June 12, 1956 O. W. DILLON 2,749,671

EDGE GRINDING MACHINES

Filed April 6, 1951 2 Sheets-Sheet 1

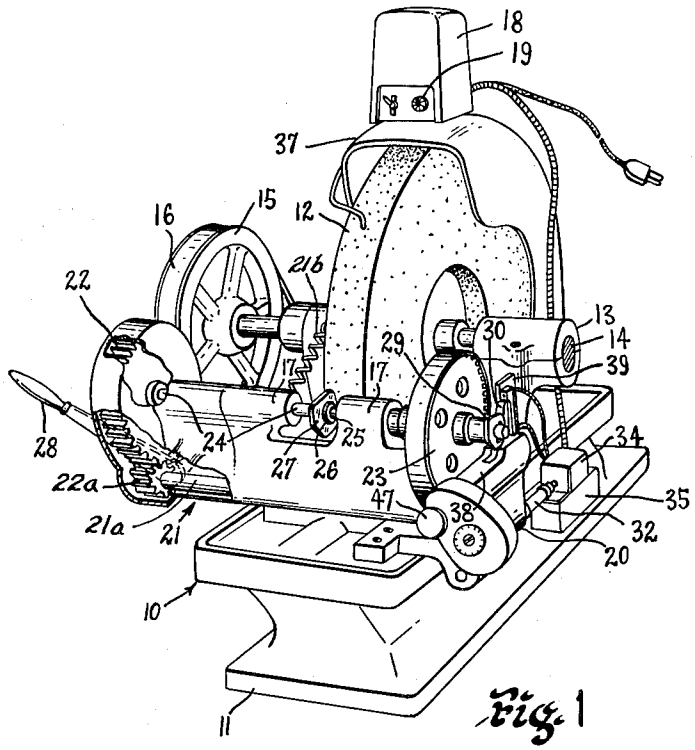


Fig. 1

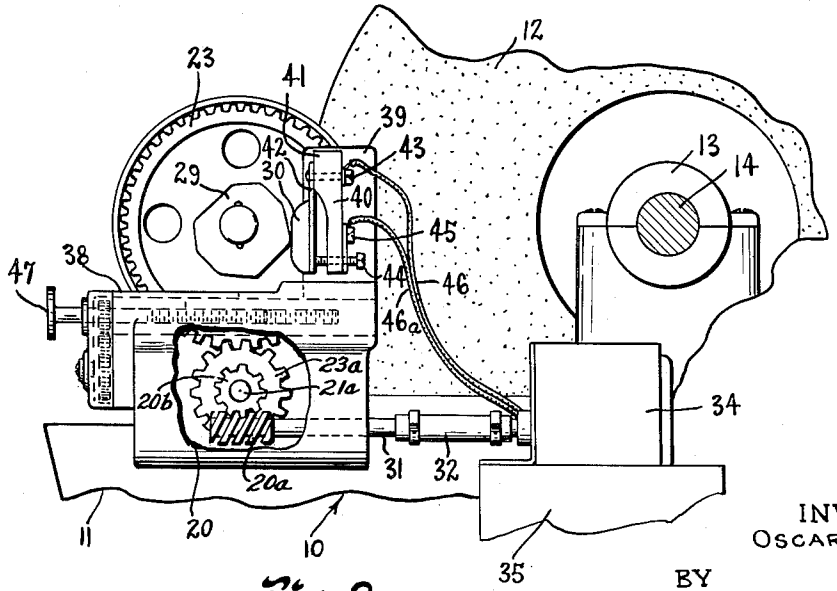


Fig. 2

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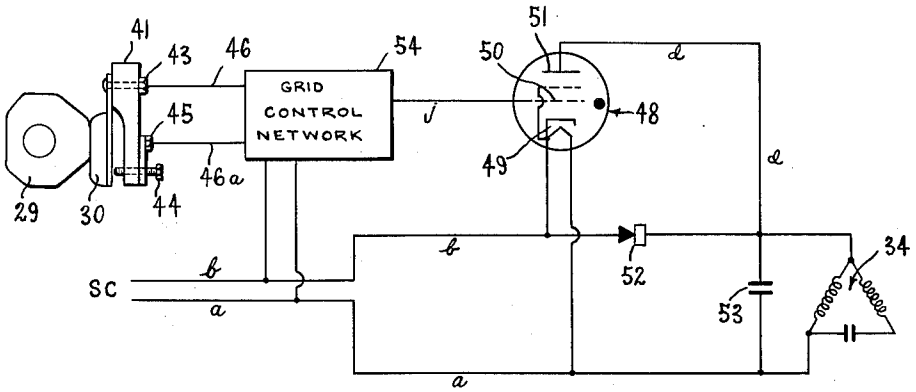


