 145 and will build up and exert a pressure on the lower plunger 144. This will cause said plunger to exert a pressure on the face plate 151 which, due to the particular angle of said face plate, will cause the plate 150 to be rotated. This causes the shaft 147 to be rotated and due to the provision of a plurality of said plungers 144 will cause successive plungers to be compressed and others to be exhausted and thereby provide a power drive for rotating the shaft 147.

As shown in Fig. 6, the angle of the plate 150 is 90° out of phase with the actual position at which it will be related with the valve ports 152 and 155, in order to be diagrammatically illustrated. In actual practice, the angle of the plate 150, relative to the valve ports 152 and 155 will be rotated approximately 90° from said illustrated position. The shaft 147 is provided with an eccentric protrusion 156 on which a pair of adjacent gears 157 and 158 are rotatably supported. The gear 158 meshes with an internal gear 159 which normally is free to rotate within the bearing 160, see Fig. 5, formed in the head 103. The head 103 adjacent the internal gear 159 is provided with a locking cam 161, pivotally supported at 162, having an external manually operable portion 163 by which the cam 161 may be moved to exert a binding pressure on the periphery of the internal gear 159. This cam member 161 thereby locks the gear 159 against rotation or will release said gear for rotation, as desired. The gear 157 meshes with an adjacent internal gear 164, see Fig. 6, which is rigidly supported in a hub 165 rotatably carried by the stud 166. The stud 166 is threadedly connected, as illustrated at 167, to the main frame of the head 103. Mounted on said hub 165 there is a gear 168 which meshes with a gear 169 carried by the shaft 107.

The gear 157 has one tooth more than the gear 158 and the internal gear 165 has one tooth more than the internal gear 159. The purpose of this arrangement is to provide a speed reduction as to the rotation of the shaft 107. This causes the shaft 147 to rotate approximately 1000 to 1 revolutions of the gear 164 thereby causing said gear 164, through the gears 168 and 169, to impart the desired speed of rotation to the shaft 107.

The gear 168 has a gear 170 meshing therewith. The gear 170 is carried by a stud shaft 171

rotatably supported in spaced bearings 172 and 173 formed in a part carried by the head. Adjacent the opposed end of said shaft 171 there is supported a gear 174. This meshes with an idler gear 175 which, in turn, meshes with the gear 176 which is, in turn, carried by the hollow shaft 111. This causes the hollow shaft 111 to be rotated simultaneous to the shaft 107 and through the lock pin 113 imparts a simultaneous rotation to the clamp 112. Due to the fact, that the former 118 is carried by the shaft 111, the said former is simultaneously rotated. When it is desired to impart a rotary movement to the gear 164, the gear 159 is clamped against rotation by the cam member 161. If it is desired to check the rotation of the gear 164 and thereby stop rotation of the shaft 107 the gear 159 is released by the cam member 161 whereupon it is free to rotate and thereby prevent the gear 164 from rotating. When the gear 159 is released by the cam member 161 the said shaft 107 may be rotated by the manually operable means 110. This permits the article 109 to be rotated for gauge purposes. Suitable resiliently urged stop members 177 are provided for engaging indentures 178 formed in the lower extremities of the pivoted portions of the head to limit the outward movement of the head in a direction away from the abrading wheel.

Referring to Fig. 11, the oil line 90 is connected with the T 91, as illustrated in Fig. 8, as previously described above, which receives its flow of oil under pressure from a variable displacement pump 69. It has been previously described that the oil forced through the line 90 passes through the pipe line 86 to the bellows 85, as illustrated in Fig. 8. The T 88 also connects said pipe line 90 to a relief valve 89 having a ball valve member 179 internally thereof. The ball member is urged into closed position by means of a coil spring 180. The spring is compressed by a plunger 181 slidably supported in the member 89. The plunger 181 is provided with a contact 182 adapted to engage a bell crank 183. The bell crank 183 is pivotally supported by the stud 51, see Fig. 7. For ease of operation, the member 183 is connected through a ball bearing 184 to said stud. The bell crank 183 is provided with a hollow arm 185 in which is slidably supported a rack member 186 carrying adjacent its outer end the former 119. In order to permit the rack to be moved longitudinally of the hollow arm 185 and to seal said arm against the entry of dirt, dust and so forth, outwardly of the hollow member there is provided a bellows 187 having a sealed connection 188 with the rack member and a sealed connection 189 with the hollow arm 185. The rack 186 meshes with an idler gear 190 which, in turn, meshes with a gear 191 carried by a manually rotatable member 192. The rotatable member 192 is calibrated on the face 193 thereof and said calibration is registered with a suitable pointer 194 which, through rotation of the member 192, causes the rack 186 to be adjusted inwardly or outwardly of the hollow arm 185. This adjustment is to move the former contact shoe 119 rearwardly or forwardly with respect to the plane of the portion of the abrading wheel which is engaged by the article to be edged and provides means for controlling the size to which the article is to be edged. It is quite apparent that as the former contact shoe 119 is adjusted rearwardly more of the material of the article will be removed from the contour thereof and

