Aug. 25, 1970 F. J. CARSON 3,525,181

EDGE GRINDING APPARATUS

Filed June 3, 1968 3 Sheets-Sheet 1

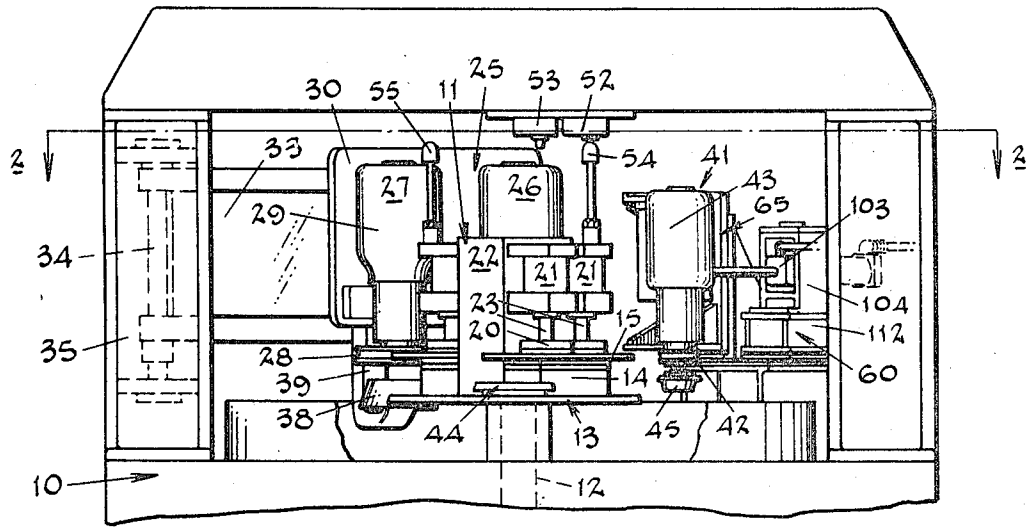

Fig. 1.

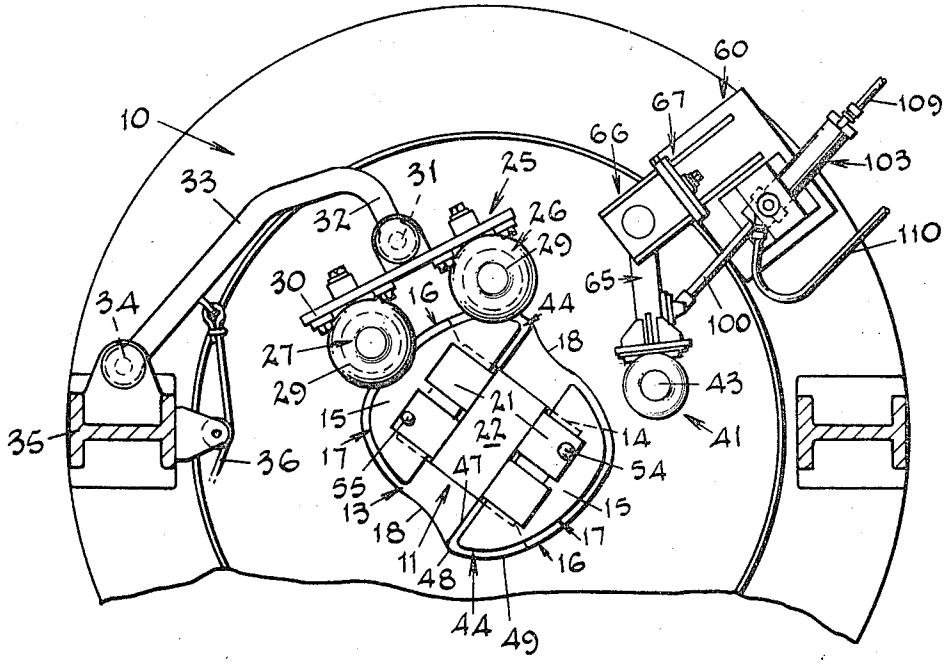

Fig. 2.

