Oct. 1, 1935. R. J. LOUVIAUX 2,015,720

EDGE GRINDING APPARATUS

Filed Nov. 9, 1931 3 Sheets-Sheet 1

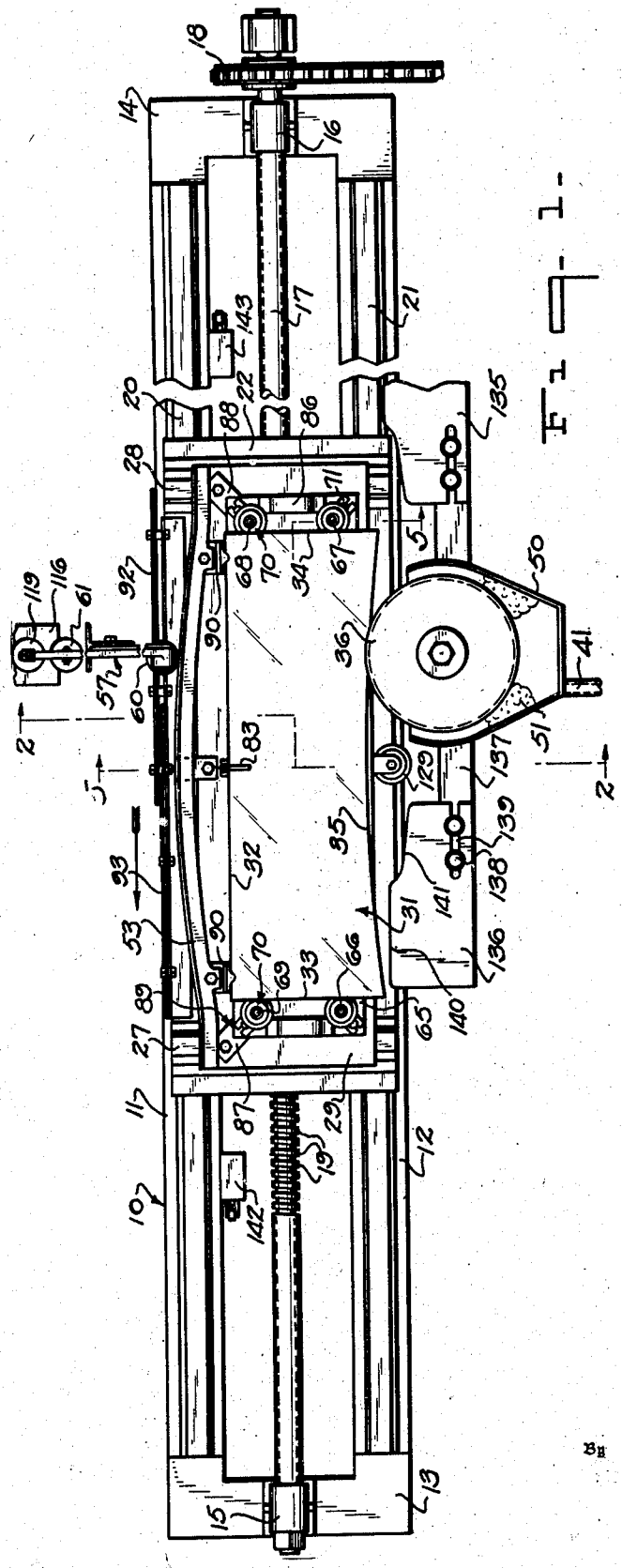


Fig. 1.

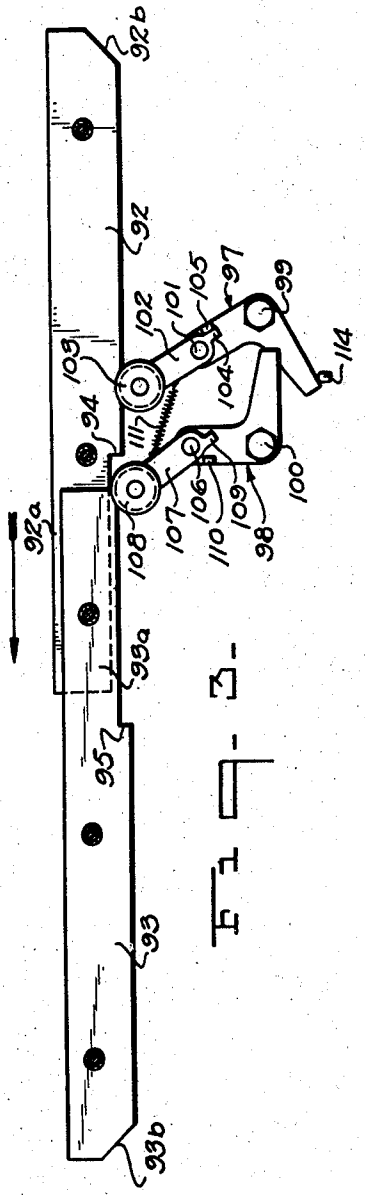


Fig. 3.