the size of the article will be accordingly controlled. Internally of the pipe line 90 there is provided a disc 195 having a restricted opening therein. This disc 195 is to retard the speed of flow of the oil through the line 90 leading into the pipe line 86 and valve member 89 and it is primarily for the purpose of avoiding an excessive flow of oil through the valve. The valve member, in addition to the ball valve member 179, is provided with an exhaust opening 196 which, if oil is forced through the port 197 at a pressure sufficient to force the ball rearwardly and to allow oil to flow through said port 197, the said oil will then be exhausted through the exhaust port 196 and thereby regulate the pressure of the oil through the line 86. The line 86, as shown in Fig. 8, is connected with the bellows 85 and is for the purpose of regulating the pressure in said bellows 85. This pressure is varied by the mechanism illustrated in Fig. 11 and functions substantially as follows:

As the article 109 is being rotated in engagement with the abrading wheel and the material is being removed from the contour of said article the former 118 is initially held out of engagement with the contact shoe 119. This is due to the fact that the article 109, of course, is initially larger in diameter than the finished size desired. At this stage the article 109 rotates very slowly and remains in a substantially fixed position relative to the stone until a sufficient amount of the engaged edge of the article 109 is removed to permit the former 118 to engage the contact shoe 119. Continued removal of the material of the article 109 causes a pressure to be exerted on the former shoe 119 through engagement of the former shoe 118 therewith. This pressure, through frictional contact of the former 118 with the contact 119, causes the bell crank 183 to be tilted about its pivot 51. Through the engagement of the bell crank 183, through the contact 182, this tilting movement will impart a pressure on said contact and will cause the plunger 181 to, in turn, impart a pressure on the coil spring 180. The coil spring 180 will, in turn, increase the pressure on the ball valve 179 and resist the incoming pressure of the oil by an amount determined by the extent of rocking movement of the bell crank 183. This increased pressure on the ball valve 179 thereby causes the oil which would normally flow through the port 197 outwardly of the exhaust port 196 to be directed through the oil line 86 to the bellows 85. As the pressure is increased in the bellows 85, the said bellows will be accordingly caused to expand and in turn force the plunger member 83 in the direction of the arrow 92. The extent of said movement of the plunger 83 depends upon the amount of pressure built up in the bellows 85. Movement of the plunger 83 in said direction will cause the bearing member 81 to rock the wobble plate 75 an amount equal to the extent of the movement of the plunger 83. This tilting of the wobble plate 75 will cause an increased stroke of the respective pistons 93 and will increase the speed of flow or pumping of the oil through the port 68 of the pipe line 67. The pipe line 67 is connected with the T 91 which, in turn, is connected through a pipe line, not shown, to the T 123 and will thereby direct said pumped oil from the line 67 to the pipe line 124 and from said pipe line 124 to the resilient flexible hose line 140 and to the oil chamber 141 thereby accordingly increasing the pressure in said chamber 141 and, in turn, increasing

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the pressure on the respective plungers 144 which are operated by said oil as previously set forth above. This causes the speed of rotation of the shaft 147 to be increased, with the amount of increase depending upon the extent of increase of stroke of the pistons 93 of the pump member 69. This, therefore, causes the speed of rotation of the article 109 to be increased and will more rapidly bring a new and progressive portion of the edge of the article to the abrading wheel for removal. Keeping in mind that the article initially is of a greater size than that desired of the finished article, this will cause the newly presented portion of said article to the abrading wheel to again lift the former 118 away from the contact shoe 119, thereby relieving pressure on the coil spring 180 whereby the inherent resiliency of the coil spring will return the bell crank to its initial position. This, of course, relieves pressure on the ball 179 and permits the pressure built up in the line 86 to be relieved whereby oil will flow outwardly through the port 197 and the exhaust port 196 and function as bleeder means for said line 86. This will reduce the pressure in the line 86 and, in turn, reduce the pressure in the bellows 85 and reduce the stroke of the pistons 93. As the material of the article 109 is reduced by abrading and the former 118 is again permitted to engage the contact shoe 119, a repetitive operation will be performed, which operation, slows down the rotation of the article during the initial abrading and speeds up the rotation of the article when reduced substantially to its final size. At no time during this operation does the article 109 completely stop but through the use of the gearings 157, 158, 159 and 164 respectively, the speed of rotation will be reduced to such a state where there is an effective substantial stopping of rotation of the article 109 when a high spot on said article is being removed by the abrading wheel.