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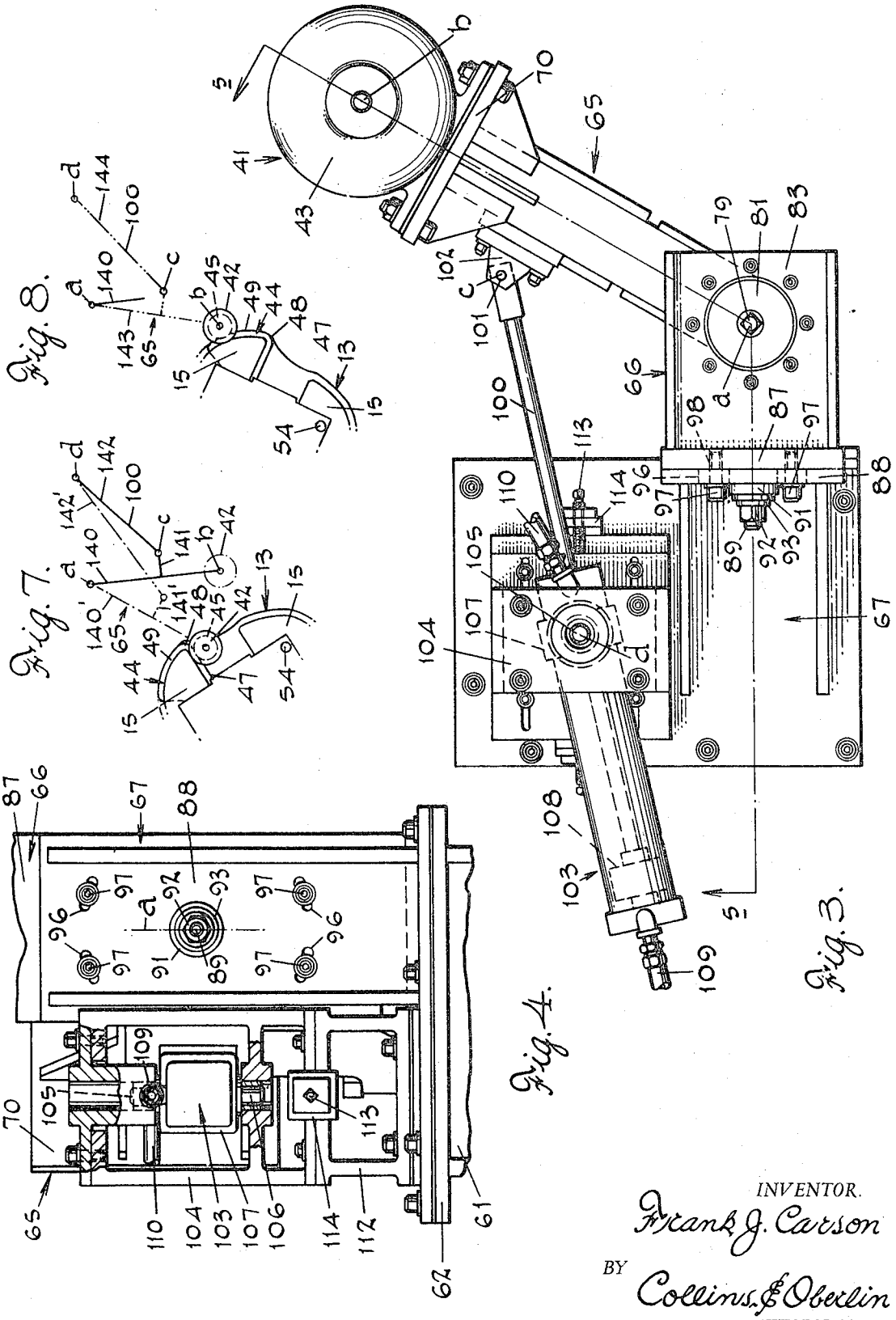

Fig. 8.

Fig. 7.

Fig. 4.

Fig. 3.