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EDGE GRINDING APPARATUS

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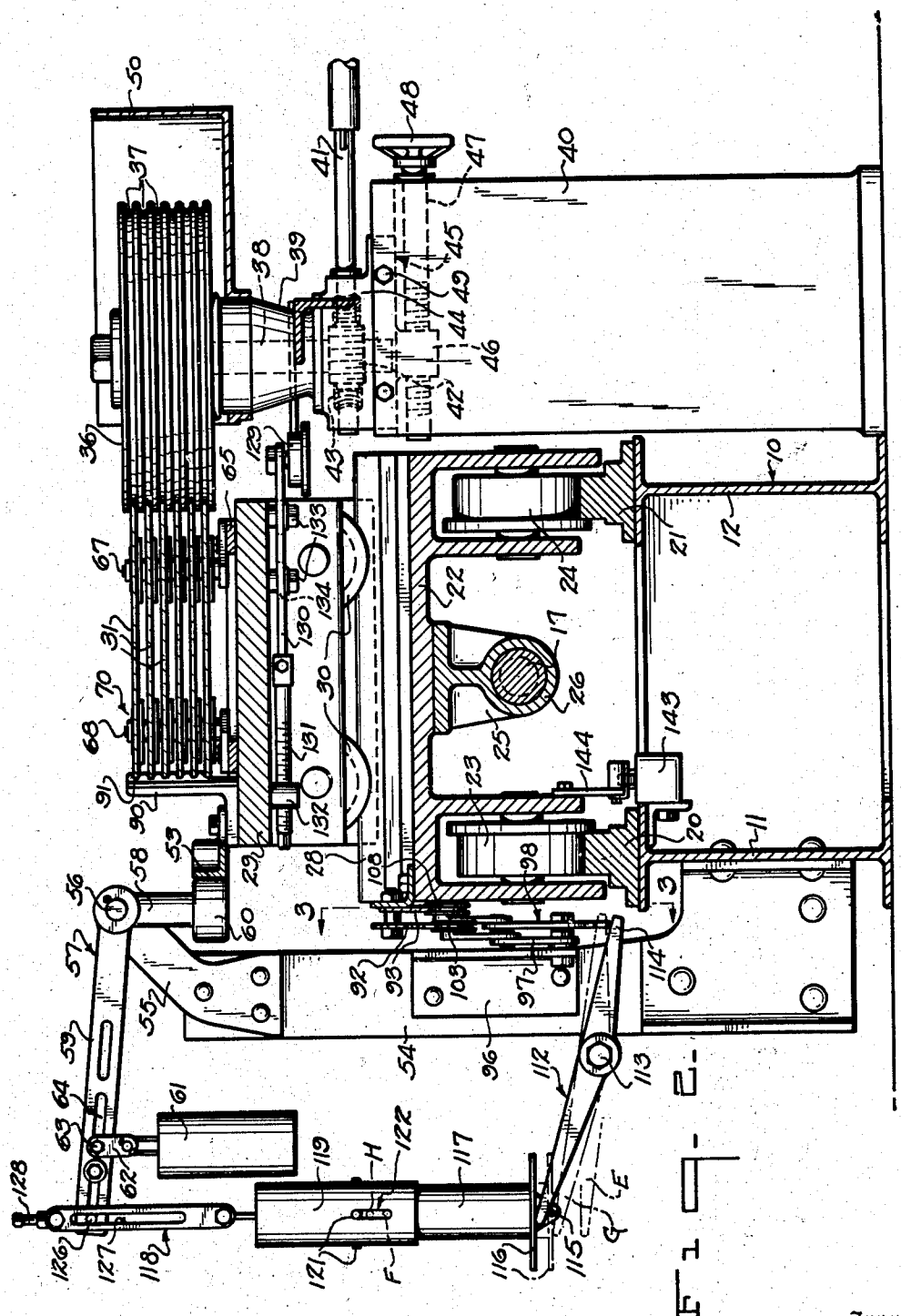


FIG. 2.

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EDGE GRINDING APPARATUS

Filed Nov. 9, 1931 3 Sheets-Sheet 3

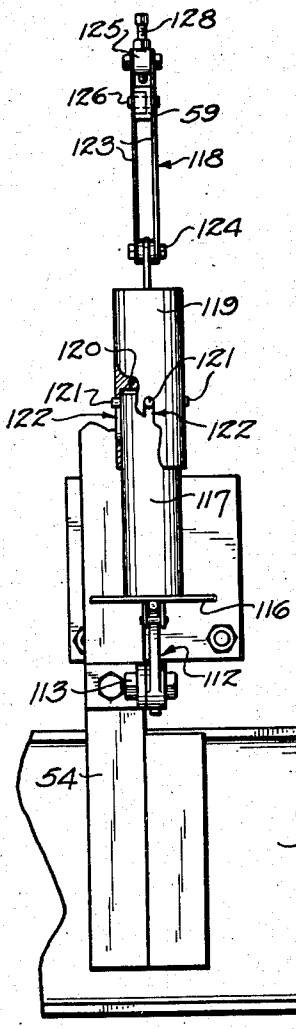


Fig. 4.

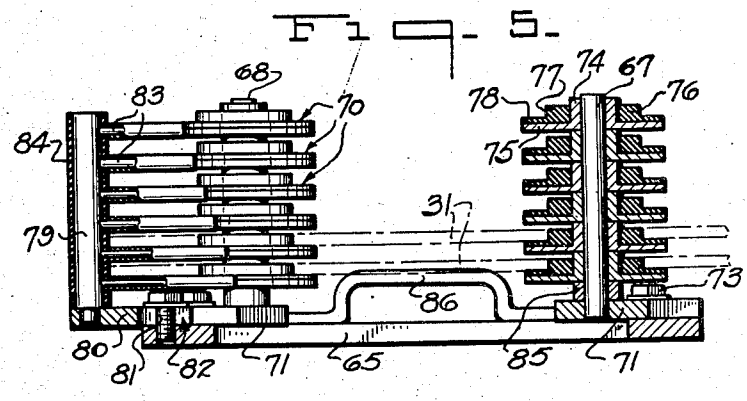


Fig. 5.

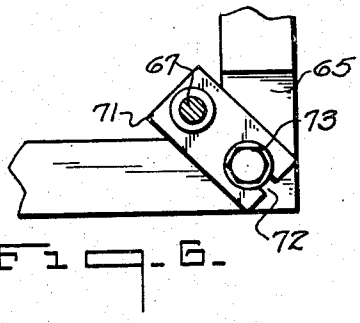


Fig. 6.

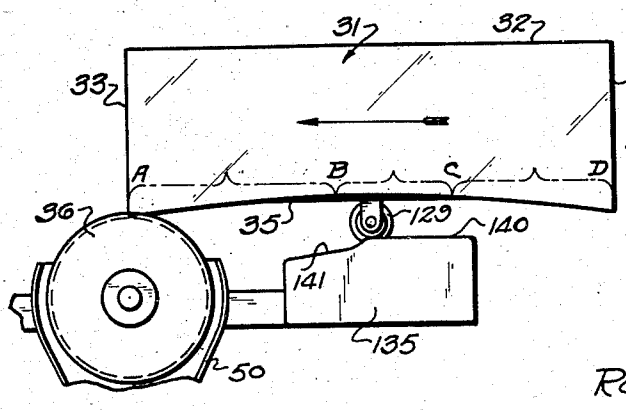


Fig. 7.

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UNITED STATES PATENT OFFICE

2,015,720

EDGE GRINDING APPARATUS

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Application November 9, 1931, Serial No. 573,762

32 Claims. (Cl. 51—100)

The present invention relates broadly to improvements in grinding machines generally, and more particularly to a machine or apparatus for rounding and/or finishing the edges of sheets or plates of glass and the like.

An important object of this invention resides in the provision of a grinding machine of simplified and inexpensive construction which is especially designed for use in grinding the lower edges of automobile windshields and the like which are cut on a curve, although it is of course in no way restricted to such use.