Fig. 3

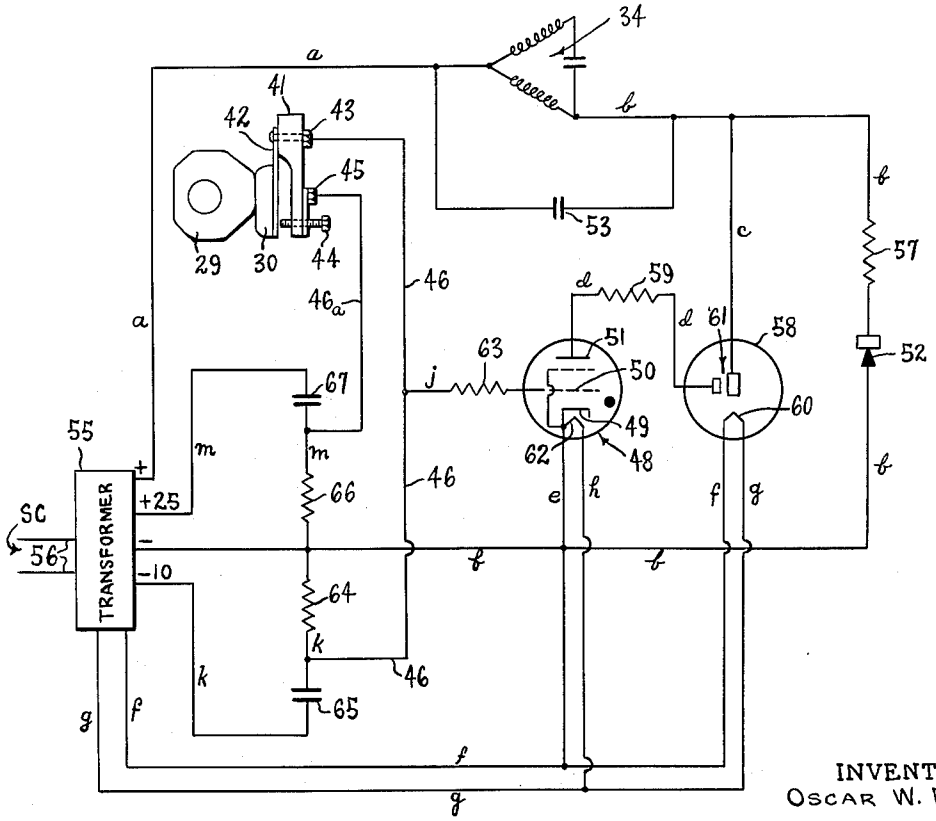


Fig. 4

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EDGE GRINDING MACHINES

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Application April 6, 1951, Serial No. 219,572

6 Claims. (Cl. 51—101)

This invention relates to machines for grinding the edges of articles such as lenses and has particular reference to improved electrical means for controlling the operation of such machines.

It is a principal object of this invention to provide improved electrical means for controlling the operation of machines for supporting articles such as lenses in engagement with means for abrading the edges of the articles to the desired contour shapes and sizes whereby the articles, upon being rotated about a controlled center will be shaped in conformity with the contour edges of selected patterns or formers, the electrical control means being constructed and arranged so as to operate in a fast, efficient manner without danger to an operator due to high voltages and with little chance of breakdowns due to overheating or burning out of elements of the electrical means.

Another object is to provide an arrangement of the above character embodying an electrical circuit having an alternating current motor therein, said electrical circuit having an electronic tube arrangement for directing A. C. current to the motor to cause said motor to advance an unedged portion of the article into abrading position, said circuit further having means operable when said unedged portion of the article has been advanced to abrading position for rendering said electronic tube arrangement ineffective and to direct D. C. current to the motor to dynamically brake the same for a period sufficient to permit desired abrasion of said portion and with the said circuit being such as to again render the electronic tube arrangement effective to direct A. C. current to the motor for advancing another unedged portion of the article when said first advanced portion has been edged to a controlled depth.

Another object is to provide edging machines of the above character wherein the drive means for rotating the work will be started and stopped quickly and without overrunning.

Another object is to provide in a machine of the above character electrical control means embodying a first circuit connecting an A. C. motor to a source of A. C. current, said first circuit having current control means therein functioning to normally apply D. C. current to said A. C. motor for dynamically braking the motor when a section of work to be abraded is positioned in abrading relation with the abrading tool, a second circuit connected with said first circuit and embodying a grid controlled electron tube capable of by-passing said current control means to cause A. C. current to flow to the motor when the grid of said tube is conditioned to allow current to flow through said tube, and a grid control operable by a switch arrangement for conditioning the electron tube to allow current to flow therethrough when the section of the work in engagement with the abrading tool is abraded to a predetermined depth whereby A. C. current will cause the motor to rotate the work to present a new section to be abraded by the abrading tool.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of an edge grinding machine embodying the invention;

Fig. 2 is a fragmentary side elevation of the machine shown in Fig. 1;

Fig. 3 is a schematic diagram of the electrical circuit embodying the invention; and

Fig. 4 is a detailed diagram of the electrical circuits embodied in the device.

It is the general practice in the manufacture of articles such as ophthalmic or other types of lenses to provide edge grinding machines to intermittently or continuously rotate a lens being ground, such rotary movement in the intermittent method being imparted to the lens upon the removal of the material down to a size governed by a pattern or former.