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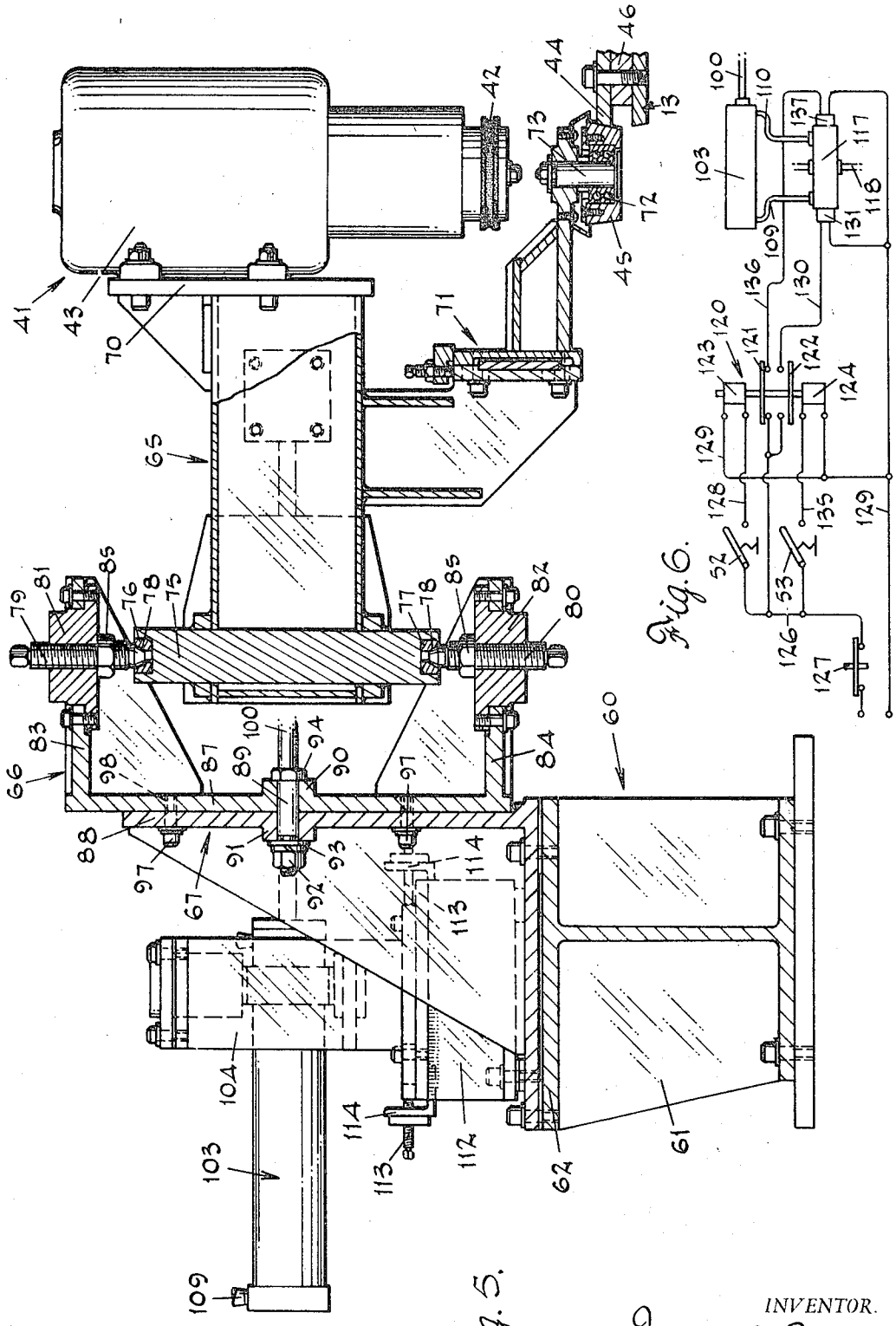

Fig. 5.

Fig. 6.