Another object of the invention is the provision of such a grinding machine of the character above described which will round and finish the curved edges of the windshields rapidly, accurately, and economically, and with a minimum effort and attention on the part of the operator, whereby uniformly rounded edges with well finished surfaces may be secured.

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

In the drawings forming a part of this application and wherein like numerals are employed to designate like parts throughout the same,

Fig. 1 is a plan view of a grinding machine constructed in accordance with the present invention,

Fig. 2 is a tranverse section taken substantially on line 2—2 of Fig. 1,

Fig. 3 is a section taken substantially on line 3—3 of Fig. 2,

Fig. 4 is a detail elevation showing the arrangement of the weights,

Fig. 5 is a section taken substantially on line 5—5 of Fig. 1,

Fig. 6 is a detail plan view of a portion of the supporting means for the glass sheets or plates, and

Fig. 7 is a diagrammatic plan view showing the position of the glass sheet or plate in relation to the grinding element at the start of the grinding operation.

Referring now to the accompanying drawings, and particularly with reference first to Figs. 1 and 2, the machine herein provided comprises a supporting base designated in its entirety by the numeral 10 and consisting of the spaced longitudinally extending parallel I-beams 11 and 12 connected at their opposite ends by the end members 13 and 14 upon which are mounted the bearings 15 and 16 respectively. Extending longitudinally of the supporting base 10 and having its opposite ends journaled within the bearings 15 and 16 is a shaft 17 driven from one end by a suitable chain drive or the like 18 and being threaded throughout a suitable portion of its length as at 19.

Carried upon the top of the I-beams 11 and 12 are the longitudinally extending parallel rails 20 and 21 respectively which are adapted to support thereupon a substantially rectangular table 22, said table being mounted upon wheels 23 and 24 which rest upon and run along the said rails 20 and 21. Secured to the undersurface of the top of table 22 is a depending bracket 25 provided with an internally threaded portion 26 through which is threaded the shaft 17 so that, upon rotation of the said shaft, the table may be moved back and forth along the rails 20 and 21.

Carried upon the top of table 22 and extending transversely thereof are the spaced parallel rails 27 and 28 which are disposed at substantially right angles to the main rails 20 and 21. Supported upon the table 22 is a substantially rectangular carriage 29 having wheels 30 which rest upon the rails 27 and 28 so that the said carriage is freely movable along the said rails in a direction at substantially right angles to the direction of movement of the table 22 along rails 20 and 21.

The glass sheets or plates to be ground are designated by the numeral 31, and one or more of these plates are adapted to be supported in a horizontal position upon the carriage 29 so that they are movable therewith. While the glass plates 31 have been illustrated in the drawings as being in the form of an ordinary windshield having the upper straight horizontal edge 32, the substantially parallel side edges 33 and 34, and the lower inwardly curved edge 35, yet it will be readily appreciated that glass plates of other shapes may also be ground. However, when grinding the lower inwardly curved edges 35 of the ordinary windshields, the said windshields are arranged in a substantially horizontal position upon the carriage 29, with the inwardly curved edges 35 facing to the front of the machine as shown in the drawings. Then, upon movement of the table 22 along rails 20 and 21, the said windshields are adapted to be carried past a grinding element 36 with the edges 35 thereof to be ground in engagement therewith, as a result of which the said grinding element will operate to round and/or finish the said edges.

The grinding element 36 is preferably in the form of a disc or wheel having formed in the pe-

riphery thereof a plurality of grooves 37 within which the adjacent curved edges 35 of the glass plates are received during the grinding operation. The grinding wheel is carried at the upper end of a vertically disposed shaft 38 journaled within a bearing 39 slidably supported upon the upper end of a stationary standard 40. The shaft 38 may be driven from a drive shaft 41 having keyed thereto a worm 42 which meshes with and drives a worm gear 43 fixed to the said shaft 38. In order to permit of the grinding wheel being moved toward or away from the table 22, the base portion 44 of bearing 39 may be slidably received within a groove 45 in the upper end of standard 40. The base portion 44 may also be provided with a depending lug 46 through which is threaded an adjusting screw 47 provided at its outer end with a hand wheel 48. Thus, upon turning of hand wheel 48 to rotate adjusting screw 47, the base portion 44 can be slid within groove 45 to move the grinding wheel toward or away from table 22. The grinding wheel can be secured in properly adjusted position by means of set screws 49 or the like which pass transversely through the standard 40 and engage base portion 44.

Carried by the bearing 39 and substantially surrounding the grinding wheel 36 is a receptacle 50, and arranged within this receptacle between the side walls thereof and the grinding wheel are sponges or the like 51. During the grinding operation, the sponges 51 are adapted to hold a sufficient amount of moisture and to apply the same to the grinding wheel.

Inasmuch as the carriage 29 is freely movable upon rails 27 and 28 toward and away from the grinding wheel 36, it is of course necessary that some means be provided to maintain the curved edges 35 of the glass plates 31 in engagement with the grinding wheel as the said plates are carried past the same upon movement of table 22 along rails 20 and 21. To this end, there is secured to the carriage 29 at the rear edge thereof a longitudinally extending cam track 53, said track being bowed or arcuately curved rearwardly, with the curvature thereof being substantially the same as the curvature of the plate edges 35 to be ground.

Secured to the I-beam 11 of the supporting base 10 at a point substantially opposite the grinding wheel 36, is a vertically disposed bracket 54 carrying at its upper end an extension plate 55 to which is pivoted intermediate its ends as at 56 a bell crank lever 57 including a substantially vertical arm 58 and a relatively longer substantially horizontal arm 59. The substantially vertical arm 58 carries at its lower end a freely rotatable roller 60 which is adapted to engage and ride along the cam track 53, while suspended from the substantially horizontal arm 59 of the bell crank lever is a weight 61 which tends to rock the said lever 57 about its pivot to maintain the roller 60 in engagement with cam track 53. The pressure of the roller against the cam track serves to urge the carriage 29 forwardly upon rails 27 and 28 and yieldably maintain the curved edges 35 of the glass plates in engagement with the grinding wheel as they are carried past the same. The weight 61 may be adjustably secured to the horizontal arm 59 by a link 62 and bolt 63, which bolt passes through a slot 64 in the said arm 59 so that the weight may be moved inwardly or outwardly to vary the pressure of the roller 60 against cam track 53.