Various types of mechanical and hydraulic controls have been devised for intermittently rotating the article being edged but have not been entirely satisfactory since they have generally proved to be slow and inefficient, and therefore not practical for modern high-speed production methods. Electrically controlled devices for this purpose have been the nearest approach to the desired control mechanism but have had some undesirable features, among them being the necessary expense and loss of time involved in repair or replacement of parts such as electrical contacts which, due to high voltage passing through them, usually become pitted, burned, charred or otherwise damaged due primarily to arcing, thus necessitating shutdown of the machine. Another disadvantage of such prior art type of devices has been their tendency to allow the work to overrun during the operation of the device. These conditions are very undesirable especially when occurring in the manufacture of such articles as ophthalmic lenses since the articles may be formed inaccurately as to desired finished sizes and shapes and the texture of the edge surfaces such as to be impractical for use. In addition, many times the parts of electrically controlled machines carrying high voltages are disposed in such positions that they may be accidentally contacted by the machine operator with possible consequent injury.

The present invention is adapted to overcome these and other difficulties found in prior art machines by accurately electrically controlling the intermittent rotation of the article relative to the grinding wheel in accordance with the amount of material to be removed from the portion of the article in direct engagement with the grinding wheel and so as to produce an edge of desirable surface texture. Such electrical control means as hereinafter disclosed has proved to be not only faster and more positive in function but more durable, simple and inexpensive in construction and entirely automatic in its operation.

In the present device, electrical control means are used to control the intermittent rotation of the article to be abraded wherein high resistance, low current circuits, substantially free from inductive effects, are used to control the operation of the abrading machine. Also, with the present device, it is possible to use the principle of the "plunge" cut whereby in forming the contour shape of the article being abraded, the first as well as each of the succeeding cuts or grinding operations may be more positively located and made to the finished dimension, thereby requiring only a single complete revolution of the article to complete the contour thereof to its final size and shape.

Referring more particularly to the drawings wherein like characters of reference designate like parts throughout the several views, the device embodying the invention as illustrated in Figs. 1 and 2 comprises broadly an

edge-grinding machine **10**, having a base **11** on which a grinding stone or wheel **12** is rotatably supported in bearings **13** by means of an arbor **14**. Power is transmitted to the arbor **14** through a pulley **15** mounted thereon and a belt **16** traversing the pulley, the belt **16** being connected to any suitable constant source of power not shown and operated at a constant speed.

A head **21** is located on the base **11** and mounted for movement toward and away from the grinding wheel on a rotatable shaft **21***a* which extends transversely of the base **11** within the head **21**. The head **21** is provided with a pair of spaced bearing portions **17** on its upper side in each of which is slidably positioned one of a pair of concentric spindles **24** and **25**. The inner ends of the spindles **24** and **25** extend into the space between the bearing portions **17** and carry pads **26** thereon. The spindles are adapted to move toward and away from one another by means of conventional mechanism (not shown) in response to manual operation of a handle **28**. Thus, an article such as a lens blank **27** may be clamped and held securely between the pads **26** and consequently become movable with the head **21** toward and away from the grinding wheel **12**.

A gear wheel **22** is secured to the outer end of spindle **24** and is adapted to mesh with one gear **22***a* of a pair carried by the shaft about which the head **21** rotates, the other gear **23***a* of said pair meshing with a gear wheel **23** carried by spindle **25**. The rotatable shaft **21***a* within the head is connected to conventional drive mechanism located within a gear box **20** embodying a gear **20***b* carried by the shaft **21***a* and driven by worm **20***a* connected to a drive shaft **31** which in turn is connected by means such as coupling **32** to an A. C. motor **34**. Thus, operation of the motor **34** will cause rotation of the shaft **31** and the shaft **21***a* within the head **21**, and consequently the gears **22***a* and **23***a* carried thereby, which in turn will cause synchronous rotation of gear wheels **22** and **23** and spindles **24** and **25**, and consequently rotate the article **27**.

The article may be formed of glass, metal or any other desired material which is to be provided with a contour shape controlled by a pattern or former. It may be a blank for a pattern, a watch crystal, lens blank or other similar article but for ease of description it is referred to in these specifications as being a lens blank.

The head **21** is pivotally attached to the base **11** as set forth above and may be swung toward or away from the grinding wheel **12** to move the lens blank **27** into and out of engagement with the grinding wheel **12**. It is normally urged toward the grinding wheel by a spring **21***b* in the conventional manner.

A lens former or pattern **29** of the desired shape of the finished lens to be ground is mounted on the outer end of tail spindle **25** which is journaled in the head **21**, the head during these initial setting up operations being stationary and held in a position away from the grinding wheel **12**. The pattern or former **29** is rigidly attached to the spindle by any suitable means and is, therefore, rotatable synchronously with the lens blank **27** and movable with the head as the head swings toward and away from the grinding wheel **12**.