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EDGE GRINDING APPARATUS

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Int. Cl. B24b 9/10
U.S. Cl. 51—101 4 Claims

ABSTRACT OF THE DISCLOSURE

Edge grinding apparatus comprising a rotatable work-support table and a main template having a pattern-contoured edge to which the exposed edge of a workpiece is to be ground. A main grinding unit includes a main grinding wheel and a template follower roll adapted to traverse the main template. The main grinding unit is yieldingly urged toward the worktable to maintain the follower roll against the main template and the main grinding wheel in engagement with the edge of the workpiece. An auxiliary grinding unit is mounted adjacent the worktable and includes a grinding wheel of relatively small diameter and template follower roll which engages an auxiliary template carried by the main template. Control means are actuated during rotation of the worktable to bring the auxiliary template follower roll into engagement with an out-of-engagement with the auxiliary template whereby to effect grinding action by the wheel of the auxiliary grinding unit along a selected area of the workpiece.

The present invention relates to improvements in edge grinding machines and more particularly to machines for grinding the edges of pattern-cut sheets of glass or other materials and to an auxiliary grinding unit adapted to finish the edge portion of a selected area of the sheets.

This invention contemplates the use of an auxiliary grinding unit in combination with an edge grinding machine embodying two main grinding units mounted in side-by-side parallel relation on a vertical support member; each unit having a grinding wheel of relatively larger diameter than the grinding wheel of the auxiliary grinding unit. The edging machine also includes a rotary worktable for supporting a workpiece or workpieces to be ground and a main template, carried by the worktable, having a contour conforming substantially to the desired curved contour to which the exposed edges of the workpieces are to be ground. Template follower rollers are carried by the support member to engage the main template and gage the grinding action of the respective main grinding wheels as they traverse the contoured edges of the glass sheets.

These main grinding wheels however are not of a diameter and are not carried in a manner to achieve similar grinding of selected areas that include curved edge portions of a relatively smaller radius than the curvature of the major length of the edge. This situation would arise in the finishing of substantially triangular sheets of glass, or other material, such as are employed to enclose the ventilator opening in the side door of an automobile. These sheets possess two adjoining sides that are disposed in converging relation to one another and the apex area there-between is formed by a curved end edge portion of relatively small radius. To conform to certain requirements of use of the workpiece, complete grinding of such a selected area of the edge of a workpiece could therefore include a portion of the exposed edge, the curved end edge portion and even a portion of the edge continuing into the unexposed side of the workpiece. Thus an auxiliary grinding unit is herein employed, in combination with the main grinding units, to automatically carry the grinding wheel thereof of relatively smaller diameter into engagement with a selected area of a glass sheet and to then remove said grinding wheel from active engagement.

It is therefore the primary object of the invention to provide the combination with an edging machine, including grinding units with grinding wheels adapted to grind the major portion of the edge of a workpiece, of an auxiliary grinding unit with a grinding wheel of relatively smaller diameter adapted to grind a selected area of the edge of said workpiece.

Another object of the invention is to provide an edging machine of the character above described wherein the main grinding units include template followers adapted to traverse the contoured curvature of a rotary main template and the auxiliary grinding unit includes a template follower adapted to traverse an auxiliary template carried by the rotary main template and having a contour corresponding to the selected area of the curved outline of a workpiece.

Another object of the invention is to provide for an auxiliary grinding unit of the above character pivotal mounting means and means moving said auxiliary grinding unit toward and away from the worktable to engage the edge of a workpiece in a selected area and then disengage the same.

A further object of the invention is to provide control means activated during rotation of the worktable to automatically operate the said moving means to move the auxiliary grinding unit toward and away from the worktable.

Other objects and advantages of the invention will become more apparent during the course of the following description when read in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

FIG. 1 is a side elevation of an edging machine with an auxiliary grinding unit constructed in accordance with the invention;

FIG. 2 is a horizontal sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is an enlarged plan view of the auxiliary grinding unit;

FIG. 4 is an end elevation of the grinding unit, parts thereof being shown in section;

FIG. 5 is a vertical sectional view taken along the line 5—5 of FIG. 3;

FIG. 6 is a diagrammatic view of a control system; and

FIGS. 7 and 8 are diagrammatic views of operation of the auxiliary grinding unit.