The means for supporting the glass plates 31 in spaced horizontal position upon the carriage 29 includes a substantially rectangular base member or frame 65 adapted to rest upon the top of carriage 29. Carried at the four corners of the frame 65 are the vertically disposed pins 66, 67, 68 and 69 respectively, each being adapted to loosely receive thereupon a plurality of discs 70 which rest one upon the other, with the discs upon the several pins being in horizontal alignment. Each vertical pin 66, 67, 68 and 69 is carried by a horizontal plate 71 having a slot 72 therein through which passes a bolt 73 by which the respective plate is adjustably secured to the frame. In other words, upon loosening bolt 73, the respective plate 71 and discs 70 carried thereby may be moved inwardly or outwardly with respect to the frame. Each of the discs 70 comprises a metallic hub 74 slidable upon the respective pins 66 to 69 and having formed integral therewith a horizontally disposed annular flange 75 upon which is carried a pad 76 preferably of relatively hard rubber or some similar material. The pad 76 is cut away or reduced in thickness to form a vertical annular shoulder 77 encircled by a horizontal annular marginal portion 78.

Also secured to the frame 65 at the rear thereof and preferably at a point intermediate its ends is a vertically disposed pin 79 carried by a horizontal plate 80, said plate resting upon the frame and being secured thereto by a bolt or other fastening element 81 which passes through a slot 82 in said plate 80, so that upon loosening of bolt 81, the pin 79 can be moved forwardly or rearwardly with respect to the frame. Carried by and extending forwardly from the pin 79 are a plurality of superimposed parallel fingers 83, said fingers being spaced from one another and in substantial alignment with the discs 70, as best shown in Fig. 5, so that the plates of glass 31 may be received therebetween. The pin 79 and also the fingers 83 are preferably provided with a covering 84 of rubber or other suitable material. The fingers 83 preferably decrease in length from the bottom finger to the upper finger although such an arrangement is not absolutely essential.

When assembling a plurality of the glass plates 31 in position upon the frame 65, all of the discs 70 are first removed from the vertical pins 66 to 69, with the exception of the lowermost disc upon each pin which is held spaced from the respective plate 71 by a spacing collar 85. One of the glass plates is then laid upon the lowermost discs carried by the four corner pins 66 to 69, with the said sheet being loosely supported at its opposite end edges 33 and 34 upon the marginal portions 78 of the rubber pads 76 as best shown in Figs. 1 and 5. After one sheet has been thus placed in position, a second plate of glass is then placed upon these discs in the same manner as described above. The remaining discs are then successively slipped onto the pins, with a plate of glass being supported upon each tier of discs. After the glass plates have been thus properly assembled in superimposed relationship, the several series of discs at the four corners of the frame are moved toward one another in a manner to engage and clamp the sheets firmly in position, at which time the end edges 33 and 34 of the plates abut the vertical shoulders 77 of the discs. When arranging the glass plates in position, they are positioned so that they are received between the fingers 83 with the rear longitudinal edges 32 thereof abutting the vertical pin 79. When it is desired to assemble a series of sheets or plates upon the frame 65, the said frame is preferably re-

moved from the machine, and this removal is greatly facilitated by the provision of handles 86 at the opposite ends of the frame. By having two frames 65 available, it is possible to be grinding one series of glass plates in the machine while a second series of glass plates is being assembled upon the other frame.

In order to effect proper positioning of the frame 65 upon the top of carriage 29 and also to prevent any rearward or lateral movement thereof relative to said carriage, there may be secured to the top of the carriage adjacent opposite ends thereof the plates 87 and 88 respectively, each plate being disposed diagonally of the carriage and having a V-shaped notch 89 within which the adjacent corner of the frame 65 is received. In order to more effectively prevent any rearward slipping movement of the glass plates relative to the frame during grinding, there may be carried by the top of the carriage at the rear thereof and adjacent each end a vertically disposed fixed retaining member 90 provided with a plurality of grooves 91 within which the rear edges of the glass plates are received.

Briefly stated, the operation of the machine as thus far described is as follows: The frame 65 is first removed from the machine and a plurality of glass plates 31 assembled thereupon in the manner explained above, after which the frame is replaced in the machine, being supported upon the top of the carriage 29 in such a manner that the frame engages the stop plates 87 and 88 while the rear longitudinal edges of the glass plates abut the retaining members 90. During the assembling of the glass plates and the insertion thereof in the machine, the table 22 is adapted to be located entirely to one side of the grinding wheel 36, such as for instance, to the right thereof when viewing the machine in Fig. 1. The shaft 17 is then rotated to effect the desired movement of the table 22 to the left upon rails 20 and 21. This movement of the table will serve to carry the carriage 29 and glass plates 31 past the grinding wheel 36, with the forward curved edges 35 of the glass plates in engagement therewith. During the travel of the glass plates past and in engagement with the grinding wheel, the said wheel is adapted to be simultaneously rotated so as to effect the rounding and finishing of the edges 35 thereof. The roller 60 engaging cam track 53 will function to urge the carriage 29 forwardly so as to maintain the curved edges of the glass plates in engagement with the grinding wheel while, at the same time, permitting rearward movement of the carriage. That is to say, since the carriage is freely movable toward and away from the grinding wheel, it will be caused to move first forwardly and then rearwardly as the inwardly curved edges 35 of the glass plates are being ground.

The curvature required in a conventional windshield is ordinarily irregular, the radius of curvature for the major portion of the lower curved edge being relatively large while that for the opposite ends of the curved edge is much shorter. When rounding and finishing curved edges of this character upon the machine herein provided, it is desirable that a relatively large degree of pressure be applied to urge the glass plates forwardly during the grinding of approximately the first half of the curved edge, and that this pressure be gradually reduced during the grinding of the second half of the curved edge. Otherwise stated, and referring particularly to Fig. 7, during the grinding of the curved edge 35 of the glass plate 31 from the point A to point B, with the glass plate moving in the direction indicated by the arrow, a relatively greater degree of pressure tending to urge the plate forwardly into engagement with the grinding wheel 36 is required than when grinding the curved edge from points B to C, with still less pressure being required in grinding the curved edge from points C to D. This varying degree of pressure is necessitated due to the fact that during the grinding of the curved edge from points A to B, the glass plate is moving forwardly toward the grinding wheel. However, when grinding the curved edge from points B to C there is no appreciable forward or rearward movement of the plate so that less pressure is required, and this pressure may be further lessened when grinding the curved edge between points C and D since at this time the glass plate is being moved rearwardly and the inertia of the carriage and its associated parts is sufficient to maintain the plate in engagement with the grinding wheel. The present invention, therefore, also contemplates the provision of pressure means tending to urge the glass plates forwardly into engagement with the grinding wheel as they are carried past the same, together with means for gradually lessening the pressure of said pressure means upon movement of the table 22 and when the glass plates reach certain predetermined positions with respect to the grinding wheel.