A shoe **30** is positioned so as to be engaged by the pattern **29** as the head, during its movement, approaches the wheel **12** and thus limits the movement of the head in that direction. The means for supporting the shoe comprises an upwardly extending bracket **39** which is carried by adjustable means located on gear box **20**. The bracket **39** is provided with an insulating member **40** having a forwardly extending enlarged portion **41** formed thereon. The portion **41** has one end of a resilient member **42** formed of conducting material attached thereto by a screw terminal **43** which extends therethrough. A screw **44** is adjustably secured in the opposed end of the insulating member **40** and is adapted to be positioned with its forward end located in predetermined spaced relation with the free end of the resilient member **42** and is conductively connected to a second terminal **45**. Wires **46** and **46***a* serve to connect the respective terminals **43** and **45** with the motor **34** through an electrical circuit to be described hereinafter. The contact shoe **30** is fixedly mounted upon the resilient member **42** in a position where it may be engaged by the edge of the pattern **29** as shown in Fig. 2.

Thus, as the pattern **29** is moved into engagement with the shoe during an abrading operation as described hereinbefore, the pressure thereof will cause the resilient member **42** to be urged toward and into contact with the screw **44** when the lens blank **27** is abraded to final size in the particular edge area in abutment with the abrading wheel **12**. This will cause the motor **34** to operate, through circuits to be described hereinafter, to rotate the lens blank **27** and present a new unabraded edge portion of the blank **27** to the wheel **12**. This will cause the pattern to be spaced away from the shoe **30** and consequently, due to the inherent resiliency of member **42**, will break the contact between the resilient member **42** and screw **44** and stop operation of the motor and consequently stop rotation of the lens blank.

It can readily be understood that, with this construction, operation of the motor **34** will cause rotation of coupling **32** and shaft **31** to rotate the lens blank **27** and pattern **29** through means recited hereinbefore, and that when the operation of the motor **34** is discontinued this will consequently stop rotation of the lens blank **27** and pattern **29** and allow that portion of the lens blank held in engagement with the abrading surface of the grinding wheel **12** by the spring **21***b* to be abraded in said abutting area. The extent of said abrading is controlled by the engaging of the pattern **29** with the contact shoe **30**.

The head **21** is pivotally supported upon the base **11** as described, thereby being capable of oscillation toward and away from the grinding wheel **12**, and in operation is constantly urged toward the grinding wheel by the spring **21***b* mentioned hereinbefore whereby the contour edge of the lens blank **27** will be held against the abrading surface of the revolving grinding wheel. Other suitable means may, if desired, be incorporated to provide additional adjustments with respect to the pressure required to maintain the head in position so that the lens blank will constantly engage the wheel. The resultant size of lens is controlled by the initial adjustment of the contact shoe **30** inwardly or outwardly relative to the abrading surface of the grinding wheel through suitable adjusting mechanism housed in the supporting means **38** and operated by the thumb wheel **47** in the conventional manner.

In the actual lens grinding operation, the lens blank **27**, which has been fabricated as to the optical surfaces formed thereon as prescribed by an optician, is allowed to rest in edge contact against the abrading surface of the grinding wheel under the action of the spring **21***b* described above. When the lens blank **27** first engages the wheel **12** the former or pattern **29**, because of the initial size of the blank, will be held spaced from the shoe **30**. However, as the edge of the lens is ground by the revolving grinding wheel, the pattern **29** will approach closer to shoe **30** until it finally actually makes contact with the shoe and urges the resilient member **42** into engagement with screw **44** which prevents the head from swinging further toward the grinding wheel, thus preventing additional material from being ground off the edge of the lens blank at said location. This completes the initial cut or what is known as a "plunge" cut; that is, the lens edge at said location has been reduced to its final depth in one cut.

The contacting of the resilient member **42** with the screw **44** at the completion of the initial "plunge" cut causes the motor **34** to be energized and thereby causes the lens blank to be rotated an amount sufficient to present an adjacent uncut portion of the blank to be abraded in a similar manner. When the progressive adjacent uncut portion of the lens blank is advanced through the energizing of the motor, the rotation thereof will simultaneously

cause the pattern 29 to draw away from the shoe 30 and thus cause the member 42 to become disengaged from the screw 44. This will automatically de-energize the motor 34 whereupon the lens blank will stop rotating for a period of time sufficient to allow the abrading wheel to grind the newly presented portion of the blank to a depth wherein the pattern will again contact the shoe to cause a repetitive function to take place. These successive "plunge" cuts are formed intermittently throughout the entire contour of the lens blank and will thereby reduce the blank to the shape of the pattern.

The A. C. motor 34 is preferably of the brushless type and is mounted by suitable means upon the machine base 11 and operatively controlled by electrical means, some of which is enclosed within a housing 35 (Fig. 1), other parts of the electrical means being located within a second housing 18 which is secured in some advantageous position on the machine whereby signalling means thereon, if desired, such as a pilot light 19, will be readily visible to the machine operator. In the present illustration the housing 18 containing some of the electronic control means is shown secured to the top of the safety guard 37 of the grinding wheel 12 and thus the pilot light 19 thereon is within the direct vision of the operator.

Mounted within the housing 18 is a portion of the electronic means for controlling the energizing and de-energizing of the motor 34 and the consequent rotation of the lens blank and which includes a thermionic tube 48 (Figs. 3 and 4) containing mercury, vapor, argon, or other noble gas.