Referring now to the drawings and particularly to FIGS. 1 and 2, the improved auxiliary grinding unit of this invention is adapted to use in combination with an edging machine which comprises an annular supporting base **10** provided with a centrally located worktable **11** mounted on the upper end of a vertically disposed rotatable spindle **12**. Generally speaking, the worktable **11** carries a horizontal main template **13** on its lower surface and a platform **14**, constituting its upper surface, for supporting workpieces **15**, such as sheets or plates of glass.

As herein described and viewed in FIG. 2, the outline of the edge of the template **13** is preferably formed to include at least two contoured areas **16** in each of which the edge of the template is curved and shaped to correspond to the curvature to which the exposed edges **17** of the workpieces **15** have been pattern-cut and are to be finish ground. The worktable **11** is thus provided with platform means **14** for carrying at least two glass sheets or workpieces **15** that are positioned in diametrically spaced relation to one another and with the corresponding

contoured areas **16** of the template **13** located in vertically spaced relation beneath the edges **17** of the sheets. As herein disclosed, the periphery of the template **13** continues from one contoured or curved area **16** into the second area **16** through intervening and oppositely disposed "dwell" areas **18**.

Each workpiece **15** is held on the platform **14** by clamping plates **20**, having a non-abrasive surface for engaging the workpiece. The clamping plates **20** are mounted for vertical reciprocal movement by powered mechanisms such as air-actuated cylinders **21** mounted on opposite sides of a vertically disposed wall **22** extending above the platform of the worktable **11**; with the piston rods **23** of the air cylinders being attached to the upper surfaces of the clamping plates. As shown, two such clamping plates **20** and air cylinders **21** are provided for securing each of the respective workpieces **15** against the surface of the platform **14**, with the workpieces positioned in such a manner that the edges **17** to be ground extend beyond the platform as shown in FIG. 1. With this arrangement, one glass sheet or workpiece can be secured on the worktable and subsequently removed in an area remote from the grinding mechanism, generally designated by the numeral **25**, while the worktable is being rotated and the grinding mechanism is acting upon the exposed edge of the diametrically-located second workpiece clamped on the opposite side of the platform **14**.

The grindnig mechanism **25** for edge-finishing the workpieces generally comprises two grinding units **26** and **27**; each including a grinding wheel **28** which is adapted to be rotatively driven about a vertical axis by means of an electric motor **29**. The two grinding units are mounted in spaced side-by-side parallel relation on a vertically disposed support member **30** that is structurally carried to pivot freely about one vertical axis, with the grinding units **26** and **27** and the support member **30** being adapted to simultaneously pivot or swing bodily about a second vertical axis. Thus, as viewed in FIG. 2, the support member **30** is pivotally mounted by a shaft **31** at the free end **32** of an arm **33** which is pivotally mounted on a vertically disposed axle **34** carried by bearings on the frame **35** of the base **10**. Although not shown in detail, it will be understood that by means of the cable **36**, attached to a weighted member, the arm **33** is pivotally swung about the first axis or that of the axle **34** and yieldingly urged toward the worktable **11**. Each grinding unit **26** and **27** is provided with a template follower roll **38** arranged in vertical axial alignment with a related grinding wheel **28** and mounted on the support member **30** by means of a bracket **39**.

It is believed apparent that as the follower rolls **38** engage the edge of the template **13**, the grinding mechanism **25** is adapted to swing toward and sway from the worktable **11** about the axis of the axle **34**, or the aforementioned first vertical axis, to urge and maintain the grinding wheels **28** of the units **26** and **27** in active engagement with the exposed edges of the workpieces. Simultaneously, the grinding units **26** and **27** together with the support member **30** will pivotally swing about the second vertical axis, or that of the shaft **31** at the free end of the arm **33**, as the template follower rolls **38** of said grinding units traverse the areas **16** and **18** of the template **13** and in so doing cause the related grinding wheels **28** to produce the desired ground finish on the edges of the workpieces or to be held in outwardly spaced relation.