To this end, there is carried at the rear of the table 22 the two longitudinally extending vertically disposed plates 92 and 93, said plates being arranged parallel with one another, with the plate 92 being disposed slightly outwardly of plate 93. The adjacent inner ends 92a and 93a of the said plates overlap one another as shown and these overlapping portions are of a somewhat reduced width so as to provide the resultant shoulders 94 and 95 respectively. Referring particularly to Figs. 2 and 3 there is pivoted to an auxiliary bracket 96 carried by upstanding bracket 54 intermediate the upper and lower ends thereof the two bell crank levers 97 and 98 respectively, said bell crank levers being of substantially the same construction but reversely positioned with respect to one another.

The bell crank lever 97 is pivoted to bracket 96 as at 99, while bell crank lever 98 is pivotally mounted upon said bracket as at 100, with the two pivot points 99 and 100 being in substantial horizontal alignment with one another. Pivoted to the upper end of bell crank lever 97 as at 101 is a plate 102 carrying a roller 103 which is adapted to engage and ride along the bottom edge of plate 92 during longitudinal movement of the table 22 along rails 20 and 21. The plate 102 is provided at its inner end with a lug 104 adapted to engage a boss 105 formed on bell crank lever 97 whereby to limit the swinging movement of the plate 102 to the left. The bell crank lever 98 has pivoted to the upper end thereof as at 106 a plate 107 similar to plate 102 and carrying a roller 108 which is adapted to engage and ride along the bottom edge of plate 93. The plate 107 is formed at its inner end with a lug 109 adapted to engage a boss 110 on bell crank lever 98 whereby to limit the swinging movement of plate 107 to the right. The two plates 102 and 107 are preferably connected together by a spring 111 so that the said plates move in unison either to the left or to the right.

Also carried by the upstanding bracket 54 is a rocker arm 112, said arm being pivotally mounted

intermediate its ends to the bracket as at 113, the inner end 114 of the rocker arm being positioned beneath and engageable by the lower ends of the two bell crank levers 97 and 98, while the outer end of the rocker arm has pivoted thereto as at 115 a horizontally disposed platform 116 upon which is adapted to be supported at all times a cylindrical weight 117.

As best shown in Figs. 2 and 4, there is suspended from the substantially horizontal arm 59 of bell crank lever 57 by means of the hanger 118, a cylindrical weight 119, said weight being provided in the bottom thereof with a recess 120 within which is received the upper end portion of the cylindrical weight 117. The weight 117 carries at its upper end a plurality of laterally projecting pins 121 which extend through vertical slots 122 formed in the wall of the recess 120 so that the weight 117 is vertically movable relative to weight 119. The hanger 118 comprises the spaced metal strips 123 pivotally connected to the weight 119 as at 124. The upper ends of strips 123 straddle the horizontal arm 59 of bell crank lever 57 and are secured thereabove to a block 125. The horizontal arm 59 of the bell crank lever carries a pin 126 which is received within vertical slots 127 in strips 123. Carried by the block 125 and extending vertically therethrough is an adjusting screw 128, said screw engaging the top of horizontal arm 59 and by means of which the hanger 118 and consequently the weight 119 carried thereby may be adjusted vertically.

In carrying out the present invention, and for the purposes of illustration, let is assume that the table 22 is at the extreme right hand end of the rails 20 and 21 in Fig. 1 and that the plates of glass to be ground have been properly assembled and positioned upon the carriage 29. At such time, the entire force of the weights 117 and 119 rests upon the platform 116, thereby holding the outer end of the rocker arm 112 downwardly in the position shown by the broken lines and designated E which, of course, throws the inner end 114 of the rocker arm upwardly. When the full force of the weights 117 and 119 is being utilized, the weight 117 is suspended from the weight 119, being supported by the pins 121 which are at this time in the lower ends of the slots 122 as indicated at F.

The shaft 17 is then rotated to move the table 22 to the left along rails 20 and 21 so as to carry the plates of glass past and in engagement with the grinding wheel 36 which is being simultaneously rotated. During the grinding of the curved edges 35 of the glass plates 31 from the point A to point B in Fig. 7, the entire force of the weights 117 and 119, as well as weight 61, is being utilized to rock the bell crank lever 57 about its pivot 56 to urge the roller 60 into engagement with cam track 53, whereby to urge the carriage 29 forwardly. During the grinding of the curved edge of the glass plate from points A to B, the said plate is not only being carried horizontally past the grinding wheel 36 but is being simultaneously moved forwardly. The glass plate gradually moves forwardly until the point B thereof is substantially opposite the grinding wheel. However, when grinding the curved edge from points B to C, there is no appreciable forward or rearward movement of the glass plate and consequently, during the grinding of this portion of the curved edge, it is desirable to release a certain amount of the force to the weights so as to reduce the pressure of the roller 60 acting to urge the carriage 29 forwardly. This is herein accomplished in the following manner:

When the point B of the glass plate arrives at a position substantially opposite the grinding wheel, the roller 103 carried by bell crank lever 97 is engaged by the inner reduced end 92*a* of plate 92, whereupon the plate 102 will be swung to the left about its pivot 100 and the lug 104 engaging boss 105 will serve to rock the bell crank lever 97 about its pivot 99. Upon such rocking movement of the bell crank lever 97, the lower end thereof will engage the inner end 114 of rocker arm 112, and will function to rock the said arm about its pivot so as to raise the outer end thereof, together with the platform 116. The raising of the platform 116 will move the weight 117 upwardly relative to weight 119 so that the force of the weight 117 will be released from the arm 59. At this time, the outer end of the rocker arm 112 will be raised to the position indicated at G, and the pins 121 carried by weight 117 to the position indicated at H within the slots 122. Therefore, during the grinding of the curved edge of the glass plate between points B and C, the roller 60 will be urged into engagement with the cam track 53 by the weights 61 and 119 only.