This tube 48 contains a filament 49, a grid 50 and a plate 51 and functions to open and close the circuit to the motor 34, and its operation is controlled by a relatively low voltage as compared with the voltage required for energizing the motor.

Referring first to the diagram shown in Fig. 3, the broad aspects of the invention comprise circuits as illustrated therein. A main circuit is comprised of conductors *a* and *b*, which are connected to a source of alternating current SC at one end and to the motor 34 at the other end. The motor 34 is preferably an A. C. capacitance-type induction motor which, when D. C. current is applied thereto, will become dynamically braked. In conductor *b* is inserted a half-wave rectifier 52 which allows current in conductor *b* to flow only in one direction. Thus current will then flow into the motor 34 from conductor *b* only in one direction and, therefore, will be in pulses. A capacitor 53 is connected across conductors *a*—*b* and is adapted to become charged on each pulse and to discharge through the motor on the reverse cycle, essentially causing continuous flow of current to the motor. This, being D. C. current, causes dynamic braking of the motor 34. The capacitor 53, however, is of such size that the flow of current to the motor is relatively smooth.

Another circuit embodying the electron tube 48 is connected to conductor *b* to by-pass the rectifier 52 for causing operation of the motor 34. Conductors *e* and *d* are connected to conductor *b* at one end and the other end of conductor *e* is connected to the filament 49 of the tube 48, while the other end of conductor *d* is connected to the plate 51. The grid 50 of the tube 48 is connected through lead *j* and the grid control network 54 to conductors *a* and *b*. Thus, to cause the motor to run, current passes in one direction from the source of current SC via conductor *b* through the half-wave rectifier 52 and motor 34, and out conductor *a*. In the other direction, it flows through conductor *a*, motor 34, conductor *d*, through tube 48, and out conductor *b*, by-passing the rectifier 52. When the tube 48 is not firing, D. C. current only is flowing into the motor 34 as described above, braking it.

The remainder of the circuit shown in Fig. 3 comprises the grid bias voltage control network 54 which controls the firing of the tube 48 and which is, in turn, operatively controlled by the engagement of the pattern 29 with the shoe 30 and consequent opening and closing of the circuit through conductors 46 and 46*a*, which connect the shoe switching arrangement, i. e. the resilient switch member 42, screw 44, and terminals 43 and 45, with the grid control network 54.

Referring now to the complete diagram shown in Fig. 4, it will be seen that a transformer 55 is connected by means of conductors 56 to the source of current SC. The transformer 55 is of a type having two windings, filament and bias windings. Conductor *b* leads from the transformer 55 to the rectifier 52, thence through a protective resistance 57 to the motor 34. Conductor *a* leads directly from the transformer 55 to the motor 34. The terminus of conductor *b* with the transformer 55 is ground potentially. Now current can pass from the transformer 55 along conductor *b* through rectifier 52, resistance 57, motor 34, and out along conductor *a*. Current in the other direction passes along conductor *a* (the plus side of the circuit) to the motor 34, through conductors *b* and *c* to a time delay relay tube 58, through conductor *d*, which embodies a protective resistance 59, through electron tube 48, and out through conductors *e* and *b*.

The time delay relay tube 58 has a heater unit 60 therein and make-and-break contact 61. The heating unit 60 is connected by conductors *f* and *g* to the filament winding of transformer 55. One of the contacts 61 is connected with conductor *c* and the other with conductor *d*. The contacts 61 are normally in open relation. Heating of the delay tube heater 60 closes the contacts 61 after a predetermined time interval such as, for example, thirty seconds. During this time the filament of the electron tube 48 has had ample time to reach its operating temperature. This feature is particularly important when first starting the machine so that the operator will not encounter difficulties caused by not waiting a sufficient interval for the electron tube to become properly heated.

The plate 51 of the electron tube 48 is connected by conductor *d* to the delay tube 58. The grid 50, when positive, allows electrons to flow from the filament 49 to the plate 51 after the heater 62 of the tube is sufficiently heated through conductors *e*—*h* and *f*—*g*.

A lead *j* is connected at one end to the grid 50 and embodies a protective resistance 63. It is desired that the electron tube 48 fire when the pattern 29 causes the shoe 30 to close the circuit through conductor 46, terminal 43, resilient switch member 42, screw 44, terminal 45, and conductor 46*a*. Therefore, conductors 46 and 46*a* are connected to a bias network, conductor 46 being connected to a conductor *k*, between a resistor 64 and a capacitor 65, and conductor 46*a* being connected to conductor *m* between a resistor 66 and a capacitor 67. Conductors *k* and *m* are attached at one end adjacent the resistors 64 and 66 to conductor *b* and the other ends thereof are connected to the transformer 55. Conductor *j* connects the grid 50 of the tube 48 with conductor 46.