As noted in FIG. 2, the contoured edge areas **16** of template are interjoined by continuations or the dwell portions **18** and these dwell areas or portions support the follower rollers **38** and grinding wheels **28** from a point adjacent an end area of one workpiece to the adjoining end area of an oppositely disposed workpiece. For certain uses to which the glass sheets or workpieces are to be put, it has been found practical to employ the use of an auxiliary grinding unit, generally designated by

the numeral **41**, having grinding wheel **42** driven by an electric motor **43**. The grinding wheel **42** is of a diameter relatively smaller than the diameter of either of the grinding wheels **28**. Accordingly it is herein contemplated, by the embodiment of the instant invention, to finish grind a selected area of at least one end of each workpiece. During this grinding action, the auxiliary grinding unit **41** is caused to move in a path determined by the contour of an auxiliary template **44** by means of a follower roll **45**. As viewed in FIGS. 2 and 5, the auxiliary template **44** is mounted by a spacer plate **46** on the main template **13** and located in registration with the selected area of a workpiece; said area including the leading end of the workpiece.

It is also contemplated that the edge of auxiliary template **44** can be contoured to conform to areas other than an area defining the leading end of a workpiece. Thus, the auxiliary template **44** can be provided with an edge having a curvature of any selected portion of the contoured areas **16** of the main template **13**. In fact, by using an auxiliary grinding wheel having a surface other than one similar to that of the main grinding wheel, and such as an angled or concave surface, any selected area of the workpiece can be finished with a beveled or convexedly rounded edge portion. In these conditions of operation, the controls for producing inward and outward movement of the auxiliary grinding unit **41** would be located to cause such movements in accordance with the selected area or areas of the workpiece to be acted upon.

Generally described, the auxiliary grinding unit **41** is adapted to be moved in a substantially radial or arcuate path and, by means of each auxiliary template, carry the grinding wheel **42** into engagement with leading end of the edge of the exposed side of a workpiece, about the curved end thereof and even along a portion of the edge of the unexposed side of the workpiece. As above mentioned, the contour of the edge of the template **44** can also be shaped to cause the grinding wheel **42** to act upon selected areas of a workpiece other than around the leading edge. However, by way of example, the substantially V-shaped contour of the edge of each auxiliary template **44** includes a leading sector **47** conforming to the entry end of the previously considered unexposed edge of a workpiece, a sharply curved end sector **48** and a trailing sector **49** conforming substantially to a similar area of the main template **13** therebeneath. The actual path of movement of the auxiliary grinding unit **41** is thus a resulting sequence or combination of forward and rearward motions. To produce this combination of motions, the auxiliary grinding unit **41** is brought into and removed from operative position with reference to the worktable **11** upon the sequential actuation of switch devices **52** and **53** by vertically disposed posts **54** and **55** carried by the wall **22**. That is to say, as one workpiece is being acted upon by the main grinding wheels **28**, the post **54** will be located to engage the switch device **52** when the auxiliary template follower roll **45** is to be brought into contact with the edge of the template **44**, such as the leading sector **47** as herein shown. The post **54** subsequently engages the switch device **53** as the follower roll **45** traverses the trailing sector **49**. The same is also true with regard to the post **55** when the opposite workpiece is being ground.

More particularly, the auxiliary grinding unit **41** comprises a support structure **60** mounted by a base **61** on the base **10** of the edging machine and having an upper horizontally disposed surface or platform **62**. Generally speaking, the unit **41** is carried on the support structure **60** by an arm **65** pivotally supported by a frame **66** that is adjustably mounted on the platform **62** by a bracket **67**. The arm **65**, as seen in FIG. 5, has an integral plate **70** at its free or outer end for supporting the motor **43** and a bracket **71** on which the auxiliary follower roll **45** is rotatably journaled by bearings **72** on an axle **73**. At its opposite and inwardly disposed end, the arm **65** is pro-

vided with a vertically disposed trunnion member **75** having axially aligned bearings **76** and **77** in the upper and lower ends thereof. Each bearing is formed with a conical surface **78** which in one instance receives the tapered end of a bolt **79** and the other the end of a similar bolt **80**. The bolts **79** and **80** are carried by internally threaded cap blocks **81** and **82** in the outwardly directed flanges **83** and **84**, respectively of the frame. The bolts **79** and **80** are aligned with an axial line *a* and are equipped with locknuts **85** which when released from the adjacent surfaces of the cap blocks permit the bolts **79** and **80** to adjust the elevation of the arm as they are turned upwardly or downwardly relative to the cap blocks **81** and **82**.