With the above arrangement there will be no abrupt change in the speed of rotation of the article but there will be a smooth rhythmic increasing of speed of rotation as the material of the lens is continually being removed by the abrading wheel. If, however, there is a hard spot in the article which is not removed as quickly as the other portions of the edge of the article there will be a relatively abrupt change or decreasing of the speed of rotation of the article through the mechanism described above, but under ordinary circumstances the change of speed resulting through the above described mechanism will be relatively smooth in function resulting in the contour edge of the article having a relative continuous and smooth edge finish. If the article is to be reduced in size considerably and the speed of removal of the edge of the article is relatively slow the said article may move throughout more than one complete cycle of movement but the speed of rotation of the article will be relatively slow during said movement and in most instances will permit the article to be reduced to size in substantially one complete cycle of movement. The function, however, of the device is such that when the article is progressively reduced to size the speed of rotation of the article will synchronously be increased.

The oil which is exhausted through the several exhaust ports mentioned above will flow downwardly under the action of gravity into the sump in the base of the machine and will be drawn

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through the filter 97 before returning to the variable displacement pump 69.

It is to be understood that during the rotation of the work 109, as set forth above, the stone or abrading wheel 16 is oscillated by the mechanism shown in Fig. 7 and which has been previously described above. As shown in Figs. 8, 9 and 10, during the oscillation of the abrading wheel 16, there is in constant engagement with said abrading wheel a truing tool 198. The truing tool or hone 198 is carried by a block 199 having a pair of bar members 200 attached thereto. The bar members 200 are slidably supported in suitable slideways 201 carried by the base of the machine. The block 199 is engaged by a bellows 202 connected through the pipe line 203 to a hone control valve 204. The hone control valve comprises a passageway 205 to which the pipe line 203 is directly connected. The said hone control valve has an inlet port 206 to which the pipe line 67 is connected by means of a suitable three-way fitting 207, as illustrated in Fig. 8. A disc 208 having a restricted orifice therein is positioned in the pipe line 67 adjacent the hone control valve 204 to regulate the flow of oil inwardly of said valve. The inlet port 206 communicates with a valve bore 209 in which the valve stem 210 is rotatably supported. Internally of the hone control valve, there is provided a network of passageways interconnected with each other and with the valve bore 209. This is best seen in Figs. 9 and 10 and comprises a passageway 211 communicating with the valve bore and connected by a passageway 212 to another passageway 213 also communicating with the valve bore 209. The passageway 212 extends transversely from the passageway 211 through the passageway 213 and communicates with a ball valve 214 mounted in a passageway 215 communicating with an additional passageway 216 also communicating with the valve bore. Opposed to the passageway 211 there is provided a passageway 217 which is adapted to communicate with the passageway 211 through an opening 218 when said opening 218 is aligned with said respective passageways 211 and 217. The passageway 217 communicates with a passageway 219 which, in turn, communicates with a passageway 220 leading into the valve bore 209 and also communicating with a spring pressed ball valve 221 supported in a passageway 222 communicating with a transversely extending passageway 223 which also communicates with the valve bore 209. The passageway 217, in addition to communicating with the passageway 219, also communicates with an additional passageway 224 which, in turn, communicates with an additional spring pressed ball valve member 225 mounted in a passageway 225. The passageway 226 communicates with a substantially normally disposed passageway 227 which, in turn, communicates with a passageway 228 communicating with a passageway 229 leading to the valve bore 209. The valve stem 210 is provided with a longitudinally disposed groove 231 formed in the side of the valve stem 210 and adapted to communicate with the passageway 229 in one position of adjustment with the said longitudinal slot 231 extending from said point of communication with the passageway 229 downwardly throughout the length of the valve stem to provide drainage means. The valve stem 210 in substantial alignment with the passageways 223 and 216 is reduced in diameter to provide a clearance 232 communicating with the longitudinal

slot 231 whereby oil may drain from said passageways 216 and 223 into the passageway 231. The valve stem 210 is provided with a flattened side area 233 intermediate its ends adapted to bring about selective communication between the main port 206 and the respective passageways 213 and 220. The main valve stem is provided with an eccentrically operated knob 234 having a pointer portion 235 communicating with a plate 236 having suitable indications thereon indicating the off, dress and hone position of adjustment of the hone operating mechanism.