Conductor *m*, for example, on one cycle is twenty-five volts positive, and conductor *k* is ten volts negative, which puts ten volts negative bias on the grid 50, which prevents the tube from firing. On the reverse cycle the opposite, of course, holds true, the out-of-phase bias voltage, however, remaining on the grid 50. If the switch member 42 operated by the pattern 29 is closed, conductor *m* is then connected through conductors 46*a*—46*j* with grid 50, which then, to continue with the above example, causes twenty-five volts positive to be applied to the grid 50, which when reduced by the ten volts negative initially applied thereto, causes a resultant fifteen volts plus to exist, which is sufficient to insure early firing of the tube.

In operation of the device, current initially passes to

the motor 34 which, due to the fact that the switch member 42 is open and the grid 50 of the tube 48 is out-of-phase with respect to the plate 51, therefore is dynamically braked. The contacts 61 of the time delay tube 53 will, after a predetermined time interval, close and thus through conductor *d* will allow the electron tube 48 to be operated.

The grinding wheel 12 will abrade the abutting edge portion of the lens blank 27 being edged until the pattern 29 engages the shoe 30 and causes the resilient switch member 42 to engage screw 44. This causes in-phase voltage to be applied to the grid 50 of tube 48 and thus electrons will flow from the filament 49 to the plate 51. This will cause A. C. current to be applied to the motor 34 as described hereinbefore.

Immediately upon being energized, the motor 34 will operate to rotate the lens blank 27 and pattern 29 to bring an uncut portion of the lens blank into abrading position. This will cause the head 21 to swing in a direction away from the grinding wheel 12, thus causing the pattern 29 to become disengaged from the contact shoe 30, and consequently the resilient member will become disengaged from the screw 44, thereby breaking the circuit to the bias network, converting the voltage to the grid 50 of electron tube 48 to out-of-phase polarity. Due to the characteristic of this electron tube this will effectively cause the stopping of the flow of electrons from filament 49 to plate 51 as soon as the plate voltage passes through zero to thus break the circuit to the motor 34, de-energizing the motor and stopping the rotation of the lens blank and pattern.

The motor will not operate to rotate the lens blank again until the portion of the blank in abutting relation with the grinding wheel 12 has been cut to the depth desired as controlled by the pattern 29, at which time the pattern will again make contact with the shoe 30 to close switch member 42 upon screw 44 and again energize the motor 34 as described, and the cycle is repeated until the entire contour edge of the lens blank has been ground to the size and shape of the pattern, after which it may be removed from the machine and a new lens blank to be ground may be substituted in its place.

It is important to note that the blank is rotated by the motor 34 only a very small amount since the contact between the member 42 and screw 44 is almost immediately broken, thus providing a very sensitive device. Only a small amount of material is removed from the blank during each grinding operation or between each interval of contact of the blank with the grinding wheel and the interval of contact of the member 42 with the screw 44. That is, the lens is ground during the period from the time that contact is broken between the member 42 and screw 44 and until contact is again established between these parts. Therefore, there will be numerous engagements and disengagements between the screw 44 and the member 42 in grinding each edge surface of the lens blank, or such surfaces as correspond to the surfaces of the pattern 29. The entire edge surface is not removed at each engagement between the lens blank and the grinding wheel, but instead only a small portion, or so much of the blank as can be presented to the abrading surface of the grinding wheel. As a result there will be numerous engagements between the member 42 and screw 44 for intermittently rotating the lens blank, because the lens blank will be out of pressure contact with the wheel when the member 42 engages the screw 44.

One complete turn or revolution of the lens blank is sufficient generally to remove the necessary material to bring the blank down to proper size and shape. However, as the last amount of material is removed, the pattern and shoe will again make contact and the circuit to the motor 34 will be established to permit the lens blank to again be rotated. This second rotation of the lens blank, if desired, will be made at a high rate of speed and, together with the rotation of the grinding wheel, insures the removal of any superfluous material and cleans up the tiny "scallops" on the edge of the blank. One revolution of the blank under this condition is sufficient to perform this cleaning up operation although the blanks are satisfactory for general use without the added operation.

With this method of removing the material and the forming of a lens, production time is reduced considerably compared with the general methods employed for this purpose, together with the added advantage of greater safety provided through the use of a high resistance circuit in areas most likely to be contacted by the operator, and great sensitivity of the device.

It can be clearly seen from the foregoing that an abrading machine of the character described hereinbefore is an improvement over the prior art by embodying novel, efficient, safe and durable electrical control means therefore whereby the machine may be operated in a fast, efficient manner without danger to an operator due to high voltages and with little chance of breakdowns due to failure of parts.