The vertical wall **87** of the frame **66** is supported on the opposed vertical wall **88** of the bracket **67** by an axle bolt **89** passed through a hub **90** of the wall **87** and aligned hub **91** of the wall **88**. When the nut **92** is turned against washers **93** facing the hub **91**, the head **94** of the axle bolt **89** acts to firmly secure the mounted relation of the frame **66** on the bracket **67**. However, the frame **66** is adapted to be adjusted angularly with reference to the bracket **67** in order that the auxiliary grind unit **41** can be bodily shifted to ensure that the axis *b* of the grinding wheel **42** and motor **43** is prependicularly "plumb." For this purpose, the wall **88** of bracket **67** is formed with radially disposed slots **96** through which securing screws **97** are passed and threaded into tapped holes **98** in the wall **88** of frame **66**.

The arm **65** is caused to swing about the axial line *a* to move the grinding wheel **42** and template follower roll **45** toward and away from the workpiece and auxiliary template **44**, by a piston and cylinder arrangement of which the piston rod **100** is pivotally connected by a pin **101** at clevis **102** to the arm **65**. As herein shown, the cylinder **103** is mounted in a bearing block **104** for swinging movement about the aligned axis of journal studs **105** and **106**, forming parts of the cylinder case **107**, in response to movement of the contained piston **108**. The head end of the cylinder **103** is connected by pipe **109** to a source of pneumatic pressure and the rod end is similarly connected by pipe **110**. The block **104** is adjustably mounted on the platform **62** of support structure **61** by a base **112**; suitable screws **113** being threaded through angle members **114** and adapted to shift the block **104** relative to the base **112**. Since the axis *c* of the pin **101** swings through a fixed arc about the axis *a*, the axis *d* about which the cylinder **103** will swing can thus be adjusted relative to the axis *a*.

Referring now to FIG. 6, there is shown an exemplary form of electric control system for connection of pipes **109** and **110** to a valve **117** in alternating sequences of operation. During location of the auxiliary grinding unit **41** in the rest or non-operating position, as in FIG, 2, the valve **117** directs pressure from a supply pipe **118** to the pipe **109** and the head end of the cylinder **103**. Valve **117** is actuated in response to circuits established through a relay switch RS **120** having contact pairs **121** and **122** and opposed solenoids **123** and **124**.

Now, when the worktable carries the post **54**, for example, into engagement with the switch device LS **52**, a circuit is made from source line **126** by way of manually operable switch **127**. When closed, LS **52** completes a circuit by line **128** through solenoid **123** of RS **120** to opposite source line **129**. This will disengage contact pair **121** and engage contact pair **122** to make a circuit from source line **126** by line **130** through the end **131** of the cylinder **103** to source line **129**. Direction of pressure through pipe **109** to the head end of cylinder **103** will result in outward movement of the piston rod **100**. This will act to swing the grinding unit **41** toward the worktable **11** to carry out the grinding action of the smaller grinding wheel **42**.

With continued rotation of the worktable **11**, the post **54** will be carried from engagement with LS **52** to break the circuit of line **128** and eventually into engagement with switch device LS **53** to close the same. This will complete a circuit from source line **126** by line **135** through opposed solenoid **124** of RS **120** to source line **129**. While energized, solenoid **124** is operated to disengage contacts **122**, opening the circuit of line **130**, and to engage contact pair **121** thereby establishing a circuit from source line **126** and line **136** through the end **137** of valve **117** to source line **129**. Thereupon the direction of pressure through said valve will be reversed from pipe **109** to pipe **110**. This will serve to retract the piston **108** and rod **100** to return the auxiliary grinding unit **42** to its rest or inactive position, as in FIG. 2.