Oil is forced through the line 67 into the passageway 206. As shown in Fig. 10, the valve stem 210 is in off position. If the face 233 is rotated to the position indicated by the dash lines 237 the oil passing through the port 206 will flow into the passageway 213, down through the communicating passageway 212, into the passageway 211 and through the transversely extending opening 218 in the valve stem 210 which in this position of adjustment is aligned with the respective passageways 211 and 217. This thereby permits the oil to flow into the respective passageways 219, 220 and 224. The pressure on the ball 221 is so controlled as to be greater than on the ball 225 whereby the oil entering the respective passageways 217, 220 and 224 will first open the ball valve 225 and will flow into the chamber 226 which, in turn, communicates with the passageways 205 and 227. Since the longitudinal groove 231 in the valve member 210, when said valve member is rotated to communicate the port 206 with the passageway 213, is out of alignment with the passageway 229 no flow of oil will be permitted through said longitudinal groove 231 and the adjacent side wall of the valve stem will close the opening 229 against the flow of oil therethrough. Oil therefore will not flow through the passageway 227 and will be permitted only to flow outwardly of the passageway 205 through the pipe 203 to the bellows 202. This exerts a relatively low pressure on the stone truing tool 198. This is brought about by reason of the fact that as the pressure is built up in the bellows 202, through the flow of oil through the pipe line 203 there will be a simultaneous building up of pressure of oil in the various passageways 211 and 212 which communicate with the ball valve 214. The ball valve 214 is so controlled by the coil spring pressure imparted thereon as to open when a predetermined pressure of the oil is reached in said passageways and will thereby allow the ball valve 214 to open to permit oil to flow into the chamber 215 and from said chamber outwardly of the passageway 216 into the clearance space 232 and to be exhausted from said clearance space into the longitudinal slot 231. This provides means for controlling the extent of pressure on the stone truing tool 198 when the valve stem is adjusted to said above described position. The indicator 235 is now in the dress position. When it is desired to hone or true the stone or abrading wheel 16 the face 233 of the valve stem is moved to a position whereby the port 206 will communicate with the port 220. This causes the transversely extending opening 218 in the valve stem to be moved out of communicating relation with the passageways 211 and 217 and thereby out of communicating relation with the low pressure valve 214. This also moves the longitudinal groove 231 out of alignment with the passageway 229 with the solid wall of the valve stem 210 again functioning to close said passageway 229. Oil, therefore, will flow inwardly of the port 206 into the

passageway 220 and will be directed from passageway 220 into the passageway 219 and into the respective passageways 217 and 224. Keeping in mind, therefore, that the pressure on the ball valve 221 is much greater than on the ball valve 225 the pressure of the oil will cause the ball valve 225 to again open and cause oil to flow along the passageway 226 through the pipe line 203 and into the bellows 202. It is to be noted that the ball valve 221 now comes into play and is designed to resist a greater pressure than the ball valve 214 and thereby permits a greater pressure to be built up in the pipe line 203 and into the bellows 202 and will permit a greater pressure to be imparted on the truing tool 198 and to thereby remove and more positively true the face of the abrading wheel 16. The resisting pressure of the valve member 221 is so controlled that when the proper amount of pressure is built up in the bellows 202, to properly hone the abrading wheel, pressure beyond that amount will cause the ball valve 221 to open permitting the oil to flow through the passageway 222, into the passageway 223 and from said passageway 223 into the spaced area 232 communicating with the longitudinal groove 231 and thereby flow outwardly thereof. This might be termed an oil bleeding process by which the pressure in the pipe line 203 may be controlled at the different positions of adjustment of the valve stem 210 set forth above.

It is to be noted that the spring pressure on the resilient means engaging the ball valves 214 and 221 respectively have to be controlled quite carefully in order to permit said bleeding to take place with the proper and desired honing operations. The pressure on the springs for the respective ball valves may be varied by adjustment of the various nut-like members 238 whereby the suitable function of said valve members may be obtained. It is to be noted that the pressure is substantially continuous on the stone truing device 198 either when in dressing or honing position and the ball valve 225 functions to prevent backward flow of oil from the bellows during the dressing or honing operation. This provides means for more positively controlling the contour shape of the abrading wheel 16.