During the grinding of the curved edge of the glass plate between points C and D even less pressure is required to urge the carriage 29 forwardly since the said carriage is being moved rearwardly and the inertia thereof will tend to hold the glass plate in engagement with the grinding wheel. Therefore, upon continued movement of the table 22 to the left and, in fact, when the point C of the curved edge arrives at a position substantially opposite the grinding wheel, the roller 103 carried by bell crank lever 97 will be engaged by the shoulder 94 on plate 92, with the result that the said bell crank lever will again be rocked about its pivot 99 to further depress the inner end 114 of rocker arm 112 so as to raise the outer end of said arm and the platform 116 to the position indicated by the full lines in Fig. 2. At this time the pins 121 carried by weight 117 will engage the upper ends of the slots 122 and will lift the weight 119 and hanger 118 so as to release the force of the weight 119 from arm 59, with the result that the only pressure tending to urge the carriage 29 forwardly will be the pressure exerted by the force of the weight 61.

Upon continued movement of the table 22 to the left, and when the plate 92 passes out of engagement with roller 103, the weights 117 and 119 will be permitted to drop downwardly since, at such time, the bell crank lever 97 will no longer function to hold the weights in their elevated position. In other words, the rocker arm 112 will be swung by the weights in the opposite direction, whereupon to raise the inner end 114 thereof, and the raising of this inner end will swing the bell crank lever 97 about its pivot to the right.

When the table 22 reaches the extreme left hand end of the rails 20 and 21, the finished glass plates may be removed from the carriage and other plates to be ground positioned thereupon. The table is then moved to the right and the above cycle of operations will be repeated, with the exception that the weights 117 and 119 will be successively released by the plate 93 engaging roller 108 carried by bell crank lever 98. In other words, when the table 22 is moved from right to left, the weights 117 and 119 are released by engagement of the plate 92 with roller 103 whereas, when the table moves from left to right, the weights are released by the plate 93 engaging roller 108.

Upon movement of the table 22 to the right, the outer bevelled end 92b of plate 92, engaging roller 103, will swing the said roller and plate 102 to the right and, due to the provision of the connecting spring 11, this swinging movement of plate 102 will also serve to swing the plate 107 and roller 108 to the right about pivot 106 so that said roller 108 will be in a position to be engaged by the plate 93 upon continued movement of the table to the right. On the other hand, when the table 22 moves to the left, the outer bevelled end 93b of plate 93 engaging roller 108 will swing the said roller, together with plate 107, to the left, and, due to the provision of spring 111, the roller 103 and plate 102 will also be swung to the left so that the said roller 103 will be in a position to be engaged by plate 92 upon continued movement of the table to the left. When the table 22 is moved to the right, however, the engagement of the inner end 93a of plate 93 with roller 108, will serve to release the weight 117, while the engagement of shoulder 95 with roller 108 will cause the release of the weight 119.

In order to prevent excessive grinding or chipping of the corners of the glass plates 31 when they are first moved to engage the grinding wheel, there may be carried by the carriage 29 at a point substantially intermediate its ends a horizontally disposed roller 129 projecting forwardly thereof. This roller, as shown in Fig. 2, is rotatably supported at the outer end of an arm 130 arranged beneath the carriage transversely thereof and pivotally connected at its inner end to a screw 131 threaded through a depending lug 132. Carried by the undersurface of the top of the carriage are a plurality of fastening elements 133 which pass through slots 134 in arm 130 so that, upon rotation of screw 131, the roller 129 may be moved inwardly or outwardly as desired.

Positioned outwardly of the table 22 and at opposite sides of the grinding wheel are the metal plates 135 and 136 (Fig. 1), each being secured to a longitudinally extending beam 137 by bolts or the like 138 which pass through a slot 139 so that the said plates 135 and 136 may be moved toward or away from the ginding wheel. The inner edge of each plate 135 and 136 is provided with a substantially straight portion 140 terminating in a forwardly curved portion 141. As best illustrated in Fig. 7, at the beginning of the grinding operation and when the left hand corner of the glass plate initially engages the grinding wheel, the roller 129 riding along the straight portion 140 of the inner edge of plate 135 will tend to offset or counteract the action of the weights 61, 117 and 119 and will hold the carriage rearwardly so as to prevent any forward movement thereof until the corner of the glass plate has been carried past the grinding wheel, at which time the roller 129 will ride upon the curved portion 141 of the inner edge of the plate so as to permit of the carriage being moved forwardly by the weights. The plate 136 will function in the same manner to prevent excessive grinding or chipping of the right hand corner of the glass plate when the table 22 is moved from left to right.

If desired, suitable limit switches 142 and 143 may be positioned in the path of travel of the table 22 and engageable thereby when the said table reaches a predetermined position to bring the same to a stop. The said limit switches 142 and 143 are preferably connected in series with the motor (not shown) operating the chain drive 18 for the shaft 17 and, to effect the opening of the limit switches, there may be carried by the table 22 adjacent each end thereof a dog 144.

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

I claim:

1. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position, means for supporting the sheet in a substantially fixed position and for conveying the same in a substantially straight path past said grinding element with the curved edge thereof to be ground in engagement therewith, said sheet supporting and conveying means being movable toward and away from said grinding element, and means for yieldably urging said sheet toward and maintaining it in engagement with the grinding element as it is carried past the same.

2. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position, means for supporting the sheet in a substantially fixed position and for conveying the same in a substantially straight path past said grinding element with the curved edge thereof to be ground in engagement therewith, said sheet supporting and conveying means being movable toward and away from the grinding element, and means acting against the said supporting and conveying means to yieldably urge the sheet toward and maintain it in engagement with said grinding element as it is carried past the same.

3. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, means for supporting the sheet in a substantially fixed position and for conveying the same horizontally in a substantially straight path past said grinding wheel with the curved edge thereof to be ground in engagement therewith, said sheet supporting and conveying means being movable toward and away from said grinding wheel, and means for yieldably urging said sheet toward and holding it in engagement with the grinding wheel as it is carried past the same.

4. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, means for supporting the sheet in a substantially fixed position and for conveying the same horizontally in a substantially straight path past said grinding wheel with the curved edge thereof to be ground in engagement therewith, said sheet supporting and conveying means being movable toward and away from the grinding wheel in a direction at substantially right angles to its direction of movement past the same, and means acting against the said supporting and conveying means to yieldably urge the sheet toward and hold it in engagement with said grinding wheel.

5. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position, means for supporting and conveying the sheet in a substantially straight path past said grinding element with the curved edge thereof to be ground

in engagement therewith, pressure means acting to yieldably urge the sheet toward and hold it in engagement with the grinding element as it is carried past the same, and means automatically operable when the sheet reaches a predetermined position with respect to said grinding element to vary the pressure of said pressure means while maintaining the said sheet in engagement with the grinding element.

6. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, means for supporting and conveying the sheet horizontally in a substantially straight path past said grinding wheel with the curved edge thereof to be ground in engagement therewith, said sheet being movable toward and away from the grinding wheel in a direction at substantially right angles to its direction of movement past the same, pressure means acting to yieldably urge the sheet toward and hold it in engagement with the grinding wheel, and means automatically operable when the sheet reaches a predetermined position with respect to said grinding wheel to vary the pressure of said pressure means while maintaining the said sheet in engagement with the grinding wheel.

7. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position, means for supporting and conveying the sheet in a substantially straight path past said grinding element with the curved edge thereof to be ground in engagement therewith, said sheet being movable toward and away from the grinding element, pressure means acting to yieldably urge the sheet toward and hold it in engagement with said grinding element as it is carried past the same, and means operable automatically when said sheet supporting and conveying means reaches a predetermined position for lessening the pressure of said pressure means while maintaining the said sheet in engagement with the grinding element.

8. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, means for supporting and conveying the sheet horizontally in a substantially straight path past said grinding wheel with the curved edge thereof to be ground in engagement therewith, said sheet being movable toward and away from the grinding wheel in a direction at substantially right angles to its direction of movement past the same, pressure means acting to yieldably urge the sheet toward and hold it in engagement with said grinding wheel, and means operable automatically when said sheet supporting and conveying means reaches a predetermined position for lessening the pressure of said pressure means while maintaining the said sheet in engagement with the grinding wheel.

9. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position, conveying means movable in a substantially straight path past said grinding element, a carriage carried by said conveying means and movable toward and away from the grinding element in a direction at substantially right angles to the direction of movement of the said conveying means, said sheet being supported upon the carriage and movable therewith past the grinding element, with the curved edge thereof to be ground in engagement therewith, and means for yieldably urging said carriage toward said grinding element to hold the sheet in engagement therewith.

10. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, conveying means movable in a substantially straight path past said grinding wheel, a carriage supported upon said conveying means and movable toward and away from the grinding wheel in a direction at substantially right angles to the direction of movement of the said conveying means, said sheet being supported horizontally upon the carriage and movable therewith past the grinding wheel, with the curved edge thereof to be ground in engagement therewith, and means for yieldably urging said carriage toward said grinding wheel to hold the sheet in engagement therewith.

11. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position, conveying means movable in a substantially straight path past said grinding element, a carriage carried by said conveying means and movable toward and away from the grinding element in a direction at substantially right angles to the direction of movement of the said conveying means, said sheet being supported upon the carriage and movable therewith past the grinding element, with the curved edge thereof to be ground in engagement therewith, pressure means for yieldably urging said carriage toward said grinding element to hold the sheet in engagement therewith, and means operable by the conveying means when the latter reaches a predetermined position to lessen the pressure of said pressure means while maintaining the said sheet in engagement with the grinding element.

12. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, conveying means movable in a substantially straight path past said grinding wheel, a carriage supported upon said conveying means and movable toward and away from the grinding wheel in a direction at substantially right angles to the direction of movement of the said conveying means, said sheet being supported horizontally upon the carriage and movable therewith past the grinding wheel, with the curved edge thereof to be ground in engagement therewith, pressure means for yieldably urging said carriage toward said grinding wheel to hold the sheet in engagement therewith, and means operable by the conveying means when the latter reaches a predetermined position to lessen the pressure of said pressure means while maintaining the said sheet in engagement with the grinding wheel.

13. In a machine for grinding the edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, a table movable in a definite predetermined path past said grinding wheel, a carriage supported upon said table and movable toward and away from the grinding wheel in a direction at substantially right angles to the direction of movement of said table, said sheet being supported horizontally upon the carriage and movable therewith past the grinding wheel, with the edge thereof to be ground in engagement therewith, a plurality of weights acting to yieldably urge said carriage toward said

grinding wheel to hold the sheet in engagement therewith, and means operable upon movement of said table to successively release the said weights.

14. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, a table movable in a substantially straight path past said grinding wheel, a carriage supported upon said table and movable toward and away from the grinding wheel in a direction at substantially right angles to the direction of movement of said table, means carried by said carriage for supporting the sheet horizontally in a substantially fixed position, said sheet being movable with the carriage past the grinding wheel, with the curved edge thereof to be ground in engagement therewith, a cam track carried by said carriage, and means engaging said cam track for yieldably urging said carriage toward said grinding wheel to hold the sheet in engagement therewith.

15. In a machine for grinding the curved edge of a glass sheet or plate, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, a table movable in a substantially straight path past said grinding wheel, a carriage supported upon said table and movable toward and away from the grinding wheel in a direction at substantially right angles to the direction of movement of said table, means carried by said carriage for supporting the sheet horizontally in a substantially fixed position, said sheet being movable with the carriage past the grinding wheel, with the curved edge thereof to be ground in engagement therewith, means for yieldably urging said carriage forwardly toward said grinding wheel to hold the sheet in engagement therewith, and means for counteracting said last-mentioned means whereby to prevent any forward movement of the carriage until the sheet reaches a predetermined position in relation to the grinding wheel.

16. In an apparatus for securing a plurality of glass plates in spaced horizontal relation with respect to one another, a base member, a plurality of vertically disposed pins carried by said base member, and a plurality of discs carried upon each pin, the said discs upon the several pins being in alignment with one another.

17. In an apparatus for securing a plurality of glass plates in spaced horizontal relation with respect to one another, a base member, a plurality of vertically disposed pins carried by said base member, and a plurality of discs carried upon each pin, the said discs upon the several pins being in alignment with one another, and each disc having a horizontal portion upon which the glass plate is adapted to rest and a vertical shoulder against which the adjacent edge of the plate is adapted to abut.

18. In an apparatus for securing a plurality of glass plates in spaced horizontal relation with respect to one another, a substantially rectangular base member, a vertically disposed pin carried at each of the four corners of said base member, a plurality of discs carried upon each pin, with the said discs upon the several pins being in alignment with one another, and a vertically disposed pin carried by the base member intermediate the ends thereof and having a plurality of horizontal superimposed fingers spaced from one another and in substantial horizontal alignment with said discs.

19. In an apparatus for securing a plurality of glass plates in spaced horizontal relation with respect to one another, a base member, a plurality of vertically disposed pins carried by said base member, and a plurality of discs carried upon each pin, the said discs upon the several pins being in alignment with one another, and means for adjustably mounting said pins upon the base member in a manner that the discs can be moved inwardly or outwardly.