It will be apparent that many changes may be made in the details of construction and arrangement of parts shown and described without departing from the spirit of the invention as expressed in the accompanying claims. Therefore, it is to be understood that all matter set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. An edging machine adapted to accurately reproduce a desired shape on a lens comprising an axially rotatable abrading wheel, a rotatable work holder for supporting a lens in position to be edged by said abrading wheel, said work holder and abrading wheel being mounted on a support to permit one to move in a controlled path toward and away from the other, a pattern rotatable with said work holder, a contact positioned to be engaged by said pattern to control the relative spacing of the work holder to the abrading means, and means for imparting simultaneous rotary movement to said pattern and work holder embodying a motor of the type which will operate only on the application of alternating current and will immediately stop on the application of uni-directional current thereto, a circuit connecting said motor to a source of alternating current, a first electronic device in said circuit permitting current to flow therethrough in only one direction, a second electronic device connected to said circuit in parallel with said first electronic device and permitting current to flow therethrough only in the opposite direction, one of said electronic devices including a control portion whose electron potential may be varied to stop and start the flow of current through said electronic device, the electron potential of said control portion being obtained by a biasing network influenced by the making and breaking of engagement of the pattern with the contact, the electron potential of said control portion being such as to permit current to flow through said electronic device only when the pattern and contact are engaged whereby the motor will operate to rotate the work to a position presenting a fresh edge to be abraded, said rotation breaking the engagement of the pattern with the contact to change the potential on the control portion to a new value where the flow of electron current through said electronic device will stop whereby only current through one electronic device will flow to the motor which uni-directional current will function to immediately stop the motor and rotation of the work holder whereby the lens may be shaped to the accurate shape desired.

2. An edging machine adapted to accurately reproduce a desired shape on a lens comprising an abrading tool and a rotatable work holder for supporting a lens in position to be edged by said tool, said work holder and tool being mounted on a support to permit one to move in a controlled path toward and away from the other, a pattern rotatable with said work holder, a contact positioned

to be engaged by said pattern to control the relative spacing of the work holder to the abrading tool, and means for imparting simultaneous rotary movement to said pattern and work holder embodying a motor of the type which will operate only on the application of alternating current and will immediately stop on the application of uni-directional current thereto, a circuit connecting said motor to a source of alternating current, a first electronic device in said circuit permitting current to flow therethrough in only one direction, a second electronic device connected to said circuit in parallel with said first electronic device and permitting current to flow therethrough only in the opposite direction, said second electronic device comprising a tube having a cathode and a plate with a control grid interposed therebetween to stop and start the flow of current through said electronic device, the voltage on said plate being alternately positive and negative, a transformer to which the cathode of said tube is potentially grounded, a first bias circuit connected to one side of the transformer and arranged to introduce voltage on the grid out of phase with the plate voltage, a second bias circuit connected to the other side of the transformer and arranged to introduce voltage on the grid in phase with the plate voltage, said latter voltage being of an amount greater than the out-of-phase voltage, the tube permitting current to flow therethrough only when the bias voltage on the grid is in phase with the plate voltage, and normally open switch means in said second bias circuit which closes on engagement of the pattern with the contact to complete the second bias circuit and cause the tube to fire and permit operation of the motor whereby it will rotate the work to a position presenting a fresh edge to be abraded, said rotation simultaneously breaking the engagement of the pattern with the contact to open the switch rendering only the out-of-phase circuit effective so that current will flow to the motor in only one direction to immediately stop the motor and rotation of the work holder whereby the shape of the pattern will be accurately reproduced on the work.

3. In an abrading machine of the character described, the combination of a rotatable abrading wheel, a rotatable work-holding device supported for movement in a controlled path toward and away from said abrading wheel, means normally urging the work-holding device toward the abrading wheel, a pattern rotatable with said work-holding device and a contact shoe, said rotatable pattern being supported for movement into and out of engagement with said contact shoe to control the extent of movement of the work holding device toward the abrading wheel, electrically operated drive means for imparting simultaneous rotary movement to the work-holding device and pattern when energized, and a first circuit for connecting said drive means to a source of electrical energy, an electron tube having a filament and plate in said circuit, said tube further having a control grid interposed between said plate and filament, a transformer in said circuit having the filament of said tube potentially grounded therewith, a first bias circuit connecting said grid with one side of said transformer for maintaining the grid in out-of-phase voltage relation with said plate to maintain the tube in normal inoperative condition, a second bias circuit connecting said grid with the other side of said transformer and providing voltage on said grid in phase with the plate voltage of an amount greater than said out-of-phase voltage, and normally open switch means in said second bias circuit preventing operation thereof whereby the out-of-phase voltage of the first bias circuit on the grid prevents the tube from firing and consequent flow of electrical energy through said first circuit to the drive means, said switch means being connected with said contact shoe and operable in response to movement of the pattern into engagement with said contact shoe for completing said second bias circuit whereby in-phase voltage is applied to the grid of an amount greater than the out-of-phase voltage causing said electron tube to fire so that electrical energy will flow through the first circuit to said drive means and energize the same to rotate the work-holding device so as to advance an unabraded portion of the work to a position for abrasion by the rotating abrading wheel where the engagement of the pattern and contact shoe will be broken and open the switch means in the second bias circuit causing only the out-of-phase voltage of the first bias circuit to appear on the grid so as to instantaneously stop the advance of the work-holding device and allow the work to be abraded until the pattern and contact shoe again engage.