When the indicator 235 is set to off position the face 233 of the valve stem 210 will be in a position such as indicated in full line in Fig. 10. This will shunt the flow of oil through the feed line 67. The longitudinal slot 231 will now be aligned with the passageways 229, 228 and 227 communicating with opening 226 and pipe line 203. This will allow the oil pressure built up in the bellows 202 to be relieved.

From the foregoing description it will be seen that hydraulically controlled means are provided for oscillating the abrading wheel 16, for imparting a rotary movement to the work 109 under variable speeds according to the above description, for hydraulically clamping or releasing the work between the clamp pads 108 and 117 and for hydraulically controlling the stone truing tool 198.

Having described my invention, I claim:

1. In a lens edging machine the combination of a base having spaced bearings, a hollow shaft rotatably supported in said bearings, an abrading wheel attached to the shaft and a head pivotally attached to the base for supporting a lens for movement toward and away from the abrading wheel, said hollow shaft having a valve stem slidably supported internally thereof, spring washerlike means secured to said valve stem and to the adjacent end of the hollow shaft for con-

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trolling the position of adjustment of the valve stem longitudinally of the hollow bore of the shaft, said shaft having a gear member adjacent its end opposed to the spring washerlike means meshing with a rotating spiral gear, said bearing means adjacent the spring washerlike means having an oil chamber therein, means for feeding oil through the hollow shaft into the oil chamber for building up an oil pressure in said oil chamber of an amount sufficient to cause the hollow shaft and abrading wheel to move in one direction with said spiral gear being adapted to continuously tend to urge the hollow shaft and abrading wheel in the opposite direction.

2. In a lens edging machine the combination of a base having spaced bearings, a hollow shaft rotatably supported in said bearings, an abrading wheel attached to the shaft and a head pivotally attached to the base for supporting a lens for movement toward and away from the abrading wheel, said hollow shaft having a valve stem slidably supported internally thereof, spring washerlike means secured to said valve stem and to the adjacent end of the hollow shaft for controlling the position of adjustment of the valve stem longitudinally of the hollow bore of the shaft, said shaft having a gear member adjacent its end opposed to the spring washerlike means meshing with a rotating spiral gear, said bearing means adjacent the spring washerlike means having an oil chamber therein, means for feeding oil through the hollow shaft into the oil chamber for building up an oil pressure in said oil chamber of an amount sufficient to cause the hollow shaft and abrading wheel to move in one direction with said spiral gear being adapted to continuously tend to urge the hollow shaft and abrading wheel in the opposite direction and means for automatically relieving the pressure in the oil chamber at a given position of movement of the hollow shaft and abrading wheel against the action of the spiral gear whereby the spiral gear will urge the hollow shaft and abrading wheel in the opposite direction to a given position whereby the oil pressure will again build up in the oil chamber.

3. In a device of the character described the combination of a rotatably supported abrading wheel, a work supporting head mounted for movement toward and away from the abrading wheel, means on said head for supporting workholder spindle means, a hydraulically operated power unit, motion transfer means between said power unit and the workholder spindle means for causing said workholder spindle means and work to be continuously rotated, a former carried by said spindle means adapted to engage a contact shoe, a fluid pressure line connected with said hydraulic power unit and means in said fluid line responsive to the movement on the contact shoe through engagement thereof by the former during the abrading of the work for regulating the speed of rotation of the hydraulically operated power unit.

4. An edging machine comprising a rotating abrading wheel, means for supporting work for rotary movement relative to the abrading wheel, former means on said work support for controlling the path of movement of the work relative to the wheel, means for causing said work support to be rotated, adjustable means having a contact shoe for engagement with the former, a fluid pump, conduit means for connecting said fluid pump with said means for imparting a rotary movement to the work support and with the

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means having the contact shoe thereon, said conduit means connecting the pump with the means supporting the contact shoe having fluid flow control means associated therewith which when the material of the work in engagement with the abrading wheel has been removed by a predetermined amount and the former exerts a pressure on the contact shoe said fluid flow control means will be automatically operated to cause the pump, through its conduit connection with the means for rotating the work support and work, to cause the speed of rotation of said means for rotating the work to be varied according to the variation of the pressure of the former on the contact shoe.