OPERATION

As diagrammatically illustrated in FIG. 7, the solid line **140** from axis *a* to axis *b* indicates the rest position of the arm **65**; line **141**, to axis *c* of the clevis **102**, and line **142** from axis *c* to axis *d* the positional relation of piston rod **100**. When these lines are swung to the phantom lines **140'**, **141'** and **142'**, the template follower roll **45** will be brought into contact with the leading sector **47** of auxiliary template **44** and the smaller grinding wheel **42** into engagement with the selected area of the workpiece. As herein indicated, this point of engagement is along the so-called "unexposed" edge of the workpiece. As the roll **45** traverses the sector **47** and around the curved end sector **48**, it is expected that the roll **45** will cause outward motion of the grinding wheel **42** and momentary retraction of the piston rod **100**. This is a temporarily imposed mechanical thrust against the pressure behind the piston **108**. However, as rotation of the worktable **11** continues in a clockwise direction, the roll **45** enters the trailing sector **49**, the mechanical thrust is progressively dissipated and the pressure in cylinder **108** again becomes effective to maintain the template follower roll against the auxiliary template **44**.

As shown in FIG. 8, and as the follower roll **45** approaches the end of the sector **49**, the then active post **54** or **55** will actuate the switch device **53** to cause reversal of pressure through the valve **117** to cylinder **103**. The positions of the arm **65** and the rod **100**, as indicated by the phantom lines **143** and **144**, will be swung rearwardly until the line **143** coincides with the original line **140** of FIG. 6 with the auxiliary grinding unit **41** in the rest position.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention.

I claim:

1. In edge grinding apparatus, the combination including rotatable worktable for holding a flat workpiece with at least one edge thereof exposed, a main grinding unit including at least one rotatable grinding wheel adapted to engage said exposed edge of the workpiece, a template carried by said worktable and rotatable therewith, a template follower roll carried by said main grinding unit and riding against said template to gage the grinding action of said grinding wheel, an auxiliary grinding unit mounted adjacent said worktable and including an auxiliary grinding wheel of relatively smaller diameter than the grinding wheel of said main grinding unit, an auxiliary template also carried by said worktable, a template follower roll carried by said auxiliary grinding unit and engageable with said auxiliary template to gage the grinding action of said auxiliary grinding wheel, means for mounting said auxiliary grinding unit and for moving the grinding wheel thereof toward and into engagement with a selected area of the exposed edge of the workpiece and the related follower roll into engagement with said auxiliary template and subsequently away therefrom, and control means activated by rotation of the worktable to move

the template follower roll of said auxiliary grinding unit into engagement with said auxiliary template and subsequently out of engagement therewith.

2. In edge grinding apparatus, as defined in claim 1, in which said auxiliary template has an edge contour corresponding in curvature to a selected area only of the edge of the workpiece to be ground.

3. In edge grinding apparatus, as defined in claim 2, in which the auxiliary grinding unit comprises means for pivotally mounting said auxiliary grinding unit, means for swingably moving said auxiliary grinding unit about the axis of said pivotal mountng means, means activated upon rotation of said worktable to operate said moving means to swing said auxiliary grinding unit and the grinding wheel thereof into engagement with a selected area of the exposed edge of the workpiece, in which said last-named means comprises switch means operatively connected with the moving means and means carried by the worktable to actuate said switch means during rotation thereof.

4. In edge grinding apparatus, as defined in claim 3, in

which said switch means includes a first switch engaged by the actuator means to swingably move said auxiliary grinding unit and the template follower roll thereof toward the said auxiliary template and grinding wheel toward the workpiece at the leading portion of the selected area to be ground and a second switch subsequently engaged by said actuator means to swingably move said auxiliary grinding unit to remove the template follower roll from said auxiliary template and said grinding wheel from the workpiece at the trailing portion of the selected area to be ground.

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