20. In an apparatus for securing a plurality of glass plates in spaced horizontal relation with respect to one another, a substantially rectangular base member, a vertically disposed pin carried at each of the four corners of said base member, a plurality of discs carried upon each pin, with the said discs upon the several pins being in alignment with one another, a vertically disposed pin carried by the base member intermediate the ends thereof and having a plurality of horizontal superimposed fingers spaced from one another and in substantial horizontal alignment with said discs, and means for adjustably mounting said first and second mentioned pins upon the base member so that they can be moved inwardly or outwardly thereof.

21. In a machine for grinding the curved edge of a glass sheet or plate, a rotatable grinding element mounted in a substantially fixed position, means for supporting and conveying the sheet in a substantially straight path past said grinding element, with the curved edge thereof to be ground in engagement therewith, means for rotating the grinding element in the plane of the sheet, said sheet being movable freely toward and away from the grinding element, means for guiding the sheet in its movements toward and from the grinding element and for preventing angular movement of said sheet with respect to said grinding element, and means acting to yieldably urge the sheet toward and maintain it in engagement with the grinding element as it is carried past the same.

22. In a machine for grinding the curved edge of a glass sheet or plate, a grinding element mounted in a substantially fixed position and rotatable about a substantial vertical axis, conveying means movable in a substantially straight path past said grinding element, spaced parallel rails carried by said conveying means and extending at substantially right angles with respect to the direction of travel thereof, a carriage mounted upon said conveying means and movable along said rails toward and away from the grinding element, said sheet being supported upon the carriage in a substantially horizontal position and movable therewith past the grinding element, with the curved edge thereof to be ground in engagement therewith, and means acting to yieldably urge the sheet toward and maintain it in engagement with said grinding element as it is carried past the same.

23. In a machine for grinding the curved edges of glass sheets or plates, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, said wheel having a plurality of horizontal grooves extending circumferentially thereof, means for supporting a plurality of sheets of glass in a substantially horizontal position and for conveying the said sheets in a substantially straight path past said grinding wheel, with the curved edges thereof to be ground in contact therewith and received within the grooves thereof, said sheets being freely movable toward and away from the grinding wheel, and means acting to yieldably urge the

sheets toward and maintain them in engagement with said grinding wheel.

24. In a machine for grinding the curved edges of glass sheets or plates, a grinding wheel mounted in a substantially fixed position and rotatable about a substantially vertical axis, said wheel having a plurality of horizontal grooves arranged circumferentially thereof, a table movable in a substantially straight path past said grinding wheel, a carriage supported upon said table and movable toward and away from the grinding wheel in a direction at substantially right angles to the direction of movement of said table, means carried by the carriage for supporting a plurality of sheets of glass in a substantially horizontal position, said sheets being movable with the carriage past the grinding wheel, with the curved edges thereof to be ground in engagement therewith and received within the grooves thereof, and means for yieldably urging the carriage toward said grinding wheel for maintaining the sheets in engagement therewith.

25. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means for carrying the sheets to be treated, means for securing a plurality of said sheets in spaced horizontal position upon said supporting means, a surfacing element positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, and means for moving said supporting means horizontally to carry the curved edges of the sheets to be treated past and in engagement with said surfacing element.

26. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means for carrying the sheets to be treated, means for securing a plurality of said sheets in spaced horizontal position upon said supporting means, a surfacing element positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, means for moving said supporting means horizontally to carry the curved edges of the sheets to be treated past and in engagement with said surfacing element, and means for mounting the said surfacing element for movement horizontally toward and away from said supporting means.

27. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means for carrying the sheets to be treated, means for securing a plurality of said sheets in spaced horizontal position upon said supporting means, a surfacing element positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, means for moving said supporting means horizontally to carry the curved edges of the sheets to be treated past and in engagement with said surfacing element, and means for effecting relative horizontal movement between the said supporting means and surfacing element while maintaining the edges of the glass sheets in engagement with said element.

28. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means upon which a plurality of sheets are adapted to be supported in spaced horizontal position, means interposed between adjacent sheets for maintaining them spaced from one another, means for clamping the plurality of sheets in position to prevent relative movement therebetween, a surfacing wheel positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, and means for moving said supporting means to carry the curved edges of the sheets to be treated horizontally past and in engagement with said surfacing wheel.

29. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means upon which a plurality of sheets are adapted to be supported in spaced horizontal position, means interposed between adjacent sheets for maintaining them spaced from one another, means for clamping the plurality of sheets in position to prevent relative movement therebetween, a surfacing wheel positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, means for moving said supporting means to carry the curved edges of the sheets to be treated horizontally past and in engagement with said surfacing wheel, and means for mounting the said surfacing wheel for movement horizontally toward and away from the supporting means.

30. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means upon which a plurality of sheets are adapted to be supported in spaced horizontal position, means interposed between adjacent sheets for maintaining them spaced from one another, means for clamping the plurality of sheets in position to prevent relative movement therebetween, a surfacing wheel positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, means for moving said supporting means to carry the curved edges of the sheets to be treated horizontally past and in engagement with said surfacing wheel, and means for effecting relative horizontal movement between the said supporting means and surfacing wheel while maintaining the edges of the glass sheets in engagement with said wheel.

31. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means upon which a plurality of sheets are adapted to be supported in spaced horizontal position, means interposed between adjacent sheets for maintaining them spaced from one another, means for clamping the plurality of sheets in position to prevent relative movement therebetween, vertically disposed retaining means carried by the supporting means and against which the inner edges of the glass sheets are adapted to abut, a surfacing wheel positioned in relatively close proximity to the supporting means and rotatable about a vertical axis in the plane of said sheets, and means for moving said supporting means to carry the curved edges of the sheets to be treated horizontally past and in engagement with said surfacing wheel.

32. In a machine for simultaneously surfacing the curved edges of a plurality of glass sheets or plates, movable supporting means upon which a plurality of sheets are adapted to be supported in spaced horizontal position, means interposed between adjacent sheets for maintaining them spaced from one another, means for clamping the plurality of sheets in position to prevent relative movement therebetween, spaced vertically disposed fixed retaining members carried by the supporting means and against which the inner edges of the glass sheets are adapted to abut, a surfacing wheel positioned in relatively close proximity

to the supporting means and rotatable about a vertical axis in the plane of said sheets, means for moving said supporting means to carry the curved edges of the sheets to be treated horizontally past and in engagement with said surfacing wheel, and means for effecting relative horizontal movement between the said supporting means and surfacing wheel while maintaining the edges of the glass sheets in engagement with said wheel.

RAOUL J. LOUVIAUX.