5. In a device of the character described the combination of an abrading wheel supported for rotary and oscillatory movement, a work supporting head pivotally supported for movement toward and away from the abrading wheel, rotatable clamp means on said head for supporting the work and for supporting a former for simultaneous rotation with said work, means for supporting a contact shoe, a honing device for engaging the abrading surface of the abrading wheel, hydraulically operated means associated with the support for the abrading wheel for imparting an oscillatory movement to said wheel, hydraulically operated means functioning cooperatively with the clamp for supporting the work, hydraulically operated means for rotating said clamp means and the former carried thereby, hydraulically operated means for controlling the movement of the honing device toward and away from the abrading wheel, a fluid pump, means for connecting said fluid pump with said various hydraulically operated means and means correlated with said various means connecting said fluid pump with said hydraulically operated means and with the former support for effecting a cooperative function of said various hydraulically operated means whereby said hydraulically operated means function in proper sequence, with the hydraulically operated means for rotating the work being responsive to varying pressure of the former on the contact shoe for varying the speed of rotation of the work relative to the abrading wheel according to the amount of material to be removed from the work immediately in engagement with the abrading wheel.

6. In a device of the character described the combination of a rotatably supported abrading wheel, work support means embodying a pair of clamp spindles, a former carried by one of said clamp spindles, a support having a contact shoe for engaging the former, gear means carried by the respective clamp spindles, a train of gears for interconnecting said gear means for simultaneous rotation thereof, a hydraulic motor embodying a plurality of plungers successively and progressively moved under hydraulic pressure imparted thereto, an angled disc-like member adapted to be engaged by said plungers and to be caused to rotate under the hydraulic pressure of said plungers, reduction gear means interconnected with said rotating disc and the train of gears for imparting the rotary movement to the clamp spindles, fluid pressure means associated with said hydraulic motor and with the means for supporting the contact shoe with the pressure of the fluid directed to said hydraulic motor being controlled according to the pressure of the former on the contact shoe whereby the speed of rotation of the motor and therefore

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the speed of rotation of the work will be varied according to the varying degrees of pressure of the former on the contact shoe.

7. An edging machine comprising a rotating abrading wheel, means for supporting work for rotary movement relative to the abrading wheel, former means on said work support for controlling the path of movement of the work relative to the wheel, hydraulically operated power means interconnected with the work support for causing said work support to be rotated, adjustable means having a contact shoe for engagement with the former, a fluid pump, conduit means for connecting said fluid pump with said means for imparting a rotary movement to the work support and with the means having the contact shoe thereon and means responding to variation of pressure of the former on the contact shoe for varying the fluid pressure on the hydraulically operated means and thereby varying the speed of rotation of the work relative to the abrading wheel according to the amount of material to be removed from the work when in engagement with the abrading wheel.

8. A device for reducing an article to a desired contour shape and size comprising rotatably supported abrading means, a head pivotally supported on suitable means for movement toward and away from the abrading means, rotatable clamp means carried by said head for clampingly supporting the article for engagement with the abrading means, means for imparting a driving force to said clamp means for continuously rotating the article, means for oscillating the head about its pivotal support in timed relation with the rotation of the clamp means, and means including a variable displacement hydraulic pump and a hydraulic control valve for con-

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trolling the output of said pump for simultaneously regulating the magnitude of said driving force in accordance with the amount of material being removed from that portion of the article in immediate engagement with the abrading means, whereby the rotation of the article relative to the abrading means will be accordingly controlled.

9. In a lens abrading machine the combination of a base having spaced bearings, a longitudinally slidable and rotatable shaft carried by said bearings for rotatably supporting an abrading wheel, a source of power, a gear system adjacent one of said bearings connecting said shaft with said source of power for rotating said shaft, means for building up a hydraulic pressure in the other of said bearing means, said gear system being so constructed as to cause said shaft to move longitudinally of the bearings in a direction toward the bearing having means for building up a hydraulic pressure therein during the rotation of said shaft, means operably functioning to build up a hydraulic pressure in said latter bearing, upon the completion of a desired amount of longitudinal movement of said shaft, of an amount sufficient to overcome the longitudinal movement of the shaft caused by the gear system and for moving said shaft in a direction opposed to the movement introduced by said gear system and means for relieving said hydraulic pressure upon movement of said shaft in said direction a controlled amount whereby the gear system will again move said shaft in said first mentioned direction with the movements of said shaft introducing an oscillatory movement to the abrading wheel in alternate and successive sequence.

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