4. In an edging machine adapted to accurately reproduce a desired peripheral shape on a lens, the combination of a rotatable abrading wheel, a rotatable work-holding device supported for movement in a controlled path toward and away from said abrading wheel, means for normally urging the work-holding device toward the abrading wheel, a pattern whose periphery is of said desired shape rotatable with said work-holding device, a contact shoe positioned for engagement by said pattern to control the extent of movement of said work-holding device, said rotatable pattern being supported for movement into and out of engagement with said contact shoe with the movement of the work-holding device relative to the abrading wheel, electrically operated drive means for imparting simultaneous rotary movement to the work-holding device and pattern when energized, an A. C. circuit connecting said drive means to a source of electrical energy, an electron tube having a filament and a plate in said circuit with a control grid interposed between said plate and filament, a first bias circuit connecting said grid with said source of energy for maintaining the grid in out-of-phase voltage relation with said plate to maintain the tube in normal inoperative condition and prevent operation of the drive means, a second bias circuit connecting said grid with said source of energy for providing voltage on said grid in phase with the plate voltage of an amount greater than said out-of-phase voltage sufficient to permit the substantially immediate flow of current through the tube and consequent operation of the drive means, and normally open switch means in said second bias circuit rendering said second bias circuit ineffective, said switch being connected with said contact shoe and operable in response to movement of the pattern into engagement with said contact shoe for closing said second bias circuit and consequently causing operation of said electron tube whereby starting and stopping of said drive means will be substantially instantaneous with the movement into and out of engagement of the pattern with the contact shoe so that the shape of the pattern is accurately reproduced by the abrading wheel on the lens.

5. In an edging machine adapted to accurately reproduce a desired peripheral shape on a lens, the combination of a rotatable abrading wheel, a rotatable work-holding device supported for movement in a controlled path toward and away from said abrading wheel, means normally urging the work-holding device toward the abrading wheel, a pattern whose periphery is of the desired shape rotatable with said work-holding device, a contact shoe positioned for engagement by said pattern and said rotatable pattern being supported for movement into and out of engagement with said contact shoe to control the extent of said movement of the work-holding device, electrically operated drive means for imparting simultaneous rotary movement to the work-holding device and pattern when energized, comprising a motor so constructed as to operate only upon application of alternating current thereto, a circuit connecting said motor to a source of A. C. electrical energy, current control means in said circuit for permitting current to flow to said motor in only one direction, an electron tube connected to said first circuit in bypassing relation with said current control means, said electron tube having a filament and a plate therein arranged to permit current to flow only in the opposite direction whereby alternating current will

flow to the motor to operate the same when the tube fires, said tube further having a control grid interposed between said plate and filament to control the firing of the tube, a first bias circuit connecting said grid with said source of energy for maintaining the grid in out-of-phase voltage relation with said plate to maintain the tube in normal inoperative condition and prevent the flow of current therethrough to dynamically brake the motor, a second bias circuit connecting said grid with said source of energy for providing voltage on said grid in phase with the plate and which is of an amount greater than said out-of-phase voltage to permit the tube to fire, and normally open switch means in said second bias circuit rendering only said first bias circuit effective, said switch means being connected with said contact shoe and operable in response to movement of the pattern into engagement with said contact shoe for closing said second bias circuit and consequently causing said electron tube to fire whereby starting and stopping of said motor and consequent rotation of the work will be substantially instantaneous with the movement of the pattern into and out of engagement with the contact shoe so that the shape of the pattern is accurately reproduced on the work.

6. In an edging machine adapted to accurately reproduce a desired peripheral shape on a lens, the combination of a rotatable abrading wheel, a rotatable work-holding device supported for movement in a controlled path toward and away from said abrading wheel, means normally urging the work-holding device toward the abrading wheel, a pattern of the desired peripheral shape mounted to rotate with said work-holding device, a contact shoe positioned for engagement by said pattern and said rotatable pattern being supported for movement into and out of engagement with said contact shoe to control the movement of said work-holding device toward and away from the abrading wheel, electrically operated drive means for imparting simultaneous rotary movement to the work-holding device and pattern when energized comprising a motor so constructed as to operate only upon application of alternating current thereto, a circuit connecting said motor to a source of A. C. electrical energy, current control means in said circuit for permitting current to flow to said motor in only one direction, an electron tube connected to said first circuit in by-passing relation with said current control means, said electron tube having a filament and a plate therein arranged to permit current to flow only in the opposite direction when the tube is fired, said tube further having a control grid interposed between said plate and filament, a transformer in said circuit to which the filament of the tube is potentially grounded, a first bias circuit connecting said grid with one side of said transformer for maintaining the grid in out-of-phase voltage relation with said plate to prevent the tube from firing, a second bias circuit connecting said grid with the other side of said transformer for providing voltage on said grid in phase with the plate voltage and which is of an amount greater than said out-of-phase voltage to permit firing of the tube, and normally open switch means in said second bias circuit rendering only the first bias circuit effective to dynamically brake the motor, said switch being connected with said contact shoe and operable in response to movement of the pattern into engagement with said contact shoe for closing said second bias circuit and consequently causing operation of said electron tube and consequent operation of said motor whereby starting and stopping of the motor and consequent rotation of the work will be substantially instantaneous with the movement of the pattern into and out of engagement with the contact shoe so that the shape of the pattern is accurately reproduced on the work.

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